Wisconsin Department of Natural Resources
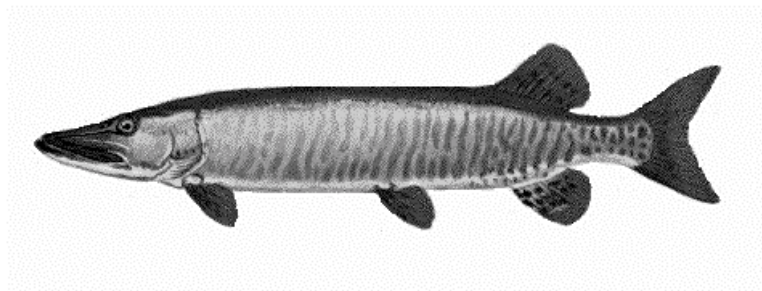
1996 Ceded Territory

Fishery Assessment Report

Andrew H. Fayram

Administrative Report #49

Walleye illustration Virgil Beck

INTRODUCTION

In 1983, the United States Court of Appeals for the Seventh Circuit ruled that the Chippewa Tribes had reserved off-reservation fishing rights in the ceded territory of Wisconsin as determined by the Treaty of 1837 and the Treaty of 1842. Since then, the Wisconsin Department of Natural Resources (WDNR) has worked to accommodate tribal harvest opportunities into existing sports fisheries in the ceded territory. In addition, the WDNR works with the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) to establish safe harvest numbers for walleyes and muskellunge on the lakes and waters of the ceded territory and to census and monitor the combined fisheries.

In order to incorporate tribal harvest into existing recreational fisheries, an intensive data collection and analysis effort began. This effort has evolved over time as knowledge in fisheries science has advanced and as unique aspects of the ceded territory fisheries have been addressed. The primary goal is to collect the necessary information to protect the ceded territory fish populations from overexploitation by the combined tribal and recreational fisheries.

Walleye *Stizostedion vitreum* and muskellunge *Esox masquinongy* are tremendously popular with anglers and are very important economically. Chippewa tribal members rely on these fisheries for preservation of their cultural heritage and as a food source. The majority of the tribal harvest occurs during a spring spearing effort while the walleyes and muskellunge are in shallow water during spawning. A smaller number are harvested throughout the remainder of the year with a variety of capture methods including spearing, gillnetting, fykenetting, setlining, and angling. Netting and spearing are highly efficient methods and, unlike low efficiency methods such as angling, are not self-regulating (Beard et al. 1997, Hansen et al. 2000). Therefore, overexploitation is a strong possibility in the absence of intensive management. Overexploitation of any population would result in long lasting and potentially irreversible damage to the resource. Due to the popularity and economic importance of walleye and muskellunge fisheries, it is imperative to understand these populations to the best of our ability.

The WDNR assesses walleye populations using three primary methods: spring adult and total population estimates, fall young of the year relative density estimates, and creel surveys of angler catch and harvest. The GLIFWC and the United States Fish and Wildlife Service conduct population estimate and young of the year surveys on additional lakes each year. In addition, the GLIFWC monitors all tribal

harvest which occurs. These methods provide information on the current harvestable population, an indication of the future harvestable population, and the degree of exploitation.

POPULATION ESTIMATES

INTRODUCTION

Population estimates are critical to the management of ceded territory lakes. Accurate population estimates allow fisheries biologists to calculate the number of fish that can be safely harvested from a given population based on knowledge of the fishery and the biology of the species in question. This allows utilization of the resource without jeopardizing future abundance or presence of walleyes and muskellunge.

It is logistically impossible to obtain accurate population estimates from all harvested lakes in the ceded territory each year. Random subsamples of lakes are selected each year for walleye population estimates and nine-month creel surveys. Fish populations in general, and walleye populations in particular, are extremely variable and can change drastically from year to year. A continuing randomized survey of lakes provides information on trends occurring in these populations.

Safe harvest levels are set on individual lakes using the most accurate population estimate available. The most reliable estimate is from mark-recapture estimates performed in the same year in which the safe harvest level is set. This population estimate can also be used to estimate abundance in successive years. Additional safety factors are incorporated to account for the largest decrease expected between years. Given the variability associated with all fish populations, these estimates are not as accurate as current year population estimates. If there have been no historic mark-recapture estimates or the population estimate is greater than two years old in a given lake, then an estimate is calculated from a regression model based on lake acreage as an indicator of population abundance (Hansen 1989). Three different regression models are used depending on the primary source of walleye recruitment in the lake including models for 1) lakes sustained primarily by natural reproduction, 2) lakes sustained primarily through stocking efforts, and 3) lakes with low density populations maintained through very intermittent natural reproduction. Each year, new population estimates from current surveys are incorporated into the appropriate regression model used to predict abundance. These regression models are used to predict abundances for the majority of the walleye lakes in the ceded territory each year.

METHODS

The lakes to be sampled by the WDNR are chosen using a stratified random design with removal. The pool of lakes considered for population estimate surveys in the current survey design are the 179 lakes that have experienced tribal harvest at least three times between 1985 and 1994. This focuses data collection efforts on lakes that receive high fishing effort and represent the core lakes of the joint fishery. All of these lakes are scheduled to be surveyed once in a seven-year period. In addition, one of the large lake chains is surveyed each year. The calculation of population estimates on these lakes allows the WDNR to update the population status of each lake and to have at least one direct measure of exploitation roughly once per generation time of walleye.

In 1996, adult walleye population estimates were calculated for 18 lakes ranging in size from 111 to 6,024 acres and encompassing two different angler regulations. This included 15 lakes with a 15-inch length restriction for walleyes and three lakes with no length restriction (Appendix 1).

Walleyes were captured with fyke nets in the spring shortly after ice out. Each fish was measured and received a permanent mark (fin clip, floy or jaw tag). In addition, the sex of each fish was determined. All walleyes whose sex could be determined or were greater than or equal to 15 inches were considered to be part of the adult population and were given a specific mark that varied by lake. Walleyes of unknown sex and less than 15 inches in length were classified as juveniles and were marked with a different lake specific fin clip. Marking effort was apportioned based on a goal for total marks of 10% of the anticipated spawning population estimate. The marking continued until this target number was reached or spawned out females began appearing in the fyke nets.

To minimize bias, the first recapture effort was accomplished with the use of electrofishing equipment. The entire shoreline of each lake, including islands, was electrofished. This recapture effort was used to calculate an adult walleye population estimate for the lake. All walleyes were measured and examined for marks. In addition, all unmarked walleyes were measured and given the appropriate mark so that a total population estimate could be calculated. The shoreline of each lake was electrofished a second time approximately two weeks later in order to calculate a total population estimate (juvenile fish + adult fish) using a similar approach to the adult population estimate.

