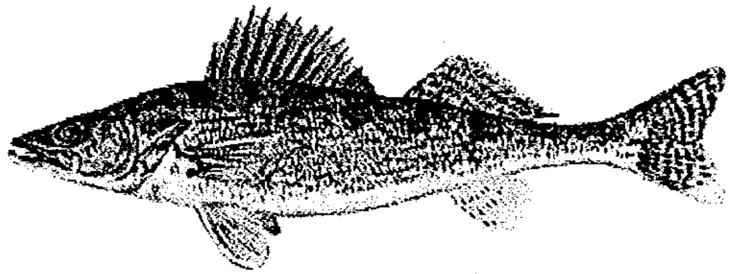

Wisconsin Department of Natural Resources

1998 Ceded Territory

Fishery Assessment Report

Andrew H. Fayram

Administrative Report #47

Treaty Fisheries Assessment Unit
Bureau of Fisheries Management and Habitat Protection
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Walleye illustration Virgil Beck

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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. The WDNR and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) work together to establish safe harvest numbers for walleye and muskellunge on the lakes and waters of the Ceded Territory and to census and monitor the combined fisheries.

In order to safely incorporate tribal harvest, 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 fisheries 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 walleye 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 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 through 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 estimates and young of the year surveys on additional lakes. 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 the ceded territory lakes. Estimates of population abundance are used to set maximum quotas for harvest by high efficiency methods like spearing and netting. 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 walleye 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 population estimates for walleye 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 2 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. Three different regression models are used depending on the primary source of walleye recruitment in the lake. There are separate 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.

MATERIALS AND METHODS

The lakes to be sampled by the WDNR are selected based on a randomized stratified selection method. 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 us 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 1998. total and adult walleye population estimates were calculated for 35 lakes ranging in size from 82 to 3054 acres. These lakes encompassed a range of angler regulations on walleye. This included 23 lakes with a 15-inch length restriction on walleye, 1 lake with a 14-18 inch slot limit where only one walleye greater than 18 inches could be retained, 6 lakes with no length restriction where only one walleye greater than 14 inches could be retained, and 5 lakes with no length restriction (Table 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 and all unsexable walleyes 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 less than 15 inches were classified as juveniles and were all marked with a different 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.

Table 1. 1998 Wisconsin Department of Natural Resources walleye population estimate data.

Lake Name	County	Acres	1998 Size Limit	1998 Recruitment Type	Adult Male Population Estimate	Adult Female Population Estimate	Total Adult Population Estimate	Lower 95% Confidence Limit	Adult Densities 0-11.9" per acre	12.0-14.9" per acre	15.0-19.9" per acre	≥ 20" per acre	Adults per acre	Total Population Estimate	Total per acre	1998 Safe Harvest
Bony	Bayfield	191	1>14	Stocked	370	132	494	308	0.03	0.84	1.66	0.05	2.59	2044	10.70	108
Drummond	Bayfield	130	15	Stocked	76	24	95	70	0.02	0.22	0.33	0.16	0.73	143	1.10	25
Middle Eau Claire	Bayfield	902	1>14	Natural	3626	1529	4099	3639	0.48	3.10	0.84	0.11	4.54	21783	24.15	1274
Nebagamon	Douglas	914	15	Stocked	1267	232	1525	1218	0.00	0.69	0.93	0.04	1.67	5585	6.11	426
Fay	Florence	247	15	Stocked	17	44	113	33	0.00	0.05	0.08	0.32	0.46	835	3.38	12
Range Line	Forest	82	15	Stocked	115	54	178	83	0.01	0.29	1.70	0.18	2.17	442	5.39	29
Silver	Forest	320	15	Other	37	40	104	53	0.00	0.01	0.20	0.12	0.33	100	0.31	19
Trump	Forest	172	15	Stocked	74	79	139	64	0.01	0.35	0.30	0.16	0.81	286	1.66	22
Pine	Iron	312	1>14	Natural	1259	121	1412	1070	3.33	0.57	0.59	0.04	4.53	9253	29.66	375
Spider	Iron	352	1>14	Natural	850	92	943	794	0.96	1.25	0.40	0.07	2.68	4469	12.70	278
Lower Post	Langlade	377	15	Stocked	26	20	80	27	0.01	0.03	0.14	0.03	0.21			9
Upper Post	Langlade	757	15	Stocked	676	189	1430	936	0.00	0.26	1.11	0.52	1.89			328
Booth	Oneida	207	15	Stocked	104	84	222	158	0.01	0.14	0.71	0.22	1.07	583	2.82	55
Kawaguesaga	Oneida	670	15	Natural	2477	924	3495	2863	0.45	2.46	1.25	1.06	5.22	7026	10.49	1002
Minocqua	Oneida	1360	15	Natural	3826	2194	6276	4020	0.64	1.82	0.70	1.46	4.61	33767	24.83	1407
North Nokomis	Oneida	476	15	Stocked	827	370	1254	840	0.05	0.76	1.24	0.59	2.63	3140	6.60	294
Rainbow Flowage	Oneida	2035	15	Natural	6454	2499	8114	6724	0.33	2.22	0.98	0.45	3.99	78943	38.79	2353
Sweeney	Oneida	187	15	Stocked	610	81	750	510	0.11	2.36	1.05	0.49	4.01	1247	6.67	179
Tomahawk	Oneida	3392	15	Natural	4672	3774	8508	6500	0.02	0.88	0.93	0.68	2.51	31571	9.31	2275
Two Sisters	Oneida	719	15	Stocked	786	540	1367	872	0.01	0.30	0.74	0.85	1.90	3555	4.94	305
Balsam	Polk	2054	15	Stocked	2614	658	3081	2827	0.00	0.41	0.88	0.21	1.50	6320	3.08	989
Amik	Price	224	none	Natural	17	30	87	38	0.03	0.03	0.25	0.08	0.39	1804	8.05	13
Butternut	Price	1006	none	Natural	2860	693	3577	3079	1.64	1.12	0.51	0.29	3.56	32581	32.39	1078
Pike	Price	806	none	Natural	1530	364	1839	1507	1.50	0.38	0.27	0.13	2.28	18393	22.82	527
Round	Price	726	none	Natural	2516	146	3658	3212	3.48	1.35	0.16	0.05	5.04	20302	27.96	1124
Turner	Price	149	none	Natural	198	149	374	239	0.59	0.62	0.92	0.38	2.51	2649	17.78	84
Round	Sawyer	3054	15	Natural	5856	1629	6399	5690	0.15	1.33	0.56	0.05	2.10	49972	16.36	1992
Rib	Taylor	320	14-18 slot	Natural	1797	124	2127	1736	3.84	1.17	0.95	0.69	6.65			608
Big Arbor	Vilas	1090	1>14	Natural	4755	638	5329	4555	3.02	1.30	0.30	0.27	4.89	36716	33.68	1594
Found	Vilas	326	15	Stocked	230	75	304	255	0.00	0.23	0.51	0.19	0.93	337	1.03	89
Kentuck	Vilas	957	15	Natural	8	724	731	420	0.00	0.00	0.01	0.76	0.76	335	0.35	147
Laura	Vilas	599	1>14	Natural	2005	370	2422	1857	2.19	1.12	0.16	0.58	4.04	13113	21.89	650
Lost	Vilas	544	15	Stocked	386	65	470	363	0.00	0.46	0.26	0.14	0.86	434	0.80	127
Lynx	Vilas	339	15	Natural	360	112	595	220	0.40	0.48	0.80	0.08	1.76	2979	8.79	77
Nancy	Washburn	772	15	Stocked	1154	220	1447	1304	0.01	0.79	0.93	0.14	1.87	2629	3.41	456

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. Using a similar approach to the adult population estimates the shoreline of each lake was electrofished a second time approximately two weeks later in order to calculate a total population estimate (juvenile fish and adult fish).

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).

Adult walleye population estimates allow calculation of an estimate of tribal spearing exploitation. Tribal exploitation is simply the number of speared walleye divided by the adult population estimate in each lake. 1990-1997 mean tribal exploitation values were also calculated. Marking effort, recapture effort, and tribal spearing focus almost exclusively on sexually mature walleye so exploitation rates are calculated for this subset of the walleye populations. Angler exploitation rates are calculated with the use of creel surveys. Results and discussion of exploitation rates are included in the creel survey section.

RESULTS

Population densities were separated into length intervals of 0-11.9 inches, 12.0-14.9 inches, 15.0-19.9 inches, and greater than or equal to 20 inches. Size specific population densities are shown for naturally reproducing lakes in Figure 1 and stocked lakes 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.

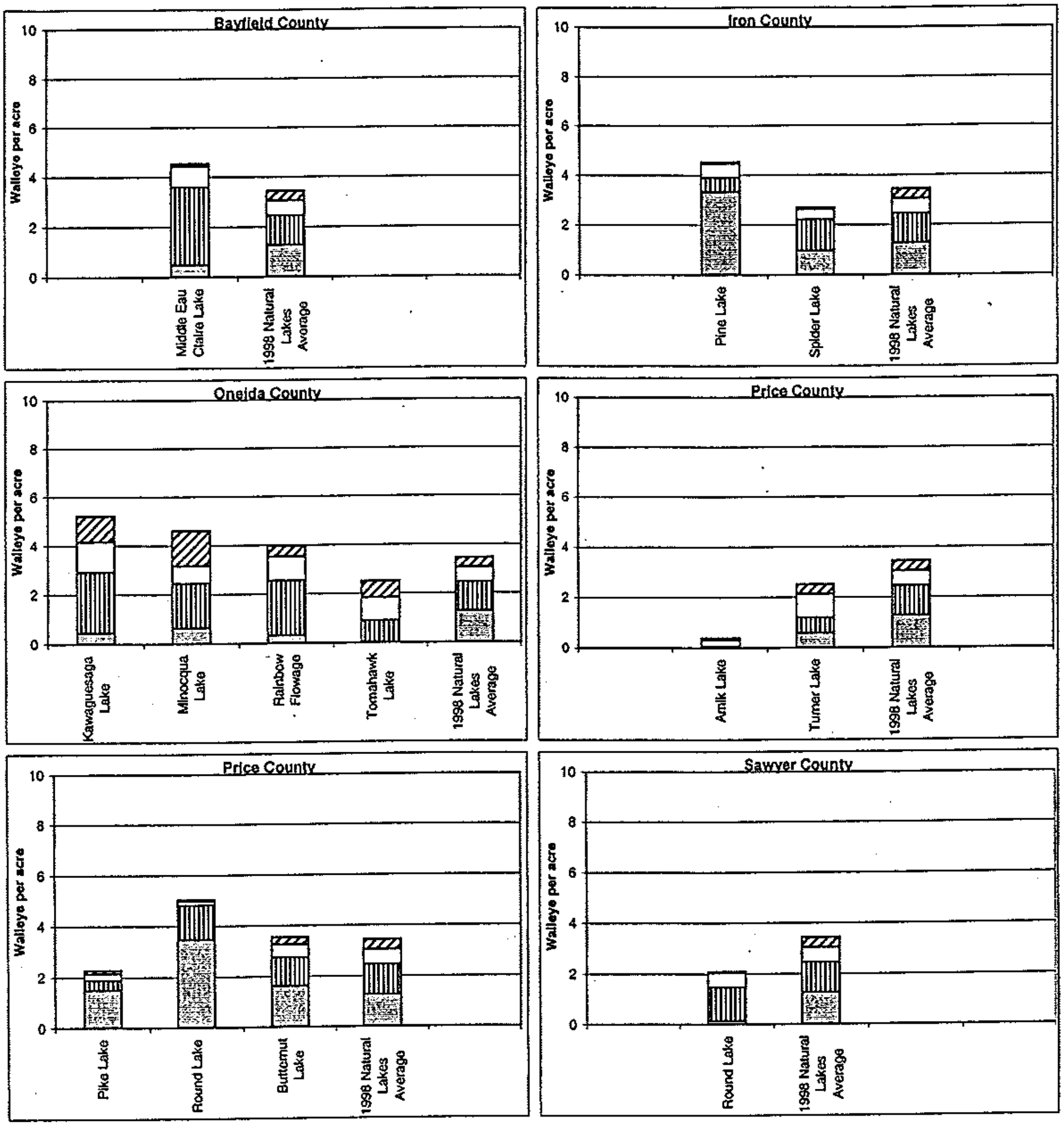

Figure 1. Population estimates by length class and 1998 statewide average of lakes classified as naturally reproducing waters.
▦ = 0-11.9 inches, ▥ = 12.0-14.9 inches, □ = 15.0-19.9 inches, and ▨ = 20.0+ inches.

