Minnesota Loon Monitoring Program 1994 - 2003

Tenth Anniversary Report

Richard J. Baker, MLMP Coordinator
Yvette C. Anderson, Project Assistant
Lisa Gelvin-Innvaer, Index Area Coordinator
Maya Hamady, Index Area Coordinator
Katie Haws, Index Area Coordinator
Pam Perry, Index Area Coordinator

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Nongame Wildlife Program
Division of Ecological Services
Minnesota Department of Natural Resources
500 Lafayette Road, Box 25
St. Paul, MN 55155

Photo by Carrol Henderson

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 loons and the health of their lake habitats in Minnesota.

The 2003 survey season marks the 10th year of the MLMP. The MLMP owes it's ongoing success to it's large base of participants throughout the state. Without the interest and dedication of these volunteers, this project would not be possible. We want to thank them, and provide this report to demonstrate how their efforts are contributing information valuable in the management of Minnesota's natural resources.

The analysis of MLMP data presented in this report 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 indicates 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) index areas, and highest in the north central (Itasca) index area. The number of juveniles per two adults seen, a measure of reproductive success, 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.

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

Why Loons?

There are at least 3 good reasons....

- **Importance to Minnesotans**
  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.

- **Stewardship Responsibilities**
  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 nation's 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.

- **Environmental Indicators for Minnesota's lakes**
  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. Further, 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.

Methods

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" (Fig. 1). The Nongame Wildlife Program does not have enough staff to collect data on 600 lakes each year. Instead, hundreds of 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 standardize methods by providing survey guidelines to all volunteers. In addition to the numbers of loons seen, observers are asked to report on such things as weather and shoreline conditions. Once the survey is completed, data forms are returned to the Nongame Wildlife Program for compilation and analysis.

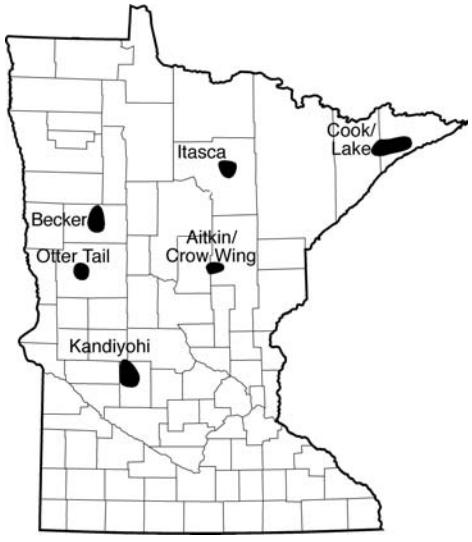


Figure 1. MLMP Index Area locations

INDEX AREA SELECTION

The Index 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 on pages 5 - 10 of this report.

DATA ANALYSES

For each index area, the following indices have been determined through analysis of MLMP data:

- **LOON ABUNDANCE:** 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.
- **LOON OCCUPANCY:** Occupancy can be thought of as the ***likelihood of seeing a loon on a lake***.
- **LOON REPRODUCTIVE SUCCESS:** 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 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. For this analysis, all lakes with fewer than 2 loons were excluded.
- **LAKE CLARITY AND LOONS:** Using water clarity data from the Water Resources Center and Remote Sensing Laboratory, University of Minnesota (http://water.umn.edu), we compared our MLMP data with lake clarity for all six of the MLMP Index Areas.

Also, the following summaries were calculated for each Index Area and year: total adult loons observed, total juvenile loons observed, number of lakes with adult loons, number of lakes with juvenile loons, and total number of lakes surveyed. The number of lakes surveyed often varied from the goal of 100 lakes per Index Area due to volunteer participation and coordination.

Results

On the following pages, the results of data analyses 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. Further, 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 respond to different environmental conditions that exist in the various areas.

LOON ABUNDANCE: Adult Loons Seen per 100 Acres of Lake Surface within an Index Area

During the ten 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 on pages 5 - 10, these are probably due to normal fluctuations that occur in all natural populations.

LOON OCCUPANCY: Percent of Lakes in an Index Area with Any Adult Loons

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 ten years, but fluctuations up to 25% were observed over the ten years.

LOON REPRODUCTIVE SUCCESS: Juvenile Loons for Every Two Adult Loons on a Lake

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.

