NORTHERN GREAT LAKES

COMMON LOON MONITORING PROGRAM:

1993 Field Season Final Report

Submitted by:

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This was the second year of our association with Earthwatch and it was a very successful joint venture. James Paruk and Ari Davila deserve recognition for their devotion to ensure the safety, understanding, and comfort of each volunteer. Earthwatch volunteers include Sherry Abts, Christine Bailey, Louise Cortright, Linda Daniels, Hazel Deuble, Wayne Frerichs, Brian Hafer, Adam Herrick, Manja Holland, Kristine Karsh, Lenny Leaman, Donald McNeil, Eleanor Monroe, Adam Paplin, Jane Philbrick, Ione Rice, Peter Schwartz, Charlotte Seymour, Claire Terni, and Doris Wyman.Their constant determination, willingness to dive into any situation, and humor brought in a component to loon research that is otherwise unmatched. Earthwatch is a large, international, non-profit environmental organization dedicated to serving the general public and researchers by finding interested volunteers to help scientists answer questions to problems requiring a large supportive labor force. Thanks to the interest and participation from Dr. Charlie Walcott from the Lab of Ornithology and Cornell University, our vocal-tagging research at Seney NWR has received a big boost — Charlie will be computerizing the yodels calls for identification.

Eric Hanson spent the months of May and June searching for returning color-marked loons in Michigan, Minnesota, and Wisconsin: a very enjoyable job but frustrating at time, especially when he had to wait 8 hours to identify a banded bird. Michael Meyer, Walter Piper, Tim Larsen, Eric Witham, Mary Derr, and Ted Gostomski also helped in determining the adult return rates. Eric also supervised and coordinated the loon capture team. The capture team included Eric, Joe Kaplan, and Ken Jacobsen. Nearly every night for 6 weeks they spent the entire time working in the dark, hauling equipment from the shore to the water and back, spending countless hours searching for and thankfully finding loons on a variety of lakes, and dealing with the many trials and tribulations of hard but rewarding, field work. Joe was instrumental in coordinating our contaminants and genetics field research. He was trained and assisted by Sara Thompson. Sara spent a considerable amount of time preparing for this season and is currently analyzing the blood and feather samples gathered in 1991 and 1992; this research is in partial fulfillment of her Master of Science Degree under Dr. Bill Robinson of Northern Michigan University. Ken assisted both Eric and Joe and filled in the gaps when needed; his truck was used to pull the capture boat through the wilds of Wisconsin - a much appreciated sacrifice.

Ken Jacobsen, Eric Hanson, and Sally Clock surveyed the eastern Upper Peninsula lakes for breeding pairs of loons. Time acitivty budget research was accomplished by James Paruk and his Earthwatch crew at the Seney National Wildlife Refuge, Ted Gostomski at Isle Royale National Park (for his Master of Science degree at Central Michigan University), and Jay Mager in the Ottawa National Forest (for his Master of Science degree at University of Miami at Ohio). Each did an excellent job in quantifying the loon's behaviors. Mary Derr helped coordinate our efforts in Voyageurs National Park and began a multi-species study for her Master of Science degree at the University of Minnesota. This pilot study is planned to be expanded to other loon research sites in 1994.

At each study site, we depended heavily on the expertise and field savvy of the resident biologists. In Wisconsin, one of our major study sites, Dr. Michael Meyer again provided the optimal work conditions for our staff. The research being carried out in Wisconsin is a joint venture to assist the DNR in understanding the loon and the effects of mercury. Mike funded all of our work in Wisconsin and is an integral part of the entire program. The efforts of Jeff Wilson and Terri Daulton were instrumental in many ways - once again, thanks for the use of your log cabin, Jeff. Jerry Hartigan and Jim Woodford were our nightly guides and always had all systems on go. In Michigan our support and guidance were from Jerry Edde, Bob Evans, and Marilyn Keifenheim in the Ottawa National Forest, Kelle Reynolds and Kevin Doran in the Hiawatha National Forest, Mike Tansy, Sally Clock, and Richard Urbanek in the Seney National Wildlife Refuge area, Jack Oelfke and Dave Soleim at Isle Royale National Park, Larry Kalameyn and Joe Kayoe at Voyageurs National Park and DNR representatives Rich Baker and Jeff Hines in the Grand Rapids area.

A new component in this project is the assistance from Dr. Walter Piper a behavioral ecologist from the Smithsonian Institution. Walter is organizing the genetic population dynamics work through DNA blood sampling and is also collecting information on the social interactions of the banded loons in Wisconsin. Dr. Jim Sikarskie, Dr. Emmet Braselton, and Dr. Bob Poppenga (all of Michigan State University) again provided advise and constant encouragement with the contaminants part of the study. Necropsies of recovered banded loons were done by Bob Poppenga and by staff of the Minnesota Zoo (Jimmy Pichner and Dr. Peregrine Wolf). Several of these loons were recovered thanks to the efforts of the Ottawa and Hiawatha National Forests and the Northwoods Wildlife Center in Minocqua, Wisconsin. Barb and Richard Wells supplied all of our blood sampling equipment; these donations saved us considerable time and money. We received valuable donations from Patagonia, Sheridan Hospital, and Fred Moon from Scientific Products. Bob Baldwin of Northword Press and the staff at the Lab of Ornithology provided high quality tape recordings of loon vocalizations. Trees for Tommorrow and Elsa Strom provided lodging at a very reasonable price.

A request for initiating a new monitoring program for the New England area was met this year. One week was spent in New Hampshire, working with Betsy Pourier of the New Hampshire Loon Preservation Committee, Chris Rimmer of the Vermont Institue of Natural Science, and Dr. Mark Pokras of Tufts University. We were able to work out many of the logisitical pitfalls that are always present with a new project. Thanks to their persistence this pilot year is a promising start. Zimra Gordon, a DVM student working under Dr. Acacia Alivar-Warren, will be investigating the genetic variability of New England loons.

Some of the others that helped that helped with the capture process, many for several nights, include Rick Baetsen, Sally Borden, Pete Clock, Marc Cook, Terry Daulton, Laura Lorenzetti Evers, Maria Fernandez, Zimra Gordon, Al Guggisberg, Helene Hansen, Bill Henson, Jason Hoeksema, Peg Hart, Heather Joyce, Jacob LaCroix, Tim Larsen, Sue Marden, Gail McPeek, Jimmy Pichner, Rosemary Piper, Betsy Pourier, Pete Reaman, Rosalind Renfrew, Chris Rimmer, Marta Swain, Sara Thompson, Lucy Vlietstra, Eric Walser, Jeff Wilson and Eric Witham.

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ABSTRACT

The northern Great Lakes Common Loon monitoring program began in 1989 following the discovery of a time-efficient capture technique of adults on the breeding grounds. Since then, it has expanded in scope and scale. Research topics now include behavioral studies, monitoring individuals through a variety of marking efforts, contaminants investigations, determining normal physiological parameters, and population dynamics through observation and genetic sampling. Study sites have increased from the initial Michigan location at the Seney National Wildlife Refuge to 7 sites across the upper Great Lakes. A total of 572 loons have now been banded and uniquely color-marked. Most of these have had blood and feather samples taken to examine the extent and degree of mercury bioaccumulation. Recently, use of these tissue samples has been incorporated into investigations of genetic and physiological values.

Information on the loon's population ecology is extensive. The Common Loon is extremely site faithful to its nesting territory, however should a nest fail there are frequent examples of mate switching. The adult return rates are at least 75%; some adults do not necessarily return each year. There have been 18 recoveries of banded loons, most are from the coastal waters of Florida. Quantifying the loon's behaviors through time-acitivty budgets is proving valuable in unlocking some of the subtle sexual and between-site differences. Over 2,000 hours have been spent making standardized observations of color-marked loons at the Seney National Wildlife Refuge, Isle Royale National Park, Ottawa National Forest, and Wisconsin's Turtle-Flambeau Flowage.

There are some concerns that contaminants, particularly mercury, are having negative effects on the reproductive success and survivorship of loons. The Common Loon appears to be extremely sensitive to environmental loads of methyl mercury and may soon be viewed as the biosentinel for this heavy metal. In 1993, observations on a pair in the Ottawa National Forest showed the male to be severely deficient in nest-sitting duties. The nest failed and the male was later found dead — the year before his mercury feather load was 35 ppm (3 times the average).

To further investigate this issue and others a number of collaborators have joined this project, including behavioral ecologists, geneticists, toxicologists, physiologists, and several graduate students. Following a pilot study in 1993, plans are being made to simulate the Great Lakes program in the New England area. Assistance from a similar guild of scientists will be coordinated. Additionally, starting in 1994, this research will be expanded into a regional-landscape ecology project that includes a host of piscivorous birds. It is hoped that a project with such a high scale of resolution will provide information to make optimal land and water conservation decisions.

(Note: Use this abstract when presenting summaries of this project in newsletters or other publications)

INTRODUCTION:

Following the discovery of a time efficient and reliable capture technique for adult Common Loons (*Gavia immer*) on their breeding grounds this project has experienced a tremendous annual expansion in scope and scale. The capture technique depends on nightlighting, playback recordings, and net maneuverability (Evers 1992) and for the first time provides the opportunity for regular individual identification of adults (McIntyre 1988). The capture rate has reached 90% and 95% of attempts being successful for adults and juveniles, respecitively. Since 1987, a total of 572 loons have been banded, including 328 adults and 244 juveniles (Appendix I).

In 1993, the capture of loons occurred in much of northern Michigan and in parts of Minnesota, Wisconsin, and in New Hampshire resulting in the banding of 150 loons, 99 adults and 51 juveniles. Three sites were involved with quantifying the behaviors of marked loon pairs (all in Michigan): Seney National Wildlife Refuge (third year), Isle Royale National Park, and the Ottawa National Forest. The investigation into environmental contaminants continued for the third full year. The 1991-92 results are included in this report and have served as a screen, filtering out the types of toxins that are the most dangerous to the loons. In 1993, all contaminant sampling work was focused at better understanding the effects of mercury. This was the second year that the return rates and site faithfulness of a large number of banded loons could be assessed. The overall annual return rate for adults is 75% and nearly all of the returning adults are site faithful (n=144 returning adults). Other interesting population ecology parameters are coming to light including the relatively high frequency of inter- and intra-year mate switching and the natal site fidelity of returning subadults. There have been 14 out-of-state recoveries of loons, 7 from Florida.

Next Year - 1994

The capture and marking of loons is only a method to the many objectives of the project. The uniquely marked loons and the opportunities of in-hand examination has generated research questions that are being investigated by several collaborators (Appendix 12 and 13). Already, certain aspects of the loon's population ecology have been discovered and the insidious effects of mercury are beginning to be fully realized. In 1994, the DNA fingerprinting research will allow further exploration of mate switching and actual parentage. Time-activity budgets will be continued to determine differences in the behaviors of loons with high mercury levels versus those with low levels and between study sites. These standardized observations also provide baseline biological and social information that is being incorporated into other studies, such as documenting the intrusion rates and relationships of floaters (i.e., loons without established territories). An attempt will be made to temporarily color-mark these floaters.

Another method of monitoring individuals will be employed next year — satellite telemetry. It is hoped that transmitters will be surgically implanted into a small sample of adult loons that will provide location data through NOAA computers and satellite technology. The emphasis on locating color-marked loons using traditional methods will continue and includes for the first time a concentrated effort to locate them on their wintering grounds in Florida. The better understanding of molecular marking also provides new opportunities to establish a national genetic database from known breeding locations to compare with tissue samples from migrant or wintering loons.

Interest in learning more of the normal physiological values of the Common Loon is increasing and will include investigations into the recently discovered feminization effects that contaminants may be having on piscivores (i.e., higher than normal estrogen levels in male birds). Information gathered on normal blood counts could be used to better treat injured or diseased loons and increase chances for survival in captivity.

The capture and marking of loons will continue at a level similar to 1993 with the exception of the mass banding of adults and juveniles at a Minnesota study site to better determine migration routes and wintering grounds. Emphasis is now being placed on recapturing loons (1) to understand the bioaccumulation of contaminants and (2) on previously visited territories that have unmarked adults. By having a marked territorial pair much more information can be determined for their social interaction and movements compared to one-adult marked territories.

An inter-regional component of this program is being developed. Feasibility pilot studies in New England indicate the use of logistical and informational knowledge now known for the Great Lakes can be easily simulated. Its application will be more thoroughly tested in 1994. More emphasis will be placed on toxicological and physiological issues versus population ecology and behavioral aspects. This expansion correlates with the overall objective to maintain a regional approach when investigating a research topic.

Lastly, an expansion in scale will be initiated in 1994 to form a more regional-landscape approach to investigating aquatic ecosystems, contaminants, and piscivorous birds. This approach begins with classification and structuring of resources and issues, followed by problem identification and structuring through multi-scale maps of intersecting opportunities. The targeted inventories will be used to test distribution hypotheses and population processes, as well as select problems for long-term monitoring. A guild of 4 species will be targeted: Common Loon, Red-necked Grebe, Common Merganser, and Hooded Merganser. This research will now be a collaboration with Drs. John Probst, Francesca Cuthbert, and Mary Henry for Ph.D. dissertation work at the University of Minnesota.

DESCRIPTION OF 1993 RESEARCH

Michigan — summary

As part of the population monitoring efforts of the Observatory, loons were counted with a standardized methodology during the spring and fall migration at Whitefish Point. A total of 3,826 and 2,922 Common Loons were counted at Whitefish Point in spring and fall, respectively.

The breeding population was surveyed across the entire eastern Upper Peninsula (Appendix IV); of the 132 lakes surveyed 64 had territorial pairs, 40 of these pairs nested and 37 chicks were produced (Table 1 and 2). Since 1990, the four years of surveys have found 62 lakes with nesting pairs (11 new ones fround in 1993), 69 different nesting territories, 50 lakes with nesting pairs that have produced chicks, and 57 different nesting territories that have produced chicks (Appendix II). The annual number of chicks produced per nest is .86 (1990), 1.05 (1991), .73 (1992), and .93 (1993). The annual number of chicks produced per territory is .38 (1990), .39 (1991), .47 (1992), and .58 (1993). A total of 134 chicks are known to have hatched since 1990; this is a productivity rate of .96 chicks per nesting pair or .57 chicks per territorial pair.

Table 1. County distribution of lakes surveyed and adult Common Loons in the eastuern Upper Peninsula, 1990-93.

County	# Lakes Surveyed					# of Adults / Territorial Pairs				
	1990	1991	1992	1993	Avg.	1990	1991	1992	1993	Avg. Ratio
Alger	37	43	33	37	38 +/- 4	33/10	32/13	29/9	59/14	3.31 +/- .72
Chippewa	26	22	25	24	24 +/- 2	32/12	24/11	19/6	18/7	2.65 +/- .41
Delta	4	0	0	1	1 +/- 2	2/1	0/0	0/0	1/0	n/a
Luce	6	6	16	12	10 +/- 5	12/6	12/6	17/4	15/5	2.81 +/- 1.07
Mackinac	22	19	15	7	16 +/- 7	42/14	33/12	27/9	27/11	2.80 +/- .26
Schoolcraft	68	59	52	51	58 +/- 8	66/20	59/20	56/18	62/27	2.92 +/- .43
Total	163	143	141	132	145 +/- 13	187/63	160/62	148/46	182/64	2.90 +/- .62

An average of 145 +/- 13 lakes are surveyed each year locating 169 +/- 18 adults (Table 1). The average number of territorial pairs in the eastern U.P. is 59 +/- 9. The ratio of the number of adults compared to the number of territorial pairs is 2.90 +/- .62, meaning there is an extra adult loon for every territorial pair. This figure only includes adults found on inland lakes. Many loons also oversummer on the Great Lakes and are not included in this comparison. Loons found on inland lakes could represent an excess in the breeding population that is readily available to fill breeding territory gaps whereas loons on the Great Lakes may be subadults or adults that are not in breeding condition.

The number of territorial pairs that lay eggs each year averages at approximately 35 +/- 5 (Table 2). Schoolcraft County has the greatest number of nesting pairs (and also varies the most each year) due to the relatively large breeding population at the Seney NWR. Luce County has the fewest (around 3 nesting pairs), but like Mackinac County is consistent in the number of pairs nesting each year. Productivity is closely related to the number of nesting attempts per county and is highest in Schoolcraft (11 chicks) and Mackinac (9 chicks). An average of 34 +/- 7 loon chicks hatch each year in the eastern U.P. (Table 2). Fledging rates are unknown, except for the Seney NWR (Table 5).

Table 2. County distribution of the Common Loon's nesting status in the eastuern Upper Peninsula, 1990-93.

County	# of Nests					# of Chicks Hatched				
	1990	1991	1992	1993	Avg.	1990	1991	1992	1993	Avg.
Alger	4	4	6	8	5.5 +/- 1.9	5	6	5	6	5.5 +/- 0.6
Chippewa	4	8	5	4	5.3 +/- 1.9	4	10	5	4	5.8 +/- 2.9
Delta	0	0	0	0	n/a	0	0	0	0	n/a
Luce	4	4	2	3	3.3 +/- 1.0	1	6	1	3	2.8 +/- 2.4
Mackinac	7	9	7	8	7.8 +/- 1.0	8	9	6	12	8.8 +/- 2.5
Schoolcraft	12	13	10	17	13.0 +/- 2.9	13	10	8	12	10.8 +/- 2.2
Total	**31**	**38**	**30**	**40**	**34.8 +/- 5.0**	**31**	**41**	**25**	**37**	**33.5 +/- 7.0**

Banding efforts in 1993 included much of the Upper Peninsula and were emphasized in the Hiawatha National Forest, Isle Royale National Park, Ottawa National Forest, and the Seney National Wildlife Refuge. A total of 32 loons, 19 adults (8 males and 11 females) and 13 juveniles were banded and an additional 10 adults were recaptured (Table 3).

Time-activity budget data were gathered at the Seney National Wildlife Refuge (fourth year), Ottawa National Forest (first year), and Isle Royale National Park (second year). The objectives of this behavioral monitoring is to quantify behaviors and document social interacations.

Information on population ecology is substantial for 1993. The minimum survival rate for 1993 returning adult loons in Michigan was 79% (Table 44). There were two known cases of breeding adults changing territories, both in the Seney NWR. The number of territories that at least one member was banded is now at 56; 39 (70%) of these territories have both adults marked and 8 (14%) of these territories have 3 adults marked (Table 39).

Table 3. Summary of banded Common Loons in Michigan, 1987-1993.

Year	# of Adults	# of Juveniles	TOTAL (new)	# Adult Males	# Adult Females	# Recaps
1987	0	3	3	-	-	-
1988	1	5	6	1	0	-
1989	4	1	5	1	3	0
1990	6	12	18	3	3	3
1991	43	32	75	23	20	3
1992	33	12	45	17	16	11
1993	19	13	32	8	11	10
Total	**106**	**78**	**184**	**53**	**53**	**27**

Whitefish Point

The Whitefish Point Bird Observatory has conducted standardized spring and fall counts at Whitefish Point since 1984. The average number of spring migrants counted between 1984 and 1993 is 6,192. Since the peak count of 9,267 in 1989 there has been a consistent decline in the number counted, dropping dramatically from 8,561 in 1990 to 4,491 in 1991 (Table 4). Since the magnitude and pathways of the migrant Common Loons are relatively unaffected by local weather patterns, and the annual return rates for adults have been shown to be at least 75%, the recent decreasing trend and one year loss of nearly half of the countable migrants is disturbing. All migrant loons passing Whitefish Point breed in Canada, as indicated by the migration chronology and local occupancy of lake territories. Since these nesting habitats remain relatively intact, a population catastrophe appears to have happened. Dieoffs are known in fall (Fay 1966, Fay et al. 1965, Kaufman and Fay 1964) and in winter (Alexander 1991). Although a large dieoff was not noted in the winter of 1990-91, the migration monitoring by the Observatory indicates one occurred between the spring of 1990 and the spring of 1991. There are indications through the Canadian Wildlife Service that up to thousands of Common Loons are legally taken each year by native Americans in the James Bay area. The fall migration monitoring research began in 1990 and has a more protracted chronology. Constant, standardized effort could provide insight on productivity in northern Canada. Red-throated Loon numbers probably vary due to differences in observer identification skills.

Table 4. Loon migration at Whitefish Point, Chipppewa County, 1984-1993.

Species by season	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	**Avg. 84-93**
SPRING (4•15 to 5•31)											
Common Loon	3,826	3,840	4,491	8,561	9,267	8,097	5,562	6,483	5,202	6,587	6,192
Red-throated Loon	151	203	214	302	272	138	26	93	36	62	150
Pacific Loon	0	1	0	0	1	1	0	0	0	1	<1
FALL (8•15 to 11•15)										**Avg.**	**89-93**
Common Loon	2,922	2,960	2,115	3,619	2,287						2,781
Red-throated Loon	156	240	85	80	79						128
Pacific Loon	1	0	0	0	0						<1

Seney National Wildlife Refuge

This refuge lies in the east-central portion of the Upper Peninsula and contains 21 artificially-controlled pools; these pools total around 7,000 acres (8,984 ha) of water and are concentrated in the eastern one-third of the refuge (Appendix V). All 21 pools are shallow, averaging less than 3-4 feet (around 1 m) in depth and reaching a maximum depth of 6-8 feet (2-2.5 m) along the dikes. This project had its beginnings at the refuge and its initial success is due to the accessibility and number of loon pairs and the tremendous financial and logistical support from the refuge.

The established territorial pairs at the refuge are easily identified and monitored. Each of the 21 pools are accessible by car and have few areas where loon pairs could escape detection. Therefore, observations between 1987 and 1993 of marked and unmarked loon pairs are believed to provide the absolute population reproductive effort (Table 5). The number of territorial pairs per year averages 8.6. Of these territorial pairs, an average of 6.7 nest (9 in 1993) and 5.1 nesting pairs are successful in hatching chicks. The number of hatched chicks averages 6.7; chick mortality rates are low with only 8 chicks known to have died since 1987. Most chick mortality is unaccounted, however a 1993 chick died from sibling rivalry on G Pool. The average number of chicks fledged (1) per territorial pair is .65, (2) per nesting pair is .83, (3) per succesful nesting pairs is 1.08, and (4) per chicks hatched is .83. Since 1987, 47 chicks have been produced, and 39 of these have fledged.

Table 5. Breeding status and population reproductive effort of Common Loons at Seney NWR, 1987-1993.

Site	Number of Territorial Pairs, Nests, Chicks Hatched, Chicks Fledged								Color-Mark
	1987	1988	1989	1990	1991	1992	1993	TOTAL	in 1993
A-2 Pool	1,1,1,1	1,0,0,0	1,1,1,1	1,1,0,0	1,1,0,0	C-2*	1,1,0,0	5,5,2,2	F—x
B Pool-south	1,1,1,1	1,1,1,1	1,1,1,1	1,1,1,1	1,1,1,1	1,1,0,0	1,1,0,0	7,7,5,5	x—M
B Pool-north	-	-	-	-	-	1,1,1,1	1,1,1,0	2,2,2,1	F—M
C-2 Pool	-	-	-	-	-	1,1,1,1	1,1,0,0	2,2,1,1	F—x
C-3 Pool	0,0,0,0	1,0,0,0	1,1,1,1	1,1,2,2	1,1,2,1	1,0,0,0	1,1,2,0	5,4,7,4	F—M
D Pool	1,1,1,1	1,0,0,0	1,1,1,1	1,1,2,2	1,0,0,0	1,1,0,0	1,1,2,2	7,5,6,6	F—M
E Pool-east	1,1,2,2	1,1,1,1	1,1,1,1	1,1,1,1	1,1,0,0	1,1,1,1	1,1,1,1	7,7,7,7	F—M
E Pool-west	-	-	-	-	-	1,1,1,1	1,0,0,0	2,1,1,1	F—M
G Pool	1,1,1,1	1,1,1,1	1,0,0,0	1,1,2,2	1,0,0,0	E-west*	1,1,2,1	6,4,6,5	F—M
J / F Pool	0,0,0,0	1,0,0,0	0,0,0,0	0,0,0,0	1,0,0,0	1,0,0,0	0,0,0,0	3,0,0,0	—
M-2 Pool	1,1,2,2	1,1,2,2	1,1,1,1	1,1,0,0	1,1,0,0	1,1,2,0	Big Spur*	6,6,7,5	x—x
T-2 East Pool	-	-	-	-	-	-	1,0,0,0	1,0,0,0	x—M
T-2 West Pool	-	-	-	-	-	1,1,0,0	1,1,1,0	2,2,1,0	F—M
Grey's Cr. Pool	1,1,1,1	0,0,0,0	0,0,0,0	0,0,0,0	0,0,0,0	0,0,0,0	0,0,0,0	1,1,1,1	—
Big Spur Pool	0,0,0,0	1,1,1,1	0,0,0,0	0,0,0,0	0,0,0,0	0,0,0,0	1,1,0,0	2,2,1,1	—

* Signifies temporary territory change of established pair to another pool — 9F-9M

	1987	1988	1989	1990	1991	1992	1993	Avg. # per year	Range
Territories / year	7	9	7	7	8	10	12	8.6+/-1.9	7-12
Nesting pairs / year	7	5	6	7	5	8	9	6.7+/-1.5	5-9
Succesful nest. pairs/year	7	5	6	5	2	5	6	5.1+/-1.6	2-7
Chicks hatched / year	9	6	6	8	3	6	9	6.7+/-2.1	3-9
Chicks fledged / year	9	6	6	8	2	4	4	5.0+/-2.3	2-9

The nesting chronology of the refuge population varies and is apparently correlated with weather conditions (Table 6). Late ice-off, colder than normal temperatures, and new pair bonds probably extend the initiation of nesting. Nesting attempts also may be correlated to the temporal length of territorial establishment and the degree of intrusion. Egg dates of first nests have varied from 19 May to 19 June and the average date for the 4-year period is 28 May (sd +/- 11 days, n=25). A total of 13 nests have been abandoned; causes include adults accidentally pushing eggs into the water (n=2), trampling by geese (n=1), water level draw downs (n=1), and unknown or no apparent cause (n=9). Other than water level fluctuations, there has not been a known nest abandonment due to human disturbance. The hatching dates of first nests range from 11 June to 6 July; the average hatching date is 25 June (sd +/- 12 days, n=16). The average number of days for incubation is 27 days (sd +/- 1.2 days, n=17) and ranges from 25 to 28 days. Since 1990, there have been 5 cases of renesting attempts by 3 different pairs (A-2 in 1990, B-south in 1993, and D in 1990, 1992, and 1993).

Table 6. Nesting chronology of the Common Loon at the Seney NWR, 1990-93.

Territory	Egg Date				Abandon Date				Hatch Date			
	1990	1991	1992	1993	1990	1991	1992	1993	1990	1991	1992	1993
A-2*	5-21	–	6-1	6-19	5-26	–	–	7-9	–	–	6-27	–
	6-9	–	–	–	6-19	–	–	–	–	–	–	–
B-south	5-19	5-19	5-22	5-19	–	–	6-17	6-12	6-13	6-14	–	–
B-north	–	–	unk	6-19	–	–	–	–	–	–	7-4	7-17
C-3	5-20	5-29	–	6-3	–	–	–	–	6-15	6-26	–	6-29
D	5-20	–	5-22	5-30	5-21	–	5-24	6-4	–	–	–	–
	6-4	–	6-9	6-15	6-5	–	7-7	–	–	–	–	7-13
	6-18	–	–	–	–	–	–	–	7-14	–	–	–
E-east	5-16	5-22	6-9	5-17	–	6-2	–	–	6-11	–	7-6	6-16
G*	5-27	–	6-7	6-9	–	–	–	–	6-23	–	7-4	7-6
M-2*	–	6-11	5-21	5-18	–	7-4	–	5-29	–	–	6-17	–
T-2 West	–	–	–	6-10	–	–	–	–	–	–	–	7-8
Avg. annual date	5-21	5-28	5-31	6-2	–	–	–	–	6-16	6-20	6-30	7-3
	(for first nesting attempt)								(for first nesting attempt)			

* The A-2 female nested on C-2 Pool in 1992 and due to water drawdowns the G male nested on E-west Pool in 1992 and the M-2 pair nested on Big Spur Pool in 1993.

A major objective at the Refuge is to color-mark all adults with established territories and all juveniles produced each year. Between 1987 and 1993, 18 adults (9 males and 9 females) and 27 juveniles have been color-marked for a total of 45 loons (Table 7). All chicks which survived to fledging age have been color-marked since 1990; in other years the number of captured chicks from the number fledged was 3 of 9 in 1987, 5 of 6 in 1988, and 1 of 6 in 1989.

In 1993, 4 adults were captured including one recapture (E Pool-east male). The 3 newly color-marked adults are the male at C-3 Pool, the female on G-Pool, and the T-2 West Pool female. The only unmarked adults that are part of traditional breeding territories are the A-2 male, B-south female, and the M-2 pair (Table 5). Three more territories were established in 1993 on C-2, G-west, and T-2 east Pools — marking the third year in which there was an increase. The F/J Pool pair of 1992 did not return to their territory. A color-marked loon, banded as a juvenile, was paired with the G-west marked female. However, his specific identity is still unknown (the 7 juveniles banded in 1987 and 1988 were not uniquely marked, so their specific identification is not possible until capture).

Each of the chicks produced in 1993 were captured and color-marked: one chick from G Pool, 2 chicks from D Pool, and one chick from E Pool-east territory. Five chicks died before fledging in 1993, more than usual: 2 from C-3 Pool, 1 from B-north Pool, 1 from G Pool, and 1 from T-2 West Pool. The E Pool-east chick was still present on 2 October. The G Pool chick crossed the dike and fledged from the western part of E Pool (the 1992 territory for its male parent) and was last seen on 3 October. No loons were found on surveys of all Unit 1 pools on 16 and 30 October. One loon in basic or immature plumage was observed on M-2 Pool on 26 October.

Table 7. Summary of banded Common Loons at Seney NWR, 1987-1993.

Year	# of Adults	# of Juveniles	TOTAL (new)	# Adult Males	# Adult Females	# Recaps
1987	0	3	3	0	0	(0)
1988	1	5	6	1	0	(0)
1989	4	1	5	1	3	(0)
1990	3	8	11	1	2	(3)
1991	2	2	4	1	1	(2)
1992	5	4	9	3	2	(1)
1993	3	4	7	2	1	(1)
Total	**18**	**27**	**45**	**9**	**9**	**(7)**

The specific outcome of color-marked juveniles remains unknown at this time. Loons generally remain on the ocean in non-breeding plumage for at least the first 3 years (approximately 1% of the migration past Whitefish Point is comprised of loons in non-breeding plumage). The first return of a loon banded as a juvenile was of an individual color-marked between 28-31 July, 1987 (loons were not uniquely color-marked in 1987 and 1988) (Table 8). On 4 June, 1990 one of these 3 individuals returned in alternate pluamage and paired with the male on J Pool until 28 June. In 1992, 3 of the 9 loon banded as chicks between 1987 and 1989 returned to the Refuge. One of these again returned to the J / F Pool territory, one paired with a male on T-2 East Pool (first seen on 21 May), and the other was seen with a group of 5 other loons on C Pool on 14 July, during a time when the T-2 East (the pair on this territory is not considered to be established) and J / F Pool birds were known to be on their respective territories. In 1993, a male paired with a color-marked female (in 1992 this female was paired with the G Pool male) and was observed copulating several times on the E Pool-west territory. This pair was also observed frequently using H Pool. In 1993, 2 other loons that were banded as juveniles in 1987-88 also returned and used I and J Pool for a two week period in late May. Both of these birds were not seen again on the refuge for the rest of the breeding season. The juvenile return rate was 18% in 1993; all returning subadults are in complete breeding plumage. In 1994, a potential total of 19 color-marked subadults could return.

