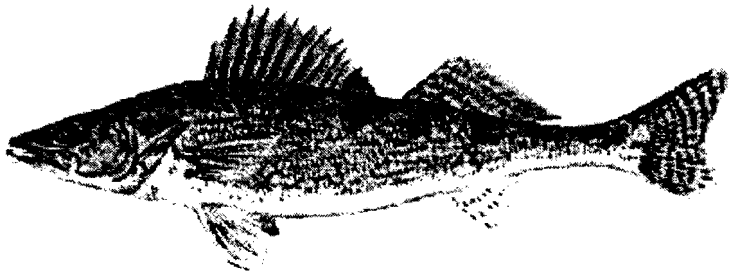
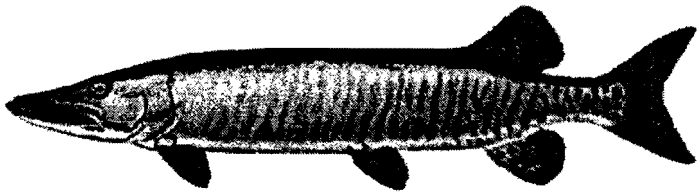


Wisconsin Department of Natural Resources

1999 Ceded Territory

Fishery Assessment Report



Andrew H. Fayram

Administrative Report #50

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

Table of Contents

	Page
List of Tables	ii
List of Figures	iii
List of Appendices	iv
Introduction	1
Population Estimates	2
Young of the Year Surveys	11
Creel Surveys	14
Summary	25
Errata	26
References	29

List of Tables

Table		Page
1	1999 Wisconsin Department of Natural Resources walleye population estimate data	4
2	Mean young of the year walleye data	12
3	1999 walleye creel survey data	17
4	1999 walleye exploitation rates and 1993-1998 mean exploitation rates	20
5	1999 and 1990-1998 mean muskellunge creel survey data	22
6	1999 and 1990-1998 mean northern pike creel survey data	22
7	1999 and 1990-1998 mean smallmouth bass creel survey data	23
8	1999 and 1990-1998 mean largemouth bass creel survey data	23

List of Figures

Figure		Page
1	Walleye population estimates by size class and 1999 statewide mean of lakes classified as naturally reproducing waters	6-7
2	Walleye population estimates by size class and 1999 statewide mean of lakes classified as stocked waters	8-9
3	Percentage of stocked surveyed walleye lakes with high densities of young of the year walleye	13
4	Percentage of surveyed lakes classified as having natural walleye reproduction with high densities of young of the year walleye	14
5	1999 species specific catch/harvest rate ratios	24

List of Appendices

Appendix

1 Lakes with population estimates calculated in 1999 and at least one historical population estimate..... 31

2 Walleye young of the year per mile and Serns Index calculations for surveyed lakes with natural reproduction in 1999..... 32

3 Walleye young of the year per mile and Serns Index calculations for surveyed lakes sustained by stocking in 1999..... 33

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 in 1999..... 34

5 1999 walleye creel data..... 35

6 1999 muskellunge creel data..... 36

7 1999 northern pike creel data..... 37

8 1999 largemouth bass creel data..... 38

9 1999 smallmouth bass creel data..... 39

INTRODUCTION

In 1983, the United States Seventh Circuit Court of Appeals 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 cultural 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. Precise 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 precise 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 precise 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 precise 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. The three regression models are 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 1999, adult walleye population estimates were calculated for 37 lakes ranging in size from 113 to 15,300 acres and included several angler regulations. In addition, total population estimates were calculated for 33 of these lakes and also for Archibald Lake (Oconto) for which no adult population estimate was calculated (Table 1). Two of these surveys (Chippewa Flowage in Sawyer county and Bass Lake in Washburn county) were joint surveys completed with the GLIFWC. The 37 lakes for which adult population estimates were calculated included 23 lakes with a 15-inch minimum length restriction for walleyes, one lake with an 18-inch minimum length restriction, one lake with a 14-18 inch slot limit where only one walleye greater than 18 inches could be retained, ten lakes had a modified bag limit allowing only one walleye over 14 inches to be harvested per angler each day, and two 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 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 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 rather than resampling with fyke nets. The entire shoreline of each lake, including islands, was

Table 1. 1999 Walleye Population Estimates in the Wisconsin Ceded Territory.

Lake Name	County	Acres	1999 Size Limit	1999 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	1999 Safe Harvest
English Lake	Ashland	244	14-18 slot; 1>18	Stocked	188	202	397	275	0.00	0.25	0.98	0.39	1.63	613	2.51	96
Lower Turtle Lake	Barron	276	15	Natural	260	97	379	237	0.00	0.05	0.90	0.42	1.37	288	1.04	83
Sand Lake	Barron	322	15	Stocked	562	183	723	570	0.17	0.70	1.02	0.35	2.25	2018	6.27	200
Upper Turtle Lake	Barron	438	15	Stocked	1239	299	1503	1284	0.01	0.53	2.33	0.57	3.43	2201	5.03	449
Amnicon Lake	Douglas	426	15	Natural	1603	152	1769	1416	7.23	3.36	0.36	0.15	4.15	4728	11.10	496
Arbutus Lake	Forest	161	15	Stocked	90	35	123	81	0.01	0.19	0.34	0.22	0.76			28
Crane Lake	Forest	337	18	Stocked	330	323	655	556	0.00	0.05	1.38	0.51	1.94	512	1.52	195
Jungle Lake	Forest	182	15	Natural	1,237	691	1,598	1,400	0.08	2.35	6.34	0.02	8.78	3982	21.88	490
Roberts Lake	Forest	414	15	Natural	1,282	237	1,515	1,154	1.71	1.33	0.16	0.46	3.66	2365	5.71	404
Stevens Lake	Forest	297	15	Stocked	862	881	1,659	1,204	0.03	0.01	3.58	1.97	5.59	2303	7.75	421
Island Lake	Iron	352	1>14	Stocked	1,086	237	1,315	1,033	0.00	0.24	0.43	0.01	3.74			362
Greater Bass Lake	Langlade	246	15	Remnant	34	17	86	0	0.00	0.00	0.02	0.33	0.35	53	0.22	0
Somo Lake	Lincoln	472	15	Stocked	316	101	454	349	0.00	0.47	0.40	0.08	0.96	2016	4.27	122
Spirit River Flowage	Lincoln	1,663	15	Natural	470	86	1,066	237	0.00	0.26	0.33	0.05	0.64			83
Big Eau Pleine Lake	Marathon	6,830	15	Natural	29,244	2,636	30,594	26,079	1.20	2.78	0.49	0.02	4.48			9128
Archibald Lake	Oconto	430	15	Remnant	N/A	N/A	N/A	N/A						784	1.82	
Malden Lake	Oconto	290	15	Natural	381	64	503	369	0.03	0.90	0.51	0.30	1.73	727	2.51	129
Bear Lake	Oneida	312	15	Stocked	78	119	182	114	0.03	0.02	0.13	0.41	0.58	256	0.82	40
Big Carr Lake	Oneida	213	15	Natural	330	381	498	340	0.00	0.01	0.69	1.63	2.34	700	3.29	119
George Lake	Oneida	435	15	Natural	1,828	316	1,981	1,740	0.66	3.59	0.25	0.05	4.55	3527	8.11	609
Long Lake	Oneida	113	15	Stocked	98	105	206	107	0.12	0.02	0.46	1.22	1.82	263	2.33	37
Thompson Lake	Oneida	382	15	Stocked	70	838	517	336	0.00	0.02	0.84	0.49	1.35	891	2.33	118
Chippewa Flowage	Sawyer	15,300	None	Natural	69,134	23,359	82,070	78,278	0.66	3.45	1.04	0.22	5.36	332014	21.70	27397
Alder Lake	Vilas	274	1>14	Natural	1,931	1,171	2,662	1,831	1.90	4.41	2.59	0.81	9.72	7742	28.26	641
Big Lake	Vilas	771	15	Natural	3,523	1,347	4,480	3,464	0.84	3.08	1.39	0.50	5.81	16000	20.75	1212
Black Oak Lake	Vilas	584	15	Stocked	811	1,498	1,965	1,592	0.00	0.11	0.85	2.41	3.36	1727	2.96	557
Boulder Lake	Vilas	524	1>14	Natural	2,033	1,698	2,796	2,288	1.04	3.04	1.18	0.08	5.34	12338	23.55	801
Clear Lake	Vilas	555	1>14	Natural	1,206	358	1,616	1,373	0.11	1.72	0.71	0.37	2.91	9798	17.65	481
Island Lake	Vilas	1,023	1>14	Natural	5,539	1,557	6,683	5,762	1.29	4.08	0.58	0.59	6.53	21907	21.41	2017
Mamie Lake	Vilas	400	15	Natural	1,143	446	1,591	1,133	0.17	2.03	1.57	0.21	3.98	6534	16.34	397
Manitowish/Little Star Lake	Vilas	750	1>14	Natural	1,102	294	1,524	976	0.52	1.04	0.36	0.11	2.03	4660	6.21	342
Razorback Lake	Vilas	362	15	Stocked	2,184	329	2,369	2,172	0.20	4.56	1.74	0.03	6.54	8087	22.34	760
Rest Lake	Vilas	808	1>14	Natural	1,552	316	1,867	1,494	0.46	1.90	0.61	0.10	3.07	6593	10.84	523
Spider/Stone Lake	Vilas	411	1>14	Natural	509	195	713	476	0.53	0.78	0.28	0.15	1.73	5458	13.28	167
Wild Rice Lake	Vilas	379	1>14	Natural	112	37	250	88	0.10	0.17	0.36	0.03	0.66	2235	5.90	31
Bass Lake	Washburn	188	1>14	Natural	611	126	775	43	0.13	2.21	1.74	0.05	4.12	2501	13.30	242
Middle Mckenzie Lake	Washburn	530	15	Natural	559	205	813	486	0.00	0.01	1.17	0.35	1.53	426	0.80	170
Shell Lake	Washburn	2,580	None	Natural	1,659	698	2,092	1,641	0.00	0.37	0.37	0.06	0.81	7994	3.10	574

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).

RESULTS

Adult 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. 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. 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. No adult population estimate could be calculated for Archibald Lake (Oconto) due to the fact that all walleyes (juveniles and adults) received the same mark. Therefore, a total population estimate could be calculated but an adult estimate could not.

