Minnesota Loon Monitoring Program

2024 Annual Report

Nongame Wildlife Program

Summary

The Minnesota Loon Monitoring Program (MLMP) was initiated in 1994 to detect changes in Minnesota's Common Loon (*Gavia immer*) population and in the health of their lake habitats in Minnesota. With the help of over 1000 volunteers, the Minnesota Department of Natural Resources (DNR) Nongame Wildlife Program has completed loon surveys in six 100-lake "Index Areas" annually since 1994. The Index Areas (Fig. 1) were chosen to represent different factors that may affect loons and their habitat throughout their breeding range within the state, including human population growth, acid rain sensitivity, densities of humans and roads, and predominant land ownership (public or private).

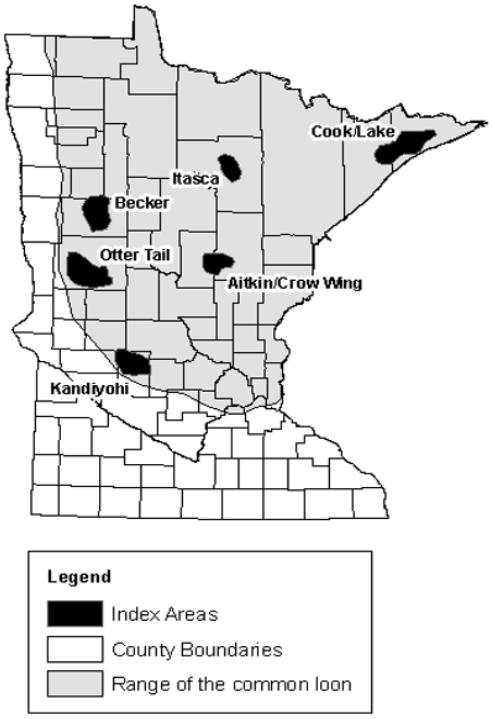

Figure 1. The six MLMP Index Areas.

After 31 years of data collection, MLMP results suggest that Minnesota's adult loon population is stable when pooling data across all index areas as a whole; however, juveniles appear to be experiencing a small but detectable decline of ~0.3% per year averaged across the time period. At the individual index area level, we are detecting increasing trends in adult loon population estimates in four index areas and declining trends in the other two. Results show a similar trend for juveniles: population estimates are likely increasing in several index areas, and either declining or likely declining in others.

Volunteers have observed loons on an average of 66% of survey lakes per year during the 31-year period; likewise, volunteers observed at least one loon on 66% of the lakes during the 2024 survey.

Methods

MLMP volunteers were assigned to survey one or more lakes during the morning hours (between 5 a.m. and noon) of one day within a 10-day period in late June to early July (in 2024, this period was from June 28th to July 8th). Only lakes over 10 acres in size and deep enough to overwinter fish were surveyed within each Index Area. Nongame Wildlife Program staff standardize data collection by providing survey guidelines to all volunteers. Survey styles vary widely depending on the size of the lake. Some volunteers used boats or canoes, and others surveyed from the shore. Similarly, some used binoculars or a spotting scope, and others did not.

Surveyors scanned the lake surface, no matter what style of data collection they used, and counted the number of adult and juvenile loons encountered. In addition to the numbers of loons observed, volunteers were asked to report on factors such as weather and shoreline conditions. Once the survey was completed, volunteers returned data forms to the Nongame Wildlife Program for compilation and analysis. Using the loon counts observed by volunteers, we created a model that incorporated survey duration, visibility, wind speed, human population density, and lake size to generate predicted loon counts for each lake each year. We used this model to calculate trends in relative abundance estimates for adults and juveniles as well as additional parameters of interest such as fecundity, a measure of reproductive success (number of juveniles per pair of adults).

2024 Results

Hundreds of volunteers along with several natural resource professionals ventured out onto Minnesota lakes and conducted 540 surveys, the fewest since implementation of the program in 1994; participation has been down since 2021 when state volunteer restrictions were put in place due to the COVID pandemic and has not yet rebounded. Despite lower turnout, results from the 2024 survey showed similar patterns to 2023 data.

LOON ABUNDANCE: Loon relative abundance varies widely across the state, and continues to be lowest in the southwest (Kandiyohi) and highest in the northcentral (Itasca) Index Area (Fig. 2).