Population estimates were calculated with the Chapman modification of a Petersen Population Estimate using the equation:

$$N = (M+1)(C+1)/(R+1)$$

where N is the population estimate, M is the total number of marked fish in the lake, C is the total number of fish captured, and R is the total number of marked fish captured. This method is used because simple Petersen Estimates tend to overestimate population sizes when R is relatively small (Ricker 1975).

Tribal spearing exploitation estimates were calculated for 1996. Tribal exploitation is simply the number of speared walleyes divided by the adult population estimate in each lake. A mean tribal exploitation value for the years 1993-1995 was also calculated. Marking effort, recapture effort, and tribal spearing focus almost exclusively on sexually mature walleyes so exploitation rates are calculated for this subset of the walleye populations. Angler exploitation rates are calculated using creel survey data. Results and discussion of exploitation rates are included in the creel survey section of this report.

RESULTS

Population densities were separated into length intervals of 0.0-11.9 inches, 12.0-14.9 inches, 15.0-19.9 inches, and greater than or equal to 20.0 inches. Length specific population densities are shown for lakes sustained primarily through natural reproduction in Figure 1 and lakes sustained primarily through stocking efforts in Figure 2. The lakes were categorized as 1) stocked, 2) natural, and 3) other. The "other" category included lakes with unknown walleye populations, lakes where stocking had been discontinued and the walleye population was expected to disappear, and stocked waters where the population had not established a reasonable density.
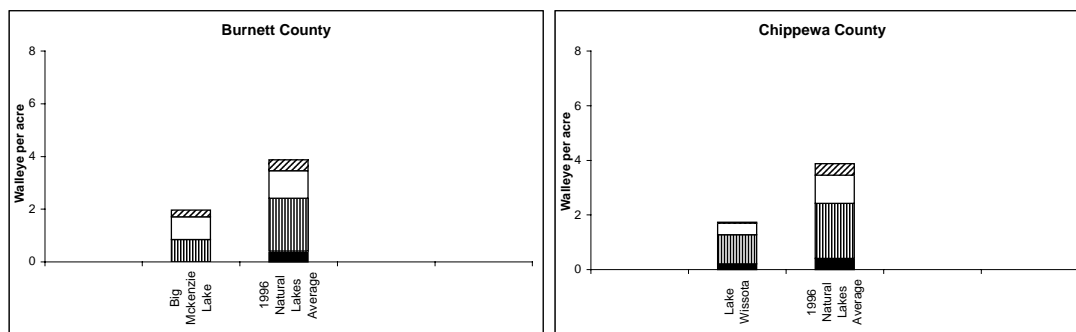

Figure 1. Population estimates by length class and 1996 statewide average of lakes classified as naturally reproducing waters.

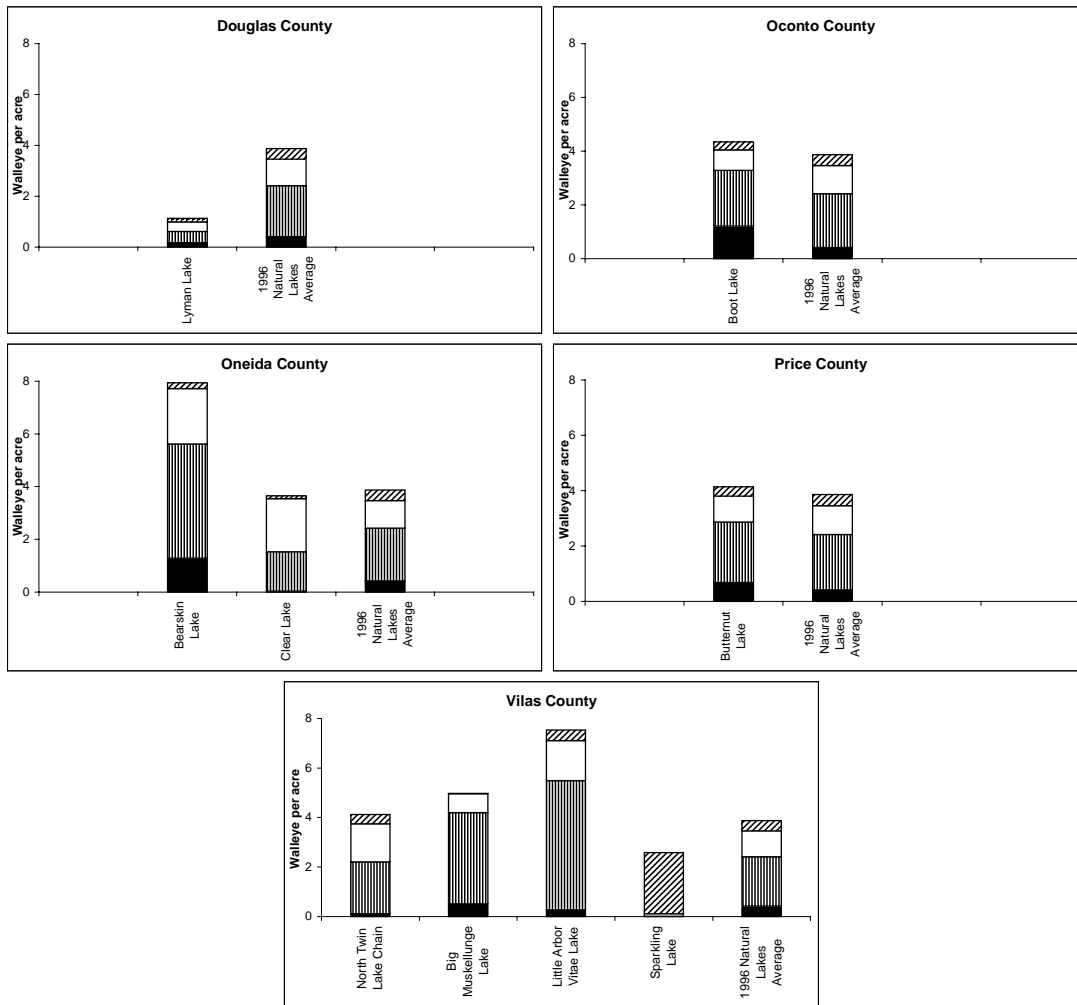■ = 0-11.9 inches, ▥ = 12.0-14.9 inches, □ = 15.0-19.9 inches, and ▨ = 20.0+ inches.
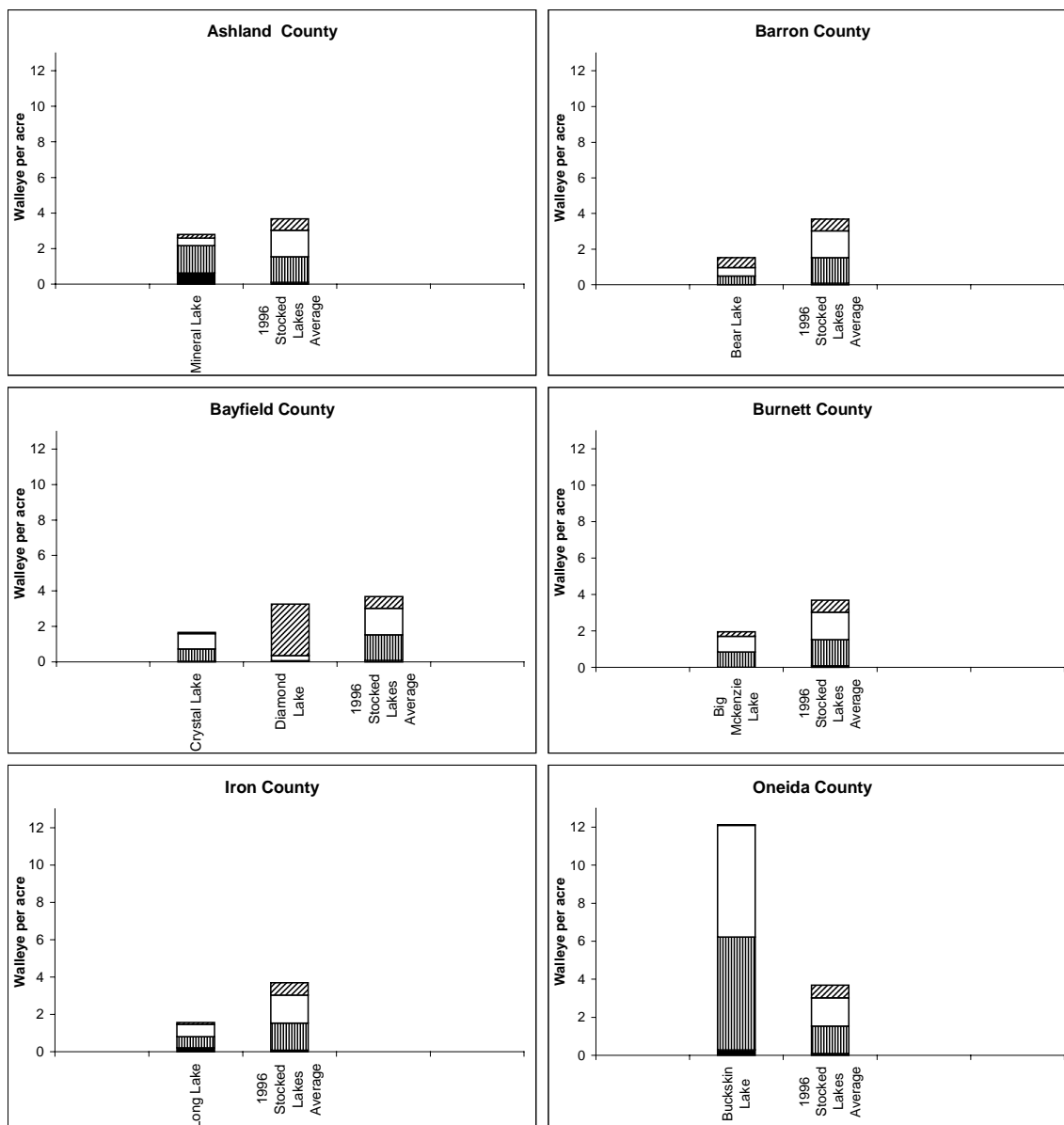
Figure 1. Continued.