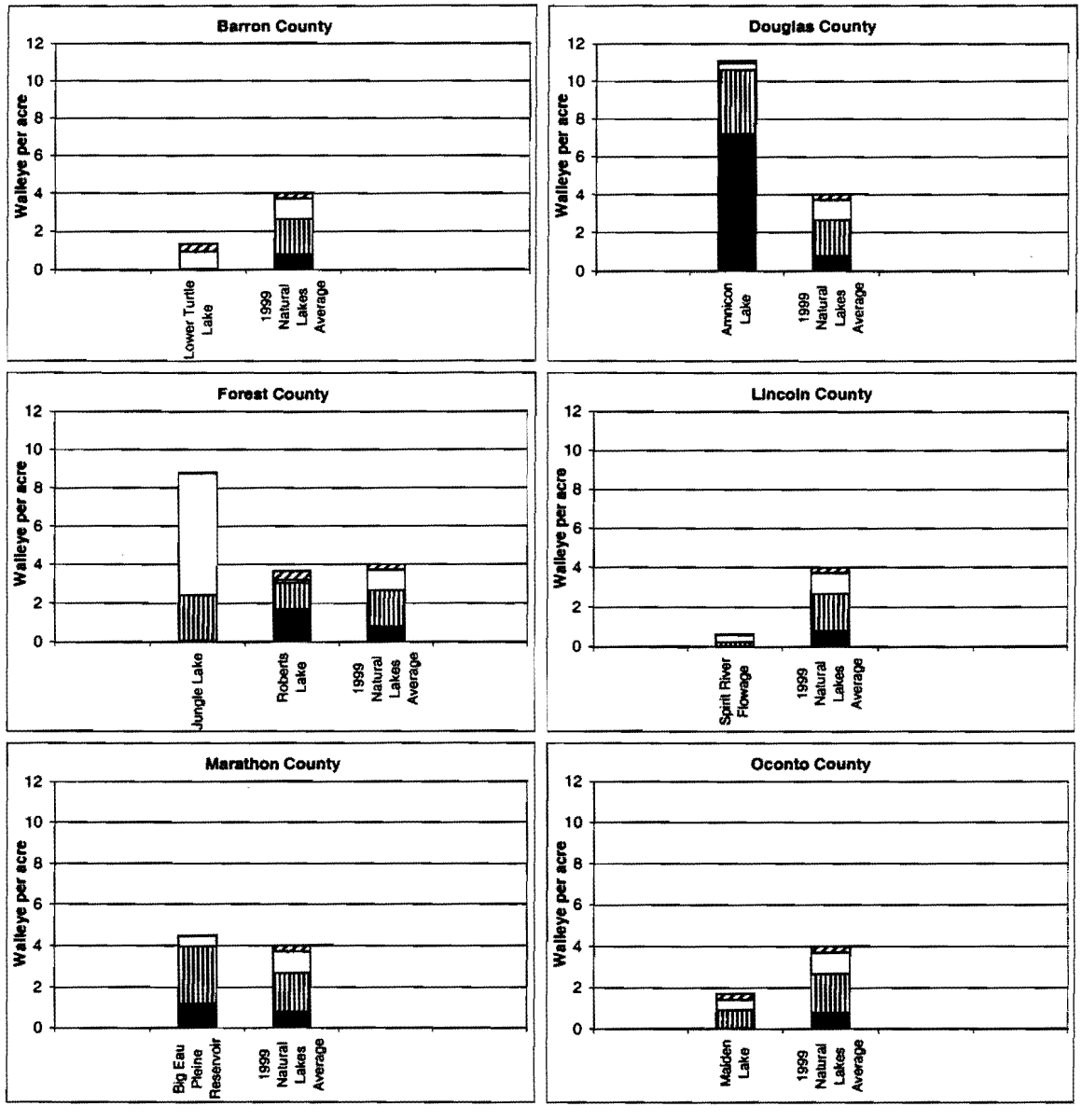


Figure 1. Population estimates by length class and 1999 statewide average of lakes classified as naturally reproducing waters.

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

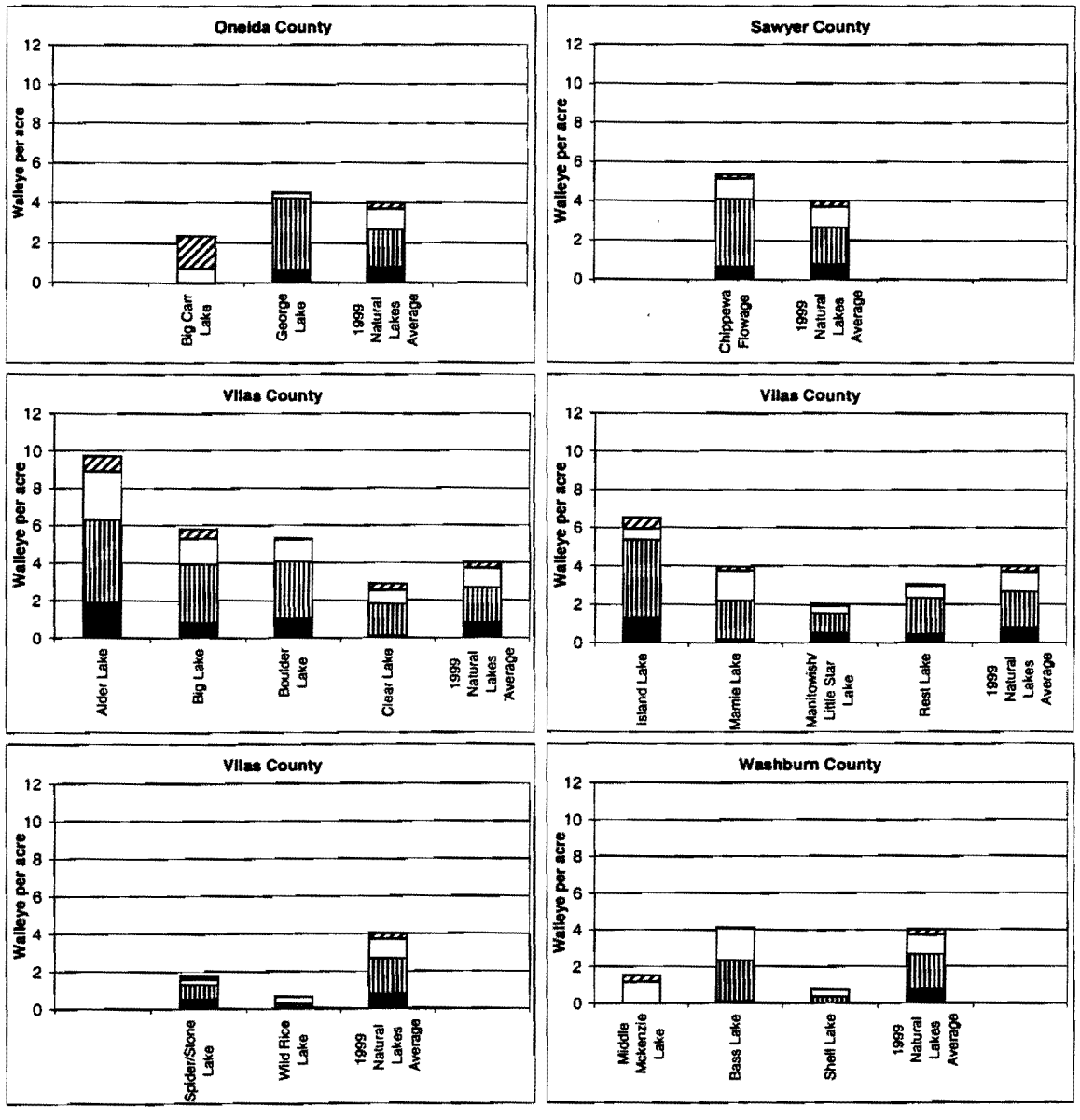


Figure 1. Continued.

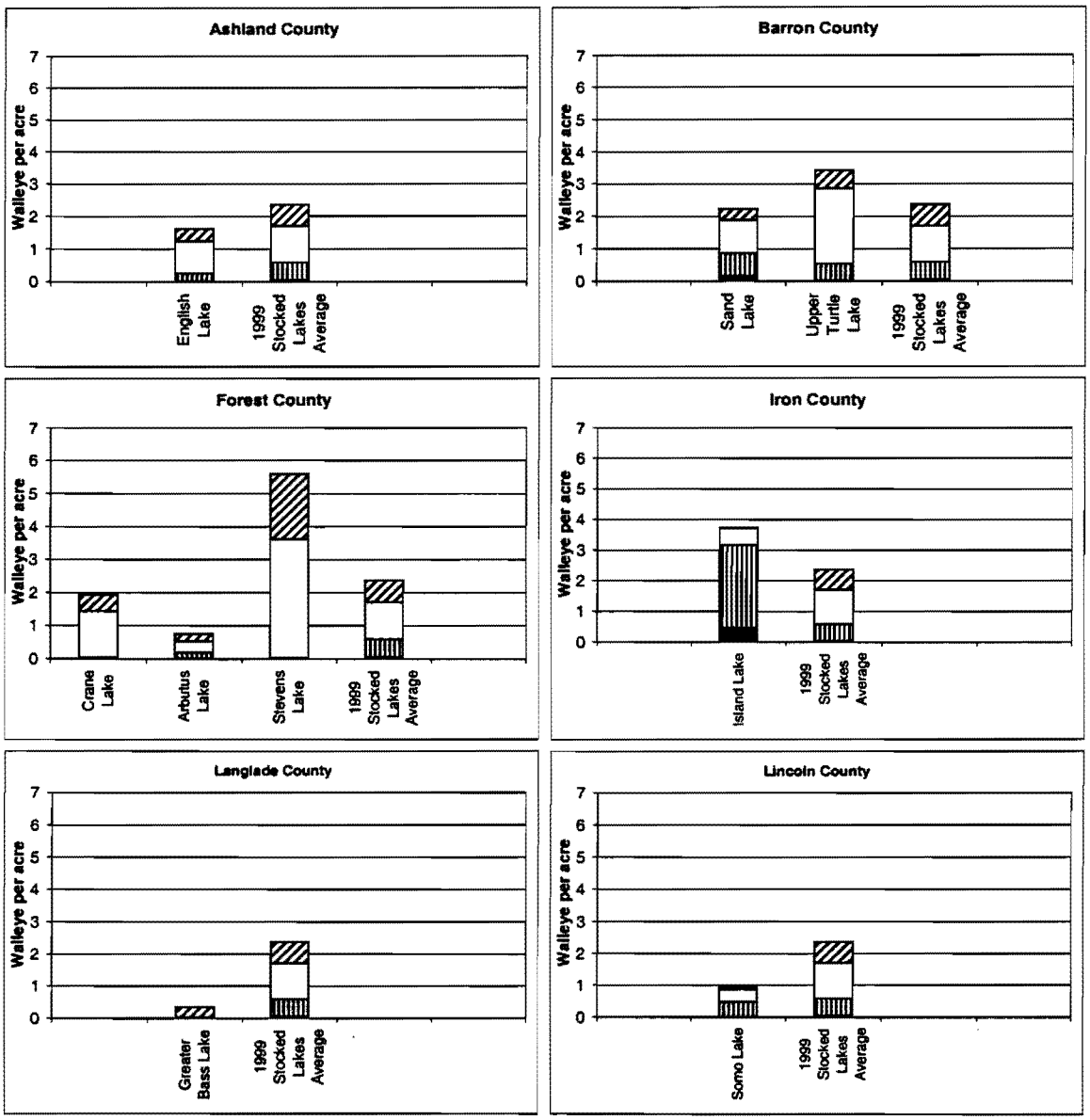


Figure 2. Population estimates by length class and 1999 statewide average of lakes classified as stocked waters. Greater Bass Lake (Langlade) was classified as having only remnant walleye populations and is no longer stocked. This lake was not included in the 1999 stocked lakes statewide average.

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

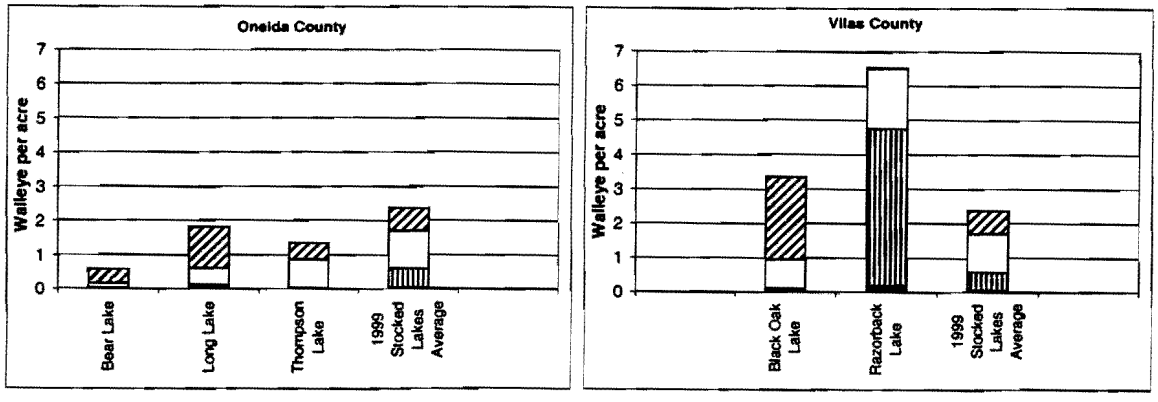


Figure 2. Continued.