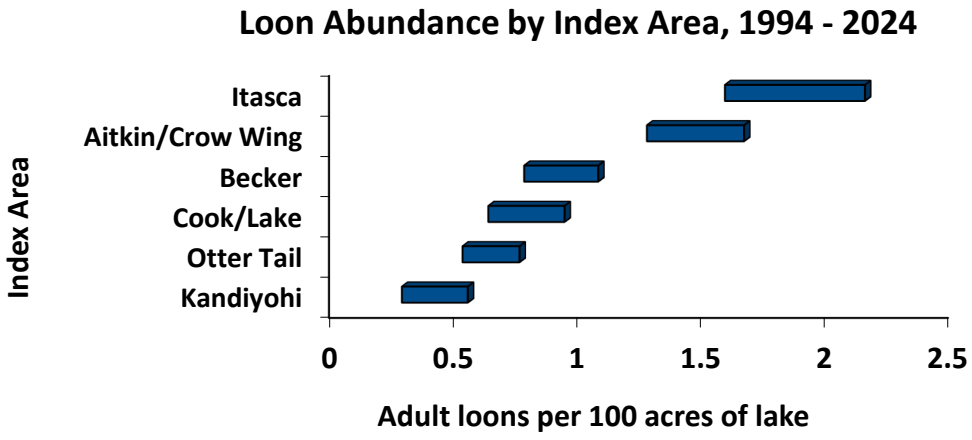

Figure 2. Loon abundance measured by the estimated average number of loons per 100 acres of lake from 1994-2024 within each of the six MLMP Index Areas. Bar length is based on minimum and maximum annual estimated abundance values.

ADULT AND JUVENILE POPULATION TRENDS:

In the two subsections below, the tables contain output from the statistical models estimating relative abundance trends for adult and juvenile loons across the 31-year period of the Minnesota Loon Monitoring Program. Each table indicates the trend in either adult or juvenile loon abundance for each index area, the probability the trend is increasing or decreasing across the time period, the average percentage change per year across the time period, and a 95% probability range indicated by the lower (2.5%) and upper (97.5%) credible bounds; given the model and data, there is a 95% probability that the average annual trend is between the lower and upper credible bounds in a given index area.

Adult Population Trends:

One measure of relative abundance (hereafter abundance), the average number of adult loons per 100 acres of lake, is shown in Figure 3 for each year of the monitoring program.

When looking at an overall Index Area-wide picture, estimated adult abundance has remained stable between 1994-2024. However, we are detecting trends in loon abundance at the individual Index Area-level across the 31-year period: adults are increasing or likely increasing in abundance in four of the six Index Areas (Aitkin/Crow Wing, Becker, Kandiyohi, and Otter Tail), and declining in the other two Index Areas (Cook/Lake and Itasca).

Index Area	Adult loon population trend	Probability of Increase or Decrease	Mean (%/yr)	Credible Bound	
				Lower (%/yr)	Upper (%/yr)
Aitkin/Crow Wing	Likely Increasing	77%	0.2	-0.3	0.7
Becker	Likely Increasing	72%	0.2	-0.5	0.8
Cook/Lake	Declining	100%	-1.3	-1.9	-0.7
Itasca	Declining	100%	-1.0	-1.4	-0.5
Kandiyohi	Increasing	100%	2.2	1.1	3.4
Otter Tail	Likely Increasing	73%	0.2	-0.5	0.9
Overall	Stable	59%	0	-0.2	0.2

Taking Aitkin/Crow Wing as an example, there is an 77% probability that adult loon abundance is increasing in the Aitkin/Crow Wing Index Area across the 31-year period; the model estimated an average increase in adult abundance of 0.2% per year. However, factoring in uncertainty of the model estimate, adult abundance could be declining by as much as 0.3% per year or increasing as much as 0.7% per year on average.

JUVENILE POPULATION TRENDS:

Juvenile abundance as measured by the average number of juvenile loons per 100 acres of lake for each year of the monitoring program is shown in Figure 4. Models indicate the estimated abundance of juveniles has declined at an average rate of approximately 0.3% per year (with 93% probability between: -0.8 – 0.1%) across all Index Areas between 1994-2024.

Trends within individual Index Areas are mixed. Juvenile abundance is likely increasing in the Aitkin/Crow Wing and Kandiyohi Index Areas, and either declining or likely declining in the Becker, Cook/Lake, Itasca, and Otter Tail Index Areas. Because there is a lot more variability in juvenile counts compared to adults, there is also more

