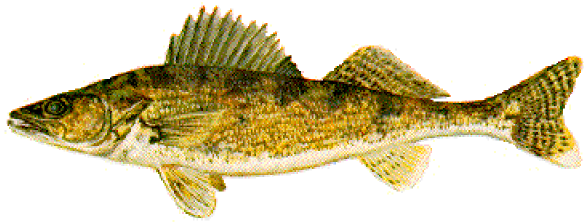
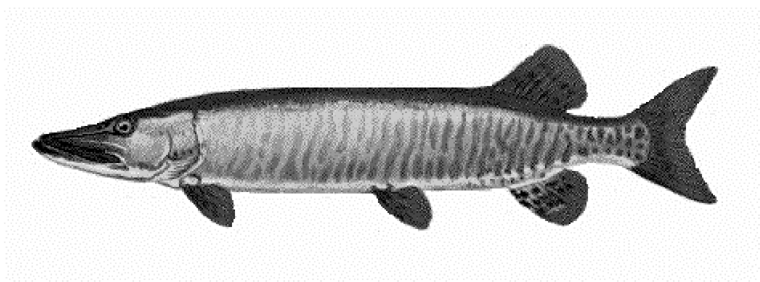


Wisconsin Department of Natural Resources

2001-2002 Ceded Territory

Fishery Assessment Report



Joseph M. Hennessy

Administrative Report # 55

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

INTRODUCTION

In 1983, the United States Court of Appeals for the Seventh Circuit acknowledged the rights of Chippewa Tribes to fish off-reservation waters in the Ceded Territory of Wisconsin using traditional methods (e.g. spearing and netting) as determined by the Treaties of 1837 and 1842. Six Wisconsin Chippewa Bands (Bad River, Lac Courte Oreilles, Lac du Flambeau, Sokaogon (Mole Lake), Red Cliff, and St. Croix) comprise the Tribal fishers. Since then, the Wisconsin Department of Natural Resources (WDNR) has worked to integrate tribal harvest opportunities with sport fisheries in the Ceded Territory. In addition, the WDNR works with the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) to establish safe harvest quotas for walleye and muskellunge in the Ceded Territory and to monitor the shared fisheries.

To facilitate and manage shared tribal and recreational angler harvest, an intensive data collection and analysis effort began in 1987, and developed into the current program in 1990. This effort has continued to evolve 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 information essential to protecting Ceded Territory fish populations from over-exploitation by the combined tribal and recreational fisheries.

Walleye (*Stizostedion vitreum*) and muskellunge (*Esox masquinongy)* are tremendously popular with Wisconsin 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 tribal harvest occurs during spring while walleyes and muskellunge are congregated in shallow water to spawn and are readily taken by spear. A smaller number are harvested throughout the remainder of the year with a variety of capture methods including spearing, gill netting, fyke netting, set-lining, 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, over-exploitation is a strong possibility in the absence of intensive management. Over-exploitation of a population could result in long lasting and potentially irreversible damage to the resource.

The WDNR assesses walleye populations using three primary methods: spring adult and total population estimates, fall young of the year relative abundance estimates, and creel surveys of angler catch and harvest. GLIFWC and the United States Fish and Wildlife Service conduct population estimates and young of the year surveys on additional lakes each year. In addition, GLIFWC monitors all tribal harvest. These methods provide information on the current harvestable population, an indication of the future harvestable population, and the degree of exploitation.

Population estimates are critical to the management of Ceded Territory lakes. Precise population estimates allow biologists to calculate the number of fish that may safely be harvested from a 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. However, it is logistically impossible to obtain precise population estimates from all harvested lakes in the Ceded Territory in one year. Therefore, 15-20 lakes are selected each year for walleye population estimates and nine-month creel surveys, using a stratified random sampling method. The data collected are incorporated into a database that can be used to examine temporal, within- and between-region trends in walleye populations and angler effort. Fish populations in general, and walleye populations in particular are extremely variable and can change dramatically from year to year. A continuing randomized survey of lakes provides information on trends in these populations.

Safe harvest levels are set on all Ceded Territory walleye and muskellunge lakes using the most accurate population estimate available. The most reliable estimates are from mark-recapture estimates performed in the same year in which the safe harvest level is set. These population estimates can also be used to estimate abundance in successive years. However, given the year-to-year variability associated with fish populations, these estimates are not as accurate as current year population estimates. Additional safety factors are incorporated to account for the largest potential decrease between years (Hansen et al. 1991). If there have been no historic mark-recapture estimates or the population estimate is greater than two years old in a given lake, then an estimate is calculated from a regression model based on lake acreage as an indicator of population abundance (Hansen 1989). Three different regression models are used depending on the primary source of walleye recruitment in the lake including models for: 1) lakes sustained primarily by natural reproduction (NR), 2) lakes sustained primarily through stocking efforts (ST), and 3) lakes with low density populations maintained through very intermittent natural reproduction (REM). Each year, new population estimates are incorporated into each regression model. These models are used to set safe harvest yearly for the majority of the walleye lakes in the Ceded Territory.

WALLEYE POPULATION ESTIMATES

Methods

The lakes sampled by the WDNR were chosen using a stratified random design. The pool of lakes from which the 2001 population survey lakes was chosen consisted of 171 lakes that had experienced tribal harvest at least three times between 1985 and 1994. Approximately 21 lakes were chosen (without replacement) for each year, resulting in each lake being surveyed once during the seven-year period from 1997-2004 (Appendix A). In addition, one large lake or lake chain was chosen to be surveyed each year. The calculation of population estimates on these lakes allowed 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 2001, adult walleye populations were estimated for 31 lakes, ranging in size from 29 to 5,039 acres. This total included 6 lakes in the Pike Chain (Bayfield Co.) and 4 lakes in the Rice-Nokomis Chain (Lincoln Co.). Composite adult walleye population estimates were calculated for the Pike Chain, Eagle and Flynn Lakes, and the Rice-Nokomis Chain. In addition, total walleye population estimates were calculated for 19 lakes individually. The 31 lakes comprised a range of walleye recruitment categorizations, lake types, and angler regulations (Table 1).

Walleyes were captured for marking in the spring shortly after ice out with fyke nets. Each fish was measured (total length; inches and tenths) and fin-clipped. Adult (mature) walleyes were defined as all fish for which sex could be determined and all fish 15” or longer. Adult walleyes were given a lake-specific mark. Walleyes of unknown sex less than 15 inches in length were classified as juveniles (immature) and were marked with a different lake-specific fin clip. Marking effort was based on a goal for total marks of 10% of the anticipated spawning population estimate. Marking continued until the target number was reached or spent females began appearing in the fyke nets.

Table 1: Lakes surveyed by WDNR sampling crews in spring 2001. Lake types include DG (drainage), DN (drained), SE (seepage), SP (spring). Minimum length restrictions are none, none but with only one fish larger than 14” allowed, 15”, and a 14-18” no-harvest slot. Recruitment codes NR, C-NR, and C- are in the natural recruitment model. Recruitment codes C-ST and ST are in the stocked model, and codes NR-2, 0-ST, and REM are in the remnant model.

WBIC	County	Lake	Acres	Lake Type	Size Limit	Recruit code
2094300	Barron	Pokegama	506	DG	15"	C-ST
2094100	Barron	Prairie	1,534	DG	15"	C-ST
	Bayfield	Eagle/Flynn	199	DG	1>14"	NR-2
	Bayfield	Pike Chain*	714	SE,DG***	1>14"	NR
2693700	Douglas	Bond	293	SE	15"	NR
394400	Forest	Metonga	1,991	DG	15"	C-ST
2303500	Iron	Long	396	DG	Slot	C-ST
	Lincoln	Nokomis Chain**	3,916	DG	15"	NR
1012100	Lincoln	Pine	134	SE	15"	0-ST
1490300	Lincoln	Seven Island	132	SE	15"	ST
1523000	Oneida	East Horsehead	184	SP	1>14"	NR
1589100	Oneida	Hasbrook	302	DN	1>14"	NR
1543300	Oneida	Katherine	590	SE	1>14"	NR
1522400	Oneida	Swamp	296	DG	15"	NR-2
2621100	Polk	Half Moon	579	DG	15"	ST
2390800	Sawyer	Lac Courte Oreilles	5,039	DG	15"	C-ST
2429300	Sawyer	Lower Clam	203	DG	15"	C-ST
2340700	Vilas	Ballard	505	DG	15"	C-ST
2338800	Vilas	Big Crooked	682	DG	None	NR
2339900	Vilas	Escanaba	293	DG	None	NR
2340900	Vilas	Irving	403	DG	15"	C-ST
1602300	Vilas	Long	872	DG	15"	C-NR
2331600	Vilas	Trout	3,816	DG	15"	C-ST
2340500	Vilas	White Birch	112	DG	15"	C-ST
2336100	Vilas	Wolf	393	DG	15"	NR
2106800	Washburn	Long	3,290	DG	15"	C-

*- Pike Chain includes Buskey Bay and Lakes Millicent, Hart, and Twin Bear.
**- Nokomis Chain includes Lake Nokomis, Bridge Lake, and the Rice River Flowage.
***- Lake Millicent is a drainage lake, the others in the Pike Lake Chain are seepage lakes.

To estimate adult abundance, walleyes were recaptured 1-2 days after netting. Because the interval between marking and recapture was short, electrofishing of the entire shoreline (including islands) was conducted to ensure equal vulnerability of marked and unmarked walleyes to capture. All walleyes in the recapture run were measured and examined for marks. All unmarked walleyes were given the appropriate mark so that a total population estimate could be estimated. To estimate total walleye abundance, a second electrofishing recapture run was conducted 2-3 weeks after the first recapture run. Again, the entire shoreline (including islands) of the lake was electrofished. Population estimates were calculated with the Chapman modification of the Petersen Estimator using the equation:

$$N = \frac{(M+1)(C+1)}{(R+1)}$$

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 in the recapture sample, and R is the total number of marked fish captured. The Chapman Modification method is used because simple Petersen Estimates tend to overestimate population sizes when R is relatively small (Ricker 1975). Abundance and variance were estimated by length-class (≤ 11.9”, 12- 14.9”, 15- 19.9”, and ≥ 20.0”) and summed to estimate adult and total abundance and variance for each lake. If spearing occurred after the start of the marking period, the number of marked walleyes speared were subtracted from the number of marked fish at large during the recapture period. These fish were added back to the estimated number of fish present at the time of marking for the populations of interest (adult or total populations).

Results

Adult walleye abundance

Adult walleye population densities (number/acre) ranged from 0.1 to 10.6 with a mean of 3.6. Adult densities were generally greater in lakes classified as NR, compared to lakes classified as ST (Table 2, Figure 1). This has been the case historically (Hewett and Simonson 1998), but the differences were not significant in 2001 (t = -0.13, df = 21, P = 0.9005). Lakes classified as “other”, which included lakes with unknown walleye populations (none), lakes where stocking had been discontinued and the walleye population was expected to disappear, and stocked waters where the population had not been established to a reasonable density (remnant, REM), had the lowest adult walleye density (Table 2). There were no statistically significant differences in walleye densities

Table 2: Walleye densities (expressed as population estimate/ lake acreage) by lake recruitment type, lake size, and angling regulation. Exempt waters in the regulation category include those with no minimum length harvest restriction. N represents number of lakes studied, SEM is standard error.

Model	Regulation	Lake Acres	N (Adult PE)	Mean Adult PE/ Acre	SEM	N (Total PE)	Mean Total PE/ Acre	SEM
Natural	all	all	11	4.4	0.63	8	8.9	2.59
Stocked	all	all	12	3.4	1.04	10	14.1	4.37
Remnant	all	all	2	1.7	0.69	2	6.1	5.28
Natural	all	>500	6	4.9	0.91	5	11.7	3.46
		<500	5	3.8	0.90	3	4.3	1.45
Stocked	all	>500	7	3.0	1.23	5	13.8	7.65
		<500	5	4.0	1.98	5	14.3	3.71
Natural	15" minimum	all	5	4.0	1.21	4	5.6	2.73
	exempt	all	6	4.8	0.65	4	12.3	3.56

between any other category (model (t-test, $t = 0.43$, $df = 20$, $P = 0.6686$), lake size ($t = -0.12$, $df = 22$, $P = 0.9020$), or regulation (exempt or 15” minimum; $t = -0.13$, $df = 21$, $P = 0.9005$).

The mean adult density in stocked lakes was greater in 2001 than in any previous year except 1996, but the relatively high densities in Ballard and White Birch Lakes (likely due to recent stocking of adult fish) is solely responsible for the apparent increase. The majority of stocked lakes had calculated walleye adult densities near the 1990-2000 overall mean (Figure 1). There have been no statistically detectable changes in adult walleye density in stocked- (ANOVA $F = 1.59$, $df = 11,85$, $P = 0.1162$) or NR-model (ANOVA $F = 1.07$, $df = 11,250$, $P = 0.3861$) waters since 1990 (Figures 1 and 2). Mean adult density in NR lakes in 2001 was at its greatest since 1992 (Figure 2).

Adult walleye densities were greater in lakes in the eastern portion of the Ceded Territory (5.2 adult walleye/ acre) than in the western portion (1.9 adult walleye/ acre; $t = 3.33$, $df = 22$, $P = 0.0031$; Figures 3 and 4). There were some also differences in the relative density of different size classes of fish within and between the regions. The eastern region had proportionally more 12.0 – 14.9” fish (mean 33.5%) than the western portion (13.2%; $t = 2.68$, $df = 22$, $P = 0.0137$), while the western portion had proportionally more fish ≥ 20”, despite a lower mean density of fish in this size class. On average, fish ≥ 20” comprised 27.8% of the adult walleye populations in the western region, and 13.1% of the adult populations in the eastern region ($t = -2.41$, $df = 22$, $P = 0.0248$).