LAKE CLARITY AND LOONS

In addition to evaluating the health of Minnesota's loon population, this year we have compared our MLMP loon data to water clarity in the six index areas. Since loons use their eyesight to capture prey, lakes with higher water clarity are more beneficial to loons. This is supported by the fact that higher lake water clarity coincides with the distribution of loons in Minnesota. Lakes in the northern, eastern, and central portions of Minnesota are much clearer than lakes in southern and western parts of the state where there are no loons (for more information on water clarity in Minnesota, see http:\\water.umn.edu). This implies a link between loon distribution and water quality in our state.

The results indicate that there is a significant relationship between water clarity (or turbidity) and adult loons ($p = 0.001$), juvenile loons ($p = 0.001$), percent of lakes with loons ($p = 0.001$), and loons per acre ($p = 0.01$; Fig. 3). As water turbidity increases, all of the above decrease, demonstrating a link between loons and overall water quality.

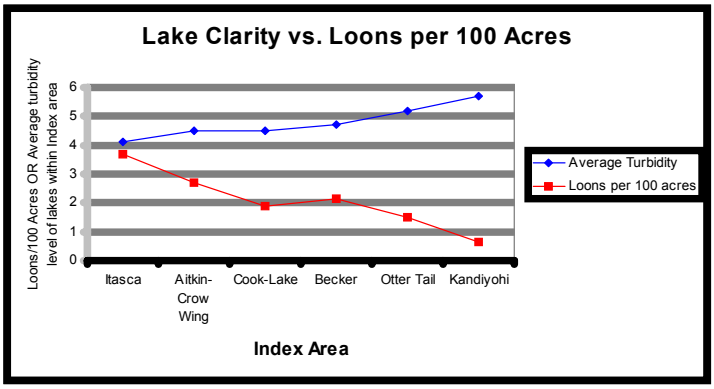


Figure 3. LAKE CLARITY AND LOONS PER 100 ACRES OF LAKE— Average turbidity of an index area compared to loons per 100 acres within the index area. Note that as turbidity increases, loons per 100 acres decrease.

Water clarity is not the only factor affecting loon distribution in Minnesota. Obviously there are many other ecological factors not accounted for in this study, including nesting habitat, prey availability, predation, and competition levels, to name a few. However, water clarity appears to affect loons, possibly by influencing these other ecological factors.

Aitkin/Crow Wing Index Area

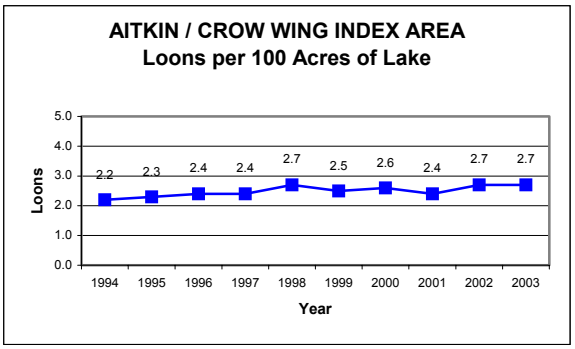


Figure 3. LOON ABUNDANCE—Adult loons seen per 100 acres of lake surface within the Aitkin/Crow Wing Index Area.

INDEX AREA CHARACTERISTICS

- ◊ Low acid rain sensitivity
- ◊ High density of humans and roads
- ◊ Rapid human population growth
- ◊ Predominantly private lands
- ◊ Average lake size = 194 acres

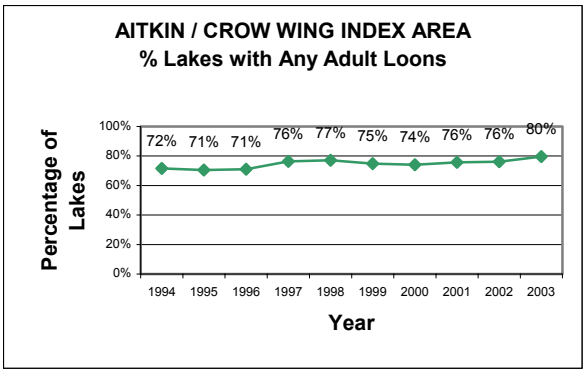


Figure 4. LOON OCCUPANCY – Percent of lakes in the Aitkin/ Crow Wing Index Area with any adult loons.