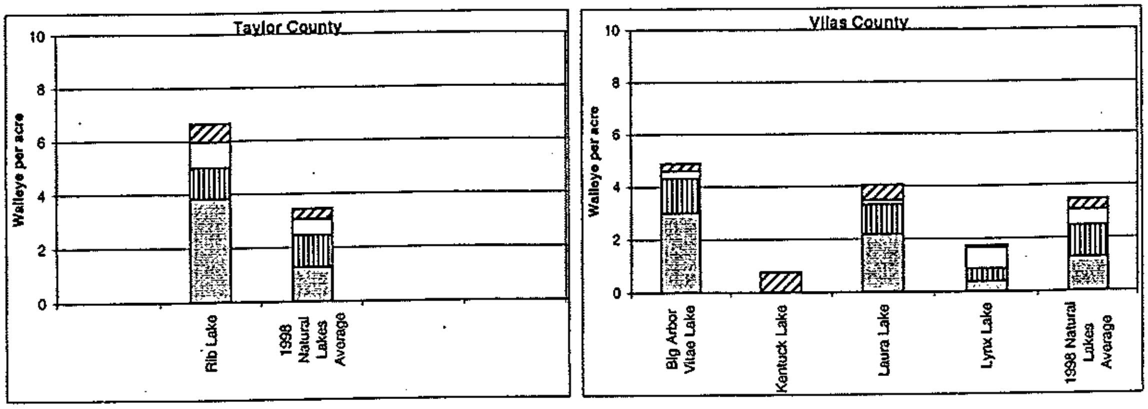

Figure 1. Continued.

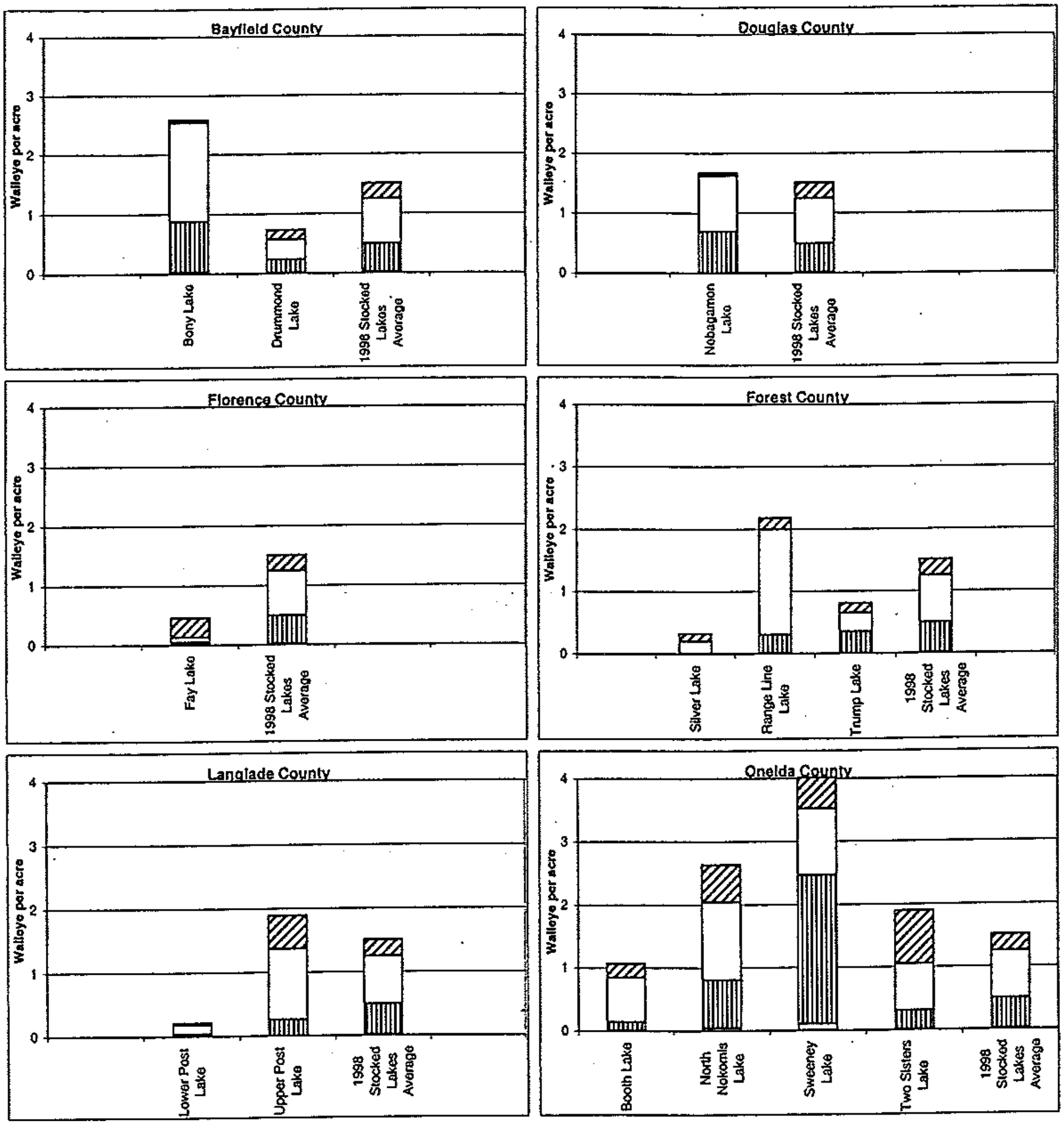

Figure 2. Population estimates by length class and 1998 statewide average of lakes classified as stocked waters. The recruitment code for Silver Lake in Forest county is currently "none". = 0-11.9 inches, = 12.0-14.9 inches, = 15.0-19.9 inches, and = 20.0+ inches.

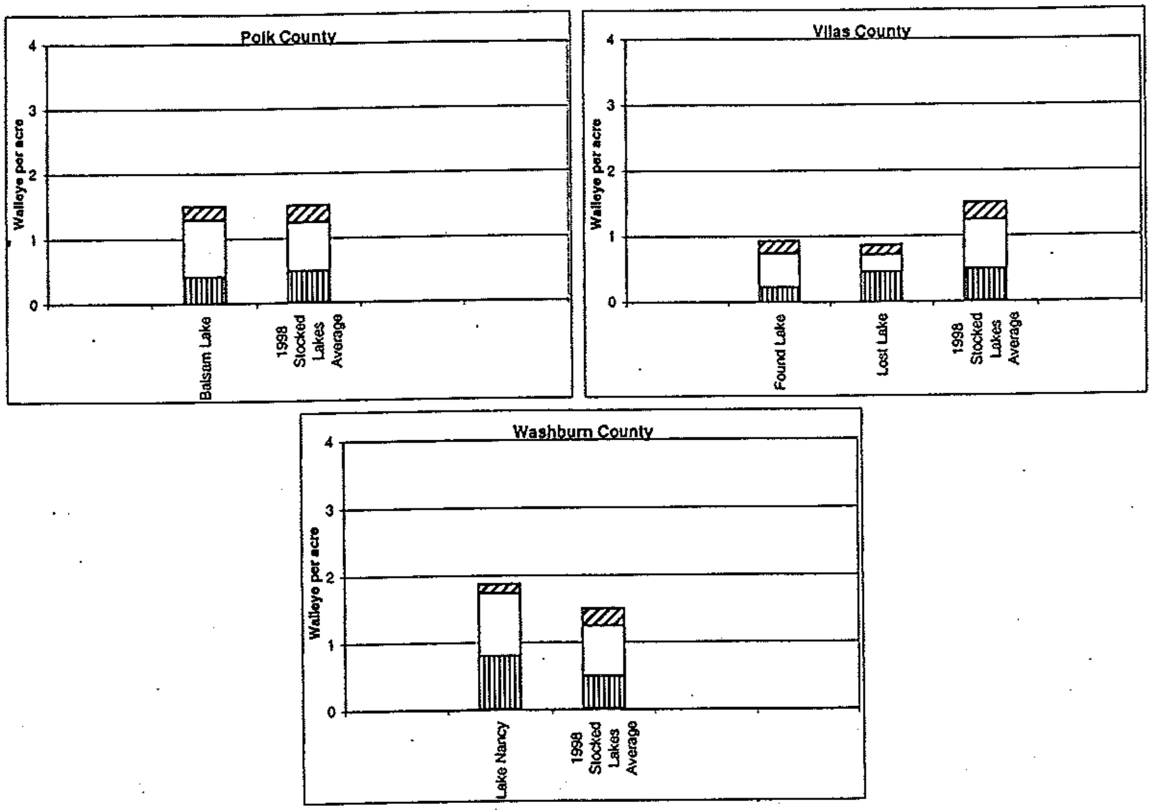

Figure 2. Continued.

Lakes surveyed in 1998 with historical population estimates are included in Appendix 1. The total number of adult marks in surveyed lakes ranged from 17.1% to 71.1% of the calculated adult population estimate, with a mean value of 35.2%. The total number of marked fish, including immature fish, ranged from 4.4% to 99.3% of the calculated total population estimate with a mean value of 26.3%. The goal of marking at least 10% of the estimated adult population was exceeded in all surveys in 1998. In general, adult walleye populations in surveyed lakes with previous population estimates have decreased slightly from higher levels in the early 1990's and are similar to levels in the late 1980's. Although there have been apparent decreases in walleye abundance, for the most part these declines are not dramatic or greater than declines expected in natural populations (Kempinger and Carline 1977).

Lakes classified as "stocked" waters had a lower average density (1.51 walleye per acre) than did lakes classified as "natural" waters (3.45 walleye per acre) (Figures 1 and 2). This has been the case historically as well (Hewett and Simonson 1998). Lakes with natural reproduction generally have a greater density of walleye than do lakes sustained through stocking. As one would expect, the lakes best suited for walleye 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.

There were relatively substantial declines in walleye population densities in Kentuck Lake (Vilas) and Turner Lake (Price). The Kentuck Lake walleye population is almost entirely comprised of individuals 20 inches or greater (Figure 1). This indicates that one should not expect improvement in this population in the next several years as there are virtually no smaller walleye present which could recruit into the adult population. While the Turner Lake population has apparently decreased, it is still close to the statewide average density for naturally reproducing waters. In addition, there are a fair number of smaller, mid-sized, and larger walleye present in the population which indicates that further decreases in this population are unlikely in the near future (Figure 1).

Pine Lake (Iron), Round Lake (Price), Big Arbor Vitae Lake (Vilas), and Rib Lake (Taylor) had relatively high densities of walleye less than 12 inches (Figure 1). This bodes well for the future walleye fisheries in these lakes. Lake Kawaguesaga and Lake Minocqua currently have relatively high densities of fish greater than 20 inches in length. These lakes should provide quality fishing opportunities for larger walleyes (Figure 1).

YOUNG OF THE YEAR SURVEYS

INTRODUCTION

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

MATERIALS AND METHODS

Young of the year surveys were completed on 115 lakes by the WDNR in 1998. Electrofishing for young of the year walleye 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 walleye were examined and measured. Serns (1982) established a relationship between the number of young of the year walleye collected per mile of shoreline electrofished and the density of young of the year walleye per acre. This in turn can be used to estimate the young of the year walleye abundance. This relationship between the number of young of the year walleye caught per mile and the density of young of the year walleye is :

$$\text{Density} = 0.234 * \text{Catch per mile}$$

Where density is estimated as number of young of the year walleye per acre.

In some lakes, conditions prevented the entire shoreline from being electrofished. To account for potential differences that may arise from this, it is useful to compare the number of young of the year walleye on a "number per mile electrofished" basis.

In the event that a lake was completely surveyed multiple times, the mean value of the sampling efforts was used. In some instances, a lake was partially surveyed on one occasion and completely surveyed on another. In these cases, only the complete survey was used.

T tests were used to compare 1998 data to 1990-1997 data. The level of significance for all tests was $\alpha = 0.05$.

RESULTS

Lake temperatures during 1998 surveys ranged from 48°F-75°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 1998 means for young of the year per mile were 31.2 (range = 0.0 – 180.6) for natural lakes, 6.8 (range = 0.00 – 89.3) for stocked lakes, and 4.4 (range = 0.0 – 36.7) for other lakes (Table 2, Appendices 2, 3, 4). The 1998 natural lake mean was slightly but not significantly lower than the eight-year mean of 34.0 ($p = 0.69$)(Table 2). Similarly, the 1998 stocked lake mean was slightly but not significantly lower than the eight-year mean of 9.1 ($p = 0.50$)(Table 2). No eight-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. 26.0% of lakes in the "natural" category (13 of 50) showed indexes of less than 1 per mile (Appendix 2). 50.0% of lakes in the "stocked" category (23 of 46) had young of the year walleye indexes of less than 1 per mile. Also, among the "stocked" lakes surveyed, 22 were stocked with walleye juveniles in 1998 (Appendix 3).