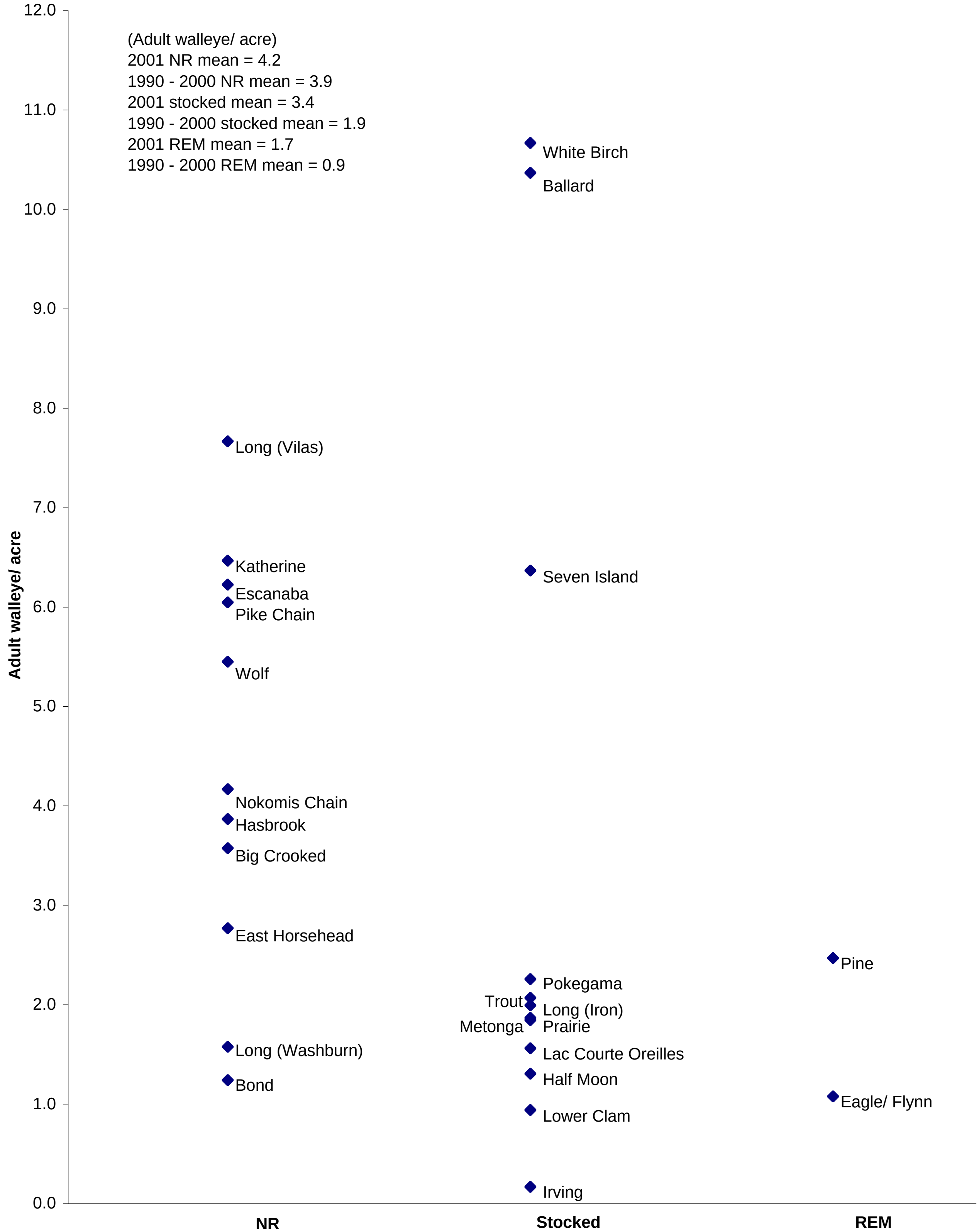

Figure 1: Adult walleye densities in lakes surveyed spring 2001, separated by recruitment model.

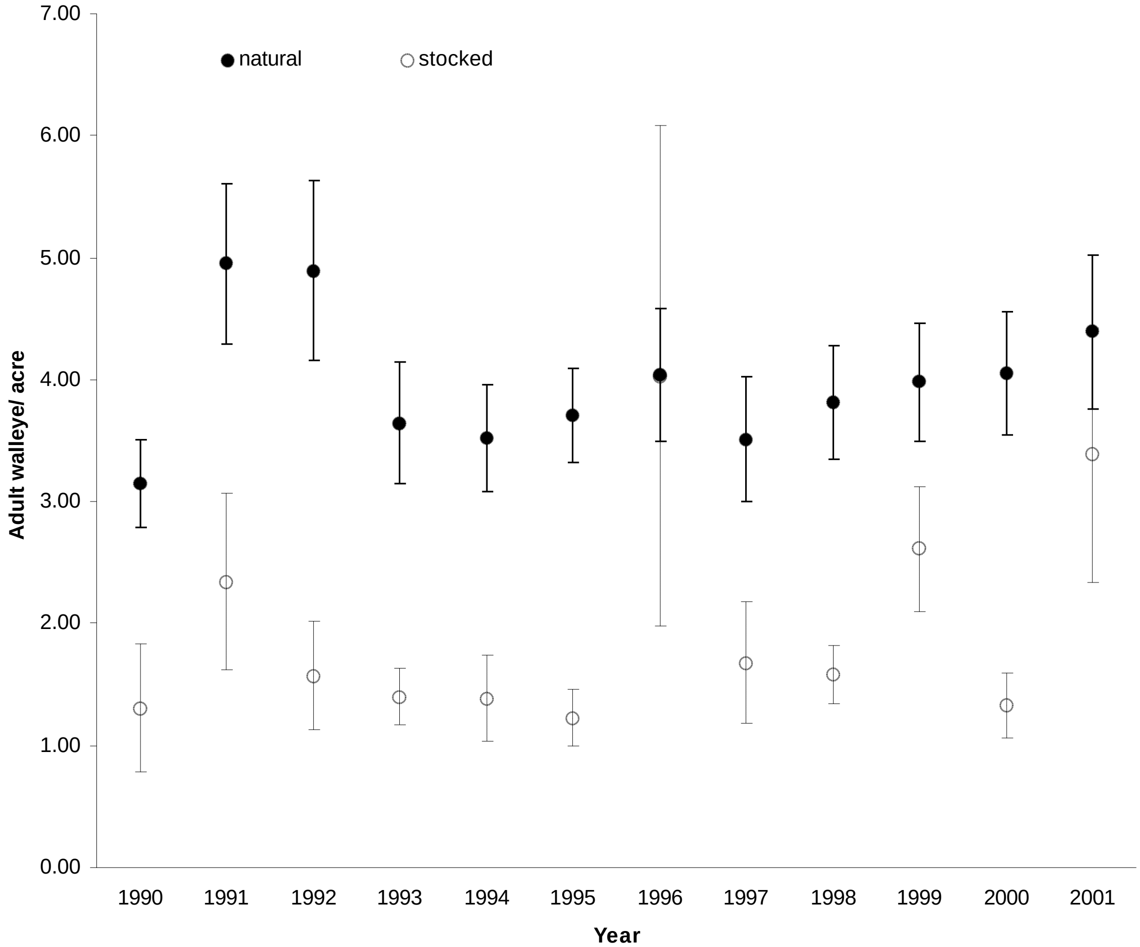

Figure 2: Mean adult walleye density in lakes surveyed by WDNR in the Wisconsin Ceded Territory, 1990-2001. Error bars represent standard error of the mean.

Excluding 3 DNR research lakes (Escanaba, Wolf, and Big Cooked, Vilas Co.), 14 lakes sampled in 2001 had at least one historic WDNR adult walleye population estimate (Table 3). Four of six lakes or chains with historical adult walleye population estimates sustained primarily by natural reproduction had increased populations, with the exceptions being Bond Lake (Douglas Co.), which had a measured adult walleye population decrease of 50% and the Pike Chain (Bayfield Co., -27%). The adult walleye population in Long Lake (Vilas Co.) was more than double that measured in 1989 and 1991. This lake was stocked with 660,000 walleye fry in 1992 and 43,600 fingerlings in 2001, but there are no records of stocking in the interim. There was no region-wide pattern of increasing or decreasing populations in lakes with populations sustained primarily by stocking. White Birch and Ballard Lakes (Vilas Co.) had the largest increases in adult walleye density. The system suffered a severe winterkill in 1995-96, and subsequent stocking has been very successful (Gilbert, personal communication), and includes the transfer of 1,144 adult walleye into the system in 1997 and 1,155 adults in 1998. The increase in adult walleye abundance, therefore, should not be viewed as a pattern of increase from what was observed in 1989 and 1991. An aeration system has been installed in these lakes to alleviate winterkill conditions. Two stocked lakes, Irving (Vilas Co.) and Long (Washburn Co.), had measured decreases of 50% or greater. Irving Lake is a connected water with Ballard and White Birch Lakes, where large increases in walleye densities were observed, suggesting a potential shift in spawning habitat use in the lakes or that sampling occurred at different points during the walleye spawning seasons in 1991 and 2001. No substantial numbers of spawning walleye were found in Irving in any of the years it was sampled. Three GLIFWC population estimates in Long Lake in 1990, 1991, and 1998 found 7,555, 5,787, and 4,420 adult walleye, suggesting that the 1994 WDNR estimate was conducted at a high point in the walleye population in the lake. The 2001 density (1.51 adults/ acre) is within the expected range for stocked waters in the western portion of the Ceded Territory. Half Moon Lake (Polk Co.) showed a downward trend in adult walleye density, and has a population sustained by stocking, with little natural reproduction occurring as it had historically.

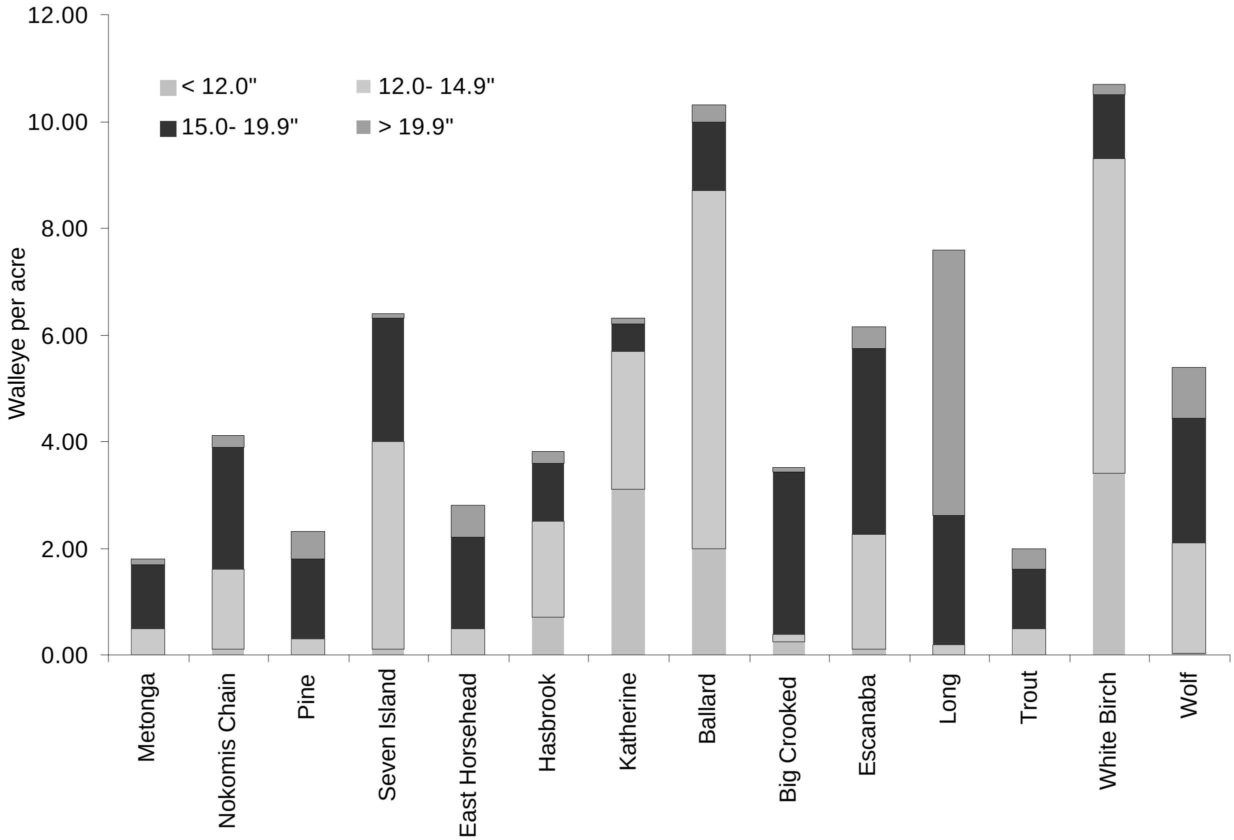

Figure 3: Walleye population densities by size range in selected walleye lakes in the eastern portion of the Wisconsin Ceded Territory.