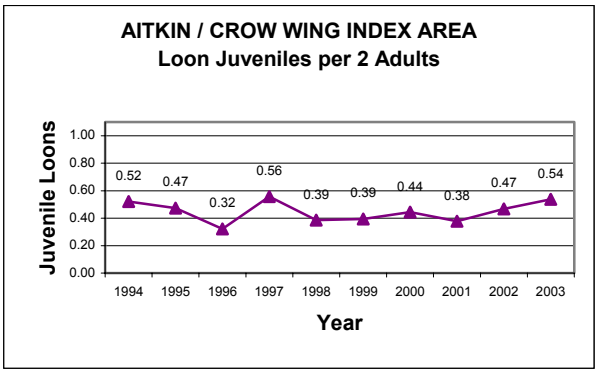


Figure 5. LOON REPRODUCTIVE SUCCESS– Juvenile loons for every two adult loons on a lake within Aitkin/Crow Wing Index Area.

In summary:

- Loon abundance in the Aitkin/Crow Wing Index Area ranged from 2.2 – 2.7 adult loons per 100 acres of lake during the past decade (Fig. 3).
- There are no statistically significant changes in occupancy within the six index areas. Occupancy (*likelihood of seeing a loon on a lake*) was calculated as 71% - 80% in the Aitkin/Crow Wing index area (Fig. 4), roughly the 3rd highest Index area, after the Itasca and Becker Index Areas (see p. 11).
- Reproductive success was calculated as 0.32 - 0.56 juveniles per 2 adult loons in the Aitkin/ Crow Wing index area (Fig. 5).

Becker Index Area

INDEX AREA CHARACTERISTICS

- ◊ Low acid rain sensitivity
- ◊ Low density of humans and roads
- ◊ Slow human population growth
- ◊ Predominantly public lands
- ◊ Average lake size = 371 acres

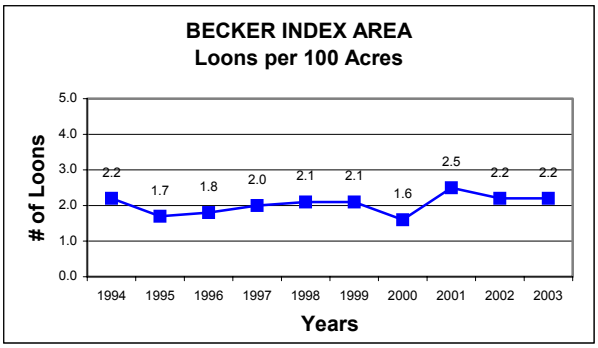


Figure 6. LOON ABUNDANCE—Adult loons seen per 100 acres of lake surface within the Otter Tail Index Area.

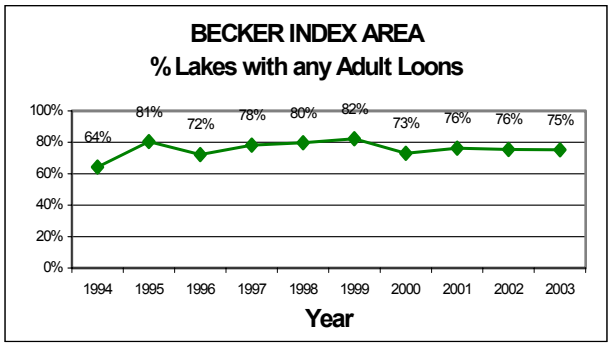


Figure 7. LOON OCCUPANCY – Percent of lakes in the Becker Index Area with any adult loons.

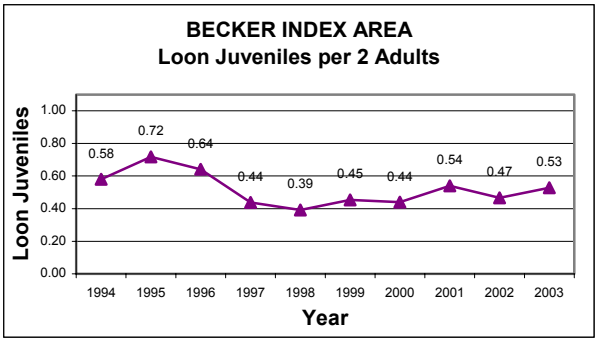


Figure 8. LOON REPRODUCTIVE SUCCESS– Juvenile loons for every two adult loons on a lake within Becker Index Area.