Lakes surveyed in 1999 with historical population estimates are included in Appendix 1. The total number of adult marks in lakes surveyed in 1999 ranged from 20.2% to 79.1% of the calculated adult population estimate, with a mean value of 46.8%. The total number of marked fish, including immature fish, ranged from 4.4% to 99.9% of the calculated total population estimate with a mean value of 30.5%. The goal of marking at least 10% of the estimated adult population was exceeded in all surveys in 1999. In general, adult walleye populations in lakes surveyed in 1999 with previous population estimates appear to have increased or remained stable compared to surveys completed in the early 1990's (Appendix 1).

Lakes classified as "stocked" waters had a lower average density (2.38 walleyes per acre) than did lakes classified as "natural" waters (4.01 walleyes per acre) (Figures 1 and 2). This has been the case historically as well (Hewett and Simonson 1998). 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 population densities are higher than or similar to densities measured in previous years (Appendix 1). Clear Lake (Vilas), Island Lake (Vilas), Rest Lake (Vilas), and Manitowish Lake (Vilas) were all surveyed in both 1999 and previously in 1993 and are part of the Manitowish Chain of lakes (Vilas). Although there were decreases in adult walleye density seen in Clear Lake (Vilas) and Rest Lake (Vilas), there were increases in Island Lake (Vilas) and Manitowish Lake (Vilas) indicating that the adult walleye population in the chain as a whole was similar in the two years in which it was sampled. There were increases in adult walleye density in the Big Eau Pleine Reservoir (Marathon), George Lake (Oneida) and Black Oak Lake (Vilas) and there was a decrease in adult walleye densities in the Spirit River

Flowage (Lincoln). Although there have been apparent decreases and increases in walleye abundance in some lakes, for the most part these changes are not dramatic or greater than declines expected in natural populations (Kempinger and Carline 1977).

There were relatively low adult walleye densities in Arbutus Lake (Forest), the Spirit River Flowage (Lincoln), Greater Bass Lake (Langlade), Somo Lake (Lincoln), and Bear Lake (Oneida) in 1999 (Figures 1 and 2). Although the population density in the Spirit River Flowage appears to be low, this may not adequately reflect the actual walleye density. Like other river systems, walleye populations often spawn in areas other than the areas that are sampled. It is thought that walleye may spawn farther upriver than they can be reached with our sampling equipment. In addition, anglers continue to catch reasonable numbers of walleyes (D. Seibel, Wisconsin Department of Natural Resources, personal communication). Therefore, the actual population density of walleye in the Spirit River Flowage is likely greater than calculated here. The low adult walleye density in Somo Lake may be due to the lack of success of the stocking regime employed historically. There has been some suggestion that extended growth walleye (stocked in 1998) may provide a better basis for the population than the fingerlings stocked in this lake historically (D. Seibel, Wisconsin Department of Natural Resources, personal communication). Greater Bass Lake has a recruitment code of "remnant". This means that the walleye population was initially introduced through stocking efforts. These stocking efforts have been discontinued and the walleye population is expected to disappear at some point in the future. Therefore, the low density of adults in this lake is expected. Bear Lake generally lacks walleye habitat and is supported through stocking efforts (M. Vogelsang, Wisconsin Department of Natural Resources, personal communication). Therefore, it is expected that the walleye density in this lake is low and is unlikely to increase dramatically. While Arbutus Lake has a walleye population supported through stocking efforts, the level of stocking has historically been low in order not to interfere with the substantial largemouth and smallmouth bass populations present in the lake. In addition, the juvenile walleye most likely experience some degree of predation by the bass populations present in this lake (S. Avelallemant, Wisconsin Department of Natural Resources, personal communication). These two factors may explain the low density of walleye present in Arbutus Lake.

There were relatively high densities of adult walleye in Amnicon Lake (Douglas), Jungle Lake (Forest), Stevens Lake (Forest), Alder Lake (Vilas), and Razorback Lake (Vilas) in 1999 (Figures 1 and 2).

The adult walleye populations in Amnicon Lake and Razorback Lake both consisted primarily of fish less than 15 inches in length. This bodes well for the walleye fishing opportunities in the near future in these lakes. Alder Lake had a mix of adults less than 15 inches, between 15 and 19 inches, and greater than 20 inches. This represents a good angling opportunity for both number of walleye as well as opportunities to catch a larger fish.

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 116 lakes by the WDNR in 1999, including two surveys which were completed as joint surveys with the GLIFWC. 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. The relationship between the number of YOY walleyes caught per mile and the density of YOY walleye is:

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

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 1999 data to 1990-1998 data. The level of significance used for all tests was $\alpha = 0.05$.

RESULTS

Lake temperatures during 1999 surveys ranged from 43°F-71°F with a mean water temperature of 59°F. Young of the year data were separated by the dominant recruitment type for each lake: 1) stocked, 2) natural, and 3) other.

The 1999 means for young of the year per mile were 29.8 (range = 0.0 – 257.1) for natural lakes, 6.5 (range = 0.00 – 88.6) for stocked lakes, and 0.5 (range = 0.0 – 4.4) for "other" lakes (Table 2, Appendices 2, 3, 4). English Lake (Ashland) was surveyed for young of the year walleye in 1999, however, the presence of age 0+ walleye could not be confirmed. The 1999 natural lake mean was slightly but not significantly lower than the nine-year mean of 33.5 ($p = 0.59$)(Table 2). Similarly, the 1999 stocked lake mean was slightly but not significantly lower than the nine-year mean of 8.7 ($p = 0.39$)(Table 2). No nine-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. In 1999, 25.5% of lakes in the natural category (14 of 55) showed indexes of less than 1 YOY walleye per mile (Appendix 2). 58.3% of lakes in the stocked category (21 of 36) 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 surveyed lakes which were supported by stocking, 16 were stocked with walleye juveniles in 1999 (Appendix 3).

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

	Natural	**Stocked**	**Other**
Mean 1999 young of the year walleyes per mile	29.8	6.5	0.5
1990-1998 mean young of the year walleyes per mile	33.5	8.7	

The 1999 mean Sern's index for estimated number of YOY walleyes per acre was 7.0 for natural lakes, 1.5 for stocked lakes, and 0.1 for other lakes. Sern's estimates of YOY walleyes per acre ranged from 0 to 60.2 in natural waters, 0 to 20.7 in stocked waters, and 0 to 1.0 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 1999, 5.7% of the surveyed lakes contained greater than 25 YOY walleyes per mile which was similar to the 1990-1998 mean value of 9.2 ($p = 0.69$) (Figure 3). No lakes surveyed in 1999 had greater than 100 YOY walleyes per mile. This was similar to the nine-year mean value of 1.3% ($p = 0.66$) (Figure 3). In waters with some degree of natural reproduction, 37.5% of the surveyed lakes had greater than 25 YOY walleyes per mile which was similar to the nine-year mean value of 38.0% ($p = 0.98$) (Figure 4). 3.6% of naturally reproducing lakes had greater than 100 YOY walleyes per mile which was similar to the nine-year mean value of 6.6% ($p = 0.59$) (Figure 4).

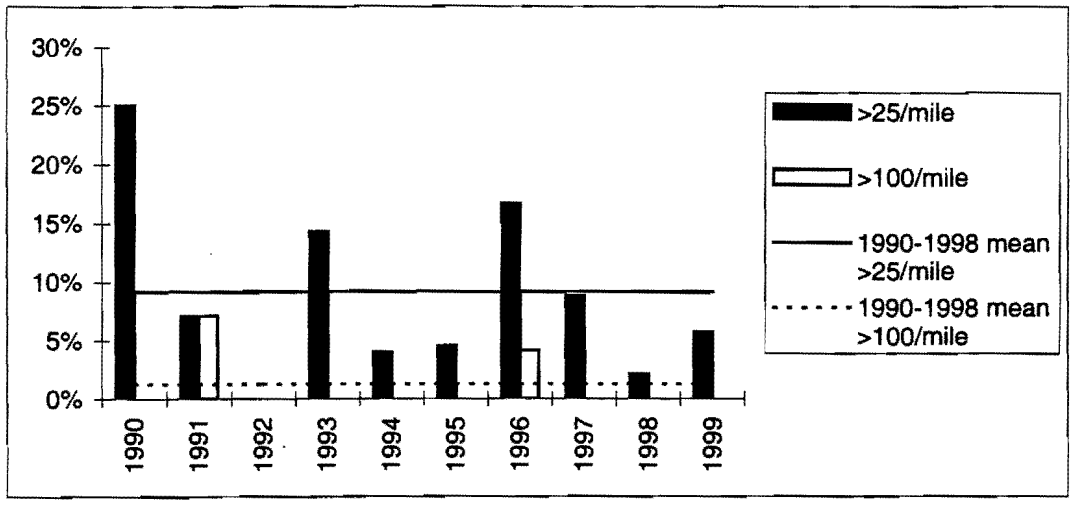


Figure 3. Percentages of stocked surveyed lakes with high densities of young of the year walleye.

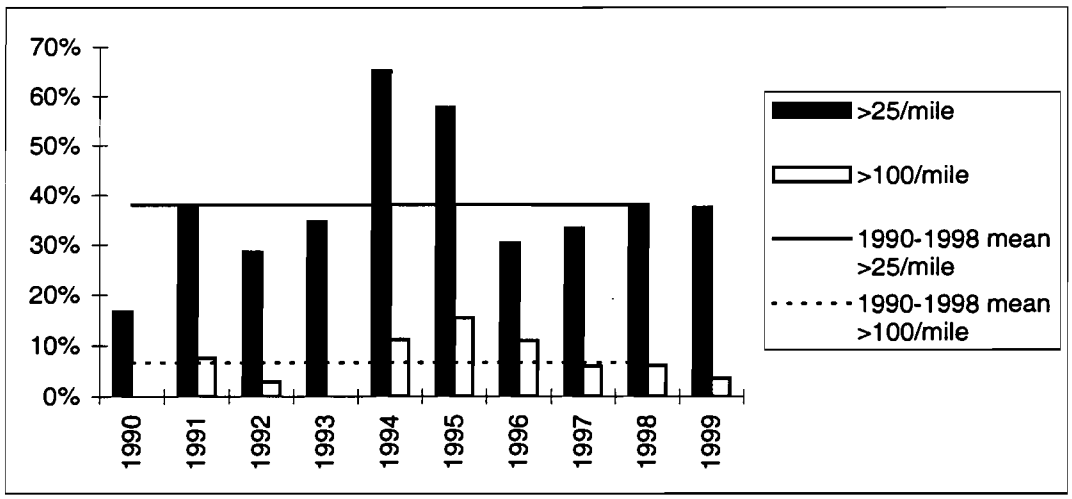


Figure 4. Percentage of surveyed lakes classified as having natural reproduction with high densities of young of the year walleye.

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, 1999 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 *Esox lucius*, largemouth bass *Micropterus salmoides*, and smallmouth bass *M. dolomieu* 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 22 lakes where population estimates were conducted in the spring of 1999. 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 two-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 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 1999 and 1993-1998 were calculated only for lakes with complete creel surveys. All fish, regardless of length and maturity, received the same fin clip in the vast majority of lakes from 1990-1992 and therefore it was not possible to calculate adult exploitation rates for lakes surveyed in these years.

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.