Figure 2. Population estimates by length class and 1996 statewide average of lakes classified as stocked waters. Mineral Lake (Ashland) was classified as 0-ST. The 0-ST designation indicates that stocking is the sole source of recruitment which had not yet resulted in a harvestable population of adults.

■ = 0-11.9 inches, ◫ = 12.0-14.9 inches, □ = 15.0-19.9 inches, and ◪ = 20.0+ inches.

Lakes surveyed in 1996 with historical population estimates are included in Appendix 2. The total number of adult marks in lakes surveyed in 1996 ranged from 5.0% to 81.1% of the calculated adult population estimate, with a mean value of 36.8%. The total number of marked fish, including immature fish, ranged from 5.8% to 40.5% of the calculated total population estimate with a mean value of 17.9%.

The goal of marking at least 10% of the estimated adult population was exceeded in all but one of the surveys in 1996.

Lakes classified as "stocked" waters had a lower average density (3.69 walleyes/acre) than did lakes classified as "natural" waters (3.87 walleyes/acre) (Figures 1 and 2). This has been the case historically as well (Hewett and Simonson 1998). The difference between these two groups of lakes is relatively small compared to other years. This is primarily the result of the unusually high density of adult walleye in Buckskin Lake (Oneida) which was classified as a stocked water. As one would expect, the lakes best suited for walleyes in terms of physical, chemical, and biological factors generally support natural reproduction and therefore have relatively high densities. Walleye populations in lakes with marginal walleye habitat are sustained through stocking and therefore have lower densities.

In general, adult walleye populations sampled in 1996 have increased or remained at similar levels when compared to populations in the same lakes sampled in the late 1980's and early 1990's (Appendix 2). The adult walleye population in Buckskin Lake has increased dramatically since it was last surveyed in 1991. A substantial portion of this population consisted of adult walleyes between 12 inches and 15 inches in length which suggests that there should be relatively high densities of adult walleyes in the near future (Figure 2).

YOUNG OF THE YEAR SURVEYS

INTRODUCTION

Young of the year (YOY) surveys provide an index of the abundance and survival of the current year class of walleyes from hatching or stocking to their first fall. Young age classes form the basis of future adult populations. Therefore, YOY surveys provide fisheries managers insight into potential adult population changes in the near future. Early indication of these potential changes allows fisheries managers to develop management strategies to accommodate expected changes in adult populations. Although YOY relative abundances give some indication of possible future adult abundances, they do not necessarily correspond directly, as survival to adulthood can be variable (Hansen et al. 1998).

METHODS

Young of the year surveys were completed on 82 lakes by the WDNR in 1996 (Appendices 2, 3, and 4). Electrofishing for YOY walleyes was done during early fall, generally when the water temperature had fallen below 70° F. The entire shoreline of a lake was electrofished and all walleyes were examined and measured. Serns (1982) established a relationship between the number of YOY walleyes collected per mile of shoreline electrofished and the density of YOY walleyes/acre. This in turn can be used to estimate YOY walleye abundance. This relationship between the number of YOY walleyes caught per mile and the density of YOY walleye is:

$$Density = 0.234 * Catch\ per\ mile$$

where density is estimated as number of YOY walleyes per acre. Abundance is then estimated by multiplying the estimated density by the number of acres in a given lake.

T tests were used to compare 1996 data to 1990-1995 data.   The level of significance used for all tests was $\alpha = 0.05$.

RESULTS

Lake temperatures during 1996 surveys ranged from 42°F-72°F with a mean water temperature of 60°F. Young of the year data were separated by the dominant recruitment type for each lake: 1) stocked, 2) natural, and 3) other.