Table 8. Outcome of banded Common Loon juveniles at the Seney NWR, 1987-1993.

Year Banded	# Banded	# that could return	# and % known to return	Date first Observed	Remarks
1987	3	–	–		
1988	5	–	0		
1989	1	–	0		
1990	8	3	1 (33)	4 June	paired with male on J-Pool to 6-28
1991	2	8	0		
1992	4	9	3 (33)	21 May	paired with male on T-2 East Pool
				3 June	paired with male on F Pool
				14 July	with group of 6 loons on C Pool
1993	4	17	3 (18)	12 May	paired with banded female on E-west
				mid to late May	loners on I and J Pools
Total	27	19 (in 1994)	7		

Documenting the return of adults is one of the main goals of this study. The annual outcome of each territorial pair is shown in Table 9, as is the reproductive effort and identification of mated pairs. These results show a high annual return rate (or miminum survival rate) of 95% (35 of 37 adults) and a high site faithfulness of 91% (32 of 35 possible returning adults) (Table 10). The 1993 return rate was 100% (14 of 14) and the site fidelity rate was 86% (12 of 14); the original C-3 female and male established new territories. Only two adults have not been observed to return the year after banding: the G Pool female was recovered dead in St. Augustine, Florida and the C-3 Pool female was not seen in 1991 (but returned to her established territory in 1992).

C-3 Pool History (702 acres): The first C-3 Pool female was banded in 1989, returned in 1990 (and recaptured), did not return in 1991, returned in 1992, and returned in 1993. Her return in 1992 complicated the pair bond that the banded male of 1991 had established with the second female (also banded in 1991). All three returned to the C-3 Pool territory in 1992, and the male was seen paired with each female and a third unmarked female on different dates from 18 to 25 May (but never with more than one female at the same time). By 26 May, the first color-marked female was paired with an unmarked male on the traditional C-3 Pool territory. The second color-marked female and color-marked male were observed as a pair on neighboring Marsh Creek Pool. The three color-marked loons from C-3 Pool were also seen frequently interacting with other unmarked loons and visiting the neighboring pools (C-2 and Marsh Creek). The return of two territorial females may have created an unusual situation for the territorial male, thereby delaying formal pair bonding and causing the lack of a nesting attempt by either female (even though each color-marked female has successfully produced chicks). In 1993, the unmarked male produced 2 chicks with the 1991 banded female and was banded. One chick died withing 36 hours after hatching when it entagled its foot on a branch. The other chick died 2 weeks after hatching from unknown causes. The 1991 banded male established a territory on T-2 East Pool and the 1989 banded female returned but moved to C-2 Pool and paired with an unknown male.

G Pool History (202 acres): The marked male of the G Pool territory returned for the fifth consecutive year. Banded in 1988, he was recaptured in 1990. In 1991, he paired with a new female. He was forced to establish a territory on neighboring E Pool in 1992 since the water levels of G Pool were drawn down. That year, he was successful in finding a new territory, pairing with an unmarked female, and producing one chick indicating that even though site fidelity is strong, loons are able to rapidly change territories. In 1993, this male returned to its original G Pool territory and was observed on the pool within 1-2 days after ice-off. The female banded in 1992 returned 2 days later but was eventually displaced by an unmarked female (banded later in 1993). There were 3 weeks of aggressive displacement displays by the male and both females. The first female banded (1990) was recovered dead on 6 January 1991 near St. Augustine, Florida (Table 45). The second female (1992) was banded on the E Pool-west territory and remained there in 1993. The third female (1993) was banded on G Pool; she produced 2 chicks, the older chick killed the younger one by the tenth day with consistent pecking.

Table 9. Annual Outcome (return rate and pair bond) of marked Common Loons at the Seney NWR, 1989-1993.

Original Banding		Year	Annual Outcome			
Territory	Sex	Banded	1990	1991	1992	1993
G Pool	M1	1988#	return-G 2 chicks w/F1	return-G paired w/F?	return-G/E west 1 chick w/F2	return-G 2 chicks w/F3
G Pool	F1	1990		died in winter		
G / E-west Pool	F2	1992			1 chick w/M1	return-E-west paired w/M1
G Pool	F3	1993				2 chicks w/M1
* *	*	* *	* *	* *	* *	* * *
B Pool south	M1	1989	return-B 1 chick	return-B 1 chick	return-B nest failed	return-B-north nest failed
* *	*	* *	* *	* *	* *	* * *
B Pool north	M1	1992			1 chick w/F1	return-B-south 1 chick w/F1
B Pool north	F1	1992			1 chick w/M1	return-B-south 1 chick w/M1
* *	*	* *	* *	* *	* *	* * *
C-3 Pool	F1	1989	return-C3	no return	return-C3, paired w/ M1	return-C2 paired w/unk. M
C-3 Pool	F2	1991			return-C3, paired w/M1	return-C3 paired w/unk. M 2 chicks w/M2
C-3 Pool	M1	1991			return-C3 paired w/F1,F2	return-T2-East no pair bond
C-3 Pool	M2	1993				2 chicks w/F2
* *	*	* *	* *	* *	* *	* * *
D Pool	F1	1989	return-D nest failed w/M1	return-D paired w/M?	return-D nest failed w/M1 nest failed w/M?	return-D 2 chicks w/M1
D Pool	M1	1990		return-Upper Goose Pen	return-D nest failed w/F1	return-D 2 chicks w/F1
* *	*	* *	* *	* *	* *	* * *
A-2/C-2	F1	1989	return-A2 nest failed	return-A2 nest failed	return-C2 1 chick	return-A-2 nest failed w/M?
* *	*	* *	* *	* *	* *	* * *
T2 West-Pool	M1	1992			nest failed	return-T2 West 1 chick w/F1
	F1	1993				1 chick w/M1
* *	*	* *	* *	* *	* *	* * *
E Pool-east	F1	1990		return-E-east nest failed w/M1	return-E-east 1 chick w/M1	return-E-east 1 chick w/M1
E Pool-east	M1	1989@, 1992	return-E 2 chicks	return-E-east nest failed w/F1	return-E-east 1 chick w/F1	return-E-east 1 chick w/F1
* *	*	* *	* *	* *	* *	* * *
E Pool-west	M1					paired w/G F2

\# The G Pool M1 returned in 1989 but did not form a pair bond.
@ The E Pool-east M1 was marked by a diagnostic growth on the lower mandible

B Pool Histories (243 acres): The B Pool-south male returned for his fourth consecutive year, but for the second time since 1987 this territory did not produce chicks. The female of this pair has not been captured despite repeated attempts. The male has been recaptured 3 times: once in 1990 and twice in 1991. In each capture it showed little hesitancy to approach the capture boat. In 1992, a newly established nesting pair occupied parts of the former B Pool-south territory in the north end of B Pool. Occupancy of this new territory was surprising, since there was no prior indication of an excess breeding pair in the area and that scouting activites in 1991 were not observed. There have been few territorial confrontations between the two pairs in 1992 and 1993, although there were observations of aggressive patrolling in the north part of the territory by the B Pool-south pair after each of their nest failures. The B Pool-north pair returned in 1993 and produced one chick, although it died within 2-3 weeks of hatching.

D Pool History (197 acres): The D Pool territory is the second case of mate switching on the Refuge (one female with two males). The female was banded in 1989 and has returned for 4 consecutive years to D Pool (1990 to 1993). In 1990, she made 3 nesting attempts, finally hatching two chicks on the third attempt on 14 July. The territorial male, present for the third nesting, was subsequently color-marked. In 1991, the color-marked D Pool male returned to the Refuge but was never seen on D Pool, instead it remained on a neighboring pool (Upper Goose Pen) until 24 May and then disappeared. This was the first known case of an adult not returning to its designated territory (Table 10). The D Pool female returned in 1991 and paired with an unmarked male but did not nest. In 1992, the color-marked D Pool male returned to D Pool and nested with the color-marked female. The nest failed on 25 May and the color-marked male was last observed on 1 June. In the morning of 3 June, an unmarked male was observed with the female. This male paired with the color-marked female; the pair began constructing a nest on 5 June and were incubating on 12 June (this nest also failed). After 1 June, the color-marked male was not observed on the Refuge for the rest of the year, while the unmarked male remained on territory with the female through late July. In 1993, the color-marked male from 1990 returned and paired with the banded female. For the third time in the past 4 years, this pair failed in their first nesting attempt; the second nesting attempt produced 2 chicks to fledging.

A-2 Pool History (282 acres): The A-2 territorial female was banded in 1989. She has returned each year from 1990 to 1993. She nested on A-2 Pool in 1990 and 1991 and failed in both years. In 1992, she moved to neighboring C-2 Pool and produced one chick with an unknown male. There were no visible changes in the water levels or wildlife activity on A-2 Pool to cause a change in territory selection for a nest site. However, this is the only established territorial pair on the Refuge observed to regularly use more than one pool during the breeding season. In 1993, the pair returned to A-2 Pool and attempted to nest, but failed. There was interaction between this pair and the newly established pair on C-2 Pool.

E Pool Histories (490 acres): The female on the E Pool-east territory was banded in 1990. She returned in 1991, 1992 (recaptured), and 1993. The male was not color-marked until 1992; however, he has a diagnostic fleshy growth on the lower mandible that has allowed identification since 1989. He has returned from 1990 to 1993 (recaptured in 1993). This territorial pair has the longest known pair bond on the Refuge (4 years) and has produced chicks in 3 of the past 4 years. The E Pool-west territory was first used when the G Pool pair switched after a water level drawdown in 1992. In 1993, the marked female was displaced by an unmarked female on G Pool and she settled with her 1992 territory and paired with one of the 1987-88 loons color-marked as a chick. This pair was observed copulating several times in the E Pool-west territory. They also spent time on H Pool. Their pair bond lasted through the breeding season (until at least early August).

T2 West-Pool History (160 acres): The male was banded in 1992, days after its nest failed. This was a newly discovered territory in 1992. In 1993, the male returned and paired with an unknown female and produced one chick. The female was banded in 1993.

Table 10. Summary of the annual return rates (minimum survival rates) and site faithfulness of Common Loons at the Seney NWR, 1988-1993.

Year (# of adults banded)	# of marked and possibly returning adults	# of returning and potentially returning adults to established territory
1988 (1)		
1989 (4)	1/1 (100%)	1/1 (100%)
1990 (3)	5/5 (100%)	5/5 (100%)
1991 (2)	6/8 (75%)	5/6 (83%)
1992 (5)	9/9 (100%)	9/9 (100%)
1993 (3)	14/14 (100%)	12/14 (86%)
Total: 1988-93 (18)	**35/37 (95%)**	**32/35 (91%)**

The annual return rate for adult loons at the Refuge is 95%, and was 100% in 1993 (Table 10). This was higher than the 1993 return rate for loons throughout Michigan — 79%. The observation intensity at the Refuge may account for some of the difference, particularly with new evidence that returning adults may not remain on territory thorughout the breeding cycle. Site faithfulness remained high at the refuge, but was not 100% as in past years (Table 10). Two marked loons changed territories. Both were from established territories that had produced chicks and include the C-3 Pool male (banded in 1989) that switched to T2-East Pool and the C-3 female (banded in 1989) that switched to C-2 Pool. Pairs have changed mates at least 20% of the time at the Refuge (Table 11). In the case of the D Pool trio, the pair was monogamous during the breeding cycle, but the female switched mates between and within years (rapid mate switching). Failed nesting attempts apparently trigger mate switching. Rapid mate switching was not documented in 1993 but there were several instances of mate and territory changes. There are now 4 cases of territory changes and 6 cases of changing mates. There were still too many unmarked adults in 1993 to fully understand the degree of site and mate fidelity. The C-3 female (banded in 1989) switched both territories and mates in 1993.

Table 11. Summary of interyear mate and territory fidelity of marked Common Loons at the Seney NWR, 1989-1993

Pattern	Males % (#)	Females % (#)	Overall % (#)
Kept Territory	88 (15)	89 (16)	89 (31)
Changed Mate	13 (2)	25 (4)	20 (6)
Kept Mate	27 (4)	25 (4)	26 (8)
Mate Loss	7 (1)	0	3 (1)
Unmated	7 (1)	0	3 (1)
Mate Unknown	46 (7)	50 (8)	48 (15)
Changed Territory	12 (2)	11 (2)	11 (4)
Changed Mate	0	50 (1)	25 (1)
Unmated	100 (2)	50 (1)	75 (3)

For the fourth consecutvie year vocal-tagging was accomplished at the refuge. Dr. Charles Walcott, Executive Director of the Lab of Ornithology and professor at Cornell University gathered the sound recordings. A total of 10 different males have been vocal-tagged since 1990 (Table 12). The importance of vocal-tagging within this project is that the male loons are known individuals, identified by their color bands. There are 4 males that have been vocal-tagged at least twice and were color-marked at the time of the recording: B Pool-south, D Pool (M1), G Pool, and E Pool-east.

Table 12. Summary of males that have been banded or vocally-tagged at the Seney NWR, 1990-93.

Location	1990		1991		1992		1993	
	Tag	Band	Tag	Band	Tag	Band	Tag	Band
A-2 Pool	yes	no	yes	no	no	no	no	no
B Pool - south	yes	yes	yes	yes	yes	yes	yes	yes
B Pool - north	–	–	–	–	–	yes	–	yes
C-3 Pool (M1)	yes	no	yes	no	no	yes	no	yes
C-3 Pool (M2)	–	–	–	–	–	–	–	yes
D Pool (M1) *	yes	no	yes	yes	yes	yes	yes	yes
D Pool (M2)	yes	no	yes	no	no	no	no	no
E Pool - east	yes	yes	yes	yes	yes	yes	yes	yes
G Pool	yes	yes	no	yes	no	yes	yes	yes
J Pool	no	no	yes	no	no	no	no	no
M-2 Pool	no	no	yes	no	no	no	no	no
T-2 West Pool	no	no	no	no	no	yes	yes	yes

* vocal-tagged on Upper Goose Pen

Behavioral and Physiological Ecology Efforts

by James Paruk, Earthwatch Co-principal Investigator

Time Activity Budgets

Two different territories were observed (G Pool and E Pool-east) for a total of 235 hours from 10 May through 30 June in 1993 (Table 13). Additional behavioral data were collected to 1 August but is not summarized here. In 3 years, since 1990, the number of hours observed is 232 during pre-nesting, 310 hours during nesting, and 184 hours during post-nesting (1991 data are not yet summarized). As in previous years foraging was most pronounced during the pre-nesting period and became a less-frequent behavior throughout the rest of the breeding cycle (although it is unknown how much food an adult may consume while catching food for its chicks). Unlike the quantified behaviors gathered in 1990, there are several indications of sexual differences in behaviors. Females spent a considerable amount of time nest sitting, 67% more time spent than males. The average ranges of percent time spent within the nest-sitting behavior for males is 39 to 48 and for females is 49 to 79 (n=12). Assuming that there is always an adult on the nest, the males incubates 17 to 41 percent of the time (mean=28.4, sd=10.5) and the female 59 to 83 percent of the time (mean=71.6, sd 10.5). These values (from a 3-year summary) are different from the equal time spent in 1990 (Evers 1991). Resting became more frequent behaviors during the post-nesting period. The amount of time spent preening remained steady throughout the breeding cycle, ranging from 3 to 9 percent. Time spent chick-rearing and foraging during the post-nesting period of 1992 and 1993 was much less than that observed in 1990.

Table 13. Daily time-activity budgets (% time) of Common Loon nesting pairs at the Seney NWR, 1990 and 1992-93.

	Pre-nesting		Nesting		Post-nesting		Pre,Nest,Post	
Behavior	Male '90,'92,'93	Female '90,'92,'93	Male '90,'92,'93	Female '90,'92,'93	Male '90,'92,'93	Female '90,'92,'93	Male (3 year avg.)	Female (3 year avg.)
Foraging	53,82, 32	57,74,44	34,26, 40	36, 9, 23	15, 4, 26	19, 3, 29	56,33,15	58,23,17
Resting	16, 8, 17	14,14, 10	5, 7, 5	4, 3, 2	32, 30, 46	22,36,34	14, 6,36	13, 3, 30
Locomotion	16, 3, 42	15, 3, 38	5, 21, 6	4, 6, 3	7, 42, 10	7,41, 9	20,11,20	19, 4, 19
Preening	8, 7, 5	8, 9, 5	7, 7, 5	6, 3, 5	4, 6, 5	4, 5, 5	7, 6, 5	7, 5, 5
Courtship	2, 0, 2	2, 0, 2	–	–	–	–	1	1
Nest-sitting	–	–	48,39,43	49,79,66	–	–	43	64
Chick-rearing	–	–	–	–	38,18,12	44,15,22	23	27
Other	5, 0, 2	4, 0, 1	1, 0, 1	1, 0, 1	4, 0, 1	4, 0, 1	2, 1, 2	2, 1, 2
# of territories	5, 5, 2	5, 5, 2	5, 5, 2	5, 5, 2	5, 4, 2	5, 4, 2	4, 4, 4	4, 4, 4
# of hours	105,57,70		102,108,100		60,59,65		77,103,61	

Incubation

Both adults incubate and appear to divide the time spent equally sitting on the nest. McIntyre (1988) has been unable to detect any patterns of nest exchange, but Taylor (1974) reports the opposite. Some pairs exchange duties every 1.5 hours for 2 weeks, then the time interval changes. Some pairs sit for longer bouts. Many have a regular day/night pattern, others do not. Males typically yodel at night suggesting females are sitting on the nest at this time, but Young (1983) caught a male sitting on a nest during nighttime. Perhaps pairs set their own schedules, or as hatching nears both parents are more attentive.

Preliminary data gathered this year from one pair only tend to support Taylor's findings. Of the 20 nest exchanges observed, 14 (70%) of them occurred within one hour of 0600, 1200, and 1800 hours, with an average incubation period of 5.9 hours. Moreover, all daylight next exchanges, gathered randomly during the 28 day hatching period, were between 5-7 hours. During the night, howerver, on a few occasions individuals would incubate for up to 8.5 hours. Two nest exchanges occurred during the night. In both cases, the female was relieved by the male.

In 1994, more pairs will be studied to determine how much varation exists between pairs in the same population. Perhaps as McIntyre (1988) suggests individual pairs may end up having their own unique schedule. Do factors such as experience of pair bond or the availability of food have any affect on next exchange patterns?

Parental Feeding

Both loon parents feed their young. To date, there has been no exhaustive study to determine if there is a pattern to parental feeding, a time schedule, or parental division of responsibilities (McIntyre 1988). Preliminary work by Christoff (1979) showed that the male did most of the feeding when the chicks were younger, but at about 4 weeks of age both parents spent equal amounts of time feeding the young.

On E Pool-east just the opposite was found. The female spent the majority of the time (70%) feeding the chick. However, on G Pool both parents spent equal amounts of time caring for the young during the first 10 days after hatching. After 4 weeks of age, the chick was fed approximately equal times by both parents of E Pool (55% and 45% for the female and male, respectively).

Christoff also observed that chicks were fed primarily during the early morning and late afternoon hours with only occasional food offerings scattered throughout the rest of the day. Sjolander and Agren (1972), however, from their Iceland study, reported continous feeding of chicks throughout the day. Data gathered this year tended to support the idea that loon chicks are fed throughout the day, but with peak periods occurring between 0800-0900, 1100-1200, and from 1600-2000 hours (Figure 1). Abundance of prey availability may be a factor in determining if patterns exist. Over 90% of the diet in both cases consisted of small fish and invertebrates (Table 14). Next year's research will focus on elucidating these patterns by observing more interactions between adult loons and chicks.

In the pools, Brown Bullhead (*Ictalurus nebulosus*) make up over 95% of the fish biomass and comprise the majority of the adult loon's diet. Of the larger fish, adult loons are also known to eat White Sucker (*Catostomus commersoni*), Northern Pike (*Esox niger*), Yellow Perch (*Perca flavescens*), and Pumpkinseed (*Lepomis gibbosus*).

Table 14. Prey items fed to loon chicks (# and %) by their parents at the Seney NWR, Michigan, 1993.

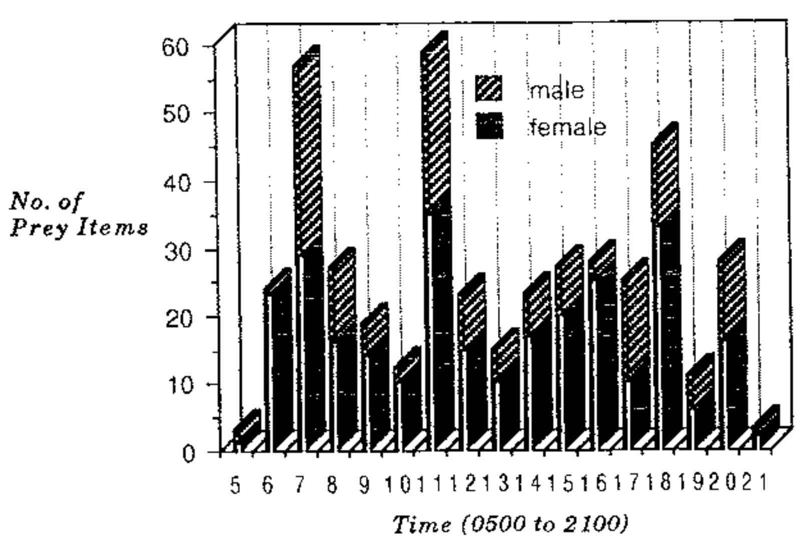
Prey Items	E Pool (n-140 hrs) °		G Pool (n=49 hrs) °°		Total (n=189 hrs)	
	Female	Male	Female	Male	Female	Male
Cyprinnids*	309 (52.4%)	140 (43.5%)	112 (84.2%)	99 (76.1%)	421 (58.2%)	239 (52.9%)
Invertebrates	228 (38.6%)	156 (48.4%)	21 (15.8%)	31 (23.8%)	249 (34.4%)	187 (41.4%)
Brown Bullhead	25 (4.2%)	12 (3.7%)	--	--	25 (3.5%)	12 (2.6%)
Crayfish	2 (.03%)	1 (.03%)	--	--	2 (.03%)	1 (.02%)
Unknown	26 (4.4%)	13 (4.0%)	--	--	26 (3.6%)	13 (2.9%)
TOTAL	590 (64.7%)	322 (35.3%)	133 (50.6%)	130 (49.4%)	723 (100%)	452 (100%)

° Data gathered over a 7 week period from 10 days after hatching to 52 days.

°° Data gathered within the first 10 days of hatching.

* Most common species include Blacknose Shiner (*Notropis Heterolepis*) and Golden Shiner (*Notemigonus crysoleucas*)

Figure 1. Parental Feeding Schedule, E Pool, Seney NWR, Michigan, 1993.



Foot Waggling

Anyone who has watched loons for any length of time will have noticed a peculiar behavior called foot waggling. During a foot waggle, the loon raises one foot in the air, holds it there for a few seconds, or sometimes shakes it loosely. Afterwards, it may be dipped in the water and repeated before eventually being placed under the wing.

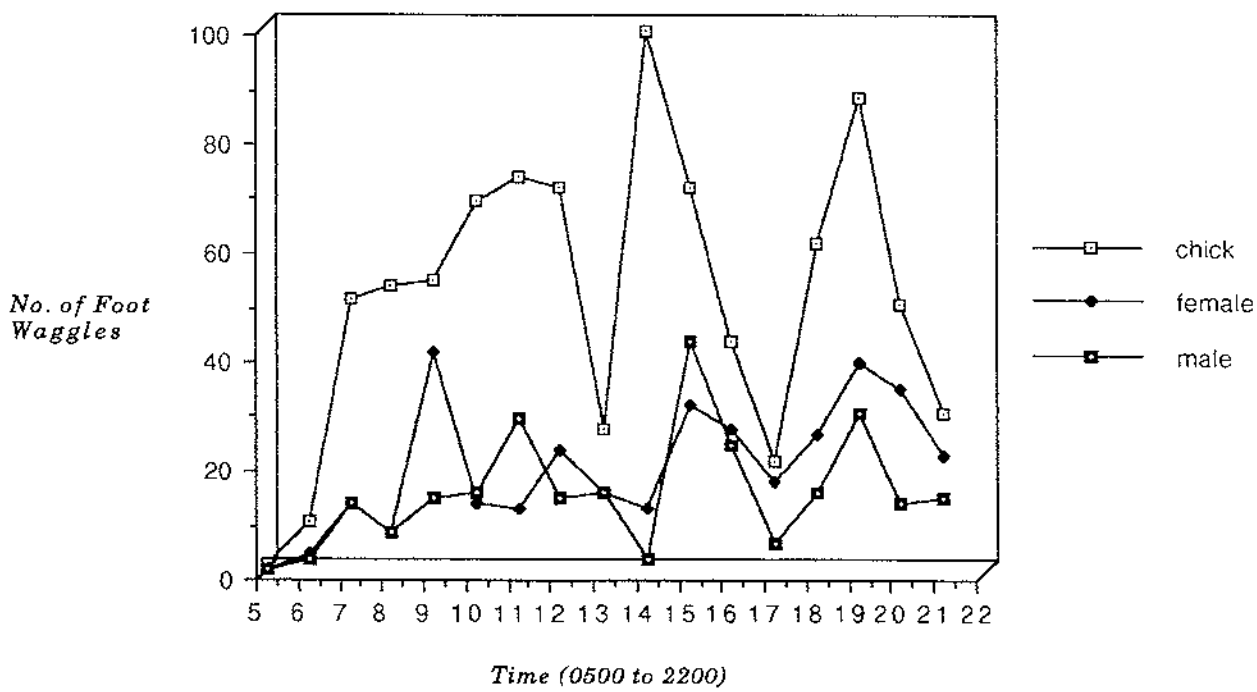
It has been speculated by many biologists that the feet are used in thermoregulation. A loon's foot is highly vascularized and has a large surface area. When a foot is brought out of the water evaporative cooling lowers the blood temperature returning to the body. To date, there have been no studies to see if there is any correlation with the number of foot waggles per hour with daytime and water temperatures and the amount of incoming solar radiation.

If foot waggles are involved in cooling the body one would expect that chicks would foot waggle more than adults because of their smaller body size. Recall that smaller bodies tend to heat up and cool down more quickly than larger ones. Secondly, one might expect that adults would foot waggle most during the hottest months of the breeding season. And lastly, that adults would foot waggle most during late afternoon hours after they had absorbed incoming radiation throughtout the majority of the day.

The data gathered so far suggest that foot waggling is involved in thermoregulation. First, chicks tended to foot waggle 3 times more than adults (2.67 time more than adult females and 3.52 times more than adult males) for a given time period. Secondly, adults foot waggled 3 times more during the month of July than May, and lastly, adults foot waggled more often during late afternoon hours. Adult females foot waggle 1.3 times more than males (Figure 2).

Next field season will focus on correlating and quantifying ambient and water temperatures, and amount of incoming solar radiation with the number of foot waggles observed per hour.

Figure 2. Total number of foot waggles per hour for a 6-day period, 15 July to 1 August, 1993 at the Seney NWR.



Hiawatha National Forest

This 860,000 acre (348,000 ha) national forest is divided into western and eastern units in the eastern Upper Peninsula. In 1993, 57 surveyed lakes showed 58 adults, 20 territorial pairs, and 13 nesting pairs that produced 8 chicks (Table 15). The number of nests and chicks produced between 1990 and 1993 is constant, although the successful territories typically change each year. When comparing the two managment units, apparently there are similar numbers of adults and territories in both the west and east, however the Eastern Unit pairs do attempt to nest and produce chicks more frequently (except in 1993, due to the influx of 5 new or returning nesting pairs in the Western Unit). The known number of hatched chicks for the past four years is 36. When compared to the 45 nesting attempts, the rate of production is typical at .837 chicks/nest, but is .462 chicks/territorial pair, much lower (probably too low) than observed at other sites (i.e., .780 chicks/territorial pair at the Seney NWR).

These lake surveys provide the basis for the banding program. This major preparatory effort is accomplished, by contacting residents and through the assistance of volunteers with the Michigan Loon Preservation Association. Even though new nesting pairs are discovered each year (either an old traditional territory or newly established territory), it is felt that the locations of nearly all the nesting pairs in the Hiawatha NF and the eastern U.P. are known. The 13 nesting pairs identified in 1993 (the highest number in the past 4 years) include the following territories in (1) the Eastern Unit — East Lake (3 nests, 2 families, 3 chicks), Sylvester Impoundment (1 chick), and Hulbert Lake and (2) the Western Unit — Als, Sixteen Mile (1 chick), Perch (1 chick), Little Round (1 chick), Bunting, Boot, Sand, and Triangle (Appendix III). Encouragingly, there were 5 new nesting pairs in 1993, although only one was successful.

Table 15. Distribution, abundance, and breeding status of the Common Loon in the Hiawatha NF, 1990-93.

Location	Adults 1990	Adults 1991	Adults 1992	Adults 1993	Territories 1990	Territories 1991	Territories 1992	Territories 1993	Nests 1990	Nests 1991	Nests 1992	Nests 1993	Chicks Hatched 1990	Chicks Hatched 1991	Chicks Hatched 1992	Chicks Hatched 1993
Eastern Unit	**25**	**30**	**25**	**18**	**10**	**12**	**8**	**8**	**6**	**8**	**7**	**5**	**5**	**7**	**6**	**4**
Mackinac Co.	13	14	11	9	5	5	4	4	4	3	4	3	4	1	3	3
Chippewa Co.	12	16	14	9	5	7	4	4	2	5	3	2	1	6	3	1
Western Unit	**34**	**32**	**24**	**39**	**9**	**13**	**6**	**12**	**4**	**3**	**4**	**8**	**4**	**2**	**4**	**4**
Alger Co.	21	23	20	25	6	10	5	7	3	2	4	5	3	2	4	3
Schoolcraft Co.	13	9	4	14	2	3	1	5	1	1	0	3	1	0	0	1
Delta	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Total	**59**	**62**	**49**	**58**	**19**	**25**	**14**	**20**	**10**	**11**	**11**	**13**	**9**	**9**	**10**	**8**

Note: The number of lakes surveyed by year is 70 (1990), 64 (1991), 54 (1992), 57 (1993) and are shown in Appendix 3.

Through the comprehensive surveys, each located loon family (with chicks at least 4 weeks of age) that was on a lake accessible by car was approached in 1993: they include East, Little Round, and Perch. Four new loons were banded in 1993, 3 adults and 1 juvenile (Table 16), plus one previously banded loon was recaptured. The ability to recapture loons provides opportunities to investigate accumulation rates of toxins and to monitor the health and reaction of loons that are banded.

Table 16. Summary of banded Common Loons at Hiawatha National Forest, 1990-1993.

Year	# of Adults	# of Juveniles	TOTAL (new)	# Adult Males	# Adult Females	# Recaps
1990	3	4	7	2	1	-
1991	6	4	10	4	2	1
1992	2	2	4	0	2	3
1993	3	1	4	2	1	1
Total	**14**	**11**	**25**	**8**	**6**	**5**

A total of 25 loons (14 adults and 11 juveniles) have been banded in the Hiawatha NF since 1990. In 1993, 6 of the 11 previously banded adults returned (55%) and all returned to their same territory (Table 17). The 5 missing adults include the male at East Lake-northwest territory, the second male banded with the 1991 Frenchman Lake territory, Bunting Lake female, and both females at Hulbert Lake. The second male banded with the 1991 Frenchman Lake territory returned in 1992 and produced one chick with the color-marked female; in 1993, the first male returned and produced one chick with the color-marked female. For the second consecutive year repeated attempts to capture the Little Round male failed; the female was recaptured in 1993. The color-marked male at Hulbert Lake paired with a new unmarked female but did not attempt to nest. This is the third female in as many years to establish a pair bond on the Hulbert Lake territory.