In summary:

- The number of adult loons has significantly increased (p=0.01) slightly in the past ten years within the Becker Index Area.
- Loon abundance in the Becker Index Area ranged from 1.6 – 2.5 adult loons per 100 acres of lake during the past decade (Fig. 6).
- There are no statistically significant changes in occupancy within the six index areas. Occupancy (*likelihood of seeing a loon on a lake*) was calculated as 64% - 82% in the Becker Index Area (Fig. 7), roughly the 2nd highest Index area, after the Itasca Index Area (see p. 11).
- Reproductive success was calculated as 0.39 to 0.72 juveniles per 2 adult loons in the Becker Index Area (Fig. 8)

Cook/Lake Index Area

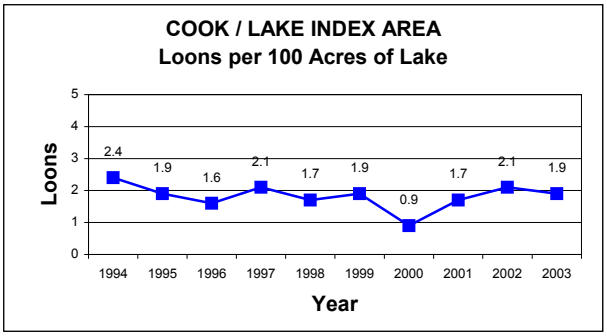


Figure 9. LOON ABUNDANCE—Adult loons seen per 100 acres of lake surface within the Otter Tail Index Area.

INDEX AREA CHARACTERISTICS

- ◊ High acid rain sensitivity
- ◊ Low density of humans and roads
- ◊ Slow human population growth
- ◊ Predominantly public lands
- ◊ Average lake size = 201 acres

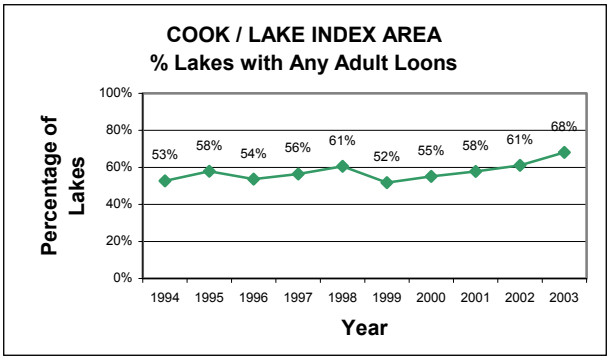


Figure 10. LOON OCCUPANCY – Percent of lakes in the Cook/ Lake Index Area with any adult loons.

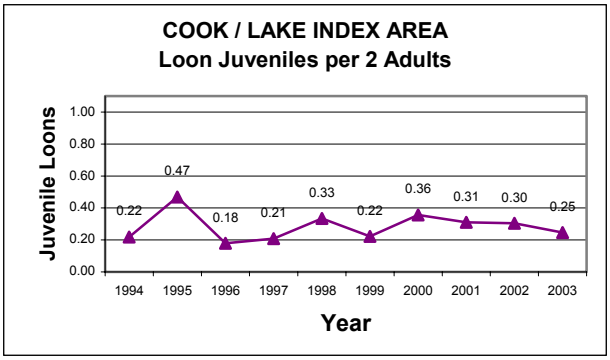


Figure 11. LOON REPRODUCTIVE SUCCESS– Juvenile loons for every two adult loons on a lake within Cook/Lake

In summary:

- Loon abundance ranged from 0.9 – 2.4 adult loons per 100 acres of lake surface during the past decade (Fig. 9).
- There are no statistically significant changes in occupancy within any of the six index areas between 1994 and 2003. Occupancy (*likelihood of seeing a loon on a lake*) was calculated as 52% - 68% within the Cook/Lake index area (Fig. 10), ranking it #5 out of the 6 Index Areas, with only the Kandiyohi Index Area demonstrating lower occupancy (see p. 11).
- Reproductive success was calculated 0.18 - 0.47 juveniles per 2 adult loons in the Cook/Lake index area (Fig. 11), the lowest reproductive success in the 6 Index Areas.