Two-tailed T tests were used to compare 1999 data to 1990-1998 (1993-1998 for exploitation rates) data. Two-tailed T tests were also used to compare lakes of different sizes and regulation types.

The level of significance used for all tests was $\alpha = 0.05$. Creel information was only included in compiled statistics for a given lake and species if the waterbody was expected to contain that species.

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.

Catch and harvest (hours/fish) rates were calculated for all gamefish 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. In addition, estimated catch and harvest/acre were calculated for all gamefish species.

The mean total effort per acre in 1999 was significantly lower in lakes 500 acres or larger (21.3 hours/acre) than in those less than 500 acres (40.2 hours/acre) ($p = 0.05$).

Walleye

Complete creel surveys were conducted on a total of 22 walleye lakes in 1999. Fifteen of these lakes had an "exempt" length limit classification meaning there was no minimum length limit for walleyes. Of the 15 exempt lakes, twelve had a modified bag limit allowing only one walleye over 14 inches to be harvested per angler each day, and one had a slot limit restriction where walleyes between 14 and 18 inches could not be kept and only one walleye over 18 inches could be retained. The remaining seven lakes had a minimum length restriction of 15 inches. Eight of the surveyed lakes were 500 acres or larger and the remaining 14 were less than 500 acres. Eighteen of the lakes were classified as having walleye populations primarily supported through natural reproduction. Walleye populations in the remaining four lakes were sustained through stocking (Table 3).

Although anglers targeting walleyes spent fewer hours to catch a walleye in exempt lakes than in lakes with the 15-inch length limit (3.9 vs. 5.4 hours/walleye), this difference was not significant ($p = 0.28$). The difference in the number of hours spent to catch a walleye in exempt lakes compared to lakes with the 15-inch length restriction was also not significantly different when 1990-1998 mean values of each regulation type were compared ($p = 0.32$) (Table 3). In addition, the 1999 mean density of adult walleye

Table 3. 1999 walleye creel survey data. 1990-1998 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 1990-1998 means for exempt waters

		N	Lake Acres	Adult PE/Acre	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
1999 Means by regulation type and lake size	All lakes	22	1179	3.30	2.91	0.98	4.3	11.2	15.0	10.5	26.6	11.5	33.3
	Exempt	15	1551	3.48	2.84	1.17	3.9	8.6	13.7	9.2	20.3	9.9	28.6
	15" size limit	7	380	2.90	3.07	0.56	5.4	31.7	17.8	14.8	77.4	15.0	43.4
	Exempt <500 acres	8	272	3.27	2.36	0.94	4.7	10.5	13.5	16.0	34.6	10.1	36.1
	Exempt ≥500 acres	7	3014	3.72	3.38	1.44	3.3	7.1	13.8	6.2	13.8	9.6	20.1
	15" <500 acres	6	355	3.12	3.44	0.56	4.9	34.1	17.5	13.6	84.3	15.5	45.7
	15"≥500 acres	1	530	1.53	0.88	0.55	14.3	22.3	19.5	32.8	52.1	12.0	29.3
1999 Means by recruitment type and regulation type	Natural	18	1372	3.43	2.76	1.06	4.3	10.0	14.4	10.1	23.3	11.3	31.7
	Stocked	4	311	2.70	3.60	0.59	4.3	24.9	17.4	12.5	71.2	12.4	40.7
	Natural 15-inch	4	415	2.77	1.93	0.43	7.9	37.6	17.5	20.8	83.9	14.9	39.1
	Natural Exempt	14	1645	3.62	2.99	1.24	3.8	8.3	13.5	8.8	19.3	10.3	29.6
	Stocked 15-inch	4	311	2.70	3.60	0.59	4.3	24.9	17.4	12.5	71.2	12.4	40.7
	Stocked Exempt	0											
1990-1998 Means by regulation type and lake size	All lakes	231	1173	3.46	3.56	0.79	4.0	16.7	16.3	7.9	33.2	12.9	33.5
	Exempt	81	1353	3.51	3.56	1.39	3.7	10.1	13.8	7.3	19.8	15.0	33.2
	15" size limit	150	1076	3.43	3.55	0.47	4.2	26.0	17.7	8.2	53.1	11.8	33.7
	Exempt <500 acres	27	257	2.96	3.17	1.19	4.5	14.5	14.0	9.5	32.6	19.3	45.8
	Exempt ≥500 acres	54	1901	3.76	3.76	1.48	3.4	8.8	13.7	6.5	16.5	12.8	26.9
	15" <500 acres	56	296	3.67	4.03	0.46	4.0	30.0	17.7	7.9	58.8	12.3	36.2
	15"≥500 acres	94	1541	3.30	3.26	0.47	4.4	24.0	17.7	8.5	50.2	11.5	32.2
1990-1998 Means by recruitment type and regulation type	Natural	181	1289	3.86	4.18	0.93	3.5	14.7	15.7	6.7	28.6	14.2	33.3
	Stocked	46	801	1.97	1.07	0.26	9.8	33.7	18.6	22.6	81.3	8.2	35.0
	Natural 15-inch	101	1228	4.13	4.63	0.55	3.3	23.5	17.2	6.4	45.9	13.6	33.2
	Natural Exempt	80	1367	3.52	3.61	1.40	3.7	10.0	13.8	7.2	19.5	15.0	33.3
	Stocked 15-inch	45	815	1.95	1.10	0.27	9.6	33.1	18.6	22.2	80.2	8.2	35.3
	Stocked Exempt	1	191	2.59	0.08	0.08	125.0	125.0	16.7	212.8	212.8	10.3	22.8

was greater, although not significantly so, in exempt lakes than in lakes with the 15-inch length limit (3.5 vs. 2.9 walleyes/acre, $p = 0.58$). It took significantly longer for anglers targeting walleyes to harvest a walleye in 1999 in lakes with the 15-inch length limit (31.7 hours) than in exempt waters (8.6 hours) ($p < 0.01$). This same result was seen when comparing mean values from 1990-1998 ($p < 0.001$) (Table 3). 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. In exempt lakes, the mean number of hours spent by anglers targeting walleyes to catch a fish in 1999 was lower in lakes 500 acres or larger (3.3 hours) than in smaller lakes (4.7 hours), but this difference was not significant ($p = 0.27$). Similarly, among exempt lakes in 1999, the mean number of hours spent by anglers targeting walleyes to harvest a walleye was lower in larger lakes (7.1 hours) than in smaller lakes (10.5 hours), although again this difference was not significant ($p = 0.19$). Differences of variables in lakes of different size classes was not examined in lakes with the 15-inch length limit since only one lake greater than 500 acres was sampled in 1999. As expected, mean length of harvested walleyes in 1999 was significantly higher in lakes with the 15-inch length limit than in exempt lakes (17.8 inches vs. 13.7 inches, $p < 0.01$).

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 in 1999.

Lakes whose walleye populations are primarily sustained through natural reproduction appeared to have a higher density of adult walleye (3.4 walleye/acre) than lakes sustained through stocking (2.7 walleye/acre) in 1999. However, this difference was not significant ($p = 0.57$). When the mean density of adult walleyes was compared between lakes supported through stocking and those supported through natural reproduction over the time period 1990-1998, the difference was significant ($p < 0.01$) (Table 3). In 1999, anglers appeared to have had greater success on lakes sustained through natural reproduction (Table 3). For example, anglers targeting walleye spent an average of 10.0 hours to harvest a walleye in lakes supported by natural reproduction compared to 24.9 hours for lakes sustained through stocking. While this difference appears large, it is not significant ($p = 0.12$). In addition, the majority of lakes sampled in 1999 supported by natural reproduction were exempt from the statewide 15-inch length limit (14 of 18) while all

(14 of 18) while all four of the sampled lakes sustained through stocking had the 15-inch minimum length limit. This means that there was, in general, a smaller proportion of walleye available for harvest in lakes whose walleye populations are supported through stocking and a greater number of hours needed to harvest a walleye would be expected. Catch rates were similar between the two categories of lake in 1999 (4.3 hours/walleye vs. 4.3 hours/walleye) ($p = 0.99$). However, this was not the case in general. When specific walleye catch rates were compared between lakes whose walleye populations were supported through stocking and those supported through natural reproduction from 1990-1998 anglers were more successful in lakes supported by natural reproduction (3.5 hours/walleye vs. 9.8 hours/walleye) ($p < 0.01$) (Table 3).

The mean catch rate for anglers targeting walleye was similar in 1999 (4.3 hours/walleye) to the nine year average 1990-1998 (4.0 walleye/acre) ($p = 0.73$). These same anglers spent fewer hours to harvest a walleye in 1999 (11.2 hours) than the mean number of hours needed from 1990-1998 (16.7 hours) ($p = 0.02$). This was most likely caused by a higher proportion of lakes sampled in 1999 being exempt from walleye length restrictions than the overall proportion seen 1990-1998. Approximately 1/3 of the lakes sampled in 1999 had the 15-inch minimum length restriction on walleye while approximately 2/3 of the lakes sampled between 1990 and 1998 had this regulation. Anglers targeting walleyes spent an average of 11.5 hours/acre in 1999 while the 1990-1998 mean value was 12.9 hours/acre ($p = 0.53$). So, angler effort in 1999 was fairly average when compared to the effort over the last decade.

Effort directed at walleyes appeared to be concentrated on lakes with natural reproduction during the 1990-1998 time period (14.2 hours/acre vs. 8.2 hours/acre) ($p = 0.001$). In 1999, effort directed at walleyes was similar between lakes with natural reproduction and those supported by stocking ($p = 0.79$) (Table 3).

Exploitation rates were calculated for 19 lakes or combinations of lakes in 1999. Spider Lake and Stone Lake (Vilas) were combined for the purposes of examining exploitation levels as there is a substantial connection between these two lakes. Similarly, Manitowish Lake and Little Star Lake (Vilas) were combined. Both adult and juvenile walleye received the same fin clip in Bass Lake (Washburn). Therefore no adult exploitation rate was calculated for this lake. Total angler exploitation rates of adult walleyes in 1999 ranged from 0.5% - 20.9%. Angler exploitation of adult walleyes greater than or equal to 14 inches ranged from 0.0% - 29.4%. Angler exploitation of adult walleyes greater than or equal to 20

inches ranged from 0.0% - 37.3%. Tribal exploitation of adult walleyes ranged from 0.0% - 9.4%. Combined total exploitation estimates (tribal exploitation + angler exploitation) ranged from 0.8% - 26.3% for lakes surveyed in 1999. Mean total angler exploitation, angler exploitation of adult walleyes greater than or equal to 14 inches, angler exploitation of adult walleyes greater than or equal to 20 inches, and total exploitation were slightly lower in 1999 than the 1993-1998 mean values although none of these differences were significant (7.5% vs. 8.6%, $p = 0.66$; 9.5% vs. 11.7%, $p = 0.42$; 4.9% vs. 12.4%, $p = 0.24$; and 12.1% vs. 13.1%, $p = 0.77$ respectively). Mean tribal exploitation was slightly higher in 1999 than the 1993-1998 mean value although this difference was also not significant (4.6% vs. 4.5%, $p = 0.98$). Adult exploitation values from 1990-1992 were excluded because in the vast majority of lakes, both juvenile and adult walleye were given the same fin clip. Therefore, angler exploitation of adult walleye could not be calculated (Table 4).

Table 4. 1999 adult walleye exploitation rates and 1993-1998 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, Krueger 1998, Krueger 1999, Krueger 2000).