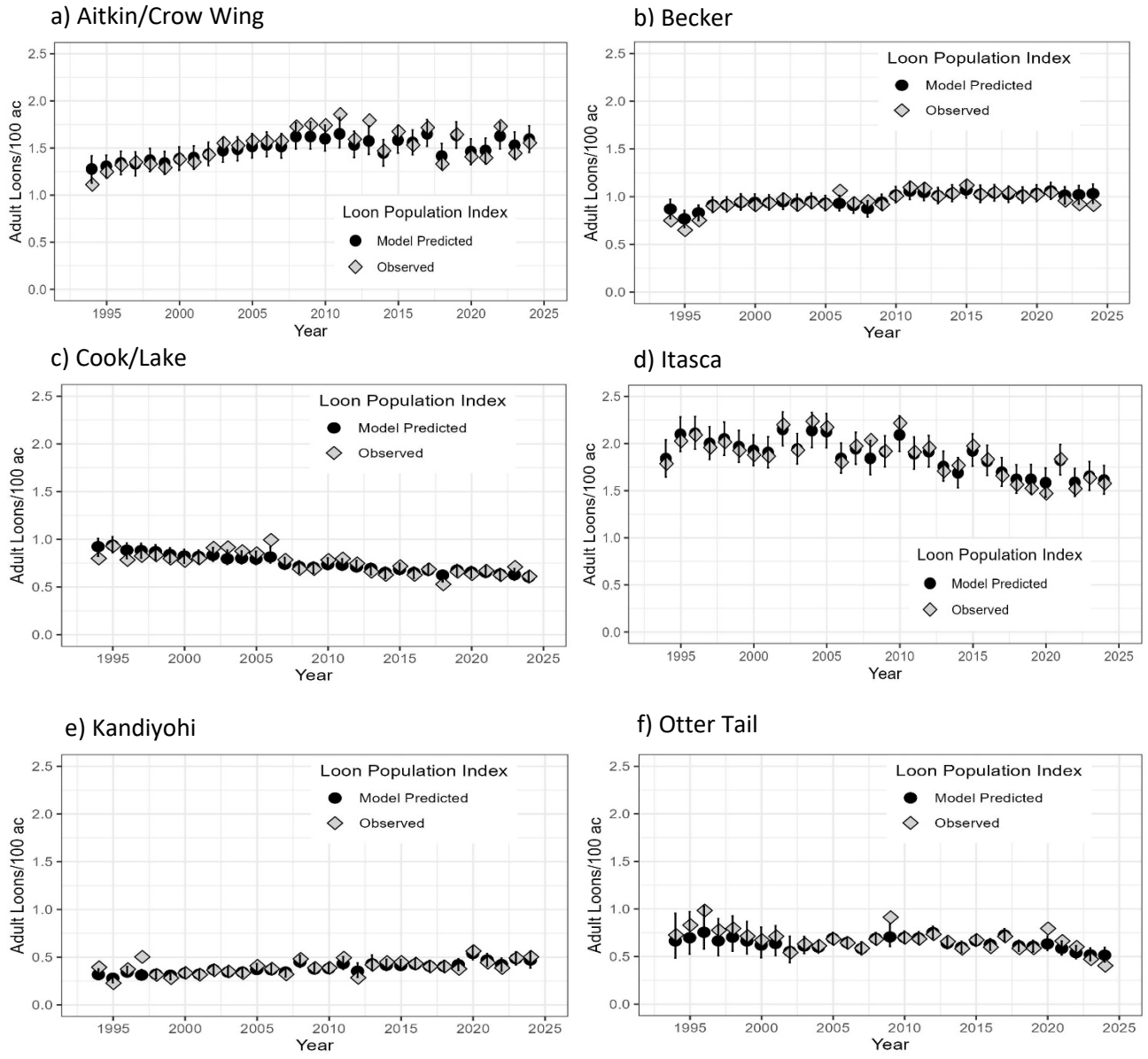

Figure 3a-f. ADULT LOON ABUNDANCE: Observed and model-predicted number of adult loons per 100 acres of lake from 1994-2024 for each of the six Index Areas. Densities of adult loons are increasing or likely increasing in the Aitkin/Crow Wing, Becker, Kandiyohi, and Otter Tail Index Areas, and declining in the Cook/Lake and Itasca Index Areas over the 31 years of the MLMP.