Itasca Index Area

INDEX AREA CHARACTERISTICS

- ◊ High acid rain sensitivity
- ◊ Low density of humans and roads
- ◊ Slow human population growth
- ◊ Predominantly public lands
- ◊ Average lake size = 170 acres

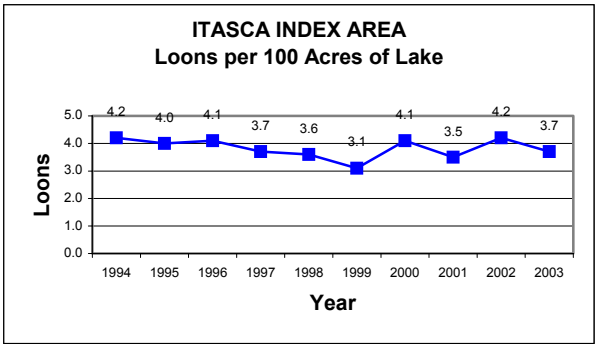


Figure 12. LOON ABUNDANCE—Adult loons seen per 100 acres of lake surface within the Itasca Index Area.

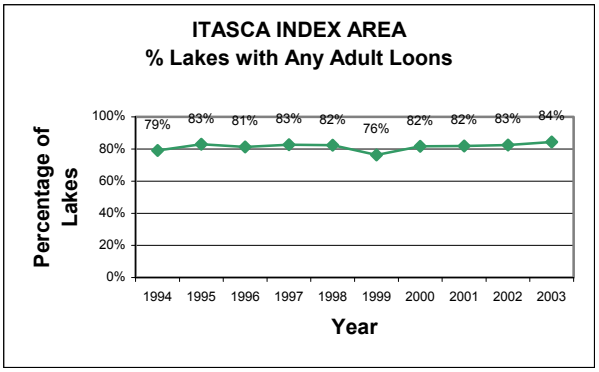


Figure 13. LOON OCCUPANCY – Percent of lakes in the Itasca Index Area with any adult loons.

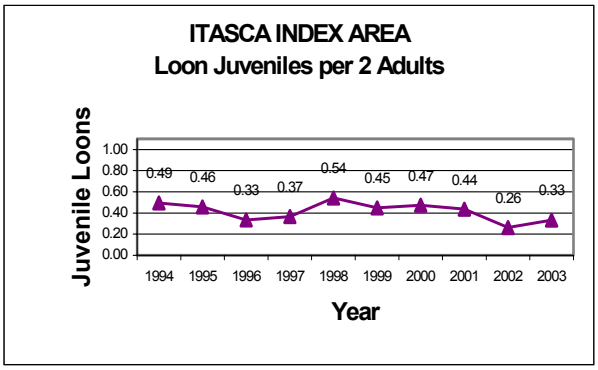


Figure 14. LOON REPRODUCTIVE SUCCESS– Juvenile loons for every two adult loons on a lake within Itasca Index

In summary:

- Loon abundance in the Itasca Index Area ranged from 3.1 – 4.2 adult loons per 100 acres of lake during the past decade (Fig. 11), the highest of the 6 index areas.
- There are no statistically significant changes in occupancy within the six index areas. Occupancy (*likelihood of seeing a loon on a lake*) was calculated as 76% - 84% in the Itasca Index Area (Fig. 12), roughly the highest amongst the Index areas (see p. 11).
- Reproductive success was calculated as 0.26 - 0.54 juveniles per 2 adult loons in the Itasca Index Area (Fig. 13).

Kandiyohi Index Area

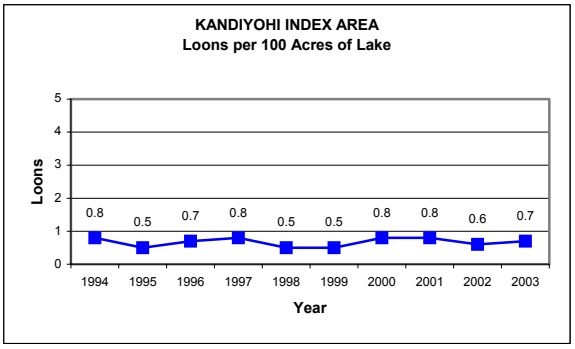


Figure 15. LOON ABUNDANCE—Adult loons seen per 100 acres of lake surface within the Kandiyohi Index Area.