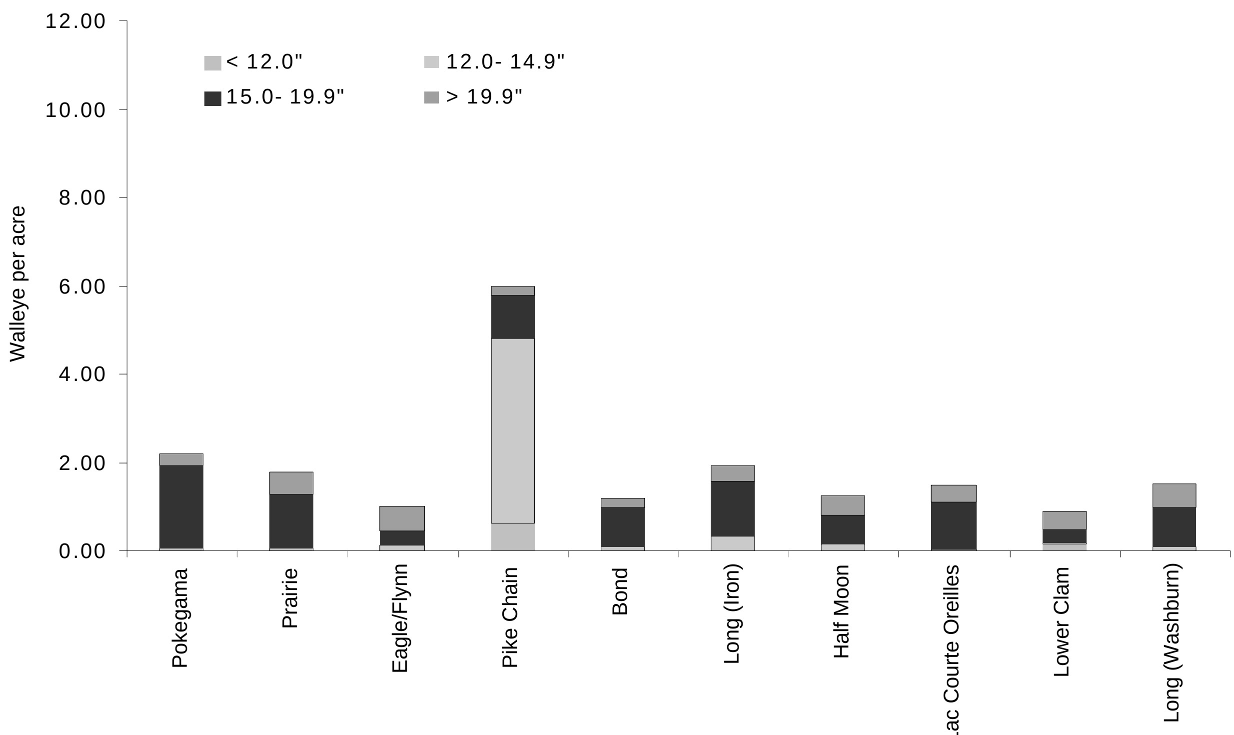

Figure 4: Walleye population densities by size range in selected walleye lakes in the western portion of the Wisconsin Ceded Territory.

Table 3: Previous adult walleye population estimates for Lakes sampled in spring 2001. Percent change reflects differences in population estimate from the prior estimate.

County	Lake	Acres	Year	Walleye Recruit. Code	Adult PE	Density (adults/ acre)	Change
Natural							
Bayfield	Pike Chain*	714	2001	NR	4272	5.98	-22%
			1991	NR	5,487^	7.68	
Douglas	Bond	292	2001	NR	344	1.18	-50%
			1988		685	2.35	
Lincoln	Nokomis Chain**	3,916	2001	NR	15,928	4.07	14%
			1991	NR	14,008^	3.56	
Oneida	Hasbrook	302	2001	NR	1152	3.81	19%
			1988		971	3.22	
Oneida	Katherine	590	2001	NR	3,766	6.38	60%
			1993	NR	2,360	4.00	
Vilas	Long	872	2001	C-NR	6,650	7.63	160%
			1991	NR	2,553	2.93	37%
			1989		1,867	2.14	
Stocked							
Forest	Metonga	2,157	2001	C-ST	3,518	1.63	-29%
			1992	C-	4,987	2.31	6%
			1989		4,706	2.18	
Iron	Long	373	2001	C-ST	763	2.05	23%
			1996	C-ST	622	1.67	
Lincoln	Seven Island	132	2001	ST	837	6.34	46%
			1996	C-NR	572	4.33	
Polk	Half Moon	579	2001	ST	717	1.24	-26%
			1991	C-NR	963	1.66	-7%
			1988		1,033	1.78	
Sawyer	Lac Courte Oreilles	5,039	2001	C-ST	7,562	1.50	15%
			1991	C-	6,587	1.31	-35%
			1988		10,185	2.02	
Vilas	Ballard	505	2001	C-ST	5,200	10.30	99%
			1991	ST	2,613	5.17	133%
			1989		1,123	2.22	
Vilas	Irving	403	2001	C-ST	39	0.10	-69%
			1991	ST	126	0.31	
Vilas	Trout	3,816	2001	C-ST	7,785	2.04	-20%
			1994	C-ST	9,673	2.53	69%
			1988		5,714	1.50	
Vilas	White Birch	117	2001	C-ST	1,189	10.16	277%
			1991	C-ST	315	2.69	
Washburn	Long	3,290	2001	ST	4,966	1.51	-51%
			1994	C-	10,238	3.11	

*- Pike Chain includes Buskey Bay and Lakes Millicent, Hart, and Twin Bear.
**- Nokomis Chain includes Lake Nokomis, Bridge Lake, and the Rice River Flowage.
^- Best available estimate.

Total walleye abundance

Total walleye abundance was estimated in 20 lakes in spring 2001. Total walleye densities varied widely in 2001, and total population estimates are generally marked by wider variation than adult PEs within each estimate (Table 4). Mean total walleye density ranged from 0.8 to 42.6 fish per acre with a mean of 8.6 and median of 7.8. Total walleye densities were greater in stocked lakes (14.1 fish/ acre) than in lakes with natural reproduction (8.9 fish/ acre). This result marks the first time since 1990 that total walleye densities in stocked waters exceeded those in waters sustained by natural reproduction. The total walleye densities in Ballard, White Birch, and Seven Island Lakes are the three greatest densities recorded in stocked waters since 1990, and the densities in 4 other lakes (Trout, Long (Iron), Lower Clam, and Lac Courte Oreilles) were among the top 20 recorded since 1990. Ballard and White Birch have received substantial adult stocking since a 1995-96 winterkill.

Table 4: Total walleye population estimates for lakes sampled in spring 2001 and historical estimates from the same lakes. Change reflects differences in the 2001 PE from the prior estimate.

			2001 estimate			Previous estimate				
County	**Lake**	**Acres**	**Total PE**	**CV**	**Walleye/ acre**	**Year**	**Total PE**	**CV**	**Walleye/ acre**	**Change**
Bayfield	Eagle/Flynn	199	166	0.28	0.8					
Bayfield	Pike Chain*	714	10,777	0.13	15.1	1991	125,266	> 0.45^	175.4	
Douglas	Bond	293	602	0.25	2.1					
Forest	Metonga	1,991	5,166	0.22	2.6	1992	14,633	0.24	7.3	-64.7%
Iron	Long	396	3,241	0.18	8.2	1996	3,321	0.17	8.4	-2.4%
Lincoln	Nokomis Chain**	3,916	53,077	0.18	13.6	1991	29,049	0.10	7.4	82.7%
Lincoln	Pine	134	1,522	0.49	11.4					
Lincoln	Seven Island	132	3,631	0.34	27.5	1996	7,105	0.18	53.8	-48.9%
Oneida	East Horsehead	184	681	0.27	3.7					
Oneida	Hasbrook	302	2,114	0.26	7.0					
Oneida	Katherine	590	13,660	0.21	23.2	1993	14,704	0.27	24.9	-7.1%
Polk	Half Moon	579	686	0.10	1.2	1991	1,881	0.23	3.2	-63.5%
Sawyer	Lac Courte Oreilles	5,039	33,409	0.53	6.6	1991	25,393	0.25	5.0	31.6%
Sawyer	Lower Clam	203	1,555	0.18	7.7					
Vilas	Ballard	505	21,493	0.24	42.6	1991	5,508	0.26	10.9	290.2%
Vilas	Irving	403	914	0.52	2.3	1991	224	0.27	0.6	308.0%
Vilas	Long	872	4,037	0.24	4.6	1991	6,427	0.18	7.4	-37.2%
Vilas	Trout	3,816	61,560	0.51	16.1	1994	13,001	0.16	3.4	373.5%
Vilas	White Birch	112	2,941	0.24	26.3	1991	638	0.36	5.7	361.0%
Washburn	Long	3,290	7,173	0.14	2.2	1994	17,927	0.11	5.4	-60.0%

*- Pike Chain includes Buskey Bay and Lakes Millicent, Hart, and Twin Bear.
**- Nokomis Chain includes Lake Nokomis, Bridge Lake, and the Rice River Flowage.
^- Best available estimate.

OTHER POPULATION ESTIMATES

Methods

Largemouth and smallmouth bass

Largemouth (*Micropterus salmoides*) and smallmouth (*Micropterus dolomieu*) bass encountered during fyke netting and subsequent electrofishing runs (adult and total walleye) were marked. Bass ≥ 12.0” were given the same primary (adult) fin-clip given to walleye for that lake. Bass 8.0- 11.9” were given the secondary (juvenile) fin-clip for the lake. Recaptures were made during electrofishing runs made during mid-late May. The entire shoreline of the lake (including islands) was sampled. Recapture efforts for bass population estimates were made in lakes designated as “comprehensive survey” lakes. In these lakes, fyke nets were set for just after ice-out in the spring and again after the first electrofishing recapture run. Four electrofishing surveys were conducted. The first electrofishing run was conducted within a week of pulling the early fyke nets. The second run was conducted approximately two weeks after the first electrofishing run. Third and fourth electrofishing runs were conducted at approximately weekly intervals thereafter. Bass populations were estimated after both the third and fourth runs.

Population estimates were calculated using the Chapman modification of the Petersen estimator, as described in the methods section for walleye population estimates. Estimates were made for each species in three length classes: 8.0- 13.9”, 14.0- 17.9”, and 18.0” and larger. The recapture run yielding the lowest coefficient of variation is the population estimate reported.

Muskellunge

Muskellunge population estimates were conducted over a two-year period, with marking in year-1 and recapture in year-2. In year-1, muskellunge were marked during fyke netting and electrofishing efforts throughout the sampling season. All muskellunge 20” and larger were given the adult clip for that lake (the same adult clip given to walleye and bass). Unknown sex fish <20” were

given a top-caudal (TC) fin-clip. In year-2, muskellunge were recaptured using fyke nets set after the first electrofishing runs are completed, which coincides with the muskellunge spawning season. Adult muskellunge populations were estimated by the Chapman modification of the Petersen Estimator as described in the methods section for walleye abundance estimates, with the following adjustment:
In the equation:

$$N = \frac{M(C+1)}{(R+1)}$$

N is the estimated adult population size, M is the total number of muskellunge ≥ 30” marked in the lake in year-1, C is the number of muskellunge ≥ 32” captured during the recapture netting in year-2, and R is the number of marked fish recaptured (Margenau and AveLallemant 2000).

Results

Largemouth and smallmouth bass

Population estimates were calculated for smallmouth bass in nine lakes and largemouth bass in eight lakes in 2001. Five lakes had both largemouth and smallmouth bass population estimates conducted (Table 5). Adult smallmouth bass population density ranged from 0.2 – 4.5 fish per acre. Adult largemouth bass density ranged from 0.1 – 9.8 fish per acre. The size structure of both largemouth and smallmouth bass was dominated by 8.0- 14” fish in both the eastern and western portions of the Ceded Territory (Figures 5 and 6). Very few fish of either species larger than 18” were measured during fyke netting or electrofishing, and the coefficients of variation for population estimates of these fish are typically larger than for smaller fish. Trout Lake was the only lake sampled in 2001 that had an 18” minimum size restriction for largemouth and smallmouth bass. This regulation has been in effect since June 21, 1996. A largemouth bass population estimate was not attempted on the lake, and a total of four smallmouth bass larger than 18” were measured during DNR sampling. However, 32.3% of the Trout Lake smallmouth bass population estimate comprised fish larger than 14”. The mean percentage of smallmouth bass >14” in the lakes sampled in 2001 was 25.5%, but ranged between 10.5 (Pike Chain) and 63.6% (Bond Lake). In general, fish larger than 14” comprised 21.4% of largemouth bass populations. Fish larger than 18” comprised 1.8% and 1.2% of smallmouth and largemouth bass populations, respectively.

Tables 5: Bass population estimates from the Ceded Territory 2001.

SMALLMOUTH BASS

COUNTY	LAKE	AREA (ACRES)	POPULATION ESTIMATE	C.V.	DENSITY (ADULTS/ACRE)
Bayfield	Pike Chain	714	3,223	0.12	4.51
Bayfield	Eagle/ Flynn	199	45	0.26	0.23
Douglas	Bond	293	65	0.34	0.22
Forest	Metonga	1,991	853	0.47	0.43
Iron	Long	396	98	0.24	0.25
Oneida	East Horsehead	184	177	0.32	0.96
Oneida	Hasbrook	302	298	0.24	0.99
Vilas	Long	872	678	0.18	0.78
Vilas	Trout	3,816	725	0.36	0.19

LARGEMOUTH BASS

COUNTY	LAKE	AREA (ACRES)	POPULATION ESTIMATE	C.V.	DENSITY (ADULTS/ACRE)
Bayfield	Pike Chain	714	910	0.26	1.27
Bayfield	Eagle/ Flynn	199	1,705	0.15	8.57
Douglas	Bond	293	758	0.11	2.59
Lincoln	Pine	134	390	0.33	2.91
Iron	Long	396	21	0.55	0.05
Oneida	East Horsehead	184	705	0.27	3.83
Polk	Half Moon	579	5,696	0.27	9.84
Vilas	Ballard Chain	1,020	1,119	0.52	1.10

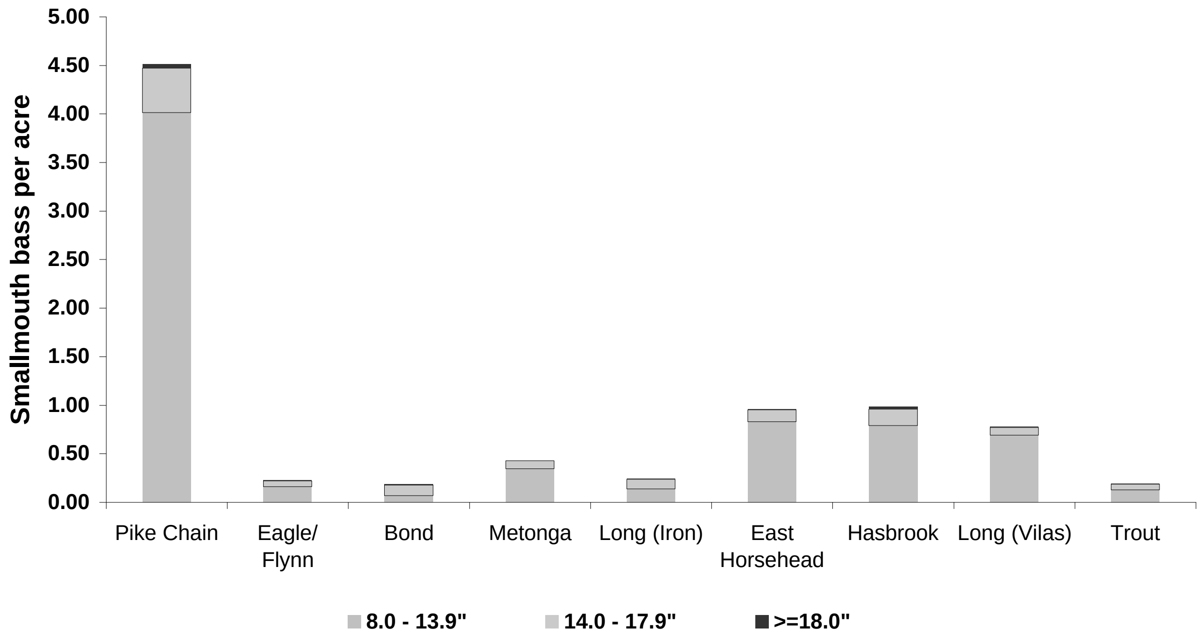

Figure 5: Smallmouth bass population densities (fish ≥ 8.0") by size range in selected walleye lakes in the Wisconsin Ceded Territory. The Pike Chain, Eagle, Flynn, Bond, and Long (Iron) Lakes are in the western portion of the Ceded Territory; all other lakes are in the eastern portion.

