The Common Loon

Population Status and Fall Migration in Minnesota

Minnesota Ornithologists' Union
Occasional Papers: Number 3

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Anthony X. Hertzel, Karen R. Sussman, and Peder H. Svingen

Common Loon Migration in the Great Lakes Basin
Peder H. Svingen

The Minnesota Ornithologists' Union

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Well before its designation as Minnesota's official state bird in 1961 (see *The Loon* 33:29–31), the Common Loon figured prominently in the storied legends and traditional artwork of Native American people. Among the Ojibwe, *maang* is noted for bravery and has an important role in creation stories.

No other bird captures the spirit of northern lakes like the Common Loon! Despite public interest in loons, national programs such as the North American Loon Fund, regional support from the Sigurd Olson Environmental Institute in Ashland, Wisconsin, and research efforts by the Minnesota Department of Natural Resources' Nongame Wildlife Program, much remains to be learned about the Common Loon in Minnesota.

Where do "our loons" overwinter and how do they get there? Migratory routes between breeding and wintering ranges are incompletely known. As loons begin staging on large lakes in the fall, do these represent the local breeding population or an influx of migrants from Canada? Where do young loons spend winters and summers before they return to the breeding grounds? Do juveniles follow adults and use the same staging areas?

Concern over declining Common Loon populations, especially in the northeastern United States, led a flurry of research — in Minnesota and elsewhere — on loon population status, habitat requirements, environmental contaminants, recreational impacts, and nesting. Results of Pamela Perry's and Kevin Woizeschke's two-year survey of small lakes in central Minnesota during 1988 and 1989 are published here for the first time. This study influenced the methodology used during subsequent statewide surveys.

In 1989, coordinated statewide loon surveys in Minnesota resulted in a valid estimate of the adult summer Common Loon population in the state, which is presented and discussed in Paul Strong's and Richard Baker's 1991 paper. Baker follows with an up-to-date summary of annual surveys that are designed to detect any changes in the status of Minnesota's Common Loon breeding population as early as possible.

Judith McIntyre and Jack Barr's study of pre-migratory behavior of loons on Mille Lacs in 1975 (*Wilson Bulletin* 95:121–125) inspired the fall surveys on Lakes Winnibigoshish and Mille Lacs by Hertzel *et al.* that are presented in this paper. Svingen concludes with a review of status and migration of the Common Loon in the Great Lakes Basin.

The Common Loon clearly has a rich ornithological tradition in Minnesota. This species has been featured once before in a monograph. In 1952, the Minnesota Museum of Natural History published an occasional paper by Olson and Marshall titled "The Common Loon in Minnesota."

We are very grateful to all who have supported and encouraged our interest in loons. They are literally too numerous to mention, but we would like to especially thank Rich Baker, Jeff Hines, and Pam Perry from the Minnesota Department of Natural Resources' Nongame Wildlife Program, and Karen Sussman for assistance.

Why all this fascination with an ancient member of our native avifauna that is still struggling to adapt to its changing environment? We don't know — but the next time we hear a male Common Loon give its territorial yodel, we will listen — and try to understand.

A Survey of Common Loons on Small Lakes in Central Minnesota

Pamela Skoog Perry and Kevin Woizeschke

This pioneering and previously unpublished survey of small lakes in Crow Wing County documented the importance of these lakes for the Common Loon breeding population in central Minnesota. Loon usage of lakes smaller than 25 acres was especially noteworthy, since previous studies in Minnesota had not identified the significance of this small lake size class.

Small lakes, those less than 50 acres, have been considered to have less use by the Common Loon (*Gavia immer*) than larger lakes. Sjölander and Ågren (1972), McIntyre (1975), and Zimmer (1979) all reported limited use of lakes less than 30 acres (12 ha). McIntyre (1986) described good loon territories as having an abundance of food, clear water, at least two nest sites, a quiet nursery location, and an average size of between 50 and 200 acres.

In central Minnesota, however, there have been frequent reports of Common Loons not only feeding but nesting on lakes less than 50 acres in size (unpublished data, Minnesota DNR Loon Watcher Survey). In 1987, Common Loon survey reports were received on five small lakes that ranged in size from 13 to 20 acres in Crow Wing and adjacent Cass counties. All five lakes had nesting loons and all produced chicks; three lakes had one chick and two produced two chicks.

A literature search revealed that loons had been reported using small lakes in other states, although infrequently. In a survey of Wisconsin lakes, Zimmer (1979) reported a 10-acre lake with one adult loon and a 16-acre lake with a breeding pair of loons. DiBello (1984) reported loons using an 11-acre lake in southern Maine. It seems that the question is not whether loons use small lakes, but what proportion of these lakes are being used.

This question becomes important when designing loon surveys for population estimates, especially if there are large numbers of small lakes. For example, a statewide survey of loons in Minnesota is a formidable task considering the large number (15,291) of lakes larger than ten acres (Minnesota Department of Conservation 1968), the inaccessibility of some areas, and the large size of the state. The methods for this type of survey need to be chosen carefully, taking into account both validity and cost efficiency.

In Minnesota there are 4,482 lakes between 10 and 24 acres in size, and 3,728 lakes between 25 and 49 acres, together comprising 54% of the lakes in the state (Minnesota Department of Conservation 1968). Considering this large number of small lakes, it is essential to know the proportion used by Common Loons and subsequently whether the use of small lakes is significant enough to include them in a statewide population survey.

The purpose of this two-year survey was to determine what proportion of the lakes less than 50 acres are used by loons in Crow Wing County. Although these results would not necessarily be directly applicable to other counties or states, it would provide information on whether these small lakes warrant further study in other areas of

Lake Size	Percent of lakes with loons			Percent with nesting loons		
(acres)	1988	1989	avg.	1988	1989	avg.
10–24	34.6 (9)	34.8 (8)	34.7	26.9 (7)	16.7 (4)	21.8
25–49	52.8 (19)	19.4 (7)	36.1	22.2 (8)	13.9 (5)	18.1

Table 1. Percent (number) of lakes with loons, and percent (number) of lakes with nesting loons — chicks or incubating adults — for two lake size classes.

the Common Loon's range and whether they should be included in statewide surveys.

Methods

Surveys were conducted in 1988 and 1989 using two separately selected random samples of Crow Wing County lakes chosen from the two smallest lake size-groups (Minnesota Department of Conservation 1968). The number of lakes surveyed was chosen to approximate a 95% confidence interval and were selected randomly each year. Of 58 lakes in the 10 to 24 acre size-group, a sample of 26 was surveyed in 1988 and 23 in 1989. Of 89 lakes in the 25 to 49 acre size-group, a sample of 36 was surveyed both years.

Lakes were surveyed from shore by Department of Natural Resources Nongame Wildlife Program personnel and volunteers. One visit was made to each lake between the last week of June and the third week of July. A minimum 15 minute observation was made at each lake. Observations of any adult loons or chicks that were either on the lake or on a nest were recorded.

Results

The percentage of lakes in the 10 to 24 acre size-group that had at least one loon present were 34.6% and 34.8% in 1988 and 1989, respectively, with an average of 34.7% for the two years (Table 1). The average number of loons observed per lake was 0.54 and 0.61 adults, and 0.19 and 0.26 chicks for 1988 and 1989, respectively (Table 2). The number of lakes that had chicks or an incubating adult (indicating nesting on the lake) was seven (26.9%) in 1988 but only four (16.7%) in 1989 for a combined percentage of 21.8% (Table 1).

The percentage of lakes in the 25 to 49 acre size-group that had at least one loon present were 52.8% and 19.4% in 1988 and 1989, respectively, with an average of 36.1% for the two years. The average number of loons observed per lake was 0.81 and 0.33 adults, and 0.31 and 0.14 chicks for 1988 and 1989, respectively. The number of lakes that had chicks or an incubating adult was eight (22.2%) in 1988 and five (13.9%) in 1989.

Discussion

Even though there were differences in the survey results between years in the 25 to 49 acre size-group, the results of the 10 to 24 acre size-group were similar and when the two years were averaged together, the results of the two size-groups were remarkably similar. Overall, the usage of small lakes by loons in this study, especially the lakes less than 25 acres, was greater than expected based on the results of other studies.

In Wisconsin, Olson (1986) reported 0.67 adults and 0.12 chicks per lake from a sample of 67 lakes 25–50 acres in size. His results are similar to what was found in our study for lakes of comparable size. However, the smallest lake with adults and chicks

Lake Size	Average # of adults per lake			Average # of chicks per lake		
(acres)	1988	1989	avg.	1988	1989	avg.
10–24	0.54 (14)	0.61 (14)	0.58	0.19 (5)	0.26 (6)	0.23
25–49	0.81 (29)	0.33 (12)	0.57	0.31 (11)	0.14 (5)	0.23

Table 2. Average (and actual number) of adult loons and chicks per lake in 1988 and 1989 — and the average for both years — for two lake size classes.

found in Olson's study was 32 acres. In our study, the smallest lake that produced chicks was 11-acre Jim Lake in 1988, which had one chick. In 1989 there were two 15-acre lakes with chicks: Little Markee Lake had two and an unnamed lake (#18-274) had one. In Olson's study, lakes smaller than 25 acres were not included in the survey and were probably considered unimportant to the population estimate total.

In another Wisconsin study, Zimmer (1979) found that only 5 of 143 lakes (3.5%) less than 30 acres in size had loons. This is much less than the percentages reported in our study. However, Zimmer also reported that 26% of the lakes in the 30 to 59 acre size had nesting loons, which is similar to the results found in our study.

The reason for the greater usage by Common Loons of small lakes in our study is not known, but may be related to lake characteristics such as degree of eutrophication, geologic history, food resources, lakeshore development on larger lakes, or other factors that make the lakes in this survey different. For example, DiBello *et al.* (1984) reported a difference in loon usage of lakes between northern and southern Maine. The smallest lake with loons was 40 acres in northern Maine but only 11 acres in southern Maine. Apparently there are geographic or geologic differences in the types of lakes that loons use.

It is possible that since many previous studies have been done in more remote areas and on oligotrophic lakes farther north into the Common Loon's range, some generalizations have developed that do not hold true across all of the loon's range. Central Minnesota, where this study was done, is closer to the edge of the Common Loon's nesting range, but is still considered excellent loon habitat. Lakes in this region tend to be numerous, with a few larger lakes and many small ones. With the proximity to farmland, some of these lakes tend to be more eutrophic than those in the northeastern part of the state.

Overall, Minnesota has diverse lake habitat types — from prairie potholes to boreal boundary waters. Whether similar small lake usage by loons will be found in other parts of the state remains to be seen, but with more than 8,000 lakes in Minnesota that are between 10 and 50 acres in size, it is worth investigating.

Finally, another factor to consider is the finding of Miller and Dring (1988) who described multiple lake territories being defended by nesting pairs of loons in Michigan's Upper Peninsula. Perhaps some loons are able to use small lakes because of their ability to defend these multiple lake territories. This hypothesis should be further investigated, especially considering the results of this study.

Acknowledgments

Special thanks are extended to Joy Cedarleaf who assisted with the survey in 1988, and Yvette Anderson and Josh LaRue who assisted in 1989. Gaining access to these small lakes was not always easy and sometimes involved trekking through woods, across marshes and fields, and battling mosquitos and ticks during the muggy Minnesota summer. Their efforts on this survey are greatly appreciated.

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DNR Regional Headquarters, 1601 Minnesota Drive, Brainerd, MN 56401.

An Estimate of Minnesota's Summer Population of Adult Common Loons

Excerpted from

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Biological Report No. 37, April 1991

Paul I. V. Strong and Richard J. Baker

LoonWatch and the Minnesota Department of Natural Resources' Nongame Wildlife Program conducted Minnesota's first statewide population estimate of Common Loons using volunteers in 1989. More than 600 volunteers and biologists searched for loons on 723 lakes greater than or equal to 10 acres, from the ground, water, and air. The calculated estimate was 11,626 adult Common Loons with a 95% confidence interval of 1,272 (10.9%). Surveyors reported at least one adult loon on 49.5% of the sample lakes. Lakes with loons tended to occur more often in west-central, north-central, and northeastern parts of the state. Occupancy rates were greatest on lakes in the 150–499 acre size class, with nearly two-thirds of the lakes harboring loons.

The Common Loon (*Gavia immer*) in Minnesota has been well studied (Olson and Marshall 1952, McIntyre 1975, Titus and VanDruff 1981, Eberhardt 1984). Surveys of portions of the state's summer population have been conducted (McIntyre 1978, 1988a, Hirsch and Henderson 1980, Mooty and Goodermote 1985, Reiser 1988, Valley 1987, Mathisen 1988, Mooty and Perry 1988). Hands *et al.* (1989) summarized the status of the Common Loon in Minnesota. However, this apparently large summer population has not been estimated using statistically valid techniques. Hirsch and Henderson (1980), utilizing a non-random sample, estimated the summer adult population at 10,700. This suggested that Minnesota may harbor one-half to two-thirds of the summer Common Loon population in the lower 48 United States.