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
English Lake	Ashland	244	1.5%	1.6%	7.5%	0.0%	1.5%
Sand Lake	Barron	322	18.4%	23.6%	11.5%	4.8%	23.2%
Amnicon Lake	Douglas	426	0.8%	3.7%	0.0%	0.0%	0.8%
Roberts Lake	Forest	414	0.5%	1.9%	0.0%	9.4%	9.8%
Stevens Lake	Forest	297	16.9%	17.0%	9.7%	9.4%	26.3%
Maiden Lake	Oconto	290	6.7%	8.8%	0.0%	9.3%	16.0%
George Lake	Oneida	435	12.1%	29.4%	0.0%	4.8%	17.0%
Lake Thompson	Oneida	382	3.6%	3.6%	6.0%	0.0%	3.6%
Lake Chippewa	Sawyer	15300	17.9%	21.0%	0.0%	3.3%	21.2%
Boulder Lake	Vilas	524	9.7%	8.8%	20.9%	4.9%	14.6%
Alder Lake	Vilas	274	0.0%	0.0%	0.0%	4.9%	4.9%
Clear Lake	Vilas	555	20.9%	28.0%	0.0%	4.9%	25.8%
Island Lake	Vilas	1023	9.4%	8.5%	0.0%	4.9%	14.2%
Manitowish/Little Star Lake	Vilas	750	0.0%	0.0%	0.0%	4.9%	4.9%
Rest Lake	Vilas	608	4.6%	9.4%	0.0%	4.6%	9.3%
Spider/Stone Lake	Vilas	411	3.9%	0.0%	0.0%	3.2%	7.1%
Wildrice Lake	Vilas	379	0.0%	0.0%	0.0%	3.6%	3.6%
Middle McKenzie Lake	Washburn	530	13.9%	14.0%	37.3%	4.8%	18.7%
Shell Lake	Washburn	2580	2.0%	1.2%	0.0%	4.9%	6.9%
1999 Mean Values+			7.5%	9.5%	4.9%	4.6%	12.1%
1993-1998 Mean Values*			8.6%	12.1%	11.7%	4.1%	12.9%

+ N = 19 for 1999 means.
* N = 132 for "Total Angler", "≥ 14 inches", and "≥ 20 inches" angler exploitation of adult walleyes 1993-1998 means. N = 131 for "Tribal" and "Total" exploitation of adult walleyes 1993-1998 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 9-613 and the number of recaptures ranged from 0-5, with fourteen 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.

The 1999 mean total exploitation rate was statistically similar to the 1993-1998 mean value and no individual lake had a total exploitation rate greater than 35%. These data indicate that overexploitation did not occur in lakes surveyed in 1999. 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 20 lakes classified as muskellunge waters in 1999. Although three muskellunge were recorded during the creel survey of Maiden Lake (Oconto), this lake was not classified as a muskellunge water. Therefore, this lake excluded from summary statistics. Eight of the surveyed lakes were 500 acres or larger and twelve were less than 500 acres. 1999 and 1990-1998 mean values of measured parameters are shown in Table 5.

In 1999, catch/acre was significantly higher in lakes less than 500 acres than in larger lakes ($p = 0.01$). While harvest/acre was also higher in smaller lakes, this difference was not significant ($p = 0.24$). Similarly, while the specific catch rate was higher in smaller lakes, this difference was not significant ($p = 0.09$). Anglers targeting muskellunge appeared to have concentrated their efforts on smaller lakes in 1999. The directed effort/acre was significantly higher in lakes less than 500 acres ($p = 0.03$).

There was a relatively large difference in specific harvest rate between the 1999 mean value of 1980 hours/muskellunge and the 1990-1998 mean value of 454 hours/muskellunge. This difference was not significant ($p = 0.10$) but there does appear to be an increase in the number of hours spent to harvest a muskellunge in the last decade which would support findings by Simonson and Hewett (1999). The difference in the mean specific catch rate between 1999 (29.8 hours) and the 1990-1998 mean value (27.6 hours) was not significant ($p = 0.72$) (Table 5). There were no muskellunge measured from lakes larger than 500 acres in 1999.

Table 5. 1999 and 1990-1998 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
1999		All lakes	20	1267	0.44	0.005	29.8	1980.2	37.7	59.8	4166.7	9.6	31.9
	Means	< 500 acres	12	308	0.63	0.008	23.3	1224.5	37.7	45.7	2553.2	11.9	39.1
		≥ 500 acres	8	2703	0.16	0.000	50.9	26666.7		111.4	80000.0	6.1	21.2
1990-1998		All lakes	197	1171	0.47	0.025	27.6	454.5	38.0	68.4	1275.2	10.1	34.9
	Means	< 500 acres	73	269	0.57	0.031	25.0	419.2	37.0	63.9	1135.3	11.4	42.3
		≥ 500 acres	124	1701	0.41	0.021	29.3	476.9	38.3	71.4	1375.8	9.3	30.5

*1990-1998 mean specific catch and harvest rates n = 190 for all lakes, n = 68 for lakes <500 acres, and n = 122 for lakes ≥500 acres.

Northern Pike

Complete creel surveys were collected from a total of 19 lakes classified as northern pike waters in 1999. Eight of the surveyed lakes were 500 acres or larger and eleven were less than 500 acres. 1999 and 1990-1998 mean values of measured parameters are shown in Table 6.

In 1999, anglers targeting northern pike seemed to focus on lakes less than 500 acres and had greater success in terms of catch and harvest in these lakes. Angler catch/acre was higher in smaller lakes but this difference was not significant ($p = 0.46$). Similarly, the number of hours of directed effort/acre was higher in smaller lakes in 1999 but this difference was also not significant ($p = 0.06$) (Table 6). 1999 mean values were all similar to 1990-1998 mean values (Table 6).

Table 6. 1999 and 1990-1998 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
1999		All lakes	19	1320	3.00	0.42	5.4	20.9	22.0	12.3	32.4	5.0	34.5
	Means	< 500 acres	11	313	3.54	0.48	6.1	29.0	22.5	13.7	23.3	6.7	44.2
		≥ 500 acres	8	2703	2.27	0.34	4.7	15.0	21.5	10.8	70.4	2.5	21.2
1990-1998		All lakes	209	1179	2.08	0.43	5.4	18.9	22.3	14.8	73.7	8.5	34.8
	Means	< 500 acres	76	281	2.38	0.47	4.9	16.1	22.0	13.1	65.8	7.6	43.3
		≥ 500 acres	133	1693	1.91	0.40	5.6	21.0	22.5	16	79	9.0	29.9

*1990-1998 mean specific catch and harvest rates n = 204 for all lakes, n = 74 for lakes <500 acres, n = 130 for lakes ≥500 acres.

Smallmouth bass

Complete creel surveys were collected from a total of 18 lakes classified as smallmouth bass waters in 1999. Eight of the surveyed lakes were 500 acres or larger and ten were less than 500 acres. 1999 and 1990-1998 mean values of measured parameters are shown in Table 7.

In general, parameter values in lakes larger and smaller than 500 acres were similar in 1999 and between 1999 mean values and 1990-1998 mean values. While the angler catch/acre was higher in smaller lakes in 1999 (2.22 vs. 0.92 smallmouth bass/acre) it was not significantly so ($p = 0.32$). Similarly, angler

harvest/acre was higher in smaller lakes in 1999 (0.069 vs. 0.029) but this difference was also not significant (p = 0.44) (Table 7). Angler harvest/acre and specific harvest rate indicated that anglers were harvesting fewer smallmouth in 1999 than the 1990-1998 mean values (0.05 vs. 0.11 and 136 hours/fish vs. 28 hours/fish respectively) (Table 7). However, neither of these differences was significant (p = 0.23 and p = 0.13).

Table 7. 1999 and 1990-1998 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
1999		All lakes	18	1369	1.64	0.05	4.3	135.8	15.7	14.1	467.4	4.07	32.43
	Means	< 500 acres	10	302	2.22	0.07	4.7	125.3	15.6	13.0	505.1	4.64	41.38
		≥ 500 acres	8	2703	0.92	0.03	3.9	151.8	15.7	15.8	427.6	3.34	21.25
1990-1998		All lakes	202	1247	1.11	0.10	3.5	28.4	14.7	18.5	195.0	3.91	33.92
	Means	< 500 acres	66	290	1.28	0.13	5.3	37.5	14.8	17.1	182.3	3.51	42.78
		≥ 500 acres	136	1711	1.03	0.09	3.0	25.6	14.7	19.2	201.9	4.11	29.60

*1990-1998 Mean specific catch and harvest rates n = 190, n = 61 for lakes <500 acres, and n = 129 for lakes ≥500 acres.

Largemouth bass

Complete creel surveys were collected from a total of 22 lakes classified as largemouth bass waters in 1999. Fourteen of the surveyed lakes were less than 500 acres and eight were less than 500 acres. 1999 and 1990-1998 mean values of measured parameters are shown in Table 8.

Although there were relatively large differences in 1999 between lakes less than 500 acres and lakes 500 acres or larger in specific harvest rate (95.3 vs. 126.2 hours/largemouth bass) and directed effort/acre (3.74 vs. 1.87 hours/acre), neither of these differences were significant (p = 0.67 and p = 0.19).

There were also relatively large differences between the 1999 mean values and the 1990-1998 means for angler harvest per acre (0.08 vs. 0.13 largemouth bass/acre) and specific harvest rate (104.6 vs. 41.6 hours/largemouth bass), but again, neither of these differences were significant (p = 0.42 and p = 0.10).

Table 8. 1999 and 1990-1998 mean largemouth bass creel data. Specific and general catch and harvest rates are measured in number of hours per fish caught or harvested.

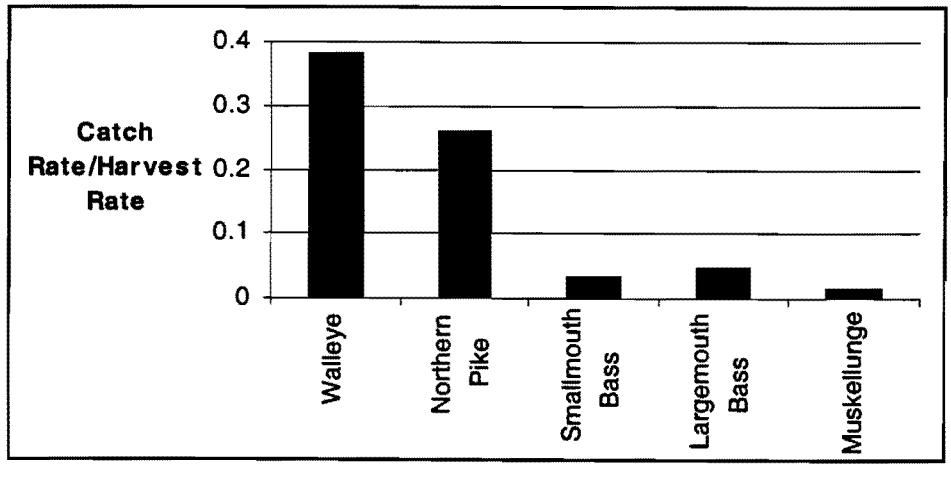
			N	Lake Acres	Angler Catch /Acre	Angler Harvest/ Acre	Specific Catch Rate*	Specific Harvest Rate*	Mean Length	General Catch Rate	General Harvest Rate	Directed Effort /Acre	Total Effort /Acre
1999		All lakes	22	1179	2.02	0.08	4.8	104.6	14.6	14.6	416.7	3.06	33.32
	Means	< 500 acres	14	308	1.80	0.07	4.9	95.3	14.8	18.4	540.5	3.74	40.22
		≥ 500 acres	8	2703	2.42	0.09	4.6	126.2	14.1	10.8	297.4	1.87	21.25
1990-1998		All lakes	227	1096	1.54	0.13	5.8	41.6	14.5	22.9	219.2	4.55	34.70
	Means	< 500 acres	84	280	1.65	0.15	6.7	49.4	14.4	23.2	228.0	4.67	41.64
		≥ 500 acres	143	1575	1.47	0.11	5.3	38.1	14.8	22.7	214.4	4.48	30.62

*1990-1998 mean specific catch and harvest rates n = 206, n = 77 for lakes <500 acres, and n = 129 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 catch a particular species of fish to the mean number of hours spent to harvest 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 requirement of this large species. In addition, muskellunge had the lowest catch rate to harvest rate ratio due to the emphasis placed on catch and release in this fishery (Figure 5). Interestingly, northern pike, walleye, largemouth bass, and smallmouth bass, all 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 hours spent to catch a walleye to 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. 1999 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.