INDEX AREA CHARACTERISTICS

- ◊ Low acid rain sensitivity
- ◊ High density of humans and roads
- ◊ Rapid human population growth
- ◊ Predominantly private lands
- ◊ Average lake size = 318 acres

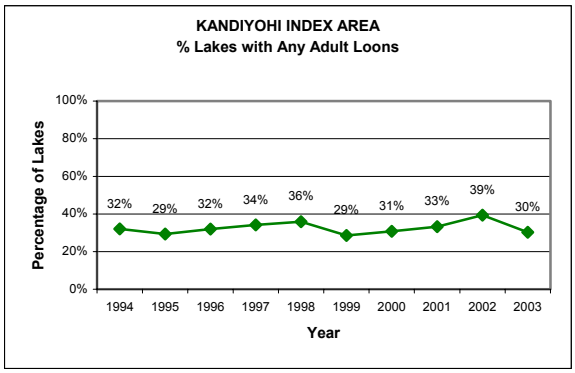


Figure 16. LOON OCCUPANCY – Percent of lakes in the Kandiyohi Index Area with any adult loons.

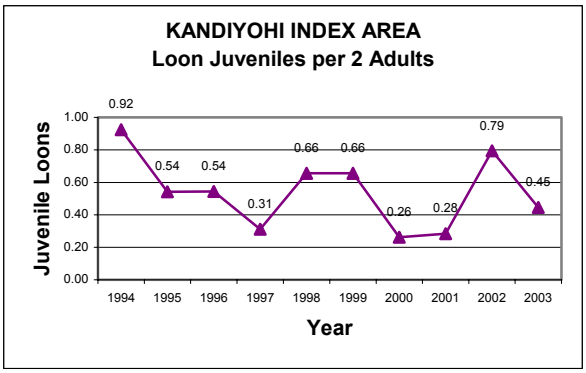


Figure 17. LOON REPRODUCTIVE SUCCESS– Juvenile loons for every two adult loons on a lake within Itasca Index Area.

In summary:

- *Loon abundance* in the Kandiyohi Index Area ranged from 0.5 – 0.8 adult loons per 100 acres of lake during the past decade (Fig. 14).
- There are no statistically significant changes in occupancy within the six index areas. Occupancy (*likelihood of seeing a loon on a lake*) was calculated as 29% - 39% in the Kandiyohi Index Area (Fig. 15), the lowest amongst the Index areas (see p. 11).
- *Reproductive success* was calculated as 0.26 - 0.92 juveniles per 2 adult loons in the Kandiyohi Index Area (Fig. 16), with some of the highest rates amongst the six Index Areas.

Otter Tail Index Area

INDEX AREA CHARACTERISTICS

- ◊ Low acid rain sensitivity
- ◊ Moderate density of humans and roads
- ◊ Slow human population growth
- ◊ Predominantly private lands
- ◊ Average lake size = 427 acres

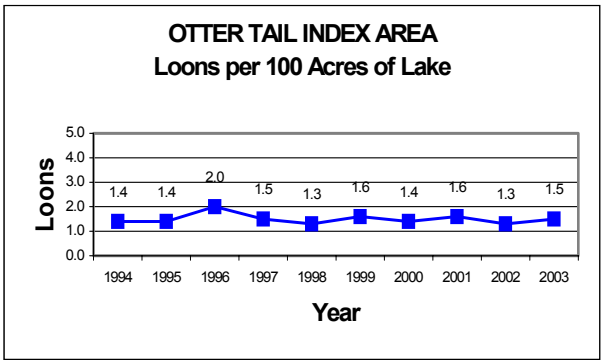


Figure 18. LOON ABUNDANCE—Adult loons seen per 100 acres of lake surface within the Otter Tail Index Area.

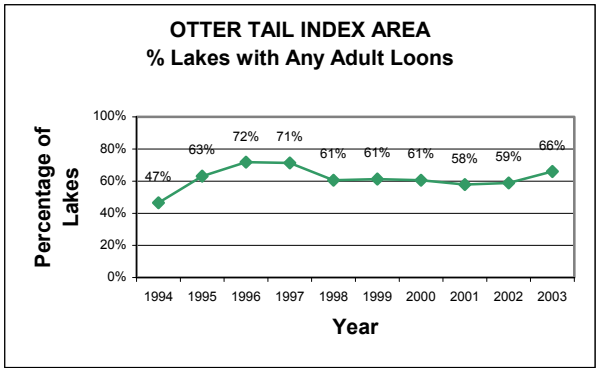


Figure 19. LOON OCCUPANCY – Percent of lakes in the Otter Tail Index Area with any adult loons.