Even though the state's summer loon population has never been estimated with accuracy, some data suggest that the population has decreased over the past century and that populations in some parts of the state may still be declining. Historically, the Common Loon nested throughout Minnesota (Roberts 1932); its breeding range at the turn of the century extended into northeastern Iowa (Palmer 1962). Hirsch and Henderson (1980) found Common Loons in 40 counties north of the Minnesota River in 1980. In a 15-year interval survey conducted in 1971 and 1986, McIntyre (1988a), also using a non-random sample, reported a smaller proportion of lakes with territorial loons in 1986. In a lake by lake comparison, she found nearly eight times as many lakes with less versus more utilization by Common Loons.

Sigurd Olson Environmental Institute (SOEI) and the Minnesota Department of Natural Resources' (MDNR) Nongame Wildlife Program began planning in 1988 for a statewide survey of the summer adult Common Loon population in 1989. This report details the methodology and results of the survey.

Methodology

Establishing the Sample. Common Loons have recent occupation histories in 41 northern and central counties (Hirsch and Henderson 1980). Anecdotal but also consistent reports from additional south-central counties (MDNR unpubl. data) suggested establishment of a sample area that included most counties north of the Minnesota River.

Based on surveys of Common Loons in Wisconsin (Olson 1986) and Michigan (Dahmer and Robinson 1985, Heitman and Robinson 1985, Robinson *et al.* 1986), and a recent study of Common Loon use of small lakes in north-central Minnesota (Perry 1987), we decided to limit the survey to lakes greater than or equal to 10 acres. Lakes smaller than 25 acres are sometimes thought unsuitable for use by Common Loons, but Perry's (1987) study reported substantial use of lakes in this size class.

Olson (1986) suggested that volunteers could be used to survey lakes for loons, but stated that their ability to do so was impaired on lakes greater than or equal to 500 acres. Accordingly, we divided the sample into two parts: one conducted by volunteers on lakes smaller than 500 acres and one conducted by professional wildlife biologists on lakes greater than or equal to 500 acres. We further divided the subsample of lakes smaller than 500 acres into three classes, based on the mean number of loons seen on lakes of various size classes in Wisconsin (Olson 1986): 10–49 acres (one loon per lake), 50–149 acres (two loons per lake), and 150–499 acres (more than two loons per lake). For the three smaller size classes, we decided that a sample of 650 lakes (approximately 5% of the total number of Minnesota lakes in these size classes) would be adequate for statistical analysis. We added 1% more to bring the total to 780 lakes, not only to accommodate a surplus of volunteers, but also to account for volunteer attrition that was expected to occur. Olson (1986) had reported that approximately 20% of the volunteers in Wisconsin failed to complete the survey.

Again following the methodology used by Olson (1986), we selected lakes using a random cross-stratified format with two strata (lake size class and county), so that there would be equitable distribution across the range of lake sizes and across the sample area. First, we obtained the most current listing (MDNR 1968) of lakes greater than or equal to 10 acres in Minnesota and deleted all lakes in the 38 counties not included in the survey. For each remaining county, we determined the number of lakes in each size class within each county. We then calculated the number of lakes to be sampled from all three smaller size classes in each county using the formula for proportional allocation (Cochran 1977).

Using this sampling routine, we found that no lakes would be sampled within Benton, Mille Lacs, and seven additional counties (Kittson, Koochiching, Lake of the Woods, Marshall, Pennington, Red Lake, Roseau). We pooled the seven northwestern counties to obtain at least a small sampling from that region.

In order to distribute the lakes among the size classes in a manner that would reduce the variance for our final estimate, we inspected data from other surveys of Common Loons in the United States and Ontario, and summarized information on lake area and numbers of loons. Using these data, we derived a pooled estimate of the variance for each size class using another formula from Cochran (1977). These values were used to determine the number of lakes to be sampled in each size class in each county. [*Editor's Note:* See the original report for formulae and statistical analyses.]

We then selected the sample lakes by assigning a random number to each lake in the three smaller class sizes within the 49 counties to be included in the survey. We grouped the lakes within each county by size class, sorted the groups by random number, and selected the lakes.

Few data were available for surveys of lakes greater than or equal to 500 acres, but large variance in the number of loons on lakes in this size was thought to exist, so we

	Size Class (acres)				
	10–49	**50–149**	**150–499**	**>499**	**Total**
Status of Lakes in Initial 5% Sample					
Existing in 1989	204	159	196	126	685
Marshy/Dry in 1989	43	26	21		90
Total	**247**	**185**	**217**	**126**	**775**
Status in Additional 1% Sample					
Existing in 1989	47	39	48		134
Marshy/Dry in 1989	9	5	1		15
Total	**56**	**44**	**49**	**0**	**149**
Lakes Visited (Initial 5% Sample)					
Existing Lakes	142	128	161	126	557
Replacements for Marshy/Dry	31	24	17		72
Lakes Visited (Additional 1% Sample)					
Existing Lakes	25	26	34		85
Replacements for Marshy/Dry	7	2	0		9
Total Lakes Visited	**205**	**180**	**212**	**126**	**723**
Lakes Not Visited (Initial 5% Sample)					
Existing Lakes	62	31	35		128
Replacements for Marshy/Dry	12	2	4		18
Lakes Not Visited (Additional 1% Sample)					
Existing Lakes	22	13	14		49
Replacements for Marshy/Dry	2	3	1		6
Total Lakes Not Visited	**98**	**49**	**54**	**0**	**201**

Table 1. Distribution of lakes included in the survey. See text for explanation of Initial vs. Additional Sample, and procedure for selecting replacement lakes (n=105) for those found to be marshy or dry after the initial selection process.

decided to sample about 20% of these lakes. From the 623 lakes greater than or equal to 500 acres in the study area, we randomly selected 126. Due to a low-level flight ban over the Boundary Waters Canoe Area (BWCA), we replaced all selected lakes within the BWCA with the nearest lake greater than or equal to 500 acres that was outside the BWCA but within the same county.

Finally, we located randomly selected lakes smaller than 500 acres on county highway maps, or on topographic maps if they did not appear on the county maps. Many lakes that were absent on both maps were apparently dry or marshy. We replaced these lakes with the closest lake in the same county and size class (Table 1).

Volunteer Recruitment. [*Editor's Note:* See the original publication for a detailed description of volunteer recruitment and assignment. Information packets, maps, forms for recording data, and instructions for conducting the survey were sent by mail. Volunteers were not trained. Report forms were inspected for unusual data and errors. Volunteers who did not return the report forms were not contacted.]

The Aerial Component. We assigned lakes greater than or equal to 500 acres to MDNR nongame wildlife biologists, other MDNR regional staff, and the LoonWatch coordinator. All flight surveyors received specific instructions. We instructed them to fly at 75–90 mph, 100–300 feet above the lake, and to circumnavigate the lake about 300 feet from the shoreline. Flight surveyors flew one or more additional passes to cover re-

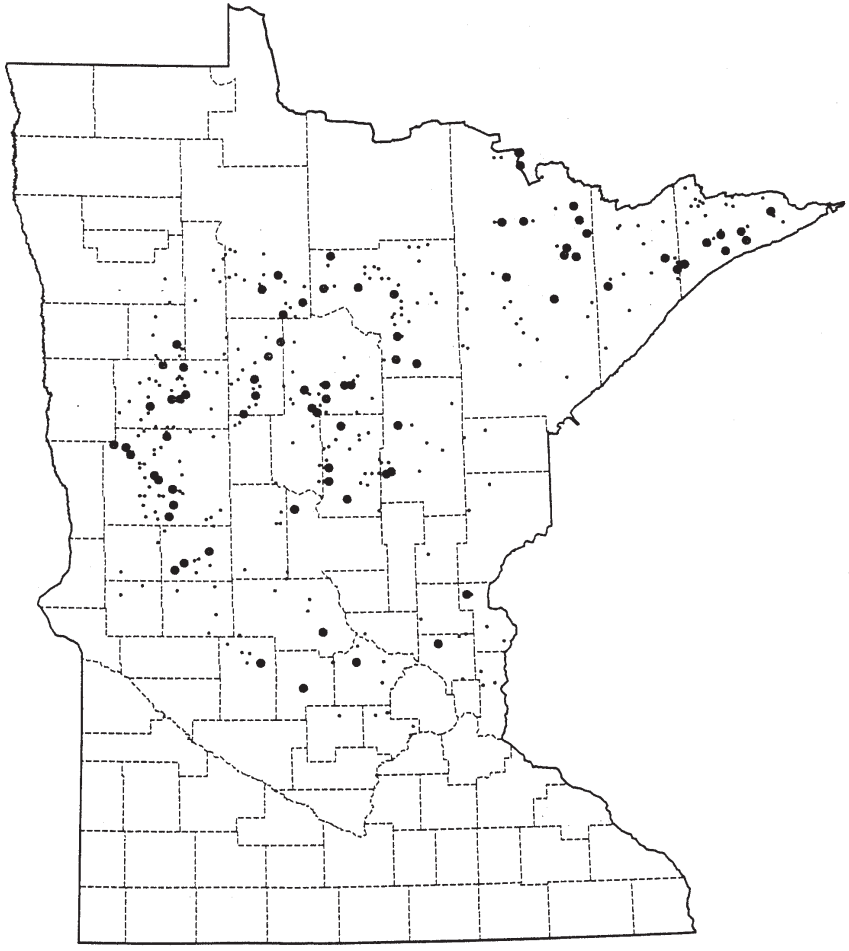

Figure 1. Lakes on which at least one adult Common Loon was seen during survey. Map legend: • = 10–499 acres, ● = 500+ acres.

maining areas of the lake, particularly lakes with open water basins and/or islands. Because visibility decreases on choppy water, flights were aborted if the wind was greater than or equal to 5 mph at the time of departure, or if conditions worsened during the flight. For consistency among flights and for optimal viewing conditions, surveyors were instructed to conduct flight surveys between 5:00 and 9:00 A.M. CST, with some latitude allowed. Surveyors counted adult loons and recorded their locations on maps. All flight surveys were done 17–24 July 1989.

Data Compilation and Analysis. All data were entered in a data management software program and carefully inspected for errors in transfer. Data on weather conditions, time spent conducting the survey, and methods of observation were summarized.

	Size Class (acres)				
	10–49	**50–149**	**150–499**	**>499**	**Total**
One	26	28	68	32	154
Two	32	54	74	0*	160
Three	5	2	16	12	35
Four	1	3	8	7	19
Five	3	1	3	5	12
Six	0	3	5	3	8
Seven	0	0	2	0	2
Eight	0	0	2	0	2
	67	**91**	**178**	**59**	**395**

Table 2. Number of sample lakes in each size class with groups of one to eight loons. *Observers in airplanes (lakes >499 acres) were instructed to report groups of three or more loons.

Within each lake size class we totaled the number of adult loons and calculated a sample mean and variance. We then estimated the number of adult loons in each size class using another formula. The total estimate was a sum of the estimates for the four class sizes. We calculated the variance of the estimate using the formula for stratified random sampling (Cochran 1977). [*Editor's Note:* See the original publication for formulae and statistical analyses.] Observers were asked to record the number of groups of loons and the size of the largest group. If these data were absent, the lake was left out of group size analysis.

Results

Rate of Reporting. We received data for 723 lakes (Table 1). Volunteers submitted data for 597 (74.8%) of the 798 assigned lakes smaller than 500 acres. All 126 of the lakes greater than or equal to 500 acres were surveyed. Lakes for which no forms were submitted tended to be small and in remote areas.

Occupancy Rates by Geography and Lake Size. Surveyors reported at least one adult loon on 358 (49.5%) of the 723 lakes. There appeared to be geographic differences between lakes with loons present (Fig. 1) vs. lakes without loons (Fig. 2). Lakes with loons present tended to occur more often in west-central, north-central, and northeastern parts of the study area. Occupancy rates varied by size class, ranging from nearly one-third of the lakes 10–49 acres to nearly two-thirds of the lakes over 149 acres (Fig. 3). Loons were absent from most of the lakes in the southern part of the study area. Occupancy rates varied greatly by size class within counties also, but generally reflected the trend of greater occupancy in the northern parts of the study area, except for the extreme northwest. [*Editor's Note:* See the original publication for more graphics depicting occupancy rates by lake size class and by county.] Observers did not spot loons on any of the survey lakes in nine counties: Dakota, Hennepin, Lake of the Woods, Marshall, Mille Lacs, Ramsey, Scott, Stevens, and Swift.

The total number of Common Loons counted on individual lakes ranged from zero to 27. The most frequent numbers of loons seen were zero, one, or two, across all size classes. Large numbers were seen most often on lakes greater than or equal to 150 acres. The probability of observing zero loons was highest in the smaller size classes. There was great variation in numbers of loons seen in all lake size classes. The mean number of loons per lake ranged from one-half on the 10–49 acre lakes to nearly three loons on lakes greater than or equal to 500 acres.

Group Size. Observers were able to determine the size of 395 groups of loons (Table 2). Group size ranged from one to eight. Most loons were seen singly (39%) or in pairs (41%). The number of groups of one and two loons was nearly equal in the 10–49 acre and 150–499 acre size classes. However, there were nearly twice as many groups of two in the 50–149 acre class. No groups of two loons were reported on lakes greater than or equal to 500 acres, because we asked for group size only for groups of more than two loons in that size class.