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

	Natural	Stocked	Other
Mean 1998 young of the year walleye per mile	31.2	6.8	4.4
1990-1997 mean young of the year walleye per mile	34.0	9.1	

The 1998 mean Sern's index for estimated number of young of the year walleye per acre was 8.2 for natural lakes, 1.6 for stocked lakes, and 1.0 for other lakes. Sern's estimates of young of the year walleye per acre ranged from 0 to 42.3 in natural waters, 0 to 20.9 in stocked waters, and 0 to 8.6 in other lakes (Appendices 2, 3, and 4).

The percentage of lakes with greater than 25 young of the year walleye per mile and greater than 100 young of the year walleye 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, 4.4% of the surveyed lakes contained greater than 25 young of the year walleye per mile and there were no lakes with greater than 100 per mile (Figure 3). The percentage of lakes containing greater than 25 young of the year walleye per mile was lower than the value in 1997. Both values are also lower than the eight-year mean values of 8.9% and 0.8% respectively (Figure 3). In waters with some degree of natural reproduction, 38.0% of the surveyed lakes had greater than 25 young of the year walleye per mile which was slightly higher than the 1997 value and similar to eight-year mean value of 38.1% (Figure 4). 6.0% of naturally reproducing lakes had greater than 100 young of the year walleye per mile which was very similar to the 1997 and the eight-year mean of 6.8% (Figure 4).

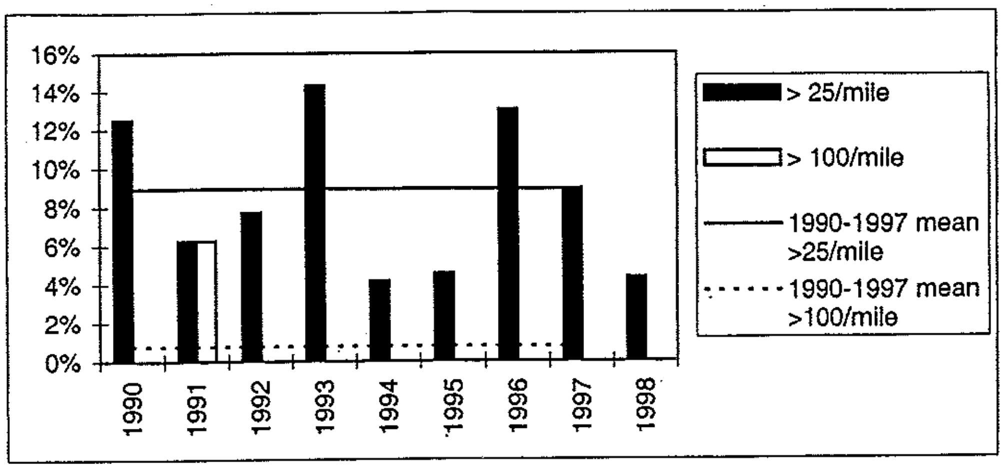

Figure 3. Percentage of stocked surveyed lakes with high densities of young of the year walleye.

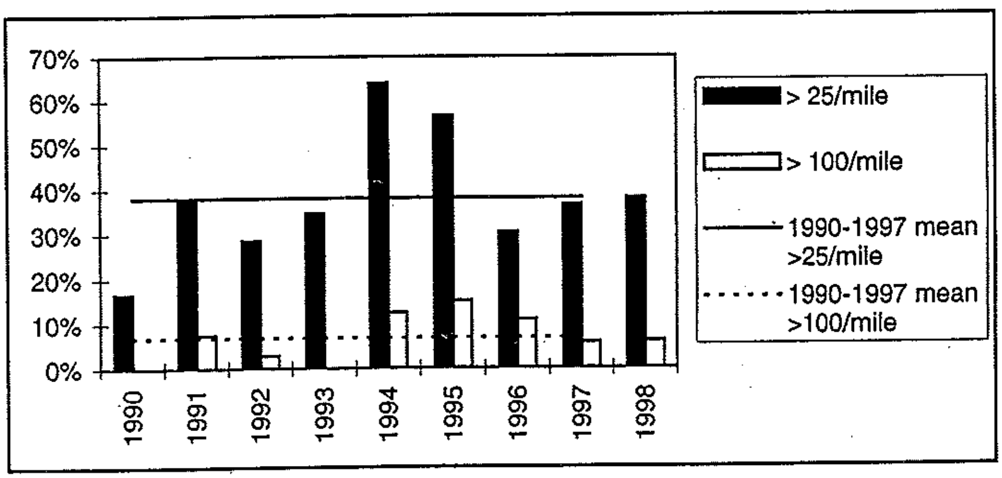

Figure 4. Percentage of surveyed lakes classified as having natural reproduction with high densities of young of the year walleye.

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, 1998 represented an average year for young of the year survival to fall. Recent years have seen good to excellent survival to fall of young of the year walleye.

CREEL SURVEYS

INTRODUCTION

Creel surveys of anglers provide information on angler effort, exploitation, and catch rates on surveyed waters. Creel surveys provide an estimate of the number of fish removed from a given body of water by anglers, information on trends in angler behavior, and information on the status of all fisheries of a lake. Records of both released and retained fish are kept. Trends in total catch and harvest, catch and release rates, hours fished for a given species, and success rates can be determined from creel survey data. Creel surveys are generally conducted on the same lakes for which population estimates are calculated. This allows the calculation of exploitation rates of the walleye populations and comparisons of catch and harvest success rates to walleye abundance on a cross section of walleye lakes in the ceded territory each year.

MATERIALS AND METHODS

Creel surveys were scheduled on the lakes where population estimates were conducted in the spring of the same year. Creel surveys were conducted on a total of 23 lakes in the ceded territory in 1998. Wisconsin creel surveys use a stratified randomized design (Beard et al. 1997, Rasmussen et al. 1998). The surveys were stratified by month and day type (weekend or weekday). Creel clerks conducted their interviews at random within these strata. Surveys were conducted on all days on 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 2nd 1998 and generally continued through March 1st 1999. The month of November was excluded due to weather and poor ice conditions limiting lake access. Information from these interviews was then expanded over the appropriate strata in order to provide a total estimate of effort, catch, and harvest of each species for each lake for the year.

In addition, creel surveys allow estimates of angler exploitation of walleye populations to be calculated. Angler exploitation rates were calculated by expanding the total number of marked walleye observed in the creel survey over the appropriate strata to estimate the projected number of marked walleye which were harvested. This number then was divided by the total number of the adult marked fish present in the lake. Although anglers are able to harvest sexually immature fish in some waters, exploitation rates are calculated to represent adult exploitation in order to allow comparison with tribal exploitation rates and to calculate an estimated total exploitation rate of adult walleye.

Mean exploitation values both for 1998 and 1990-1997 were only calculated for lakes with complete creel surveys. Lakes with summer data only were excluded. 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 1998 data to 1990-1997 data. T tests were also used to compare lakes of different sizes and regulation types. The level of significance for all tests was $\alpha = 0.05$.

RESULTS

Creel data were summarized by all lakes, lakes less than 500 acres, and lakes 500 acres or larger. Species specific creel data were extrapolated only over lakes containing a given species (based on past WDNR surveys). In addition, walleye creel data were grouped based on length limit regulation and population recruitment code. A creel survey was conducted on Little Round Lake (Sawyer) but it was not possible to calculate a population estimate due to the very small number of walleye captured. For this reason, Little Round Lake data is included in the summary tables but is not included in exploitation rate calculations. The Rainbow Flowage (Oneida) was also surveyed, but only winter data was available for analysis so these data was excluded from summary calculations.

Catch and harvest statistics were calculated for all species in "fish per acre" and "hours per fish" (catch and harvest rates) formats. Catch and harvest per acre give an indication of the walleye production of a given lake or group of lakes. Number of hours to catch and harvest a fish give an indication of the success of an average angler on a given lake or group of lakes. Specific catch and harvest rates (hours per fish) 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 was very similar between the lakes 500 acres or larger (33.3 hours/acre) and those less than 500 acres (33.2 hours/acre) ($p = 0.98$).

Walleye

Creel surveys were conducted on a total of 22 walleye lakes in 1998. Eleven of these lakes had an "exempt" length limit classification meaning there was no minimum length limit on walleye. Of the 11 exempt lakes, 6 had the additional restriction that only one walleye over 14 inches could be harvested per angler each day. The remaining 11 lakes had a minimum length restriction of 15 inches. Fifteen of the surveyed lakes were 500 acres or larger and the remaining 7 were less than 500 acres. Seventeen of the lakes were classified as having substantial natural reproduction. Walleye populations in the remaining 5 lakes were sustained through stocking (Table 3).

In general, walleye creel data followed expected trends in 1998 (Table 3). It took fewer hours for anglers targeting walleye to catch a walleye in exempt lakes than in lakes with the 15-inch length limit (4.3 hours/walleye vs. 5.8 hours/walleye) but this difference was not significant ($p = 0.35$). It took significantly longer for anglers targeting walleye to harvest a walleye in lakes with the 15-inch length limit (29.1 hours) than in exempt waters (12.0 hours, $p = 0.01$). This is likely due to the fact that there are generally fewer walleye available for harvest in lakes with the 15-inch length limit, as a large proportion of the populations consist of fish under 15 inches in length. In exempt lakes, the mean number of hours spent by anglers targeting walleye to catch a fish was lower in lakes 500 acres or larger (3.2 hours) than in smaller lakes (6.9 hours). However, this difference was not significant ($p = 0.06$). Similarly, among lakes with the 15-inch length limit, the mean number of hours spent by anglers targeting walleye to catch a walleye was lower in larger lakes (5.0 hours) than in smaller lakes (21.4 hours), although this difference was not significant ($p = 0.22$). Larger lakes often have a greater amount of habitat preferred by walleye than do smaller lakes. As expected, mean length of harvested walleye was significantly higher in lakes with the 15-inch length limit than in exempt lakes (18.3 inches vs. 13.4 inches, $p < 0.01$).

Table 3. 1998 walleye creel survey data. 1990-1997 mean values are calculated using only lakes with complete population estimate and creel information. Specific and general catch and harvest rates are measured in number of hours per fish caught or harvested. All lakes without a 15-inch length limit are included in the 1990-1997 means for exempt waters