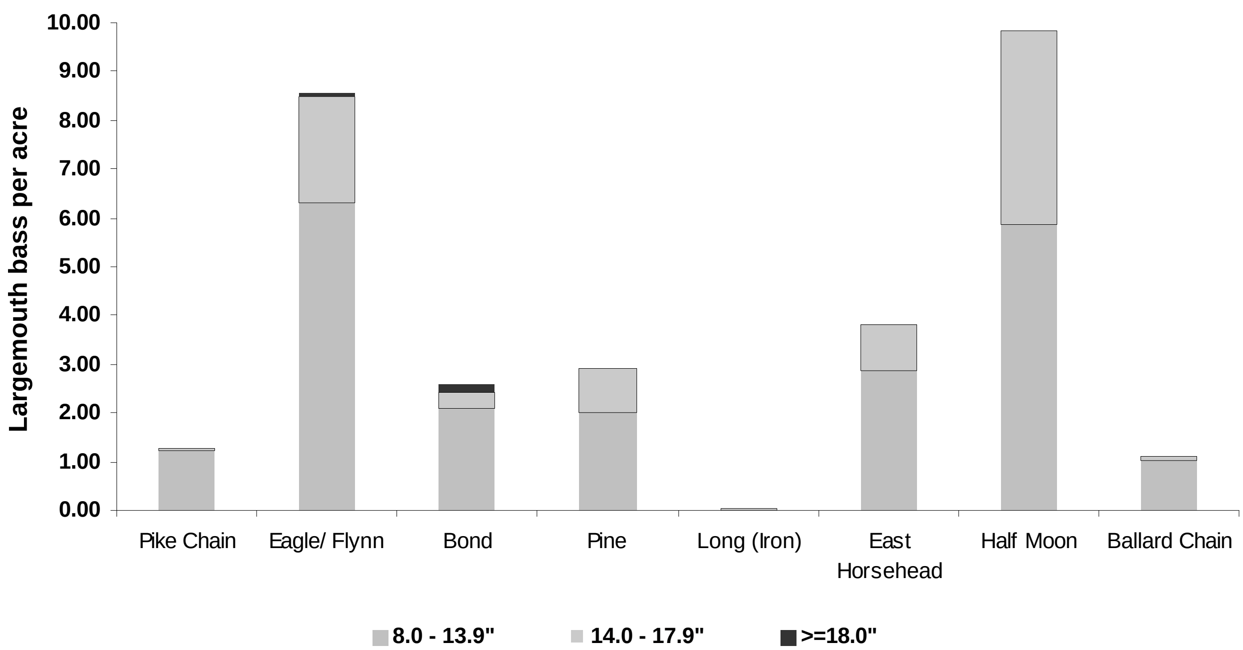

Figure 6: Largemouth bass population densities (fish ≥ 8.0") by size range in selected walleye lakes in the Wisconsin Ceded Territory. The Pike Chain, Eagle, Flynn, Bond, Pine, and Long (Iron) Lakes are in the western portion of the Ceded Territory; all other lakes are in the eastern portion.

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. These surveys provide fisheries managers with 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 abundance gives some indication of possible future adult abundance it does not necessarily correspond directly, as survival to adulthood varies (Hansen et al. 1998).

Methods

Young of the year (YOY) surveys were completed on 156 lakes by WDNR in 2001. Of the lakes sampled, 61 were classified as naturally reproducing (NR, C-NR, or C-), 59 as stocked (ST or C-ST), and 21 as “other” (REM, O-ST, NR-2). Fifteen lakes did not have an assigned walleye recruitment code. Electrofishing for YOY walleyes was done at night in early fall, generally when the water temperature had fallen below 70° F. The entire shoreline of a lake was electrofished and all walleyes were examined and measured. Serns (1982) established a relationship between the number of YOY walleyes collected per mile of shoreline electrofished and the density of YOY walleyes/acre. This in turn can be used to estimate YOY walleye abundance. This relationship between the number of YOY walleyes caught per mile and the density of YOY walleye is:

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

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. Two-sample t-tests were used to test the assumption that mean YOY walleye / mile in 2001 was the same as the 1990-2000 mean ($\alpha = 0.05$).

Results

Water temperatures during 2001 YOY walleye surveys ranged from 42 - 75°F with a mean of 60°F. Walleye YOY per mile in 2001 ranged from 0.0 to 367.8 with a mean of 25.3 and median of 2.04. The median and modal length of YOY walleye was 6.3". Lakes sustained primarily by natural reproduction (NR) on average had higher walleye YOY per mile (mean = 52.4, median = 16.1, range = 0.0 – 367.8) than lakes sustained by stocking ((ST) mean = 10.2, median = 1.6, range = 0.0 – 134.4) or lakes classified as "other" (mean = 7.8, median = 0.0, range = 0.0 – 89.6). The 2001 mean YOY walleye per mile was more than double the 2000 means for both natural and stocked lakes, but was not significantly greater than the 1990-2000 mean for either class (natural lakes: t = -1.95, df = 62, P = 0.056); (stocked lakes: t = -0.90, df = 76, P = 0.37). The mean value YOY/ mile values for both natural and stocked lakes were among the highest observed since 1990 (Figure 7), and reverse the trend of four consecutive years of below-average recruitment in both lake classes. In 2001, 13.6% of NR lakes (8 of 59) and 46.6% (27 of 58) of ST lakes had YOY walleye indices lower than 1 per mile.

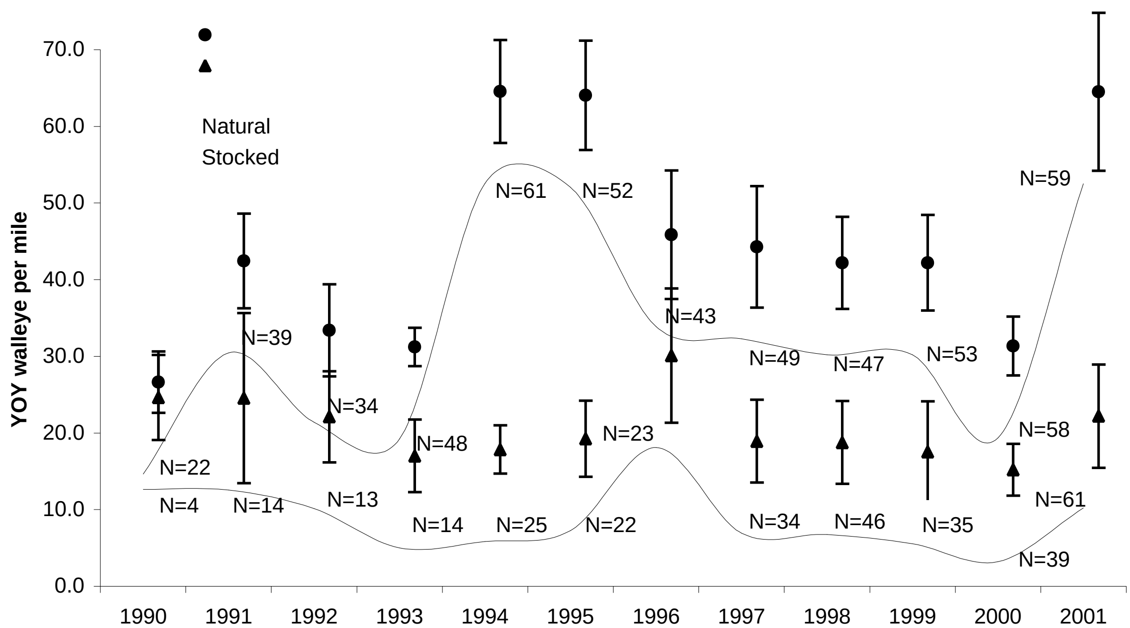

Figure 7: Mean number of young-of-the-year walleye caught per mile of shoreline electrofished in fall, 1990-2001. Lakes are separated by the main source of walleye recruitment. Error bars represent standard error of the mean.

The percentages of lakes with greater than 25 YOY walleye per mile and greater than 100 YOY walleye per mile are also used to indicate strong annual year classes in the Ceded Territory. These values are less affected by large values for individual lakes than are the mean or median number of YOY walleye caught per mile. In 2001, the percentage of NR lakes with YOY indices > 25 per mile was greater (44.1%) than the 1990- 2000 mean (37.0%), as was the percentage of NR lakes with YOY walleye indices > 100 per mile (18.6%) greater than the 1990- 2000 mean (6.1%). Those percentages were not statistically evaluated. The percentage of lakes with an index value > 100 fish/ mile was the highest observed in the treaty fisheries data set, kept since 1990. Good YOY survival was observed in all three classes of lakes included in the natural recruitment model (Figure 8).

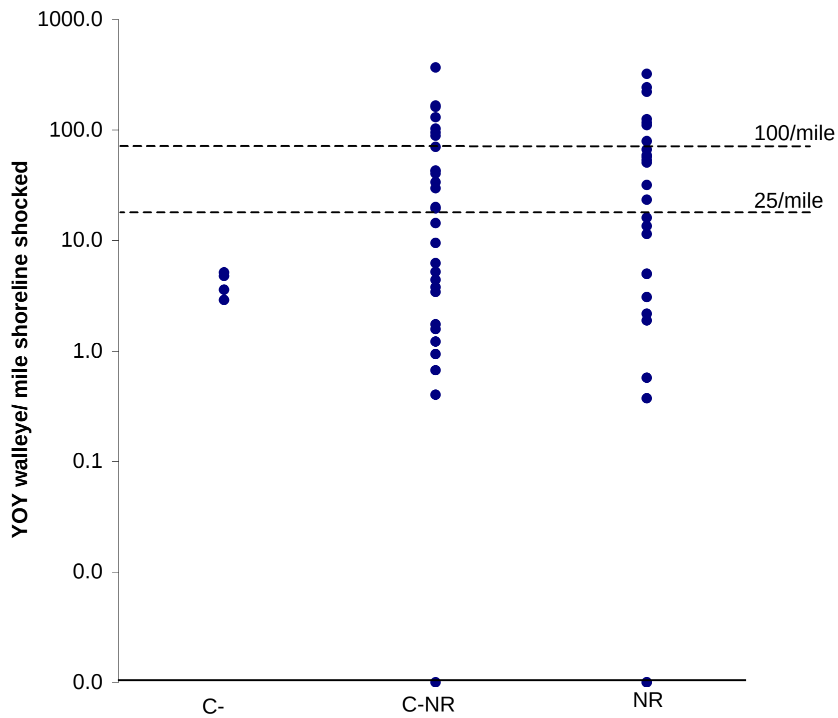

Figure 8: Number of young-of-the-year walleye per mile of shoreline electrofished in fall 2001 within three categories of lakes sustained primarily by natural recruitment. Note log scale on the y-axis.

There was a similar pattern seen in ST lakes in 2001. The percentage of ST lakes with an index > 25 YOY walleye per mile was greater (13.8%) than the 1990-2000 mean (6.3%). There was one ST lake (Razorback Lake, Vilas Co.) with a YOY walleye index > 100 per mile in 2001. Only twice previously has a stocked lake had a YOY index greater than 100 YOY walleye/ mile (Buckskin Lake, Oneida Co., 1991 and Ballard Lake, Vilas Co., 1996). Razorback Lake was reclassified as C-NR after the 2001 sampling season, and therefore was excluded from the following analyses of lakes in the stocked model.

Currently, WDNR recommends a stocking rate of 50 spring walleye fingerlings/ acre. Some lakes were stocked at higher rates in 2001, but there was no significant difference in YOY walleye per mile observed in lakes stocked with 50 or fewer fingerlings per acre in June 2001 and those stocked with 75 or more fingerlings per acre in June 2001 ($t = 0.15$, $df = 15$, $P = 0.88$, Figure 9).