The Population Estimate. Observers counted a total of 1,135 adult loons on the survey lakes, yielding an estimate of 11,626 adult Common Loons with a 95% confidence

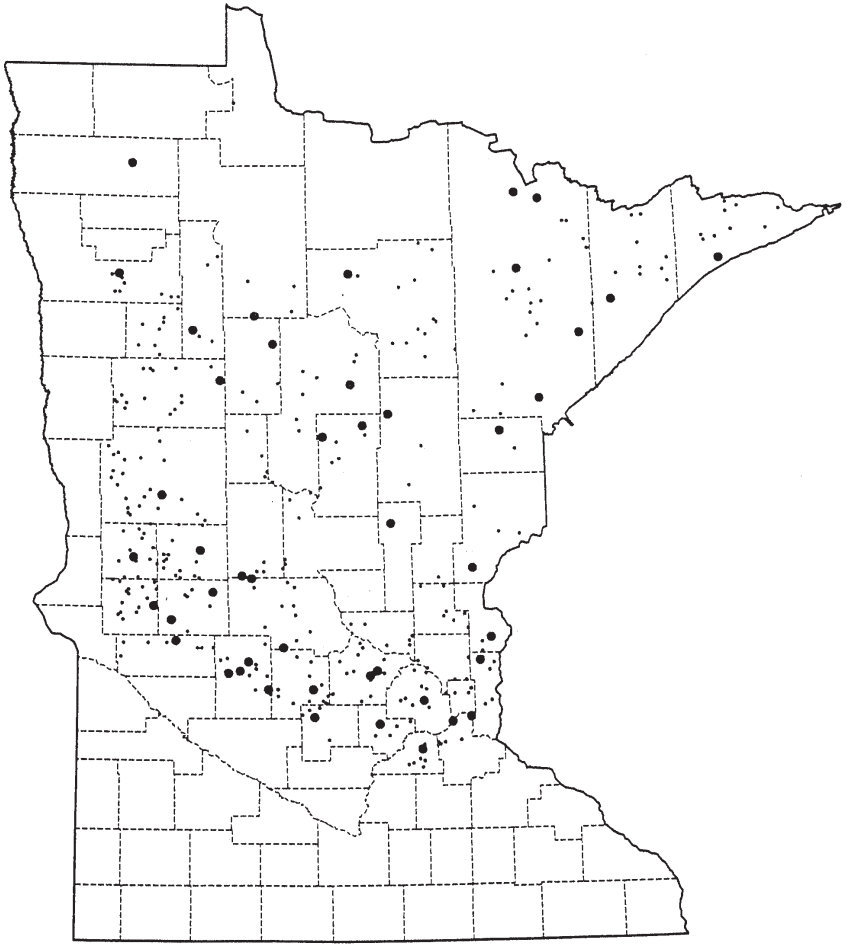

Figure 2. Lakes on which no adult Common Loons were seen during survey. Map legend: • = 10–499 acres, ● = 500+ acres.

interval of +/- 1,272 (10.9%). The estimated population was distributed fairly evenly across the lake size classes, although lakes in the 10–49 acre class accounted for twice as many loons as lakes greater than or equal to 500 acres (Fig. 4). All but 14 (2%) of the ground surveys were completed on 15 July 1989. The rest used one of the substitute dates.

Discussion

The Population Estimate. Our estimate of about 12,000 adult Common Loons compares favorably with the estimate of 10,700 by Hirsch and Henderson (1980). It is the largest concentration of Common Loons in the lower 48 United States and accounts

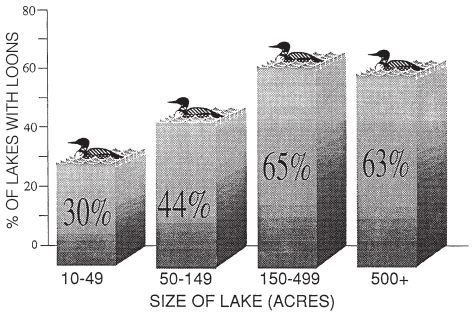

Figure 3. Occupancy rate of lakes surveyed, by size class.

for approximately three-quarters of the Common Loons in the Midwest, and over half of the Common Loons in the lower 48 (McIntyre 1988b:152).

Occupancy rates suggest that loons are most common in the north-central and northeastern regions of Minnesota, which correlates with the forested and lightly settled parts of the state. Low occupancy rates were primarily in southern and northwestern counties. While loons were not observed on any of the lakes in nine counties, it is likely that some Common Loons summer in these areas. A larger sample of lakes, particularly those lakes most likely to harbor loons, would be necessary to conclude that no Common Loons summer in those counties.

Loons were more likely to be found on lakes greater than or equal to 150 acres. However, the majority of the state's loon population apparently resides on lakes smaller than 150 acres because the vast majority of lakes are in this size class. Therefore, the importance of small lakes to the loon population should not be overlooked. The recent discovery of multi-lake Common Loon territories in Michigan's western Upper Peninsula and northeastern Wisconsin (Miller and Dring 1988), a phenomenon that occurs mostly on lakes smaller than 50 acres in close proximity to one another, suggests that occupancy rates on small lakes should be interpreted cautiously. Loon pairs may defend two to four small lakes, but their presence on only one lake at any time will lower occupancy rate estimates. The proportion of lakes actually being used by resident loons may be substantially higher.

Mean numbers of loons per lake are similar to those reported by Olson (1986) in northern Wisconsin. Few conclusions should be drawn about any correlations between lake size and mean numbers of loons observed, because the means for the two smallest size classes were greatly affected by the large numbers of lakes with zero loons. Loons were absent on over half of the sample lakes in these size classes. The aerial survey technique used on lakes greater than or equal to 500 acres almost always counts less than 75% of the actual number of loons present (Dibello *et al.* 1984). The proper interpretation of these statistics is that they represent the average number of loons one is likely to see on a lake of a given size class selected at random from all of the lakes in that size class in the survey area. [*Editor's Note:* See original publication for the sections "Dry and Replacement Lakes" and "Use of Volunteers."]

Recommendations

The results of this survey indicate that Minnesota has a large summer Common Loon population. However, since it is the first estimate of its kind for loons in the state, it does not indicate any trend in population size, distribution, reproductive success, or habitat suitability. It would be prudent to either repeat this survey on a regular basis, or implement a monitoring program designed to detect significant changes in Minnesota's Common Loon population.

If a decision is made that repeating the survey is most desirable, we recommend that it be conducted every five years for three reasons. First, large amounts of time, effort, and funds were needed to plan and conduct the survey. It would be logistically and economically unfeasible to conduct it annually. The estimated cost associated with planning, implementing, and reporting this survey was $40,000. Second, the Common

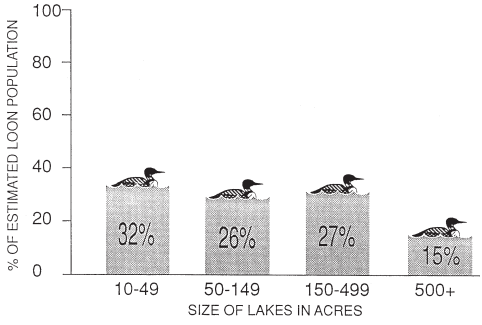

Figure 4. Percent of estimated Common Loon population in each size class.

Loon population is large and widely distributed, and since it is harbored on lakes surrounded by a variety of public and private lands; it is in no immediate danger of sudden decline due to changes on the breeding grounds. Third, adult loon populations probably change slowly due to low reproductive rates, recruitment, and adult mortality rate; it is therefore unlikely that short-interval surveys would be able to detect small changes in the population.

At the same time, effort should be made to assess the reproductive success of the breeding population and monitor habitat quality of important breeding lakes. Minnesota's loon population could remain nearly stationary for a number of years despite little or no reproduction. Periodic surveys of reproductive success would augment adult population data. McIntyre's (1988a) study suggested that lakeshore development and recreation on lakes may have correlated with decreases in some population parameters. Further investigation of this phenomenon seems warranted. Lastly, a survey to update the status of Minnesota's lakes should be a high priority for the near future.

Conclusion

The methodology used in the 1989 Minnesota Loon Survey allowed a valid estimate of the state's adult summer loon population, established a list of lakes and volunteers that can be used in the future, and generated substantial positive public relations for wildlife protection in the state. The estimate of about 12,000 adult Common Loons is probably a minimum because the methodology undercounted loons on lakes larger than 500 acres and because the lake list used to establish the sample contained many lakes that were dry or marshy.

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Minnesota Loon Monitoring Program

Six-year Report: 1994–1999

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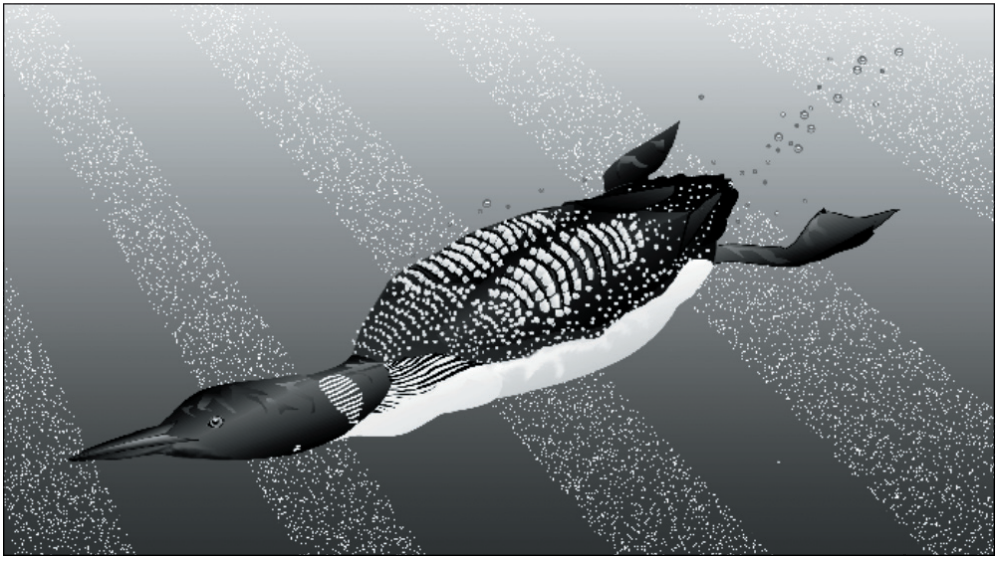
Nongame Wildlife Program
Minnesota Department Of Natural Resources
May 1, 2000

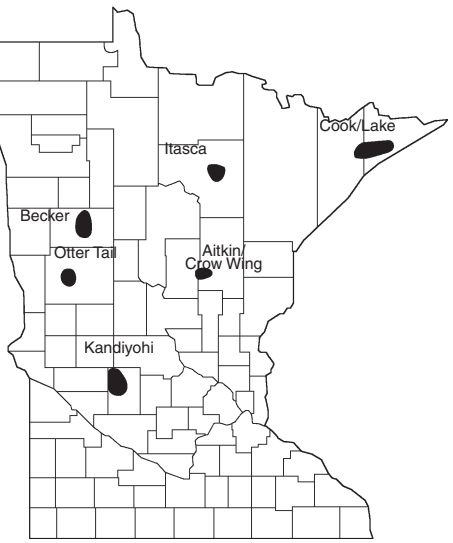


Tom Klein

Summary

The Minnesota Loon Monitoring Program (MLMP) is a long-term project of the Minnesota Department of Natural Resources' Nongame Wildlife Program. Since 1994, nearly 1000 volunteer observers have annually gathered information about Common Loons in six 100-lake regions, or "index areas" of the state. The data these generous citizens collect provide the Nongame Wildlife Program with an early warning system for detecting changes in the numbers of these birds and the health of their lake habitats in Minnesota. In addition to reporting information about loons and habitat quality, observers also report on the presence of Canada geese on the lakes they survey.

An analysis of six years of MLMP data indicates that Minnesota's Common Loon population remains healthy in both number of adults and number of juveniles observed within the index areas. Indeed, data from the Becker index area indicate a slight, but significant increase in that area's loon population. The abundance of loons varies greatly across the state, and is lowest in the southwestern (Kandiyohi and Otter Tail) and northeastern (Cook/Lake) index areas, and highest in the north central (Itasca) index area. The number of juveniles per two adults seen, a measure of reproductive success,



Locations Of MLMP Index Areas.

also varies among index areas, but appears to be highest in the southwestern (Kandiyohi) index area and lowest in the northeastern (Cook/Lake) index area. Finally, data on Canada Goose abundance illustrate a dramatic increase in the southwestern (Kandiyohi and Otter Tail) index areas, but stable populations elsewhere.

The value of MLMP data is widely recognized by Minnesota's biologists and planners, and its results have been incorporated into several summaries of statewide ecological health, including Minnesota Milestones, Minnesota Environmental Indicators Initiative, and Water Management 2000. The Nongame Wildlife Program hopes to continue this effort into the future.

Why We Monitor The Health Of Minnesota's Loon Population

The Common Loon (*Gavia immer*) is Minnesota's state bird, and a source of pleasure to the thousands of lake dwellers and visitors who enjoy its enchanting sights and sounds. A statewide survey conducted by the Nongame Wildlife Program in 1989 found that Minnesota is the summer home to roughly 12,000 adult loons, more than in all other states combined, excluding Alaska. As with the Bald Eagle and grey wolf, Minnesotans are responsible for the stewardship of one of the nations' largest loon populations. The DNR uses the MLMP to track the health of the state's loons and lakes, and to help insure that this bird will grace Minnesota far into the future.