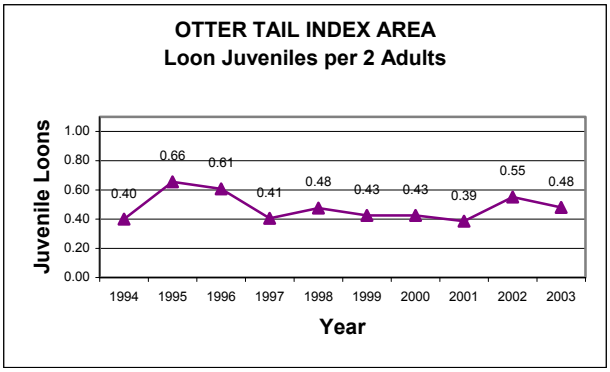


Figure 20. LOON REPRODUCTIVE SUCCESS– Juvenile loons for every two adult loons on a lake within Otter Tail Index Area.

In summary:

- Loon abundance in the Otter Tail Index Area ranged from 1.3 – 2.0 adult loons per 100 acres of lake during the past decade (Fig. 18).
- There are no statistically significant changes in occupancy within the six index areas. Occupancy (*likelihood of seeing a loon on a lake*) was calculated as 47% - 72% in the Otter Tail Index Area (Fig. 19), roughly the 4th highest Index area, after the Itasca, Becker, and Aitkin/Crow Wing Index Areas (see p. 11).
- Reproductive success was calculated as 0.39 - 0.66 juveniles per 2 adult loons in the Otter Tail Index Area (Fig. 20).

Index Area Comparison

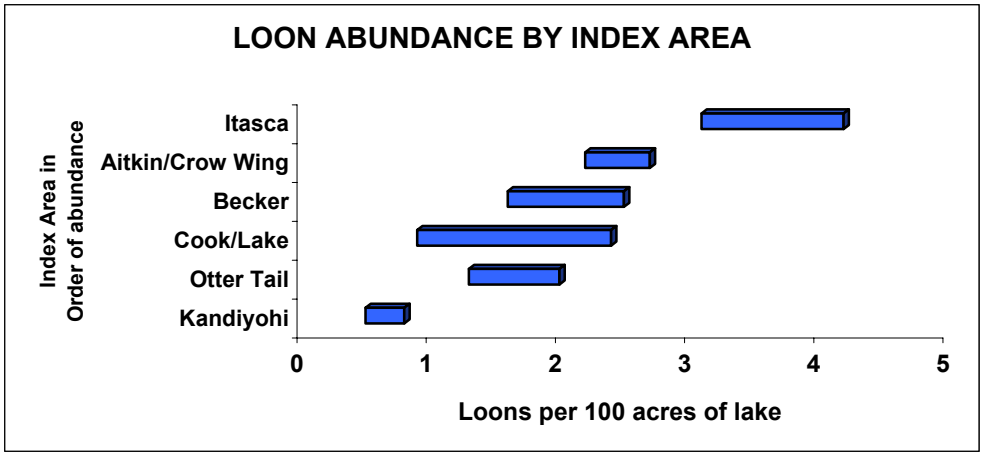


Figure 21. LOON ABUNDANCE comparison amongst index areas. The bars represent the span between highest and lowest values observed during the past decade (1994—2003).

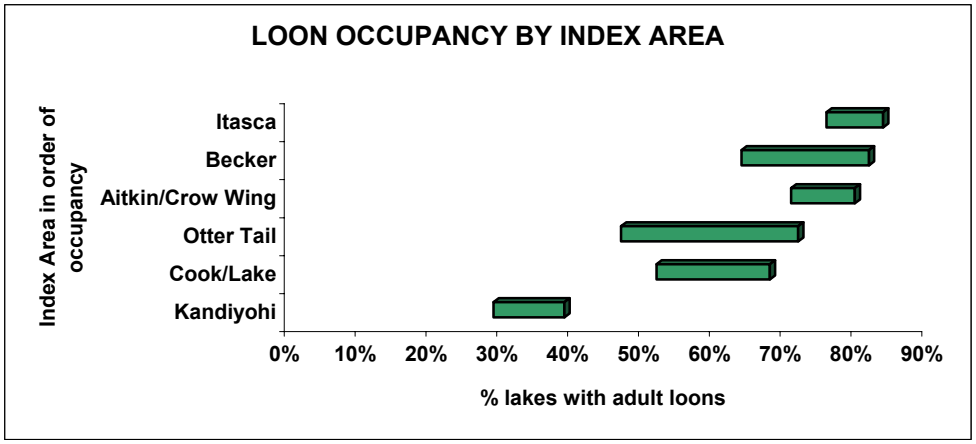


Figure 22. LOON OCCUPANCY comparison amongst index areas. The bars represent the span between highest and lowest values observed during the past decade (1994—2003).