The 1996 means for young of the year per mile were 30.9 (range = 0.0 – 197.5) for natural lakes, 18.1 (range = 0.00 – 153.9) for stocked lakes, and 11.9 (range = 0.0 – 75.7) for "other" lakes (Table 2, Appendices 3, 4, 5). The 1996 natural lake mean was slightly but not significantly lower than the six-year mean of 34.8 (p = 0.58)(Table 2). The 1996 stocked lake mean was higher than the six-year mean of 7.9 although not significantly (p = 0.06)(Table 2). No six-year mean value was calculated for "other" lakes, as this value varies widely depending on the number of surveyed lakes which were stocked but lacked an established adult population. 10.4% of lakes in the natural category (5 of 48) showed indexes of less than 1 YOY walleye per mile (Appendix 3).   39.1% of lakes in the stocked category (9 of 23) had young of the year walleye indexes of less than 1 per mile. Number of lakes stocked in a year has a dramatic effect of YOY walleye densities in lakes sustained though stocking. Among the stocked lakes surveyed, 11 were stocked with walleye juveniles in 1996 (Appendix 4).

Table 2. Mean young of the year walleye data for three categories of lakes.

	Natural	Stocked	Other
Mean 1996 young of the year walleyes per mile	30.9	18.1	11.9
1990-1995 mean young of the year walleyes per mile	34.8	7.9	

The 1996 mean Sern's index for estimated number of YOY walleyes per acre was 7.2 for natural lakes, 4.2 for stocked lakes, and 2.8 for other lakes. Sern's estimates of YOY walleyes per acre ranged from 0 to 46.2 in natural waters, 0 to 36.0 in stocked waters, and 0 to 17.7 in other lakes (Appendices 2, 3, and 4).

The percentage of lakes with greater than 25 YOY walleyes per mile and greater than 100 YOY walleyes per mile may give a better indication of the overall success rate of year class production because unlike the mean number per mile, these values are unaffected by very large values in a single lake. In stocked waters in 1996, 17.4% of the surveyed lakes contained greater than 25 YOY walleyes per mile which was similar to the 1990-1995 mean value of 8.6% ($p = 0.14$) (Figure 3). 4.3% of the stocked lakes surveyed in 1996 had greater than 100 YOY walleyes per mile. This was similar to the six-year mean value of 1.2% ($p = 0.36$) (Figure 3). In waters with some degree of natural reproduction, 29.2% of the surveyed lakes had greater than 25 YOY walleyes per mile which was similar to the six-year mean value of 39.7% ($p = 0.62$) (Figure 4). 10.4% of naturally reproducing lakes had greater than 100 YOY walleyes per mile which was similar to the seven-year mean value of 6.6% ($p = 0.63$) (Figure 4).
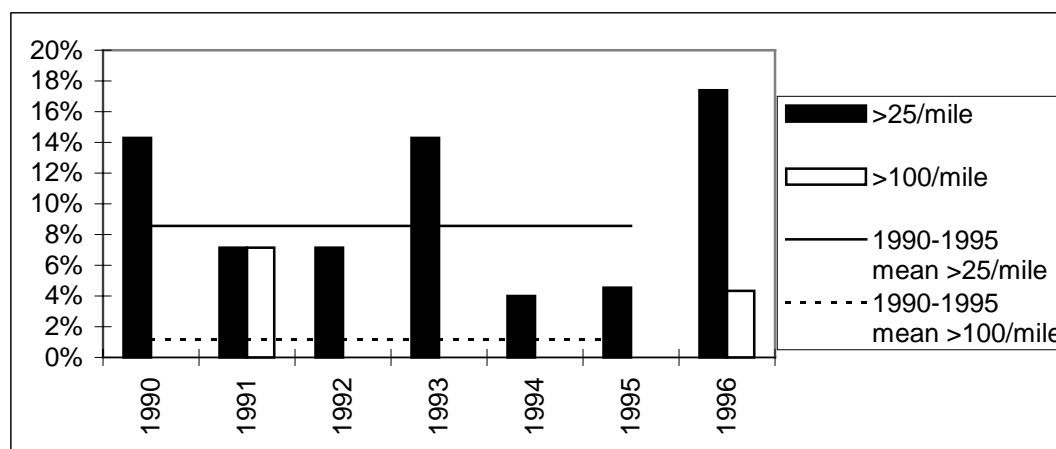

Figure 3. Percentages of stocked surveyed lakes with high densities of young of the year walleye.
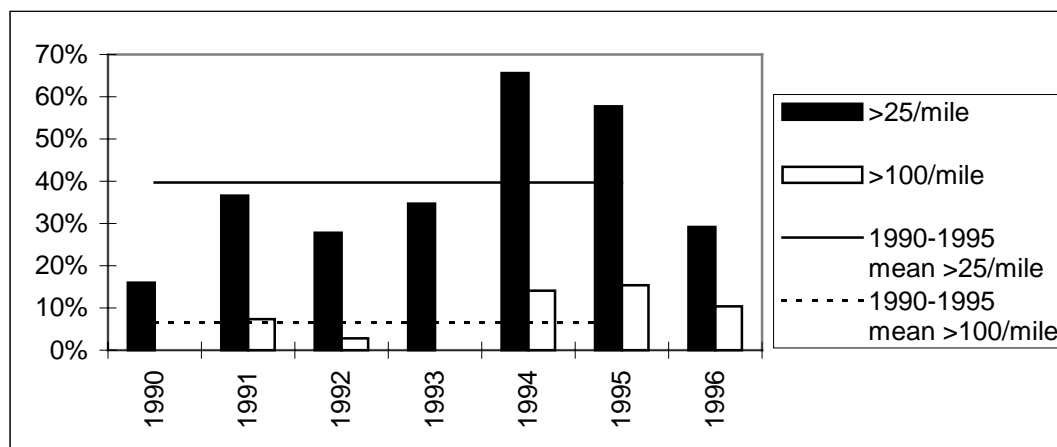
Figure 4. Percentage of surveyed lakes classified as having natural reproduction with high densities of young of the year walleye.

Sporadic recruitment is characteristic of walleye populations both within and among individual lakes. It is common to have almost a total lack of recruitment in 25% or more of lakes with natural reproduction. Even higher percentages are common among lakes whose walleye populations are sustained through stocking. Generally, successful recruitment occurs in a given lake every 3-4 years. Sporadic recruitment appears to reduce competition between year classes of walleye (Li et al. 1996). Therefore, lack of recruitment in a given lake for one or more years is a natural and expected occurrence and is generally not a cause for concern. Overall, 1996 represented an average year for young of the year survival.

CREEL SURVEYS

INTRODUCTION

Creel surveys provide information on angler effort, exploitation, harvest, and catch on surveyed waters. Information on both released and retained fish is recorded. Trends in total catch and harvest, hours fished for a given species, and success rates can be determined from creel survey data. Information collected for walleye, muskellunge, northern pike, largemouth bass, and smallmouth bass are presented here. Creel surveys are generally conducted on the same lakes for which population estimates are calculated. This allows the calculation of exploitation rates of walleye populations and comparisons of catch and harvest rates on a cross section of walleye lakes in the ceded territory each year.