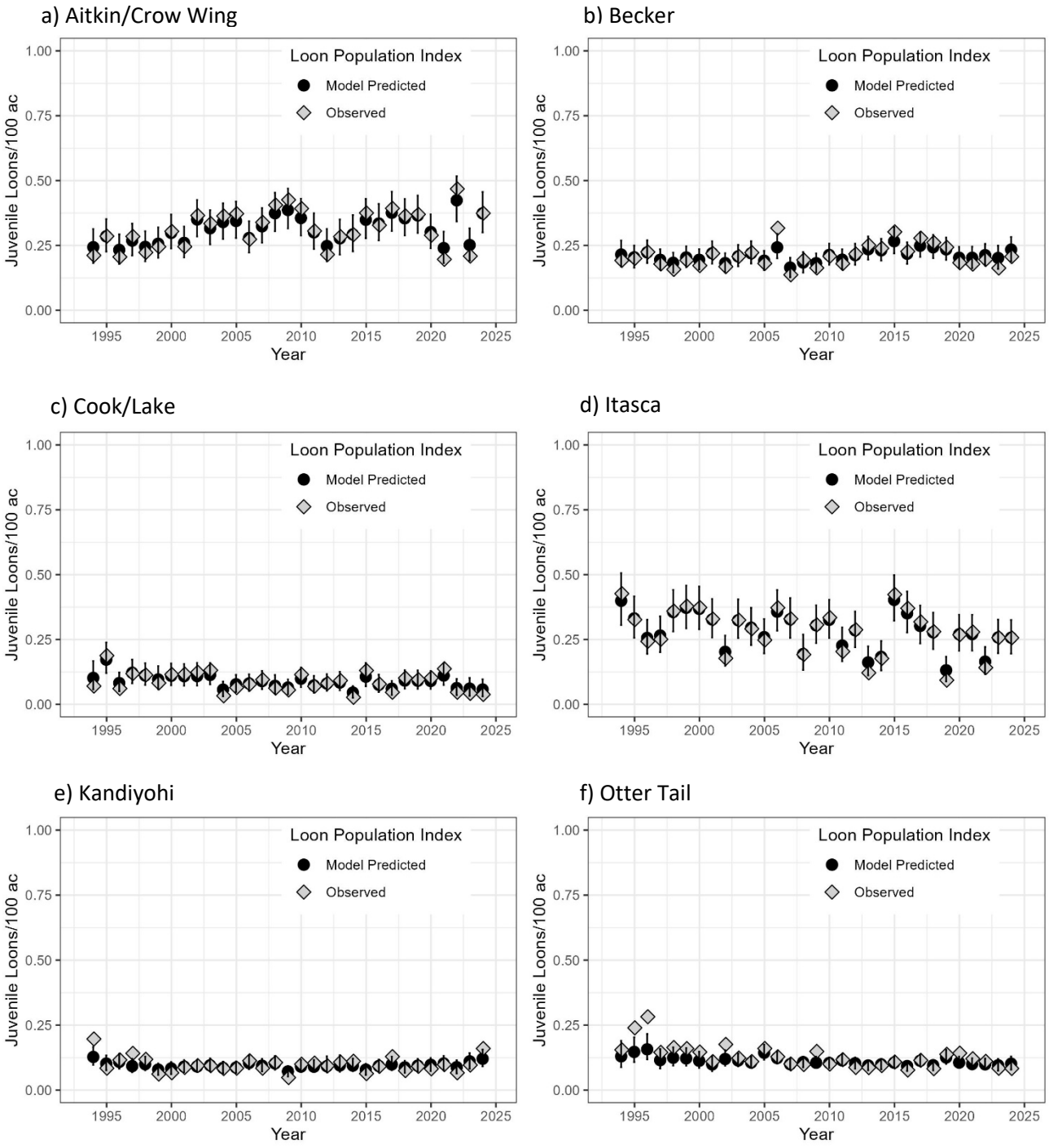

Figure 4a-f. JUVENILE LOON ADUNDANCE: Observed and model-predicted number of juvenile loons per 100 acres of lake from 1994-2024 for each of the six Index Areas. Due to the difficulty of observing juvenile loons and the biotic and abiotic factors that can impact seasonal nest success, reports are highly variable from year to year. However, densities generally ranged between 0.1 and 0.4 juveniles per 100 acres; they are lowest in Kandiyohi and highest in the Aitkin/Crow Wing index area.

uncertainty in the model trend estimates resulting in larger ranges in lower and upper credible bounds as indicated in the table below.

Index Area	Juvenile loon population trend	Probability of Increase or Decrease	Mean (%/yr)	Credible Bound	
				Lower (%/yr)	Upper (%/yr)
Aitkin/Crow Wing	Likely Increasing	76%	0.4	-0.8	1.6
Becker	Likely Declining	72%	-0.4	-1.6	0.9
Cook/Lake	Declining	97%	-2.1	-4.3	0.1
Itasca	Declining	99%	-1.8	-3.3	-0.3
Kandiyohi	Likely Increasing	85%	1.0	-0.9	3.0
Otter Tail	Likely Declining	82%	-0.6	-1.9	0.7
Overall	Declining	93%	-0.3	-0.8	0.1

For example, there is a 99% probability that juvenile loon abundance is declining in the Itasca Index Area across the 31-year period; the model estimated an average decline in juvenile abundance of 1.8% per year. Factoring model uncertainty into account, juvenile abundance could be declining within the Itasca Index Area by as much as 3.3% per year or as little as a 0.3% decline per year.