			N	Lake Acres	Adult PE/Acre	Angler Catch /Acre	Angler Harvest /Acre	Specific Catch Rate	Specific Harvest Rate	Mean Length (Inches)	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1998	Means by regulation type and lake size	All lakes	22	946	2.90	2.38	0.70	4.9	17.0	15.9	10.4	36.5	10.1	33.3
		Exempt	11	578	3.37	2.85	1.04	4.3	12.0	13.4	9.4	26.4	11.4	31.8
		15" length limit	11	1315	2.39	1.92	0.35	5.8	29.1	18.3	11.7	58.8	8.9	34.7
		Exempt <500 acres	5	246	2.54	1.86	0.76	6.9	15.8	13.7	15.0	36.5	10.5	35.1
		Exempt ≥500 acres	6	855	4.06	3.68	1.28	3.2	10.0	13.2	7.1	21.5	12.2	29.1
		15" <500 acres	2	284	1.76	0.47	0.10	21.4	79.4	17.6	48.9	224.7	7.1	28.3
		15" ≥500 acres	9	1544	2.46	2.24	0.41	5.0	25.5	18.5	10.0	50.5	9.3	36.2
1998	Means by recruitment type and 15" regulation	Natural	17	951	3.21	2.66	0.80	4.5	15.3	15.4	9.6	32.7	10.5	35.1
		Stocked	5	930	1.91	1.44	0.35	7.4	28.2	17.5	14.9	60.2	8.9	27.0
		Natural 15 inch	7	1429	2.83	1.99	0.32	5.7	33.5	18.6	11.5	64.4	9.1	38.5
		Natural Exempt	10	617	3.45	3.13	1.14	3.9	11.0	13.1	8.6	24.3	11.5	32.7
		Stocked 15 inch	4	1115	1.74	1.78	0.42	6.0	23.6	17.7	12.1	51.1	8.5	28.1
		Stocked Exempt	1	191	2.59	0.08	0.08	125.0	125.0	16.7	212.8	212.8	10.3	22.8
1990-1997	Means by regulation type and lake size	All lakes	211	1189	3.51	3.75	0.82	3.9	16.2	16.3	7.4	31.4	13.3	33.8
		Exempt	72	1447	3.50	3.76	1.46	3.4	9.4	13.9	6.5	17.8	15.2	32.8
		15" length limit	132	1096	3.62	3.79	0.48	4.1	26.3	17.6	7.9	53.4	12.6	34.5
		Exempt <500 acres	23	256	2.94	3.33	1.23	4.1	14.4	14.1	9.0	32.8	20.4	46.7
		Exempt ≥500 acres	49	2006	3.74	3.97	1.57	3.2	8.2	13.8	5.8	14.6	12.8	26.4
		15" <500 acres	47	293	4.04	4.53	0.48	3.7	32.3	17.6	7.3	60.4	14.2	39.2
		15" ≥500 acres	69	1632	3.62	3.94	0.52	4.0	23.1	17.4	7.4	47.8	12.7	33.5
1990-1997	Means by recruitment type and 15" regulation	Natural	167	1308	3.90	4.40	0.96	3.3	14.2	15.7	6.3	27.0	14.7	33.4
		Stocked	41	788	2.00	1.23	0.28	10.0	34.8	18.7	22.1	81.1	8.3	37.6
		Natural 15 inch	95	1203	4.19	4.89	0.57	3.3	23.1	17.1	6.2	45.2	14.4	33.8
		Natural Exempt	72	1447	3.50	3.76	1.46	3.4	9.4	13.9	6.5	17.8	15.2	32.8
		Stocked 15 inch	41	789	1.99	1.22	0.28	10.1	35.0	18.7	22.3	81.8	8.2	37.5
		Stocked Exempt	0	0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Also in 1998, anglers appeared to have greater success on lakes sustained through natural reproduction, although none of the comparisons showed significant differences (Table 3). General anglers took slightly, although not significantly, longer to catch a walleye in lakes sustained through stocking efforts than in waters with natural reproduction (14.9 hours vs. 9.6 hours)($p = 0.45$). Similarly, anglers targeting walleye took 4.5 hours vs. 7.4 hours to catch a walleye in natural vs. stocked lakes ($p = 0.26$). Mean length of harvested walleye slightly smaller in natural waters than in lakes sustained by stocking (15.4 inches vs. 17.5 inches, $p = 0.24$), but this difference was not significant.

In general, parameters were slightly but not significantly lower in 1998 than the 1990-1997 mean values (Table 3). The mean adult walleye density was 2.9 walleye/acre in 1998 compared to the 1990-1997 mean value of 3.5 walleye per acre ($p = 0.35$). Anglers targeting walleye spent an average of 10.1 hours/acre in 1998 while the 1990-1997 mean value was 13.3 hours/acre ($p = 0.18$). In addition, angler success, in terms of average number of hours spent to catch and harvest a walleye, was lower in 1998 than the 1990-1997 mean values. Anglers targeting walleye spent an average of 4.9 hours to catch a walleye in 1998 compared to 3.9 hours for the 1990-1997 mean value ($p = 0.33$).

Effort directed at walleyes appeared to be concentrated on lakes with natural reproduction and lakes with exempt length restrictions in both 1998 as well as on average from 1990-1997 (Table 3). Anglers targeting lakes exempt from length restrictions and sustained by natural reproduction appeared to have greater success in regard to catch and harvest per hour. Anglers may assume that they have a better chance of catching and harvesting walleye in lakes with no length limit. 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 both general anglers and those targeting walleyes spent fewer hours to catch a walleye in exempt lakes, and the number of adult walleye per acre remains higher in exempt lakes than in lakes with a 15-inch length limit.

Total angler exploitation rates of walleye in 1998 ranged from 0.0% - 15.0%. Angler exploitation of walleye greater than or equal to 14 inches ranged from 0.0% - 24.9%. Angler exploitation of walleye greater than or equal to 20 inches ranged from 0.0% - 31.5%. Tribal exploitation of adult walleye ranged from 0.0% - 9.5%. Combined total exploitation estimates (tribal exploitation + angler exploitation) ranged from 0.0% to 21.3% for lakes surveyed in 1998 (Table 4). Mean total angler exploitation, tribal exploitation, and total exploitation rates were lower in 1998 than the 1990-1997 mean values although none of these differences were significant (6.2% vs. 9.2% $p = 0.24$, 3.1% vs. 4.2% $p = 0.68$, and 9.3% vs. 13.2% $p = 0.21$, respectively) (Table 4).

Table 4. 1998 adult walleye exploitation rates and 1990-1997 mean exploitation rates. Tribal harvest data used to calculate tribal exploitation provided by the Great Lakes Indian Fish and Wildlife Commission (Kmiecik 1991, Kmiecik and Ngu 1992, Ngu and Kmiecik 1993, Ngu 1994, Ngu 1995, Ngu 1996, Krueger 1997, Krueger 1998, Krueger 1999).

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
Bony Lake	Bayfield	191	0.0%	0.0%	0.0%	0.0%	0.0%
Middle Eau Claire Lake	Bayfield	902	13.9%	24.9%	31.5%	7.4%	21.3%
Nebagamon Lake	Douglas	914	14.9%	18.0%	0.0%	1.2%	16.1%
Pine Lake	Iron	312	6.4%	17.5%	0.0%	0.0%	6.4%
Spider Lake	Iron	352	6.9%	8.5%	0.0%	0.0%	6.9%
Kawaguesaga Lake	Oneida	670	4.8%	8.2%	0.0%	3.7%	8.5%
Minocqua Lake	Oneida	1360	3.6%	8.6%	0.0%	4.5%	8.2%
Tomahawk Chain	Oneida	3392	5.9%	7.4%	11.1%	8.4%	14.3%
Two Sisters Lake	Oneida	719	0.6%	0.7%	0.0%	3.1%	3.8%
Balsam Lake	Polk	2054	11.8%	13.0%	18.9%	3.4%	15.2%
Amik Lake	Price	224	0.0%	0.0%	0.0%	0.0%	0.0%
Butternut Lake	Price	1006	6.0%	5.8%	5.3%	3.5%	9.5%
Pike Lake	Price	806	2.3%	10.8%	0.0%	3.8%	6.1%
Round Lake	Price	726	4.2%	7.3%	0.0%	3.7%	7.9%
Turner Lake	Price	149	12.8%	13.3%	18.6%	0.0%	12.8%
Round Lake	Sawyer	3054	8.4%	17.4%	27.9%	9.5%	17.9%
Big Arbor Vitae Lake	Vilas	1090	15.0%	10.9%	7.0%	4.5%	19.5%
Kentuck Lake	Vilas	957	0.0%	0.0%	0.0%	0.0%	0.0%
Laura Lake	Vilas	599	3.5%	5.4%	0.0%	5.4%	8.9%
Lynx Lake	Vilas	339	0.0%	0.0%	0.0%	0.0%	0.0%
Nancy Lake	Washburn	772	9.5%	11.7%	15.3%	3.2%	12.7%
1998 Mean Values⁺			6.2%	9.0%	6.5%	3.1%	9.3%
1990-1997 Mean Values*			9.2%	12.8%	12.6%	4.2%	13.2%

⁺ N = 21 for 1998 means.

* N = 196 for "Total", "≥ 14 inches", and "≥ 20 inches" angler exploitation of adult walleye 1990-1998 means.

N = 192 for "Tribal" and "Total" exploitation of adult walleye 1990-1997 means.

Although exploitation of walleye greater than or equal to 20 inches provides an estimate of exploitation of 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 walleye greater than or equal to 20 inches which received marks ranged from 8-324 and the number of recaptures ranged from 0-4 with thirteen lakes recording zero recaptures of this length. Therefore small changes in the number of fish recorded in a creel survey would have a relatively large effect on the associated exploitation rate. Consequently, the variances associated with the estimates of exploitation rates for these fish are very large.

The fact that the 1998 average exploitation rate was lower than the 1990-1997 average bodes well for walleye populations in lakes in the ceded territories. In addition, none of the lakes had a total exploitation rate greater than 35% which indicates that overexploitation is not occurring in these lakes. The current management practices are meeting the expected goal of maintaining exploitation rates of less than 35% in Ceded Territory walleye populations.

Muskellunge

Complete creel surveys were collected from a total of 20 lakes classified as muskellunge waters in 1998. Thirteen of the surveyed lakes were 500 acres or larger and 7 were less than 500 acres. 1998 and 1990-1997 mean values are shown in Table 5.

Total catch was higher in lakes 500 acres or larger. There was a relatively large difference in specific harvest rate between the 1998 mean value of 2597.4 hours and the 1990-1997 mean value of 424.1 hours ($p = 0.06$). This most likely results from the increase in popularity of catch and release fishing for this species since, unlike the specific harvest rate, the 1998 mean specific catch rate of 33.3 hours was very similar to the 1990-1997 mean value of 27.2 hours ($p = 0.34$).

Table 5. 1998 and 1990-1997 mean muskellunge creel survey 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 (Inches)	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1998		All lakes	20	892	0.41	0.004	33.3	2597.4	40.4	75.9	5405.4	9.6	33.4
	Means	<500 acres	7	257	0.57	0.008	27.7	1296.3	39.6	62.1	2692.3	11.4	33.2
		≥500 acres	13	1235	0.32	0.003	37.4	5652.2	40.7	86.3	11818.2	8.6	33.6
1990-1997		All lakes	182	1190	0.46	0.026	27.2	424.1	37.9	68.6	1206.7	9.9	34.8
	Means	<500 acres	68	275	0.56	0.032	25.2	395.4	36.9	64.2	1102.1	11.0	42.7
		≥500 acres	114	1736	0.40	0.023	28.5	441.8	38.2	71.4	1279.7	9.2	30.1

*1990-1997 mean specific catch and harvest rates n = 174 for all lakes, n = 62 for lakes <500 acres, and n = 112 for lakes ≥500 acres.

Northern Pike

Complete creel surveys were collected from a total of 21 lakes classified as northern pike waters in 1998. Fourteen of the surveyed lakes were 500 acres or larger and 7 were less than 500 acres. 1998 and 1990-1997 mean values are shown in Table 6. Mean values for lakes <500 acres were all very similar to lakes ≥500 acres.

Mean specific and general harvest rates were higher in 1998 than the 1990-1997 mean values (35.7 hours vs. 18.7 hours and 121.4 hours vs. 73.2 hours). However, neither of these differences was significant ($p = 0.83$ and $p = 0.31$).

Table 6. 1998 and 1990-1997 mean northern pike 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 (inches)	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1998		All lakes	21	963	2.11	0.23	5.3	35.7	22.8	13.9	121.4	4.0	34.3
	Means	<500 acres	7	257	2.51	0.29	4.9	61.2	21.4	12.8	115.7	5.5	33.2
		≥500 acres	14	1316	1.92	0.20	5.4	29.5	23.2	14.5	124.4	3.2	34.9
1990-1997		All lakes	197	1183	1.99	0.43	5.5	18.7	22.3	15.5	73.2	8.6	34.9
	Means	<500 acres	71	285	2.31	0.48	4.9	15.3	22.0	13.4	64.0	7.6	43.6
		≥500 acres	126	1689	1.80	0.40	5.9	21.3	22.4	17.0	79.7	9.2	30.0

*1990-1997 mean specific catch and harvest rates n = 190 for all lakes, n = 68 for lakes <500 acres, n = 122 for lakes ≥500 acres.

Smallmouth bass

Complete creel surveys were collected from a total of 21 lakes classified as smallmouth bass waters in 1998. Fourteen of the surveyed lakes were 500 acres or larger and 7 were less than 500 acres. 1998 and 1990-1997 mean values are shown in Table 7.

Mean angler catch/acre was higher in 1998 than the 1990-1997 mean value (1.81 vs. 0.99), although this difference was not significant ($p = 0.09$). Mean specific and general harvest rates were also higher in 1998 than the 1990-1997 mean values (41.1 hours vs. 29.5 hours and 380.4 hours vs. 199.6 hours) although neither of these differences was significant ($p = 0.58$ and 0.18).