There are two recoveries of Hiawatha NF banded loons (Table 45). The East Lake-northeast chick banded on 13 August 1992 was recovered dead on 12 June 1993 in Oak Hill, Flordia. The East Lake-northwest territory (M2) died 2 weeks after banding. This loon may have been a loner and not paired with the F1 captured in 1993. The male was recovered and a full necropsy was performed at Michigan State University.

Table 17. Annual Outcome of banded Common Loons at the Hiawatha National Forest, 1991-1993.

Territory	Sex	Year Banded	Annual Outcome 1991	1992	1993
Bunting	F1	1990	return, 2 chicks w/M1	return, 1 chick w/M1	no return
Bunting	M1	1991	2 chicks w/F1	return, 1 chick w/F1	return, nest failed
East-northeast	M1	1990	unknown	return, 1 chick	return, nest failed
East-northwest	M1	1990	unknown	unknown	no return
East-northwest	M2	1993	–	–	died on 8-1-93
East-northwest	F1	1993	–	–	1 chick w/M2?
Frenchman	F1	1991	–	return, 1 chick w/M2	return, nest failed
Frenchman	M1	1991	–	no return	return, nest failed
Frenchman	M2	1991	–	return, 1 chick w/F1	no return
Hulbert	F1	1991	–	no return	no return
Hulbert	F2	1992		1 chick w/M1	no return
Hulbert	M1	1992	–	1 chick w/F2	return paired w/F?
Little Round	F1	1992	–	1 chick	return, 1 chick
Perch	F1	1993	–	–	1 chick

Ottawa National Forest

This was the third year of banding at this site. The Ottawa NF Watersmeet District has one of the highest densities of nesting loons in Michigan. Most of the capture research was based on this District but also included all known loon families in the Bessemer District. Only 8 loons were banded in 1993; the sole juvenile was from Clearwater Lake (Table 18). The 7 adults captured in 1993 were from Imp (pair), Honeysuckle (pair), Loon Pond (male), Clearwater (male), and Little Oxbow (female) lakes. Twenty one territories now have at least one banded adult, 17 have 2 adults color-marked, and two territories have three adults marked: Clark Lake-north and Thousand Island (Table 39). The high number of sampled territories with marked pairs (81%) is important to investigate pair relationships and the incidence of mate switching. Five adults were recaptured from the following territories: Long (pair), Little Oxbow (male), and Little Langford (pair).

The return rates and site faithfulness of color-marked adults were assessed for the second year (Table 19). Of the 30 adults banded in 1991 and 1992, 26 are known to have returned (all returnees were found on the territory that they were banded). This 87% minimum survival rate for adults is higher than the overall 79% return rate (Table 44). Territories with adults that were not known to have returned are Clark-southwest (female), Crooked (male), and Little Duck (pair). The Clark-southwest returning male paired with a new female and attempted to nest, the Crooked Lake female was paired with a new male, and the Little Duck Lake pair was replaced by a new pair. Two adult loons that were not observed in 1992 did return in 1993: the Clark-north female and the Loon Pond male.

The emphasis of capture efforts in the Sylvania Wilderness Tract has produced a concentration of seven territories within a 3 mile radius of the Sylvania Campground. The territories with banded pairs include Clark-north, Clark-southwest, Crooked-north, Snapjack, Long, and Thousand Island plus the male at Helen Lake (Appendix VI). The proximity of these 7 territories provides optimal observation opportunities in the future.

Two loons banded as juveniles are known to have died. The Redboat Lake chick (banded on 21 July 1991) was recovered on Melbourne Beach, Florida on 10 January 1992 (Table 45). When banded the Langford Lake chick had a large existing injury on its underside; approximately 2 weeks after banding this chick died. The laceration may have occurred as the chick crossed the 300 feet (91 m) of land between its natal lake (Little Langfod) and the lake that the adults regularly use for foraging and chick rearing once the chick is at least 4-5 weeks of age. On 7 July 1992, the chick and adult female were captured on Little Langford and then both were transferred and released on Langford Lake. On 16 October, the Clearwater Lake male that was banded on 3 July 1992 was recovered dead south of Escanaba on the Lake Michigan shoreline in Menominee County (Table 45); only the band number and colored bands were reported. In 1993, three other adults were found dead and their bodies recovered. The Clearwater Lake male (only banded 2 weeks earlier on its territorial lake—28 July) was captured on Thousand Island Lake on 14 August, transferred to the Northwoods Wildlife Center in Minocqua, WI, and later died. The Snapjack Lake male (see next page for the history of this loon) was found dead on its territorial lake on 18 August. The Long Lake male (banded in 1991 and recaptured in 1992 and 1993) was found dead on Little Bay de Noc, Delta Co., Michigan on 30 October 1993. The mid to late October recovery of two adults from the Lake Michigan shoreline near Escanaba, Michigan indicates that Ottawa National Forest adults gather in this area each fall before moving (eastward ?) in November.

Table 18. Summary of banded Common Loons at the Ottawa National Forest, 1991-1993.

Year	# of Adults	# of Juveniles	TOTAL (new)	# Adult Males	# Adult Females	# Recaps
1991	16	11	27	8	8	-
1992	19	4	23	10	9	5
1993	7	1	8	3	4	5
Total	**42**	**16**	**58**	**21**	**21**	**10**

With the assistance of staff from the Watersmeet and Bessemer District Offices, the capture team and behavioral observers surveyed lakes for loon families. A total of 23 territories were located with chicks, producing 38 fledged chicks: 28 in the Watersmeet District and 10 in the Bessemer District (Table 19). Since 1985, the average number of chicks to fledge from the Bessemer and Watersmeet Districts is 35 +/- 8. The past 5-year fledging rate has been much lower in the Bessemer and Watersmeet Districts since the high total of 48 in 1988 (although it did increase in 1993). Lakes with notable consistency in producing young are within the Sylvania Wilderness Area and include Clark and Crooked lakes. The mean total number of years that chicks are fledged per territory over the eight year period (1985-86, 1988-93) is 2.86. Or, for nearly every 3 breeding seasons, the territorial pair is successful in fledging at least one chick.

Table 19. Breeding status, banding summary, and return rates of the Common Loon on the Ottawa National Forest Watersmeet District, 1985-1993.

Territory/Location	# of chicks fledged								Band '91		Band '92		Band '93		Return Rates*	
	1985	1986	1988	1989	1990	1991	1992	1993	ad.	juv.	ad.	juv.	ad.	juv.	1992	1993
Watersmeet District																
Allen (44,39,10)	--	--	1	--	0	0	0	0								
Bass (45,39,10)	2	1	--	0	1	1	1	0								
Beatons/L. Beaton (45,40,6)	--	--	1	1	0	0	0	1								
Berdner (44,42,1)	1	0	0	1	--	1	--	--								
Big Bateau (44,40,27)	0	0	2	1	0	0	0	2								
Big Lake (44,41,16)	2	--	1	--	--	3	1	2								
Castle (45,38,8)	0	2	1	1	2	2	0	0								
Cisco (44,41,4)	0	0	2	3	--	2	1	0	1	0	1	0	0	0	Fn	Fy
Clark (44,40,5)	1	2	1	1	2	2	2	2								
Clark-north									2	0	1,1R	0	0	0	Fn,My	F,My
Clark-southwest									2	1	2R	0	0	0	F,My	Fn, My
Clear (45,40,35)	1	2	0	0	--	0	0	0								
Clearwater (45,41,34)	2	2	--	2	1	2	1	1	1	1	1	0	1	1	Fy	
County Line (45,40,2)	--	--	2	0	--	0	1	0	0	0	2	1	0	0	--	F,My
Crooked (45,40,34)	1	0	2	1	4	2	2	2	0	0	2	0	0	0	--	Fy,Mn
Damon (45,41,25)	--	--	1	1	--	--	--	1								
Deadman's (45,38,36)	2	1	1	2	0	2	0	0	2	0	0	0	0	0	F,My	F,My
Deer Island (44,40,23)	1	0	2	0	2	0	0	0								
Devilshead (44,40,13)	0	0	0	0	1	1	0	0								
Dinner (44,39,24)	--	--	--	--	--	--	--	0	0	0	1	1	0	0	--	My
East Bear (44,40,1)	--	--	1	0	--	0	0	0								
Fisher (44,40,21)	2	0	0	0	--	0	0	0								
Gray (44,41,8)	1	--	--	--	--	--	2	--								
Hattie (45,41,36)	--	-	--	--	--	--	--	2								
Helen (45,40,32)	1	0	2	0	--	1	1	0	0	0	1	0	0	0	--	My
High (44,40,2)	2	1	0	2	1	0	1	1								
Imp (44 38 17)	0	0	0	0	0	0	0	2	0	0	0	0	2	0	--	--
Indian (44,41,13)	--	2	0	--	--	0	0	2								
Lindsley (44,41,15)	-	--	--	--	--	--	2	1								
Little Duck (44,39,7)	0	0	1	1	0	1	0	0	2	1	0	0	0	0	F,My	F,Mn
Long (44,41,1)	1	0	1	1	0	2	1	0	2	2	2R	1	2R	0	F,My	F,My
Loon (44,40,15)	0	0	--	--	1	0	0	0								
Loon Pond (45,38,26)	--	--	--	--	--	2	0	1	1	1	0	0	1	0	Mn	My
Marion (45,38,29)	1	1	1	2	0	0	1	0	0	0	2	0	0	0	--	F,My
Moon (44,37,32)	0	0	--	2	0	0	0	2								
Mountain (44,40,11)	0	0	4	--	0	0	0	0								
Muskeg (44,38,22)	1	1	1	0	0	1	2	0								
Ogima (45,40,23)	1	0	0	1	0	--	0	0								
Poor (44,41,14)	--	--	--	--	--	0	2	0								
Powwow (44,39,1)	--	--	1	1	0	0	0	0								
Shadow (44,39,10)	2	1	0	1	0	0	0	1								
Snapjack (45,40,31)	1	0	0	0	--	0	1	0	0	0	2	0	0	0	--	F,My
Tamarack (44, 38, 12)	--	0	--	0	--	1	--	0								
Tenderfoot (44,42,11)	--	--	--	--	--	--	1	--								
Thousand Is. (44,41,2)	1	1	5	--	2	3	2	4	1	2	2	0	0	0	Mn	F,My
Whitefish (44,40,18)	2	0	2	1	1	0	0	0								
Wolf (45,40,15)	0	3	2	0	2	0	0	1								
Watersmeet District Total:	29	20	38	26	20	29	25	28	14	8	15,5R	3	4,2R	1	10/14	20/24

* Fn = Female did not return, Fy = Female did return, Mn = Male did not return, My = Male did return

Table 19, cont'd. Breeding status, banding summary, and return rates of Common Loons on the Ottawa National Forest Bessemer District, 1985-1993.

Territory/Location	# of chicks fledged 1985	1986	1988	1989	1990	1991	1992	1993	Band '91 ad.	Band '91 juv.	Band '92 ad.	Band '92 juv.	Band '93 ad.	Band '93 juv.	Return Rates* 1992	Return Rates* 1993
Bessemer District																
Barb (45, 42, 5)	--	0	0	--	--	0	2	2								
Bluebell (45, 43, 30)	1	--	0	--	--	0	1	--								
Eel (45,44,13)	1	0	2	0	0	0	0	0								
Gaylord (45,43,21)	1	0	1	0	0	0	2	0								
Holly (45, 42, 30)	0	0	0	--	0	0	0	1								
Honeysuckle(45,43,30)	2	1	1	--	--	1	0	2	0	0	0	0	2	0	--	--
Langford(45,41,19)	0	0	0	2	1	0	0	--	1	1	0	0	0	0	My	My
L. Langford (45,41,19)	0	1	1	--	--	0	1	1	0	0	1	1	2R	0	Fy	Fy
L. Oxbow (45,43,34)	0	0	2	0	0	0	1	2	0	0	1	0	1,1R	0	--	My
Mink (45,44,11)	1	1	--	--	--	0	0	0								
Ormes (45,43,26)	1	1	1	--	2	0	1	2	0	0	2	0	0	0	--	M,Fy
Redboat (46,44,35)	2	1	1	--	0	2	0	0	1	2	0	0	0	0	Fy	Fy
Roach (44,42,10)	2	0	--	3	--	--	1	0								
Summit (45,43,36)	2	1	0	--	2	0	0	0								
Sundance (46,43,26)	1	0	1	--	--	--	0	0								
Bessemer Dist. Total:	14	6	10	5	5	3	9	10	2	3	4	1	3,3R	0	3/3	6/6
Watersmeet Dist. Total:	29	20	38	26	20	29	25	28	14	8	15,5R	3	4,2R	1	10/14	20/24
TOTAL	**43**	**26**	**48**	**31**	**25**	**32**	**34**	**38**	**16**	**11**	**19**	**4**	**7**	**1**	**13/17**	**26/30**

* Fn = Female did not return, Fy = Female did return, Mn = Male did not return, My = Male did return

The overall breeding population in the Ottawa National Forest is relatively stable. However, using the number of chicks fledged divided by the number of stratum one lakes checked (lakes with a known history of nesting pairs), the index shows a steady decline from 1988 to 1992, slightly rebounding in 1993 (Table 20).

Table 20. Summary of the reproductive success of Common Loons in the Ottawa NF, 1985-93.

Description:	1985	1986	1988	1989	1990	1991	1992	1993	
# lakes checked:	–	98	88	101	75	142	177	154	(for entire Ottawa NF)
# Stratum 1 lakes checked:	69	66	73	65	54	77	93	71	(for entire Ottawa NF)
# Chicks fledged:	54	32	51	42	34	40	48	41	(for entire Ottawa NF)
INDEX:	.783	.485	.697	.646	.630	.519	.516	.577	(for entire Ottawa NF)

Jay Mager, a graduate student from the University of Miami at Ohio began his research in 1993, investigating role partitioning in color-marked breeding pairs. A total of 490 hours (424 hours used for analysis) was spent from 30 May to 4 August (between 0500 and 2100 hours each day) observing parental care from the beginning of incubation to six weeks after hatching. Observations included 8 different families, each at different stages of breeding (see table 42).

These observations included the Snapjack Lake family. Two eggs were laid on 11 June. The male was captured in 1992 and was found to have 35 ppm of mercury in its feathers, nearly 4 times the average for the area (Evers 1992, table 43). Observations showed that the male would not regularly incubate the eggs, but would patrol and watch the nest entrance while the female spent time foraging. After more than a week, he would spend an increasing amount of time on the nest but usually not for the entire period of the female's absence. The eggs disappeared on 2 July. Observations (n=50 hours) quantified time spent on the nest, 53% by the female, 19% by the male, and 28% unattended. According to time activity budgets from Seney NWR over a 3-year period the average nest attendance by males is 43% and females is 64% (n=310 hours). The abnormal behavior displayed by this male which had high mercury levels affected the reproductive success in 1993. Is this a coincidence or a valid correlation?

A total of 156 hours were spent on Loon Pond, a very small lake of only several acres in size. Both adults frequently spent long periods of time on other water bodies during the chick-rearing and even incubation periods. Three weeks after the chick hatched both adults would leave the pond for the entire day, returning in the evening (between 1900 and 2100 hours) and leaving in the morning (0500 to 0700). The adults were not observed carrying in food.

Isle Royale National Park

Isle Royale is a critical study site for this project as it is the only site with a breeding population of loons using the Great Lakes shoreline for nesting and foraging. The long, protected coves characteristic of the island afford suitable nest sites. Although wave action is reduced in these areas, major seiches of up to 30 inches (12 cm) can inundate nests (wave oscillations in enclosed water bodies caused by atmospheric disturbances) (Fettig 1991a,b). This research is concentrating on the shoreline nesting pairs, most of which are on the eastern third of the island.

In 1991, of the 30-35 nesting pairs on the island, 17 attempted to nest and produced 17 chicks (1.00 chicks/nesting pair) in the coves and bays of the Lake Superior shoreline (Fettig 1991b). In 1992 and 1993 only territorial pairs within or near Tobin Harbor, Rock Harbor, Duncan Bay, and Lane Cove were frequently monitored (Appendix VII). Two regions are surveyed with regularity and also have the largest number of territorial pairs: Southeast and Northeast. In the past 4 years, there have been major inter-year differences in the number of nests and chicks. This may be related to the seiches. The Southeast Region's productivity was greater than normal in 1993, over twice the number of chicks hatched in 1993 compared to the past 3 years (Table 21). This is due to each of the five traditional Tobin Harbor pairs being productive and the addition of the new nesting territory at Rock Harbor-Lorelei Lane.

Table 21. Breeding status of the Common Loon on the Lake Superior shoreline of Isle Royale 1985, 1990-1993.

Area on Isle Royale/	Territories					Nests/Chicks Hatched				
Loon Territory Name	1985	1990	1991	1992	1993	1985	1990	1991	1992	1993
Southeast	**5**	**6**	**6**	**6**	**7**	**5/7**	**5/4**	**5/4**	**6/5**	**7/11**
Rock Harbor-Lorelei L./In. Hill Is.	0	0	0	0	1	–	0/0	0/0	0/0	1/1
Rock Harbor-Caribou/Cemetary Is.	1	1	1	1	1	1/2	1/0	1/0	1/1	1/2
Tobin Harbor-Boys Is. / Merritt L.	1	1	1	1	1	1/1	0/0	1/0	1/2	1/2
Tobin Harbor-Emerson / Gale Is.	1	1	1	1	1	1/2	1/1	1/2	1/0	1/2
Tobin Harbor-Moose Pt.	1	1	1	1	1	1/2	1/2	1/2	1/1	1/2
Tobin Harbor-Suzy's Cave	0	1	1	1	1	0/0	1/0	0/0	1/1	1/1
Tobin Harbor-Tallman Is.-east	1	1	1	1	1	1/0	1/1	1/0	1/0	1/1
Northeast	**4**	**4**	**5**	**5**	**7**	**4/3**	**4/0**	**5/5**	**5/6**	**6/5**
Duncan Bay (west, east)	1	1	1	2	2	1/1	1/0	1/2	2/2w	2/1w, 1e
Five Finger Bay	1	1	1	1	1	1/1	1/0	1/1	1/2	0/0
Lane Cove	1	1	1	1	1	1/1	1/0	1/2	1/1	1/0
Robinson Bay-Pickerel Cove	0	0	1	–	1	0/0	0/0	1/0	–	1/1
Robinson Bay-Belle Isle	1	0	0	1	1	1/0	0/0	0/0	1/1	1/1
Robinson Bay-Keyhole	0	1	1	–	1	0/0	1/0	1/0	–	1/1
Northcentral										
McCargo Cove-Campground	1	1	1	1	1	1/2	1/1	1/2	1/0	1/0
McCargo Cove-Brady Cove	1	1	1	–	1	1/0	1/1	0/0	0/0	1/1
Southcentral										
Chippewa Harbor (west, east)	1	1	1	2	2	1/1	1/1	1/1	2/1w	2/1e
Malone Bay-Ross Is.	1	1	1	–	–	1/1	1/1	1/2	–	–
Malone Bay-Wright Is. (west,east)	--	1	2	–	–	–	1/0	2/2e	–	–
West										
Washington Harbor	1	1	1	1	1	1/1	1/0	1/1	0/0	0/0
Total*	16	14	18	15	18	16/16	13/8	17/17	11/9	19/21

* Note: This total includes loon nests (*with chicks) also found in only one year: Fire Island (1985), Robinson Bay-Homer Island (1991), Moskey Basin (1985), Siskiwit Bay (1993)*, and McCormick Rocks (1993)*.

The capture research on Isle Royale is particularly filled with difficult logistic problems, primarily the (1) isolation of the capture sites, (2) potentially dangerous nighttime boating conditions due to underwater rock outcroppings, cold water temperatures, and exposure to rapidly changing weather conditions, and (3) lack of readily accessible launching sites (i.e., long boat rides are sometimes required between target pairs). Still, after three years of effort, cautious and deliberate capture attempts have minimized these challenges and no incidents have occurred. In 1993, 9 new loons were banded and the Tobin Harbor-Boys Island male was recaptured (Table 22). The Boys Island female was captured as were adults in Lorelei Lane (male), the Duncan Bay-west (female), and Suzys Cave (female). Juveniles were banded in Duncan Bay-east, Robinson Bay-Pickerel Cove, and Tobin Harbor's Emerson (2 chicks) and Suzys Cave territories.

Table 22. Summary of banded Common Loons at Isle Royale National Park, 1991-1993.

Year	# of Adults	# of Juveniles	TOTAL (new)	# Adult Males	# Adult Females	# Recaps
1991	9	8	17	4	5	-
1992	1	2	3	1	0	1
1993	4	5	9	1	3	1
Total	**14**	**15**	**29**	**6**	**8**	**2**

The return rate and site faithfulness for the 10 possibly returning adults was 80% (Table 23), slightly higher than the 75% return rate for the Great Lakes Region (Table 44). The Duncan Bay-west female and McCargo Cove male did not return in 1993. The Tobin Harbor-Moose Pt. banded pair returned in 1993, however only the male remained on its original territory (i.e., banding site). The Moose Pt. female was briefly observed on Duncan Bay but did not establish a pair bond in Duncan Bay or Tobin Harbor in 1993. This is the first case of breaking site faithfulness (88% in 1993). The Moose Pt. male, Duncan Bay-west male, and McCargo Cove female each paired with new mates and attempted to nest in 1993.

Table 23. Annual Outcome of banded Common Loons on Isle Royale National Park, 1992-93.

Territory	Sex	Year Banded	Annual Outcome 1992	1993
Rock Harbor-Lorelei L./In. Hill Is.	M1	1993	–	1 chick
Tobin Harbor-Boys Is./Merrit L.	M1	1992	–	return, 2 chicks w/F1
	F1	1993	–	2 chicks w/M1
Tobin Harbor-Emerson/Gale Is.	M1	1991	return, nest failed w/F1	return, 2 chicks w/F1
	F1	1991	return, nest failed w/M1	return, 2 chicks w/M1
Tobin Harbor-Moose Pt.	M1	1991	return, 1 chick w/F1	return, 2 chicks w/F?
	F1	1991	return, 1 chick w/M1	return to Duncan Bay
Tobin Harbor Suzy's Cave	F1	1993	–	1 chick
Duncan Bay-west	M1	1991	return, 2 chicks w/F1	return, 1 chick w/F2
	F1	1991	return, 2 chicks w/M1	no return
	F2	1993	–	1 chick w/M1
Lane Cove	F1	1991	return, 1 chick	return, nest failed
McCargo Cove-Campground	M1	1991	return, nest failed w/F1	no return
	F1	1991	return, nest failed w/M1 2nd nest failed w/M?	return, nest failed w/M?

Ted Gostomski, a graduate student from Central Michigan University gathered time-activity budget data on color-marked pairs in 1992 and 1993. Logistical difficulties reduced the efficiency and timing of observations but he did provide indications of the percent time spent by pairs nesting along Lake Superior during the pre-nesting (Lane Cove), nesting (Moose Point, Emerson Island, and Lane Cove), and post-nesting (Moose Point) periods (Table 24). Time spent foraging throughout the breeding cycle was much lower than the Seney NWR site (Table 13), steadily ranging from 6% to 33%. There were sexual differences in time spent nest sitting, higher in the male for both years. The three nests were incubated 59-61% of the time by the males and 48-58% of the time by females.

Table 24. Daily time-activity budgets (% time) of nesting pairs of Common Loons at Isle Royale National Park, 1992-93.

Behavior	Pre-nesting ('92=6hrs, '93=11hrs)		Nesting ('92=50hrs, '93=39hrs)		Post-nesting ('92=6hrs,'93=6hrs)	
	Male '92,'93	Female '92,'93	Male '92,'93	Female '92,'93	Male '92,'93	Female '92,'93
Foraging	8,30	12,33	12,10	13,18	12,6	10,6
Resting	34,17	36,20	10,12	16,1	54,31	51,35
Locomotion	43,41	38,41	12,10	10,13	5,25	1,8
Preening	4,10	10,4	5,6	10,7	4,7	4,3
Nest-sitting	–	–	59,61	48,58	–	–
Chick-rearing	–	–	–	–	25,31	34,48
Other	11,2	5,2	2,1	3,3	0,0	0,0
Total	100	100	100	100	100	100
	(1-2 territories)		(3 territories)		(1 territory)	

Vocal-tags of males were not gathered in 1993. In the past 3 years, only the Tobin Harbor-Emerson Island male has been vocal-tagged while being banded (Table 25). Ten different males have been tagged, 4 for two consecutive years, and 2 for three years.

Table 25. Summary of males that have been banded or vocally-tagged at Isle Royale NP, 1990-92.

Location	1990 Tag	1990 Band	1991 Tag	1991 Band	1992 Tag	1992 Band
Shoreline Sites						
Chippewa Harbor	no	no	yes	no	no	no
Moskey Basin	yes	no	yes	no	no	no
Tobin Harbor-Boys Is.	yes	no	no	no	no	yes
Tobin Harbor-Emerson Is.	yes	no	yes	no	yes	yes
Tobin Harbor-Moose Pt.	yes	no	yes	no	no	yes
Tobin Harbor-Tallman Is.	yes	no	yes	no	yes	no
Inland Sites						
Angleworm Lake	yes	no	no	no	no	no
Eva Lake	yes	no	no	no	no	no
Forbes Lake	yes	no	no	no	no	no
Sumner Lake	yes	no	no	no	no	no

Other Michigan Sites

Two other general study areas are used in Michigan: the Lake Superior State Forest of the eastern Upper Peninsula and lakes within the Elk River Watershed, Antrim County in the northwestern Lower Peninsula (Appendix IV)). In the state forest 2 adults were banded in 1993, the pair on Pike Lake, Luce County and 2 juveniles on South Manistique Lake-Wolf Bay territory, Mackinac County (Table 26). A total of 14 loons, 9 adults and 5 juveniles have been baned in the past three years on Cedar, Kennedy, South Manistique, Strouble, Pike, and Upper Shoe Lakes. In 1993, 5 of the 7 adults returned to their same territories: the male on Upper Shoe (Alger Co.) and the male on Strouble Lake (Mackinac Co.) did not return (Table 28). The Strouble Lake female was not reobserved in 1992 but did return in 1993 and paired with a new male. The South Manistique Lake-Wolf Bay pair returned and were recaptured. The Kennedy Lake male was recovered from Lake Erie near Cleveland, Ohio on 9 December 1991 (Table 45). A pair was present on Kennedy Lake in 1992, but did not attempt to nest.

Table 26. Summary of banded Common Loons at other Michigan sites, 1991-1993.

Site/ Year	# of Adults	# of Juveniles	TOTAL (new)	# Adult Males	# Adult Females	# Recaps
Lake Superior State Forest						
1991	4	3	7	3	1	-
1992	3	0	3	1	2	0
1993	2	2	4	1	1	2
Subtotal	9	5	14	5	4	2
Northern Lower Peninsula, Antrim County						
1991	6	4	10	3	3	-
1992	3	0	3	2	1	1
Subtotal	9	4	13	5	4	1
Total	**18**	**9**	**27**	**10**	**8**	**3**

In the northern Lower Peninsula, Antrim County, 13 loons, 9 adults and 4 juveniles have been banded (Table 26). This site was not visited in 1993. Currently, all four of the targeted lakes, Bellaire, Clam, Intermediate, and Elk have both adults color-marked (3 adults are marked on the Clam Lake territory). Five of the 8 banded adults returned in 1993 (63%) (Table 28). The Lake Bellaire pair were not reobserved in 1993, however, this is the only territory for which banded loons have not been replaced (n=197 territories with at least one banded loon). This pair may have been missed while determining initial return rates, but the territory was vacant for the entire breeding season. The Clam Lake pair returned (M2 and F1), as did the Elk Lake pair. The Intermediate Lake female returned and paired with a new male. The banded male from 1991, returned in 1992 but was later recovered from an ice-covered Long Lake, Grand Traverse County, Michigan on 31 December 1992. It was released within a couple days and appeared to be healthy. It did not return in 1993.

Vocal-tagging was not attempted in 1993. Yodels have been gathered from 4 different territories and from one loon while it was banded, the Intermediate Lake male (Table 27).

Table 27. Summary of males that have been banded or vocally-tagged in Antrim County, Mich., 1991-92.

Location	1991		1992		1993	
	Tag	Band	Tag	Band	Tag	Band
Bellaire	yes	no	no	yes	no	no
Clam	no	no	yes	no	no	no
Elk	yes	no	no	yes	no	no
Intermediate	yes	no	yes	yes	no	no

Table 28. Annual Outcome of banded Common Loons at other sites in Michigan, 1991-1993.

Territory	Sex	Year Banded	Annual Outcome 1992	1993
Lake Superior SF				
Cedar	F1	1992	–	return, 1 chick
Kennedy	M1	1991	died, F w/ unk. M	–
Pike	F1	1993	–	1 chick w/M1
Pike	M1	1993	–	1 chick w/F1
S. Manistique-Wolf Bay	F1	1992	–	return, 2 chicks w/M1
S. Manistique-Wolf Bay	M1	1992	–	return, 2 chicks w/F1
Strouble	M1	1991	return, nest failed w/F1	no return
Strouble	F1	1991	return, nest failed w/M1	return, paired w/ unk. M
Upper Shoe	M1	1991	return, nest failed	no return, female paired w/ unk. M
Antrim County				
Bellaire	M1	1991	return, nest failed w/F1	no return
Bellaire	F1	1991	return, nest failed w/M1	no return
Clam	M1	1991	no return	no return
Clam	M2	1992	1 chick w/F1	return, 1 chick w/F1
Clam	F1	1991	return, 1 chick w/M2	return, 1 chick w/M2
Elk	M1	1992	–	return, 2 chicks w/F1
Elk	F1	1992	–	return, 2 chicks w/M1
Intermediate	M1	1991	return, 1 chick w/F1	no return
Intermediate	F1	1991	return, 1 chick w/M1	return, 1 chick w/ unk. M

Minnesota-summary

The number of loons nesting in Minnesota far exceeds the study sites in Michigan and Wisconsin. The capture research team targeted two locations in 1993: the dense concentration of lakes around Grand Rapids in Itasca County and Voyageurs National Park. Many of the lakes that were visited contained multiple loon territories. A total of 16 territories (9 in Voyageurs NP and 7 in the Grand Rapids area) were approached resulting in the capture of 30 loons, 18 adults and 12 juveniles (Table 29). Lakes were surveyed prior to our arrival by biologists at each site. The return rate for Minnesota adults was 61% (17 of 28 potentially returning adults), slightly lower than the 75% Great Lakes Region return rate (Table 44).

Table 29. Summary of banded Common Loons in Minnesota, 1992-1993.