METHODS

Creel surveys were conducted on 17 lakes where population estimates were conducted in the spring of 1996. Wisconsin creel surveys use a random stratified roving access design (Beard et al. 1997, Rasmussen et al. 1998). The surveys were stratified by month and day type (weekend and holiday or weekday), and creel clerks conducted their interviews at random within these strata. Surveys were conducted on all weekends and holidays and a randomly chosen three of five weekdays. Only completed trip interview information was used in the analysis. Information recorded during the course of interviews included harvest, catch, lengths and marks of harvested fish, fishing effort, and species targeted.

The surveys began May 4th 1996 and generally continued through March 1st 1997. The month of November was excluded due to extremely low effort. Information from these interviews was then expanded over the appropriate strata in order to provide an estimate of total effort, catch, and harvest of each species in each lake for the year.

Creel surveys used in conjunction with population estimates also allow estimates of angler exploitation of walleye populations to be calculated. Angler exploitation rates were calculated by dividing the estimated number of marked harvested adult walleye by the total number of the adult marked walleye present in the lake. Although anglers are able to harvest immature fish in some waters, exploitation rates were calculated to represent adult exploitation in order to allow comparison with tribal exploitation rates and to calculate an estimated total exploitation rate of adult walleyes. Mean exploitation values both for 1996 and 1993-1995 were calculated only for lakes with complete creel surveys. All fish marked in 1990-1992 received the same fin clip and therefore it was not possible to calculate adult exploitation rates for lakes surveyed in these years.

A creel survey was conducted on Boot Lake (Oconto) in 1996; however, this survey only continued through the open water period. Since creel information was not collected from ice anglers, data from this survey were not included in mean value calculations. In addition, the creel survey on Lake Wissota was completed at the end of April rather than March 1st. This is due to the fact that Lake Wissota had no closed season for walleye. The season for walleye generally closes on other Wisconsin waters on March 1st. Lake Wissota data were included in mean value calculations. Tribal exploitation rates were only calculated where adult population estimates were available. Total exploitation was only calculated where both tribal and angler exploitation rates were available.

T tests were used to compare 1996 data to 1990-1995 (1993-1995 for exploitation rates) data. T tests were also used to compare lakes of different sizes and regulation types. The level of significance used for all tests was $\alpha = 0.05$.

RESULTS

Creel data were summarized for all lakes, lakes less than 500 acres, and lakes 500 acres or larger. In addition, walleye creel data were grouped based on length regulation and population recruitment code. Species specific creel data were extrapolated only over lakes containing a given species.

Catch and harvest (hours/fish) rates were calculated for all species. Number of hours to catch and harvest a fish give an indication of the success of an average angler and provide an estimate of walleye production on a given lake or group of lakes. Specific catch and harvest rates are calculated only for hours spent fishing in which a specific fish species was targeted. General catch and harvest rates reflect total hours spent fishing by all anglers.

The mean total effort per acre in 1996 was lower (23.6 hours/acre) than the 1990-1995 mean value (34.7 hours/acre) (p = 0.05).

Walleye

Complete creel surveys were conducted on a total of 16 walleye lakes in 1996. Three of these lakes had an "exempt" length limit classification meaning there was no minimum length limit for walleyes. The remaining thirteen lakes had a minimum length restriction of 15 inches. Nine of the surveyed lakes were 500 acres or larger and the remaining 7 were less than 500 acres. Twelve of the lakes were classified as having substantial natural reproduction. Walleye populations in the remaining four lakes were sustained through stocking (Table 3).

In lakes surveyed in 1996, lakes with the 15-inch minimum length limit were similar to exempt lakes in regard to several variables including number of adult walleye/acre (3.4 vs. 4.6, p = 0.60) and directed effort/acre (10.1 vs. 11.3, p = 0.84). Both categories of lake had similar walleye abundances and anglers targeting walleye spent similar amounts of time to catch a walleye. However, It took significantly fewer hours for anglers targeting walleyes to harvest a walleye in exempt lakes than in lakes with the 15-inch length limit (8.1 vs. 18.5 hours/walleye, p = 0.03). This is likely due to the fact that there are generally fewer walleyes available for harvest in lakes with the 15-inch length limit, as a large proportion of the populations is comprised of individuals under 15 inches in length. Accordingly, the mean length of a

harvested walleye was significantly greater in lakes in lakes with the 15-inch minimum size limit (13.72 inches vs. 16.82 inches, $p < 0.01$) (Table 3).

Among lakes with the 15-inch minimum length limit, anglers targeting walleye spent similar amounts of time to catch a walleye (2.2 hours vs. 2.3 hours, $p = 0.91$) in lakes less than 500 acres and lakes greater than or equal to 500 acres. However, the number of hours spent to harvest a walleye was significantly lower in larger lakes (13.5 vs. 32.9, $p = 0.05$) (Table 3). These results may indicate that while there were similar densities of walleye in both size category of lake, there may have been a greater number of walleye greater than 15 inches in larger lakes.

Smaller more abundant walleyes are often harvested from exempt lakes reducing the average length of the harvested fish. However, the population sizes in these lakes do not seem to be adversely affected, as there was no significant difference in the number of adult walleyes/acre between lakes with the 15-inch length limit and exempt lakes.

There were similar densities of adult walleye in both lakes sustained through stocking efforts as well as those sustained through natural reproduction (4.62 walleye/acre vs. 4.32 walleye/acre, $p = 0.89$) among lakes surveyed in 1996. Although anglers caught and harvested a greater number of walleye per acre in lakes sustained through natural reproduction than those sustained through stocking (8.2 vs. 2.3 and 0.8 vs. 0.5 respectively), neither of these differences were significant ($p = 0.34$ and $p = 0.41$). Similarly, although the mean number of hours spent by anglers targeting walleye to catch a fish was lower in lakes sustained through natural reproduction (1.9 vs. 3.7), this difference was not significant ($p = 0.25$) (Table 3).

The mean adult walleye density was similar between 1996 (4.3 walleyes/acre) and the 1990-1995 mean value (3.5 walleye/acre) ($p = 0.31$). Anglers targeting walleyes spent an average of 13.6 hours/acre in 1996 which was the same as the 1990-1995 mean value of 13.6 hours/acre ($p = 0.99$). Angler success, in terms of average number of hours spent to catch and harvest a walleye, was higher in 1996 than the 1990-1995 mean values. Anglers targeting walleyes spent significantly less time to 2.3 hours to catch a walleye in 1996 (2.3 hours) than the 1990-1995 mean value (4.4 hours) ($p < 0.01$). These same anglers spent an average of 15.5 hours to harvest a walleye in 1996 compared to 17.9 hours for the 1990-1995 mean value ($p = 0.52$) (Table 3).