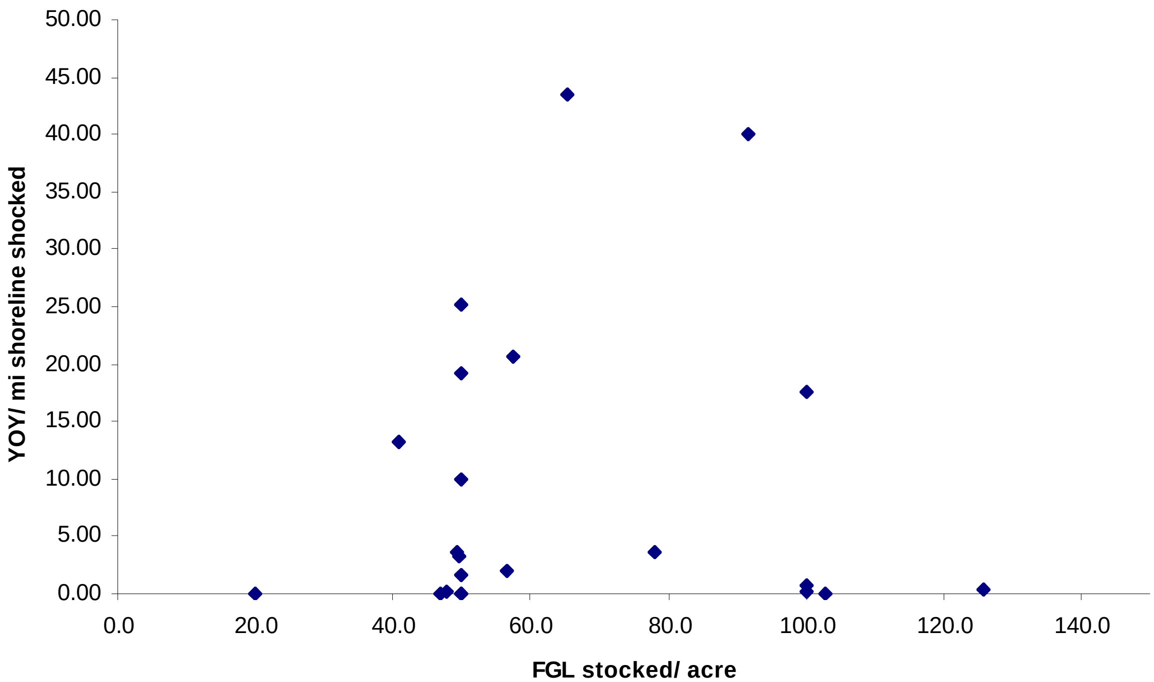

Figure 9: Stocking rates and YOY walleye captured by electrofishing in ST and C-ST lakes in fall 2001. Stocking data are for small fingerlings stocked in late spring/ early summer.

The mean number of YOY walleye captured per mile in lakes that were stocked (10.1 YOY/ mile) with fry or small fingerlings in 2001 was significantly greater than in lakes that were not stocked (3.5 YOY/ mile) in 2001 ($t = 2.08$, $df = 41$, $P = 0.04$). Lakes that were not stocked more frequently had YOY indices of 0 than lakes that were stocked, and were less likely to have a YOY index >5 fish per mile (Table 6).

Table 6: Young-of-the-year indices in lakes categorized as being sustained primarily by stocking (ST or C-ST), separated by whether the lake was stocked in 2001 or not.

	Stocked in 2001	Not Stocked in 2001
No. Lakes	28	28
Mean YOY walleye/ mile	10.1	3.5
Median	3.5	0.0
Variance	216.5	59.7
Lakes with 0 YOY/ mile	5 (17.8%)	15 (53.6%)
Lakes with <1 YOY/ mile	10 (35.7%)	17 (60.7%)
Lakes with >10 YOY/ mile	8 (28.6%)	3 (10.7%)

Sern's indices for NR lakes ranged from 0.0 – 86.1 YOY walleye per acre with a mean of 10.4 and median of 1.2. In ST lakes, Sern's indices ranged from 0.0 – 31.5 YOY walleye per acre with a mean of 3.1 and median of 0.8. Lakes classified as "other" had even lower Sern's indices, ranging from 0.0 –3.8, with a mean of 0.4 and median of 0.0 YOY walleye per acre. Gross estimates of fingerling survival in stocked lakes were calculated by multiplying Serns' index by lake acreage and dividing the product by the number of fingerlings stocked. Mean fingerling survival by this method in ST lakes was 1.7% (n = 9, range 0.0004% - 8.3%).

Sporadic recruitment is common for walleye populations both within and among individual lakes. It is common to have almost complete lack of recruitment in 25% or more of lakes with natural reproduction. Even higher percentages are common in lakes with populations sustained by stocking. Generally, successful recruitment occurs in a given lake every 3-4 years. This type of 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 natural and expected. It is also appears that there may be region-wide annual effects on walleye recruitment as well (Figure 7). One might expect annual percentages to be similar across years if there was no year effect. Overall, YOY abundance in 2001 was the greatest recorded in 12 years of comprehensive, region-wide data.

CREEL SURVEYS

Introduction

Creel surveys provide vital information related to the use of fisheries by anglers, including angling effort, catch, harvest, and exploitation rates on surveyed waters. Further, estimates on surveyed lakes can be used to estimate effort, catch and harvest at a larger scale (e.g. Ceded Territory) for all species of interest in that lake. The WDNR treaty fisheries program focuses primarily on game species (walleye, muskellunge, largemouth and smallmouth bass, and northern pike (*Esox lucius*)). Creel surveys are generally conducted in each lake in the same year in which a walleye population estimate is made. Marking of fish during spring population estimates and subsequent creel surveys allows for the estimation of walleye exploitation rates.

Methods

Creel surveys were conducted on 24 lakes in which walleye population estimates were made during spring 2001. 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 / 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 or three weekdays. Only completed-trip interview information was used in the analysis. Clerks recorded effort, catch, harvest, and targeted species from anglers completing their fishing trip. Clerks also measured harvested fish and examined them for fin-clips, recording any seen.

Creel surveys began May 5, 2001 and were completed March 1, 2002. An open-water-only creel survey was conducted on Mud Lake (Washburn County), and terminated October 31, 2001.The month of November was excluded due to poor ice conditions and low angler effort. Information from interviews was then expanded over the appropriate stratum to provide an estimate of total effort, catch, and harvest of each species in each lake for the year.

Angler exploitation rates for adult walleye were calculated by dividing the estimated number of marked adult walleye harvested by the total number of marked adult walleye present in the lake (R/M; Ricker 1975). Although anglers are able to harvest immature walleye in some waters, adult walleye exploitation rates were calculated so an estimate of total adult walleye exploitation could be made in waters where both angling and spearing were conducted. Tribal exploitation rates were calculated in lakes where adult population estimates were conducted. Tribal exploitation was calculated as the total number of adult walleyes harvested divided by the adult population estimate (C/N; Ricker 1975). Total adult walleye exploitation rates were calculated by summing angling and tribal exploitation.

Results

Effort

Creel data (Appendix B) were summarized for all lakes, lakes less than 500 acres (“small lakes”), and lakes 500 acres and larger (“large lakes”). In addition, walleye creel data were grouped based on population recruitment source and length regulation. The five current regulations include 15” and 18” minimum size limits; one fish >14” allowed; a 15”-18” no-harvest slot with one fish >18” allowed; and no size restriction. Angler bag limits in the Ceded Territory are set on an annual basis using a “sliding bag-limit” system based upon tribal declarations and range between 2 and 5 fish.

Catch and harvest (hours/fish) rates were calculated for all gamefish species. The number of hours required to catch and harvest a fish gives an indication of success of an average angler and potentially provides an index of relative abundance of that species. Specific catch and harvest rates were calculated using only fishing effort targeted at given species. General catch and harvest rates were calculated using total angler effort, regardless of species targeted.

The mean total angler effort per acre in lakes 500 acres and larger (22.1 hours/acre) in 2001-2002 was not statistically different ($t = -1.65$, $df = 17$, $P = 0.11$) than the effort in lakes less than 500 acres (31.8 hours/acre). Since 1990, mean total angler effort has been lower in large lakes and reservoirs (29.0 hours/ acre) than in small lakes (39.9 hours/ acre; t = 4.0, df = 195, P = 0.00009; Figure 10). There has been no statistically detectable trend in angling effort across all lakes since 1990 (F= 1.37, df = 11, 289, ANOVA P= 0.1876). However, total effort per acre was significantly higher in the years 1990-1993 than 1994-2001 (F = 8.86, df = 11, ANOVA P= 0.0032; Figure 11).

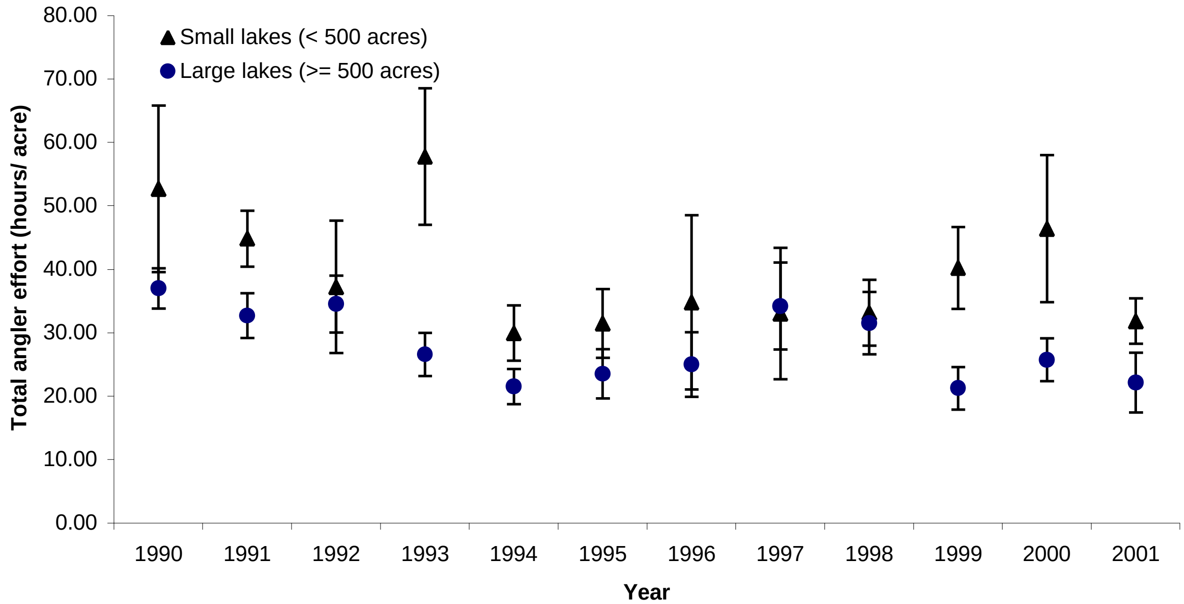

Figure 10: Total angler effort per acre, by lake size, in creeled lakes in the Wisconsin Ceded Territory, 1990-2001. Error bars represent standard error of the mean.

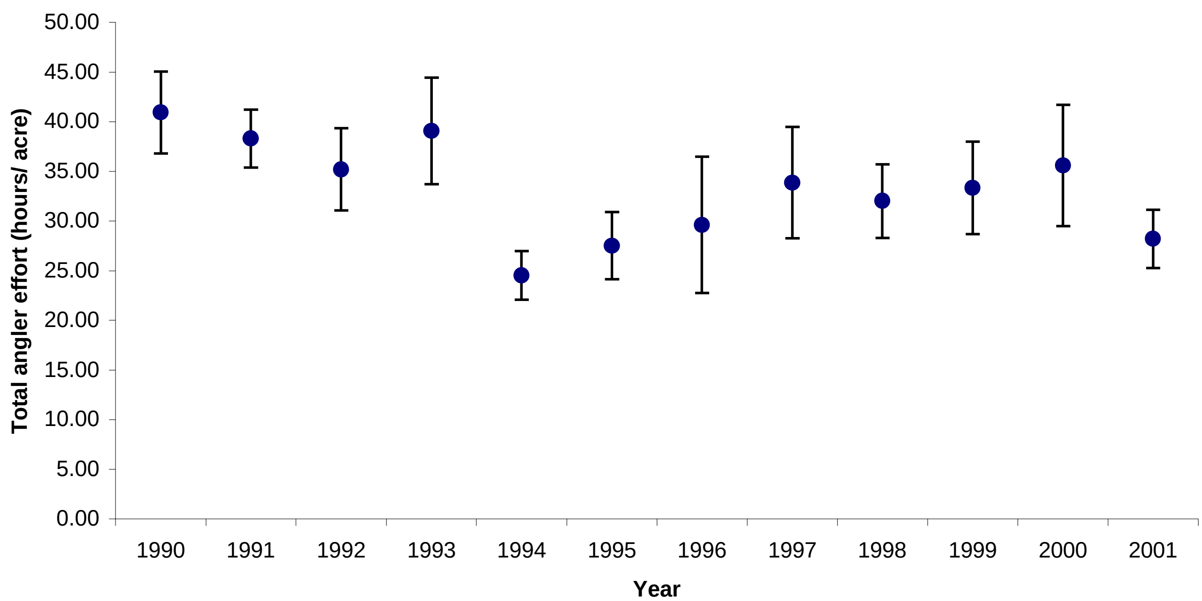

Figure 11: Total angler effort per acre in creeled lakes in the Wisconsin Ceded Territory, 1990-2001. Error bars represent standard error of the mean.

Walleye

Catch and effort

Directed effort for walleye averaged 9.2 hours per acre in 2001. Neither minimum length nor bag limit restrictions significantly influenced where anglers fished for walleye in 2001 (F = 0.93, df = 6,16, p = 0.50). Since 1996, when the one fish >14" regulation was introduced, directed effort for walleye has averaged 9.5 hour/ acre in lakes with a 15" minimum, and 11.4 hours/acre in exempt lakes, but the difference is not statistically significant (t = -1.60, df = 91, P = 0.11). Walleye anglers exerted similar pressure walleye fishing in lakes sustained by natural reproduction (10.52 hours/ acre) as they did in lakes sustained by stocking (7.51 hours/ acre; t = 1.10, df = 19, P = 0.29). Directed effort was also similar in large (9.3 hours/ acre) and small lakes (9.1 hours/ acre; t = 0.07, df = 21, P = 0.94). Overall directed angler effort (hours/acre) for walleye has remained stable since 1995 (F = 1.88, df = 4,39, P = 0.13; Figure 12), and has not fluctuated significantly within lake sizes or length restrictions. Prior to 1995, lake selection was based on the intensity of tribal harvest, and so focused on lakes with large walleye populations. In 1995, a randomized selection process was adopted.