Site/ Year		# of Adults	# of Juveniles	TOTAL (new)	# Adult Males	# Adult Females	# Adult sex unk.	# Recaps
Voyageurs NP								
	1992	20	12	32	11	6	3	-
	1993	11	8	19	5	6	0	1
Subtotal		**31**	**20**	**51**	**16**	**12**	**3**	**1**
Grand Rapids Area, Itasca County (and Superior NF, St. Louis County)								
	1992	12	5	17	7	5	0	-
	1993	7	4	11	3	4	0	1
Subtotal		**19**	**9**	**28**	**10**	**9**	**0**	**1**
Total	1992	32	17	49	18	11	3	–
	1993	18	12	30	8	10	0	2
Total		**50**	**29**	**79**	**26**	**21**	**3**	**2**

Voyageurs National Park, St. Louis County

This site comprises 3 large reservoirs: Rainy, Kabetogoma, and Namakan (Appendix VIII). Water levels fluctuate widely throughout the loon's breeding season and severely disrupt nesting success (Reiser 1988). Renesting is common. Although there are an estimated 130 nesting pairs of Common Loons, surveys in 1993 by Park Service personnel found the number of pairs producing chicks to be low (but consistent with past surveys): 0 on Kabetogoma, 1 on Namakan, and many (?) on Rainy Lake. Nine of these families were approached in 1993, resulting in the capture and banding of 19 loons, 11 adults and 8 juveniles (Table 29). The Rainy Lake-Dryweed Island-Tango Bay male was the only loon recaptured. A total of 22 territories have at least one adult banded, 9 with both adults banded (Table 39).

The gathering of return rates was difficult at Voyageurs National Park. Large water bodies, inclement weather, a large logistically hard area to cover by one person, and increased mate and territory switching on multi-territory water bodies were responsible for some territories to be less than adequately covered by initial spring observations. Continued surveys in the summer did find two birds not found earlier: the Namakan-Blind Indian Narrows female and the Rainy-Harrison Bay-male. Eleven of the 18 adults that were checked for presence/absence (61%) were known to have returned in 1993 (Table 30). Non-returning loons were from Ek Lake (female), Kabetogama-Cutover Island (male), Namakan-Narrows (male), and on Rainy Lake the Dryweed Island-north (unknown sex) and northwest (male) territories, Lost Bay-middle (female), and the Sobolesky Bay female. The two Brule Narrows loons were not checked due to logistical difficulties and are not included in the return rates. The only territories that were not checked more than once were Dryweed Island-north and Lost Bay-middle. One of the most interesting findings of 1993 was the confirmed observation of one of the Seney National Wildlife Refuge, Michigan loons banded as chicks in 1987 and 1988. One of the 7 chicks banded in those 2 years (each has green/red on right and silver on left) was found at Voyageurs National Park in the Namakan-Blind Indian Narrows territory. It was observed at close range by two of the biologists working on return rates. This is the first case of long-distance dispersal by loons (over 500 miles, 800 km, from the natal lake). It was not reobserved for the remainder of the breeding season.

Table 30. Annual Outcome of banded Common Loons in Voyageurs National Park, 1993.

Territory	Sex	Year Banded	Annual Outcome 1993
Inland Lakes			
Ek Lake	M1	1992	return, nest failed
Ek Lake	F1	1992	no return
Lake Kabetogoma			
Kabetogama-Cutover Is.	M1	1992	no return
Kabetogama-Ek Bay	M1	1992	return, nest failed
Kabetogama-Narrows	M1	1993	1 chick w/F1
Kabetogama-Narrows	F1	1993	1 chick w/M1
Namakan Lake			
Namakan-Blind Indian	F1	1992	return, did not pair
Namakan-Old Dutch	M1	1992	return, nest failed w/F1
Namakan-Old Dutch	F1	1992	return, nest failed w/M1
Namakan-Narrows	M1	1992	no return, 2 chick produced in territory
Rainy Lake			
Rainy-Black Bay-n	F1	1993	1 chick
Rainy-Brule Narrows-1	M1	1992	did not check
Rainy-Brule Narrows-2	Unk.	1992	did not check
Rainy-Dove Bay-n	M1	1993	1 chick w/F1
Rainy-Dove Bay-n	F1	1993	1 chick w/M1
Rainy-Dove Bay-s	M1	1993	loner?
Rainy-Dryweed Is.-n	Unk.	1992	no return
Rainy-Dryweed Is.-nw	M1	1992	no return
Rainy-Dryweed Is.-nw	F1	1993	1 chick w/ unk. M
Rainy-Frazer Bay	F1	1993	2 chicks
Rainy-Harrison Bay	M1	1992	return, nest failed w/F1
Rainy-Harrison Bay	F1	1992	return, nest failed w/M1
Rainy-Lost Bay-mid	M1	1992	return, nest failed w/ unk. F
Rainy-Lost Bay-mid	F1	1992	no return
Rainy-Lost Bay-upper	M1	1993	loner
Rainy-Neil Pt.	Unk.	1992	return, nest failed
Rainy-Snag Is.	M1	1993	1 chick w/F1
Rainy-Snag Is.	F1	1993	1 chick w/M1
Rainy-Sobolesky Bay	M1	1992	return, nest failed w/ unk. F
Rainy-Sobolesky Bay	F1	1992	no return
Rainy-Tango Bay	M1	1992	return, 2 chicks w/ unk. F

Mary Derr, a graduate student with the University of Minnesota is undertaking a pilot study to investigate the environmental contaminants in a selected piscivorous waterbird community: Common Loon, Red-necked Grebe (*Podiceps grisegena*), Common Merganser (*Mergus merganser*), and Hooded Merganser (*Lophodytes cucullatus*). She used 3 methods to obtain blood or tissue samples. Nest boxes provided eggs and allowed the capture of adult Common (2) and Hooded (1) Mergansers. A submerged drive trap was marginally successful for catching 6 Common Merganser chicks. The main capture technique was nightlighting, and was responsible for 36 birds; 19 (10 Common Mergansers and 9 Red-necked Grebes) had blood or feather samples extracted. Red-necked Grebes with or without were captured with relative ease through nightlighting. A total of 47 birds were captured using these 3 different techniques, and 53 tissue samples (blood, feather, and carcass) and eggs from 14 nests were collected.

The resulting mean mercury levels are (listed as blood / feathers): 0.5 / 5.5 ppm for adult Common Mergansers (n = 9 / 8) and adult grebes (n = 7 / 8); 0.1 / 2.9 ppm for juvenile Common Mergansers (n = 5 / 4); 0.3 ppm (blood only) for a juvenile grebe; and 0.4 / 5.8 ppm for a Hooded Merganser adult. Two non-targer species were also captured and tested; these species are not piscivores and as expected their mercury levels are lower. A juvenile Common Goldeney (Bucephala clangula) had 1.0 ppm in its feathers and a Wood Duck (Aix sponsa) had 0.05 / 0.3.

Grand Rapids Area, Itasca County (and Superior NF, St. Louis County)

Another major concentration of breeding loons is in Itasca County (Strong and Baker 1991). Jeff Hines, a DNR biologist from the Grand Rapids office, guided the capture efforts. A total of 11 loons, 7 adults and 4 juveniles were captured and banded (Table 23). One loon was recaptured — the Wabana-lower male. Wabana and Bass lakes were revisited in 1993 and territories from Pokegama were added to the sampling effort (Appendix IX).

Six of ten banded adults (60%) returned in 1993 (Table 30), including the Black Island and Wabana-central pairs, the Wabana-lower male, and the Bass-Sunset Cover female. Wabana-upper was checked early and late in the season; the territory was occupied by 2-3 unmarked adult loons. It is rare for a territory to lose both adults in a single season (the only other case is the pair from Lake Bellaire, Antrim County, Michigan). The Wabana-lower female failed to return or was displaced by an unmarked female that was captured with the male and 3 week old chick. The Bass-Sunset Cove male also did not return in 1993; he was the first loon observed (from a sample of 229 adults) to have differences in plumage compared to other adults. The atypical plumage of this male was a brown rump (the brown feathers were worn) interspersed by only a few black feathers, a brownish cast to the head feathers with only a minor amount of green irredescence on the nape, and the primary coverts had very little white spotting (3 feathers). The captured female with typical plumage was used for comparison and showed the typical total black feathering on the rump (no brown feathers), green irredescence in all the feathers of the head, and primary coverts that were heavily patterened with white spotting. This may be a three-year-old male that had successfully produced chicks, a rare occurrence since returning subadults probably need 1-3 years to establish pair bonds.

Table 31. Annual Outcome of banded Common Loons in the Grand Rapids area, Itasca County and nearby areas, 1993.

Territory	Sex	Year Banded	Annual Outcome 1993
Grand Rapids Area			
Bass-Sunset Cove	M1	1992	no return
Bass-Sunset Cove	F1	1992	return, paired w/ unk. M
Bass-Cedar Pt.	M1	1993	2 chicks
Black Island	M1	1992	return, unk. breeding status
Black Island	F1	1992	return, unk. breeding status
Pokegama-Sugar Bay-n	F1	1993	2 chicks
Pokegama-Sugar Bay-s	F1	1993	1 chick
Pokegama-Chisholm Pt.	M1	1993	1 chick
Wabana-Buhella Bay	M1	1993	1 chick w/F1
Wabana-Buhella Bay	F1	1993	1 chick w/M1
Wabana-lower	M1	1992	return, 1 chick w/F2
Wabana-lower	F1	1992	no return
Wabana-lower	F2	1993	1 chick w/M1
Wabana-central	M1	1992	return, nest failed w/F1
Wabana-central	F1	1992	return, nest failed w/M1
Wabana-upper	M1	1992	no return
Wabana-upper	F1	1992	no return
Superior National Forest			
Whiteface Reservoir	M1	1992	no return
Whitewater-south bay	M1	1992	no return

New Hampshire-summary

A collaborative pilot study was initiated in the New England area in 1993. Chris Rimmer of the Vermont Institute of Natural Science, Betsy Pourier of the New Hampshire Loon Preservation Committee, and Dr. Mark Pokras of the School of Veterinary Medicine's Wildlife Clinic at Tufts University assisted with funding, logistical support, and providing participants. Our goal is to replicate and expand the Common Loon monitoring program that was developed in the Great Lakes Region.

Although eventually the New England research may include several states, loons were only captured in New Hampshire in 1993. A total of 7 loons (3 adults and 4 juveniles) were captured in 6 nights. The low capture rate was due to new capture team participants and inclement weather (thunderstorms and fog). One adult and 2 juveniles were captured in the Lakes Region, from Little Squam and White Oak Lakes. The Lake Umbagog region was visited for 3 nights resulting in 2 adults and 1 juvenile banded on Lake Umbagog and the Androscroggin River (Appendix XI) and a juvenile was also banded on neighboring Dummer Lake.

When feasible, blood and feather samples were taken. Tufts University has undertaken a longitudinal study on causes of morbidity and mortality of the loon in New England and need baseline data on apparently healthy birds. A total of 124 loons have been sent to the Wildlife Clinic since 1989 and analysis does suggest that organochlorine and mercury levels may be elevated. Lead levels were <0.05 ppm in an adult and its chick that nested on Lake Umbagog (Androscroggin River-Sweatt Meadow). The chick from Dummer Lake had a lead level of 0.18. Serum lead levels from 23 loons, recovered alive in New England in 1991, showed levels ranging from 0.01 to 0.78 ppm. The mercury level of the adult loon from Lake Umbagog-Three Island Cove was 2.49 ppm. Serum mercury levels from 10 birds recovered alive in New England during 1991 ranged from 0.54 ppm to 5.52 ppm.

Physiological information is being gathered by others at Tufts University. Dr. Acacia Alcivar-Warren at the Department of Comparative Medicine and her graduate student, Zimra Gordon, is examining genetic diversity. The long-term goal is to create a DNA database to develop molecular markers that can be used to follow genetic diversity of loon populations and to relate them with toxicological data. Her short-term goal is to examine genetic diversity using restriction fragment length polymorphisms (RFLP) and random amplified polymorphic DNA (RAPD). Nuclear DNA polymorphisms have been examined from 15 loon samples from 6 states.

In 1994, capture success and efficiency will greatly exceed the 1993 pilot year. Lake Umbagog is an ideal site due to a high density of breeding territories on one water body and minimal interaction with the general public. The Lakes Region is a difficult area to capture loons due to the intense interest of the general public and the high degree of shoreline development. Information on estrogen levels will be added to the sampling strategy in 1994.

Ontario-summary

No effort was made to gather return rate information in Ontario for 1993. The Long Point Bird Observatory's Loon Watch program attempted to inspire their volunteers to search the selected lakes; 2 banded loons were located. Banded adults returned to Cooper Lake and Kennisis Lake and although the observers reported color-marked birds and only one adult was banded on each lake, their color combinations could not be confirmed.

In 1992, 24 adults, from 19 different territories in 17 lakes, were banded in southeastern Ontario (Appendix 1). The objective of capturing these loons was to assist the Canadian Wildlife Service to determine the extent of mercury contamination in the Common Loon. The Ontario study area includes lakes in the townships of Parry Sound, Muskoka, Haliburton, Victoria, Peterborough, Hastings, Lennox and Addington, Frontenac, and Lanark. It is hoped that funding will be available to cover this large area to document return rates in 1994. The loons from this area are the only banded birds that we did not attempt to reobserve in 1993.

Blood and feather samples were taken from most of the captured loons in 1992 (Table 32). Feather mercury levels in Ontario adult loons (mean of 12.87) are slightly higher than values recorded in 1991 (a mean of 9.47) (Evers 1992) and 1992. There also appears to be sexual differences in mercury body burdens, males have higher levels. The mean mercury concentration in juveniles was lower in Ontario (2.33) compared to the 1991 analysis (3.78).

Table 32. Summary of mercury levels (micrograms/ml or ppm) in blood and feathers from Ontario, 1992.

Age	Sex	Hg in Blood			Hg in Feathers		
		mean +/- sd	range	n	mean +/- sd	range	n
Adult	Male	2.37 +/- 1.05	1.11-4.26	13	15.03 +/- 4.09	8.82-18.66	12
Adult	Female	1.56 +/- .53	.93-2.57	8	10.70 +/- 2.88	7.65-15.36	8
Juvenile		.142 +/- .112	.062-.594	35	2.33 +/- .61	1.56-3.35	15

Wisconsin-summary

The study sites in Wisconsin primarily encompass a three county area in the north-central part of the state: Iron, Oneida, and Vilas. The capture research was initiated in cooperation with the Wisconsin DNR; this collaborative project is focusing on the effects of environmental contaminants (particularly mercury) with the loon's reproductive success. In the past three years a total of 242 loons have been banded, including 145 adults, 97 juveniles and the recapture of 17 adults (Table 33). In 1993, the return of the 61 of 84 adults banded in 1991 and 1992 (73%) was documented (Table 37). This is a slight decline compared to the 1991 return rate of 80%. All known returnees were found on the territories from which they were originally banded.

In 1993, 81 loons were banded over a three week capture period, including 59 adults and 22 juveniles. Unlike 1992, the number of females (34) exceeded the number of captured males (25). Much of the research in Wisconsin is directed toward better understanding the relationship of mercury and loon productivity. Dr. Michael Meyer of the Wisconsin Department of Natural Resource's Bureau of Research is overseeing this research as well as other components. In 1993, collaboration began with Dr. Walter Piper of the Smithsonian Institution to examine social relationships and mate faithfulness of loons through their genetic identities.

Table 33. Summary of banded Common Loons in Wisconsin, 1991-1993.

Site/ Year		# of Adults	# of Juveniles	TOTAL (new)	# Adult Males	# Adult Females	# Adult sex unk.	# Recaps
Turtle-Flambeau Flowage								
	1991	7	6	13	3	4	0	-
	1992	13	8	21	6	6	1	0
	1993	9	4	13	4	5	0	1
Subtotal		**29**	**18**	**47**	**13**	**15**	**1**	**1**
Northern Wisconsin								
	1991	28	25	53	16	12	0	-
	1992	38	36	74	22	16	0	4
	1993	50	18	68	21	29	0	12
Subtotal		**116**	**79**	**195**	**59**	**57**	**0**	**16**
Total	1991	35	31	66	19	16	0	-
	1992	51	44	95	28	22	1	4
	1993	59	22	81	25	34	0	13
Total		**145**	**97**	**242**	**72**	**72**	**1**	**17**

Turtle-Flambeau Flowage, Iron County

This nearly 19,000 acre (7,689 ha) reservoir was created in 1926 (Appendix X). The breeding loon population has been well studied (Belant 1989 and Belant and Anderson 1991), including recent work with several capture techniques. Although a time-efficient and dependable capture method was not established, 23 loons (9 adults and 14 juveniles) were captured and banded between 1985 and 1987 (Table 33). Reobserving these color-marked loons was not emphasized in 1991; more intensive efforts in 1992 located a loon banded as a juvenile in 1987 (Table 36). This male established a territory (Horseshoe Bay-west) in an area that was vacant and attracted a female but did not attempt to nest. He did not return in 1993, although the territory was occupied and the pair produced 2 chicks. Another loon that was banded as a chick on the Flowage, between 1985 and 1988, was found to have returned. In 1994, the captured male on the Merkle territory was found to have a toe band (number 1889 or 1289, the second digit was badly worn) on the outer toe of its left foot. The territory from which it was originally banded is not yet known. This loon is not one of those listed in Table 36.

In 1991, 13 loons were banded on the Flowage (7 adults and 6 juveniles). When combined with the successful efforts in 1992 (21 loons including 13 adults and 8 juveniles), in 1993 (13 loons including 9 adults and 4 juveniles), and past efforts from 1985-1987 (23 loons including 9 adults and 14 juveniles), the total number of loons banded on the Flowage is 70 (38 adults and 32 juveniles) (Tables 33 and 35). Only one adult has been recaptured — the Narrows male in 1993. A total of 20 loons that were banded as juveniles will be at least 3 years of age in 1994.

Five of the seven adults (71%) banded in 1991 returned in 1992 and 13 of 19 (68%) returned in 1993 (Table 37). The total return rate for 1992 and 1993 is 69% (18 of 26). Two of the 5 adults that returned in 1992 were found in 1993: the Teal Bay male and Trude-west female. Of the non-returnees, the Fisherman's Landing female was recovered dead on Sand Key Island, Florida (near Tampa Bay) on 7 January, 1992 (Table 45). The male from Blaire Lake did not return in 1992 or 1993. The captured male on the Blaire Territory did not have chicks in 1991 and it is possible that this was a lone, wandering male. In 1993, the Big Island Bridge female, Murray's Landing female, North Bonies second male (this territory had 2 males caring for the young in 1992), and Snoose Alley female (Table 34) did not return. All known returning adults used their original breeding territories (i.e., site fidelity was 100%). There appears to be higher intrusion rates and more inter-territorial interaction which may promote less territorial stability and increased difficulties when determining true return rates.

Table 34. Annual Outcome of banded Common Loons in the Turtle-Flambeau Flowage, WI, 1992-1993.

Territory	Sex	Year Banded	Annual Outcome 1992	1993
Beaver Creek	M1	1993	--	1 chick w/F1
Beaver Creek	F1	1993	--	1 chick w/M1
Big Island Bridge	F1	1991	return, nest failed	no return
Blaire	M1	1991	no return	no return
Fisherman's Landing	F1	1991	died in winter	--
Fisherman's Landing	M1	1991	return, nest failed	no return
Fourth of July Slough	M1	1993	--	1 chick w/F1
Fourth of July Slough	F1	1993	--	1 chick w/M1
Merkle	M1	1993	--	1 chick w/F1
Merkle	F1	1993	--	1 chick w/M1
Murray's Landing	F1	1991	return, 1 chick w/M1	no return
Murray's Landing	M1	1992	--	return
Narrows	M1	1992	--	return
North Bonie	M1	1992	--	return, paired w/F1
North Bonie	M2	1992	--	no return
North Bonie	F1	1992	--	return, paired w/M1
Rat	M1	1993	--	1 chick w/F1
Rat	F1	1993	--	1 chick w/M1
Seifert Slough	M1	1993	--	1 chick w/F1
Seifert Slough	F1	1993	--	1 chick wM1
Snoose Alley	F1	1992	--	no return
South Bonie	F1	1992	--	return
South Horseshoe	M1	1992	--	return, paired w/F1
South Horseshoe	F1	1992	--	return, paired w/M1
Springstead Landing	M1	1992	--	return, paired w/F1
Springstead Landing	F1	1992	--	return, paired w/M1
Sturgeon Bay	F1	1992	--	return
Teal Bay	M1	1991	return	return
Trude-east	Unk.	1992	--	return
Trude-west	F1	1991	return	return
Total Return Rate: 18 of 26 (69%)			**5/7 (71%)**	**13 of 19 (68%)**

Territories for which both adults of a pair were marked (by the end of the 1993 breeding season) include Beaver Creek, Fourth of July Slough (Hotdog Island), Merkle, Rat, Horseshoe Bay-south, Horseshoe Bay-west (Seifert Slough), and Springstead Landing (Table 34). This represents 37% (7 of 19) of the territories that have been visited in the past 3 years or 29% of the territories on the flowage (7 of 24). The North Bonies territory has 3 marked adults (2 males and 1 female) and observations suggest one of the males serving as a helper to increase survivorship of the young (see page 42 for summary).

In 1994, emphasis will be placed on color-marking new adults that are paired with marked adults (see table 35 for a 3-year history on productivity and banding success). Note that the number of territories (21-24) and adults present (41-44) can be high, yet the number of chicks that reach at least 4 weeks of age may represent only 7-9 families.

Table 35. Common Loon territories, breeding status, and identification status for the Turtle-Flambeau Flowage, Wisconsin, 1991-93.

Territory Name	1991 Adult	1991 Juv.*	1992 Adult	1992 Juv.	1993 Adult	1993 Juv.	Band 1991 Adult	Band 1991 Juv.	Band 1992 Adult	Band 1992 Juv.	Band 1993 Adult	Band 1993 Juv.
Bastine			2	1	2	0	–	–	–	–	–	–
Big Is. Bridge	2	1	2	0	?	?	1	0	–	–	–	–
Beaver Creek			2	0	2	1	–	–	–	–	2	1
Blair	2	0	2	0	2	0°	1	–	–	–	–	–
Deadhorse L.			0	0	2	0°	–	–	–	–	–	–
Donut Lake			2	0	?	?	–	–	–	–	–	–
Fisherman's L.	2	1	2	0	2	0	2	1	–	–	–	–
Flambeau			2	0	2	0	–	–	–	–	–	–
4th July Slough (Hotdog Is.)			0	0	2	1	–	–	–	–	2	0
Horseshoe Bay-s	2	1	2	2	2	0°	–	1	2	1	–	–
Horseshoe Bay-west (Seifert's Slough)					2	2	–	–	–	–	1	2
Merkle			0	0	2	2	–	–	–	–	2	0
Murray's L.	2	1	2	1	2	0	1	1	1	1	–	–
Narrows			2	0	2	2	–	–	1	0	–	–
North Bonies			3	2	2	0°	–	–	3	1	–	–
Rat Lake			2	0	2	2	–	–	–	–	2	0
Snoose Alley			2	1	2	0	–	–	1	1	–	–
South Bonies			2	2	2	0°	–	–	1	1	–	–
Springstead L.			2	2	2	0°	–	–	2	2	–	–
Sturgeon Bay			2	2	2	0	–	–	1	1	–	–
Swimmer's Is.	2	1	2	0	2	0°	0	1	–	–	–	–
Teal Bay	2	1	2	0	2	0°	1	1	–	–	–	–
Trude-east	2	1	2	0	2	1	–	–	1	0	0	1
Trude-west	2	2	2	1	2	0°	1	1	–	–	–	–
TOTAL	?	?	41	14	44	11	7	6	13	8	9	4

* = chicks alive in July
° = pair nested or hatched chick, but chick did not survive into July

Table 36. Common Loons banded on the Turtle-Flambeau Flowage, Wisconsin, 1985-88 (prior to the current banding program initiated in 1991).

Year	Age	USFWS Band	Colored Leg Bands Left	Colored Leg Bands Right
1985	Adult	–	–	red
1985	Juv.	758-100-14	silver	white
1986	Adult	758-100-22	yellow	silver
1986	Adult	758-100-24	silver	green
1986	Adult	758-100-33	yellow / blue	silver
1986	Juv.	758-100-25	blue	silver
1986	Juv.	758-100-23	silver	red
1986	Juv.	758-100-28	yellow / white	silver
1986	Juv.	758-100-29	white / blue	silver
1986	Juv.	758-100-30	red / yellow	silver
1986	Juv.	1353-102-92	white	silver
1986	Juv.	1353-102-93	silver	white
1986	Juv.	1353-102-94	green	silver

Year	Age	USFWS Band	Colored Leg Bands Left	Colored Leg Bands Right
1987	Adult	758-100-38	silver	yellow/b
1987	Adult	758-100-39	yellow/green	silver
1987	Adult	758-100-40	white/green	silver
1987	Adult	758-100-41	silver	red/blue
1987	Adult	758-100-45	green/yellow	silver
1987	Juv.	758-100-46	silver	red/blue
1987	Juv.	758-100-47	silver	white/red
1987	Juv. *	758-100-48	silver	white/yel
1987	Juv.	758-100-49	white/yellow	silver
1987	Juv.	758-100-50	yellow/red	silver

* returned in 1992 and established a territory (Horseshoe Bay west or Seifert's Slough) and formed a pair bond

Northern Wisconsin

This basically three-county study site includes a high density of lakes and nesting loon pairs (the inclusive Turtle-Flambeau Flowage is covered separately for this report). Most lakes are relatively small and rarely harbor more than one loon nesting pair (except the Rainbow Flowage). A total of 195 loons have been banded, 53 in 1991, 74 in 1992, and 68 in 1993 (Table 37), representing individuals from 62 families (Table 39). Of the 116 banded adults (59 males and 57 females), only 27 of them represent single banded loon territories. In other words, over 69% of the territories with marked loons (n=43) have at least 2 marked adults.

There are 6 territories with 3 adults marked: French, Indian, Lumen, Jag, Nineweb, and Razorback. Observations on these territories will be emphasized in 1994 to further investigate rapid mate switching. Mate switching was noted for two territories in 1992 and 4 territories in 1993; they include Jag and North Bonies in 1992 and Teal Bay (Turtle-Flambeau Flowage), Moon Lake, and Little Bass Lake (see pages 41 and 42 for summary).

A total of 79 loons have now been banded as juveniles. This large sample size will be valuable for examining subadult recruitment rates beginning in 1994 (3 years after the banding of juveniles in 1991). Four loons banded in 1991 were recaptured in 1992, Wilson /Deer female, Washburn male, Little Bearskin male, and Jag Lake female; 12 loons were recaptured in 1993 and include the Bills pair, Flannery/Velvet male, Hemlock male, Indian male, the Jag male, Pardee female, Razorback female, Shallow male, Sugar Maple male, Sunset female, and Whitefish male (Table 41).

The adult return rate for 1992 was 23 of 28 (82%) and for 1993 was 48 of 65 (74%) (Table 44). There are noticeable differences in individual adult return rates between years for Wisconsin and the Turtle-Flambeau Flowage (Table 37). The average rate of return observed for first-time returning adults is 83% (71 of 86) while for second-time returning adults it is 46% (16 of 35). The return rates for the Turtle-Flambeau Flowage are typically lower for first (70%) and second time (29%) returnees compared to the other Wisconsin banded adults (86% for first time back, 50% for the second time back). The differences may be due to social infrastructures: dynamic pair bonds and an adjacent excess in the breeding population (Turtle-Flambeau Flowage) compared to highly site and mate faithful adults on smaller lakes that can be better defended against intruders. There is also a slight tendency for males to have higher return rates than females.

The adults that did not return in 1992 (4 females and one male) had territories on Nineweb, Wharton, Indian, French (male), and Rainbow Flowage. The 1991 pH levels were 5.1 (Nineweb) and 5.0 (Wharton) and are among the lowest recorded within this study site. The Indian Lake male paired with an unmarked female and made one nest attempt. On Nineweb Lake, the returning color-marked male was replaced by an unmarked pair by 3 June. The Wharton Lake territory was occupied by the color-marked male that was found on nest. The female was not observed, however this pair frequently uses other lakes for foraging. The male was replaced on the French Lake territory and pair successfully nested. Lastly, the Rainbow Flowage territory was occupied by an unmarked pair that failed in their nesting attempt.

Two recoveries have been reported: both are juveniles banded in 1991 (Table 45). The Washburn loon was found emaciated on 19 July, 1992 at North Beach, New Jersey and was rehabilitated and released alive and one of the George Lake juveniles was found dead on Marco Island, Florida (west of Everglades National Park) on 29 November, 1991. The juvenile banded on McDonald Lake on 10 July was recaptured and released on 21 September 1992 at Little St. Germain Lake to remove hook and line from its neck and bill. Three chicks are known to have died on their natal lake after banding (from 1991-93): Lumen (618-111-52) in 1991, Muskie in Oneida County (838-150-05) in 1992, and Indian (758-781-39) in 1991 (Table 46). No banded chicks died in 1993; chicks were found missing following the capture of adults on Hemlock, Pardee, and Woff lakes. The Woff Lake chick was found on a road 1/4 mile away from its natal lake, one week after banding efforts. It was returned to the lake but was later missing.

Dr. Walter Piper, a behavioral ecologist with the National Zoological Park, Smithsonian Institutution is collaborating with the investigation of mating and territorial behavior using DNA fingerprinting techniques. From May through July 1993, Dr. Piper and a field assistant observed the pre-nesting and nesting behavior of 18 marked Wisconsin loon pairs: they include Alva, Langley/Vicks, Little Bass, Little Bearskin, Lumen, McDonald, Muskie, Shallow, Soo, Sunset, and Washburn and on the Turtle-Flambeau Flowage, Horseshoe Bay-south, Murrays Landing, Narrows, North Bonies, Springstead, and Teal Bay (Table 43). The objective was to determine the likelihood that females (particularly those on multi-lake territories) might leave their mates and copulate with other males either as a means of: 1) ensuring the fertility of the eggs they laid, 2) increasing the genetic variability of the brood (e.g., if a 2-chick brood was sired by 2 different males), or 3) providing their offspring with genes superior to those of their mates. Behavioral observations strongly suggested that few or no extra-pair mating occurred. DNA fingerprinting is being used on the putative families to determine if the parents that raise chicks are, in all cases, their biological parents.

In 1993, frequent intrusions into established territories by unmated loons (floaters) occurred including 4 cases (out of 18 territories) of some form of mate switching. The temporal pattern of intrusions and the frequent replacement of territorial males suggest that floaters intrude in order to lay the groundwork for future takeovers of the territories they visit. In 1994, it is hoped that floaters can be marked to trace their local movements by stationing observers on adjacent lakes. Over time, a record of movements by floaters will accumulate, and this will make it possible to determine the strategies used by floaters in assessing territory quality and acquiring territories.

Table 37. Summary of adult return rates for Wisconsin, 1992-93.

year/sex	# banded	# returned Year 1	# returned Year 2	rate (%) Year 1	rate (%) Year 2
Turtle-Flambeau Flowage					
1991 Male	3	2	1	67	33
1991 Female	4	3	1	75	25
1991 Total	7	5	2	71	29
1992 Male	6	5	–	83	–
1992 Female	6	4	–	67	–
1992 Unk.	1	0	–	0	–
1992 Total	13	9	–	69	–
91&92 Male	9	7	–	78	–
91&92 Female	10	7	–	70	–
91&92 Unk.	1	0	–	0	–
91&92 Total	20	14	–	70	–
Northern Wisconsin (Vilas, Oneida, Iron County lakes)					
1991 Male	15	14	8	93	53
1991 Female	13	9	6	69	46
1991 Total	28	23	14	82	50
1992 Male	22	19	–	86	–
1992 Female	16	15	–	94	–
1992 Total	38	34	–	89	–
91&92 Male	37	33	–	89	–
91&92 Female	29	24	–	83	–
91&92 Total	66	57	–	86	–
Total Wisconsin					
1991 Male	18	16	2	89	50
1991 Female	17	12	7	71	41
1991 Total	35	28	16	80	46
1992 Male	28	24	–	86	–
1992 Female	22	19	–	86	–
1992 Unk.	1	0	–	0	–
1992 Total	51	43	–	84	–
91&92 Male	46	40	–	87	–
91&92 Female	39	31	–	79	–
91&92 Unk.	1	0	–	0	–
91&92 Total	86	71	–	83	–

Summary of Banding Efforts

Since 1987, a span of 7 years, a total of 572 Common Loons have been banded under this program (Table 38). The key to this success has been the development of a time-efficient, low-risk capture method for breeding adults that can be applied to a wide variety of lake and weather conditions. The breakthrough in this technique came in 1989 and was experimented with and improved on in 1990. In 1991, an intensive effort across northern Michigan and Wisconsin proved that this capture effort (combining nightlighting, playback recordings, and net maneuverability) was indeed a valuable resource — 141 loons were captured and banded and the capture rate efficiency for adults and juveniles was 85% and 95%, respectively. Even the average searching (14.8 minutes), catching (4.7 minutes for adults), and handling (32.8 minutes) times were streamlined in 1991 to an average of 52.3 minutes spent on a lake, from the time of leaving shore to the time of release (Evers 1991).