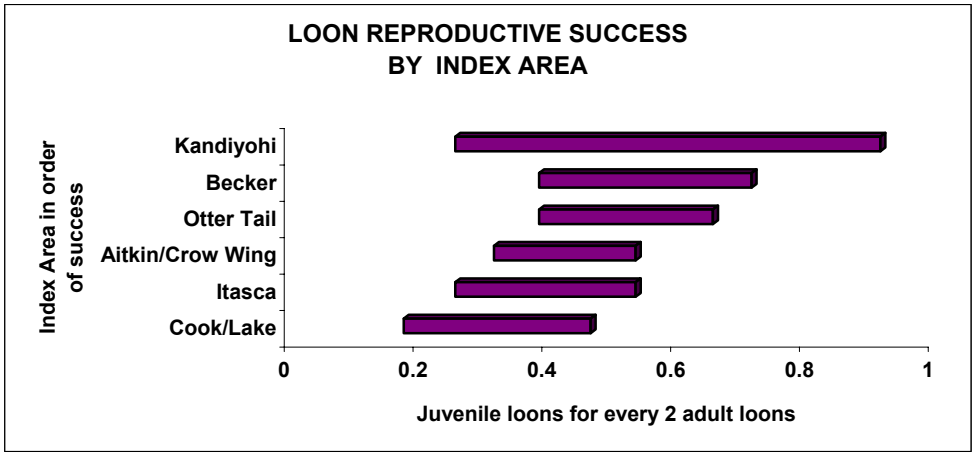
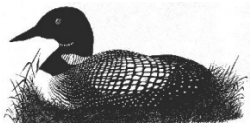


Figure 23. LOON REPRODUCTIVE SUCCESS comparison amongst index areas. The bars represent the span between highest and lowest values observed during the past decade (1994—2003).

Conclusions

The loon populations within the six index areas of the MLMP have remained stable for the past decade. This is good news for Minnesotans, who appreciate the charm and appeal of loons on our beloved lakes. The DNR's Nongame Wildlife Program plans to continue monitoring loons through the MLMP while human population and lakeshore development continue to grow throughout Minnesota.

The results of this study also indicate that there are other ecological factors related to water quality that affect loon populations in Minnesota. Careful water quality and land use management may influence where loons choose to live. Managers, homeowners, and educators can use this insight when formulating landscape management plans, and when addressing water quality issues on lakeshore property. Minnesotans are stewards of over 15,000 lakes, and only through careful management will these lakes provide both recreational and esthetic benefits far into the future.



For more information on the MLMP, and to download this report, visit our website:
http://www.dnr.state.mn.us/ecological_services/nongame/projects/mlmp_state.html

Acknowledgements:

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!

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Contact Information

For more information, please contact the following DNR staff:

Rich Baker, Statewide MLMP Coordinator
Minnesota DNR, Nongame Wildlife Program
500 Lafayette Rd., Box 25, St. Paul, MN 55155
Phone: 651/259-5073
E-mail: richard.baker@dnr.state.mn.us

Lisa Gelvin-Innvaer, Kandiyohi Index Area Coordinator
Minnesota DNR, Nongame Wildlife Program
261 Hwy 15 South, New Ulm, MN 56073
Phone: 507/359-6033
E-mail: lisa.gelvin-innvaer@dnr.state.mn.us

Maya Hamady, Itasca and Cook/Lake Index Area Coordinator
Minnesota DNR, Nongame Wildlife Program
1201 East Hwy 2, Grand Rapids, MN 55744
Phone: 218/327-4518
E-mail: maya.hamady@dnr.state.mn.us

Katie Haws, Becker and Otter Tail Index Area Coordinator
Minnesota DNR, Nongame Wildlife Program
2115 Birchmont Beach Rd., Bemidji, MN 56601
Phone: 218/755-2976
E-mail: katie.haws@dnr.state.mn.us

Pam Perry, Aitkin/Crow Wing Index Area Coordinator
Minnesota DNR, Nongame Wildlife Program
1601 Minnesota Drive, Brainerd, MN 56401
Phone: 218/833-8728
E-mail: pam.perry@dnr.state.mn.us