Table 7. 1998 and 1990-1997 mean smallmouth 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 (inches)	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1998		All lakes	21	893	1.81	0.05	3.8	41.1	15.2	16.3	380.4	3.0	32.7
	Means	<500 acres	7	257	1.27	0.04	5.2	151.8	15.5	16.6	507.2	4.5	33.2
		≥500 acres	14	1212	2.08	0.05	3.3	30.1	15.1	16.1	338.2	2.3	32.4
1990-1997		All lakes	198	1213	0.99	0.10	3.6	29.5	14.7	19.3	199.6	3.7	34.9
	Means	<500 acres	70	290	1.21	0.12	5.2	38.1	14.8	17.4	195.4	3.0	43.7
		≥500 acres	128	1718	0.87	0.10	3.1	26.4	14.6	20.5	201.9	4.1	30.1

*1990-1997 Mean specific catch and harvest rates n = 183, n = 63 for lakes <500 acres, and n = 120 for lakes ≥500 acres.

Largemouth bass

Complete creel surveys were collected from a total of 22 lakes classified as largemouth bass waters in 1998. Fifteen of the surveyed lakes were 500 acres or larger and 7 were less than 500 acres. 1998 and 1990-1997 mean values are shown in Table 8.

Although there were relatively large differences between lakes less than 500 acres and lakes 500 acres or larger in mean catch/acre (0.53 largemouth bass/acre vs. 3.75 largemouth bass/acre), specific harvest rate (96.7 hours vs. 625.0 hours), and directed effort/acre (2.9 hours/acre vs. 4.3 hours/acre) in 1998, none of these differences were significant ($p = 0.25$, $p = 0.24$, and $p = 0.62$ respectively).

There were also relatively large differences between the 1998 mean values and the 1990-1997 means for catch/acre (2.72 largemouth bass/acre vs. 1.38 largemouth bass/acre) and specific harvest rate (137.3 hours vs. 38.9 hours). While the difference in catch/acre was not significant ($p = 0.15$), specific harvest rate was significantly greater in 1998 when compared to the 1990-1997 mean value ($p = 0.05$). This is most likely due to the increased popularity of catch and release angling for this species as the 1998 specific catch rate was not significantly different from the 1990-1997 mean value ($p = 0.25$).

Table 8. 1998 and 1990-1997 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 (inches)	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1998		All lakes	22	946	2.72	0.12	4.5	137.3	16.0	14.6	353.1	3.9	33.3
	Means	<500 acres	7	257	0.53	0.01	9.6	625.0		44.0	2692.3	2.9	33.2
		≥500 acres	15	1268	3.75	0.16	3.5	96.7		11.1	251.3	4.3	33.3
1990-1997		All lakes	209	1121	1.38	0.13	6.0	38.9	14.4	24.8	212.8	4.5	34.6
	Means	<500 acres	78	283	1.73	0.16	6.5	45.8	14.2	22.5	213.2	4.8	42.3
		≥500 acres	131	1620	1.17	0.10	5.7	35.7	14.5	26.4	212.5	4.4	30.0

*1990-1997 mean specific catch and harvest rates n = 187, n = 72 for lakes <500 acres, and n = 112 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 capture of a given species. This information is presented in Figure 5 as the ratio of the mean number of hours of directed effort to catch a fish of a given species to the mean number of hours spent to harvest a fish of the same species. Muskellunge were the most difficult species both to catch and to harvest and had the lowest catch rate to harvest rate ratio (Figure 5). This is due to the relatively low densities of muskellunge dictated by the biology and habitat requirements of this larger species, as well as the emphasis placed on catch and release in this fishery. Interestingly, the other species, northern pike, walleye, largemouth bass, and smallmouth bass, required approximately the same amount of directed effort to catch, although their harvest rates differed substantially. Walleye are highly valued for purposes of consumption; thus the ratio of the number of hours spent to catch a walleye to the number of hours to harvest 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 catch to harvest rate ratios for northern pike, smallmouth bass, and largemouth bass.

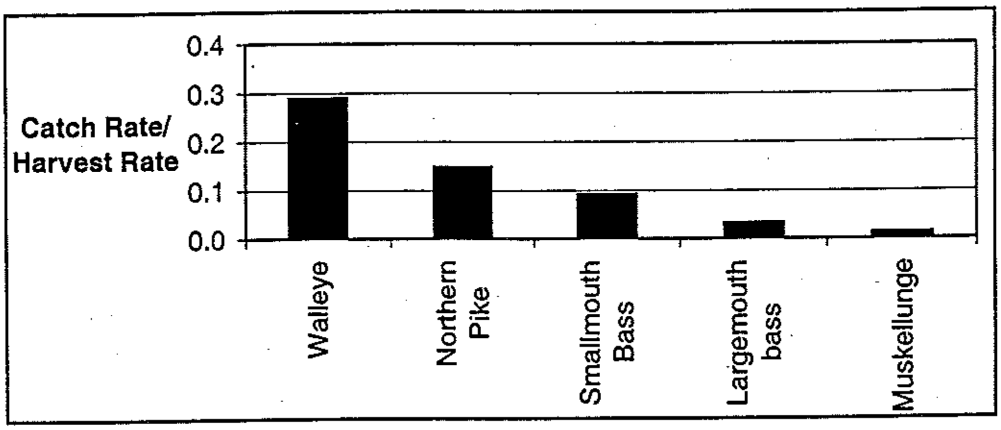

Figure 5. 1998 species comparisons of specific catch/harvest rate ratio.

Species Composition and Lake Size

Since catch rate is related to population size (Ricker 1975), catch rate can indicate the type of lake preferred by a given species. Many biotic and abiotic factors determine the suitability of a body of water for a given species. Many of these parameters were not measured in the course of this sampling. However, lake size has some affect on physical and chemical factors present in a given lake (Cole 1979). Figure 6 relates specific catch rate to lake size. In 1998, anglers spent less time to catch muskellunge, and to a lesser extent northern pike, in lakes less than 500 acres compared to lakes 500 acres or greater (Figure 6). Both of these species are primarily littoral predators and the littoral zone in smaller lakes generally represents a larger portion of the total acreage. Therefore, muskellunge and northern pike may have a higher density in smaller lakes and may be more accessible to anglers in these smaller lakes. Walleye often utilize open water pelagic areas which are more common in larger lakes. In addition, clean gravel in shallow areas is a spawning requirement for walleye. This type of habitat is often created on lakeshores through wave action. Larger lakes have a generally have a greater fetch and therefore greater wave action. Accordingly, anglers were more successful fishing for walleye in lakes 500 acres or larger (Figure 6). Although smallmouth bass are predominantly found in the littoral zone of lakes, they are considered a generalist species. Lake size does not seem to be a good predictor of smallmouth bass specific catch rate. Although largemouth bass appear to have higher catch rates in lakes greater than 500 acres, the low number of largemouth bass caught make comparisons between larger and smaller lakes problematic.

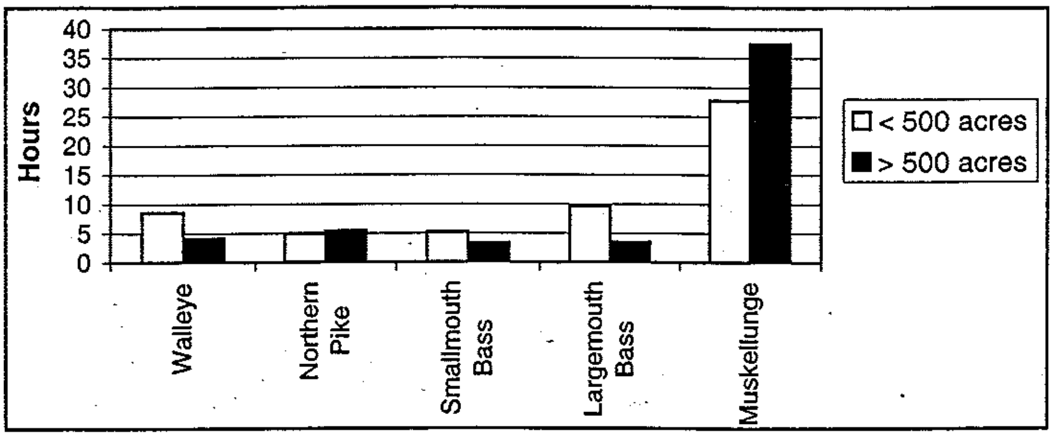

Figure 6. 1998 species specific catch rates in lakes <500 acres and ≥500 acres.

SUMMARY

These surveys completed by the WDNR provide protection against overharvest 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. Based on population estimates, the number of fish which can be safely harvested can be determined. 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 total allowable catch of walleye from a given lake is 35% of the estimated adult population and the total allowable catch of muskellunge is 27% of the estimated adult population. 35% of the adult walleye population and 27% of the estimated adult muskellunge population were determined to be the maximum sustainable exploitation rates in Northern Wisconsin (Staggs 1990). The federal court mandated that overharvest occur in not more than 1 of 40 waters. Since there is a certain degree of uncertainty inherent in population estimates, safe harvest is based on the lower 95% confidence interval of the current population estimate in each lake. 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 fact that fish populations are variable over time, the reliability in a population estimate declines with time and a mark-recapture population estimate is only used 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).

Each spring each tribe makes a declaration of how many walleye and muskellunge they intend to harvest from each lake based on a declared proportion of the safe harvest levels determined for 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 walleye using a variety of high efficiency methods including spearing and gillnetting. Spearing in the spring is by far the most utilized method. All fish that are speared are documented each night. 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. 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 are 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 appear to be at acceptable densities, and overexploitation does not appear to be occurring. The surveys and management techniques discussed in this report appear are 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.

REFERENCES

Beard, T. D., Jr., S. W. Hewett, Q. Yang, R. M. King, and S. J. Gilbert. 1997. Prediction of angler catch rates based on walleye population density. North American Journal of Fisheries Management 17 (4): 621-627.

Cole, G. A. 1979. Textbook of limnology, second edition. C. V. Mosby Company, St. Louis, Missouri.

Hansen, M. J., M.D. Staggs, and M. H. Hoff. 1991. Derivation of safety factors for setting harvest quotas on adult walleyes from past estimates of abundance. Transactions of the American Fisheries Society 120: 620-628.

Hansen, M. J., T. D. Beard Jr., S. W. Hewett. 2000. Catch rates and catchability of walleyes in angling and spearing fisheries in Northern Wisconsin lakes. North American Journal of Fisheries Management- In press.

Hewett, S. W. and T. D. Simonson. 1998. Wisconsin's walleye management plan: moving management into the 21st century. Wisconsin Department of Natural Resources, Administrative Report #43, Bureau of Fisheries Management and Habitat Protection, Madison, Wisconsin.

Kempinger, J. J. and R. F. Carline. 1977. Dynamics of the walleye (*Stizostedion vitreum vitreum*) population in Escanaba Lake, Wisconsin, 1955-1972. Journal of the Fisheries Research Board of Canada 34: 1800-1811.

Kmiecik, N. and H. H. Ngu. 1991. Open water spearing in northern Wisconsin by Chippewa Indians during 1990. Great Lakes Indian Fish and Wildlife Commission, Administrative Report 91-4, Odanah, Wisconsin.

Kmiecik, N. and H. H. Ngu. 1992. Open water spearing in northern Wisconsin by Chippewa Indians during 1991. Great Lakes Indian Fish and Wildlife Commission, Administrative Report 92-8, Odanah, Wisconsin.

Krueger, J. 1997. Open water spearing in northern Wisconsin by Chippewa Indians during 1996. Great Lakes Indian Fish and Wildlife Commission, Administrative Report 97-02, Odanah, Wisconsin.

Krueger, J. 1998. Open water spearing in northern Wisconsin by Chippewa Indians during 1997. Great Lakes Indian Fish and Wildlife Commission, Administrative Report 98-01, Odanah, Wisconsin.

Krueger, J. 1999. Open water spearing in northern Wisconsin by Chippewa Indians during 1998. Great Lakes Indian Fish and Wildlife Commission, Administrative Report 99-4, Odanah, Wisconsin.

Li, J., Y. Cohen, D. H. Schupp, and I. R. Adelman. 1996. Effects of walleye stocking on year-class strength. North American Journal of Fisheries Management 16(4): 840-850.

Ngu, H. H. and N. Kmiecik. 1993. Open water spearing in northern Wisconsin by Chippewa Indians during 1992. Great Lakes Indian Fish and Wildlife Commission, Administrative Report 93-4, Odanah, Wisconsin.

Ngu, H. H. 1994. Open water spearing in northern Wisconsin by Chippewa Indians during 1993. Great Lakes Indian Fish and Wildlife Commission, Administrative Report 94-1, Odanah, Wisconsin.

Ngu, H. H. 1995. Open water spearing in northern Wisconsin by Chippewa Indians during 1994. Great Lakes Indian Fish and Wildlife Commission, Administrative Report 95-03, Odanah, Wisconsin.