Table 38. Summary of banded, dead, and recaptured Common Loons for 1987-1993, by age and sex class.

State/Province (by year)	# adults	# juvenile	Total (new)	Known dead	# adult males	# adult females	# adult sex unk.	# recaps	# of males	# of females
Michigan										
1987	0	3	3	0	-	-	-	-	-	-
1988	1	5	6	0	1	0	0	-	-	-
1989	4	1	5	0	1	3	0	0	0	0
1990	6	12	18	0	3	3	0	3	2	1
1991	43	32	75	3	23	20	0	3	2	1
1992	33	12	45	3	17	16	0	11	7	4
1993	19	13	32	6	8	11	0	10	6	4
MI TOTAL	**106**	**78**	**184**	**12**	**53**	**53**	**0**	**27**	**17**	**10**
Minnesota										
1992	32	17	49	0	18	11	3	-	-	-
1993	18	12	30	0	8	10	0	2	2	0
MN TOTAL	**50**	**29**	**79**	**0**	**26**	**21**	**3**	**2**	**2**	**0**
New Hampshire										
1993	3	4	7	0	0	2	1	-	-	-
NH TOTAL	**3**	**4**	**7**	**0**	**0**	**2**	**1**	-	-	-
Ontario										
1992	24	36	60	2	15	8	1	-	-	-
ON TOTAL	**24**	**36**	**60**	**2**	**15**	**8**	**1**	-	-	-
Wisconsin										
1991	35	31	66	3	18	16	1	-	-	-
1992	51	44	95	4	28	21	2	4	2	2
1993	59	22	81	0	25	34	0	13	9	4
WI TOTAL	**145**	**97**	**242**	**7**	**72**	**72**	**1**	**17**	**11**	**6**
All Sites (by year)										
1987-89	5	9	14	0	2	3	0	0	0	0
1990	6	12	18	0	3	3	0	3	2	1
1991	78	63	141	6	41	36	1	3	2	1
1992	140	109	249	6	78	56	6	15	9	6
1993	99	51	150	7	41	57	1	25	17	8
Great Lakes (1987-93)	325	**240**	**565**	**19**	**166**	**154**	**5**	**46**	**30**	**16**
New England (1993)	3	**4**	**7**	**0**	**0**	**2**	**1**	**0**	**0**	**0**
TOTAL	328	**244**	**572**	**19**	**166**	**156**	**6**	**46**	**30**	**16**

The banding efforts by state (Figure 3) and for the states of Michigan (Figure 4) and Wisconsin (Figure 5) are shown.

Figure 3. Summary of the banding effort by state/province.

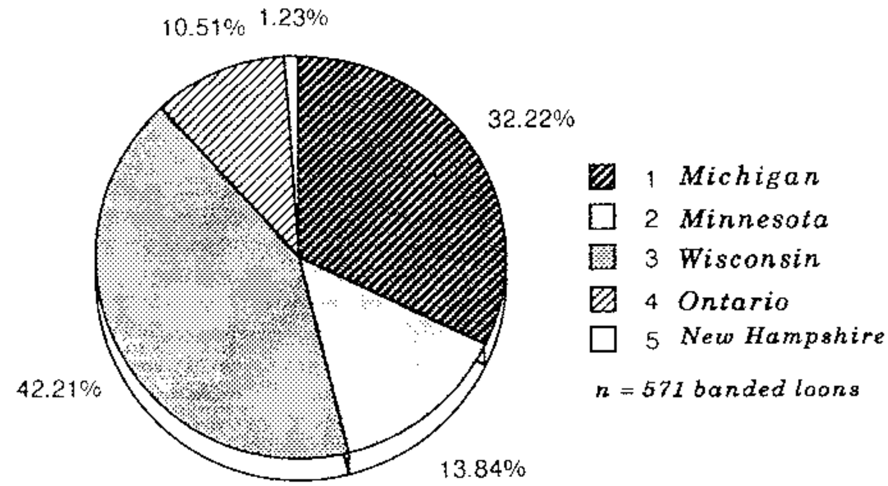


Figure 4. Summary of the Michigan banding effort, 1989-93.

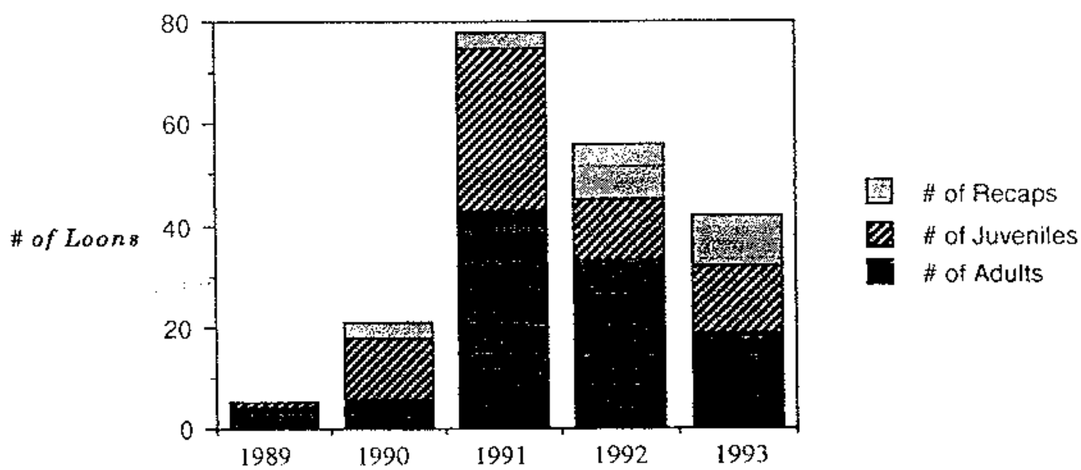
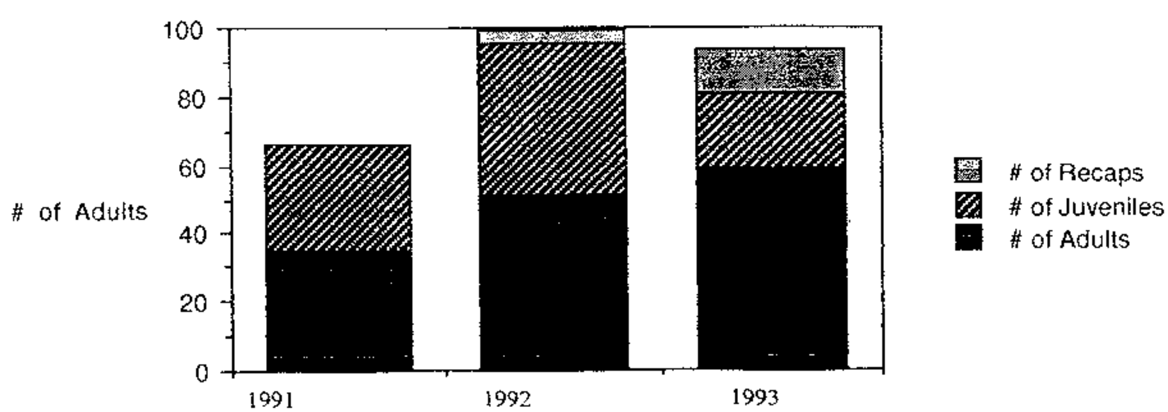


Figure 5. Summary of the Wisconsin banding effort, 1991-93.



In 1993, the adult capture rate efficiency remained steady at around 90%; the addition of taped chick calls to the repertoire of potential capture tools has increased the capture success on otherwise uncatchable adults. The limitations of the capture process still remain: to capture adults they generally must be accompanied by chicks. The presence of chicks promotes the territorial and protective parental urge. This instinct may still be operating soon after a nest or chick is lost which can permit the capture of chickless adults. In 1991, four adults without chicks were captured, 9 in 1992, and one in 1993. Loons were captured in both motorboats and paddling with canoes, and although the silence of canoes would seem to improve "captureability" both methods are equally successful.

In 1993, 150 Common Loons were captured and banded (Table 38). Of this total, 99 were adults including 41 males, 57 females, and 1 adults that was not sexed. The disparity between banded males and females is the opposite to what happened in 1992. A total of 25 adults were recaptured (17 males and 8 females); these birds were carefully examined and found to be healthy (i.e., weights were typical, normal in-hand behavior, and fresh plumage). Some birds did show wear on the legs from the old-style bands (Strong et al. 1987), no open wounds were found but small and localized calluses were present on some birds. A much improved band style was developed in 1992 and used throughout 1993. Recaptured birds from 1992 that had the new style bands showed less wear than the old style bands.

Of the 572 banded loons, 19 are known to have died; 15 have been recovered outside of the breeding area (7 adults and 8 juveniles) and 4 chicks died after being banded but before fledging. The capture ratio for adults and bandable juveniles is 1.4 : 1. Of the 325 adults, 51% are males, 47% are females, and 2% remain sex unknown. Even though certain situations favor the capture of one sex over the other (i.e., using yodels for an agitated male) the capture technique is able to equally sample both sexes. There is a disparity in the sex ratio for recaptured loons (n=46), nearly two times the number of males are captured from a pool of a relatively equal number of banded females and males. Previously banded loons tend to be more elusive, in males this may be overcome by a greater instinct to protect the territory and offspring.

Table 39. The number of territories that at least one member was captured/banded and the number of territories that have both or three adults marked, 1989-1993.

Study Site	No. of Territories w/ at least one marked	No. & % of Territories w/ both adults marked		No., %, & name of Territories w/ 3 adults marked*		
Michigan						
Seney National Wildlife Refuge	10	7	70%	2		C-3, G Pool
Hiawatha National Forest	7	3	43%	2		Frenchman, Hulbert
Ottawa National Forest	21	17	81%	2		Clark-n, Thousand Is.
Isle Royale National Park	8	5	63%	1		Duncan Bay-west
Lake Superior State Forest	6	3	30%	0		
Northern Lower Peninsula	4	4	100%	1		Clam
Michigan Subtotal	56	39	70%	8	14%	
Minnesota						
Voyageur's National Park	22	9	41%	0		
Grand Rapids/Other	11	6	55%	1		Wabana-lower
Minnesota Subtotal	33	15	45%	1	3%	
New Hampshire	3	0	0%	0		
Ontario	27	4	15%	0		
Wisconsin						
Turtle-Flambeau Flowage	19	7	37%	1		North Bonie
N. Highland State Forest/Other	62	43	69%	6		French, Indian, Lumen,
Wiscosin Subtotal	81	50	62%	7	11%	Jag, Nineweb, Razorback
TOTALS	**197**	**104**	**(53%)**	**18**	**(9%)**	

*This does not include territories for which one or more adults were known to be dead before the spring of 1993.

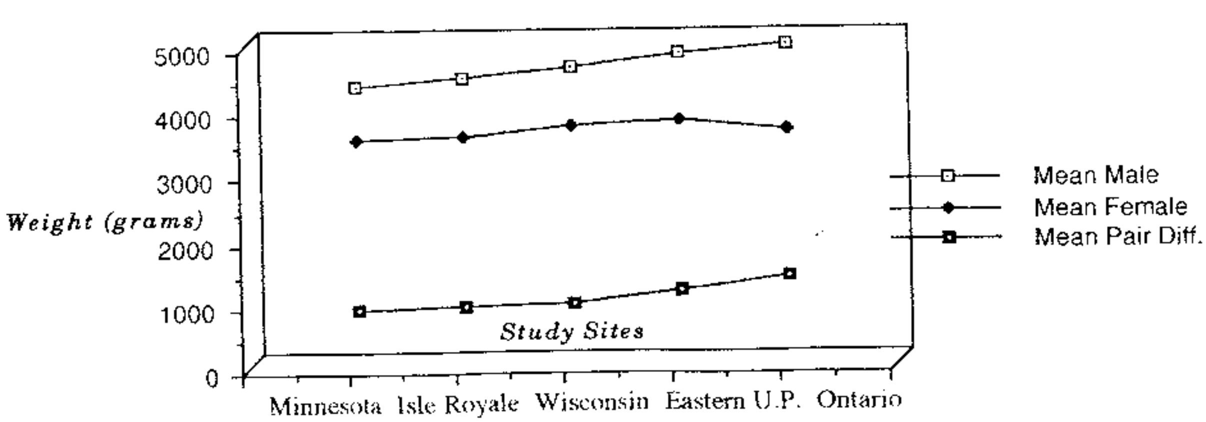
The number of different territories that at least one loon has been banded totals 197 (Table 39). The greatest concentration of territories with banded birds is the 3-county area in northern Wisconsin (62). An important part of the banding program is to get each mate in a pair banded. A color-marked pair provides much more information on loon ecology than the marking of one individual. The number of territories with both sexes marked is 104 and of these 18 territories have 3 adults marked. Michigan (47) and Wisconsin (57) have a large sample size of territories with at least 2 adults marked. The more than doubling of the number of territories with 3 adults marked (8 in 1992 and 18 in 1993) is due to the further findings of mate switching and helpers as well as revisiting territories that have an unbanded bird replacing a previously captured one. The missing birds should not be categorized as mortality; the Clark Lake-north territory in the Ottawa National Forest is a good example. In 1991, the female and male were banded. The female did not return in 1992, but the banded male paired with a new female, produced a chick, and she was banded. In 1993, the 1991 banded female returned and attempted to nest with the banded male, the 1992 banded female was not observed in 1993. A similar situation happened on C-3 Pool in the Seney NWR in 1992 (Table 9) and on Frenchman Lake in the Hiawatha NF in 1993 (Table 17).

All captured loons are weighed. The weights of adults provides a reliable method of sexing. Measurements from Michigan and Wisconsin loons in 1990 and 1991 showed that 94% of the adults can be reliably sexed by weight (Evers 1991). The main assumption used for sexing adult loons is that only the male yodels (McIntyre 1988). During and after capture, the adult male typically gives a yodel call thereby confirming the sex of the captured individual. The 1991 results (Michigan and Wisconsin adults) also showed that 94% of the adults weighing less than 4,000 grams were females and those over 4,300 grams were males. Loon pairs exhibit a strong sexual dimorphism, averaging 931 +/- 382 grams (n=121) (Table 40). This trait of the male always being larger than the female provides another reliable reference for sexing adult loons (if both members of the pair are captured). The weight differences within a pair tend to be greater as one moves from west (Minnesota) to east (Ontario) (Figure VI). There is only one case of a male not being larger than a female; the Rat Lake pair of the Turtle-Flambeau Flowage, Wisconsin both weighed 4,000 g.

Table 40. Summary of weights (grams) of Common Loons by region and sex, 1990-93.

Location	Range of Male Wt.	Mean of Male Wt.	Range of Female Wt.	Mean of Female Wt.	Difference within pairs Range	Difference within pairs Mean
Ontario	4470-5440 (n=14)	4927+/-272 (n=14)	3360-4050 (n=8)	3595+/-306 (n=8)	1070-1600 (n=5)	1326+/-241 (n=5)
Eastern U.P./ Northern LP	4400-5400 (n=26)	4786+/- 246 (n=18)	3430-4425 (n=20)	3756+/-254 (n=20)	535-1800 (n=19)	1097+/- 364 (n=19)
Ottawa N.F./ Wisconsin	4000-5390 (n=87)	4596+/-280 (n=62)	3325-4065 (n=93)	3663+/-225 (n=93)	0-1880 (n=77)	915+/-391 (n=77)
Isle Royale	3950-4870 (n=6)	4403+/-355 (n=5)	3190-3710 (n=7)	3519+/-165 (n=7)	500-1300 (n=5)	877+/-384 (n=5)
Minnesota	3920-4820 (n=25)	4309+/-243 (n=16)	3145-3840 (n=21)	3480+/-167 (n=21)	470-1420 (n=15)	818+/-317 (n=15)
Great Lakes	**3920-5440** (n=158)	**4607+/-321** (n=158)	**3145-4425** (n-149)	**3638+/-235** (n=149)	**0-1880** (n=121)	**931+/-382** (n=121)

Figure 6. Mean weights for male and female loons in the Great Lakes Region, 1991-93.



In 1993, the larger sample of weights continue to show the reliability of sexing adult loons by weight alone, however the geographic variability known in the loon begins to show east and west of Michigan. In Minnesota, the mean weights of adult loons were lower than any other study site and were particularly apparent with males (4,309 g versus the Great Lakes Region mean of 4,607 g) (Table 40). Isle Royale loons had mean weights more than those in Minnesota but less than individuals in northern Wisconsin and east through Michigan. Ontario adult males and females had the highest mean weights within the Great Lakes Region. From a sample of 68 pairs that were banded and weighed during the same night of capture, the male weighed more than the female in every case: averaging nearly 1,000 g more (Table 40). Larger sample sizes will provide more definitive trends in geographic and gender weight trends. Expectedly, there are variations in the weight of individuals over time (even during the same season). The annual weights of same-individual loons that raise chicks can vary up to 395 g and average a difference of 135 +/- 107 g (Table 41).

Table 41. Summary of recaptured adult Common Loons and their respective weights, 1990-93.

General Locale	Territory	Sex	First Banded		Recapature		Weight
			Date	Weight	Date	Weight	Difference
Antrim Co.	Intermediate	Male	6/28/91	4,870g	6/20/92	5,120g	+ 250
Grand Rapids Area	Wabana-lower	Male	7/30/92	4,770g	8/7/93	4,800g	+30
Hiawatha NF	Bunting	Female	7/18/90	3,790g	7/2/91	3,570g	- 220
Hiawatha NF	East Lake-northeast	Male	7/26/90	4,420g	8/13/92	4,110g	- 310
Hiawatha NF	Frenchman	Male-2	8/8/91	4,665g	6/21/92	--	
Hiawatha NF	Frenchman	Female	7/7/91	3,655g	6/21/92	3,620g	- 35
Hiawatha NF	Little Round	Female	6/27/92	3,520g	7/16/93	3,415g	-115
Isle Royale NP	Duncan Bay-west	Male	8/3/91	4,010g	8/13/92	4,250g	+ 240
Isle Royale NP	Tobin Harbor-Boys Is.	Male	8/12/92	4,555g	8/1/93	4,575g	+20
Lake Superior SF	S. Manistique-Wolf Bay	Female	6/25/92	3,520g	7/18/93	3,675g	+155
Lake Superior SF	S. Manistique-Wolf Bay	Male	6/25/92	4,660g	7/18/93	4,590g	-70
Northern Wisconsin	Bills	Male	7/12/91	4,350g	7/5/93	4,465g	+115
Northern Wisconsin	Bills	Female	7/8/92	3,680g	7/5/93	3,680g	0
Northern Wisconsin	Flannery/Velvet	Male	7/20/92	4,790g	7/17/93	4,600g	-190
Northern Wisconsin	Hemlock	Male	7/9/92	4,600g	7/4/93	4,600g	0
Northern Wisconsin	Indian	Male	7/24/91	4,335g	7/20/93	4,300g	-35
Northern Wisconsin	Jag	Female	8/16/91	3,625g	7/18/92	3,480g	- 145
Northern Wisconsin	Jag	Male	7/26/92	4,555g	7/22/93	4,850g	+295
Northern Wisconsin	Little Bearskin	Male	7/10/91	4,900g	7/2/92	4,660g	- 240
Northern Wisconsin	Pardee	Female	7/11/92	3,665g	7/21/93	3,700g	+35
Northern Wisconsin	Razorback	Female	7/15/91	3,725g	7/2/93	3,860g	+135
Northern Wisconsin	Shallow	Male	7/9/92	4,375g	7/4/93	4,100g	-275
Northern Wisconsin	Sugar Maple	Male	7/25/91	4,320g	7/21/93	4,300g	-20
Northern Wisconsin	Sunset	Female	7/19/92	3,675g	7/14/93	3,500g	-175
Northern Wisconsin	Washburn	Male	7/9/91	5,390g	7/3/92	4,995g	- 395
Northern Wisconsin	Whitefish	Male	7/24/91	4,385g	7/21/93	4,250g	-135
Northern Wisconsin	Wilson / Deer	Female	7/18/91	3,730g	7/12/92	3,510g	- 220
Ottawa NF	Clark-north	Male	7/20/91	4,520g	7/10/92	4,525g	+ 5
Ottawa NF	Clark-southwest	Male	7/19/91	4,635g	7/10/92	4,610g	- 25
Ottawa NF	Clark-southwest	Female	7/19/91	3,830g	7/10/92	3,750g	- 80
Ottawa NF	Langford/L. Langford	Female	7/7/92	3,575g	6/27/93	3,375g	-200
Ottawa NF	Langford/L. Langford	Male	7/22/91	4,500g	6/27/93	4,690g	+190
Ottawa NF	Little Oxbow	Male	7/7/92	--	6/26/93	4,480g	
Ottawa NF	Long	Male	7/19/91	4,750g	7/9/92	5,090g	+ 340
Ottawa NF	Long	Female	7/22/91	3,540g	7/4/92	3,700g	+ 160
Ottawa NF	Long	Male	7/9/92	5,090g	6/26/93	5,050g	-40
Ottawa NF	Long	Female	7/4/92	3,700g	6/26/93	3,790g	+90
Seney NWR	B Pool-south	Male	7/18/89	--	7/7/90	4,950g	
Seney NWR	B Pool-south	Male	7/18/89	--	6/26/91	4,550g	
Seney NWR	B Pool-south	Male	7/18/89	--	7/7/91	4,660g	
Seney NWR	C-3 Pool	Female	7/23/89	--	7/20/90	3,775g	
Seney NWR	E Pool-east	Female	7/6/90	--	7/24/92	4,425g	
Seney NWR	E Pool-east	Male	7/24/92	5,015g	7/8/93	4,970g	-45
Seney NWR	G Pool	Male	7/10/88	--	7/10/90	5,400g	
Turtle-Flambeau Flowage	Narrows	Male	7/6/92	4,570g	7/9/93	4,510g	-60
Voyageurs NP	Rainy-Dryweed Is.-Tango	Male	8/4/92	4,465g	8/10/93	4,500g	+35

Summary of Behavioral Efforts

The combined effort for gathering behavioral information through time activity budgets totaled 715 hours (81 hours during the pre-nesting period, 316 hours during the nesting period, and 318 hours during the post-nesting period) (Table 42). The three 1993 sites include the Seney National Wildlife Refuge (year 4), Ottawa National Forest (year 1), and Isle Royale National Park (year 2). Methodolgies for each site and each year are based on Evers (1993). Three years of data at Seney National Wildlife Refuge (NWR) are summarized in Table 13. Jim Paruk, Ari Davila, and 21 Earthwatch volunteers gathered the behavioral information at Seney NWR. In addition to the baseline data annually gathered through time activity budgets, more specific questions were investigated including the comparison and chronology of chick and adult foot waggling, role partitioning and food preferences during the chick rearing period, and sexual patterns in incubation strategy.

Jay Mager spent 490 hours quantifying the time spent by breeding loon pairs in the Ottawa National Forest (NF)(424 hours are summarized in the table). Observations were made between 0500 and 2100 each day from 30 May to 4 August, 1993. Parental care was observed from the beginning of incubation to 6 weeks after hatching for 8 different families. At least 4 families were observed at one time during different stages of the breeding season. Ted Gostomski monitored 3 breeding pairs for 56 hours on Isle Royale National Park (NP): Tobin Harbor-Emerson Island, Tobin Harbor-Moose Point, and Lane Cove. These territories and all others with marked adult loons are on Lake Superior; most are within the protected coves formed by the island's topography.

Human disturbance is minimal at each site, although there are potential influencial activities on Tobin Harbor territories in Isle Royale NP and for a few of the 8 lakes in the Ottawa NF. The differences in time spent foraging between Seney NWR and Isle Royale NP in 1992 were tramatic during pre-nesting (74-82% in Seney and 8-12% for Isle Royale) (Evers 1992). In 1993, these difference were not as apparent (32-44% in Seney and 30-33% for Isle Royale) (Table 42). However, as in 1992, the time spent chick rearing for adults (i.e., primarily diving and catching prey) was again more for Isle Royale (31-48%) than Seney (12-22%). The water quality and prey availability are vastly different between the two sites and may explain some of these perceived differences. Although not quantified, the water column is extremely turbid at Seney and is very clear in Isle Royale. Seney adult loons primarily prey on brown bullhead, which typically reside within vegetation and are bottom dwellers, whereas Isle Royale coves are filled with schools of young lake herring (*Cisco ardeii*) and provide ample prey for adult loons. Since loons are visual hunters, schooling fish in a clear water column are probably more efficiently captured than bottom dwelling fish in turbid water. The differences between sites for time spent rearing the chicks is also related to prey availability, but in a different way. The shallow pools at Seney are actually ideal sites for raising loon chicks. The ambient water temperature is relatively warm and shiners, minnows, darters, and invertebrates (e.g., Odonate larvae) abound. The Lake Superior waters surrounding Isle Royale have a comparatively much reduced faunal diversity. Therefore, adults on Isle Royale spend more time searching for suitable prey to provide chicks (which also probably have a higher caloric intake need to maintain their body temperatures) than adults at Seney.

Preening times ranged from 3-10%, averaging 6.4% of time spent throughout the breeding cycle (7.6% in 1992). For 1992 and 1993, the amount of time spent on the nest by the male averages 47.5% +/- 13.0% (range 29-61%) and for the female averages 57.5% +/- 12.6% (range 45-79%). The average difference between the pair for nest-sitting duties is 16.3% (n=6).

Table 42. Comparison of daily time-activity budgets (% time) of Common Loon nesting pairs at Seney NWR (SE), Ottawa National Forest (OT), and Isle Royale (IR) in 1993.

	Pre-nesting		Nesting		Post-nesting	
	Male	Female	Male	Female	Male	Female
Behavior	SE, OT, IR	SE, OT, IR	SE, OT, IR	SE, OT, IR	SE, OT, IR	SE, OT, IR
Foraging	32, --, 30	44, --, 33	40, 28, 10	23, 23, 18	25, 28, 6	28, 23, 6
Resting	17, --, 17	10, --, 20	5, 5, 12	2, 10, 1	45, 33, 31	23, 38, 35
Locomotion	42, --, 41	38, --, 41	6, 6, 10	3, 5, 13	10, 12, 25	9, 10, 8
Preening	5, --, 10	5, --, 4	5, 8, 6	5, 10, 7	5, 10, 7	5, 11, 3
Nest-sitting	--	--	41, 56, 61	64, 51, 58	--	--
Chick-rearing	--	--	--	--	12, 15, 31	22, 15, 48
Other	1, --, 2	1, --, 2	1, 1, 1	1, 1, 3	2, 1, 0	2, 2, 0
# of territories	2, -- ,1		2, 4, 3		2, 4, 1	
# of hours	70, --, 11		100,177,39		65, 247, 6	

Unlike 1992, time activity budgets were not developed for the Turtle-Flambeau Flowage, although social interactions and daily movements were observed for the Flowage as well as the 3-county northern Wisconsin area as part of a study involving 18 focal loon territories (Table 43). Dr. Walter Piper and Dr. Michael Meyer are leading this investigation and were assisted by Eric Witham, Tim Larsen, Jerry Hartigan, and Jim Woodford.

Table 43. Summary of 18 focal loon territories in northern Wisconsin, 1993.

Location	Territory	Location	Territory
Oneida/Vilas Counties	Alva	Turtle-Flambeau Flowage	Horseshoe Bay-south
	Langley/Vicks		Murrays Landing
	Little Bass *		Narrows
	Little Bearskin		North Bonies
	Lumen		Springstead
	McDonald		Teal Bay *
	Moon *		
	Muskie		
	Shallow		
	Soo		
	Sunset		
	Washburn		

In 1993, part of the blood sampling protocol included the preservation of red blood cells in solutions (Phosphate-buffered saline or PBS and Longmeyer) that would provide needed material for extracting nuclear DNA. Samples were gathered on each of the loons that had blood drawn. This year's emphasis was to investigate the parentage of chicks through DNA fingerprinting. Samples were taken from both adults and at least one chick from 12 loon families in 1993: (1) Wisconsin territories include Big Martha, Windowpane, Cunard, Indian, Kathan, Nineweb, Jag, Mosquito, Bills, and Razorback lakes, (2) the Michigan territory includes South Manistique - Wolf Bay, and (3) the Minnesota territory includes Wabana-Buhella Bay. Analysis of the DNA samples are currently being made at the National Zoological Park, Smithsonian Institution, Washington, D.C. by Dr. Walter Piper using procedures developed by Rabenold et al. (1990). Preliminary results from 1991 samples (from Isle Royale) and initial finding of 1993 samples indicate that the adults found with the chicks at the time of banding are their putative parents.

In 1994, the effect of non-breeding adult intruders (floaters) on the stability of pair bonds and the reproductive success of marked territorial pairs of loons will be examined. The two major goals will be to estimate the population of non-breeding adults through systematic censusing and behavioral observations within the focal study area (near Eagle River, Wisconsin) and to examine the impact that the intrusions of floaters might have on the stability of pairs and reproductive success.

Summary of Population Ecology Efforts

The main purpose for this program is to investigate the population ecology of the Common Loon using a landscape ecology approach; the adult minimum survival rate or annual return rate is a key component. This year marked the second year with a significant sample of potential returnees. This year's results show an overall 75% (246 of 328) return rate for marked adults (Table 44). The 1993 Michigan return rate (77%) was slightly lower than the 1992 rate of 80%, while the Wisconsin rate was 4% lower than 1992. The Seney NWR (95%) return rates continue to be higher than the average and is closely followed by Isle Royale rates. Both sites have minimal human disturbance. Less protected sites with associated higher human intrusion potential (e.g., Turtle-Flambeau Flowage) have lower return rates. Minnesota rates are comparatively low and probably reflect less intensive observational efforts.

Table 44. Adult minimum survival rate (annual return rate) for banded Common Loons, 1989-93.