Effort directed at walleyes appeared to be concentrated on lakes with natural reproduction and lakes with exempt length restrictions during the 1990-1995 time period. Walleye anglers spent an average

of 12.2 hours/acre in lakes with the 15-inch minimum length limit compared to 16.5 hours/acre in exempt lakes between 1990 and 1995 (p = 0.02). Walleye anglers also spent significantly more time fishing in lakes supported by natural reproduction (15.2 hours/acre) than in lakes supported by stocking efforts (7.8 hours/acre) (p < 0.01). In 1996, effort directed at walleyes was similar between lakes with natural reproduction and those supported by stocking (p = 0.44) and among lakes with the 15-inch minimum length restriction and exempt lakes (p = 0.84) (Table 3).

Exploitation rates were calculated for 16 lakes in 1996. Total angler exploitation rates of adult walleyes in 1996 ranged from 0.0- 20.4%. Angler exploitation of adult walleyes greater than or equal to 14 inches ranged from 0.0% - 40.8%. Angler exploitation of adult walleyes greater than or equal to 20 inches ranged from 0.0% - 277.5%. Tribal exploitation of adult walleyes ranged from 0.0% - 10.7%. Combined total exploitation estimates (tribal exploitation + angler exploitation) ranged from 1.0% to 20.8% for lakes surveyed in 1996. Mean total exploitation, mean total angler exploitation, and mean tribal exploitation of adult walleyes were all slightly lower in 1996 than the 1993-1995 mean values although none of these differences were significant (11.1% vs. 14.1%, p = 0.54; 7.4% vs. 8.8%, p = 0.64; and 3.7% vs. 5.1%, p = 0.71; respectively). Mean angler exploitation of walleyes greater than or equal to 14 inches in 1996 was the same as the 1993-1996 mean value (12.2% vs. 12.2%, p = 0.99). The mean angler exploitation of walleyes greater than or equal to 20 inches was significantly higher in 1996 than the 1993-1995 mean value (34.4% vs. 8.8%, p < 0.01) (Table 4). This was due to the extremely high exploitation level of walleye of this length in Bass-Patterson Lake (Washburn).

Table 4. 1996 adult walleye exploitation rates and 1993-1995 mean exploitation rates. Tribal harvest data used to calculate tribal exploitation provided by the Great Lakes Indian Fish and Wildlife Commission (Ngu 1994, Ngu 1995, Ngu 1996, Krueger 1997).

Lake	County	Acres	Total Angler Exploitation of Adult Walleye	Angler Exploitation ≥14 inches	Angler Exploitation ≥20 inches	Tribal Exploitation of Adult Walleye	Total Exploitation of Adult Walleye
Bear Lake	Barron	1358	11.1%	14.8%	19.7%	2.2%	13.2%
Diamond Lake	Bayfield	341	5.8%	5.9%	6.9%	0.0%	5.8%
Big McKenzie	Burnett	1185	3.1%	3.9%	5.4%	10.7%	13.8%
Lake Wissota	Chippewa	6300	1.3%	4.1%	24.2%	2.5%	3.9%
Lyman Lake	Douglas	403	10.1%	8.0%	8.6%	0.0%	10.1%
Long Lake	Iron	396	17.5%	25.0%	68.5%	0.0%	17.5%
Boot Lake	Oconto	235	20.4%	40.8%	0.0%	0.4%	20.8%
Bearskin Lake	Oneida	400	13.2%	27.4%	39.9%	4.3%	17.5%
Buckskin Lake	Oneida	634	3.7%	5.8%	38.0%	5.1%	8.8%
Clear Lake	Oneida	846	10.9%	13.0%	38.2%	8.7%	19.6%
Butternut Lake	Price	1006	3.1%	4.5%	0.0%	3.4%	6.5%
Big Muskellunge	Vilas	930	6.4%	9.6%	0.0%	6.3%	12.7%
Little Arbor Vitae	Vilas	534	6.8%	15.6%	20.2%	4.5%	11.3%
Sparkling Lake	Vilas	127	0.0%	0.0%	0.0%	1.0%	1.0%
Twin Lake Chain	Vilas	3430	1.2%	1.9%	3.9%	5.3%	6.5%
Bass-Patterson	Washburn	188	3.8%	15.6%	277.5%	4.9%	8.7%
1996 Mean Values[+]			7.4%	12.2%	34.4%	3.7%	11.1%
1993-1995 Mean Values*			8.8%	12.2%	8.8%	5.1%	14.1%

[+] N = 16 for 1996 means.

* N = 77 for "Total", "≥ 14 inches", and "≥ 20 inches" angler exploitation of adult walleyes 1993-1995 means. N = 76 for "Tribal" and "Total" exploitation of adult walleyes 1993-1995 means.

Although calculated exploitation of walleyes greater than or equal to 20 inches provides an estimate of exploitation for this segment of the population, the estimates have a high degree of variability. This is due to both the relatively low number of marked fish of this length and the small number of fish of this length recorded in the creel surveys. Number of walleyes greater than or equal to 20 inches which received marks ranged from 4-234 and the number of recaptures ranged from 0-5, with three lakes recording zero recaptures of this length. Therefore, small changes in the number of fish of this size recorded in a creel survey would have a relatively large effect on the associated exploitation rate and thus, the variances associated with the estimates of exploitation rates for these fish are very large. This is evident in the 277.5% exploitation level of this category of fish in Bass-Patterson Lake in Washburn County (Table 4)

The 1996 mean total exploitation rate was statistically similar to the 1993-1995 mean value and no individual lake had a total exploitation rate greater than 35%. These data indicate that overexploitation did not occur in these lakes. The current management practices are meeting the expected goal of preventing overexploitation in ceded territory walleye populations.

Muskellunge

Complete creel surveys were collected from a total of 14 lakes containing muskellunge in 1996. Eight of the surveyed lakes were 500 acres or larger and six were less than 500 acres. 1996 and 1990-1995 mean values of measured parameters are shown in Table 5.

Measured parameters were very similar between lakes greater than or equal to 500 acres and those smaller than 500 acres. Although anglers targeting muskellunge appeared to spend fewer hours to harvest a muskellunge in smaller lakes (526 hours) than larger lakes (941 hours), this difference was not significant (p = 0.41). Similarly, most parameters calculated in 1996 and listed in Table 5 were similar to the 1990-1995 mean values. One seemingly large difference appears in the number of hours spent by muskellunge anglers to harvest a muskellunge. Anglers targeting muskellunge appeared to have greater success in terms of number of hours spent to harvest a muskellunge in 1990-1995 (388 hours) than in 1996 (704 hours). However, this difference was not significant (p = 0.39).

Table 5. 1996 and 1990-1995 mean muskellunge creel survey data. Specific and general catch and harvest rates are shown in number of hours per fish caught or harvested.