Loons have several characteristics that make them a valuable "indicator" of the health of the state's lakes. As diving birds that use sight to hunt their fish prey, they thrive in clear lakes with healthy fish populations. Also, loons only nest on undisturbed shorelines or islands with plenty of natural vegetation. Because loons nest at the waters' edge, they are easily disturbed by excessive boat traffic and wakes, and are displaced by human residential activity. Loon chicks venture onto the lake soon after hatching, and can be injured or killed by careless boaters. Finally, like other animals that eat carnivorous fish, loons will accumulate health-threatening pollutants in their bodies if their habitat is contaminated. This can in turn reduce the birds' survival and reproductive success.

Index Areas

Because it would be far too difficult to collect loon data from all 12,000 of Minnesota's lakes each year, the MLMP is designed to measure the health of loon populations within six 100-lake "index areas." These areas have been selected because they are typical of larger portions of the state in ways that matter to loons. For example, we know that loons can be adversely affected by shoreline development. To help us detect problems that may stem from loss of shoreline habitat, the MLMP index areas are divided between those likely to experience rapid human population growth (e.g., Aitkin/Crow Wing and Kandiyohi index areas) and those in which human populations and their impacts are likely to change more slowly in the near future (e.g., Becker, Cook/Lake,

Itasca, and Otter Tail index areas). The six index areas are similarly divided between those where acid rain sensitivity, public or private land ownership, or road density are expected to increase or to stay the same. The index areas are named for the counties in which they are located. The characteristics of each index area are detailed at the end of this report.

Volunteer Observers

The Nongame Wildlife Program does not have enough staff to collect data at 600 lakes each year. Instead, hundreds of generous volunteers visit their assigned lakes on one morning during a ten-day period in early July. Depending on the size of the lake they survey, the volunteers' survey styles vary widely, with some using boats or canoes, and others surveying from the shore. Similarly, some use binoculars or spotting scopes, and others don't. However, Nongame Wildlife Program staff try to standardize methods by providing survey guidelines to all volunteers. In addition to the numbers of loons and geese seen, observers are asked to report on such things as weather and shoreline conditions. Data forms are returned to the Nongame Wildlife Program for compilation and analysis.

Results Of Data Analysis

On the following pages, the results of data analysis are presented for each index area. Because of the way the MLMP is designed, the analyses must evaluate the data from each index area separately. Furthermore, conclusions reached about populations within the six index areas do not precisely describe the status of the state's entire loon population. Taken together, however, conclusions regarding loon populations within the six index areas do provide an overall picture of the status of loons in Minnesota.

Data generated by the MLMP were analyzed in two ways: 1) Within each index area, we looked for trends that indicate population changes occurring over time; 2) Among the index areas, we compared data to learn how loons and geese respond to different environmental conditions that exist in the various areas. Three analyses of loon data and one analysis of goose data are described below, and are presented in detail at the end of this report.

Loon Abundance: Adult Loons Seen Per 100 Acres Of Lake Surface Within An Index Area

Within an index area, abundance measures such as *total number of loons seen* or *average number of loons seen per lake* can be compared from year to year. However, since average lake size varies among index areas, we have converted these to the *average number of adult loons seen per 100 acres of lake surface* so that we can also make comparisons among index areas. During the six years studied, no statistically significant changes in adult loon abundance have been observed within any of the six index areas. Although slight differences between years can be seen in the figures found at the end of this report, these are probably due to normal fluctuations that occur in all natural populations.

Loon abundance ranged from 0.5 – 0.8 adult loons per 100 acres of lake surface in the Kandiyohi index area to 3.2 – 3.8 in the Itasca index area. These differences among index areas confirm previous observations that in Minnesota, loons are most abundant in the central lakes region, and least abundant in the southwest agricultural region, where the species is at the very southern edge of its current distributional range in North America.

Loon Occupancy: Percent Of Lakes In An Index Area With Any Adult Loons

Occupancy can be thought of as the *likelihood of seeing a loon on a lake*. A small,

but statistically significant increase in occupancy was detected within the Becker index area. Occupancy in all other index areas remained stable during the six years, but fluctuations up to 10% were observed in several areas. Occupancy was calculated as 65% – 73% in the Aitkin/Crow Wing index area, 59% – 73% in the Becker index area, 44% - 54% in the Cook/Lake index area, 69% – 76% in the Itasca index area, 24% – 32% in the Kandiyohi index area, and 48% – 58% in the Otter Tail index area, again consistent with previous observations regarding the distribution of loons within Minnesota.

Loon Reproductive Success: Juvenile Loons For Every Two Adult Loons On A Lake

Measures of reproductive success are particularly important in monitoring the health of wildlife populations. Especially with long-lived species like the loon, focusing only on adult abundance or occupancy might cause biologists to miss less obvious problems. For example, adults might be present on a lake every year, but fail to raise young year after year. Eventually, this could result in the disappearance of loons from the lake (unless other adults moved in), although this might not occur for many years. Because it is the young of a species that keeps the population going after the adults die, it is critical that a population reproduce successfully.

In this analysis, we calculated the *average number of juvenile loons seen for every two adult loons seen*. Since a healthy pair of loons typically produce a two-egg clutch each year, this ratio would equal 1.0 in the ideal world. However, rarely in any wildlife population do all young survive. To maintain a population, each pair of adults need to raise only two young to breeding age during the course of their lives. Although species that only reproduce in one year must raise their young in that one year, loons may nest for many years, and so can afford to be less successful in any one year. Consequently, a low reproductive success in a single year is not necessarily a concern.

During the study period, no statistically significant changes in reproductive success were observed within any of the six index areas. This ratio fluctuates between years in all index areas, but given the smaller sample size than was used for other measures (since lakes with fewer than 2 loons were dropped from the analysis) and the fact that juvenile loons are more likely than adults to be missed by observers, this measure may be less precise than those using only adult data.

Among index areas, reproductive success was calculated as 0.29 – 0.44 in the Aitkin/Crow Wing index area, 0.35 – 0.63 in the Becker index area, 0.07 – 0.41 in the Cook/Lake index area, 0.28 – 0.54 in the Itasca index area, 0.46 – 0.82 in the Kandiyohi index area, and 0.32 – 0.61 in the Otter Tail index area. These surprising results indicate that although the Kandiyohi index area has the lowest abundance and occupancy, the adults living there are the most successful of any index area at raising young. The reason for this is unclear. The relatively poor reproductive success observed in the Cook/Lake index area may be due to the generally low productivity of lakes in that region of the state, or to heavy metal contamination in some of its waters. Further research would be needed to determine the causes of these patterns.

Thank You!!!

We extend our heartfelt thanks to the hundreds of volunteer observers who continue to make the Minnesota Loon Monitoring Program a success. Without your persistence and hard work, the DNR would be without a means of reporting on the health of Minnesota's state bird. We and the loons appreciate your commitment!

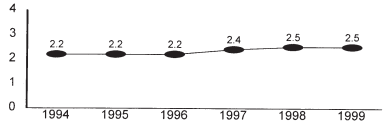
We also acknowledge the assistance of Dr. Douglas Hawkins, University of Minnesota, for statistical analysis, Bill Schuna and Jeremy Kershaw for data management, and Eric Hanson for the initial design and implementation of the MLMP.

AITKIN/CROW WING INDEX AREA

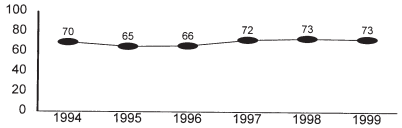
CHARACTERISTICS

LOW ACID RAIN SENSTIVITY
HIGH DENSITY OF HUMANS AND ROADS
RAPID HUMAN POPULATION GROWTH
PREDOMINANTLY PRIVATE LANDS
AVERAGE LAKE SIZE = 193 ACRES

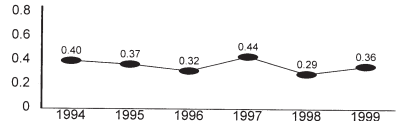
ADULT LOONS PER 100 ACRES OF LAKE



PERCENT OF LAKES WITH ANY ADULT LOONS



LOON JUVENILES PER TWO ADULTS

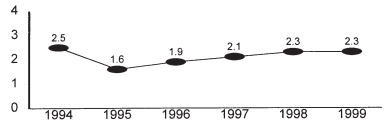


BECKER INDEX AREA

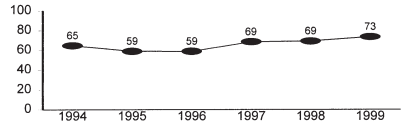
CHARACTERISTICS

LOW ACID RAIN SENSTIVITY
LOW DENSITY OF HUMANS AND ROADS
SLOW HUMAN POPULATION GROWTH
PREDOMINANTLY PUBLIC LANDS
AVERAGE LAKE SIZE = 421 ACRES

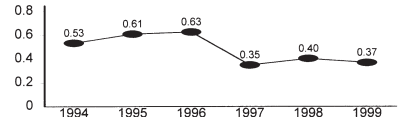
ADULT LOONS PER 100 ACRES OF LAKE



PERCENT OF LAKES WITH ANY ADULT LOONS



LOON JUVENILES PER TWO ADULTS

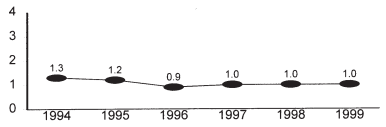


COOK/LAKE INDEX AREA

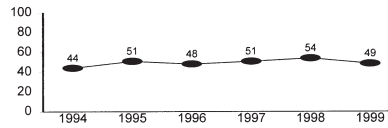
CHARACTERISTICS

HIGH ACID RAIN SENSTIVITY
LOW DENSITY OF HUMANS AND ROADS
SLOW HUMAN POPULATION GROWTH
PREDOMINANTLY PUBLIC LANDS
AVERAGE LAKE SIZE = 213 ACRES

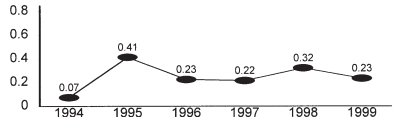
ADULT LOONS PER 100 ACRES OF LAKE



PERCENT OF LAKES WITH ANY ADULT LOONS



LOON JUVENILES PER TWO ADULTS

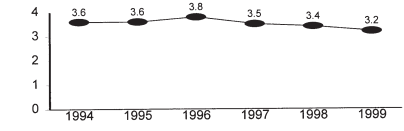


ITASCA INDEX AREA

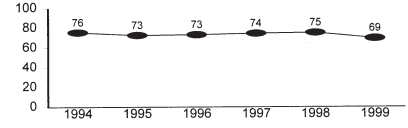
CHARACTERISTICS

HIGH ACID RAIN SENSTIVITY
LOW DENSITY OF HUMANS AND ROADS
SLOW HUMAN POPULATION GROWTH
PREDOMINANTLY PUBLIC LANDS
AVERAGE LAKE SIZE = 199 ACRES

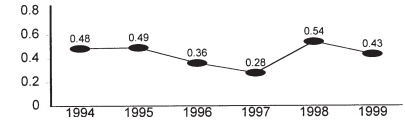
ADULT LOONS PER 100 ACRES OF LAKE

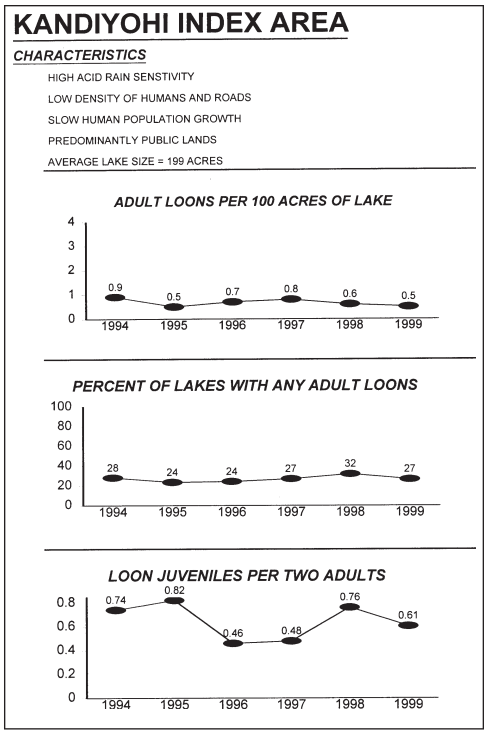


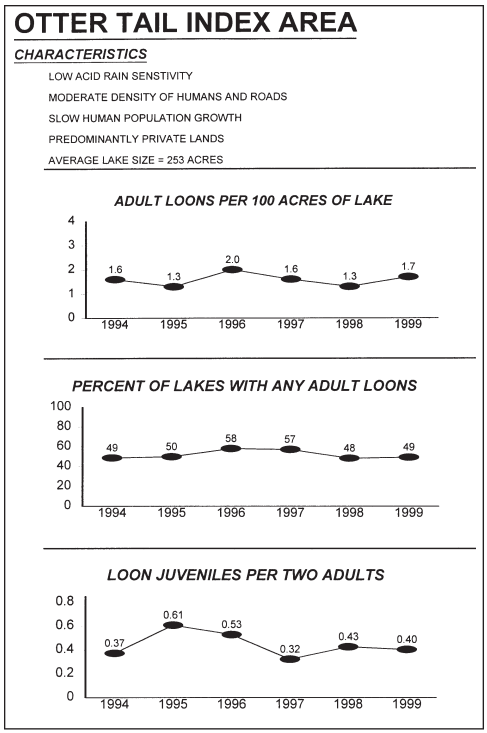
PERCENT OF LAKES WITH ANY ADULT LOONS



LOON JUVENILES PER TWO ADULTS







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Fall Staging of the Common Loon on Lakes Winnibigoshish and Mille Lacs

Anthony X. Hertzel, Karen R. Sussman, and Peder H. Svingen

Forty Common Loons on Mille Lacs near Wealthwood, Aitkin County, October, 1998. Photo by Anthony X. Hertzel.