Study Site	Year						TOTAL # of returns
	1988	1989	1990	1991	1992	1993	
MICHIGAN (total)		**1/1**	**5/5 (100)**	**8/11 (73%)**	**43/54 (80%)**	**65/84 (77%)**	**122/155 (79%)**
Ottawa National Forest				16	12/16 (75%)	27/34 (79%)	39/50 (78%)
Hiawatha National Forest			3	2/3 (67%)	6/9 (66%)	6/11 (55%)	14/23 (61%)
Seney National Wildlife Refuge	1	1/1 (100%)	5/5 (100%)	6/8 (75%)	10/10 (100%)	14/14 (100%)	36/38 (95%)
Isle Royale National Park				9	9/9 (100%)	8/10 (80%)	17/19 (89%)
Lake Superior State Forest				4	2/4 (50%)	5/8 (63%)	7/12 (58%)
Antrim County, Northern L.P.				6	4/6 (67%)	5/7 (71%)	9/13 (69%)
MINNESOTA (total)					**28**	**17/28 (61%)**	**17/28 (61%)**
Voyageurs National Park					18	11/18 (61%)	11/18 (61%)
Grand Rapids Area, Itasca County					10	6/10 (60%)	6/10 (60%)
WISCONSIN (total)				**35**	**28/35 (80%)**	**61/84 (73%)**	**89/119 (75%)**
Turtle-Flambeau Flowage				7	5/7 (71%)	13/19 (68%)	18/26 (69%)
Northern Wisconsin				28	23/28 (82%)	48/65 (74%)	71/93 (76%)
Total/year		**1/1** (100%)	**5/5** (100%)	**8/11** (73%)	**71/89** (80%)	**143/196** (73%)	**228/302** (75%)

Even though there are 53 adults that did not return the year after being banded, their disappearance can not be construed as mortality. In nearly all cases, the non-returning mate or pair (e.g., Wabana-upper territory) are replaced by another adult. The new pair bond does not necessarily require an entire season to form; in 1992 10 of the 14 territories (71%) that included a new adult produced chicks. Therefore, an excess in the loon's breeding population appears to be currently filling in any gaps that are created by mortality or non-returns. There are 3 cases of individuals returning after missing for one year: C-3 Pool female in Seney NWR, Clark Lake-north first banded female in Ottawa NF, and the Frenchman Lake first banded male in Hiawatha NF. Other study sites rarely have the intensity of observations that charactrize Seney NWR. Although nesting loons apparently are highly site faithful to their breeding territory, there are 4 cases proving that this fidelity does not necessarily happen each year and throughout the breeding season. Therefore, territories need to be monitored regularly throughout the nesting season (the months of May and June) to confirm the absence of a color-marked adult.

The quick replacement process may be due to a high degree of inter- and intra-year mate switching; a possible reproductive strategy that occurs whether or not a mate returns. This rapid mate switching does frequently occur in birds (Pinkowski 1977, Nolan 1978, Harris 1979, Wunderle 1984) and is only now being proven for the Common Loon. The trigger for mate switching in loons appears to be a nest failure. There are 11 known cases of mate switching since 1991. They have occurred in three widely-scattered populations and in three different types of loon territories: on large lakes with many nesting pairs (partial), with pairs that use several lakes for foraging during the breeding season (multi), and on lakes supporting one nesting pair (whole). The following describes the occurrences of within- and between-year mate-switching. A conservative estimate of the incidence of rapid (within-season) mate-switching is 20%.

Seney National Wildlife Refuge, Michigan

1. D-Pool: Type of territory: whole Type of Pairing Bond: 1 female and 2 males
Situation: The 1989 marked female (F1) returned in 1990, she produced 2 young on her third nesting attempt, this male (M1) was banded. In 1991, F1 returned to her territory, M1 was never seen on D-Pool but did return and was found on adjacent Upper Goose Pen Pool and was last seen in late May. An unmarked male paired with F1 for the entire breeding season. No nesting attempts were observed. In 1992, M1 returned to D-Pool and nested with F1, their nest failed on 25 May and M1 was last observed on 1 June. In the morning of 3 June, an unmarked male was observed with the female. This male paired with the color-marked female; the pair began constructing a nest on 5 June and were incubating on 12 June (this nest also failed). After 1 June, the color-marked male was not reobserved , while the unmarked male remained on territory with the female through late July. The F1 and M1 paired, nested, and produced 2 chicks on their second nesting attempt in 1993.

2. C3-Pool: Type of territory: multi Type of Pairing Bond: 2 females and 1 male
Situation: The 1989 marked female (F1) returned in 1990 and produced 2 chicks. In 1991, F1 did not return to this territory or to the refuge. An unmarked male returned and paired with an unmarked female, 2 young were produced and the female (F2) and male (M1) were banded. In 1992, F1 and F2 returned to the C3 Pool territory as did M1. The male was seen paired with each female and a third unmarked female on different dates from 18 to 25 May (but never with more than one female at the same time). By 26 May, the first color-marked female was paired with an unmarked male on the traditional C-3 territory. The second color-marked female and color-marked male were observed as a pair on neighboring Marsh Creek Pool. The three color-marked loons from C-3 Pool were also seen frequently interacting with other unmarked loons and visiting the neighboring pools (C-2 and Marsh Creek). In 1993, the F2 remained on C-3 Pool and paired with a new male (banded in 1993) and produced 2 chicks. F1 returned but changed territories and paired with a new male on C-2 Pool and the returning M1 also switched territories to T-2 East but remained unpaired.

3. G Pool: Type of territory: whole Type of Pairing Bond: 2 females and 1 male
Situation: In 1988, the male was banded and has returned every year since (5 years). The F1 mate was banded in 1990 but was found dead that winter. F2 was banded in 1992 on E Pool-west territory (G Pool M1 and F2 were forced to this pool after a spring drawdown on G Pool). In 1993, M1 was observed on the pool within 1-2 days after ice-off. F2 returned 2 days later but was displaced by an unmarked female after 3 weeks of aggressive displacement displays between the trio. F3 was banded in 1993 and produced 2 chicks. F2 left M1 and paired with one of the chicks banded in 1987 or 1988 and remained on her 1992 territory (E Pool-west).

Northern Wisconsin

4. **Moon Lake:** Type of territory: whole Type of Pairing Bond: 1 female and 2 males
Situation: M1 and F1 both returned in 1993 (both banded in 1992), attempted to nest but failed twice. M1 deserted the territory in early July. The banded female remained and was repeatedly seen with an unbanded male.
5. **Jag Lake:** Type of territory: whole Type of Pairing Bond: 1 female and 2 males
Situation: The male (M1) and female (F1) were banded in 1991. In 1992, both returned and attempted nesting but failed. A subsequent check found a pair nesting; the male (M2) was unmarked and would have had to replace the first male by at least 1 June. Later, the capture team caught the 2 adults with the 2 chicks, F1 was present and M2 was banded. The return of the Jag Lake male banded in 1993 is suspect since it was recorded dead in Alabama on 22 April. Either a band was read wrong on Jag Lake (which would mean a territory switch for a nearby male) or the band number reported from the wintering grounds was incorrect. M2 returned in 1993 and paired with an unbanded female. The female and chick was banded in 1993.
6. **Little Bass Lake:** Type of territory: whole Type of Pairing Bond: 1 female and 2 males
Situation: The Little Bass M1 (banded in 1991) and F1 (banded in 1992) both returned in 1993. After the first nest failure on 28 May, M1 was replaced by an unmarked male. This male copulated with F1. An unmarked male remained with the F1 for the remainder of the summer. No further nesting was attempted.

Turtle-Flambeau Flowage, Wisconsin

7. **North Bonies:** Type of territory: partial Type of Pairing Bond: 1 female and 2 males
Situation: The male (M1) and female (F1) were banded on 4 July 1992, 2 chicks were produced by this pair. Subsequent daily observations were made and behaviors quantified. In late July, I visited the family and found F1 but the male was unmarked and was helping feed and protect the 2 chicks. That night, the chicks were captured but the adults could not be approached. Immediately adjacent to this territory a lone male (M2) was easily captured and banded. Although this male was not observed with the chicks its nocturnal behavior strongly suggested it was involved with chick rearing. Later observations showed M1 and M2 to be sharing chick rearing duties (but never at the same time). M1 and F1 returned and attempted to nest. M2 was not observed in 1993.
8. **Teal Bay:** Type of territory: partial Type of Pairing Bond: 1 female and 2 males
Situation: The 1991 banded male returned in 1993 and paired with an unmarked female. M1 disappeared between late May and early June after a nest failure. The female repaired with an unmarked male.

9. **Isle Royale National Park, Michigan, McCargo Cove:**
Type of territory: partial Type of Pairing Bond: 1 female and 2 males
Situation: The male (M1) and female (F1) were banded in 1991. In 1992, both returned and attempted nesting but failed between 5 and 25 June. This color-marked male was replaced by an unmarked male that was observed copulating with the color-marked female on 25 June. This pair subsequently nested, laid two eggs, but failed. In 1993, F1 returned, paired with an unmarked male. M1 was not observed in 1993.

10. **Hiawatha National Forest, Michigan, Frenchman Lake:**
Type of territory: whole Type of Pairing Bond: 1 female and 2 males
Situation: The male (M1) and female (F1) were banded in June of 1991, but the chick was too young. We returned on 8 August 1991 to catch the chick but not the parents. When finding the family the chick was captured and the attending adult was found to be unmarked. We captured this male (M2) and banded it. Subsequent checks that summer (2) found M1 and F1 with the banded chick but not M2. In 1992, M2 and F1 returned, nested, and produced 1 young. M1 was not seen in 1992.

11. **Ottawa National Forest, Michigan, Little Duck Lake:**
Type of territory: whole Type of Pairing Bond: 1 female and 2 males
Situation: The male (M1) and female (F1) were banded in 1991; they produced 1 chick. In 1992, F1 returned but the status of the male (marked or unmarked) could not be determined during the first observation visit in early June. In mid July, frequent visits including a full day of observations showed F1, M1, and an unmarked male on the lake. The unmarked male was obviously pair bonded with the female and was observed actively pursuing M1 for several hours; whenever the unmarked male reached M1, there would be intensive surface fighting (bill jabbing, hitting with upper breast, and wing thrashing), underwater chases, or the escape of M1 always being pursued by the unmarked male. M1 was never seen close to F1, the unmarked male always thwarted the advances of M1. During this time, the female spent most of her time feeding, being followed and closely watched by the unmarked male.

A total of fourteen recoveries have been made outside of the banded loon's territory, 12 of these have been outside of the Michigan-Wisconsin-Minnesota-Ontario study sites (Table 45 and Figure 7). This very high return rate is attributed to the size and conspicuousness of the loon, wide recognition by the general public, regular and frequent patterns of mortality (particularly in winter), and public solicitation of recoveries. The 14 recoveries of birds banded prior to the 1993 banding season represents 3.41% of the 410 banded loons that could be reobserved (3.35% in 1992). An additional 4 adult loons (all males) have been recovered near their breeding territory, three are known to have died. Of the 18 loons recovered after their initial banding, 10 were banded as adults (8 males, 2 females) and 8 as juveniles.

Table 45. Recoveries of Common Loons banded between 1987-1993.

Location banded/ band number	Date Banded	Age/Sex	Location recovered (lat-long)	Recovery date	Status
Loons Recovered in 1991					
Seney NWR - G Pool (618-111-14)	7-10-90	adult / female	St. Augustine, FL (294-0811)	1-6-91	dead
N. Wisconsin - George (758-781-15)	7-22-91	juvenile	Marco Island, FL (255-0814)	11-29-91	dead
L. Superior SF -Kennedy (758-781-74)	8-11-91	adult / male	Cleveland, OH (413-0813)	12-9-91	dead*
Loons Recovered in 1992					
Tu-Fl. Flow. -Fisherman (618-111-64)	7-14-91	adult / female	Sand Key Island, FL (275-0825)	1-7-92	dead
Ottawa NF - Redboat (758-781-08)	7-21-91	juvenile	Melbourne Beach, FL (280-0803)	1-10-92	dead
N. Wisconsin - Jag (618-111-77)	7-7-91	adult / male	Gulf Shores, AL (301-0874)	4-22-92	dead
N. Wisconsin -Washburn (618-111-47)	7-9-91	juvenile	North Beach, NJ (393-0740)	7-19-92	alive
Ottawa NF - Thousand Is. (758-781-43)	8-15-92	juvenile	Cape Hatteras, NC	8-15-92	alive
Ottawa NF - Clearwater (758-781-83)	7-3-92	adult / male	Menominee, MI (450-0873)	10-16-92	dead
Antrim Co. - Intermediate	6-28-91	adult / male	Long L., Grand Traverse Co., MI	12-31-92	alive
Loons Recovered in 1993					
Isle Royale NP - Five Finger Bay (758-781-60)	8-3-91	juvenile	Surf City, NC (342-0773)	3-15-93	dead
Ontario - Sharbot Is. (838-147-84)	7-28-92	juvenile	Callahan, FL (303-0814)	3-21-93	dead
Hiawatha NF - East L.-ne (838-150-91)	8-13-92	juvenile	Oak Hill, FL (285-0805)	6-12-93	dead
Ontario - Sydennam-Eel (838-147-92)	7-31-92	juvenile	Corolla, NC (362-0754)	7-15-93	alive
Hiawatha NF-East L.-nw (838-148-55)	7-14-93	adult / male	East L., Mackinac Co., MI	8-1-93	dead*
Ottawa NF - Clearwater (838-145-84)	7-28-93	adult / male	Thousand Is., Gogebic Co., MI	8-14-93	dead*
Ottawa NF - Snapjack (838-150-03)	7-12-92	adult / male	Snapjack L., Gogebic Co., MI	8-18-93	dead*
Ottawa NF - Long (618-111-94)	7-19-91	adult / male	Little Bay de Noc, Delta Co., MI	10-30-93	dead*

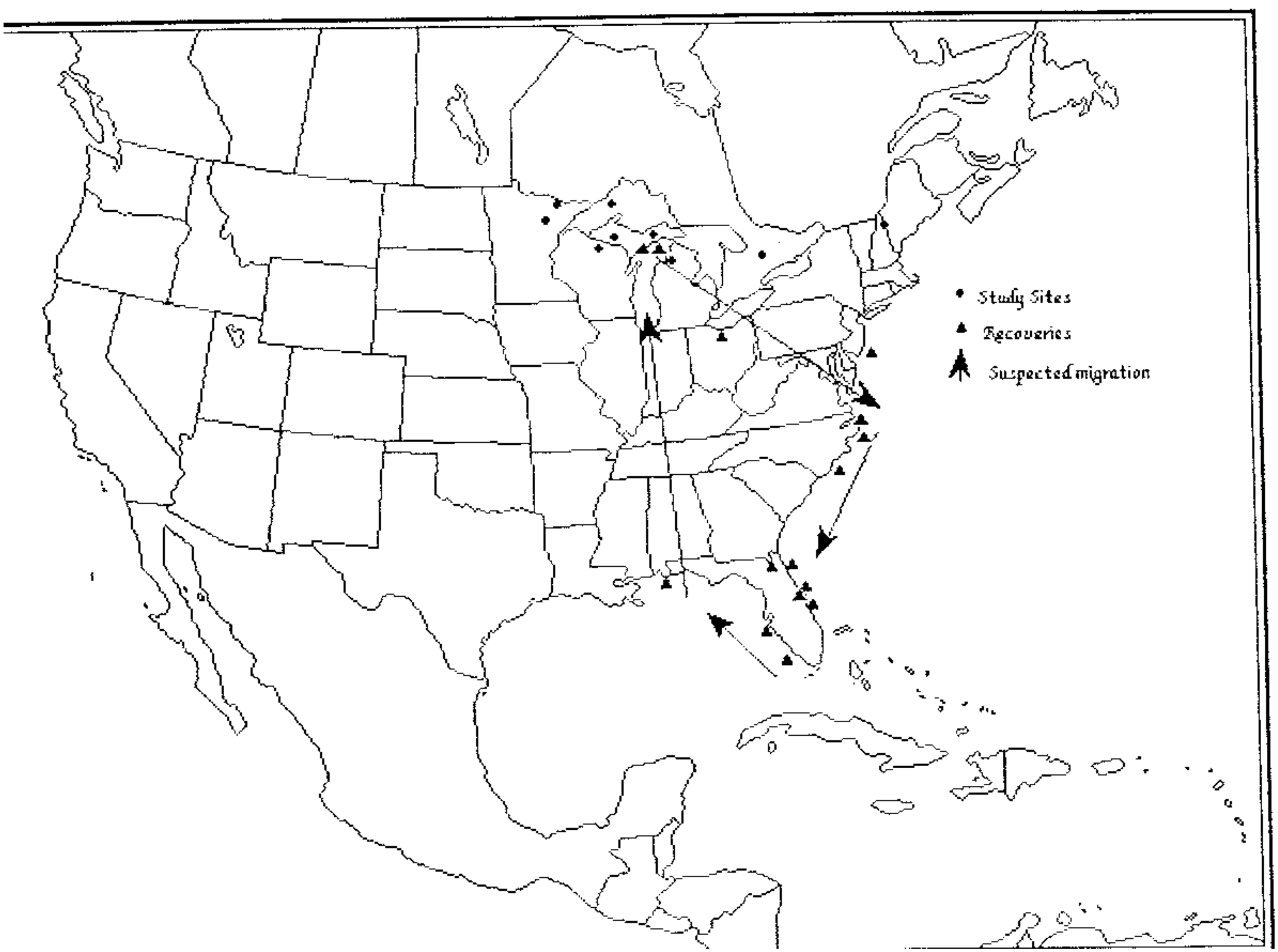
* carcass recovered and analyzed at Michigan State University (necropsies done at MSU and the Minnesota Zoo)

Only 5 chicks are known to have died after their banding and before fledging from their natal lake (Table 46). Most territories that are targeted for banding are rechecked especially in Wisconsin, Isle Royale NP, and Seney NWR. The capture and banding effects on chicks before fledging are negligible.

Table 46. Summary of banded Common Loon chicks known to have died before fledging.

Location banded	Band number	Date banded	Recovery date	Comments
N. Wisconsin-Lumen	618-111-52	7-10-91	unknown	1 of 2 chicks died, chose smallest
Ottawa NF - Langford	758-781-17	7-22-91	8-14-91	Large abdominal laceration present when captured, found on shore
N. Wisconsin-Indian	758-781-39	7-28-91	unknown	none
N. Wisconsin - Muskie	838-150-05	7-16-92	7-23-92	Large abdominal trama, probably from a large fish
Ontario - Barrette	838-147-73	7-22-92	12-8-92	none

Figure 7. Distribution of breeding season study sites and known recovery locations and suspected migration patterns for the Common Loon.



Life Cycle of the Great Lakes Common Loon

(interpreted from 5 years of data collection)

One or two loon chicks hatch from 140-160 gram eggs following a 26-28 day incubation from both parents (48% of the male's time, 58% of the female's time). An adult loon pair's first nesting attempt produces chicks between mid and late June. After the adults' first nesting attempt, at least 20% of the males desert the breeding territory and are replaced by another male that will form a pair bond and may nest with the original female. Some cases of rapid mate switching involves 2 females and one male. Nearly 50% of the pairs renest (usually within 2 weeks after a nest failure), and some individual birds may attempt to nest 3 times (although mate switching probably occurs in these cases). Generally, an established pair produces fledged chicks every third year. The chicks grow through two downy plumages, the first plumage of black down is pushed out between 10-14 days of age. The brown downy plumage is replaced by juvenile contour feathers beginning around 4 weeks. The juvenile body plumage molt is nearly complete by 6 weeks and the flight feathers are nearly complete in 10-11 weeks. Family units typically remain intact through mid-September or until the juveniles can fly. Breeding pairs that are unsuccessful begin to wander from their territories beginning in mid July. Sometimes one of the pair will remain through September while the other mate leaves 1-2 months earlier.

Most adult loons move to the Great Lakes and congregate in flocks until early November, although some remain through the winter (most of these are probably injured). Loons continue to move around on the Great Lakes sometimes forming movement patterns that peak in September. The general pattern is an east to west one. Young-of-the-year begin to arrive on the Great Lakes in early September, most leave their natal lakes by mid October and are observed moving with adult loons along the Great Lakes shorelines. Adult loons begin to molt by mid September (beginning on the chin and throat) and most are in complete basic plumage by mid October: all are by the beginning of November. Most of the Great Lakes population migrates east to Chesapeake Bay, arriving in late October and early November. Paul Spitzer has linked the loon's arrival and stopover times with the availability of menhaden (*Brevoortia tyrannus*). Specifially, loons move from Lake Superior and northern Lake Michigan to Lake Huron and leave Georgian Bay, crossing to Lake Ontario. Another overland route is taken from Lake Ontario through the finger lakes of New York south toward the Chesapeake Bay. Preliminary counts by Bill Evans, stationed on the south end of Lake Cayuga, have shown thousands of loons (around 5,000 in 1992 and 8,000 in 1993) moving 1-3 hours after sunrise through the area from late October through early November. Peak numbers of over 1,000 in a day occur ahead of northerly cold fronts (usually the first few days of November). Another probable fall migration route for western Great Lakes loons is across the Missippii River watershed to the Gulf of Mexico.

By late November loons are moving south and dispersing along the southern Atlantic shoreline. Some individuals continue, dispersing to the Gulf of Mexico shoreline of Florida. In late January, the adult loons begin a complete molt including a simultaneous remigial molt; it lasts through early March. Adults maintain territories during their flightless period while subadults (1/2 to 2 1/2 year olds) are not as territorial: subadults do not start the complete molt until June. Adult loons move from the shores of Alabama and Florida in mid March arriving in the southern Great Lakes Region at ice off in mid to late March.

The northerly progression continues as lake ice thaws. Adults arrive on territory in mid to late April; loons arrive as soon as the ice clears. Males arrive first or simultaneously with females. Peak migration at Whitefish Point is the first week of May; this follows the establishment of loon pairs on Michigan territories. The annual return rate for adult loons is 75%. This is a minimal survival rate since some adults return after disappearing for one year (3 cases). Nearly all loons (98%) return to their same territory (there are only 4 known cases of territory switching, n=197 territories with banded loons). Upon arrival, 2-3 weeks are spent foraging and establishing territorial and pair bonds.

Most subadults remain on coastal waters for three winters. During their mid-summer molt (June through August) they are found from New Jersey south to North Carolina and Florida (some climb to shore to dry their new, not yet fully oiled feathers). Some subadult loons return to the Great Lakes (1%) and remain through the summer. In the second summer, their molt occurs earlier than the year before, and by their third summer they molt into the alternate plumage by mid May and migrate north to their natal lakes in early to mid June. Upon arrival, the subadults may pair with an established bird or remain in an unoccupied territory until late June or early July and then disperse to Lake Michigan or Superior. Each year the subadult returns it remains on its breeding territory longer, and spends less time on the Great Lakes (where 400-500 loons are killed each year by commercial fishery nets). At 5-7 years it is reproductively ready to defend a territory, pair bond, and attempt to nest.

SUMMARY OF ENVIRONMENTAL CONTAMINANTS EFFORTS

by Dr. Michael W. Meyer and Sara M. Thompson

A mass balance study of mercury (Hg) in aquatic systems indicated that a significant portion of Hg found in fish is of atmospheric and anthropogenic origin (Rada et al. 1989). An analysis of lake sediment cores in Minneosta and Wisconsin indicates that the current rate of mercury deposition into regional lakes is 3-4x greater than it was in 1850 (Swain et al. 1992); important sources of atmospheric Hg are fossil fuel combustion, municipal water incineration, and industrial processes. It has also been determined that aquatic biota from low pH, low alkalinity lakes receiving increased mercury depostion are more likely to bioaccumulate Hg than biota from neutral/alkaline pH lakes. This is reflected in the strong inverse relationship between the pH and alkalinity of lakes in northern Wisconsin and the mercury content of piscivorous fish (Cope et al. 1990; Lathrop et al. 1989). Because of the highly toxic effects of methyl Hg, concern has been expressed that piscivorous wildlife inhabiting low pH lakes may be exposed to toxic levels of methyl Hg in their prey (Wiener 1987, Scheuhammer 1991).

The low pH, low alkalinity lakes of the northern U.S. and Ontario are important nesting habitat of the Common Loon. During nesting and brood rearing (April-September) loons consume nearly all of their prey (mostly fish) from these waters. Therefore, loons inhabiting these lakes are at risk to merucry bioaccumulation and there is evidence that this may lead to reduced reporductive potential. Impaired Common Loon productivity was related to the consumption of mercury-contaminated preyo n the Wabigoon/English River system in Ontario, Canada (Barr 1986). It is known that loons nesting in Wisconsin are exposed to prey with levels of mercury which Barr (1986) determined was associated with impaired reproduction (WDNR, unpubl. data). To investigate whether mercury exposure poses a health risk to loons nesting in the northcentral U.S., the Wisconsin Department of Natural Resources has undertaken an intensive investigation in northern Wisconsin to 1) investigate the relationship between lake water chemistry and loon mercury exposure, and 2) to determine whether loons with greatest mercury exposure exhibit toxic effects (i.e., reduced survival or breeding success). Additional adult and juvenile loons have been captured in Minnesota, Ontario, and Michigan. Tissue (blood and feather) mercury concentrations from these loons are being determined to assess whether there are differences in regional exposure levels. This information will then be used to develop a risk assessment model to estimate the impact of mercury exposure on Common Loon productivity and survival in the northcentral United States.

METHODS

Sample collection

Adult Common Loons and chicks were captured using the nightlighting technique (Evers 1992). Adult and chick secondary feathers and blood were sampled for Hg analysis. Blood was obtained using 22 guage needles and 3-10 cc syringes; 3-10 cc was drawn from the brachial vein of the adults, 1-3 cc from the brachial vein of the chicks (> 3 1/2 weeks old). In the 1991 pilot study, blood was placed in orange top vaccutainers, allowed to clot, then centrifuged at 4500 rpm for 10 minutes. The serum was separated from the clotted material (red blood cells and fibrin) and both portions were frozen. Whole blood (1 cc) was placed in purple top vaccutainers and refrigerated for lead analysis. In 1992 and 1993, loon blood was collected with 22 and 25 guage needles 3-10 cc plastic syringes. Blood was immediately placed in green top (heparinized) vaccutainers, preserved with formalin (1 cc formalin : 20 cc whole blood), and was refrigerated until analyzed.

Sample analysis

Feather and blood samples collected in 1991 were analyzed at the Animal Health Diagnostics Laboratory (AHDL) at Michigan State University. Feathers, serum, and clot material (blood cells and fibrin) were analyzed for trace metal and mineral content using inductively coupled argon plasma (ICP) emission spectroscopy (Jarrell Ash Polyscan 60 ICP and Jarrell Ash Model 955). Whole blood was analyzed for lead content by anodic stripping voltometry using a ESA, Inc. Model 3010A Blood Lead Analyzer. The 1992 whole blood samples collected in Wisconsin were analyzed for mercury content using cold vapor atomic absorption spectrophotometry at Hazelton Analytical Laboratories, Madison, Wisconsin, under contract with the U.S. Fish and Wildlife Service. The 1992 whole blood samples collected in other regions and all juvenile feathers were analyzed for total mercury content using cold vapor atomic absorption spectrophotometry at the AHDL. Adult feathers collected in 1992 were analyzed with ICP emission spectrophotometry at the AHDL; cold vapor AA and ICP analysis produced nearly identical results when tissues exceed 1g and are >1 ppm total Hg; cold vapor AA analysis is required for small sample sizes or when mercury concentration are <1 ppm in the tissue.

RESULTS

Loon tissue mercury concentrations - 1992

The mercury concentrations of whole blood collected from 105 adult loons (62 males, 43 females), and 43 loon chicks in Minnesota, Wisconsin, and Michigan are presented in tables 51-55. The mean mercury content of adult male whole blood (range 0.33 - 4.08 ppm total mercury) was slightly greater than that of adult females (range 0.06 - 2.85 ppm total mercury) in most regions (Table 49); both were 5-10x greater than chick whole blood mercury content (range 0.05-1.88) in all regions. A more rigorous test of differential male and female exposure will be performed by comparing tissue concentrations of males and females from the same lake; it has been found that mercury exposure is linear related to the water chemistry of the lakes loons are captured (see below).

The mercury concentrations of secondary feathers collected from 107 adults loons (63 males, 44 females) and 20 loon chicks in Minnesota, Wisconsin, and Michigan are presented in table 50. The mean mercury content of adult male feathers (range 4.82-24.8 ppm total mercury) was slightly greater than adult females (range 5.09 - 21.0 ppm total mercury) in most regions; both were 5-10x greater than chick feather mercury (range 0.86 - 13.0) in all regions. Feather mercury concentrations of adults and chicks were 5-10x greater than blood mercury concentration in all regions, illustrating the importance of feather mercury deposition in reducing the concentration of biologically available mercury in loons.

The blood heatocrit content was measured in adult and loon chicks in 1993 (Tables 57-59). While male and female hematocrit levels were similar, that of loon chicks was less.

Regional comparisons

The mean mercury concentration of loon feather and whole blood collected in various geographical regions is presented in tables 48-50. A rigorous statistical analysis of differences in mercury exposure between locations awaits a pooling of data collected from 1991-1994. A preliminary assessment of the 1992 data indicates that the range of adult and chick whole blood and feather mercury concentrations was similar between regions. As stated, adult male mercury exposure appears greater than adult female mercury exposure, as evidenced consistently greater mean blood and feather mercury concentrations, and this trend was consistent in most regions.

Loon mercury exposure vs lake pH

In 1991, the WDNR Bureau of Research, Sigurd Olson Environmental Institute, and Whitefish Point Bird Observatory undertook a pilot study to investigate whether fish mercury contamination poses a health risk to loons nesting in Wisconsin. Blood and feather samples were collected from 35 adults and 30 chicks captured on 22 lakes in northern Wisconsin in 1991. The pH and alkalinity of the study lakes ranged from 5.0 to 8.7 and -9.4 to 889.4 ueq/L respectively and were highly correlated. There was a highly significant negative linear relationship between adult loon serum Hg and lake pH (r^2 =0.38, P<0.001); the relationship was greater amongst adult males (r^2 =0.56) than amongst adult females (r^2 =0.36). There was also a significant positive linear relationship between adult serum and feather calcium concentrations and lake pH (serum Ca, r^2=0.30, F=10.52, P<0.01; feather Ca, r^2=0.35, F=13.66, P<0.001). The linear relationship between lake pH and feather Hg, serum Pb, serum and feather Se, and feather aluminum, were not significant (P>0.05). Unlike blood mercury, feather mercury is unrelated to breeding lake water chemistry; this is not surprising as adult loons molt and regrow flight feathers while on the wintering grounds (Atlantic and Gulf of Mexico).

A total of 99 Common Loons were captured in Wisconsin in 1992; whole blood samples from 41 adult loons and 24 chicks were collected on 31 study lakes (pH 4.9 - 8.5). Again, the linear relationship between lake pH and adult male whole blood mercury exposure was significant, r^2=0.42; the relationship was weaker for adult females, r^2=0.11. Most significant was the finding that chick whole blood mercury was even more closely related to lake pH, r^2=0.64, likely due to the fact that chicks receive all their prey from the nest lake while some adults forage on additional lakes as well. The relationship between adult feather mercury concentrations and lake pH was again not significant.

To directly assess the impact of mercury exposure on loons, the productivity of adults with the greatest mercury will be compared to that of adult loons with the least mercury exposure. The adult annual return rates are also being measured, and the return rates of loons with greatest mercury exposure will be compared to those with the least mercury exposure. Similarly, fledging rates of chicks with the greatest mercury exposure will be compared to that of chicks with the least exposure. These measurements will be made through 1996.

(end of written text by Dr. Michael Meyer and Sara Thompson)

Table 49. Mean blood mercury (Hg) concentrations in adult and juvenile Common Loons 1992.