REPRODUCTIVE SUCCESS:

An index to loon reproductive success as measured by the number of juveniles per adult pair is lowest in the northeast (Cook/Lake) and highest in the southwest (Kandiyohi) Index Area (Fig. 5).

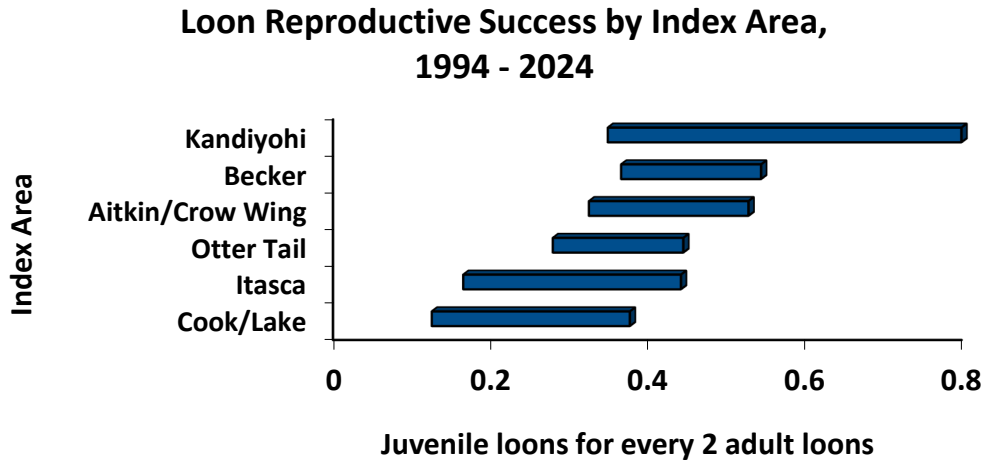

Figure 5. Loon reproductive success measured by the estimated average number of juvenile loons per pair of adults from 1994-2024 within each of the six MLMP Index Areas. Bar length is based on minimum and maximum annual estimated abundance values.

While the average number of juvenile loons reported per pair of adults is highly variable from year to year, overall reproductive success has likely declined slightly at a rate of approximately 0.26% per year between 1994-2024 when combining data from all 6 Index Areas. Based on model estimates, the number of juvenile loons per adult pair is likely increasing in the Aitkin/Crow Wing Index Area, stable in the Cook/Lake Index Area, and declining or likely declining in the Becker, Itasca, Kandiyohi, and Otter Tail Index Areas (Fig. 6). Any downward trend in reproductive success of loons, regardless of how slight, is concerning and will continue to be monitored closely in future years. One interesting negative trend to highlight is for the Kandiyohi Index Area. While population trends for Kandiyohi indicate both adults and juveniles are increasing in abundance, overall reproductive success shows a strong negative trend. The reason for this is because adult densities are increasing at a faster rate than juvenile densities, meaning that juvenile recruitment is not keeping pace with the increased number of adults on lakes in this Index Area.

LOON OCCUPANCY:

Loon occupancy (percentage of lakes where volunteers observed at least one loon) is highest in the northcentral (Itasca) and lowest in the southwest (Kandiyohi) Index Area (Fig. 7).

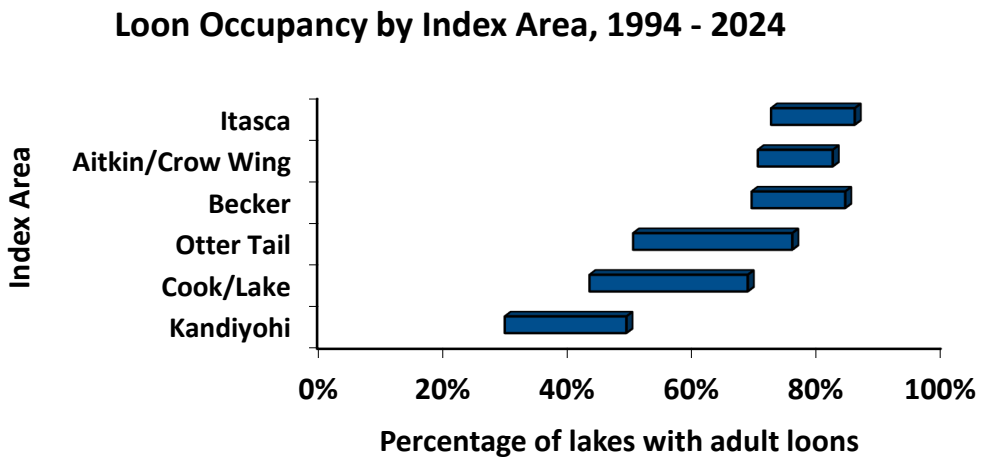

Figure 7. Loon occupancy as measured by the percentage of lakes with loons from 1994-2024 within each of the six MLMP Index Areas. Bar length is based on minimum and maximum annual estimated abundance values.