Introduction

Mille Lacs has long been known as a lake for pre-migratory fall staging of the Common Loon (*Gavia immer*) in Minnesota, based primarily on surveys there from 24 September – 11 November 1975 by Judith McIntyre and Jack Barr; they documented a peak of 600–750 loons during the last week of October (McIntyre and Barr 1983). Other large lakes in northern Minnesota, including Lake of the Woods, Leech Lake, Upper and Lower Red Lake, and Lake Vermilion, may also serve as staging areas but none of these have ever been systematically surveyed for loons during fall migration.

On 20 October 1996, Karl Bardon and Peder Svingen counted 1,497 Common Loons on Lake Winnibigoshish (Tessen 1997) which included a single, compact flock of 1,090 birds on Bena Bay! As a follow-up to this astonishing discovery, the authors surveyed "Lake Winnie" on a regular basis during fall 1997 and found 474 loons on 8 September, 655 loons on 14 September, 911 loons on 4 October, 1,108 loons on 6 October includ-

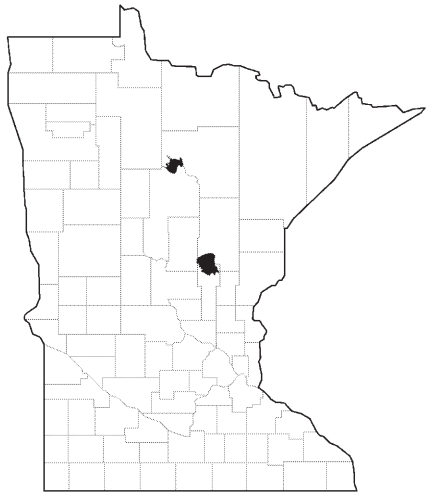

Figure 1. Location in Minnesota of Lake Winnibigoshish (north) and Mille Lacs (south).

ing 418 in one flock, over 1,100 loons on 13 October, 1,080 loons on 20 October including 424 in one flock, 534 loons on 27 October, but then less than 20 loons on three November dates (unpub. data). These data and discussion with local resort owners suggested that pre-migratory staging of the Common Loon occurs each fall on Lake Winnie as well as on Mille Lacs.

The following study was designed to compare the magnitude and timing of pre-migratory fall staging on these two Minnesota lakes (Figure 1). We hypothesized that pre-migratory staging peaks earlier in the fall on Lake Winnie compared to Mille Lacs. We also hypothesized that the total number of Common Loons staging on Lake Winnie is equal to or greater than the number on Mille Lacs through at least mid-October.

Methods

Lake Winnibigoshish. Numbers of Common Loons staging on Lake Winnibigoshish in north-central Minnesota were determined by systematic ground-based surveys on 16 dates from 15 August through 22 November 1998, and a boat survey on 28 September 1998. Lake Winnie is a 28,256 hectares shallow lake in Cass and Itasca counties, well-known for sport fishing and waterfowl hunting. Counts were made from 12 shore locations (Figure 2), from Bowen Lodge on Sugar Bush Point, then around the lake clockwise to the Lake Winnie Campground, located just north of the Mississippi River inflow. Surveys by airplane were considered unnecessary due to the topography and layout of Lake Winnie. Bowen Lodge, Plug Hat Point, Tamarack Point Campground, and Birches public access are elevated well above lake level and provide excellent vantage points, although the northwest aspect of Lake Winnie still cannot be adequately surveyed from shore. North of the Lake Winnie campground to Third River Flowage and then along the north shore as far east as Gull Point, there are no readily accessible locations for counting from shore. Surveys by boat were therefore planned in order to examine inaccessible areas, identify favored locations for flocking, and assess the validity of ground-based surveys.

In preparation for these boat surveys, north-south transects at one mile intervals were plotted onto a map of Lake Winnie with Universal Transverse Mercator (UTM) coordinates for each waypoint; these were also programmed into a Global Positioning System (GPS). We followed every other transect line (i.e. at two mile intervals) and counted each loon that was encountered; seven and a half hours were needed to complete the 28 September boat survey. We stopped periodically to scan with binoculars from both sides of the boat and when flocks were detected, we departed from the transect to count them and then returned to the original transect. Flocks larger than 100 individuals were counted three times and the median number was recorded, along with UTM coordinates and time of day. Singles or small groups were difficult to detect at more than one-half mile from the transect line, especially when surface conditions were choppy; it is therefore unlikely that loons were double counted during the paral-

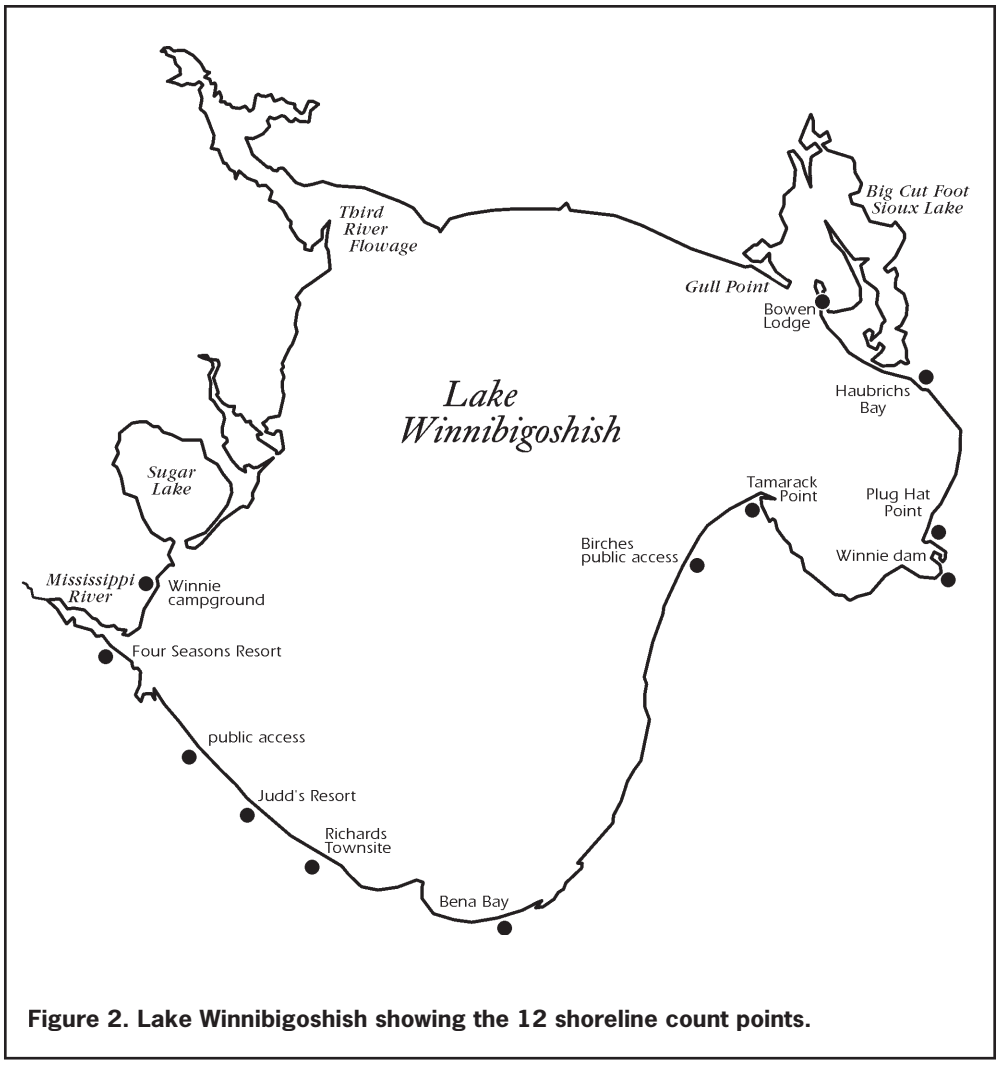

Figure 2. Lake Winnibigoshish showing the 12 shoreline count points.

lel transects. Flocks received special consideration, not only to avoid disturbance but also to minimize the possibility of double counting by periodically noting their position during the boat survey.

Mille Lacs. Numbers of Common Loons staging on Mille Lacs in east-central Minnesota were determined by systematic ground-based surveys on 14 dates from 10 August through 27 November 1998, and two aerial surveys on 13 September and 2 November 1998. Mille Lacs is a 53,628 hectares shallow lake in Aitkin, Crow Wing, and Mille Lacs counties, approximately 80 miles southeast of Lake Winnie, well-known for walleye and other sport fishing. Surveys by boat were initially proposed for Mille Lacs as well; however, our experience on Lake Winnie immediately suggested that Mille Lacs could not be completely surveyed in one day, unless at least two boats were used. Mille Lacs is nearly twice as large in surface area compared to Lake Winnie. It is also less

Figure 3. Mille Lacs showing the 28 shoreline count points.

sheltered by surrounding topography; boating conditions are less predictable and can change quickly.

Numbers of loons were recorded at 28 shore locations around the entire lake (Figure 3), but all loons seen on Mille Lacs were included in the totals, even those seen while driving between two locations. The west and northwest sides of Mille Lacs, where McIntyre and Barr found the highest loon concentrations in 1975, could be readily surveyed from shore; however, we could not adequately see those areas near distant islands in the southwest and southeast portions of the lake where they found additional concentrations. Our experience surveying loons on these lakes since 1996 has shown that accurate counts from shore are impossible when moderate chop is present on the lake surface. Calm or near-calm surface conditions are rare on Mille Lacs during late October when loon numbers are expected to peak. Unlike Lake Winnie, there are few

elevated vantage points around Mille Lacs which further limits visibility from shore, thus the vast majority of Mille Lacs cannot be surveyed from shore.

In order to address these limitations, all of Mille Lacs was surveyed by air on 13 September and again on 2 November. On the latter date, a simultaneous shore-based survey was conducted. Each aerial survey required just over two hours of flying time over the lake. East-west transects at one mile intervals were flown at altitudes of 400 (2 November) to 500 (13 September) feet above the lake surface. When flocks of loons were encountered, the pilot circled at a lower altitude until a satisfactory count was determined. Exact locations of large flocks (>100 loons) were recorded using the airplane's GPS coordinates.

For both lakes, shore-based counts were made through a Swarowski ST-80 spotting scope @20–60X with number of loons and time spent counting recorded at each stop. Time of day, wind speed and direction, cloud cover, and lake surface conditions were recorded at the beginning and end of each survey, and also whenever these changed significantly. The time of day and approximate location were also noted whenever loon flocks were encountered. Counts of over 100 loons from any location were recounted at least once with the higher of two numbers used, to ensure that actively diving loons were included. The largest flocks were counted three times and the median number was used, to minimize the chance of recounting those individuals that were diving and resurfacing among loons that had not yet been counted. Two counts from Lake Winnie (20 loons on 29 August and 82 loons on 1 November) and one from Mille Lacs (130 loons on 11 October) were excluded from analyses because adverse weather and/or lake surface conditions resulted in low counts that were known to be inaccurate; these data were still included in the relevant tables.

Results

Lake Winnibigoshish. The total number of Common Loons counted on Lake Winnie was consistently 400–500 throughout September and into mid-October, when numbers significantly increased (Table 1). The first large flock of loons (88) was found on 5 September. Single flocks of over 400 loons were found during three of the October surveys; the largest (528) was found off Birches public access on 21 October. This was also the date of the highest total count (**1,599**) this season (Figure 4) and exceeds the previous record high count for Lake Winnie (1,497 on 20 October 1996). Just four days later on 25 October the count was 914 and on 8 November it was 580. A powerful storm passed through northern Minnesota on 10–11 November 1998, producing an all time low barometric pressure reading in Duluth with winds up to 70 mph on Lake Superior; although subsequent surveys of Lake Winnie were hampered by downed trees which blocked access to two shore locations, only five loons could be found on 15 November!