Ngu, H. H. 1996. Open water spearing in northern Wisconsin by Chippewa Indians during 1995. Great Lakes Indian Fish and Wildlife Commission, Administrative Report 96-01, Odanah, Wisconsin.

Rasmussen, P. W., M. D. Staggs, T. D. Beard, Jr., and S. P. Newman. 1998. Bias and confidence interval coverage of creel survey estimators evaluated by simulation. Transactions of the American Fisheries Society 127: 460-480.

Ricker, W. E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bulletin of the Fisheries Research Board of Canada 191. Department of the Environment, Fisheries, and Marine Science, Ottawa. 382 p.

Serns, S. L. 1982. Relationship of walleye fingerling density and electrofishing catch per effort in northern Wisconsin lakes. North American Journal of Fisheries Management 2 (1): 38-44.

Staggs, M. D, R. C. Moody, M. J. Hansen, and M. H. Hoff. 1990. Spearing and sport angling for walleye in Wisconsin's ceded territory. Wisconsin Department of Natural Resources Bureau of Fisheries Management, Administrative Report 31, Madison.

Appendix 1. Lakes with population estimates calculated in 1998 as well as at least one historical population estimate.

County	Lake	Year	Adult Population Estimate	Adult Walleye Per Acre
Bayfield	Bony Lake	1998	494	2.6
		1989	682	3.6
	Drummond Lake	1998	95	0.7
		1989	155	1.2
	Middle Eau Claire Lake	1998	4099	4.5
		1993	4577	5.1
Douglas	Lake Nebagamon	1998	1525	1.7
		1994	2362	2.6
		1986	1374	1.5
Iron	Pine Lake	1998	1412	5.7
		1992	2196	8.9
Oneida	Kawaguesaga Lake	1998	3495	5.2
		1992	2973	4.4
		1987	4823	7.2
	Minoqua Lake	1998	6276	4.6
		1992	7638	5.6
		1987	7028	5.2
	North Nokomis Lake	1998	1254	2.6
		1988	807	1.7
	Rainbow Flowage	1998	8114	4.0
		1990	8745	4.3
	Sweeney Lake	1998	750	4.0
		1988	277	1.5
	Tomahawk Lake	1998	8508	2.5
		1992	8172	2.4
		1987	6684	2.0
		1986	12581	3.7
	Two Sisters Lake	1998	1367	1.9
		1992	2245	3.1
		1988	1487	2.1
Polk	Balsam Lake	1998	3081	1.5
		1994	3399	1.7
		1989	7020	3.4
		1988	7102	3.5
		1987	3845	1.9
Price	Amik Lake	1998	87	0.4
		1991	339	1.5
	Butternut Lake	1998	3577	3.6
		1996	4165	4.1
		1990	1999	2.0
		1987	5614	5.6
	Pike Lake	1998	1839	2.3
		1991	3132	3.9
		1988	5398	6.7
	Round Lake	1998	3658	5.0
		1991	3070	4.2
		1988	2610	3.6
	Turner Lake	1998	374	0.5
		1991	1680	2.3
Sawyer	Round Lake	1998	6399	2.1
		1991	9618	3.1
		1989	10130	3.3
		1987	7222	2.4
Vilas	Big Arbor Vitae Lake	1998	5329	4.9
		1996	5793	5.3
		1993	9864	9.0
		1988	6960	6.4
		1986	12003	11.0
	Kentuck Lake	1998	731	0.8
		1989	7383	7.7
	Laura Lake	1998	2422	4.0
		1995	3530	5.9
		1994	3737	6.2
		1989	4499	7.5
	Lynx Lake	1998	595	1.8
		1994	473	1.4
Washburn	Nancy Lake	1998	1447	1.9
		1993	1993	2.6

Appendix 2. Walleye young of the year per mile and Serns Index calculations for surveyed lakes with natural reproduction in 1998.

Lake	County	Acres	Total Shoreline (mi)	Shoreline Shocked (mi)	Age 0+ Walleye (#/mi)	Serns Index (YOY/acre)
Spillerberg Lake	Ashland	75	1.5	1.5	66.7	15.6
Duck Lake	Barron	100	1.5	1.5	12.7	3.0
Lower Turtle Lake	Barron	276	3.8	3.8	0.0	0.0
Red Cedar Lake	Barron	1841	15.9	4.2	10.2	2.4
Jackson Lake	Bayfield	142	2.8	2.4	1.3	0.3
Middle Eau Claire Lake	Bayfield	902	11.0	11.0	99.1	23.2
Tainter Lake*	Dunn	1752	25.7	21.1	33.0	7.7
Keyes Lake	Florence	202	3.2	3.2	1.9	0.4
Patten Lake	Florence	255	4	4	16.5	3.9
Gile Lake	Iron	3384	27.2	6.6	76.8	18.0
Lake of the Falls	Iron	338	6.7	2.5	0.8	0.2
Pine Lake	Iron	312	6.0	6.0	98.7	23.1
Spider Lake	Iron	352	7.3	7.3	14.2	3.3
Trude Lake	Iron	781	15.1	4.0	149.3	34.9
Turtle Flambeau Flowage	Iron	13545	206.3	7.8	180.6	42.3
Seven Island Lake	Lincoln	132	4	3.4	0.0	0.0
Bass Lake	Oconto	149	2.7	2.7	0.0	0.0
Boot Lake	Oconto	235	3.8	3.1	0.0	0.0
Wheeler Lake	Oconto	293	4.6	4.6	11.1	2.6
Big Carr Lake	Oneida	213	3.6	3.6	0.0	0.0
Lake Kawaguesaga	Oneida	670	11.1	11.1	3.1	0.7
Minocqua Lake	Oneida	1,360	15.9	15.9	7.5	1.8
Rainbow Flowage	Oneida	2,035	22.3	12.9	54.2	12.7
Tomahawk Lake Chain	Oneida	3,552	32.5	32.5	29.0	6.8
Ward Lake	Polk	91	2.3	2.3	0.0	0.0
Amik Lake	Price	224	5.3	5.3	1.9	0.4
Butternut Lake	Price	1006	11.2	11.2	85.5	20.0
Pike Lake	Price	806	10.9	10.9	18.4	4.3
Round Lake	Price	726	5.1	5.1	53.5	12.5
Turner Lake	Price	149	2.6	2.6	0.0	0.0
Chain Lake	Rusk	468	7.9	4.6	7.0	1.6
Island Lake	Rusk	526	5.8	4.2	0.0	0.0
Blaisdell Lake	Sawyer	356	7.6	4.3	4.0	0.9
Lake Chippewa	Sawyer	15300	99.9	4.8	66.9	15.6
Round Lake	Sawyer	3054	20.2	20.2	17.5	4.1
Windfall Lake	Sawyer	102	1.6	1.6	88.8	20.8
Cedar Lake	St. Croix	1100	6.3	4.1	139.8	32.7
Rib Lake	Taylor	320	3.3	3.3	10.6	2.5
Alder Lake	Vilas	274	2.5	2.5	26.8	6.3
Big Arbor Vitae Lake	Vilas	1,090	7.8	7.8	29.1	6.8
Dead Pike Lake	Vilas	297	3.8	3.8	0.0	0.0
Kentuck Lake	Vilas	957	6	6	0.0	0.0
Laura Lake	Vilas	613	4.8	4.8	44.6	10.4
Little Star Lake	Vilas	245	3.8	3.8	7.1	1.7
Lynx Lake	Vilas	339	6.3	6.3	3.0	0.7
Sparkling Lake	Vilas	127	2.3	2.3	0.0	0.0
Spectacle Lake	Vilas	171	3.9	2.2	0.0	0.0
Spider Lake	Vilas	272	5.9	5.9	42.7	10.0
Wild Rice Lake	Vilas	379	3.7	3.7	12.7	3.0
Shell Lake	Washburn	2580	10.2	8.1	35.8	8.4
Average					31.2	7.3

*Average of 10/12, 10/13, and 10/14 sampling efforts used for Tainter Lake Values

Appendix 3. Walleye young of the year per mile and Serns Index calculations for surveyed lakes sustained by stocking in 1998.

Lake	County	Acres	Total Shoreline (mi)	Shoreline Shocked (mi)	Age 0+ Walleye (#/mi)	Serns Index (YOY/acre)	Stocked in 1998
English Lake	Ashland	244	4.1	3.8	26.6	6.2	Y
Upper Clam Lake	Ashland	166	3.2	3.2	0.0	0.0	N
Loon Lake	Barron	94	2.4	2.4	0.0	0.0	Y
Upper Turtle Lake	Barron	438	4.8	4.8	6.3	1.5	Y
Atkins Lake	Bayfield	176	2.3	2.3	7.0	1.6	Y
Bony Lake	Bayfield	191	2.7	2.7	89.3	20.9	N
Crystal Lake	Bayfield	111	2.5	2.5	16.8	3.9	N
Diamond Lake	Bayfield	341	5.0	5.0	7.4	1.7	Y
Drummond Lake	Bayfield	99	3.1	2.4	2.5	0.6	Y
Lipsett Lake	Burnett	393	3.5	3.5	2.9	0.7	Y
Lake Nebagamon	Douglas	914	10.8	10.8	7.9	1.8	N
Fay Lake	Florence	282	4.5	2.8	16.8	3.9	Y
Halsey Lake	Florence	517	4.1	1.6	0.0	0.0	N
Rangeline Lake	Forest	82	1.3	1.3	0.0	0.0	N
Trump Lake	Forest	172	2.8	2.6	0.0	0.0	N
Fisher Lake	Iron	410	7.5	1.7	0.0	0.0	N
Grand Portage Lake	Iron	144	3.1	1.9	0.0	0.0	N
Long Lake	Iron	396	11.6	2.7	5.2	1.2	N
Mercer Lake	Iron	184	4.2	1.9	0.0	0.0	N
Owl Lake	Iron	129	4.2	4.2	0.0	0.0	N
Lower Post Lake	Langlade	378	8.4	2.7	0.0	0.0	N
Rose Lake	Langlade	112	7.3	4.3	0.0	0.0	N
Upper Post Lake	Langlade	758	7.6	7.6	0.0	0.0	N
Bear Lake	Oneida	312	4.3	4.3	0.0	0.0	N
Booth Lake	Oneida	207	3.6	3.6	1.4	0.3	Y
Long Lake	Oneida	113	2.9	2.9	0.7	0.2	N
North Nokomis Lake	Oneida	468	7.3	6.2	0.0	0.0	N
Sweeney Lake	Oneida	187	3.3	3.3	16.7	3.9	Y
Two Sisters Lake	Oneida	719	9.3	9.3	19.2	4.5	Y
Balsam Lake	Polk	2054	22.7	22.7	0.7	0.2	Y
Amacoy Lake	Rusk	278	3.7	3.7	0.0	0.0	N
Barber Lake	Sawyer	238	4.8	4.8	0.2	0.0	Y
Hayward Lake	Sawyer	247	8.6	6.8	6.5	1.5	Y
Ballard Lake	Vilas	505	5.1	5.1	11.4	2.7	Y
Found Lake	Vilas	326	3.6	3.6	11.7	2.7	Y
Frank Lake	Vilas	141	3.1	3.1	11.6	2.7	N
Little St. Germain Lake	Vilas	980	14.5	14.5	0.0	0.0	N
Lost Lake	Vilas	544	4.6	4.6	10.4	2.4	Y
White Birch Lake	Vilas	112	2.2	2.2	7.3	1.7	Y
Dunn Lake	Washburn	193	3.6	3.6	7.8	1.8	Y
Gilmore Lake	Washburn	389	7.6	5.7	4.6	1.1	Y
Lake Nancy	Washburn	772	10.9	7.5	12.9	3.0	N
Little Sand Lake	Washburn	74	1.3	1.3	0.0	0.0	N
Matthews Lake	Washburn	263	2.6	2.6	0.0	0.0	Y
Ripley Lake	Washburn	190	2.5	2.5	0.0	0.0	N
Stone Lake	Washburn	523	4.0	4.0	0.0	0.0	Y
Average					6.8	1.6	

Appendix 4. Walleye young of the year per mile and Serns Index calculations for surveyed lakes with remnant populations, unharvestable stocked populations, populations with unknown reproductive classification, and lakes with no known walleye population.