		N	Lake Acres	Angler Catch /Acre	Angler Harvest/ Acre	Specific Catch Rate*	Specific Harvest Rate*	Mean Length	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1996	**All lakes**	14	1187	0.48	0.015	24.6	703.5	39.5	54.0	1917.8	8.5	24.2
Means	**< 500 acres**	6	292	0.49	0.019	22.5	526.3	40.3	43.3	1463.4	8.3	23.3
	≥ 500 acres	8	1858	0.46	0.011	26.5	941.2	39.1	66.3	2500.0	8.6	24.9
1990-1995	**All lakes**	151	1170	0.48	0.029	26.8	388.1	37.6	68.5	1089.3	10.3	35.8
Means	**< 500 acres**	57	271	0.60	0.035	24.7	374.1	36.2	65.3	1019.7	11.9	44.6
	≥ 500 acres	94	1714	0.41	0.025	28.2	392.0	38.0	70.6	1136.9	9.4	30.4

*1990-1995 mean specific catch and harvest rates n = 145 for all lakes, n = 52 for lakes <500 acres, and n = 93 for lakes ≥500 acres.

Northern Pike

Complete creel surveys were collected from a total of 11 lakes containing northern pike in 1996. Seven of the surveyed lakes were 500 acres or larger and four were less than 500 acres. 1996 and 1990-1995 mean values of measured parameters are shown in Table 6.

Harvest of northern pike appeared to be higher in lakes 500 acres or larger. These lakes had a higher number of northern pike harvested/acre (0.14 vs. 0.06) and a lower mean number of hours spent by fishermen targeting northern pike to harvest a fish (38.4 vs. 109.9) than in smaller lakes. However, neither of these differences was significant (p = 0.49 and p = 0.35 respectively). Other values shown in Table 6 were similar between the two categories of lake.

The mean length of a harvested northern pike was significantly greater in 1996 than the 1990-1995 mean value (24.1 inches vs. 22.1 inches, p = 0.01). Anglers were either releasing larger fish in 1996 than in previous years or were catching larger fish on average. Although anglers targeting northern pike harvested fewer per acre (0.11 vs. 0.42) and spent longer to harvest fish (50.3 hours vs. 17.8 hours) in 1996 than the 1990-1995 mean values, neither of these differences was significant (p = 0.09 and p = 0.33 respectively). In addition, although there appeared to be a lower amount of fishing effort/acre directed toward northern pike in 1996 than the 1990-1995 mean value (1.9 hours/acre vs. 7.4 hours/acre), this difference was also not significant (p = 0.49) (Table 6).

Table 6. 1996 and 1990-1995 mean northern pike creel data. Specific and general catch and harvest rates are shown in number of hours per fish caught or harvested.

		N	Lake Acres	Angler Catch /Acre	Angler Harvest/ Acre	Specific Catch Rate*	Specific Harvest Rate*	Mean Length	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1996	**All lakes**	11	1472	1.22	0.11	4.9	50.3	24.1	17.4	165.7	1.9	22.4
Means	**< 500 acres**	4	338	0.94	0.06	4.3	109.9	26.4	18.5	449.4	1.1	25.2
	≥ 500 acres	7	2120	1.38	0.14	5.3	38.4	23.0	16.9	121.7	2.3	20.7
1990-1995	**All lakes**	164	1150	1.74	0.42	6.0	17.8	22.1	17.5	72.1	7.4	35.4
Means	**< 500 acres**	60	278	2.17	0.49	5.4	14.4	21.8	14.8	61.7	8.0	44.6
	≥ 500 acres	104	1654	1.48	0.38	6.5	20.7	22.3	19.5	79.9	7.0	30.1

*1990-1995 mean specific catch and harvest rates n = 159 for all lakes, n = 58 for lakes <500 acres, n = 101 for lakes ≥500 acres.

Smallmouth bass

Complete creel surveys were collected from a total of 14 lakes containing smallmouth bass in 1996. Eight of the surveyed lakes were 500 acres or larger six were less than 500 acres. 1996 and 1990-1995 mean values of measured parameters are shown in Table 7.

In 1996, anglers targeting smallmouth bass appeared to have greater success both in terms of number of hours to catch and to harvest a smallmouth bass in lakes larger than 500 acres. In lakes less than 500 acres, these anglers spent a mean value of 2.4 hours to catch and 96.6 hours to harvest a smallmouth bass. In larger lakes, these anglers spent only 0.6 hours to catch and 27.7 hours to harvest a smallmouth bass. However, neither of these differences was significant (catch rate p = 0.39 and harvest rate p = 0.32). Other values shown in Table 7 were similar between both size categories of lake.

Mean angler catch/acre was higher in 1996 than the 1990-1995 mean value (1.83 vs. 0.83, p = 0.05), indicating that anglers caught a greater number of smallmouth bass/acre of lake surveyed in 1996 than they did in general between 1990 and 1995. Mean specific catch rate was lower in 1996 than the

1990-1995 mean value (0.9 hours vs. 5.0 hours, p < 0.01), which also indicates greater success of anglers fishing for smallmouth bass in 1996 than between 1990 and 1995. Other values shown in Table 7 were similar between the 1996 mean values and the 1990-1995 mean values.

Table 7. 1996 and 1990-1995 mean smallmouth bass creel data. Specific and general catch and harvest rates are shown in number of hours per fish caught or harvested.

		N	Lake Acres	Angler Catch /Acre	Angler Harvest/ Acre	Specific Catch Rate*	Specific Harvest Rate*	Mean Length	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1996	**All lakes**	14	1234	1.83	0.08	0.9	39.9	14.6	7.3	187.7	2.4	25.5
Means	**< 500 acres**	6	282	2.40	0.07	2.4	96.6	15.0	5.5	208.3	3.2	24.1
	≥ 500 acres	8	1949	1.40	0.09	0.6	27.7	14.1	9.6	174.7	1.8	26.6
1990-1995	**All lakes**	163	1201	0.83	0.10	5.0	28.6	14.7	24.1	204.8	4.0	35.3
Means	**< 500 acres**	57	288	1.07	0.12	6.5	44.8	14.9	24.0	193.7	3.2	45.4
	≥ 500 acres	106	1691	0.70	0.09	4.5	24.1	14.7	24.1	211.3	4.4	29.9

*1990-1996 Mean specific catch and harvest rates n = 148, n = 50 for lakes <500 acres, and n = 98 for lakes ≥500 acres.

Largemouth bass

Complete creel surveys were collected from a total of 15 lakes containing largemouth bass in 1996. Nine of the surveyed lakes were 500 acres or larger and six were less than 500 acres. 1996 and 1990-1995 mean values of measured parameters are shown in Table 8.

Although there were relatively large differences in 1996 between lakes less than 500 acres and lakes 500 acres or larger in mean catch/acre (0.17 vs. 0.77 largemouth bass/acre), mean harvest/acre (0.01 vs. 0.09 largemouth bass/acre), specific catch rate (22.9 vs. 8.3 hours/largemouth bass), and specific harvest rate (157.9 vs. 54.2 hours/largemouth bass) in 1996, none of these differences were significant (p = 0.22, p = 0.23, p = 0.17 and p = 0.40 respectively).