LOCATION	ADULT MALES Mean Blood Hg (ppm)				ADULT FEMALES Mean Blood Hg (ppm)				JUVENILES Mean Blood Hg (ppm)			
	n	range	mean	st.dev.	n	range	mean	st.dev.	n	range	mean	st.dev.
Hiawatha NF	2	0.75-0.90	0.83	0.111	1	0.60	0.60	--	1	0.11	0.11	--
Atrim Co.	1	1.77	1.77	--	1	0.91	0.91	--	0	--	--	--
Seney NWR	3	0.91-1.44	1.18	0.291	3	0.67-1.01	0.87	0.172	2	0.06-0.16	0.11	0.073
L. Superior SF	1	1.15	1.15	--	2	0.50-0.54	0.52	0.03	0	--	--	--
Ottawa NF	15	0.56-2.21	1.63	0.5	9	0.83-2.85	1.64	0.655	5	0.12-.20	0.16	0.033
I. Royale NP	2	0.89-1.19	1.04	0.209	0	--	--	--	1	0.07	0.07	--
G. Rapids	5	0.80-1.55	1.33	0.272	5	0.57-1.44	0.83	0.354	5	0.07-0.12	0.08	0.023
Voyageurs NP	10	0.83-2.95	1.97	0.635	6	0.06-2.19	1.11	0.69	11	0.09-0.21	0.14	0.042
Superior NF	1	2.26	2.26	--	0	--	--	--	0	--	--	--
Wisconsin*	22	0.381-4.08	1.46	0.875	16	0.335-2.46	1.06	0.507	18	0.046-1.88	0.20	0.122

*Wisconsin blood samples were analyzed at Hazelton Laboratories (USFWS contract). Split blood samples will be analyzed in 1993 at both labs.

Table 50. Mean feather mercury (Hg) concentrations in adult and juvenile Common Loons 1992.

LOCATION	ADULT MALES Mean Feather Hg (ppm)				ADULT FEMALES Mean Feather Hg (ppm)				JUVENILES Mean Feather Hg (ppm)			
	n	range	mean	st.dev.	n	range	mean	st.dev.	n	range	mean	st.dev.
Hiawatha NF	1	6.52	6.52	--	1	10.6	10.60	--	1	2.15	2.15	--
Atrim Co.	0	--	--	--	0	--	--	--	0	--	--	--
Seney NWR	2	11.4-13.8	12.60	1.697	3	6.65-12.6	8.72	3.365	2	0.86-2.35	1.60	1.056
L. Superior SF	0	--	--	--	1	6.52	6.52	--	0	--	--	--
Ottawa NF	15	4.82-36.7	12.45	7.927	8	5.09-12.0	9.44	2.221	0	--	--	--
I. Royale NP	2	8.02-11.0	9.51	2.107	0	--	--	--	1	1.60	1.60	--
G. Rapids	3	11.5-16.5	14.78	2.532	5	5.48-19.0	9.75	5.764	2	1.47-1.78	1.62	0.944
Voyageurs NP	10	7.08-17.1	12.65	2.921	6	6.05-21.1	11.62	6.399	5	2.19-4.26	2.98	1.653
Superior NF	1	15.4	15.4	--	0	--	--	--	0	--	--	--
Wisconsin	22	5.26-22.24	11.73	4.124	16	5.8-17.5	9.95	3.76	3	0.45-12.3	7.46	3.67

Table 51. Blood and feather analysis results of Michigan loons from Hiawatha National Forest, Atrim County, Seney National Wildlife Refuge, and Lake Superior State Forest, (1992).
Samples analyzed for : mercury (Hg), lead (Pb), cadmium (Cd), aluminum (Al), calcium (Ca).

GENERAL LOCATION	LAKE NAME	USFWS BAND NUMBER	AGE	SEX	WHOLE BLOOD (values in ppm)	FEATHER (values in ppm)				
					Hg	Hg	Pb	Cd	Al	Ca
Hiawatha NF	Frenchman	618-111-44	A	F	0.595	SNC				
Hiawatha NF	Frenchman	758-781-67	A	M	0.747	SNC				
Hiawatha NF	East Lake-northwest	758-781-04	A	M	0.904	6.52	<1.02	<0.204	3.77	691
Hiawatha NF	Little Round	758-781-61	A	F	SB	10.8	<1.72	<0.344	3.63	270
Hiawatha NF	East Lake-northeast	838-150-91	J	U	0.109	2.15	<0.181	<0.362	<3.62	488
Atrim	Elk	758-781-75	A	M	1.77	SNC				
Atrim	Elk	758-781-76	A	F	0.911	SNC				
Seney NWR	E-Pool-east	618-111-15	A	F	0.676	6.65	<0.108	<0.216	2.55	448
Seney NWR	E-Pool-east	838-147-66	A	M	1.44	13.8	<0.880	<0.178	1.81	393
Seney NWR	B-Pool-north	838-147-61	A	M	1.39	11.4	<1.09	<0.217	<2.17	334
Seney NWR	B-Pool-north	838-147-68	A	F	1.01	6.90	<0.858	<0.172	5.02	480
Seney NWR	B-Pool-north	838-150-94	J	U	0.162	2.36	<1.31	<0.262	3.34	484
Seney NWR	G/E Pool-west	838-147-67	A	F	0.911	12.6	<1.28	<0.256	3.72	572
Seney NWR	G/E Pool-west	838-150-90	J	U	0.059	0.857	<0.269	<0.538	<5.38	439
Seney NWR	T2-West Pool	758-781-78	A	M	0.913	SNC				
Lake Superior SF	Cedar	838-147-63	A	F	0.538	6.52	<1.32	<0.265	4.76	337
Lake Superior SF	S. Manistique-Wolf	758-781-79	A	M	1.15	SNC				
Lake Superior SF	S. Manistique-Wolf	758-781-80	A	F	0.495	SNC				

(A=Adult, J=Juvenile, M=Male, F=Female, U=Unknown, SNC=Sample Not Collected, SB=Sample tube Broken after collection)

Table 52. Blood and feather analysis results of Michigan loons from Ottawa National Forest and Isle Royale National Park (1992). Samples analyzed for: mercury (Hg), lead (Pb), cadmium (Cd), aluminum (Al) and calcium (Ca).

GENERAL LOCATION	LAKE NAME	USFWS BAND NUMBER	AGE	SEX	WHOLE BLOOD (values in ppm)	FEATHER (values in ppm)				
					Hg	Hg	Pb	Cd	Al	Ca
Ottawa NF	Long	618-111-94	A	M	1.41	8.98	<0.916	<0.183	5.49	431
Ottawa NF	Long	758-781-13	A	F	1.34	9.41	<1.29	<0.258	24.4	336
Ottawa NF	Long	758-781-97	J	U	0.154	SNC				
Ottawa NF	Clark-southwest	618-111-86	A	F	1.47	12.0	<1.29	<0.258	<2.58	333
Ottawa NF	Clark-southwest	618-111-97	A	M	2.01	16.8	<1.17	<0.234	11.2	275
Ottawa NF	Clark-north	618-111-99	A	M	1.89	10.2	<1.03	<0.206	2.48	288
Ottawa NF	County Line	758-781-82	A	M	1.94	10.3	<0.903	<0.181	10.9	221
Ottawa NF	Clearwater	758-781-83	A	M	1.46	8.58	<1.12	<0.224	13.9	293
Ottawa NF	Crooked-north	758-781-84	A	M	0.555	4.82	<0.833	<0.167	6.30	326
Ottawa NF	Crooked-north	758-781-85	A	M	0.737	8.58	<1.14	<0.228	5.36	383
Ottawa NF	Helen	758-781-86	A	M	1.70	10.9	1.07	<0.211	12.2	275
Ottawa NF	Marion	758-781-87	A	M	1.92	16.0	<0.658	<0.132	4.48	313
Ottawa NF	Cisco	758-781-89	A	F	0.83	8.42	<1.29	<0.258	10.3	359
Ottawa NF	Langford/L. Lang.	758-781-90	J	U	0.198	SNC				
Ottawa NF	Langford/L. Lang.	758-781-91	A	F	1.40	11.6	<1.09	<0.219	5.03	336
Ottawa NF	Ormes	758-781-92	A	M	2.21	9.8	<1.15	<0.229	6.57	288
Ottawa NF	Ormes	758-781-93	A	F	2.85	9.71	<1.09	<0.219	6.82	368
Ottawa NF	Little Oxbow	758-780-94	A	M	2.10	SNC				
Ottawa NF	Dinner	758-781-95	J	U	0.121	SNC				
Ottawa NF	Dinner	758-781-96	A	M	1.70	11.5	<1.04	<0.207	2.53	317
Ottawa NF	County Line	758-781-98	A	F	1.57	8.36	<1.05	<0.211	4.48	374
Ottawa NF	County Line	758-781-99	J	U	0.174	SNC				
Ottawa NF	Clark-north	758-782-00	A	F	1.76	SNC				
Ottawa NF	Thousand Island	838-150-01	A	M	1.59	8.68	<0.648	<0.130	1.49	336
Ottawa NF	Thousand Island	838-150-02	A	F	1.01	5.09	<1.04	<0.208	6.37	354
Ottawa NF	Snap Jack	838-150-03	A	M	QNS	36.7	<1.20	<0.240	17.70	310
Ottawa NF	Snap Jack	838-150-04	A	F	2.49	10.9	<1.08	<0.216	3.74	246
Isle Royale NP	Duncan Bay-west	758-781-61	A	M	0.894	11.0	<1.09	<0.218	9.40	452
Isle Royale NP	Lane Cove	838-148-32	J	U	0.072	SNC				
Isle Royale NP	Tobin Harbor-Boy's Is.	838-148-33	A	M	1.19	8.02	<1.04	<0.207	2.39	514
Isle Royale NP	Tobin Harbor-Boy's Is.	838-148-34	J	U	QNS	1.60	<0.919	<0.184	2.97	415

(A=Adult, J=Juvenile, M=Male, F=Female, U=Unknown, QNS=sample Quantity Not Sufficient for analysis, SNC=Sample Not Collected)

Table 53. Blood and feather analysis results of Minnesota loons from Grand Rapids and Superior National Forest (1992). Samples analyzed for: mercury (Hg), lead (Pb), cadmium (Cd), aluminum (Al) and calcium (Ca).

GENERAL LOCATION	LAKE NAME	USFWS BAND NUMBER	AGE	SEX	WHOLE BLOOD (values in ppm)	FEATHER (values in ppm)				
					Hg	Hg	Pb	Cd	Al	Ca
Grand Rapids	Wabana-lower	838-150-42	A	F	0.596	6.09	<1.24	<0.249	3.07	494
Grand Rapids	Wabana-lower	838-150-43	A	M	0.799	SNC				
Grand Rapids	Wabana-lower	838-150-44	J	U	0.083	1.78	<2.02	<0.405	6.04	469
Grand Rapids	Wabana-lower	838-150-45	J	U	0.069	1.47	<2.13	<0.426	<4.26	397
Grand Rapids	Wabana-upper	838-150-46	A	F	0.567	5.48	<1.31	<0.262	<2.62	504
Grand Rapids	Wabana-upper	838-150-47	A	M	1.13	SNC				
Grand Rapids	Wabana-upper	838-150-48	J	U	0.068	SNC				
Grand Rapids	Wabana-central	838-150-49	A	F	0.762	11.8	<1.27	<0.254	13.6	473
Grand Rapids	Wabana-central	838-150-50	A	M	1.19	13.3	<1.05	<0.210	6.93	517
Grand Rapids	Wabana-central	838-150-51	J	U	0.068	SNC				
Grand Rapids	Black Island	838-150-52	A	M	1.55	11.5	<0.092	<0.184	2.25	311
Grand Rapids	Black Island	838-150-53	A	F	1.44	19.0	<0.121	<0.242	6.44	293
Grand Rapids	Black Island	838-150-54	J	U	0.121	SNC				
Grand Rapids	Bass-Sunset Cove	838-150-55	A	M	1.04	16.5	<1.01	<0.202	3.37	584
Grand Rapids	Bass-Sunset Cove	838-150-56	A	F	0.787	6.36	<1.20	<0.241	<2.41	503
Superior NF	Whitewater-south bay	838-150-93	A	M	2.26	15.4	<0.097	<0.194	15.1	514

(A=Adult, J=Juvenile, M=Male, F=Female, U=Unknown, SNC=Sample Not Collected)

Table 54. Blood and feather analysis results of Minnesota loons from Voyageurs National Park (1992). Samples analyzed for: mercury (Hg), lead (Pb), cadmium (Cd), aluminum (Al) and calcium (Ca).

GENERAL LOCATION	LAKE NAME	USFWS BAND NUMBER	AGE	SEX	WHOLE BLOOD (values in ppm)	FEATHER (values in ppm)				
					Hg	Hg	Pb	Cd	Al	Ca
Voyageurs NP	Namakan-Blind Ind.	838-150-57	J	U	0.127	2.71	<1.70	<0.340	<3.40	364
Voyageurs NP	Namakan-Blind Ind.	838-150-58	A	F	1.23	8.61	<1.34	<0.269	2.84	402
Voyageurs NP	Namakan-Williams	838-150-60	A	M	2.95	12.2	<1.08	<0.217	3.28	318
Voyageurs NP	Namakan-Old Dutch	838-150-61	A	M	1.47	9.44	<1.11	<0.223	4.43	371
Voyageurs NP	Namakan-Old Dutch	838-150-85	A	F	2.19	18.3	<1.29	<0.258	2.79	413
Voyageurs NP	Namakan-Old Dutch	838-150-63	J	U	0.184	*2.19	<2.03	<0.407	10.4	438
Voyageurs NP	Namakan-Old Dutch	838-150-62	J	U	0.089	*				
Voyageurs NP	Rainy-Brule Narrows	838-150-64	A	U	1.75	10.4	<0.916	<0.183	2.70	271
Voyageurs NP	Rainy-Brule Narrows	838-150-65	A	M	1.91	17.1	<0.893	<0.179	<1.79	298
Voyageurs NP	Rainy-Sobolesky Bay	838-150-66	A	M	2.46	15.8	<1.07	<0.214	3.00	272
Voyageurs NP	Rainy-Sobolesky-Bay	838-150-67	A	F	0.921	6.05	<0.942	<0.188	10.90	315
Voyageurs NP	Rainy-Sobolesky Bay	838-150-68	J	U	0.091	*2.44	<2.05	<0.410	12.2	493
Voyageurs NP	Rainy-Sobolesky Bay	838-150-69	J	U	0.106	*				
Voyageurs NP	Rainy-Lost Bay-mid	838-150-70	A	M	1.55	14.6	<0.969	<0.194	<1.94	195
Voyageurs NP	Rainy-Lost Bay-mid	838-150-72	A	F	0.063	21.1	<1.09	<0.218	8.32	288
Voyageurs NP	Rainy-Lost Bay-mid	838-150-71	J	U	0.126	SNC				
Voyageurs NP	Rainy-Neil Point	838-150-73	J	U	0.172	3.28	<1.79	<0.358	<3.58	359
Voyageurs NP	Rainy-Neil Point	838-150-74	A	U	2.72	18.1	<1.20	<0.240	3.54	362
Voyageurs NP	Rainy-Tango Bay	838-150-75	A	M	2.38	12.1	<1.08	<0.216	<2.16	375
Voyageurs NP	Rainy-Tango Bay	838-150-76	J	U	0.206	*4.28	<2.44	<0.488	17.1	679
Voyageurs NP	Rainy-Tango Bay	838-150-77	J	U	0.175	*				
Voyageurs NP	Rainy-Dryweed Is.-n	838-150-78	A	U	1.11	7.56	<1.33	<0.265	6.08	367
Voyageurs NP	Rainy-Dryweed Is.-nw	838-150-79	A	M	1.47	11.8	<1.15	<0.230	4.86	362
Voyageurs NP	Rainy-Dryweed Is.-nw	838-150-80	J	U	0.088	SNC				
Voyageurs NP	Rainy-Harrison Bay	838-150-81	A	F	0.938	8.67	<1.23	<0.246	3.75	391
Voyageurs NP	Rainy-Harrison Bay	838-150-82	A	M	SNC	7.08	<1.25	<0.251	<2.51	315
Voyageurs NP	Kabetogoma-Cutover Is	838-150-83	A	M	0.833	13.0	<1.26	<0.252	<2.52	376
Voyageurs NP	Kabetogoma-Ek Bay	838-150-84	A	M	2.38	SNC				
Voyageurs NP	Ek Lake	838-150-86	A	M	2.31	13.4	<1.11	<0.221	9.62	379
Voyageurs NP	Ek Lake	838-150-87	A	F	1.31	6.99	<1.40	<0.281	13.10	322
Voyageurs NP	Ek Lake	838-150-88	J	U	0.122	SNC				

(A=Adult, J=Juvenile, M=Male, F=Female, U=Unknown, SNC=Sample Not Collected)

* Sibling feather samples were pooled to obtain sufficient weight for analysis.

Table 55. Feather analysis results of Wisconsin loons from the Turtle-Flabeau Flowage (1992). Samples analyzed for: mercury (Hg), lead (Pb), cadmium (Cd), aluminum (Al) and calcium (Ca).

GENERAL LOCATION	LAKE NAME	USFWS BAND NUMBER	AGE	SEX	FEATHER (values in ppm)				
					Hg	Pb	Cd	Al	Ca
Turtle-Flambeau	Murray's Landing	838-147-03	A	M	15.8	<1.17	<0.234	<2.34	298
Turtle-Flambeau	Murray's Landing	838-150-32	J	U	10.8	<8.62	<1.72	<17.2	491
Turtle-Flambeau	North Bonie	838-147-06	A	F	13.5	<1.49	<0.298	<2.98	316
Turtle-Flambeau	North Bonie	838-150-33	A	M	22.4	<0.986	<0.197	2.55	369
Turtle-Flambeau	North Bonie	838-150-34	J	U	7.39	<4.72	<0.943	<9.43	502
Turtle-Flambeau	South-Bonie	838-150-35	J	U	2.04	<1.17	<0.233	<2.33	128
Turtle-Flambeau	South Horseshoe	838-147-08	A	M	5.90	<0.503	<0.101	1.24	139
Turtle-Flambeau	South Horseshoe	838-147-09	A	F	12.8	<1.30	<0.260	<2.60	335
Turtle-Flambeau	South Horseshoe	838-150-31	J	U	2.18	<2.56	<0.513	<5.13	211
Turtle-Flambeau	Sturgeon Bay	838-147-11	A	U	8.64	<1.14	<0.228	<2.28	292
Turtle-Flambeau	Springstead Landing	838-147-12	J	U	5.24	<2.62	<0.524	<5.24	223
Turtle-Flambeau	Springstead Landing	838-147-13	A	F	10.5	<1.11	<0.222	<2.22	339
Turtle-Flambeau	Springstead Landing	838-150-30	A	M	19.3	<0.912	<0.182	1.87	274
Turtle-Flambeau	Snoose Alley	838-147-15	A	F	11.0	<1.17	<0.234	4.06	393
Turtle-Flambeau	Narrows	838-147-16	A	M	22.7	<1.21	<0.242	<2.42	327
Turtle-Flambeau	Trude-east	838-147-58	A	U	19.6	<1.12	<0.224	4.70	323

(A=Adult, J=Juvenile, M=Male, F=Female, U=Unknown)

Table 54. Feather analysis results of Wisconsin loons from Northern Wisconsin lakes (1992). Samples analyzed for: mercury (Hg), lead (Pb), cadmium (Cd), aluminum (Al) and calcium (Ca).

GENERAL LOCATION	LAKE NAME	USFWS BAND NUMBER	AGE	SEX	FEATHER (values in ppm)				
					Hg	Pb	Cd	Al	Ca
N. Wisconsin	Washburn	618-111-46	A	M	17.7	<1.25	<0.250	4.25	254
N. Wisconsin	Little Bearskin	618-111-50	A	M	10.8	<1.36	<0.271	<2.71	357
N. Wisconsin	Little Bearskin	838-147-01	A	F	8.06	<1.35	<0.270	<2.70	633
N. Wisconsin	Jag	618-111-78	A	F	12.1	<1.00	<0.200	6.45	223
N. Wisconsin	Jag	838-150-41	A	M	10.5	<1.42	<0.285	5.03	375
N. Wisconsin	Wilson/Deer	618-111-68	A	F	10.1	<1.38	<0.276	<2.76	273
N. Wisconsin	Washburn	838-147-02	A	F	9.74	<1.09	<0.217	5.90	232
N. Wisconsin	Stone	838-147-18	A	M	8.68	<1.07	<0.214	2.57	406
N. Wisconsin	French	838-147-20	A	M	9.20	<1.40	<0.281	<2.81	285
N. Wisconsin	French	838-147-21	A	F	10.6	<1.33	<0.265	4.29	253
N. Wisconsin	North Bass	838-147-22	A	M	7.89	<1.33	<0.267	<2.67	414
N. Wisconsin	Muskie/Birch	838-147-25	A	M	11.6	<1.23	<0.246	<2.48	451
N. Wisconsin	Bills	838-147-28	A	F	8.99	<1.21	<0.243	2.52	402
N. Wisconsin	Wishow	838-147-30	A	M	5.82	<0.528	<0.106	1.72	135
N. Wisconsin	Wishow	838-150-14	J	U	*13.6	<2.65	<0.529	<5.29	274
N. Wisconsin	Wishow	838-147-29	J	U	*				
N. Wisconsin	Shallow	838-147-31	A	M	16.7	<1.15	<0.229	<2.29	300
N. Wisconsin	Shallow	838-147-32	A	F	10.5	<1.28	<0.256	<2.56	333
N. Wisconsin	Hemlock	838-147-33	A	M	10.8	<1.16	>0.231	6.05	339
N. Wisconsin	Camp 12	838-147-34	A	F	7.89	<1.40	<0.281	<2.81	324
N. Wisconsin	McDonald	838-147-36	A	F	9.28	<1.37	<0.275	<2.75	317
N. Wisconsin	McDonald	838-150-23	A	M	13.1	<1.17	<0.233	3.34	335
N. Wisconsin	McDonald	838-147-37	J	U	*12.8	<2.72	<0.543	24.5	374
N. Wisconsin	McDonald	838-147-39	J	U	*				
N. Wisconsin	Little Bass	838-147-38	A	F	8.84	<1.49	<0.298	<2.98	299
N. Wisconsin	Pardee	838-147-40	A	F	8.11	<1.31	<0.262	<2.62	389
N. Wisconsin	Pardee	838-147-41	A	M	12.2	<1.27	<0.254	3.09	405
N. Wisconsin	Adelade	838-147-42	A	F	19.1	<1.54	<0.308	4.60	318
N. Wisconsin	Adelade	838-147-43	A	M	6.88	<1.12	<0.225	5.82	303
N. Wisconsin	Alva	838-147-47	A	M	9.84	<1.23	<0.245	2.93	368
N. Wisconsin	Big Muskie-Iron Co.	838-147-55	A	M	13.0	<0.579	<0.116	<1.16	169
N. Wisconsin	Trilby	838-150-08	A	M	10.5	<0.938	<0.188	7.49	431
N. Wisconsin	Trilby	838-150-09	A	F	18.0	<1.64	<0.328	8.60	474
N. Wisconsin	Sunset	838-150-16	A	M	14.2	<1.03	<0.207	4.94	324
N. Wisconsin	Sunset	838-150-17	A	F	13.0	<1.59	<0.317	8.65	357
N. Wisconsin	Soo	838-150-19	A	M	12.4	<1.18	<0.237	2.62	328
N. Wisconsin	Dollar	838-150-20	A	M	12.5	<1.13	<0.225	3.34	369
N. Wisconsin	Langeley	838-150-21	A	M	13.1	<0.909	<0.182	4.01	229
N. Wisconsin	Flanary/Velvet	838-150-22	A	M	13.2	<1.32	<0.264	4.78	294
N. Wisconsin	Moon	838-150-24	A	M	10.7	<0.988	<0.198	2.25	344
N. Wisconsin	Wildcat	838-150-26	A	M	10.8	<0.940	<0.188	5.71	519
N. Wisconsin	Wildcat	838-150-27	A	F	8.77	<1.10	<0.220	2.95	437
N. Wisconsin	Wildcat	838-150-28	J	U	1.80	<3.40	<0.680	34.2	404
N. Wisconsin	Tamarack	838-150-36	A	F	8.44	<1.28	<0.256	<2.56	265
N. Wisconsin	Tamarack	838-150-37	A	M	24.6	<1.19	<0.238	12.9	313
N. Wisconsin	Bluegill	838-150-38	J	U	5.48	<4.10	<0.820	<8.20	650

(A=Adult, J=Juvenile, M=Male, F=Female, U=Unknown)

* Sibling feather samples were pooled to obtain sufficient weight for analysis.

Table 57. Hematocrit values of Common Loons 1993.

GENERAL LOCATION	LAKE NAME	BAND NUMBER	AGE	SEX	HEMAT
Grand Rapids MN	Wabana-lower	838-150-43	A	M	0.62
Grand Rapids, MN	Pokegama-Chisholm	838-145-95	A	M	0.50
Grand Rapids, MN	Bass-Cedar Pt.	838-145-98	A	M	0.42
Grand Rapids, MN	Wabana-Buhelia Bay	838-148-65	A	M	0.49
N. Wisconsin	Whitefish	758-781-23	A	M	0.50
N. Wisconsin	Sugar Maple	758-781-27	A	M	0.49
N. Wisconsin	Bird	838-145-03	A	M	0.49
N. Wisconsin	Big Martha	838-145-09	A	M	0.51
N. Wisconsin	Wolf	838-145-15	A	M	0.50
N. Wisconsin	McKinnley	838-145-16	A	M	0.48
N. Wisconsin	Found	838-145-20	A	M	0.46
N. Wisconsin	Gilmore	838-145-22	A	M	0.46
N. Wisconsin	Kathan	838-145-24	A	M	0.48
N. Wisconsin	Window Pane	838-145-35	A	M	0.52
N. Wisconsin	Nineweb	838-145-42	A	M	0.51
N. Wisconsin	Buckatabon	838-145-46	A	M	0.47
N. Wisconsin	Mosquito	838-145-49	A	M	0.48
N. Wisconsin	Shallow	838-147-31	A	M	0.55
N. Wisconsin	Hemlock	838-147-33	A	M	0.50
N. Wisconsin	Razorback	838-148-41	A	M	0.50
N. Wisconsin	Frank	838-148-42	A	M	0.48
N. Wisconsin	West Plum	838-148-45	A	M	0.50
N. Wisconsin	Canard	838-148-46	A	M	0.42
N. Wisconsin	Otto Mielke	838-148-49	A	M	0.51
N. Wisconsin	Oneida	838-148-51	A	M	0.45
N. Wisconsin	Hancock	838-148-53	A	M	0.52
N. Wisconsin	Flannery/Velvet	838-150-22	A	M	0.50
Ottawa NF, MI	Clearwater	838-145-84	A	M	0.45
T.-Flambeau, WI	Merkle	838-145-04	A	M	0.48
T.-Flambeau, WI	Narrows	838-147-16	A	M	0.57
Voyageurs NP, MN	Rainy-Lost Bay-upper	838-145-88	A	M	0.43
Voyageurs NP, MN	Kabetogama-Narrows	838-148-70	A	M	0.66
Voyageurs NP, MN	Rainy-Dove Bay-s	838-148-78	A	M	0.45
Voyageurs NP, MN	Rainy-Snag Is.	838-148-81	A	M	0.55
Voyageurs NP, MN	Rainy-dove Bay-n	838-148-84	A	M	0.71
Voyageurs NP, MN	Rainy-Dryweed Is.-w	838-150-75	A	M	0.50

Mean	0.503
St. Dev.	0.060
Range	0.42-0.71

Table 58. Hematocrit values of Common Loons 1993.

GENERAL LOCATION	LAKE NAME	BAND NUMBER	AGE	SEX	HEMAT
Grand Rapids MN	Pokegama-Sugar Bay-s	838-145-96	A	F	0.44
Grand Rapids MN	Pokegama-Sugar Bay-n	838-145-97	A	F	0.50
Grand Rapids MN	Wabana-lower	838-148-68	A	F	0.48
N. Wisconsin	Razorback	618-111-75	A	F	0.41
N. Wisconsin	Window Pane	838-145-01	A	F	0.43
N. Wisconsin	Big Musky-Iron Co.	838-145-06	A	F	0.47
N. Wisconsin	Stone	838-145-07	A	F	0.51
N. Wisconsin	N. Bass	838-145-08	A	F	0.53
N. Wisconsin	Jag	838-145-13	A	F	0.54
N. Wisconsin	Mosquito	838-145-14	A	F	0.47
N. Wisconsin	Found	838-145-19	A	F	0.48
N. Wisconsin	Found	838-145-21	A	F	0.48
N. Wisconsin	Gilmore	838-145-23	A	F	0.48
N. Wisconsin	Kathan	838-145-26	A	F	0.49
N. Wisconsin	Flannery/Velvet	838-145-28	A	F	0.47
N. Wisconsin	Broken Bow	838-145-30	A	F	0.45
N. Wisconsin	Burnam	838-145-37	A	F	0.49
N. Wisconsin	Cunard	838-145-39	A	F	0.48
N. Wisconsin	Indian	838-145-43	A	F	0.50
N. Wisconsin	Nineweb	838-145-44	A	F	0.51
N. Wisconsin	Sugar Maple	838-145-47	A	F	0.51
N. Wisconsin	Whitefish	838-145-50	A	F	0.50
N. Wisconsin	Bills	838-147-28	A	F	0.49
N. Wisconsin	Pardee	838-147-40	A	F	0.48
N. Wisconsin	Frank	838-148-43	A	F	0.45
N. Wisconsin	West Plum	838-148-44	A	F	0.46
N. Wisconsin	Hemlock	838-148-47	A	F	0.48
N. Wisconsin	Otto Mielke	838-148-50	A	F	0.51
N. Wisconsin	Hancock	838-148-52	A	F	0.48
N. Wisconsin	Sunset	838-150-17	A	F	0.46
Turtle-Flambeau WI	Merkle	838-145-05	A	F	0.46
Voyageurs NP, MN	Kabetogama-Narrows	838-148-71	A	F	0.70
Voyageurs NP, MN	Rainy-Black Bay-n	838-148-74	A	F	0.29
Voyageurs NP, MN	Rainy-Dove Bay-n	838-148-83	A	F	0.56
Voyageurs NP, MN	Rainy-Dryweed Is.-nw	838-148-87	A	F	0.50
			Mean		0.484
			St. Dev.		0.058
			Range		0.29-0.70

Table 59. Hematocrit values of Common Loons 1993.