Examining all Index Areas combined, adult and juvenile loon occupancy has remained relatively stable overall across the 31-year history of the MLMP; on average, approximately 66% of all survey lakes have been occupied by at least one adult and 24% of all lakes occupied by at least one juvenile loon. However, there is considerable variability both within and across years in the percentage of lakes where volunteers report observing adult and juvenile loons within individual Index Areas. While variable, the observed percentage of lakes occupied by adult and juvenile loons shows an increasing trend in Aitkin/Crow Wing, Kandiyohi, and Otter Tail Index Areas, a stable-to-slight decreasing trend in the Becker Index Area, and a decreasing trend in the Cook/Lake and Itasca Index Areas (Fig. 8).

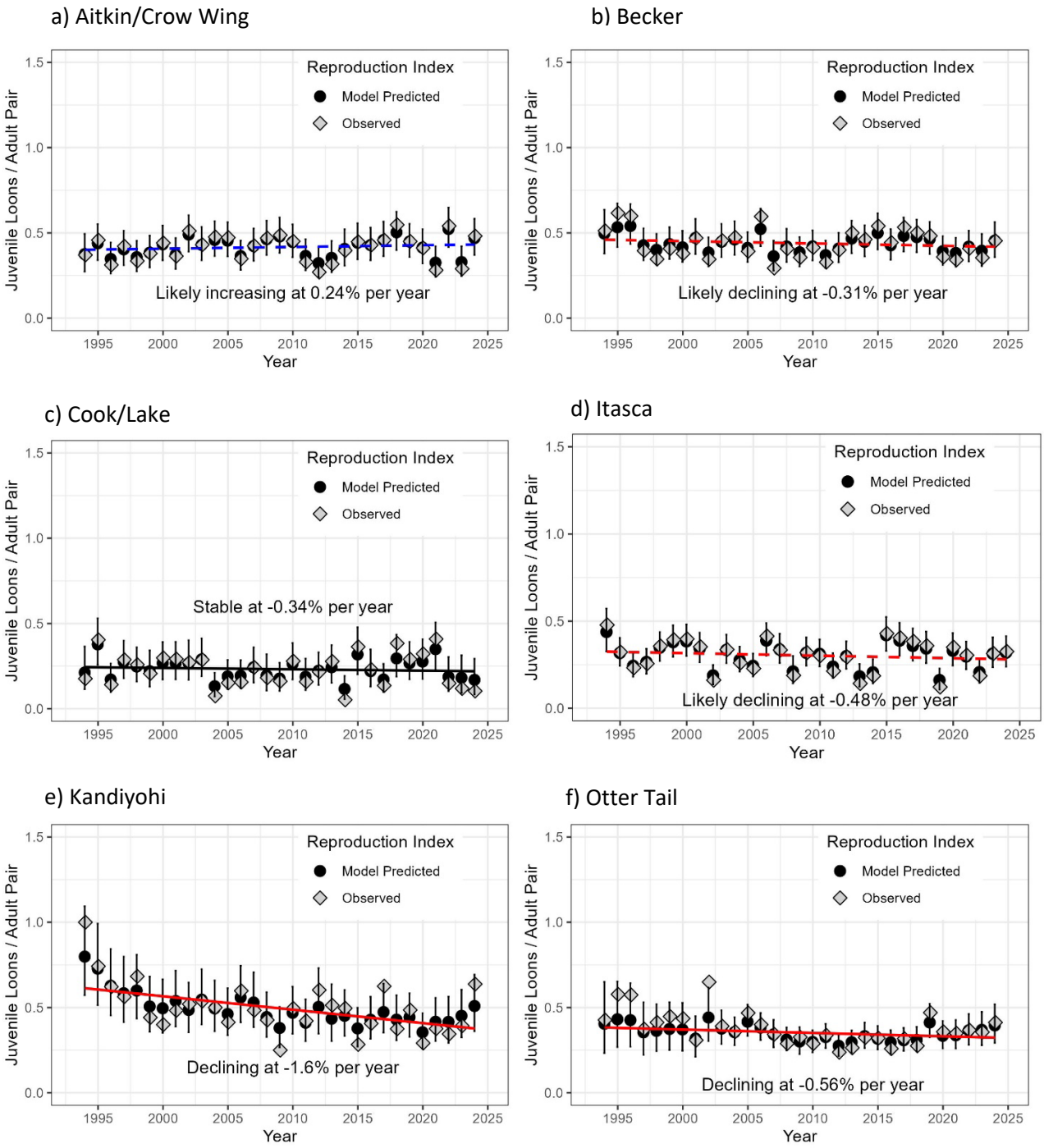

Figure 6a-f. LOON REPRODUCTIVE SUCCESS: Observed and model-predicted number of juvenile loons per pair of adults from 1994-2024 for each of the six Index Areas. A blue trendline indicates an increase (dashed blue = likely increase), a red trendline indicates a decrease (dashed red = likely decrease), and a black trendline is stable. Estimated values across the time period range from an average of 0.17 juveniles per adult pair in the Cook/Lake index area to an average of 0.51 juveniles per adult pair in Kandiyohi index area. Due to the difficulty of observing juvenile loons and the biotic and abiotic factors that can impact seasonal nest success, reports are highly variable from year to year.