The entire lake was surveyed by boat on 28 September 1998 (Figure 5). Additional boat surveys on Lake Winnie were planned and attempted on three other dates, but all were aborted due to adverse weather and lake conditions. Compared with the shore-based counts of 413 one week earlier and 492 one week later, the total of 414 loons counted by boat was remarkably consistent. We also performed a shore-based count on 27 September for comparison to the boat survey; windy conditions apparently suppressed this count to 331 but we did not include a distant flock estimated at 180 birds (unidentifiable loons or cormorants) north of Bena. During the boat survey the following day, we did locate a flock of 186 loons approximately two miles southwest of Birches at UTM coordinates 0411872 & 5253630. This flock, discovered at 11:15 A.M. Central Daylight Savings Time (CDST), was in an area that consistently produced flocks during our 1997 shore-based surveys. The loons were mostly swimming or preening, and giving soft "hoot" calls (McIntyre and Barr 1997) when first encountered; we

Loons	Date	Survey Method	Viewing Conditions	Time of day
148	15 August	shore	warm, light winds	1:45 P.M.– 6:20 P.M.
142	22 August	shore	light wind, fog clearing	3:00 P.M.– 7:35 P.M.
20	29 August	shore	poor, windy, rainy	3:30 P.M.– 8:15 P.M.
408	5 September	shore	calm, very warm	2:10 P.M.– 7:40 P.M.
424	14 September	shore	NW winds, mild chop	12:45 P.M.– 6:55 P.M.
413	21 September	shore	NW winds, mild chop	11:35 A.M.– 6:40 P.M.
331	27 September	shore	NW wind, heavy chop	2:42 P.M.– 7:25 P.M.
414	28 September	boat	calm, clear	7:45 A.M.– 3:15 P.M.
492	4 October	shore	E winds, choppy	1:00 P.M.– 4:55 P.M.
330	10 October	shore	NE winds, hazy	11:55 A.M.– 4:30 P.M.
441	14 October	shore	SE winds, mod. chop	7:45 A.M.– 2:00 P.M.
1599	21 October	shore	light winds, clear	8:30 A.M.– 2:35 P.M.
914	25 October	shore	windy then calm	7:20 A.M.– 1:45 P.M.
82	1 November	shore	calm, foggy	11:10 A.M.– 3:35 P.M.
580	8 November	shore	calm, cold	8:50 A.M.– 3:08 P.M.
5	15 November	shore	light wind, mild chop	8:55 A.M.– 2:00 P.M.
0	22 November	shore	calm, clear	9:40 A.M.– 12:10 P.M.

Table 1. Count totals, count dates, and survey method for Lake Winnibigoshish.

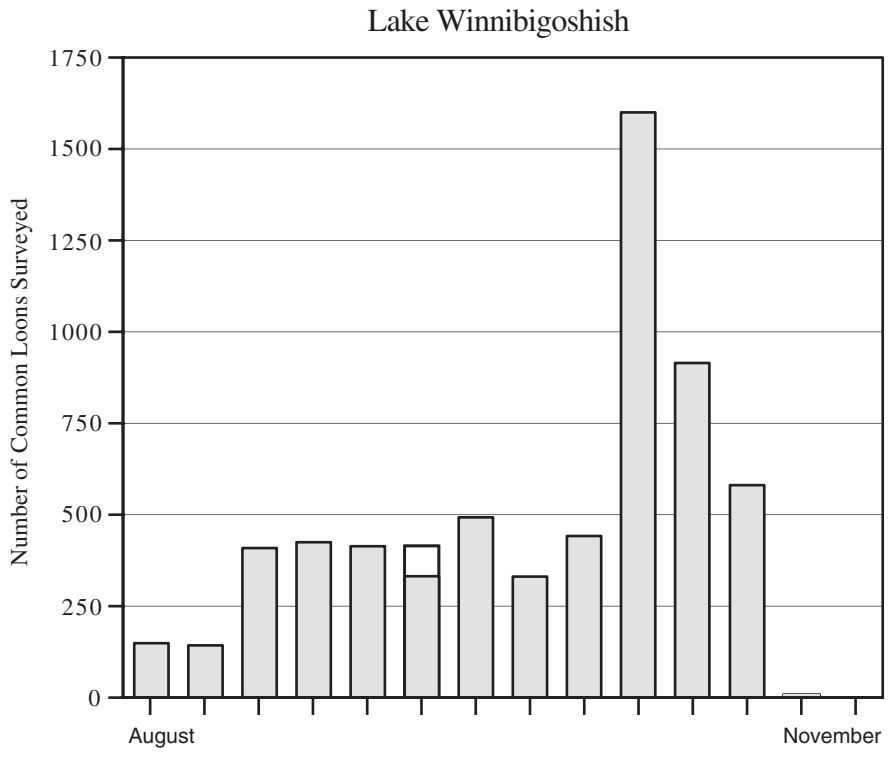

Figure 4. Significant Common Loon counts on Lake Winnibigoshish, 15 August to 8 November 1998. Gray and white bar indicates totals from both shore (gray) and boat (white).

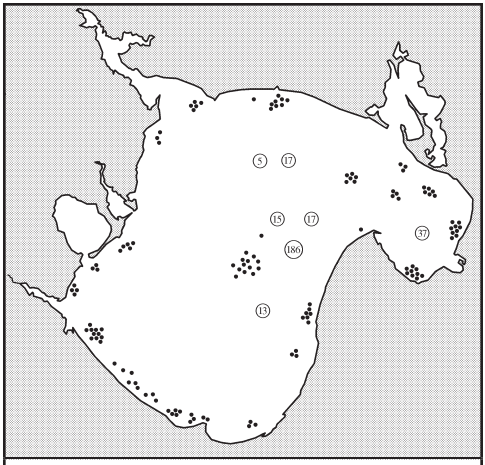

Figure 5. Locations of 414 Common Loons counted during a boat survey of Lake Winnibigoshish, 28 September 1998. A "•" represents 1 loon; numbers represent small groups or flocks.

watched them disperse in smaller groups as diving and feeding activities increased. Six smaller flocks containing 5, 13, 15, 17, 17, and 37 loons were located during this boat survey; all except the flock of 13 were found between 9:30 and 11:15 A.M. CDST.

Mille Lacs. The total number of Common Loons counted on Mille Lacs was consistently at or below 200 individuals for the first six weeks of the survey beginning in mid-August, but by the second half of September numbers began increasing steadily (Table 2). By 21 September the number of Common Loons on Mille Lacs had risen to 280. Not coincidentally, no large flocks were recorded until this date when 102 birds were seen off Wealthwood. The next count was two weeks later on 5 October. This produced a total of 628 loons and a single large group of 367 birds off Lakeside Drive.

Poor weather conditions and limited visibility resulted in a count of only 130 Common Loons on 11 October, but certainly the actual number present was considerably higher. One week later, on 20 October, four large, separate flocks of over 100 loons each were observed, and the total count for the day was an astounding 1688 birds — the season high count for Mille Lacs (Figure 6) and a record high count for any lake in Minnesota at any time. The largest group, containing 380 birds, was found at Wigwam Bay, and the remaining larger groups were found in the northeast (Reddy Creek, 304), the east (Carlsona Beach Club, 164), and the southwest (County Road 35, 124). Additional groups numbering 95 (dead end road), 93 (U.S. highway 169 rest stop), and 86 (Wealthwood public access) were also noteworthy.

The following week produced the second highest count for the season with 629 Common Loons tallied, but this high number still represents a decrease of over a thousand birds from the previous week. Only one large concentration of loons was noted, that of 192 birds found at the dead end road access in the northwest. Another 38 loons which were not associating with the larger flock were also counted from this location. Smaller groups of 82 birds near the Wealthwood public access, 64 birds at Wigwam Bay, and 62 birds at the Garrsion harbor were also recorded.

Numbers of Common Loons on Mille Lacs dropped quickly over the next three weeks. A total of 454 was counted during a 2 November aerial survey of the entire lake (Figure 7), while a simultaneous ground-based survey totaled 308 loons. The largest flocks recorded during this effort were a group of 70 loons counted from shore at Agate Bay and approximately 80 individuals found three miles west of Liberty Beach during the aerial survey. It is quite possible, however, that these two counts actually represented the same flock of loons.

On 9 November the total count declined to 277 birds, and the following week, on 22 November, no loons were seen at all. The final survey was conducted on 27 November when only two mCommon Loons were recorded.

Loons	Date	Survey Method	Viewing Contitions	Time of day
41	10 August	shore	calm, clear	9:40 A.M.– 2:13 P.M.
27	17 August	shore	windy, clear	10:48 A.M.– 3:38 P.M.
99	24 August	shore	calm, clear	11:25 A.M.– 4:55 P.M.
200	1 September	shore	warm, clear	9:10 A.M.– 2:45 P.M.
45	7 September	shore	poor, choppy	9:10 A.M.– 1:55 P.M.
55	13 September	air	clear	10:00 A.M.– 12:20 P.M.
280	21 September	shore	windy, choppy	9:45 A.M.– 2:30 P.M.
628	5 October	shore	slight wind	9:38 A.M.– 3:12 P.M.
130	11 October	shore	very poor, windy	1:50 P.M.– 5:55 P.M.
1688	20 October	shore	calm, clear	9:35 A.M.– 3:29 P.M.
629	27 October	shore	light wind	9:38 A.M.– 4:03 P.M.
454	2 November	air	clear, windy	9:00 A.M.– 11:30 A.M.
308	2 November	shore	clear, windy	9:00 A.M.– 3:00 P.M.
277	9 November	shore	poor, foggy	7:00 A.M.– 1:05 P.M.
0	22 November	shore	light wind	2:00 P.M.– 5:00 P.M.
2	27 November	shore	clear, calm	1:20 P.M.– 4:40 P.M.

Table 2. Count totals, count dates, survey method, and conditions for Mille Lacs. Bracket indicates simultaneous counts.

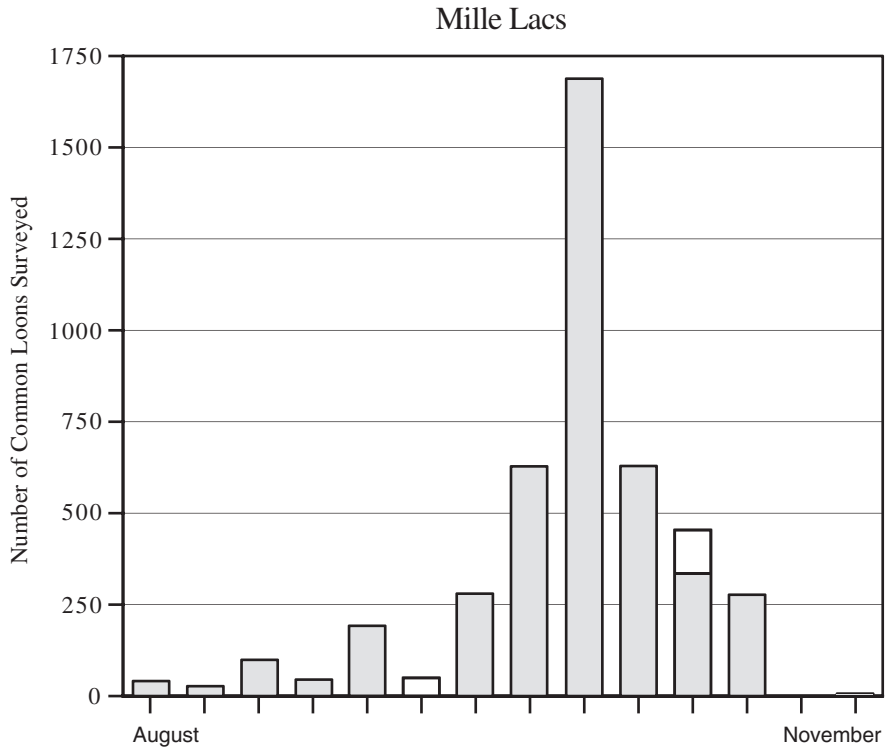

Figure 6. Significant Common Loon counts on Mille Lacs, 10 August to 10 November 1998. Gray indicates totals from shore and white indicates totals from air.

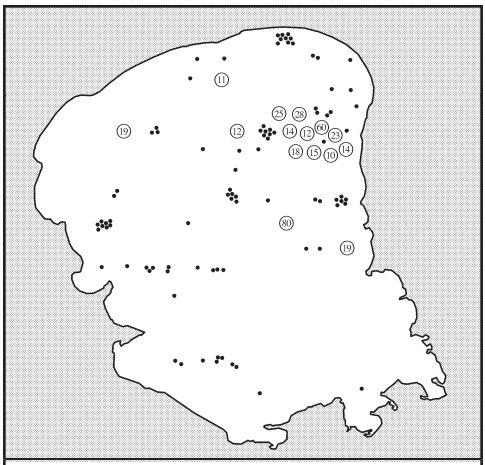

Figure 7. Locations of 454 Common Loons counted during an aerial survey of Mille Lacs, 2 November 1998. A "•" represents 1 loon; numbers represent small groups or flocks.

Discussion

We consistently found greater numbers of Common Loons on Lake Winnie than on Mille Lacs through late September (Figure 8). Unfortunately, due to poor weather conditions, we lack a reliable 1998 count for Mille Lacs between 4 October when 628 were found, and 20 October when a remarkable 1,688 were found. It appears that pre-migratory fall staging on Lake Winnie in 1998 started earlier and that higher numbers were sustained into October. These data confirm that both Lakes Winnibigoshish and Mille Lacs are major fall staging areas for the Common Loon in Minnesota; both these lakes deserve consideration as Important Bird Areas (IBAs).

Based on the available data, the initial build-up was apparently delayed on Mille Lacs compared to Lake Winnie. However, peak counts occured at about the same time on both lakes (Figure 8). McIntyre and Barr (1983) recorded peak counts on Mille Lacs during the last week of October, about a week later than our study.