Mean specific catch rates (SCR) were 0.20 walleye per hour (5 hours fishing/ walleye caught) of directed effort in both natural and stocked lakes in 2001. There was no significant difference between mean SCR in lakes with a 15" minimum (0.19 fish/ hour) and "exempt" lakes (lakes with no minimum size restriction or a one fish >14" regulation; mean = 0.19 fish/ hour; t = 0.09; df = 20; P = 0.93). Since 1990, the mean SCR in lakes with a 15" minimum has been 0.23 fish/ hour, similar to the catch rate in exempt lakes (0.28 fish/hour; t = 1.91, df = 256, P = 0.056). However, since the 1 fish >14" was introduced in 1997, SCR has averaged 0.31 fish/ hour in exempt lakes and 0.18 in lakes with a 15" minimum (t = -3.92, df = 91, P = 0.0009).

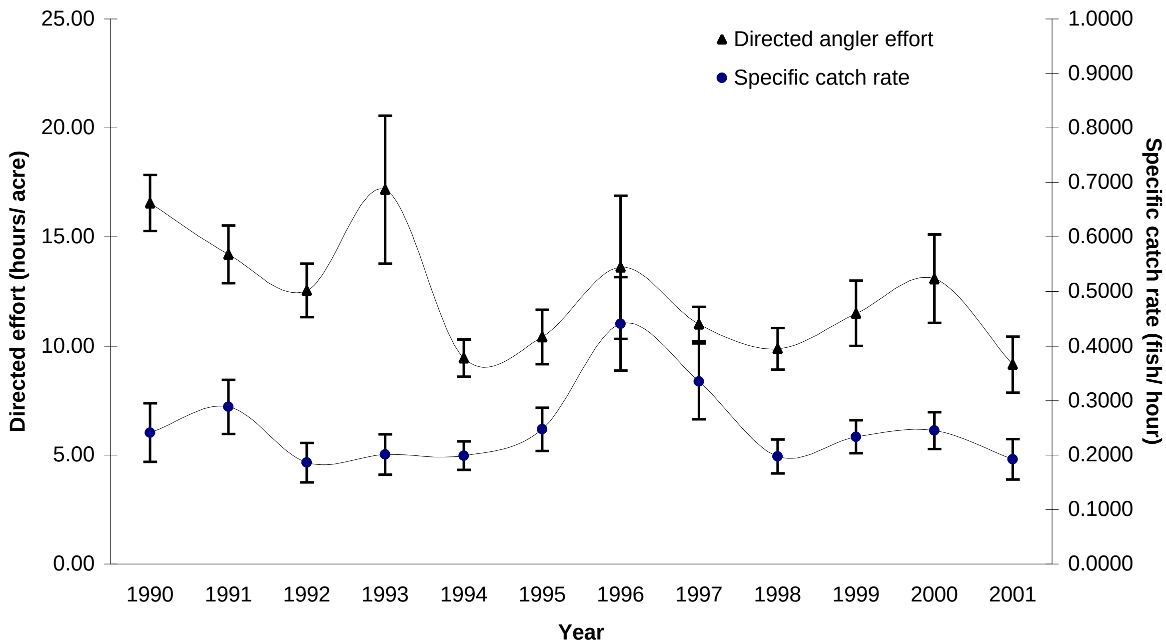

Figure 12: Directed angler effort per lake surface acre and specific catch rate for walleye in surveyed lakes in the Wisconsin Ceded Territory, 1990-2001. Directed effort is defined as hours reported by anglers fishing for a specific species. Specific catch rate is number of walleye caught divided by time spent fishing for walleye. Error bars represent standard error of the mean.

Exploitation

Walleye exploitation rates were estimated for 24 lakes during 2001 (Table 7). Complete walleye exploitation data are provided in Appendix C. Total adult walleye exploitation ranged from 1.9% to 16.8%. Angler exploitation of adult walleyes ranged from 1.3% to 12.2%. Angler exploitation of walleyes 14" or longer ranged from 1.5% to 23.5%. Angler exploitation of adult walleyes 20" and longer ranged from 0.0% to 106.0%. Tribal exploitation of adult walleyes ranged from 0.0% to 8.7%. Total adult walleye exploitation ($t = 1.03$, $df = 187$, $P = 0.30$), angler adult walleye exploitation ($t = 0.93$, $df = 187$, $P = 0.35$), and angler exploitation of walleye ≥ 14" ($t = 1.02$, $df = 168$, $P = 0.31$) or ≥ 20" ($t = -0.22$, $df = 181$, $P = 0.82$) were not significantly different than the 1993-2000 means (Table 7). Adult exploitation rates from 1990-1992 were excluded because in most lakes, both juvenile and adult walleyes were given the same fin clip. No individual lakes or designated chains had an exploitation rate higher than 35% in 2001.

Table 7: 2001 adult walleye exploitation rates and 1993-2000 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, 1998, 1999, 2000, 2001).

Lake	County	Acres	Angler exploitation	Angler expl. >14"	Angler expl. >20"	Tribal expl.	Total adult exploitation
Eagle/ Flynn#	Bayfield	199	0.0238	0.0260	-	-	0.0238
Pike Chain*	Bayfield	714	0.1057	0.2350	0.0515	0.0624	0.1681
Bond	Douglas	293	0.1071	0.1180	0.1167	-	0.1071
Metonga	Forest	2,157	0.0122	0.0146	0.1034	0.0867	0.0989
Long	Iron	396	0.1224	0.1402	1.0612	-	0.1224
Deer	Lincoln	152	0.0152	0.0175	-	0.0298	0.0450
Nokomis Chain**	Lincoln	3,764	0.0633	0.0917	0.1377	0.0311	0.0944
Pine	Lincoln	145	0.0828	0.0836	0.0984	-	0.0828
East Horsehead	Oneida	184	0.0190	0.0208	-	-	0.0190
Hasbrook	Oneida	302	0.0125	0.0315	-	0.0599	0.0724
Katherine	Oneida	590	0.0706	0.0746	-	0.0337	0.1043
Half Moon	Polk	579	0.0554	0.0570	0.0436	0.0502	0.1056
Lac Courte Oreilles	Sawyer	5,039	0.0741	0.0748	0.0877	0.0308	0.1050
Ballard Chain***	Vilas	1,025	0.0336	0.0769	0.2259	-	0.0336
Trout	Vilas	3,816	0.0573	0.0615	0.0404	0.0565	0.1138
Long	Washburn	3,920	0.0886	0.0899	0.1501	0.0667	0.1552
2001 means		1455	0.0590	0.0759	0.1323	0.0317	0.1136
1993-2000 means		1049	0.0810	0.1093	0.1175	0.0457	0.1265

* Pike Chain includes Buskey Bay, Hart, Millicent, and Twin Bear.
** Nokomis Chain includes Nokomis, Rice, and Bridge Lakes.
*** Ballard Chain includes Ballard, Irving, and White Birch Lakes.
# Single PE calculated for Eagle and Flynn Lakes.

Muskellunge

Creel surveys were conducted on 23 lakes classified as muskellunge waters in 2001. Creel clerks on 19 of the 23 lakes recorded at least one musky caught. For the purpose of statistical analyses of catch and effort, lakes not classified or having a remnant population were excluded. In 2001, specific catch rates and directed angler effort were higher in lakes larger than 500 acres than in lakes smaller than 500 acres. These data are atypical when compared to data collected 1990-2001, as overall catch and effort rates have been higher in lakes smaller than 500 acres than in lakes larger than 500 acres. Catch and effort were higher in stocked lakes than in lakes sustained by natural recruitment in 2001, but there are no differences in the 12-year means for these variables. In general, the “action classification” assigned to lakes (Simonson and Hewett 1999) is a better predictor of musky catch and effort than those typically used by WDNR to dissect catch and effort (Table 8). Overall specific catch rate in 2001 (0.0327 fish/ hour, or 1 fish caught per 30.6 hours of directed effort) was near the 1990-2000 average (0.0371, 30.0). SCR for muskellunge has remained stable in the Ceded Territory since 1990, despite year-to-year fluctuations in effort (Figure 13).

Table 8: Muskellunge catch and effort rates in the Wisconsin Ceded Territory, 1990-2002, by musky lake classification.

Class	Description	Lakes sampled	Specific catch rate (fish/ hour)	Directed effort (hours/ acre)
A1	Trophy waters	81	0.0273	6.8671
A2	Action waters	125	0.0449	14.6003
B	Intermediate action/ size	25	0.0354	5.6728
C	Low importance	7	0.0079	2.3227
Total		238	0.0371	10.7693

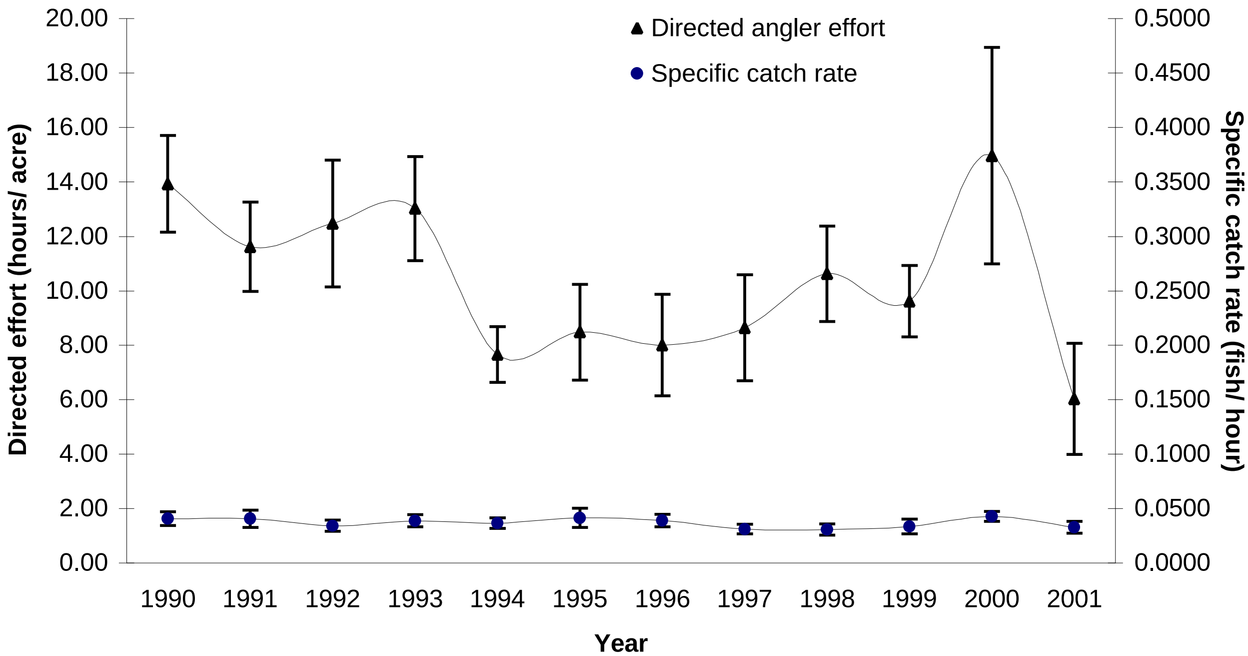

Figure 13: Directed angler effort per lake surface acre and specific catch rate for muskellunge in selected lakes in the Wisconsin Ceded Territory, 1990-2001. Directed effort is defined as hours reported by anglers fishing for a specific species. Specific catch rate is number of muskellunge caught divided by time spent fishing for muskellunge. Error bars represent standard error of the mean.

Northern Pike

Creel surveys were conducted on 24 lakes classified as northern pike waters in 2001. Fifteen of the lakes surveyed were smaller than 500 acres and 9 were 500 acres or larger. In 2001, there were no significant difference in directed angler effort/ acre, specific catch rate, or specific harvest rate in lakes smaller than 500 acres compared to lakes 500 acres and larger (Table 9).

Table 9: Creel statistics for anglers targeted northern pike in 24 surveyed lakes in the Wisconsin Ceded Territory in 2001.

Lake Size	N	Directed angler effort (hrs pike fishing/ acre)	T-value, df, p-value	Specific catch rate (fish/ hour directed effort)	T-value, df, p-value	Specific harvest rate (fish/ hour directed effort)	T-value, df, p-value
Small	15	2.97	0.52, 22, **0.6099**	0.1682	1.05, 22, **0.2040**	0.0449	1.09, 22, **0.2871**
Large	9	3.66		0.2359		0.0668	

For lakes of all sizes, the 2001 mean values for these variables were also similar to the means observed between 1990-2000 (Figure 14). Historically, directed angler effort/ acre has been higher in lakes smaller than 500 acres (6.6 hours/ acre) than in larger lakes (3.9 hours/ acre; $t = 2.22$, $df = 135$, $p > 0.0284$). That higher effort has not been accompanied by concurrent increases in angler catch ($t = -0.47$, $df = 183$, $p = 0.6372$) or harvest rates ($t = -0.49$, $df = 127$, $p = 0.6254$).