There were also relatively large differences between the 1996 mean values and the 1990-1995 means for catch/acre (0.53 vs. 1.24 largemouth bass/acre), harvest/acre (0.06 vs. 0.12 largemouth bass/acre), specific catch rate (11.2 vs. 5.9 hours/largemouth bass) and specific harvest rate (73.5 hours vs. 36.1 hours/largemouth bass), but again, none of these differences were significant (p = 0.44, p = 0.36, p = 0.12, and p = 0.22 respectively).

Table 8. 1996 and 1990-1995 mean largemouth bass creel data. Specific and general catch and harvest rates are measured in number of hours per fish caught or harvested.

		N	Lake Acres	Angler Catch /Acre	Angler Harvest/ Acre	Specific Catch Rate*	Specific Harvest Rate*	Mean Length	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1996	**All lakes**	15	1207	0.53	0.06	11.2	73.5	14.7	35.3	326.8	1.6	24.4
Means	**< 500 acres**	6	314	0.17	0.01	22.9	157.9	15.1	111.1	1176.5	1.1	23.6
	≥ 500 acres	9	1803	0.77	0.09	8.3	54.2	14.4	24.3	220.6	1.9	25.0
1990-1995	**All lakes**	172	1093	1.24	0.12	5.9	36.1	14.3	25.8	206.3	4.8	35.1
Means	**< 500 acres**	65	277	1.62	0.16	6.6	42.5	14.1	22.2	201.4	4.8	43.7
	≥ 500 acres	107	1588	1.01	0.09	5.6	33.0	14.4	28.7	209.4	4.8	29.9

*1990-1996 mean specific catch and harvest rates n = 156, n = 60 for lakes <500 acres, and n = 96 for lakes ≥500 acres.

Catch and Harvest Rates

Comparing catch and harvest rates among species indicates both the importance of catch and release to a given fishery as well as the relative difficulty of capturing a given species. This information is presented in Figure 5 as the ratio of the mean number of hours of directed effort to harvest a particular species of fish to the mean number of hours spent to catch a fish of the same species. Muskellunge were the most difficult species to catch and to harvest due to the relatively low densities dictated by the biology and habitat requirements of this large species. In addition, muskellunge had the lowest harvest rate to catch rate ratio due to the emphasis placed on catch and release in this fishery (Figure 5).

Walleye are highly valued for purposes of consumption; thus the ratio of hours spent to harvest a walleye to hours to catch a walleye is high compared to other species. Increased emphasis on catch and release fishing, along with minimum length limit regulations may account for the lower harvest to catch rate ratios for northern pike, smallmouth bass, and largemouth bass.
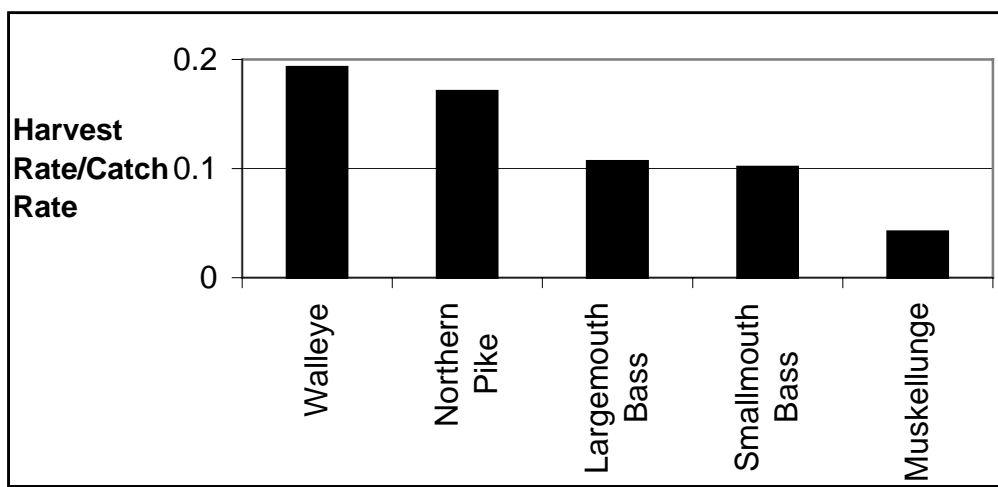

Figure 5. 1996 species specific catch/harvest rate ratios.

SUMMARY

These surveys completed by the WDNR protect of fish populations in Northern Wisconsin by providing the necessary biological information to manage harvest of these populations. Population estimates and creel surveys allow fisheries biologists to monitor harvest and exploitation levels and determine the number of fish that can be safely harvested. Total harvests are generally kept at or below this number in each lake through direct regulation of high efficiency methods, such as spearing, and indirect regulation of low efficiency methods, such as angling.

The maximum sustainable exploitation rate for adult walleye in Northern Wisconsin was determined to be 35% (Staggs 1990). Similarly, the maximum sustainable exploitation rate of adult muskellunge was estimated to be 27%. The federal court mandated that exploitation levels not exceed these levels in more than 1 of 40 waters. Since there is a certain degree of uncertainty inherent in population estimates, the safe harvest level for each lake is 35% of the lower 95% confidence level of the current population estimate in a given lake. Due to the variability in fish populations over time, the reliability of a population estimate declines with time and a mark-recapture population estimate is only used to determine allowable harvest for two years. In the first year after the population estimate is calculated, the estimate is multiplied by a safety factor of 35%, as 65% is the maximum decline which can be expected in a year in a walleye population in Northern Wisconsin (Hansen et al. 1991).

Every spring each tribe makes a declaration of how many walleyes and muskellunge they intend to harvest from each lake. Angler bag limits are adjusted according to the percent of the safe harvest level which the tribes declare. The greater the percentage, the lower the daily bag limit.

The Chippewa Tribes in Wisconsin are legally able to harvest walleyes using a variety of high efficiency methods including spearing and gillnetting, but spring spearing is the most frequently utilized method. Nightly permits are issued to individual tribal spearers. Each permit allows a specified number of fish to be harvested, including one walleye between 20 and 24 inches and one additional walleye of any size. All fish that are taken are documented each night. The tribal spearer registers all of the fish that are speared in a given evening with a tribal clerk or warden present at each boat landing utilized in a given lake. This number is added to the total number speared from a given lake each morning during the spearing season. Once the level of declared harvest is reached in a given lake, no more permits are issued for that lake, and spearfishing ceases.

Fall young of the year surveys are currently utilized in determining the recruitment codes of lakes in the ceded territory. In concert with other data, these surveys allow fisheries managers to determine whether further management actions may be necessary in order to protect or enhance a given fish population.

As a whole, fisheries in the ceded territory continue to represent quality fishing opportunities. The vast majority of fish populations remain at acceptable densities, and there are no indications of overexploitation. The surveys and management techniques discussed in this report appear to be successful in allowing management agencies to maintain and protect fish populations in the ceded territory. The use of these techniques will help continue the success of fisheries resources in the ceded territory of Wisconsin.

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