ERRATA

Young of the Year

The Wisconsin Department of Natural Resources 1998 Ceded Territory Fishery Assessment Report (Administrative Report #47) reported two values which were incorrect and thereby changed the mean values. The errors were small and therefore are not expected to affect statistical tests. The errors and corresponding corrections are as follows:

1) Appendix 2. Error: Red Cedar Lake (Barron), Age 0+ Walleye (#/mile) = 10.2, Serns Index (YOY/acre) = 2.4.

   Correction: Age 0+ Walleye (#/mile) = 9.3, Serns Index (YOY/acre) = 2.2.

   Error: Spider Lake (Iron), Age 0+ Walleye (#/mile) = 14.2, Serns Index (YOY/acre) = 3.3.

   Correction: Age 0+ Walleye (#/mile) = 42.7, Serns Index (YOY/acre) = 10.0.

These corrections change the mean 1998 young of the year walleye per mile for lakes with natural walleye reproduction (Table 2) from 31.2 to a corrected value of 31.8.

The Wisconsin Department of Natural Resources 1997 Ceded Territory Fishery Assessment Report (Administrative Report #48) neglected to report values from one lake which in turn changed the mean values. The resulting changes were small and therefore are not expected to affect statistical tests. The addition is as follows:

1) Appendix 2. Red Cedar Lake, Barron County, 1841 acres, 15.9 miles of total shoreline, 4.2 miles of

shoreline sampled, 40.2 age 0+ walleye/mile, and 9.4 age 0+ walleye per acre.

These corrections change the mean 1997 young of the year walleye per mile for lakes with natural walleye reproduction (Table 2) from 32.6 to a corrected value of 32.7.

Although Red Cedar Lake was inadvertently omitted from Appendix 2, its values were included in Figures 3 and 4. Therefore, no changes to these figures result from this omission.

Creel Surveys

Walleye exploitation values reported in the Wisconsin Department of Natural Resources 1998 Ceded Territory Fishery Assessment Report (Administrative Report #47) included 1990-1997 mean values. In the vast majority of lakes, all fish, regardless of sex and length that received marks in 1990-1992 received the same fin clip. Therefore it was not possible to calculate adult exploitation. 1998 exploitation values should have been compared to the 1993-1997 mean values. The resulting corrections affect the results only slightly and do not change any of the conclusions reached. The errors and corresponding corrections are as follows:

1) Table 4. Errors: 1990-1997 mean values, Total Angler Exploitation of Adult Walleye = 9.2%, Angler Exploitation $\geq$ 14 inches = 12.8%, Angler Exploitation $\geq$ 20 inches = 12.6%, Tribal Exploitation of Adult Walleye = 4.2%, Total Exploitation of Adult Walleye = 13.2%. N = 196 for "Total", "$\geq$ 14 inches", and "$\geq$ 20 inches" angler exploitation of adult walleye 1990-1998 means. N = 192 for "Tribal" and "Total" exploitation of adult walleye 1990-1997 means. Corrections: 1993-1997 mean values, Total Angler Exploitation of Adult Walleye = 9.0%, Angler Exploitation $\geq$ 14 inches = 12.2%, Angler Exploitation $\geq$ 20 inches = 13.5%, Tribal Exploitation of Adult Walleye = 4.8%, Total Exploitation of Adult Walleye = 13.8%. N = 111 for "Total", "$\geq$ 14 inches", and "$\geq$ 20 inches" angler exploitation of adult walleye 1990- 1998 means. N = 110 for "Tribal" and "Total" exploitation of adult walleye 1990-1997 means.

2) Text. Errors: 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).

Corrections: 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. 9.0% $p = 0.24$, 3.1% vs. 4.8% $p = 0.55$, and 9.3% vs. 13.8% $p = 0.21$, respectively).

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Appendix 1. Lakes with adult walleye population estimates calculated in 1999 and at least one historical population estimate.

County	Lake	Year	Adult Population Estimate	Adult Walleye Per Acre
Ashland	English Lake	1999	397	1.6
		1993	392	1.6
Barron	Sand Lake	1999	723	2.2
		1993	542	1.7
Forest	Crane Lake	1999	655	1.9
		1988	463	1.4
	Roberts Lake	1999	1515	3.7
		1987	1808	4.4
Lincoln	Spirit River Flowage	1999	1066	0.6
		1986	3056	1.8
Marathon	Big Eau Pleine Reservoir	1999	30594	4.5
		1993	12770	1.9
		1985	10130	1.5
Oneida	Big Carr Lake	1999	498	2.3
		1988	435	2.0
	George Lake	1999	1981	4.6
		1995	1144	2.6
	Thompson Lake	1999	517	1.4
		1995	452	1.2
Sawyer	Lake Chippewa	1999	82070	5.4
		1990	80202	5.2
Vilas	Black Oak Lake	1999	1965	3.4
		1993	689	1.2
	Boulder Lake	1999	2796	5.3
		1995	2282	4.4
		1990	1629	3.1
	Clear Lake	1999	1616	2.9
		1993	1987	3.6
	Island Lake	1999	6683	6.5
		1993	3591	3.5
	Manitowish Lake	1999	1524	2.0
		1993	508	0.7
	Rest Lake	1999	1867	2.9
		1993	2450	3.8
Washburn	Middle Mckenzie Lake	1999	813	1.5
		1990	1110	2.1
	Lake Nancy	1999	2092	2.7
		1998	1447	1.9
		1993	538	0.7

Appendix 2. Walleye young of the year per mile and Serns Index calculations of surveyed lakes with natural reproduction in 1999.

Lake	County	Acres	Total Shoreline (mi)	Shoreline Shocked (mi)	Age 0+ Walleye (#/mi)	Sern's Index (YOY/acre)
Spillerberg Lake	Ashland	75	1.5	1.5	85.3	20.0
Horseshoe Lake	Barron	115	2.5	2.5	0.0	0.0
Red Cedar Lake	Barron	1841	15.9	8.4	36.2	8.5
Silver Lake	Barron	337	4.4	4.4	0.0	0.0
Spring Lake	Barron	60	2.3	2.3	2.6	0.6
Long Lake	Chippewa	1052	14.0	14.0	53.1	12.4
Amnicon Lake	Douglas	426	6.0	6.0	0.0	0.0
Tainter Lake	Dunn	1752	25.7	3.0	57.7	13.5
Keyes Lake	Florence	202	3.2	3.1	0.0	0.0
Patten Lake	Florence	255	3.9	3.3	81.8	19.1
Jungle Lake	Forest	177	2.2	2.2	53.6	12.6
Roberts Lake	Forest	415	4.5	4.5	0.2	0.1
Echo Lake	Iron	220	4.9	2.7	21.1	4.9
Gile Flowage	Iron	3384	27.2	22.7	39.2	9.2
Trude Lake	Iron	781	15.1	3.6	55.0	12.9
Turtle Flambeau Flowage	Iron	13545	206.3	7.8	257.1	60.2
Tug Lake	Lincoln	151	2.7	2.7	8.9	2.1
Boot Lake	Oconto	235	3.8	3.1	0.6	0.2
Maiden Lake	Oconto	269	5.6	5.5	0.5	0.1
Wheeler Lake	Oconto	293	4.6	4.6	20.0	4.7
Big Carr Lake	Oneida	213	3.6	3.6	1.4	0.3
Emma Lake	Oneida	40	1.4	1.4	0.0	0.0
George Lake	Oneida	435	5.5	5.5	51.6	12.1
Swamp Lake	Oneida	262	2.8	2.8	0.0	0.0
Magnor Lake	Polk	231	2.6	2.6	0.0	0.0
Pipe Lake	Polk	342	6.9	6.9	0.0	0.0
Big Dardis Lake	Price	144	2.8	2.6	0.0	0.0
Butternut Lake	Price	1006	11.2	4.0	18.0	4.2
Lac Sault Dore Lake	Price	561	14.1	5.2	38.1	8.9
Long Lake	Price	418	11.9	2.3	17.4	4.1
Pike Lake	Price	806	10.9	8.5	27.6	6.5
Solberg Lake	Price	859	12.4	3.5	53.1	12.4
Blaisdell Lake	Sawyer	356	7.6	5.8	0.0	0.0
Hunter Lake	Sawyer	126	3.8	3.8	0.3	0.1
Lake Chippewa	Sawyer	15300	232.9	30.1	27.3	6.4
Lost Land Lake	Sawyer	1304	11.3	4.9	23.3	5.4
Sand Lake	Sawyer	928	5.1	5.1	9.8	2.3
Windfall Lake	Sawyer	102	1.6	1.6	183.1	42.9
Cedar Lake	St. Croix	1100	6.3	4.3	75.8	17.7
Rib Lake	Taylor	320	3.3	3.3	38.5	9.0
Alder Lake	Vilas	274	2.5	2.5	8.4	2.0
Big Lake (MI Border)	Vilas	771	13.8	13.8	67.1	15.7
Boulder Lake	Vilas	524	7.7	7.7	64.8	15.2
Duck/Lynx Lake	Vilas	130	2.5	2.5	17.2	4.0
Little Star Lake	Vilas	244	3.8	3.8	2.9	0.7
Mamie Lake	Vilas	400	5.9	4.9	15.1	3.5
Otter Lake	Vilas	196	2.3	2.3	17.8	4.2
Scattering Rice Lake	Vilas	267	3.0	3.0	12.0	2.8
Spider Lake	Vilas	272	5.9	5.9	10.3	2.4
Wild Rice Lake	Vilas	379	3.7	3.7	2.2	0.5
Yellow Birch	Vilas	202	3.7	3.7	22.2	5.2
Lake Nancy	Washburn	772	10.9	3.4	2.4	0.6
Middle McKenzie Lake	Washburn	530	4.1	4.1	2.0	0.5
Shell Lake	Washburn	2580	10.2	10.2	53.4	12.5
Spring Lake	Washburn	211	2.5	2.5	2.4	0.6
Average					29.8	7.0

Appendix 3. Walleye young of the year per mile and Serns Index calculations for surveyed lakes sustained by stocking and whether each lake was stocked with juvenile walleye in 1999.