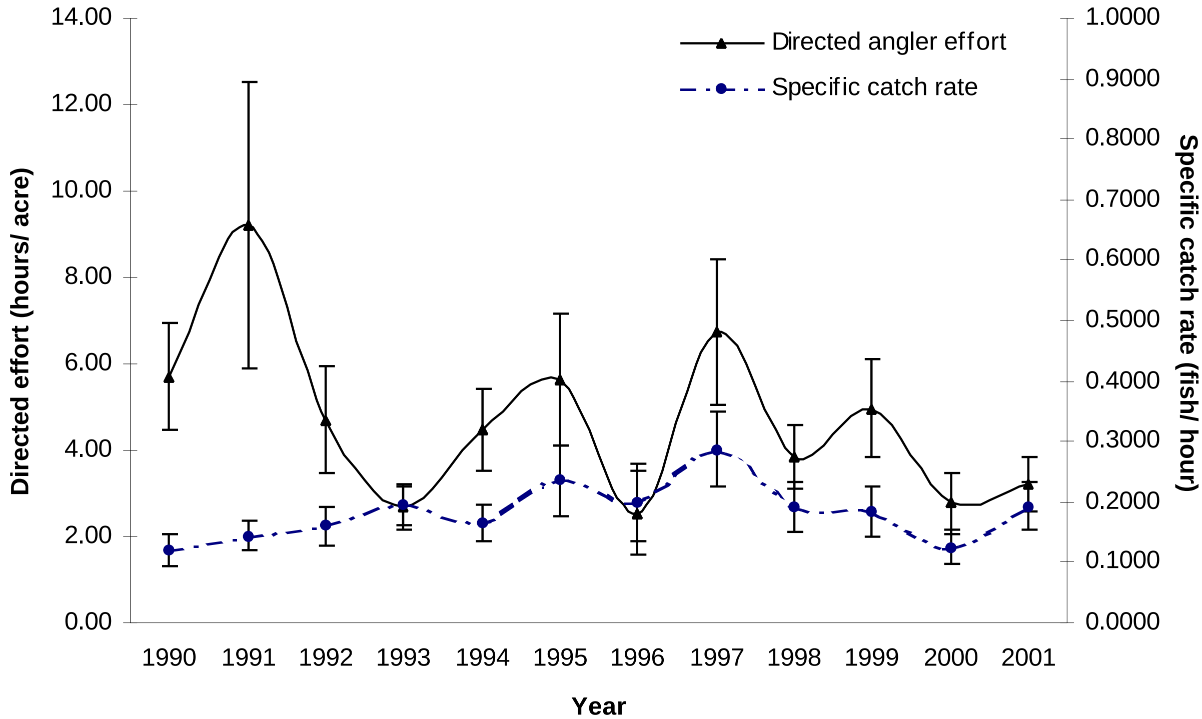

Figure 14: Directed angler effort per lake surface acre and specific catch rate for northern pike in surveyed lakes in the Wisconsin Ceded Territory, 1990-2001. Directed effort is defined as hours reported by anglers fishing for a specific species. Specific catch rate is number of northern pike caught divided by time spent fishing for northern pike. Error bars represent SEM.

Smallmouth Bass

Creel surveys were conducted on 20 lakes classified as smallmouth bass waters in 2001. Thirteen of the lakes were smaller than 500 acres and 7 were 500 acres or larger (Table 10). There were no significant differences in directed angler effort (t = -1.26, df =18, P = 0.2241) or specific catch rate (t = -0.01, df = 18, P = 0.9888) between lakes smaller or larger than 500 acres in 2001 (Table 10). Data from creel surveys conducted between 1990-1993 was excluded from analysis of smallmouth bass catch and effort because lake selection during those years was skewed towards lakes considered very important in the tribal walleye fishery. In 1994, a stratified, random lake selection process was implemented, providing a more representative sample of the variety of lakes in the Wisconsin Ceded Territory. Overall, angler directed effort for smallmouth bass was significantly higher in 2001 than 1994-2000 (F = 12.32, df = 1, P = 0.0006), which is part of a trend of increasing effort observed since 1994 (F = 3.30, df = 7, 157, P = 0.0027; Figure 15). This increasing effort has been mirrored by an overall increase in specific catch rate (F = 2.45, df = 7, 150 P = 0.0207; Figure 16). Specific harvest rate has not demonstrated a similar trend (F = 1.36, df = 7, 150, P = 0.2265). General catch rates have also been increasing since 1993 (F = 3.26, df = 7, 153, P = 0.0030), while general harvest rates have remained constant (F = 1.54, df = 8, 152, P = 0.1490).

Table 10: Mean values calculated from 2001 and 1994-2000 smallmouth bass creel survey data. Specific and general catch and harvest rates are reported as number of fish caught or harvested per angling hour.

Year	Lake Size	N	Acres	Catch/ Acre	Angler Harvest/ Acre	Specific Catch Rate	Specific Harvest Rate	General Catch Rate	General Harvest Rate	Directed Effort/ Acre
2001	All lakes	20	944	3.37	0.17	0.3817	0.0174	0.1626	0.0081	5.45
	< 500 acres	13	255	4.10	0.20	0.3824	0.0142	0.1727	0.0078	6.27
	> 500 acres	7	2,761	2.49	0.15	0.3804	0.0231	0.1440	0.0088	3.92
1994-2000	All lakes	142	1,035	1.47	0.07	0.2548	0.0294	0.0671	0.0038	2.84
	< 500 acres	61	295	1.40	0.07	0.2293	0.0220	0.0714	0.0033	3.33
	> 500 acres	81	1,597	1.55	0.06	0.2738	0.0349	0.0639	0.0042	2.48

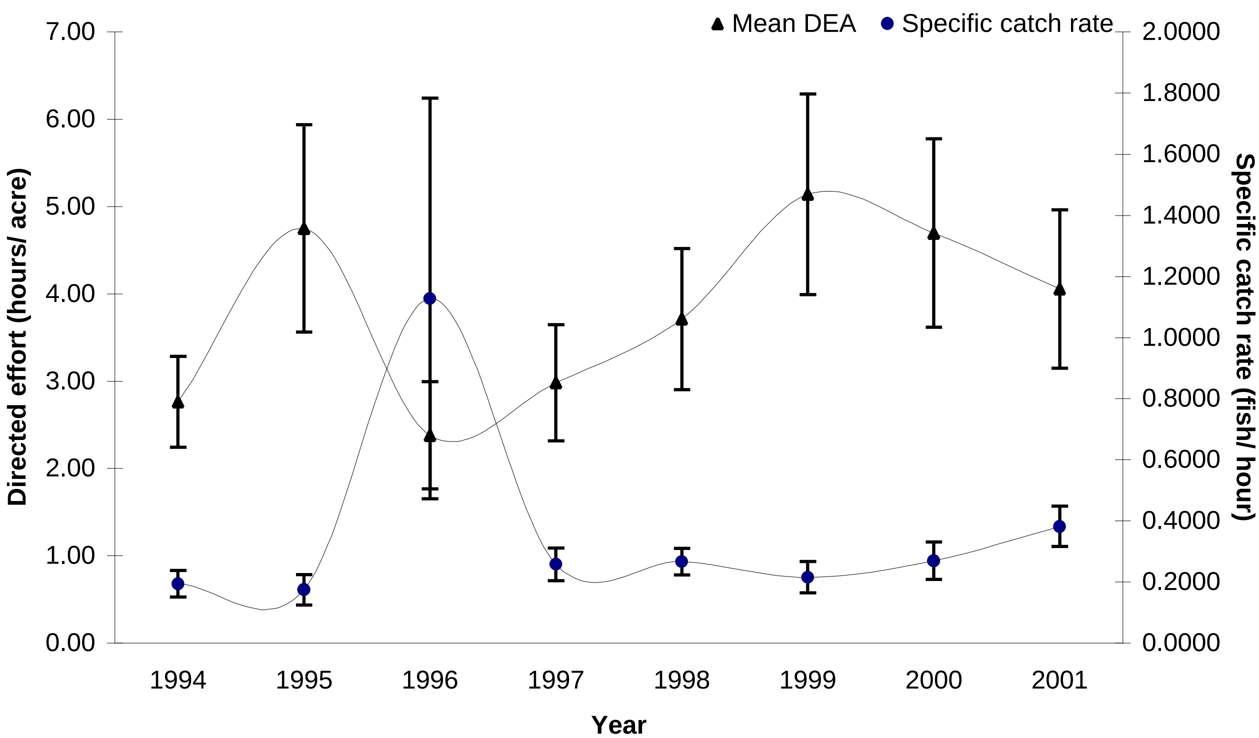

Figure 15: Directed angler effort per lake surface acre and specific catch rate for smallmouth bass in surveyed lakes in the Wisconsin Ceded Territory, 1994-2001. Directed effort is defined as hours reported by anglers fishing for a specific species. Specific catch rate is number of smallmouth bass caught divided by time spent fishing for smallmouth bass. Error bars represent SEM.

Largemouth Bass

Creel surveys were conducted on 24 lakes classified as largemouth bass waters in 2001. Fifteen of the lakes sampled were smaller than 500 acres and 9 were 500 acres or larger (Table 13). There were relatively large differences in parameters of catch and harvest between lakes smaller than 500 acres and lakes 500 acres and larger (Table 11). In 2001, there were no differences in angler effort ($t = 0.49$, $df = 20$, $P = 0.6284$) or success (specific catch ($t = 0.03$, $df = 20$, $P = 0.9801$) or harvest rates ($t = 0.51$, $df = 20$, $P = 0.6155$)) between lake sizes. Overall, there has been no significant trend of increasing or decreasing angler effort in the years 1994 – 2001, but specific catch rates have increased overall ($F = 2.19$, $df = 7, 151$, $P = 0.0383$; Figure 13), and in lakes smaller than 500 acres ($F = 3.79$, $df = 7, 67$, $P = 0.0016$).

Table 11: Mean estimates calculated from 2001 and 1994-2000 largemouth bass creel survey data. Specific and general catch and harvest rates are reported as number of fish caught or harvested per angling hour.

Year	Lake Size	N	Acres	Catch/ Acre	Angler Harvest/ Acre	Specific Catch Rate	Specific Harvest Rate	General Catch Rate	General Harvest Rate	Directed Effort/ Acre
2001	All lakes	24	944	3.73	0.2354	0.4051	0.0178	0.1335	0.0079	4.62
	< 500 acres	15	221	3.20	0.1442	0.4039	0.0157	0.1336	0.0060	4.15
	> 500 acres	9	2148	4.61	0.4309	0.4076	0.0222	0.1334	0.0115	5.62
1994-2000	All lakes	145	1,035	2.13	0.1190	0.1942	0.0152	0.0620	0.0034	3.39
	< 500 acres	64	295	1.72	0.1076	0.1504	0.0119	0.0430	0.0027	4.09
	> 500 acres	81	1,597	2.47	0.1280	0.2283	0.0177	0.0767	0.0040	2.84

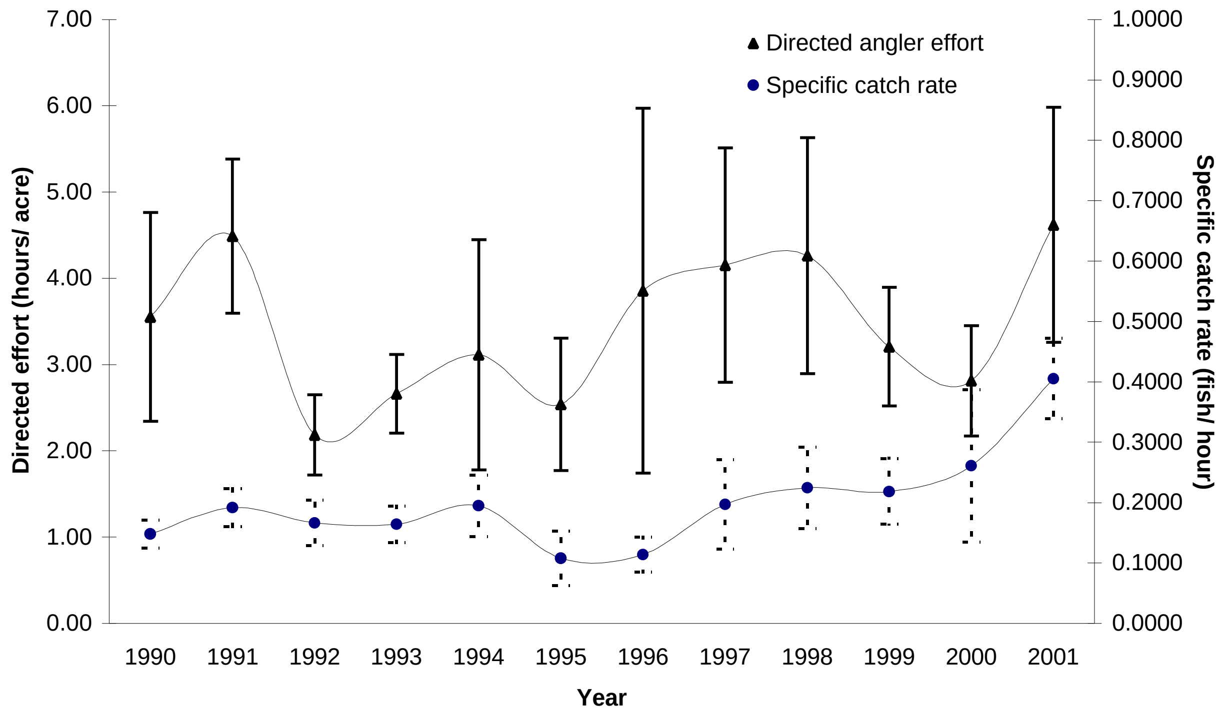

Figure 16: Directed angler effort per lake surface acre and specific catch rate for largemouth bass in surveyed lakes in the Wisconsin Ceded Territory, 1994-2001. Directed effort is defined as hours reported by anglers fishing for a specific species. Specific catch rate is number of largemouth bass caught divided by time spent fishing for largemouth bass. Error bars represent SEM.