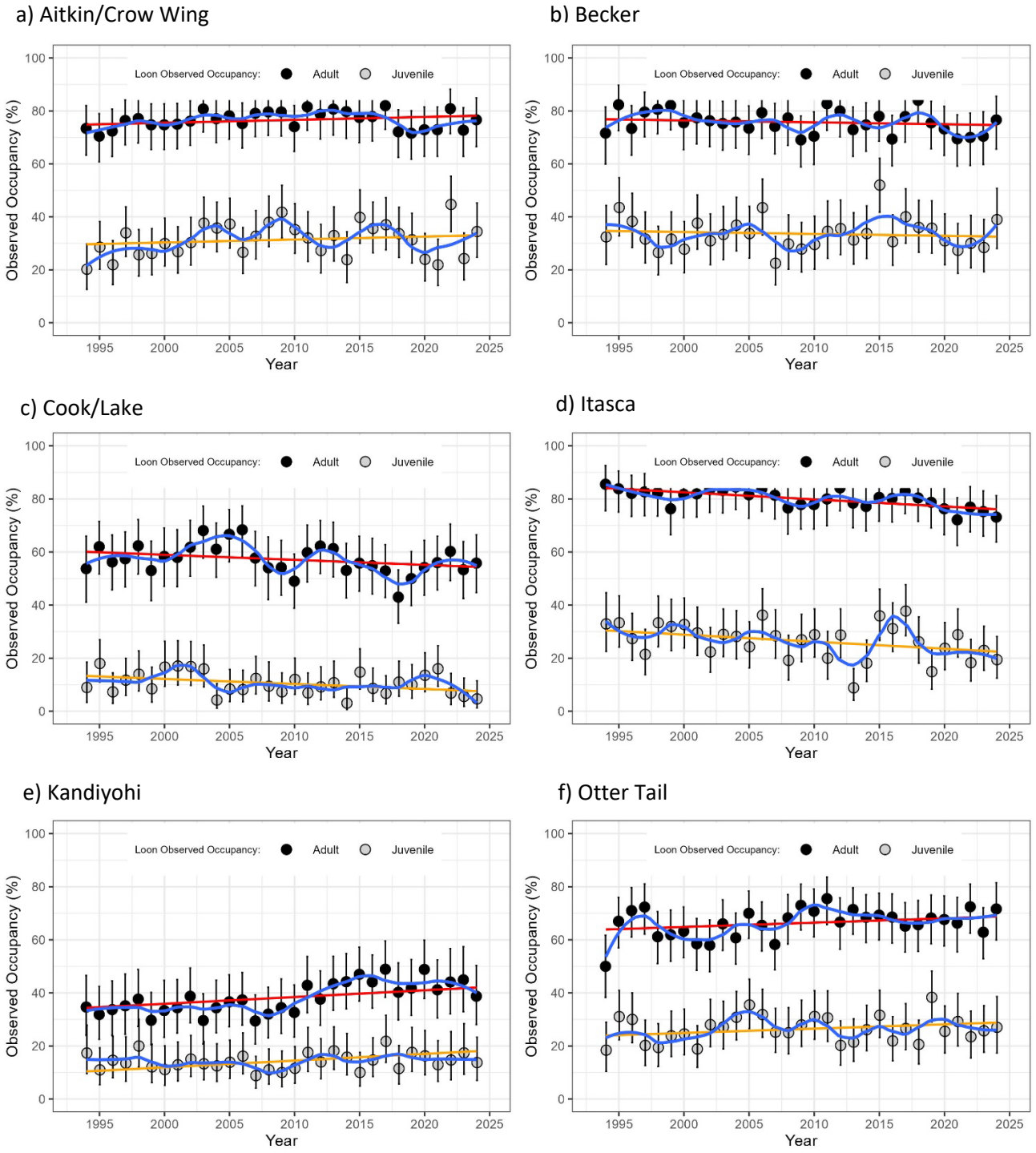

Figure 8a-f. OBSERVED OCCUPANCY: Percentage of lakes with adult and juvenile loons from 1994-2024 for each of the six Index Areas. Error bars indicate 95% confidence bounds around the annual means. For each adult and juvenile occupancy trend, the red or yellow line is a simple linear regression trendline, and the blue line uses the closest 30% of the data in a given year to estimate a nonlinear trend. Loon occupancy is highest in the Itasca, Becker, and Aitkin/Crow Wing Index Areas and lowest in the Kandiyohi, Cook/Lake, and Otter Tail Index Areas.

Conclusions

Overall, adult loon relative abundance across the six Index Areas appears to be in good shape with small increases observed in some areas and small decreases in others over the past 31 years of the monitoring program. This is good news for Minnesotans, who recognize and enjoy our state bird as an integral part of our lake ecosystems. Despite the good news with adult relative abundance trends Index Area-wide, for the third year in a row we are detecting a slight decline in juvenile loon abundance overall across Index Areas, with mean estimated declines in the Becker, Cook/Lake, Itasca, and Otter Tail Index Areas of 0.4%, 2.1%, 1.8%, and 0.6% per year, respectively. These model-estimated trends are concerning, and we will continue to monitor these areas closely in future years.

The long-term declines we have detected appear to be very gradual, and there could be more than one explanation for these trends. We are in the process of formulating testable hypotheses that we can challenge with additional data including the possibility that these apparent declines are influenced by development activities around lakes, increased recreation, extreme weather events, species-wide population declines, and others.

On a positive note, both adult and juvenile loon abundance trends as well as loon occupancy are increasing or likely increasing in the Kandiyohi Index Area. While biologists predict that climate change could have negative impacts on our state bird, to date we are not detecting reduced loon abundance or occupancy in the southern-most Index Area of our monitoring program. The DNR Nongame Wildlife Program will continue to rely on MLMP to monitor loons as Minnesota's human population and lakeshore development continue to increase.