Lake	County	Acres	Total Shoreline (mi)	Shoreline Shocked (mi)	Age 0+ Walleye (#/mi)	Sern's Index (YOY/acre)	Stocked in 1999?
English Lake	Ashland	244	4.1	3.8			N
Meder Lake	Ashland	135	2.2	2.2	0.0	0.0	N
Mineral Lake	Ashland	225	5.3	5.3	5.5	1.3	N
Upper Clam Lake	Ashland	166	3.2	2.9	0.3	0.1	N
Sand Lake	Barron	322	6.3	6.3	9.7	2.3	Y
Staples Lake	Barron	305	3.5	3.5	0.0	0.0	Y
Atkins Lake	Bayfield	176	2.3	2.3	26.1	6.1	N
Crystal Lake	Bayfield	111	2.5	2.5	2.8	0.7	Y
Diamond Lake	Bayfield	341	5.0	5.0	0.0	0.0	N
Long Lake	Bayfield	263	6.8	6.8	0.0	0.0	N
Big Mckenzie Lake	Burnett	1185	7.1	7.1	8.0	1.9	Y
Red Lake	Douglas	258	3.5	3.5	0.0	0.0	N
Grand Portage Lake	Iron	144	3.1	3.1	2.3	0.5	Y
Mercer Lake	Iron	184	4.2	4.2	0.0	0.0	Y
Owl Lake	Iron	129	4.2	4.2	1.4	0.3	Y
Somo Lake	Lincoln	472	11.9	11.9	0.1	0.0	N
Carrol Lake	Oneida	352	6.1	6.1	0.0	0.0	Y
Julia Lake	Oneida	401	6.6	6.6	0.0	0.0	Y
Long Lake	Oneida	113	2.9	2.9	0.3	0.1	N
Pier Lake	Oneida	257	5.0	5.0	0.2	0.0	N
Thompson Lake	Oneida	411	6.7	6.7	1.6	0.4	N
Sand Lake	Polk	187	2.6	2.6	0.0	0.0	Y
Musser Lake	Price	563	12.1	2.7	0.0	0.0	N
Amacoy Lake	Rusk	278	3.7	3.7	0.0	0.0	Y
Ghost Lake	Sawyer	372	7.3	2.1	0.0	0.0	Y
Hayward Lake	Sawyer	247	8.6	5.4	0.2	0.0	Y
Lower Clam Lake	Sawyer	203	4.2	2.8	88.6	20.7	Y
Kathyrn Lake	Taylor	62	2.7	2.2	0.0	0.0	Y
Alma Lake	Vilas	58	1.6	1.6	0.6	0.1	Y
Ballard Lake	Vilas	505	5.5	5.5	8.4	2.0	N
Hunter Lake	Vilas	184	3.2	3.2	14.1	3.3	N
Moon Lake	Vilas	131	2.0	2.0	13.0	3.0	N
Razorback Lake	Vilas	362	7.3	7.3	41.2	9.6	N
White Birch Lake	Vilas	112	2.3	2.3	9.6	2.2	N
Big Bass Lake	Washburn	203	2.4	2.4	0.0	0.0	N
Matthews Lake	Washburn	263	2.6	2.6	0.0	0.0	N
Stone Lake	Washburn	523	4.0	4.0	1.3	0.3	N
Average					6.5	1.5	

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)	Sern's Index (YOY/acre)
Potter Lake	Ashland	29	0.9	0.9	0.0	0.0
Buffalo Lake	Bayfield	179	3.3	3.0	0.0	0.0
Pigeon Lake	Bayfield	213	6.4	6.4	0.0	0.0
Taylor Lake	Bayfield	94	1.7	1.7	3.5	0.8
Des Moines Lake	Burnett	229	3.2	3.2	0.6	0.1
Long Lake	Burnett	251	4.7	4.7	0.6	0.1
Richardson Lake	Forest	54	1.5	1.5	0.0	0.0
St. Johns Lake	Forest	104	2.2	3.3	0.0	0.0
Ada Lake	Langlade	73	1.6	1.6	0.0	0.0
Deep Wood Lake	Langlade	63	2.6	2.5	0.0	0.0
Glade Lake	Langlade	26	1.0	1.0	0.0	0.0
Greater Bass Lake	Langlade	258	6.6	6.3	0.0	0.0
Halfmoon Lake	Lincoln	100	2.3	2.3	0.0	0.0
Long/Bass Lake	Lincoln	132	5.9	8.7	0.0	0.0
Archibald Lake	Oconto	393	8.8	8.0	1.6	0.4
Burrows Lake	Oneida	131	2.4	2.4	0.0	0.0
Vincent Lake	Polk	70	2.6	2.6	0.0	0.0
North Spirit Lake	Price	213	5.4	3.2	0.0	0.0
Black Dan Lake	Sawyer	128	3.0	3.0	0.0	0.0
Grimh Flowage	Sawyer	86	3.9	3.9	0.3	0.1
Island Lake	Sawyer	67	1.5	1.5	0.0	0.0
Lower Gresham Lake	Vilas	149	2.0	2.0	2.0	0.5
Robinson Lake	Vilas	37	1.1	0.1	0.0	0.0
Slim Lake*	Washburn	224	2.6	2.6	4.4	1.0
Average					0.5	0.1

*Slim Lake values are the means of two samping events.

Appendix 5. 1999 walleye creel data. MWB Code is the master water body code assigned to a given lake by the Wisconsin Department of Natural Resources. Catch and harvest rates are measured in fish per hour. Lengths are measured in inches. Effort parameters are measured in hours.

Lake Name	County Name	MWB CODE	1999 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
English	Ashland	2914800	C-ST	5	slot	244	397	1.63	156	0.64	51	0.21	0.1427	0.0465	15	15.41	0.0416	0.0135	1039	4.26	3840	15.74
Sand	Barron	2661100	C-ST	3	15	322	723	2.25	1803	5.60	239	0.74	0.3600	0.0489	77	16.96	0.1065	0.0141	4740	14.72	17102	53.11
Amnicon	Douglas	2858100	NR	2	15	426	1769	4.15	508	1.19	50	0.12	0.1684	0.0102	15	16.72	0.0424	0.0042	2398	5.63	12185	28.60
Roberts	Forest	378400	C-NR	3	15	414	1515	3.66	1218	2.94	66	0.16	0.1338	0.0074	12	16.34	0.0546	0.0030	8924	21.56	23219	56.08
Stevens	Forest	683000	C-ST	2	15	297	1659	5.59	1756	5.91	390	1.31	0.2309	0.0549	108	18.87	0.1157	0.0257	6875	23.15	15398	51.84
Malden	Oconto	487500	NR-2	3	15	290	503	1.73	785	2.71	259	0.89	0.1331	0.0439	47	17.34	0.0646	0.0213	5897	20.33	12317	42.47
George	Oneida	1569600	NR	3	1>14	435	1981	4.55	1768	4.06	722	1.66	0.1599	0.0676	137	13.50	0.0717	0.0293	10678	24.55	25160	57.84
Thompson	Oneida	1569900	ST	3	15	382	517	1.35	866	2.27	43	0.11	0.1969	0.0106	10	18.52	0.0572	0.0029	2834	7.42	16141	42.25
Chippewa	Sawyer	2399700	C-NR	3	none	15300	82070	5.36	109512	7.16	36002	2.35	0.4291	0.1438	1084	13.46	0.2230	0.0733	239280	15.64	490989	32.09
Alder	Vilas	2329600	NR	3	1>14	274	2662	9.72	254	0.93	127	0.46	0.1529	0.0767	6	13.68	0.0508	0.0255	1659	6.05	5915	21.59
Boulder	Vilas	2338300	NR	3	1>14	524	2796	5.34	1359	2.59	702	1.34	0.3978	0.2059	207	13.87	0.1901	0.0981	3407	6.50	7149	13.64
Clear	Vilas	2329000	NR	3	1>14	555	1616	2.91	2820	5.08	1291	2.33	0.2929	0.1334	225	14.45	0.1436	0.0657	9525	17.16	19644	35.40
Island	Vilas	2334400	NR	3	1>14	1023	6683	6.53	4073	3.98	1977	1.93	0.4974	0.2431	235	13.15	0.2617	0.1270	8031	7.85	16030	15.67
Little Star^	Vilas	2334300	NR	3	1>14	244	496	2.03	52	0.21	52	0.21	0.0772	0.0772	1	10.70	0.0295	0.0295	677	2.77	1945	7.97
Manitowish^	Vilas	2329400	NR	3	1>14	506	1028	2.03	123	0.24	66	0.13	0.0590	0.0317	5	13.44	0.0157	0.0084	2093	4.14	8400	16.60
Rest	Vilas	2327500	NR	3	1>14	608	1867	3.07	2479	4.08	944	1.55	0.3427	0.1306	138	13.74	0.2382	0.0908	7191	11.83	10571	17.39
Spider#	Vilas	2329300	NR	3	1>14	272	472	1.74	592	2.18	280	1.03	0.4939	0.2333	56	13.17	0.1351	0.0638	1199	4.41	5248	19.29
Stone#	Vilas	2328800	NR	5	1>14	139	241	1.73	1108	7.97	353	2.54	0.4032	0.1261	42	13.37	0.0776	0.0247	2671	19.22	14357	103.29
Wildrice	Vilas	2329800	NR	3	1>14	379	250	0.66	519	1.37	215	0.57	0.1693	0.0689	40	14.27	0.0470	0.0195	2667	7.04	11338	29.91
Bass	Washburn	2451900	NR	3	1>14	188	775	4.12	280	1.49	158	0.84	0.1068	0.0620	52	14.11	0.0454	0.0256	2315	12.31	6228	33.13
Middle Mckenzie	Washburn	2706500	C-NR	3	15	530	813	1.53	469	0.88	294	0.55	0.0699	0.0449	62	19.52	0.0305	0.0192	6356	11.99	15522	29.29
Shell	Washburn	2496300	NR	3	none	2580	2092	0.81	1402	0.54	1105	0.43	0.1201	0.0958	178	14.74	0.0549	0.0432	11336	4.39	25542	9.90

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.

^Adult population estimate for Manitowish and Little Star combined (1524). This estimate was divided by surface area of each lake for individual lake population estimates

#Adult population estimate for Spider and Stone combined (713). This estimate was divided by surface area of each lake for individual lake population estimates

Appendix 6. 1999 muskellunge creel data. MWB Code is the master water body code assigned to a given lake by the Wisconsin Department of Natural Resources. Catch and harvest rates are measured in fish per hour. Lengths are measured in inches. Effort parameters are measured in hours.

Lake Name	County Name	MWB CODE	1999 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
Stone	Vilas	2328800	C-	34	139	146	1.05	0	0.00	0.0301	0.0000			0.0108	0.0000	3461	24.90	14357	103.29
Bass	Washburn	2451900	NR	34	188	262	1.39	0	0.00	0.1049	0.0000			0.0460	0.0000	1346	7.16	6228	33.13
English	Ashland	2914800	C-	34	244	135	0.55	0	0.00	0.0713	0.0000			0.0422	0.0000	1393	5.71	3840	15.74
Little Star	Vilas	2334300	C-	34	244	0	0.00	0	0.00	0.0000	0.0000			0.0000	0.0000	1014	4.16	1945	7.97
Spider	Vilas	2329300	C-	34	272	111	0.41	8	0.03	0.0299	0.0022	1	36.10	0.0213	0.0015	3523	12.95	5248	19.29
Alder	Vilas	2329600	C-	34	274	81	0.30	0	0.00	0.0344	0.0000			0.0151	0.0000	2359	8.61	5915	21.59
Sand	Barron	2661100	ST	34	322	103	0.32	0	0.00	0.0158	0.0000			0.0077	0.0000	4243	13.18	17102	53.11
Wildrice	Vilas	2329800	C-ST	34	379	310	0.82	4	0.01	0.0469	0.0007	2	42.65	0.0275	0.0004	5525	14.58	11338	29.91
Thompson	Oneida	1569900	C-	34	382	154	0.40	0	0.00	0.0288	0.0000			0.0105	0.0000	5131	13.43	16141	42.25
Roberts	Forest	378400	NR	40	414	282	0.68	0	0.00	0.0292	0.0000			0.0146	0.0000	7955	19.21	23219	56.08
Amnicon	Douglas	2858100	C-	34	426	586	1.38	26	0.06	0.1076	0.0069	5	34.38	0.0628	0.0028	3849	9.04	12185	28.60
George	Oneida	1569600	C-	34	435	94	0.22	0	0.00	0.0156	0.0000			0.0042	0.0000	4510	10.37	25160	57.84
Manitowish	Vilas	2329400	C-	34	506	150	0.30	0	0.00	0.0305	0.0000			0.0190	0.0000	4330	8.56	8400	16.60
Boulder	Vilas	2338300	C-	34	524	88	0.17	0	0.00	0.0247	0.0000			0.0142	0.0000	3307	6.31	7149	13.64
Middle Mckenzie	Washburn	2706500	ST	34	530	6	0.01	0	0.00	0.0000	0.0000			0.0006	0.0000	537	1.01	15522	29.29
Clear	Vilas	2329000	C-	34	555	114	0.21	0	0.00	0.0161	0.0000			0.0066	0.0000	6911	12.45	19644	35.40
Rest	Vilas	2327500	C-	34	608	117	0.19	0	0.00	0.0380	0.0000			0.0113	0.0000	2632	4.33	10571	17.39
Island	Vilas	2334400	C-	34	1023	172	0.17	0	0.00	0.0292	0.0000			0.0121	0.0000	5362	5.24	16030	15.67
Shell	Washburn	2496300	ST	34	2580	34	0.01	0	0.00	0.0034	0.0000			0.0015	0.0000	3680	1.43	25542	9.90
Chippewa	Sawyer	2399700	C-NR	34	15300	2912	0.19	38	0.00	0.0152	0.0003			0.0065	0.0001	150389	9.83	490989	32.09

*Stevens Lake (Forest) and Maiden Lake (Oconto) are not classified as a muskellunge waters.