The most recent estimate of the Minnesota breeding population is between 10,359 and 12,893 loons based upon a coordinated survey of 723 Minnesota lakes on 15 July 1989 (Strong and Baker 1991). It is possible that the September build-up at Lake Winnie primarily represents loons from nearby breeding locations, while the more dramatic October peaks on both lakes reflect an influx from populations farther north. During fall 1998 on Lake Winnie, numbers peaked at 1,599 on 21 October. Similar shore-based surveys of Lake Winnie the previous fall, from the same 12 access points, peaked at 1,108 loons on 6 October 1997 and 1,080 loons on 20 October 1997. Presumably, the count of 1,497 loons on 20 October 1996 represented the peak for that year, although systematic surveys were not begun until 1997. These October dates for peak counts on Lake Winnie have been remarkably consistent for three years in a row.

The largest flocks on Lake Winnie in 1998 were 528 off Birches public access on 21 October, 424 off Bena on 25 October, 410 off Bowen Lodge on 4 October, and 319 off Birches plus an uncountable large flock off Bena on 14 October. The largest flocks in 1997 were 418 off Birches on 6 October and 424 off Bena on 20 October. The largest single flock ever found in Minnesota was 1,090 loons off Bena on 20 October 1996. The location of large flocks on Lake Winnie in 1998 was apparently correlated with wind speed and direction; the only two times that large flocks were found off Richard's Townsite and Judd's Resort were on days with southwest to northwest winds >10 mph. Two days with east to northeast winds >10 mph apparently resulted in formation of a large flock off Bowen Lodge. Large flocks were seen off Bena, Birches, or Tamarack Point on days with southwest to southeast winds >10 mph, or on days with winds <10 mph from any direction. This suggests either that loons prefer relatively sheltered areas when forming large flocks, or that individual loons seek the same sheltered areas for other reasons, inadvertently resulting in formation of a large flock in those areas. The relationship between wind direction and flock location was less clear on Mille Lacs, possibly due to the larger size of the lake and the lack of sheltering topography.

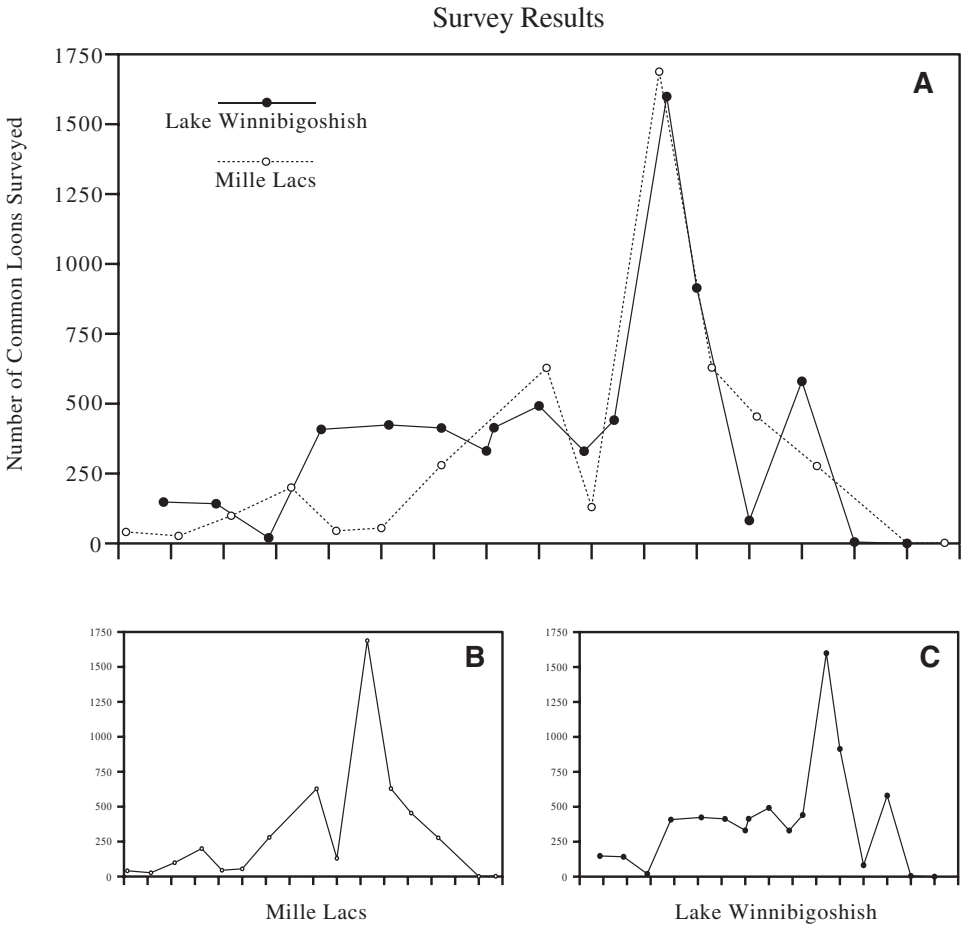

Figure 8. Common Loon count totals for Lake Winnigigoshish and Mille Lacs over the same 16 week period (10 August – 27 November). A= both lakes; B=Mille Lacs; C=Lake Winnibigoshish. The interval between tick marks on the horizontal axis is one week.

We analyzed our 1998 and 1997 shore-based surveys of Lake Winnie for timing of flock formation, with all times adjusted to CDST. In 1998, 10 out of 16 flocks containing 20 or more individuals were discovered between 10:30 A.M. and 1:05 P.M.; the others were 8:00 to 9:15 A.M. (3 flocks) and 3:00 to 5:30 P.M. (3 flocks). In 1997, 9 out of 13 flocks containing 20 or more individuals were discovered between 11:45 A.M. and 1:10 P.M.; a flock of 261 was seen at 8:55 A.M. and the others were found between 2:45 and 5:35 P.M. Although we did not make detailed notes on behavior of loons within these large flocks on Lake Winnie, our data suggests that the largest flocks were encountered at times of day when active feeding may be less likely.

McIntyre and Barr (1983) found that over 80% of all feeding groups studied on Mille Lacs contained 20 or fewer individuals; feeding behavior was initiated at about

9:00 A.M. CDST, declined between 11:00 and 12:00, and then resumed after noon with a peak of feeding activity between 2:00 and 4:00 P.M. Loons forage more than 50% of daylight hours in both fall and winter (McIntyre and Barr 1997). In McIntyre's and Barr's (1983) Mille Lacs study, larger flocks sometimes arose through sudden convergence of smaller feeding groups. Only 47% of the groups engaged in activities other than feeding were comprised of 20 or fewer individuals (McIntyre and Barr 1983).

Shore-based surveys of Common Loons staging on Lake Winnibigoshish are cost-effective and appear to be reliable, based on comparison with only one completed boat survey. Additional comparisons between shore-based and boat surveys are needed, and the use of aerial surveys at Lake Winnie should be evaluated in future years. Aerial surveys are efficient and are most accurate for monitoring pre-migratory fall staging on Mille Lacs; shore-based surveys are relatively inexpensive but extensive areas of this lake cannot be seen from shore, and results are strongly influenced by wind and lake surface conditions. Boat surveys have an important role on both lakes for detailed behavioral observations, and determination of flock sizes, flock locations, and flock movements.

Systematic shore-based surveys of pre-migratory fall staging areas avoid many of the limitations inherent to single surveys (Belant *et al.* 1993). However, large flocks may be difficult to accurately count when birds are actively diving and resurfacing. A minimum of three counts at each location where large flocks are encountered is recommended. These concerns are not alleviated by using a boat and may even be more problematic, since the observers have a reduced line of sight even if standing up in the boat, while the boat itself is drifting and rocking in the swells. Videography from shore and aerial photography may be useful tools for counting flocks. Aerial surveys using standardized methodology are efficient and reliable, but also expensive (Lanctot and Quang 1992, Groves *et al.* 1996). A simultaneous shore-based, boat, and aerial survey over Lake Winnibigoshish on a relatively calm day would help evaluate the reliability and validity of these three methods for long term monitoring during pre-migratory fall staging of the Common Loon in Minnesota.

Acknowledgments

The 1998 loon surveys were supported by a grant from the Minnesota DNR Nongame Program; we thank Pam Perry (Region III, Brainerd) and Jeff Hines (Region II, Grand Rapids) for coordinating technical and logistical support for this project. Dick Stoltman was our pilot during the aerial surveys over Mille Lacs and shared our enthusiasm for loons. We thank the DNR Fisheries Program in Grand Rapids for the use of their boat, and Jerry and Joyce Karau for letting us launch and dock the boat at the Williams Narrows Resort. Karl Bardon, Kim Eckert, and Ann Hertzel helped during several surveys. We gratefully acknowledge the many resort owners on both lakes who granted permission to count loons from their property; special thanks to our friends at Bowen Lodge and Judd's Resort on Lake Winnie.

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Common Loon Migration in the Great Lakes Basin

Peder H. Svingen

Flocks of Common Loons (*Gavia immer*) have been reported during all seasons, including summer (Rand 1948, Predy 1972, Nero 1974, Lysack 1985, Croskery 1988). In late summer, loons gather from early to mid-morning and again from late afternoon into early evening, for "ritualized ceremonies" that are sometimes referred to as Summer Flocking, Social Gatherings, or Greeting Ceremonies (McIntyre 1976).

During a fall 1975 study (McIntyre and Barr 1983) on Mille Lacs in Minnesota, over 80% of the feeding flocks contained 20 or fewer loons. Even when much larger rafts formed at dusk, these smaller groups remained intact overnight and moved together to feeding areas in the early morning. Common Loons also form rafts at night in wintering areas (McIntyre 1978, Daub 1989, Ford and Gieg 1995).

Common Loon Migration

Migration of the Common Loon occurs primarily during the first few hours of daylight in spring and fall, as individuals or small groups of two to fifteen birds (Preston 1956, Williams 1973, Ewert 1982, Kerlinger 1982, Powers and Cherry 1983). Adverse weather occasionally "grounds" birds on small lakes during migration, such as the flock of 150 at Buckeye Lake, Ohio, on 2 November 1927 (Trautman 1940). Tracking radar documented loon migration at altitudes between 973 and 2,167 meters above ground level over eastern New York state (Kerlinger 1982), but two studies found migration at lower altitudes (200 meters or less) over the Great Lakes (Ewert 1982, Sanders 1993).

There are limited data regarding the actual migration routes used by Common Loons breeding within the Great Lakes Basin (McIntyre and Barr 1997). Common Loons from the western Great Lakes are believed to winter along the Gulf Coast (McIntyre 1988a, Belant *et al.* 1991). Eberhardt (1984) reported 17 recoveries from the 154 loons banded in Minnesota between 1975 and 1982; the 4 recovered during the winter season were all in Florida waters.

Migration in Minnesota

Spring migration of the Common Loon in Minnesota occurs from late March through late May (Janssen 1987). Peak counts during spring migration include "two to three hundred loons" reported on Centerville Lake, Anoka County, on about 19 April 1950 (Haag 1966); 200 on Lake Gervais, Ramsey County, on 24 April 1951 (Lupient 1951); and 200 reported by Judith McIntyre from Lake of the Woods on 2 May 1972 (Eckert 1972).

Fall migration of the Common Loon in Minnesota occurs from late August into early December (Janssen 1987). Historical counts from Mille Lacs include at least 500 loons observed from a boat on 11 November 1969 (Campbell 1970) and Savaloja's estimate of 1,000 loons on 23 October 1972 (Eckert 1973). Composite aerial, boat, and shoreline counts during a 1975 study of pre-migratory fall staging on Mille Lacs found a peak of 600–750 loons during the last week in October (McIntyre and Barr 1983).

Pre-migratory fall staging is known to occur annually on Lakes Winnibigoshish and

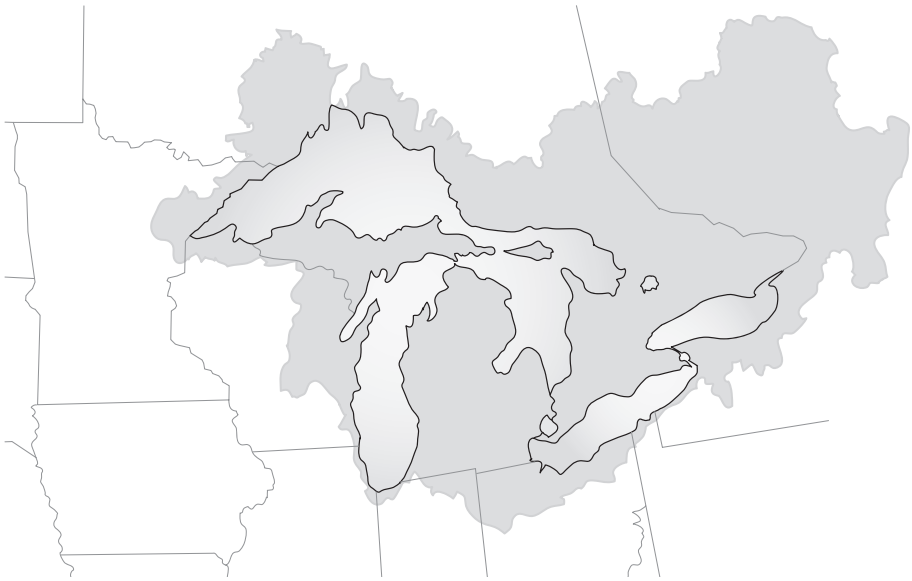

Figure 1. The Great Lakes Basin (GLB). GLB North includes all of Lake Superior. GLB Central includes Lakes Ontario and Huron, plus the northern two-thirds of Lake Michigan. GLB South includes Lake Erie and the southern one-third of Lake Michigan (adapted from Russell, unpubl. ms).