Lake	County	Acres	Total Shoreline (mi)	Shoreline Shocked (mi)	Age 0+ Walleye (#/mi)	Serns Index (YOY/acre)
Mineral Lake	Ashland	225	5.3	4.7	24.0	5.6
Moquah Lake	Ashland	50	2.7	1.4	0.0	0.0
Potter Lake	Ashland	29	0.9	0.9	36.7	8.6
Spider Lake	Ashland	103	2.7	2.7	0.4	0.1
Bass Lake	Barron	118	1.8	1.8	0.0	0.0
Lake Tahkodah	Bayfield	152	2.6	2.6	0.0	0.0
Long Lake	Burnett	251	4.7	4.7	0.0	0.0
Lost Lake	Florence	92	1.5	1.5	0.0	0.0
Bear Lake	Forest	68	1.6	1.6	0.0	0.0
Silver Lake	Forest	320	3.8	3.8	0.3	0.1
Long Lake	Langlade	79	3.3	3.3	0.0	0.0
Pine Lake	Lincoln	134	2.7	2.7	0.0	0.0
Big Blake Lake	Polk	217	4.9	4.9	0.0	0.0
Whitcomb Lake	Price	44	1.7	1.7	16.5	3.9
Potato Lake	Rusk	534	9.2	5.1	3.1	0.7
Fishtrap Lake	Sawyer	216	6.8	3.3	0.0	0.0
South Twin Lake	Taylor	25	0.9	0.9	0.0	0.0
Fravil Lake	Vilas	42	1.3	1.3	0.0	0.0
Slim Lake	Washburn	224	2.6	2.6	2.3	0.5
Average					4.4	1.0

Appendix 5. 1998 walleye creel data.

Lake Name	County Name	MWB CODE	1998 Walleye Code	Bag Limit	Size Limit	Lake Acres	Adult PE	Adult PE/Acre	Angler Catch	Angler Catch /Acre	Angler Harvest	Angler Harvest/ Acre	Specific Catch Rate	Specific Harvest Rate	Number of fish Measured	Mean Length	General Catch Rate	General Harvest Rate	Angler Directed Effort	Directed Effort /Acre	Angler Total Effort	Total Effort /Acre
Bony Lake	Bayfield	2742500	C-ST	5	1>14	191	494	2.59	16	0.08	16	0.0838	0.0080	0.0080	3	16.73	0.0047	0.0047	1970	10.31	4351	22.78
Middle Eau Claire Lake	Bayfield	2742100	C-NR	2	1>14	902	4099	4.54	3667	4.07	1511	1.6752	0.3380	0.1382	364	14.37	0.1782	0.0734	10614	11.77	20629	22.87
Lake Nebagamon	Douglas	2865000	C-ST	2	15	914	1525	1.67	3324	3.64	724	0.7921	0.2926	0.0646	131	16.60	0.2065	0.0450	11215	12.27	16100	17.61
Pine Lake	Iron	2949200	NR	2	1>14	312	1412	4.53	1618	5.19	586	1.8782	0.4241	0.1562	139	11.70	0.2237	0.0810	3752	12.03	7325	23.48
Spider Lake	Iron	2306300	NR	2	1>14	352	943	2.68	386	1.10	220	0.6250	0.0947	0.0538	62	13.17	0.0455	0.0258	4002	11.37	8547	24.28
Kawaguesaga Lake	Oneida	1542300	NR	3	15	670	3495	5.22	2131	3.18	182	0.2716	0.2260	0.0133	14	16.09	0.0609	0.0052	9007	13.44	36672	54.73
Minocqua Lake	Oneida	1542400	NR	3	15	1360	6276	4.61	6925	5.09	1022	0.7515	0.3122	0.0461	48	16.78	0.1027	0.0152	21402	15.74	69940	51.43
Tomahawk Chain	Oneida	1542700	C-	3	15	3392	8508	2.51	2765	0.82	1036	0.3054	0.0784	0.0293	94	17.88	0.0337	0.0126	34978	10.31	84196	24.82
Two Sisters Lake	Oneida	1588200	ST	3	15	719	1367	1.90	827	1.15	162	0.2253	0.1291	0.0255	27	19.24	0.0571	0.0112	6339	8.82	14487	20.15
Balsam Lake	Polk	2620600	C-ST	3	15	2054	3081	1.50	2778	1.35	677	0.3296	0.1037	0.0250	50	17.84	0.0316	0.0077	14900	7.25	95120	46.31
Amik Lake	Price	2268600	NR	5	none	224	87	0.39	116	0.52	77	0.3438	0.0600	0.0346	10	11.90	0.0130	0.0087	1520	6.79	11436	51.05
Butternut Lake	Price	2283300	C-NR	3	none	1006	3577	3.56	3124	3.11	1180	1.1730	0.2590	0.0981	220	12.68	0.1060	0.0400	12019	11.95	29546	29.37
Pike Lake	Price	2268300	C-	2	none	806	1839	2.28	1621	2.01	371	0.4603	0.1876	0.0300	52	12.88	0.0782	0.0179	7530	9.34	20745	25.74
Round Lake	Price	2267800	C-	3	none	726	3658	5.04	2981	4.11	676	0.9311	0.3914	0.0894	147	12.56	0.1750	0.0397	7459	10.27	17151	23.62
Turner Lake	Price	2268500	C-	2	none	149	374	2.51	358	2.40	130	0.8725	0.1367	0.0631	14	14.82	0.0461	0.0168	1766	11.85	8040	53.96
Little Round Lake*	Sawyer	2395500	NR	5	15	229	*	*	8	0.03	8	0.0349	0.0109	0.0109	1	18.50	0.0021	0.0021	744	3.25	7558	33.00
Round Lake	Sawyer	2395600	C-NR	3	15	3054	6399	2.10	11942	3.91	2162	0.7079	0.5180	0.0942	272	16.58	0.3692	0.0668	22307	7.30	32379	10.60
Big Arbor Vitae Lake	Vilas	1545600	NR	3	1>14	1090	5329	4.89	7100	6.51	2931	2.6890	0.2676	0.1099	515	12.68	0.1070	0.0442	26222	24.06	66482	60.99
Kentuck Lake	Vilas	716800	NR	5	15	957	731	0.76	2	0.00	2	0.0021	0.0007	0.0007	1	27.90	0.0000	0.0000	2507	2.62	68540	71.62
Laura Lake	Vilas	995200	C-NR	3	1>14	599	2422	4.04	1381	2.31	452	0.7546	0.4044	0.1323	143	14.15	0.1951	0.0638	3416	5.70	7166	11.96
Lynx Lake	Vilas	2954500	C-NR	5	15	339	595	1.76	308	0.91	54	0.1593	0.0824	0.0143	10	16.61	0.0388	0.0068	3740	11.03	7965	23.50
Nancy Lake	Washburn	2691500	C-ST	3	15	772	1447	1.87	765	0.99	246	0.3187	0.1457	0.0545	43	17.21	0.0355	0.0144	4479	5.80	21871	28.33
Rainbow Flowage**	Oneida	1595300	NR	3	15	2035	8114	3.99	574	0.28	243	0.1194	0.0709	0.0299	76	17.60	0.0688	0.0291	8103	3.98	8346	4.10

Slot regulation indicates walleye between 14 and 18 inches must be released; only one fish over 18 inches may be kept.
All lakes without a 15-inch size limit are included in the summary for exempt waters.
*No population estimate on Little Round Lake.
**Winter data only on Rainbow Flowage. Summer data has not yet been analyzed.

Appendix 6. 1998 muskellunge creel data.

Lake Name	County Name	MWB CODE	1998 Musky Code	Musky Size Limit	Lake Acres	Angler Catch	Angler Catch /Acre	Angler Harvest	Angler Harvest/ Acre	Specific Catch Rate	Specific Harvest Rate	Number of fish Measured	Mean Length	General Catch Rate	General Harvest Rate	Angler Directed Effort	Directed Effort /Acre	Angler Total Effort	Total Effort /Acre
Bony Lake	Bayfield	2742500	NR	40	191	0	0.00	0	0.0000	0.0000	0.0000	0		0.0000	0.0000	981	5.14	4351	22.78
Middle Eau Claire Lake	Bayfield	2742100	C-	40	902	58	0.06	0	0.0000	0.0239	0.0000	0		0.0035	0.0000	2091	2.32	20629	22.87
Lake Nebagamon*	Douglas	2865000																	
Pine Lake	Iron	2949200	NR	40	312	209	0.67	8	0.0256	0.0959	0.0039	1	41.50	0.0348	0.0013	1958	6.28	7325	23.48
Spider Lake	Iron	2306300	C-	34	352	88	0.25	10	0.0284	0.0280	0.0015	2	37.75	0.0113	0.0013	2617	7.43	8547	24.28
Kawaguesaga Lake	Oneida	1542300	C-ST	34	670	483	0.72	0	0.0000	0.0340	0.0000	0		0.0139	0.0000	12328	18.40	36672	54.73
Minocqua Lake	Oneida	1542400	C-ST	34	1360	249	0.18	0	0.0000	0.0345	0.0000	1	42.10	0.0190	0.0000	2501	1.84	69940	51.43
Tomahawk Chain	Oneida	1542700	C-ST	34	3392	631	0.19	21	0.0062	0.0210	0.0008	2	35.75	0.0082	0.0003	25587	7.54	84196	24.82
Two Sisters Lake	Oneida	1588200	C-	40	719	108	0.15	0	0.0000	0.0206	0.0000	0		0.0080	0.0000	4364	6.07	14487	20.15
Balsam Lake*	Polk	2620600	NONE																
Amik Lake	Price	2268600	NR	34	224	375	1.67	0	0.0000	0.0532	0.0000	0		0.0330	0.0000	6678	29.81	11436	51.05
Butternut Lake	Price	2283300	C-ST	34	1006	867	0.86	16	0.0159	0.0568	0.0006	3	37.77	0.0321	0.0006	14966	14.88	29546	29.37
Pike Lake	Price	2268300	C-ST	34	806	384	0.48	0	0.0000	0.0418	0.0000	0		0.0210	0.0000	8111	10.06	20745	25.74
Round Lake	Price	2267800	C-ST	34	726	354	0.49	0	0.0000	0.0408	0.0000	0		0.0212	0.0000	8207	11.30	17151	23.62
Turner Lake	Price	2268500	C-ST	34	149	169	1.13	0	0.0000	0.0441	0.0000	0		0.0214	0.0000	3561	23.90	8040	53.96
Little Round Lake	Sawyer	2395500	NONE	34	229	0	0.00	0	0.0000	0.0000	0.0000	0		0.0000	0.0000	346	1.51	7558	33.00
Round Lake	Sawyer	2395600	ST	34	3054	35	0.01	0	0.0000	0.0062	0.0000	0		0.0012	0.0000	2331	0.76	32379	10.60
Big Arbor Vitae Lake	Vilas	1545600	C-	34	1090	535	0.49	7	0.0064	0.0227	0.0004	1	42.00	0.0092	0.0001	20329	18.65	66482	60.99
Kentuck Lake	Vilas	716800	NR	40	957	488	0.51	5	0.0052	0.0337	0.0005	1	46.00	0.0084	0.0001	11344	11.85	68540	71.62
Laura Lake	Vilas	995200	ST	34	599	22	0.04	0	0.0000	0.0058	0.0000	0		0.0041	0.0000	2614	4.36	7166	11.96
Lynx Lake	Vilas	2954500	NR	34	339	97	0.29	0	0.0000	0.0315	0.0000	0		0.0122	0.0000	2056	6.06	7965	23.50
Lake Nancy	Washburn	2691500	C-NR	40	772	18	0.02	0	0.0000	0.0055	0.0000	0		0.0009	0.0000	3266	4.23	21871	28.33
Rainbow Flowage**	Oneida	1595300	NR	40	2035	7	0.00	0	0.0000	0.0000	0.0000	0		0.0241	0.0000	0	0.00	8346	4.10

* Lake Nebagamon and Balsam Lake are not classified as musky waters.
**Winter data only on Rainbow Flowage. Summer data has not yet been analyzed.

Appendix 7. 1998 northern pike creel data.