Appendix 7. 1999 northern pike creel data. MWB Code is the master water body code assigned to a given lake by the Wisconsin Department of Natural Resources. Catch and harvest rates are measured in fish per hour. Lengths are measured in inches. Effort parameters are measured in hours.

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
Sand	Barron	2661100	322	4009	12.45	434	1.35	0.3889	0.0758	165	20.88	0.2344	0.3889	5015	15.57	17102	53.11
Roberts	Forest	378400	414	2671	6.45	521	1.26	0.2673	0.0804	58	21.63	0.1150	0.0224	5500	13.29	23219	56.08
Stevens	Forest	683000	297	1067	3.59	97	0.33	0.1705	0.0225	40	28.63	0.0693	0.0063	3524	11.87	15398	51.84
Maiden	Oconto	487500	290	339	1.17	42	0.14	0.1457	0.0064	3	20.33	0.0302	0.0038	1371	4.73	12317	42.47
George	Oneida	1569600	435	2155	4.95	383	0.88	0.1995	0.0517	74	20.38	0.0858	0.0153	4680	10.76	25160	57.84
Thompson	Oneida	1569900	382	281	0.74	31	0.08	0.0853	0.0159	6	26.82	0.0183	0.0020	957	2.51	16141	42.25
Chippewa	Sawyer	2399700	15300	51871	3.39	7376	0.48	0.3329	0.0830	203	20.43	0.1056	0.0150	47652	3.11	490989	32.09
Alder	Vilas	2329600	274	155	0.57	0	0.00	0.0677	0.0000			0.0594	0.0000	391	1.43	5915	21.59
Boulder	Vilas	2338300	524	57	0.11	13	0.02	0.0546	0.0465	10	20.73	0.0144	0.0032	270	0.52	7149	13.64
Clear	Vilas	2329000	555	894	1.61	182	0.33	0.1024	0.0607	71	22.17	0.0455	0.0093	1263	2.28	19644	35.40
Island	Vilas	2334400	1023	604	0.59	65	0.06	0.0773	0.0391	17	20.48	0.0390	0.0042	1304	1.27	16030	15.67
Little Star	Vilas	2334300	244	0	0.00	0	0.00	0.0000	0.0000			0.0000	0.0000	90	0.37	1945	7.97
Manitowish	Vilas	2329400	506	235	0.46	68	0.13	0.1190	0.1190	2	24.85	0.0391	0.0113	500	0.99	8400	16.60
Rest	Vilas	2327500	608	169	0.28	9	0.01	0.0435	0.0000	1	19.50	0.0180	0.0010	654	1.08	10571	17.39
Spider	Vilas	2329300	272	49	0.18	14	0.05	0.0000	0.0000	2	20.80	0.0151	0.0043	75	0.28	5248	19.29
Stone	Vilas	2328800	139	711	5.12	73	0.53	0.2079	0.0317	42	20.78	0.0521	0.0054	1204	8.66	14357	103.29
Wildrice	Vilas	2329800	379	1394	3.68	260	0.69	0.2631	0.0946	50	21.83	0.1261	0.0236	1733	4.57	11338	29.91
Middle Mckenzie	Washburn	2706500	530	5581	10.53	756	1.43	0.7558	0.1399	183	20.63	0.3602	0.0488	4584	8.65	15522	29.29
Shell	Washburn	2496300	2580	3064	1.19	532	0.21	0.2133	0.0437	131	23.29	0.1200	0.0208	6244	2.42	25542	9.90

*Amnicon Lake (Douglas), Bass Lake (Washburn), and English Lake (Oneida) are not classified as northern pike waters.

Appendix 8. 1999 largemouth bass creel data. MWB Code is the master water body code assigned to a given lake by the Wisconsin Department of Natural Resources. Catch and harvest rates are measured in fish per hour. Lengths are measured in inches. Effort parameters are measured in hours.

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
English	Ashland	2914800	244	106	0.43	11	0.05	0.0888	0.0193	2	16.10	0.0352	0.0035	549	2.25	3840	15.74
Sand	Barron	2661100	322	2234	6.94	173	0.54	0.5087	0.0446	25	15.65	0.1356	0.0105	3330	10.34	17102	53.11
Amnicon	Douglas	2858100	426	329	0.77	8	0.02	0.1846	0.0091	1	14.00	0.0386	0.0009	826	1.94	12185	28.60
Roberts	Forest	378400	414	735	1.78	20	0.05	0.2180	0.0070			0.0389	0.0011	1829	4.42	23219	56.08
Stevens	Forest	683000	297	149	0.50	22	0.07	0.0984	0.0249	6	17.25	0.0104	0.0016	543	1.83	15398	51.84
Maiden	Oconto	487500	290	778	2.68	37	0.13	0.2799	0.0154	7	16.50	0.0735	0.0035	2397	8.27	12317	42.47
George	Oneida	1569600	435	104	0.24	0	0.00	0.0238	0.0000			0.0057	0.0000	1078	2.48	25160	57.84
Thompson	Oneida	1569900	382	318	0.83	8	0.02	0.1219	0.0093	1	9.10	0.0249	0.0006	816	2.14	16141	42.25
Chippewa	Sawyer	2399700	15300	4661	0.30	0	0.00	0.1533	0.0000			0.0111	0.0000	11211	0.73	490989	32.09
Alder	Vilas	2329600	274	32	0.12	0	0.00	0.0566	0.0000			0.0168	0.0000	566	2.07	5915	21.59
Boulder	Vilas	2338300	524	0	0.00	0	0.00	0.0000	0.0000			0.0000	0.0000	0	0.00	7149	13.64
Clear	Vilas	2329000	555	266	0.48	15	0.03	0.0799	0.0000	4	14.38	0.0143	0.0008	681	1.23	19644	35.40
Island	Vilas	2334400	1023	25	0.02	0	0.00	0.0086	0.0000			0.0022	0.0000	1000	0.98	16030	15.67
Little Star	Vilas	2334300	244	23	0.09	0	0.00	0.2222	0.0000			0.1395	0.0000	103	0.42	1945	7.97
Manitowish	Vilas	2329400	506	125	0.25	12	0.02	0.1112	0.0164			0.0218	0.0022	759	1.50	8400	16.60
Rest	Vilas	2327500	608	26	0.04	0	0.00	0.1481	0.0000			0.0063	0.0000	103	0.17	10571	17.39
Spider	Vilas	2329300	272	76	0.28	0	0.00	0.4595	0.0000			0.0296	0.0000	166	0.61	5248	19.29
Stone	Vilas	2328800	139	919	6.61	8	0.06	0.2584	0.0000	3	14.50	0.0711	0.0006	1265	9.10	14357	103.29
Wildrice	Vilas	2329800	379	124	0.33	11	0.03	0.0441	0.0151	1	15.00	0.0125	0.0011	431	1.14	11338	29.91
Bass	Washburn	2451900	188	663	3.53	13	0.07	0.3033	0.0022	2	15.40	0.1292	0.0025	1010	5.37	6228	33.13
Middle Mckenzie	Washburn	2706500	530	9547	18.01	327	0.62	1.1446	0.0417	68	15.04	0.6553	0.0225	4410	8.32	15522	29.29
Shell	Washburn	2496300	2580	723	0.28	33	0.01	0.0751	0.0053	1	12.80	0.0300	0.0014	5265	2.04	25542	9.90

Appendix 9. 1999 smallmouth bass creel data. MWB Code is the master water body code assigned to a given lake by the Wisconsin Department of Natural Resources. Catch and harvest rates are measured in fish per hour. Lengths are measured in inches. Effort parameters are measured in hours.

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
Roberts	Forest	378400	414	439	1.06	0	0.00	0.1559	0.0000			0.0272	0.0000	1974	4.77	23219	56.08
Maiden	Oconto	487500	290	2397	8.27	125	0.43	0.4380	0.0243	12	16.50	0.2266	0.0118	5142	17.73	12317	42.47
George	Oneida	1569600	435	253	0.58	0	0.00	0.0606	0.0000			0.0139	0.0000	1032	2.37	25160	57.84
Thompson	Oneida	1569900	382	186	0.49	0	0.00	0.0581	0.0000			0.0143	0.0000	794	2.08	16141	42.25
Chippewa	Sawyer	2399700	15300	23905	1.56	725	0.05	0.5030	0.0207	19	14.98	0.0534	0.0016	23865	1.56	490989	32.09
Alder	Vilas	2329600	274	56	0.20	0	0.00	0.0852	0.0000			0.0253	0.0000	663	2.42	5915	21.59
Boulder	Vilas	2338300	524	106	0.20	0	0.00	0.2774	0.0000			0.0270	0.0000	333	0.64	7149	13.64
Clear	Vilas	2329000	555	481	0.87	6	0.01	0.1647	0.0000	1	17.00	0.0261	0.0003	654	1.18	19644	35.40
Island	Vilas	2334400	1023	266	0.26	5	0.00	0.0735	0.0000	1	15.20	0.0174	0.0004	1401	1.37	16030	15.67
Little Star	Vilas	2334300	244	53	0.22	0	0.00	0.0876	0.0000			0.0935	0.0000	260	1.07	1945	7.97
Manitowish	Vilas	2329400	506	175	0.35	0	0.00	0.0549	0.0000			0.0273	0.0000	791	1.56	8400	16.60
Rest	Vilas	2327500	608	1013	1.67	28	0.05	0.3014	0.0137	5	16.14	0.0973	0.0027	1374	17.39	10571	17.39
Spider	Vilas	2329300	272	42	0.15	0	0.00	0.0632	0.0000			0.0152	0.0000	292	1.07	5248	19.29
Stone	Vilas	2328800	139	240	1.73	9	0.06	0.1241	0.0084	1	14.00	0.0183	0.0007	1087	7.82	14357	103.29
Wildrice	Vilas	2329800	379	131	0.35	19	0.05	0.1010	0.0319	3	17.57	0.0145	0.0022	407	1.07	11338	29.91
Bass	Washburn	2451900	188	1722	9.16	27	0.14	0.9512	0.0152	12	14.30	0.3231	0.0051	1134	6.03	6228	33.13
Middle Mckenzie	Washburn	2706500	530	120	0.23	0	0.00	0.1905	0.0000			0.0168	0.0000	55	0.10	15522	29.29
Shell	Washburn	2496300	2580	5700	2.21	325	0.13	0.5000	0.0183	48	15.30	0.2405	0.0137	7581	2.94	25542	9.90