Acknowledgements

THANK YOU MLMP VOLUNTEERS!!!

We extend our heartfelt thanks to the hundreds of volunteer observers who continue to make the MLMP a success. Without your persistence and hard work, the DNR would not have as comprehensive of a long-term data set to track the health of our state bird. We and Minnesota's loons appreciate your commitment!

The MLMP is supported by contributions to the Nongame Wildlife Checkoff on Minnesota's tax forms and by the State Wildlife Grants program administered by the U.S. Fish and Wildlife Service.

*You can donate online anytime at: **mndnr.gov/checkoff***

Contact Us to Participate

For more information, or if you are interested in participating in the MLMP, please visit:
mndnr.gov/eco/nongame/projects/mlmp_state.html

Report Authors:

Krista Larson, MLMP Coordinator
DNR Nongame Research Biologist
E-mail: krista.larson@state.mn.us

Chris Jennelle, MLMP Data Analyst
DNR Nongame Wildlife Biometrician
Email: christopher.jennelle@state.mn.us

500 Lafayette
Road St. Paul, MN
55155-4040

888-646-6367 or 651-296-6157

mndnr.gov

The Minnesota DNR prohibits discrimination in its programs and services based on race, color, creed, religion, national origin, sex, marital or familial status, disability, public assistance status, age, sexual orientation, and local human rights commission activity. Individuals with a disability who need a reasonable accommodation to access or participate in DNR programs and services, including those who would like to request this document in an alternative format, should contact the DNR ADA Title II Coordinator at info.dnr@state.mn.us or

651-296-6157. We welcome calls from Telecommunications Relay Service (TRS) users. For assistance in other languages, please call 651-296-6157 or 888-MINNDNR (646-6367). Discrimination inquiries should be sent to Minnesota DNR, 500 Lafayette Road, St. Paul, MN 55155-4049; or Office of Diversity, Inclusion and Civil Rights,

U.S. Department of the Interior, 1849 C. Street NW, Washington, DC 20240.