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APPENDIX A

1997-2004 Lake Sampling Plan, WDNR Treaty Program

MWBIC	County	Lake	Lake acres	Walleye recruit code	Musky recruit code	Years Speared	Survey Year
2654500	BURNETT	CLAM R FL	473	NR	NONE	2	1997
2678100	BURNETT	LIPSETT L	393	C-ST	REM	4	1997
2747300	DOUGLAS	UPPER ST CROIX L	855	C-NR	NONE	6	1997
692400	FOREST	BUTTERUT L	1,292	NR	NONE	11	1997
692900	FOREST	FRANKLIN L	892	NR	NONE	10	1997
2295200	IRON	TRUDE L	781	NR	C-ST	8	1997
2294900	IRON	TURTLE-FLAMBEAU FL	13,545	NR	C-ST	11	1997
159XX00	ONEIDA	SUGARCAMP CHAIN	1,798	NR		10	1997
1536300	ONEIDA	SQUIRREL L *	1,317	NR	C-	12	1997
1605600	ONEIDA	LONE STONE L	172	NR	NR	4	1997
1605800	ONEIDA	SEVENMILE L	503	NR	NR	9	1997
2620600	POLK	BALSAM L	2,054	C-ST	NONE	11	1997
2627400	POLK	BIG ROUND L	1,015	C-ST	REM	12	1997
2283300	PRICE	BUTTERNUT L	1,006	C-NR	C-ST	7	1997
2113300	SAWYER	L CHETAC	1,920	C-ST			1997
2393500	SAWYER	SISSABAGAMA L	719	NR	C-	4	1997
2311100	VILAS	BIRCH L	528	NR	NR	8	1997
2958500	VILAS	HARRIS L	507	NR	NR	10	1997
1596300	VILAS	LITTLE ST. GERMAIN	980	ST	C-	8	1997
2328700	VILAS	PAPOOSE L	428	NR	C-	7	1997
1593100	VILAS	STAR L	1,206	NR	C-	11	1997
		Total Area	**32,384**	**21**			
2742500	BAYFIELD	BONY L	191	C-ST	NR	2	1998
2742100	BAYFIELD	MIDDLE EAU CLAIRE L	902	C-NR	C-	9	1998
2865000	DOUGLAS	L NEBAGAMON	914	C-NR	NONE	5	1998
677100	FLORENCE	FAY L	247	ST	NONE	5	1998
2949200	IRON	PINE L	312	NR	NR	2	1998
2306300	IRON	SPIDER L	352	NR	C-	3	1998
1542300	ONEIDA	KAWAGUESAGA L	670	NR	C-ST	10	1998
1542600	ONEIDA	MID	215	NR-2	C-ST		1998
1542400	ONEIDA	MINOCQUA L	1,360	NR	C-ST	11	1998
1542x00	ONEIDA	TOMAHAWK CHAIN	3,552	C-	C-ST	12	1998
1595300	ONEIDA	RAINBOW FL	2,035	NR	NR	8	1998
1588200	ONEIDA	TWO SISTERS L	719	ST	C-	9	1998
2268300	PRICE	PIKE L	806	C-	C-ST	9	1998
2267800	PRICE	ROUND L	726	C-	C-ST	9	1998
2268600	PRICE	AMIK L	187	NR			1998
2268500	PRICE	TURNER L	149	NR	C-ST	3	1998
2113300	SAWYER	L CHETAC	1,920	C-ST	NONE	2	1998
2395500	SAWYER	LITTLE ROUND L	229	NR	NONE	5	1998
2395600	SAWYER	ROUND L	3,054	C-NR	C-ST	11	1998

1545600	VILAS	BIG ARBOR VITAE L	1,090	NR	C-	11	1998
716800	VILAS	KENTUCK L *	957	NR	NR	10	1998
995200	VILAS	L LAURA	599	NR	ST	10	1998
2954500	VILAS	LYNX L	339	NR	NR	6	1998
2691500	WASHBURN	L NANCY	772	C-ST	0-ST	9	1998
		Total Area	**22,297**	**24**			
2914800	ASHLAND	ENGLISH L	244	ST	C-	2	1999
2661100	BARRON	SAND L	322	C-ST	ST	8	1999
2858100	DOUGLAS	AMNICON L	426	NR	C-	3	1999
378400	FOREST	ROBERTS L	414	NR	NR	6	1999
683000	FOREST	STEVENS L	295	C-ST	NONE	5	1999
487500	OCONTO	MAIDEN L	290	NR	NONE	4	1999
1569600	ONEIDA	GEORGE L	435	NR	C-	4	1999
1569900	ONEIDA	L THOMPSON	382	C-NR	C-	2	1999
2399700	SAWYER	L CHIPPEWA	15,300	NR	C-	11	1999
2963800	VILAS	BIG L	771	NR	C-	9	1999
2964100	VILAS	MAMIE L	400	NR	C-	4	1999
2338300	VILAS	BOULDER L	524	NR	C-	9	1999
2329x00	VILAS	MANITOWISH CHAIN	4,074	NR	C-	10	1999
2451900	WASHBURN	BASS L *	188	NR	REM	5	1999
2706500	WASHBURN	MIDDLE MCKENZIE L	530	C-ST	ST	8	1999
2496300	WASHBURN	SHELL L	2,580	NR	ST	6	1999
		Total Area	**27,175**	**16**			
2105100	BARRON	BEAR L	1,358	C-ST	NONE	4	2000
2461100	BURNETT	DEVILS L	1,001	C-ST	NONE	4	2000
2493100	BURNETT	ROONEY L	322	ST	NONE	3	2000
2495100	BURNETT	SAND L	962	ST	NONE	9	2000
2351400	CHIPPEWA	LONG L	1,052	NR	ST	4	2000
2866200	DOUGLAS	L MINNESUING	432	NR	NONE	4	2000
672900	FLORENCE	KEYES L	202	NR	NONE	6	2000
653700	FLORENCE	PATTEN L	255	NR	NONE	5	2000
2942300	IRON	GILE FL	3,384	NR	C-ST	6	2000
1516x00	LINCOLN	NOKOMIS/RICE CHAIN	3,916	NR	NR	9	2000
1523600	ONEIDA	BEARSKIN L	400	NR	ST	8	2000
977500	ONEIDA	CLEAR L	846	NR	NR	10	2000
1564200	ONEIDA	CRESCENT L	612	NR	C-	9	2000
1517200	ONEIDA	MANSON L	236	NR	ST	3	2000
2242500	PRICE	SOLBERG L	859	NR	C-	7	2000
2391200	SAWYER	GRINDSTONE L	3,111	NR	ST	11	2000
2418600	SAWYER	LOST LAND L	1,304	NR	C-ST	8	2000
2417000	SAWYER	TEAL L	1,049	NR	C-ST	7	2000
2953500	VILAS	CRAB L	949	NR	C-	10	2000
160xx00	VILAS	EAGLE CHAIN	4,174	NR	C-	10	2000
1018500	VILAS	SNIPE L	239	C-NR	NR	3	2000
		Total Area	**26,663**	**21**			
290xx00	BAYFIELD	PIKE CHAIN	714	NR	C-NR	8	2001
2693700	DOUGLAS	BOND L	292	NR	NONE	2	2001
2694000	DOUGLAS	WHITEFISH L	832	C-NR	NONE	6	2001
394400	FOREST	L METONGA	2,157	C-	NONE	11	2001

2303500	IRON	LONG L	396	C-ST	C-ST	2	2001
1516x00	LINCOLN	NOKOMIS/RICE CHAIN	3,916	NR	NR	9	2001
1589100	ONEIDA	HASBROOK L	302	NR	C-	6	2001
1543300	ONEIDA	KATHERINE L	590	NR	C-	10	2001
1579900	ONEIDA	PELICAN L	3,585	NR	ST	12	2001
1539700	ONEIDA	GUNLOCK L	250	REM			2001
1539600	ONEIDA	SHISHEBOGAMA L	716	0-ST	C-	4	2001
2641000	POLK	BIG BUTTERNUT L	378	C-	NONE	8	2001
2621100	POLK	HALF MOON L	579	C-	NONE	9	2001
2236800	PRICE	LAC SAULT DORE	561	NR	C-ST	3	2001
2390800	SAWYER	LAC COURTE OREILLES	5,039	C-	ST	11	2001
2392000	SAWYER	WHITEFISH L	786	C-ST	ST	9	2001
2331600	VILAS	TROUT L	3,816	C-ST	C-NR	10	2001
1623x00	VILAS	TWIN CHAIN	3,430	C-NR	C-	12	2001
2106800	WASHBURN	LONG L	3,290	C-	NONE	9	2001
		Total Area	**31,629**	**19**			
2897100	BAYFIELD	DIAMOND L	341	C-ST	NONE	6	2002
2767100	BAYFIELD	LONG L	263	NR	NONE	3	2002
2742700	BAYFIELD	UPPER EAU CLAIRE L	1,030	C-NR	C-	9	2002
2675200	BURNETT	YELLOW L	2,287	C-	ST	9	2002
2674800	BURNETT	LITTLE YELLOW L	348	C-	ST	3	2002
2152800	CHIPPEWA	L WISSOTA	6,300	NR	C-	5	2002
2741600	DOUGLAS	LOWER EAU CLAIRE L	802	C-NR	C-	8	2002
396500	FOREST	L LUCERNE	1,026	C-ST	NONE	9	2002
1579700	LANGLADE	ENTERPRISE L	502	NR	C-	5	2002
1427400	MARATHON	BIG EAU PLEINE RESERVOIR	6,830	NR	ST	4	2002
439800	OCONTO	WHEELER L	293	NR	NONE	4	2002
1595600	ONEIDA	MUSKELLUNGE L	284	NR	C-	6	2002
1590400	ONEIDA	PICKEREL L	736	ST	ST	4	2002
2350500	RUSK	CHAIN L	468	NR	ST	3	2002
2350600	RUSK	CLEAR L	95	NR	ST		2002
2350400	RUSK	MCCANN L	133	NR	ST		2002
2350200	RUSK	ISLAND L	526	NR	ST	3	2002
2704200	SAWYER	NELSON L	2,503	NR	NONE	10	2002
1629500	VILAS	BIG PORTAGE L	638	NR	NONE	8	2002
1591100	VILAS	BIG ST GERMAIN L	1,617	C-	ST	12	2002
1602300	VILAS	LONG L	872	NR	NR	8	2002
2954800	VILAS	OXBOW L	511	NR	C-	8	2002
2962900	VILAS	PALMER	635	C-ST	C-	3	2002
2962400	VILAS	TENDERFOOT	437	C-ST	C-	3	2002
29565xx	VILAS	PRESQUE ISLE CHAIN	1,571	NR	C-	11	2002
		Total Area	**31,048**	**25**			
2081200	BARRON	BEAVER DAM L	1,112	C-ST	NONE	8	2003
2106900	BARRON	RED CEDAR L	1,841	NR	NONE	4	2003
2109800	BARRON	HEMLOCK L	357	NR	NONE		2003
2112800	WASHBURN	BALSAM L	295	NR	NONE	4	2003
1881100	BARRON	SILVER L	337	C-	NONE	3	2003
2900200	BAYFIELD	L OWEN	1,323	C-	NONE	10	2003

2492100	DOUGLAS	RED L	258	ST	NONE	2	2003
679300	FLORENCE	HALSEY L	512	ST	NONE	8	2003
406900	FOREST	PINE L	1,670	ST	NONE	9	2003
1515400	LINCOLN	L MOHAWKSIN	1,910	NR	C-ST	3	2003
417400	OCONTO	ARCHIBALD L	430	NR-2	NR	3	2003
2272600	ONEIDA	BUCKSKIN L	634	C-ST	ST	6	2003
1586600	ONEIDA	SPIRIT L (w/3 lakes)	368	NR	C-ST	2	2003
161xx00	ONEIDA	THREE LAKES CHAIN	6,024	NR	C-ST	7	2003
1613500	ONEIDA	WHITEFISH L (w/3 lakes)	205	NR	C-ST	5	2003
2490500	POLK	PIPE L	270	NR	NONE	5	2003
2420600	SAWYER	MOOSE L	1,670	NR	NR	2	2003
234xx00	VILAS	BALLARD CHAIN	1,025	ST	C-	8	2003
1631900	VILAS	LAC VIEUX DESERT	4,300	C-NR	C-	11	2003
1545300	VILAS	LITTLE ARBOR VITAE L	534	NR	C-	10	2003
2271600	VILAS	SQUAW L*	785	NR	C-	10	2003
		Total Area	**25,860**	**21**			
2081200	BARRON	BEAVER DAM L	1,112	C-ST	NONE	8	2004
2732600	BAYFIELD	NAMEKAGON L	3,227	C-NR	C-	11	2004
2734200	BAYFIELD	JACKSON L	142	NR-2	REM	3	2004
2882300	BAYFIELD	SISKIWIT L *	330	NR	NONE	3	2004
2706800	BURNETT	BIG MCKENZIE L	1,185	C-	ST	10	2004
692400	FOREST	BUTTERNUT L *	1,292	NR	NONE	11	2004
157xx00	ONEIDA	MOEN CHAIN	1,172	NR	C-	2	2004
1528300	ONEIDA	WILLOW FL	5,135	NR	NR	8	2004
2275300	SAWYER	L OF THE PINES	273	NR			2004
2275100	SAWYER	CONNORS L	429	NR	C-ST	4	2004
2393200	SAWYER	SAND L	928	NR	ST	8	2004
968800	VILAS	ANVIL L	380	NR	NONE	7	2004
2343200	VILAS	FISHTRAP L	329	NR	C-ST	3	2004
2344000	VILAS	HIGH L	734	NR	C-	10	2004
1855900	VILAS	JAG L	158	NR	NONE	2	2004
1592400	VILAS	PLUM L	1,108	C-NR	C-	8	2004
1881900	VILAS	SPARKLING L	127	NR	NR	5	2004
231xx00	VILAS	TURTLE CHAIN	945	NR	C-	4	2004
2953800	VILAS	ANNABELLE L *	213	NR	C-ST	2	2004
2334700	VILAS	BIG L	850	NR	C-	11	2004
1835300	VILAS	BIG MUSKELLUNGE L	930	NR	C-	9	2004
2339100	VILAS	WHITE SAND L	728	C-ST	C-	9	2004
2695800	WASHBURN	GILMORE L	389	C-ST	NONE	2	2004
2710800	WASHBURN	MATTHEWS L	263	ST	ST	2	2004
		Total Area	**22,379**	**24**			