Mille Lacs. On 20 October 1996, Karl Bardon and Peder Svingen discovered and carefully counted a single flock of 1,090 loons on Lake Winnibigoshish; an additional 407 were found elsewhere on "Lake Winnie" for a total of 1,497 (Budde *et al.* 1997). At the time, this became the record high count for Minnesota. Shore-based surveys on Lake Winnie during fall 1997 found over 1,000 loons on three different October dates. The two largest flocks in 1997 were 418 loons on the 6th and 424 loons on the 20th (unpubl. data).

These remarkable findings led to the 1998 comparative study of pre-migratory fall staging that is described elsewhere in this occasional paper. Record high counts of 1,688 loons on 20 October (Mille Lacs) and 1,599 on 21 October (Lake Winnie) were documented during that study. The largest flock in 1998 was 528 on Lake Winnie, on 21 October. Other large lakes in northern Minnesota, such as Lake of the Woods, Leech Lake, Upper and Lower Red Lakes, and Lake Vermilion, may also serve as staging areas but these have never been systematically surveyed for Common Loons during fall migration.

Migration in the Great Lakes Basin

Staging of the Common Loon occurs during both spring and fall migration (McIntyre and Barr 1997). Lake Winnie and Mille Lacs fall outside of the Great Lakes Basin, yet high counts from these two Minnesota lakes (see above) rival some of those from the Great Lakes. Representative high counts for the Great Lakes Basin are listed in Table 1. These data were gleaned from *American Birds*, *Field Notes,* and *Michigan Birds and Natural History.* High counts published elsewhere, such as *Kingbird* and *Ontario Birds*

may not be included. Submission of additional counts for Russell's manuscript is most welcome.

The highest counts during the spring migration within the Great Lakes Basin are from Whitefish Point on eastern Lake Superior (Table 1). Whitefish Point Bird Observatory (WPBO) conducts an annual spring and fall census of loon migration. WPBO should be credited for the counts from Whitefish Point in Table 1. A Spring 1982 study of Common Loon migration at Whitefish Point discovered that about 70% of the seasonal total (3,381 of 4,838) occurred between 7 and 10 May, yet the largest migrating group consisted of only 11 birds (Ewert 1982). In Wisconsin, Kohel (1972) suggested that spring migration routes follow large rivers in addition to the Lake Michigan shoreline.

Elsewhere in the Great Lakes Basin, the highest counts are from fall. Large flocks of Common Loons routinely form on the Great Lakes during late autumn. "Hundreds or even thousands" of loons may congregate off Kettle Point on Lake Huron (Klein 1996); e.g., during just two hours on 17 October 1992 a total of 1,680 was tallied.

Studies based on loons found dead along the north shore of Lake Michigan during October, and along the south shore during November and December (McIntyre 1988a), provide insight into the magnitude and timing of fall migration. Eight major outbreaks of Type E botulism between 1959 and 1983 killed thousands of loons (Brand *et al.* 1983, Klein 1996). About 3,300 died November–December 1963 and 3,570 died during the fall of 1964 alone (Robinson *et al.* 1988).

Impressive numbers of Common Loons migrate through the "Finger Lakes" region of western New York, especially at Taughannock Falls State Park on Cayuga Lake (Wells 1991, Evans *et al.* 1994). The 3,416 Common Loons counted from the loon watch at Taughannock Falls on 29 November 1995 (Table 1) is apparently the highest count by a single party within the Great Lakes Basin (Russell unpub. ms). The boundaries of the Great Lakes Basin (Fig. 1) are based on NOAA chart 14500 from the National Ocean Service and Coast Survey.

Status in Minnesota

In Minnesota, the breeding population of Common Loons had already declined due to shooting and nesting disturbances by the time (1932) that Roberts' *The Birds of Minnesota* was published. Since then, recreational use of lakes in Minnesota has increased significantly (Ream 1976, Titus and Van Druff 1981, McIntyre 1988a). The impact of jetskis needs further study.

Heavy metal toxicity also threatens the state's Common Loon population. Ensor *et al.* (1993) documented mercury levels associated with imparied reproduction. Lead sinkers have been identified as another mortality factor (Pokras and Chafel 1992, Franson and Cliplef 1993, Twiss and Thomas 1998).

The Common Loon population in the Knife Lake area of the Boundary Waters Canoe Area Wilderness during late July 1984 (Mooty and Goodermote 1985) was stable compared to surveys done in 1950 (Olson and Marshall 1952). However, McIntyre (1988b), in a 15-year interval survey of 230 Minnesota lakes, found a downward trend in lake use by loons from 1971 to 1986.

Coordinated surveys of 723 Minnesota lakes during mid-July 1989 resulted in an estimated adult summer Common Loon population of 10,359 to 12,893 loons in the state (Strong and Baker 1991). Recent follow-up surveys are summarized by Baker elsewhere in this occasional paper.

Status in the Great Lakes Basin

Common Loons no longer nest across the southern tier of the Great Lakes Basin where formerly common (Bent 1919, McIntyre and Barr 1997). Concern about Com-

	Total	Location	Lake	Count Date	Reference
Great L. Basin — NORTH	2,094	Whitefish Point, MI	Superior	7 May 1996	Reinoehl 1996
	1,882	Whitefish Point, MI	Superior	8 May 1982	Ewert 1982
	1,500	Whitefish Point, MI	Superior	4 May 1995	Reinoehl 1995
	1,486	Whitefish Point, MI	Superior	2 May 1995	Granlund 1995
	1,463	Whitefish Point, MI	Superior	17 May 1989	Powell 1989
	1,341	Whitefish Point, MI	Superior	6 May 1984	Powell 1984
	1,117	Whitefish Point, MI	Superior	3 May 1994	Reinoehl 1994
	1,087	Whitefish Point, MI	Superior	29 Apr 1990	Powell 1990
	1,084	Whitefish Point, MI	Superior	3 May 1997	Reinoehl 1997
	1,054	Whitefish Point, MI	Superior	2 May 1999	Reinoehl 1999
	1,007	Whitefish Point, MI	Superior	15 Sep 1997	Chartier 1998
Great L. Basin — CENTRAL	3,000	Hamlin Beach, NY	Ontario	1 Nov 1986	Kibbe 1987
	2,400	Kettle Point, ON[1]	Huron	4 Nov 1977	Goodwin 1978
	2,000	Sodus Bay, NY	Ontario	9 Nov 1985	Kibbe *et al.* 1986
	2,000	Ipperwash, ON[1]	Huron	11 Nov 1977	Russell, unpub. ms
	2,000	Ipperwash, ON	Huron	21 Nov 1971	Russell, unpub. ms
	1,680	Kettle Point, ON	Huron	17 Oct 1992	Ridout 1993a
	1,500	Manistee Co., MI	Michigan	26 Oct 1997	Chartier 1998
	1,000	Webster Park, NY	Ontario	20 Oct 1989	Paxton *et al.* 1990
	1,000	Tawas Point, MI	Huron	24 Oct 1988	Tessen 1989
	941	Manitoulin Is., ON	Huron	2 May 1993	Ridout 1993b
	912	P.E. Point, ON	Ontario	25 Apr 1986	Weir 1986
Great L. Basin — SOUTH	3,416	Taughannock, NY[2]	Cayuga	29 Nov 1995	Russell, unpub. ms
	3,337	Taughannock, NY	Cayuga	22 Nov 1995	Paxton *et al.* 1996
	3,206	Taughannock, NY	Cayuga	Fall 1996	Russell, unpub. ms
	1,300	Berrien Co., MI	Michigan	10 Nov 1992	Tessen 1993
	1,224	Taughannock, NY	Cayuga	2 Nov 1993	Boyle *et al.* 1994
	1,140	Taughannock, NY	Cayuga	7 Nov 1993	Boyle *et al.* 1994
	1,077	Presque Isle, PA	Erie	11 Dec 1993	Hall 1994
	1,030	Indiana "shoreline"	Michigan	2 Apr 1999	Brock 1999
	952	LaPorte Co., IN	Michigan	19 Nov 1988	Peterjohn 1989
	943	Taughannock, NY	Cayuga	1 Nov 1993	Boyle *et al.* 1994
	938	Headlands, OH	Erie	18 Nov 1989	Peterjohn 1990

Table 1. Representative high counts of the Common Loon for three parts of the Great Lakes Basin. Locations refer to Whitefish Point in Chippewa County, Michigan; Hamlin Beach State Park in Monroe County, New York; Kettle Point and Ipperwash Provincial Park in Lambton County, Ontario; Webster Park east of Rochester, Monroe County, New York; Tawas Point State Park in Iosco County, Michigan; Prince Edward Point (P.E. Point) in Prince Edward County, Ontario; Taughannock Falls State Park in Tompkins County, New York; Presque Isle State Park in Erie County, Pennsylvania; and Headlands Beach State Park in Lake County, Ohio. [1]Counts from Kettle Point and Ipperwash may overlap. [2]The total of 3,365 for 29 November 1995 (Paxton et al. 1996) is erroneous according to Russell. "Russell, unpub. ms" refers to "Single party high counts for birds of the Great Lakes."

mon Loon populations precipitated regional and international efforts in the Great Lakes Basin (Plunkett 1979, Hands *et al.* 1989, Rimmer 1992, Vogel 1996). Recent North American Breeding Bird Survey data show positive trends for the period 1980–98 across the southern limit of its current range (Sauer *et al.* 1999). The Common Loon is designated

as a *migratory nongame bird of management concern* by the U. S. Fish and Wildlife Service, but it is not federally listed as threatened or endangered in either the United States or Canada (Trapp 1995, Klein 1996).

The Ontario Lakes Loon Survey (Ashenden 1988) was expanded in 1990 to include the rest of Canada (McCall 1991, Timm and McCall 1993). Although it is not geographically within the Great Lakes Basin, loon population data from Quebec are presented for comparison purposes. Provincial population estimates are 97,000 pairs in Ontario (McCall 1990, Wayland and McNicholl 1990) and 35,000 in Quebec (DesGranges and LaPorte 1979). The number of breeding pairs in Ontario and southern Quebec appeared stable during aerial surveys between 1990 and 1995 (Vogel 1996).

In the state of New York, the Common Loon has been designated a *species of special concern* (Klein 1996). McIntyre (1979) reviewed its historical status. Since the early 1900s, Common Loon breeding in the state has been mostly restricted to the Adirondack Ecological Zone, where surveys in 1984 and 1985 resulted in a population estimate of 216–270 breeding pairs plus more than 800 nonbreeding adults (Parker and Miller 1988).

In Michigan, Common Loon breeding populations apparently declined during the early 1900s but then stabilized. The Common Loon was listed as *threatened* in Michigan in 1987, with an estimated 225 pairs in 1985 and 275 pairs in 1987 (Robinson *et al.* 1988). This estimate rose to 493 breeding pairs in 1991, plus more than 500 nonbreeding adults (Robinson 1993, McPeek and Adams 1994).

The Wisconsin breeding population had also declined until recently (Strong 1988, Robbins 1991, Dunn 1992). The summer Common Loon population in Wisconsin was comprehensively surveyed in 1976–77; an estimated total of 1,300 adults and 258 juveniles was reported, primarily in the northern one-third of the state (Zimmer 1982). In the summer of 1985, a coordinated survey by volunteers for Wisconsin Project LoonWatch found growth in the loon population compared to Zimmer's data (Olson 1986, Strong 1988). This survey was designed to be repeated at five year intervals; the 1995 estimate of 3,017 adults and 678 juveniles in Wisconsin (Daulton *et al.* 1997) was encouraging (Gostomski 1999).

Worldwide Population Trends

The worldwide population estimate for the Common Loon is 500,000–700,000 (Rose and Scott 1996). The population as a whole does not appear threatened, even though this species declined during the 20th century in the southern aspect of its mainly Nearctic breeding range (del Hoyo *et al.* 1992). Loss of suitable habitat, direct human disturbance, entanglement in fishing nets, poisoning by acid rain or other airborne pollutants, ingestion of lead sinkers, oil pollution, and heavy metal poisoning from lead, mercury, and other contaiminants are significant threats (Vermeer 1973, Locke *et al.* 1982, Barr 1986, Belant and Anderson 1990, Wayland and McNicholl 1990, Jung 1991, Pokras *et al.* 1991, Burger *et al.* 1994).

Common Loon population estimates for all of Canada range from 250,000 to 500,000 (Fair 1994). Some sources (e.g., Christmas Bird Count data from 1959 to 1988) report no significant trends (Vogel 1996). Reliable historical data are limited. Few studies sample the deeper waters offshore, where substantial numbers have been found (Lee 1987, Haney 1990).

Breeding Bird Surveys sample only roadside habitats, which limits detection of loons (McNicholl 1988). Single surveys are considered inaccurate for the assessment of breeding populations (Belant *et al.* 1993). Standardized methodology using aerial surveys are more reliable but expensive (Lanctot and Quang 1992, Groves *et al.* 1996). Surveys of pre-migratory staging areas (Hertzel *et al.* 1999) may prove to be both reliable and cost-effective.

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