Lake Name	County Name	MWB CODE	Lake Acres	Angler Catch	Angler Catch /Acre	Angler Harvest	Angler Harvest/ Acre	Specific Catch Rate	Specific Harvest Rate	Number of fish Measured	Mean Length	General Catch Rate	General Harvest Rate	Angler Directed Effort	Directed Effort /Acre	Angler Total Effort	Total Effort /Acre
Bony Lake	Bayfield	2742500	191	142	0.74	0	0.0000	0.0965	0.0000	0		0.0663	0.0000	958	5.02	4351	22.78
Middle Eau Claire Lake	Bayfield	2742100	902	4137	4.59	249	0.2761	0.3979	0.0527	65	20.16	0.2010	0.0121	3542	3.93	20629	22.87
Lake Nebagamon	Douglas	2865000	914	2815	3.08	602	0.6586	0.3461	0.0893	133	21.46	0.1749	0.0374	5069	5.55	16100	17.61
Pine Lake	Iron	2949200	312	10	0.03	0	0.0000	0.1910	0.0000	0		0.0088	0.0000	53	0.17	7325	23.48
Spider Lake	Iron	2306300	352	96	0.27	21	0.0597	0.0404	0.0142	4	21.17	0.0118	0.0025	1165	3.31	8547	24.28
Kawaguesaga Lake	Oneida	1542300	670	2962	4.42	96	0.1433	0.1135	0.0052	19	24.45	0.0828	0.0027	2578	3.85	36672	54.73
Minocqua Lake	Oneida	1542400	1360	3921	2.88	1012	0.7441	0.1523	0.0835	66	23.50	0.0563	0.0145	10539	7.75	69940	51.43
Tomahawk Chain	Oneida	1542700	3392	1586	0.47	178	0.0525	0.0700	0.0164	18	24.67	0.0194	0.0022	4868	1.44	84196	24.82
Two Sisters Lake	Oneida	1588200	719	359	0.50	31	0.0431	0.1023	0.0193	5	19.24	0.0261	0.0022	564	0.78	14487	20.15
Balsam Lake	Polk	2620600	2054	7673	3.74	177	0.0862	0.2147	0.01	25	27.92	0.0807	0.0019	12958	6.31	95120	46.31
Amik Lake	Price	2268600	224	801	3.58	57	0.2545	0.1867	0.0252	6	21.40	0.0752	0.0054	1770	7.90	11436	51.05
Butternut Lake	Price	2283300	1006	191	0.19	23	0.0229	0.0514	0.0135	6	25.77	0.0077	0.0009	1363	1.35	29546	29.37
Pike Lake	Price	2268300	806	465	0.58	95	0.1179	0.0734	0.0227	19	22.92	0.0232	0.0048	3625	4.50	20745	25.74
Round Lake	Price	2267800	726	521	0.72	16	0.0220	0.0833	0.0027	8	25.11	0.0307	0.0009	2394	3.30	17151	23.62
Turner Lake	Price	2268500	149	610	4.09	61	0.4094	0.2078	0.0151	8	20.70	0.0782	0.0078	1239	8.32	8040	53.96
Little Round Lake	Sawyer	2395500	229	2016	8.80	300	1.3100	0.5751	0.0598	23	22.37	0.3009	0.0448	3124	13.64	7558	33.00
Round Lake	Sawyer	2395600	3054	2953	0.97	598	0.1958	0.4843	0.0757	71	23.68	0.0978	0.0198	4278	1.40	32379	10.60
Big Arbor Vitae Lake	Vilas	1545600	1090	6	0.01	0	0.0000	0.0000	0.0000	0		0.0002	0.0000	356	0.33	66482	60.99
Kentuck Lake	Vilas	716800	957	0	0.00	0	0.0000	0.0000	0.0000	0		0.0000	0.0000	139	0.15	68540	71.62
Laura Lake*	Vilas	995200															
Lynx Lake	Vilas	2954500	339	6	0.02	0	0.0000	0.1219	0.0000	0		0.0062	0.0000	35	0.10	7965	23.50
Lake Nancy	Washburn	2691500	772	3663	4.74	286	0.3705	0.4829	0.0814	52	20.1	0.1678	0.0131	3395	4.40	21871	28.33
Rainbow Flowage**	Oneida	1595300	2035	1493	0.73	779	0.3828	0.2654	0.1605	159	21.21	0.1789	0.0934	2888	1.42	8346	4.10

*Lake Laura is not classified as a northern pike water.

**Winter data only on Rainbow Flowage. Summer data has not yet been analyzed.

Appendix 8. 1998 largemouth bass creel data.

Lake Name	County Name	MWB CODE	Lake Acres	Angler Catch	Angler Catch /Acre	Angler Harvest	Angler Harvest/ Acre	Specific Catch Rate	Specific Harvest Rate	Number of fish Measured	Mean Length	General Catch Rate	General Harvest Rate	Angler Directed Effort	Directed Effort /Acre	Angler Total Effort	Total Effort /Acre
Bony Lake	Bayfield	2742500	191	64	0.34	0	0.0000	0.0345	0.0000	0		0.0214	0.0000	1847	9.67	4351	22.78
Middle Eau Claire Lake	Bayfield	2742100	902	483	0.54	22	0.0244	0.1250	0.0119	5	17.10	0.0256	0.0012	1677	1.86	20629	22.87
Lake Nebagamon	Douglas	2865000	914	16	0.02	0	0.0000	0.0000	0.0000	0		0.0020	0.0000	90	0.10	16100	17.61
Pine Lake	Iron	2949200	312	48	0.15	0	0.0000	0.1778	0.0000	0		0.0153	0.0000	267	0.86	7325	23.48
Spider Lake	Iron	2306300	352	0	0.00	0	0.0000	0.0000	0.0000	0		0.0000	0.0000	63	0.18	8547	24.28
Kawaguesaga Lake	Oneida	1542300	670	1748	2.61	0	0.0000	0.2870	0.0000	0		0.0517	0.0000	5529	8.25	36672	54.73
Minocqua Lake	Oneida	1542400	1360	3008	2.21	154	0.1132	0.3411	0.0000	7	15.46	0.0466	0.0024	6062	4.46	69940	51.43
Tomahawk Chain	Oneida	1542700	3392	2780	0.82	99	0.0292	0.2144	0.0057	5	14.34	0.0373	0.0013	10225	3.01	84196	24.82
Two Sisters Lake	Oneida	1588200	719	241	0.34	0	0.0000	0.0459	0.0000	0		0.0194	0.0000	1645	2.29	14487	20.15
Balsam Lake	Polk	2620600	2054	49897	24.29	3576	1.7410	0.7961	0.0569	113	14.82	0.527	0.0378	53207	25.90	95120	46.31
Amik Lake	Price	2268600	224	90	0.40	0	0.0000	0.1275	0.0000	0		0.0127	0.0000	326	1.46	11436	51.05
Butternut Lake	Price	2283300	1006	0	0.00	0	0.0000			0		0.0000	0.0000	0	0.00	29546	29.37
Pike Lake	Price	2268300	806	35	0.04	0	0.0000	0.0378	0.0000	0		0.0029	0.0000	669	0.83	20745	25.74
Round Lake	Price	2267800	726	47	0.06	0	0.0000	0.0169	0.0000	0		0.0037	0.0000	188	0.26	17151	23.62
Turner Lake	Price	2268500	149	155	1.04	0	0.0000	0.2289	0.0000	0		0.0258	0.0000	340	2.28	8040	53.96
Little Round Lake	Sawyer	2395500	229	366	1.60	15	0.0655	0.1576	0.0112	1	19.60	0.0615	0.0026	1370	5.98	7558	33.00
Round Lake	Sawyer	2395600	3054	241	0.08	33	0.0108	0.0000	0.0000	4	15.65	0.0104	0.0014	194	0.06	32379	10.60
Big Arbor Vitae Lake	Vilas	1545600	1090	170	0.16	6	0.0055	0.0521	0.0000	1	14.80	0.0029	0.0001	381	0.35	66482	60.99
Kentuck Lake	Vilas	716800	957	14191	14.83	212	0.2215	0.9332	0.0170	20	16.68	0.2330	0.0035	10012	10.46	68540	71.62
Laura Lake	Vilas	995200	599	6	0.01	0	0.0000			0		0.0157	0.0000	0	0.00	7166	11.96
Lynx Lake	Vilas	2954500	339	50	0.15	0	0.0000	0.0000	0.0000	0		0.0225	0	27	0.08	7965	23.50
Lake Nancy	Washburn	2691500	772	7901	10.23	253	0.3277	0.9180	0.0430	4	15.97	0.3743	0.012	5319	6.89	21871	28.33
Rainbow Flowage**	Oneida	1595300	2035	0	0.00	0	0.0000	0.0000	0.0000	0		0.0000	0.0000	0	0.00	8346	4.10

**Winter data only on Rainbow Flowage. Summer data has not yet been analyzed.

Appendix 9. 1998 smallmouth bass creel data.

Lake Name	County Name	MWB CODE	Lake Acres	Angler Catch	Angler Catch /Acre	Angler Harvest	Angler Harvest/ Acre	Specific Catch Rate	Specific Harvest Rate	Number of fish Measured	Mean Length	General Catch Rate	General Harvest Rate	Angler Directed Effort	Directed Effort /Acre	Angler Total Effort	Total Effort /Acre
Bony Lake	Bayfield	2742500	191	120	0.63	0	0.0000	0.0633	0.0000	0		0.0371	0.0000	1608	8.42	4351	22.78
Middle Eau Claire Lake	Bayfield	2742100	902	520	0.58	31	0.0344	0.2290	0.0086	5	14.98	0.0290	0.0017	1065	1.18	20629	22.87
Lake Nebagamon	Douglas	2865000	914	1026	1.12	80	0.0875	0.3320	0.0437	13	17.43	0.0706	0.0055	1331	1.46	16100	17.61
Pine Lake	Iron	2949200	312	797	2.55	30	0.0962	0.3201	0.0159	6	15.05	0.1291	0.0048	1875	6.01	7325	23.48
Spider Lake	Iron	2306300	352	198	0.56	26	0.0739	0.1198	0.0189	4	15.72	0.0254	0.0033	1363	3.87	8547	24.28
Kawaguesaga Lake	Oneida	1542300	670	1724	2.57	14	0.0209	0.2508	0.0000	1	13.80	0.0508	0.0004	4370	6.52	36672	54.73
Minocqua Lake	Oneida	1542400	1360	1578	1.16	19	0.0140	0.1989	0.0042	1	17.50	0.0220	0.0000	453	0.33	69940	51.43
Tomahawk Chain	Oneida	1542700	3392	9523	2.81	83	0.0245	0.4499	0.0025	5	14.54	0.1219	0.0011	15119	4.46	84196	24.82
Two Sisters Lake	Oneida	1588200	719	1283	1.78	79	0.1099	0.4366	0.0355	11	15.33	0.0983	0.0060	2224	3.09	14487	20.15
Balsam Lake*	Polk	2620600															
Amik Lake	Price	2268600	224	50	0.22	0	0.0000	0.1223	0.0000	1	16.60	0.0065	0.0000	85	0.38	11436	51.05
Butternut Lake	Price	2283300	1006	63	0.06	7	0.0070	0.1633	0.0000	1	12.10	0.0034	0.0004	70	0.07	29546	29.37
Pike Lake	Price	2268300	806	149	0.18	5	0.0062	0.0992	0.0000	1	14.30	0.0103	0.0004	598	0.74	20745	25.74
Round Lake	Price	2267800	726	223	0.31	20	0.0275	0.1060	0.0367	2	15.00	0.0156	0.0014	190	0.26	17151	23.62
Turner Lake	Price	2268500	149	27	0.18	0	0.0000	0.3677	0.0000	0		0.0098	0.0000	37	0.25	8040	53.96
Little Round Lake	Sawyer	2395500	229	24	0.10	0	0.0000	0.0000	0.0000	0		0.0155	0.0000	166	0.72	7558	33.00
Round Lake	Sawyer	2395600	3054	3756	1.23	170	0.0557	0.3839	0.0086	22	16.44	0.1289	0.0058	6764	2.21	32379	10.60
Big Arbor Vitae Lake	Vilas	1545600	1090	353	0.32	63	0.0578	0.2389	0.1180	2	14.75	0.0068	0.0012	430	0.39	66482	60.99
Kentuck Lake	Vilas	716800	957	16129	16.85	247	0.2581	0.9419	0.0140	35	15.45	0.2762	0.0042	10740	11.22	68540	71.62
Laura Lake	Vilas	995200	599	40	0.07	0	0.0000	0.2283	0.0000	0		0.0159	0.0000	102	0.17	7166	11.96
Lynx Lake	Vilas	2954500	339	1565	4.62	45	0.1327	0.3450	0.0113	9	14.72	0.1973	0.0057	3987	11.76	7965	23.50
Lake Nancy	Washburn	2691500	772	44	0.06	27	0.0350	0.1935	0.1935	5	15.28	0.0219	0.0133	74	0.10	21871	28.33
Rainbow Flowage**	Oneida	1595300	2035	0	0.00	0	0.0000	0.0000	0.0000	0		0.0000	0.0000	0	0.00	8346	4.10

*Balsam Lake is not classified as a smallmouth bass water.

**Winter data only on Rainbow Flowage. Summer data has not yet been analyzed.