GENERAL LOCATION	LAKE NAME	BAND NUMBER	AGE	SEX	HEMAT
Grand Rapids, MN	Bass-Cedar Pt.	838-145-99	J	U	0.21
Grand Rapids, MN	Bass-Cedar Pt.	838-146-00	J	U	0.33
Grand Rapids, MN	Deer-nw	838-148-64	J	U	0.35
Grand Rapids, MN	Wabana-Buhella Bay	838-148-67	J	U	0.39
N. Wisconsin	Big Martha	838-145-11	J	U	0.29
N. Wisconsin	McKinnley	838-145-16	J	U	0.42
N. Wisconsin	Kathan	838-145-25	J	U	0.35
N. Wisconsin	Shallow	838-145-27	J	U	0.36
N. Wisconsin	Washburn	838-145-29	J	U	0.32
N. Wisconsin	Broken Bow	838-145-31	J	U	0.34
N. Wisconsin	Window Pane	838-145-36	J	U	0.39
N. Wisconsin	Bird	838-145-38	J	U	0.39
N. Wisconsin	Cunard	838-145-40	J	U	0.40
N. Wisconsin	Cunard	838-145-41	J	U	0.38
N. Wisconsin	Bills	838-14533	J	U	0.36
N. Wisconsin	McKinnley	838-147-17	J	U	0.41
N. Wisconsin	Sunset	838-148-18	J	U	0.33
N. Wisconsin	Wabasso	838-148-48	J	U	0.36
N. Wisconsin	Mosquito	838-148-48	J	U	0.40
N. Wisconsin	Indian	NB	J	U	0.31
N. Wisconsin	Nineweb	NB	J	U	0.27
N. Wisconsin	Frank	NB	J	U	0.33
N. Wisconsin	Frank	NB	J	U	0.27
N. Wisconsin	Big Musky	NB	J	U	0.31
N. Wisconsin	Razorback	NB	J	U	0.32
N. Wisconsin	Razorback	NB	J	U	0.33
Ottawa NF, MI	Clearwater	838-145-84	J	U	0.33
T.-Flambeau, WI	Trude-east	NB	J	U	0.12
Voyageurs NP, MN	Rainy-Dryweed Is.-nw	838-148-69	J	U	0.15
Voyageurs NP, MN	Rainy-Dryweed Is.-w	838-148-72	J	U	0.23
Voyageurs NP, MN	Rainy-Dryweed Is.-w	838-148-73	J	U	0.50
Voyageurs NP, MN	Rainy-Frazer Bay	838-148-76	J	U	0.23
Voyageurs NP, MN	Rainy-Frazer Bay	838-148-77	J	U	0.41
Voyageurs NP, MN	Rainy-Snag Is.	838-148-79	J	U	0.31
Voyageurs NP, MN	Rainy-Dove Bay-n	838-148-82	J	U	0.73
Voyageurs NP, MN	Rainy-Black Bay-n	838-148-86	J	U	0.31
			Mean		0.340
			St. Dev.		0.101
			Range		0.12-0.73

(NB=bird Not Banded)

In addition to the blood and feather sampling for mercury analysis, DNA fingerprinting, and baseline information, necropsies are performed (Table 47). An attempt is made to ascertain the cause of death either through gross examination or through tissue analysis. From 1980 to 1993, necropsies have been performed on 69 loons. Causes of mortality include drowning (14 loons or 20%), lead poisoning (5 or 7%), Aspergillosus (4 or 6%), malnutrition (4 or 6%), trama (6 or 9%), Type E Botulism (21 or 30%), and unknown causes (15 or 22%). Most dead loons are found on the Great Lakes shoreline. During the botulism outbreak in the fall of 1991, 46 dead loons found along the beach between Thompson and Wiggons Pt., Schoolcraft County in mid to late October. There are 5 cases of healthy loons that were captured and had blood and feather samples taken on the breeding territory and were later found dead.

Table 47. Necropsies of Michigan loons collected by the MDNR Rose Lake Wildlife Reserach Center and anaylzed by Michigan State University Animal Health Diagnostics Lab, 1980-93.

Year	Date Collected	No.	Age/Sex	Location	Diagnosis
1980	14 May	6	adult/male	Big Bay de Noc, L. Michigan	drowning
	14 May	2	adult/female	" "	drowning
1981	9 June	1	adult/male	Pictured Rocks NL, L. Superior	drowning
	17-27 July	9	adult/male	Whitefish Bay, L. Superior	Type E Botulism
	21-27 July	4	adult/female	Whitefish Bay, L. Superior	Type E Botulism
	28 July	1	adult	Whitefish Bay, L. Superior	unknown
	13 November	1	adult/male	Isle Royale NP, L. Superior	unknown
1982	29 May	1	adult/male	Little Bay de Noc, L. Michigan	trama
	1 June	1	adult/female	Tawas Pt., L. Huron	malnutrition
	9 June	1	adult/female	Schoolcraft Co., L. Michigan	drowning
1983	22 October	6	adult/male	Schoolcraft Co., L. Michigan	Type E Botulism
	22 October	2	adult/female	Schoolcraft Co., L. Michigan	Type E Botulism
	30 December	1	adult/female	Leelanau Co., L. Michigan	malnutrition
1984	27 October	1	adult/male	Cheboygan Co., L. Huron	Lead (sinker)
	21 November	1	adult/male	Leelanau Co., L. Michigan	Lead
1985	June	1	adult/male	St. Ignace, L. Huron	unknown
	4 July	2	adult/male	Whitefish Bay, L. Superior	unknown
	4 July	1	adult/female	Whitefish Bay, L. Superior	unknown
	7 July	1	adult/female	Keweenaw Co., L. Superior	unknown
	27 July	1	adult/female	Muskallong Lake SP, L. Superior	unknown
	31 July	1	adult/unk.	Marquette, L. Superior	unknown
	16 October	1	imm./female	Houghton L., Roscommon Co.	trama (gunshot)
	19 October	1	adult/male	Sturgeon Bay Pt., L. Michigan	malnutrition
	8 November	1	imm./male	Tawas Pt., L. Huron	unknown
	30 December	1	adult/female	Hulbert L., Chippewa Co.	Aspergillosis
1986	18 January	1	adult/male	Cheboygan Co., Lake Huron	malnutrition
	26 June	1	adult/unk.	Iron Co.	trama
	16 July	1	imm./male	Sand Pt., Alger Co., L. Superior	unknown
	30 July	1	adult/female	Isle Royale NP, L. Superior	trama (gunshot)
	4 August	3	adult/female	Naubinway, L. Michigan	unknown
	4 August	1	adult/male	Naubinway, L. Michigan	unknown
	3 December	1	imm./male	Sagniaw Bay, L. Huron	Aspergillosis
	December	1	adult/male	unknown	lead
1987	8 April	1	adult	Tuscola Co., L. Huron	drowning
	20 July	1	adult/female	Presquie Isle. Co.	trama
	21 July	1	adult/male	Naubinway, L. Michigan	drowning
	27 July	1	adult/male	Drummon Is., L. Huron	Aspergillosis
	25 August	1	imm./male	Burt L., Cheboygan Co.	trama
	6 September	1	adult/female	Wilderness SP, L. Michigan	drowning
	4 October	1	adult/female	Mackinaw City, L. Huron	drowning
	14 October	1	imm./female	Ottawa L., Iron Co.	trama (fish hook)
	15 November	1	adult/female	Newberry, Luce Co.	Lead and Aspergillosis
1990	21 April	1	adult/male	Anna R., Alger Co.	Lead
1991	9 December	1*	adult/male	Cleveland, Lake Erie	unknown
1993	4 August	1*	adult/male	East L., Mackinac Co.	unknown
	13 October	1	adult/unk.	Munising, L. Superior	Lead

* These loons were recovered after being captured, banded, and samples of blood and feathers were taken.

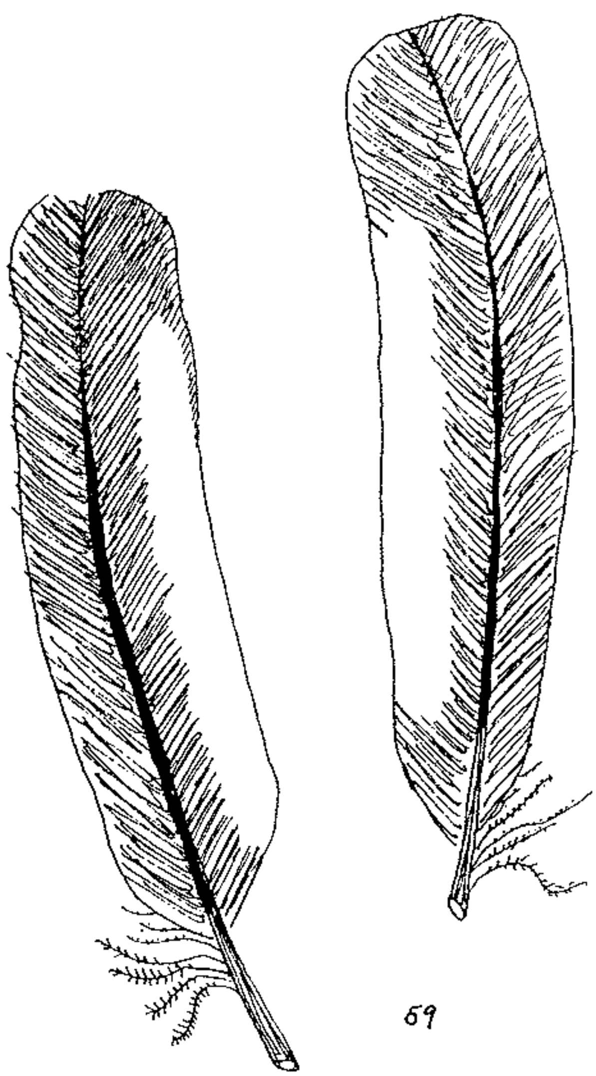
As a comparison to 1992 results, Table 48 shows the mean and reanges by location for feather mercury levels in 1991. Other heavy metal levels (Pb, Cd, Al, Ca) are also shown for feathers in tables 51-56. Lead (Pb) concentrations of 6-8 ppm in the liver have been shown to cause lead poisoning (Ensor et al. 1992). Although the level of feather concentrations are currently not comparable, the data show very low Pb levels. The Pb levels of the necropsied loon diagnosed with lead poisoning on 21 April 1990 (Table 47) had kidney level of 90.3 ppm and liver level of 98.2 ppm. Indications from captured, healthy loons show that Pb does not bioaccumulate and it is not found in moderate levels; it originates from a point source (i.e., fish sinker) and causes nearly immediate death. Concentrations of cadmium (Ca) in feathers are below levels of toxicological concern (22 ppm) (Sileo and Beyer 1985) and in most cases for aluminum (<50 ppm) (Wren et al. 1983).

Two secondary feathers are taken from adult and juvenile loons for heavy metal analysis. Breast or other smaller body feathers are not taken due to the volume of feather tissue required (Figure 8). Negative impacts from feather extraction have never been observed.

Table 48. Mercury concentrations in adult and juvenile Common Loon feathers, 1991.

Location	Adults (Hg in ppm)			Juveniles (Hg in ppm)		
	n	Range	Mean	n	Range	Mean
Seney NWR/L. Sup. SF	7	5.31-11.90	9.14 +/- 4.90	2	5.11-5.55	5.33 +/- .31
Hiawatha NF	7	6.00-16.00	11.42 +/- 3.75	1	3.31	3.31
Ottawa NF	8	5.03-18.30	9.11 +/- 4.29	5	2.77-12.70	5.34 +/- 4.28
Isle Royale NP	7	3.97-12.20	8.09 +/- 3.18	1	1.28	1.28
N. Lower Peninsula	6	1.60-12.10	8.48 +/- 3.67	-	–	–
N. Wisconsin	32	6.30-13.40	10.59 +/- 3.63	8	1.73-5.75	3.66 +/- 1.30

Figure 8. Actual minimum size of Common Loon secondaries needed for Hg analysis



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PROMOTION: Presentations in 1993 were given at the Michigan Loon Preservation Association annual meeting (keynote speaker) and University of Minnesota. The Earthwatch conference in Boston was attended. Several newsletter and newspaper announcements were made, including the Detroit Free Press. Two manuscripts will be coauthored with collaborators: (1) Measuring the effect of mercury exposure on common loon productivty in Wisconsin by Michael Meyer et al. at the International Mercury Conference and (2) Application of molecular genetics techniques to the study of genetic diversity and the effect of toxic substances on gene expression of wild animals by Acacia Alivar-Warren et al. at the Center for Environmental Management at Tufts University.

BUDGET: The following budget of $26,935 partially covered project expenditures for field work from mid April to mid August and office work into the beginning of December. Funding sources are listed with respective projected expenditures. In 1993, funding was received from the U.S. Forest Service including the Hiawatha (HINF), U.S. Fish and Wildlife Service Office of Migratory Bird Management (Region 3) (FWS), Wisconsin DNR (WISC), Michigan State Unversity School of Veterinary Medicine ASSESS Program (MSU), National Park Service (NPS), and Earthwatch (EW). Labor, lodging, transportation, and equipment were partly covered at no expense by each of the National Forest Service offices, Seney National Wildlife Refuge, Voyageurs and Isle Royale National Parks, and the DNRs of Wisconsin and Minnesota. The WDNR Mercer Field Office was particularly supportive. The estimated total of in-kind matching support was approximately $5,500. The Wisconsin part of this project was in collaboration with Dr. Michael Meyer of the Wisconsin DNR and Dr. Walter Piper of the Smithsonian Institution.

Actual Budget for 1993

Description	HINF	WDNR	FWS	NPS	EW	MSU
I. Salaries:	4200	3800	500		5250	
II. Travel	600	1000	300	250	1830	
III. Equipment		500	200		115	
IV. Expendables:	200				1640	
V. Food / Lodging:	1450				3300	
VI. Analytic Costs:						2000
Total Expenses	5000	6550	1000	250	12,135	2000

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General Locale	Name	USFWS	RL	LL	Age	Sex	Blood	Date
Antrim Co	Bellaire	618-111-34	green/silver	blue / blue	adult	male	8	29 June 1991
Antrim Co	Bellaire	618-111-35	yellow / yellow	blue / silver	juvenile	unknown	4	29 June 1991
Antrim Co.	Bellaire	618-111-36	blue / silver	yellow / blue	adult	female	10	29 June 1991
Antrim Co	Clam	618-111-27	red / silver	red / white	adult	male	+	26 June 1991
Antrim Co.	Clam	618-111-28	green / silver	yellow	adult	female	+	26 June 1991
Antrim Co.	Clam	618-111-29	yellow	Red / silver	juvenile	unknown	+	26 June 1991
Antrim Co	Clam	618-111-30	white	green / silver	juvenile	unknown	+	26 June 1991
Antrim Co.	Clam	758-781-77	Red / Silver	White / Red	Adult	Male	0	19 June 1992
Antrim Co.	Elk	758-781-75	red / silver	red / yellow	Adult	Male	9	19 June 1992
Antrim Co	Elk	758-781-76	Red / Silver	White / Green	Adult	Female	10	19 June 1992
Antrim Co	Intermediate	618-111-31	red / silver	yellow / white	adult	female	8	28 June 1991
Antrim Co.	Intermediate	618-111-32	blue / white	green / silver	juvenile	unknown	4	28 June 1991
Antrim Co.	Intermediate	618-111-33	green / silver	blue / white	adult	male	10	28 June 1991
Grand Rapids	Bass-Cedar Pt	838-145-96	silver	blue / red	adult	male	3	6 August 1993
Grand Rapids	Bass-Cedar Pt	838-145-99	green / yellow	silver	juvenile	unknown	2	6 August 1993
Grand Rapids	Bass-Cedar Pt.	838-146-00	white / red	silver	juvenile	unknown	1	6 August 1993
Grand Rapids	Bass-Sunset Cove	838-150-55	Silver / White	White / Yellow	Adult	Male	11	31 July 1992
Grand Rapids	Bass-Sunset Cove	838-150-56	Silver / white	Yellow / Yellow	Adult	Female	4	31 July 1992
Grand Rapids	Black Island	838-150-52	Silver / White	Blue / Yellow	Adult	Male	4	31 July 1992
Grand Rapids	Black Island	838-150-53	Silver / White	Green / Yellow	Adult	Female	4	31 July 1992
Grand Rapids	Black Island	838-150-54	Yellow / Yellow	Silver / White	Juvenile	Unknown	3	31 July 1992
Grand Rapids	Deer-nw	838-148-64	yellow / red	silver	juvenile	unknown	2.5	6 August 1993
Grand Rapids	Pokegama-Chisholm	838-145-95	silver	red / green	adult	male	1.5	5 August 1993
Grand Rapids	Pokegama-Sugar Bay-n	838-145-97	silver	blue / white	adult	female	2	5 August 1993
Grand Rapids	Pokegama-Sugar Bay-s	838-145-98	silver	yellow / green	adult	female	1	5 August 1993
Grand Rapids	Wabana-Buhelia Bay	838-148-65	silver	red / blue	adult	male	2.5	7 August 1993
Grand Rapids	Wabana-Buhelia Bay	838-148-66	silver	green / green	adult	female	2.5	7 August 1993
Grand Rapids	Wabana-Buhelia Bay	838-148-67	blue / white	silver	juvenile	unknown	2.5	7 August 1993
Grand Rapids	Wabana-central	838-150-49	Silver / White	Red / Yellow	Adult	Female	10	30 July 1992
Grand Rapids	Wabana-central	838-150-50	Silver	Yellow / Red	Adult	Male	6.6	30 July 1992
Grand Rapids	Wabana-central	838-150-51	Yellow / Green	Silver / White	Juvenile	Unknown	3.4	30 July 1992
Grand Rapids	Wabana-lower	838-148-68	silver	white /blue	adult	female	5.5	7 August 1993
Grand Rapids	Wabana-lower	838-150-42	Silver / White	Red / Red	Adult	Female	10	30 July 1992
Grand Rapids	Wabana-lower	838-150-43	Silver / White	Yellow / Red	Adult	Male	7	30 July 1992
Grand Rapids	Wabana-lower	838-150-44	Blue / Red	Silver / White	Juvenile	Unknown	4.5	30 July 1992
Grand Rapids	Wabana-lower	838-150-45	Green / Red	Silver / White	Juvenile	Unknown	5	30 July 1992
Grand Rapids	Wabana-upper	838-150-46	Silver / White	Green / Red	Adult	Female	10	30 July 1992
Grand Rapids	Wabana-upper	838-150-47	Silver / White	Blue / Red	Adult	Male	10	30 July 1992
Grand Rapids	Wabana-upper	838-150-48	White / Red	Silver / White	Juvenile	Unknown	3.6	30 July 1992
Hiawatha NF	Bunting	618-111-11	red / silver	white	adult	female	3	18 July 1990
Hiawatha NF	Bunting	618-111-12	red	red / silver	juvenile	unknown	0	16 July 1990
Hiawatha NF	Bunting	758-781-63	white	red / silver	juvenile	unknown	4	7 August 1991
Hiawatha NF	Bunting	758-781-64	red / silver	white / yellow	adult	male	9	7 August 1991
Hiawatha NF	Bunting	758-781-65	yellow / white	yellow / silver	juvenile	unknown	1.5	7 August 1991
Hiawatha NF	East Lake-northeast	618-111-22	red / silver	green	adult	male	0	26 July 1990
Hiawatha NF	East Lake-northeast	618-111-23	green	silver / red	juvenile	unknown	0	22 July 1990
Hiawatha NF	East Lake-northeast	618-111-24	blue	red / silver	juvenile	unknown	0	26 July 1990
Hiawatha NF	East Lake-northeast	838-150-91	Green / Yellow	Red / Silver	Juvenile	Unknown	4	13 August 1992
Hiawatha NF	East Lake-northwest	758-781-04	red / silver	blue	adult	male	0	26 July 1990
Hiawatha NF	East Lake-northwest	758-781-07	–	silver / white	juvenile	unknown	0	26 July 1990
Hiawatha NF	East Lake-northwest	838-148-55	red / silver	blue / blue	adult	male	2.5	14 July 1993
Hiawatha NF	East Lake-northwest	838-148-60	red / silver	white / white	adult	female	5	19 July 1993
Hiawatha NF	Frenchman	618-111-43	red / silver	green / blue	adult	male	8.5	7 July 1991
Hiawatha NF	Frenchman	618-111-44	red / silver	yellow / blue	adult	female	5	7 July 1991
Hiawatha NF	Frenchman	758-781-67	yellow / silver	yellow / white	adult	male	10	8 August 1991
Hiawatha NF	Frenchman	758-781-68	yellow / green	yellow / silver	juvenile	unknown	3	8 August 1991
Hiawatha NF	Hulbert	618-111-41	red / silver	blue / white	adult	female	6.5	6 July 1991
Hiawatha NF	Hulbert	618-111-42	red / silver	white / blue	adult	male	10	6 July 1991
Hiawatha NF	Hulbert	758-781-66	white / white	yellow / silver	juvenile	unknown	4	8 August 1991
Hiawatha NF	Hulbert	838-150-96	Red Silver	Blue / Yellow	Adult	Female	0	28 August 1992
Hiawatha NF	Hulbert	838-150-97	White / Blue	Red / Silver	Juvenile	Unknown	0	25 August 1992
Hiawatha NF	Little Round	758-781-81	Red / Silver	Yellow / Green	Adult	Female	6	27 June 1992
Hiawatha NF	Little Round	838-148-56	yellow	silver / red	juvenile	unknown	1	16 July 1993
Hiawatha NF	Perch	838-148-63	red / silver	green / green	adult	male	1.5	4 August 1993
Isle Royale NP	Duncan Bay-east	838-145-88	yellow / blue	white / silver	juvenile	unknown	3	31 July 1993
Isle Royale NP	Duncan Bay-west	758-781-52	green / silver	green / red	adult	female	9	31 July 1991
Isle Royale NP	Duncan Bay-west	758-781-53	yellow / red	green / silver	juvenile	male	3	31 July 1991
Isle Royale NP	Duncan Bay-west	758-781-54	green / red	green / silver	juvenile	female	3.5	31 July 1991
Isle Royale NP	Duncan Bay-west	758-781-61	white / silver	yellow / white	adult	male	+	3 August 1991
Isle Royale NP	Duncan Bay-west	838-145-87	white / silver	blue / red	adult	female	3	31 July 1993
Isle Royale NP	Five Finger Bay	758-781-60	yellow / green	white / silver	juvenile	unknown	3	3 August 1991
Isle Royale NP	Lane Cove	758-781-59	yellow / red	silver / white	juvenile	unknown	1	3 August 1991
Isle Royale NP	Lane Cove	758-781-62	white / silver	green / green	adult	female	9.5	4 August 1991
Isle Royale NP	Lane Cove	838-148-32	Blue	White / Silver	juvenile	unknown	3.0	11 August 1992
Isle Royale NP	McCargo Cove	758-781-56	white / silver	yellow / green	adult	female	11	2 August 1991
Isle Royale NP	McCargo Cove	758-781-57	white / silver	green / yellow	adult	male	10	2 August 1991
Isle Royale NP	McCargo Cove	758-781-58	yellow	white / silver	juvenile	unknown	4	2 August 1991
Isle Royale NP	Pickerel Cove	838-145-89	red / green	white / silver	juvenile	unknown	3	31 July 1993
Isle Royale NP	Rock Harbor-Lorelei	838-145-86	white / silver	red / blue	adult	male	7	30 July 1993
Isle Royale NP	Tobin Harbor-Boy's Is.	838-145-94	white / silver	blue	adult	female	9	1 August 1993
Isle Royale NP	Tobin Harbor-Boys Is	838-148-33	White / Silver	Red	adult	male	5.5	12 August 1992
Isle Royale NP	Tobin Harbor-Boys Is	838-148-34	White	White / Silver	juvenile	unknown	1	12 August 1992
Isle Royale NP	Tobin Harbor-Emerson	758-781-50	red	white / silver	juvenile	female	3.25	30 July 1991
Isle Royale NP	Tobin Harbor-Emerson	758-781-51	silver / green	green	adult	female	7	31 July 1991
Isle Royale NP	Tobin Harbor-Emerson	758-781-65	white / silver	red / green	adult	male	11	2 August 1991
Isle Royale NP	Tobin Harbor-Emerson	838-145-92	green / blue	white / silver	juvenile	unknown	3	1 August 1993
Isle Royale NP	Tobin Harbor-Emerson	838-145-93	yellow / red	white / silver	juvenile	unknown	3	1 August 1993
Isle Royale NP	Tobin Harbor-Moose Pt.	758-781-46	white / silver	green	adult	male	10	30 July 1991
Isle Royale NP	Tobin Harbor-Moose Pt.	758-781-47	white / silver	yellow	adult	female	11	30 July 1991
Isle Royale NP	Tobin Harbor-Moose Pt.	758-781-48	green	silver / white	juvenile	female	3.5	30 July 1991
Isle Royale NP	Tobin Harbor-Moose Pt.	758-781-49	green	white / silver	juvenile	male	3	30 July 1991
Isle Royale NP	Tobin Harbor-Suzys	838-145-90	white / silver	yellow / red	adult	female	6	1 August 1993
Isle Royale NP	Tobin Harbor-Suzys	838-145-91	red / white	white / silver	juvenile	unknown	2.5	1 August 1993
Lake Superior SF	Cedar	838-147-63	Yellow / Silver	Red	Adult	Female	10	19 July 1992
Lake Superior SF	Kennedy	758-781-72	white / green	yellow / silver	juvenile	unknown	4+	11 August 1991
Lake Superior SF	Kennedy	758-781-73	white / yellow	yellow / silver	juvenile	unknown	4+	11 August 1991
Lake Superior SF	Kennedy	758-781-74	yellow / silver	white / green	adult	male	10	11 August 1991
Lake Superior SF	Pike	838-150-98	red / silver	yellow / red	adult	male	0	21 June 1993
Lake Superior SF	Pike	838-150-99	red / silver	blue / green	adult	female	0	21 June 1993
Lake Superior SF	S. Manistique-Wolf	758-781-79	Yellow / Silver	White / Red	Adult	Male	9	26 June 1992
Lake Superior SF	S. Manistique-Wolf	758-781-80	Yellow / Silver	Green / Red	Adult	Female	10	25 June 1992
Lake Superior SF	S. Manistique-Wolf	838-148-57	blue	silver / red	juvenile	unknown	1	16 July 1993
Lake Superior SF	S. Manistique-Wolf	838-148-58	red / yellow	red / silver	juvenile	unknown	1	16 July 1993
Lake Superior SF	Strouble	758-781-69	yellow / silver	yellow / green	adult	female	9.5	9 August 1991
Lake Superior SF	Strouble	758-781-70	yellow / silver	green / yellow	adult	male	10	9 August 1991
Lake Superior SF	Upper Shoe	618-111-39	red / silver	green / white	adult	male	10	4 July 1991
Lake Superior SF	Upper Shoe	618-111-40	white	silver / white	juvenile	unknown	0	4 July 1991
Lake Umbagog	Androscoggin	838-149-01	green / green	orange / silver	juvenile	unknown	1.5	22 August 1993
Lake Umbagog	Androscoggin	838-149-02	orange / silver	yellow / white	adult	female	0	22 August 1993
Lake Umbagog	Three Is. Cove	838-148-96	orange / silver	green / green	adult	female	0	22 August 1993
Lakes Region	L. Squam-River Bend	838-148-55	blue / blue	orange / silver	juvenile	unknown	3.6	17 August 1993
Lakes Region	L. Squam-River Bend	838-148-94	orange / silver	blue / blue	adult	unknown	4	17 August 1993
Lakes Region	White Oak	838-148-98	green / blue	orange / silver	juvenile	unknown	.5	19 August 1993
N. Wisconsin	Adelade	838-147-42	Silver	Yellow	Adult	Female	6	12 July 1992
N. Wisconsin	Adelade	838-147-43	Silver	Red	Adult	Male	0	12 July 1992
N. Wisconsin	Adelade	838-147-44	White / White	Green / Silver	Juvenile	Unknown	0	12 July 1992
N. Wisconsin	Adelade	838-147-45	Yellow / Yellow	Green / Silver	Juvenile	Unknown	3.5	12 July 1992
N. Wisconsin	Alva	838-147-46	Red / Yellow	Silver / Blue	Juvenile	Unknown	3.5	12 July 1992
N. Wisconsin	Alva	838-147-47	Green / Silver	White / Red	Adult	Male	3.6	12 July 1992
N. Wisconsin	Alva	838-147-48	White / Yellow	Silver / blue	Juvenile	Unknown	1.5	12 July 1992
N. Wisconsin	Big Martha	838-145-09	silver / yellow	green / red	adult	male	4	11 July 1993
N. Wisconsin	Big Martha	838-145-10	silver / red	white / blue	adult	female	9.5	11 July 1993
N. Wisconsin	Big Martha	838-145-11	blue / blue	silver / blue	juvenile	unknown	3	11 July 1993
N. Wisconsin	Big Muskie-Iron Co	838-145-06	silver / red	blue / white	adult	female	2	10 July 1993
N. Wisconsin	Big Muskie-Iron Co	838-147-64	White / White	Silver / Blue	Juvenile	Unknown	3	14 July 1992
N. Wisconsin	Big Muskie-Iron Co	838-147-65	Silver / Blue	Yellow / Yellow	Adult	Male	10	14 July 1992
N. Wisconsin	Bill's	618-111-60	yellow	silver / blue	juvenile	unknown	3.4	12 July 1991
N. Wisconsin	Bill's	618-111-61	silver / blue	green	adult	male	10	12 July 1991
N. Wisconsin	Bill's	838-147-26	Yellow / Red	Blue / Silver	Juvenile	Unknown	3	8 July 1992
N. Wisconsin	Bill's	838-147-27	Blue / Red	Blue / Silver	Juvenile	Unknown	0	8 July 1992
N. Wisconsin	Bill's	838-147-28	Silver / Blue	Blue	Adult	Female	6	8 July 1992
N. Wisconsin	Bills	838-145-33	white / blue	silver / red	juvenile	unknown	3	16 July 1993
N. Wisconsin	Bird	838-145-03	silver / red	red / white	adult	male	6	8 July 1993
N. Wisconsin	Bird	838-145-04	yellow / green	silver / yellow	juvenile	unknown	3.5	10 July 1993

Appendix I. Summary of Common Loons banded, 1987-93

General Locale	Name	USFWS	RL	LL	Age	Sex	Blood	Date
N. Wisconsin	Bluegill	838-150-36	Red / Red	Green / Silver	Juvenile	Unknown	3.4	24 July 1992
N. Wisconsin	Broken Bow	838-145-30	silver / yellow	red / green	adult	female	3	18 July 1993
N. Wisconsin	Broken Bow	838-145-31	green / yellow	silver / red	juvenile	unknown	3	18 July 1993
N. Wisconsin	Broken Bow	838-145-32	white / blue	silver / yellow	juvenile	unknown	3.5	18 July 1993
N. Wisconsin	Bucketabon	838-145-45	white / red	silver / red	adult	female	7	20 July 1993
N. Wisconsin	Bucketabon	838-145-46	silver / yellow	red / yellow	adult	male	9.5	20 July 1993
N. Wisconsin	Burnam	838-145-02	silver / red	green / red	adult	male	5	8 July 1993
N. Wisconsin	Burnam	838-145-37	silver / yellow	yellow / white	adult	female	7	19 July 1993
N. Wisconsin	Camp 12	838-147-34	Green / Silver	Red / White	Adult	Female	4	19 July 1992
N. Wisconsin	Camp 12	838-150-15	Red / Blue	Blue / Silver	Juvenile	Unknown	4	19 July 1992
N. Wisconsin	Catherine	618-111-63	blue / silver	white / blue	Adult	male	11	18 July 1991
N. Wisconsin	Catherine	618-111-64	–	blue / silver	juvenile	unknown	3.25	18 July 1991
N. Wisconsin	Catherine	618-111-65	blue / silver	white / white	adult	female	2	18 July 1991
N. Wisconsin	Catherine	618-111-66	green	silver / white	juvenile	unknown	1.5	18 July 1991
N. Wisconsin	Cunard	838-145-39	silver / yellow	blue / white	adult	female	11	19 July 1993
N. Wisconsin	Cunard	838-145-40	white / green	silver / red	juvenile	unknown	3	19 July 1993
N. Wisconsin	Cunard	838-145-41	yellow / yellow	silver / yellow	juvenile	unknown	4	19 July 1993
N. Wisconsin	Cunard	838-145-46	silver / red	yellow / green	adult	male	3.5	4 July 1993
N. Wisconsin	Dollar	838-150-13	Red / Blue	Silver / Blue	Juvenile	Unknown	2.5	19 July 1992
N. Wisconsin	Dollar	838-150-20	Green / Silver	Yellow / Yellow	Adult	Male	12	19 July 1992
N. Wisconsin	Flanery / Velvet	838-150-22	Green / Silver	Red / Green	Adult	Male	13	20 July 1992
N. Wisconsin	Flannery/Velvet	838-145-28	silver / red	green / blue	adult	female	6.5	17 July 1993
N. Wisconsin	Found	838-145-19	silver / red	green / green	adult	female	7	14 July 1993
N. Wisconsin	Found	838-145-20	silver / yellow	red / red	adult	male	10	14 July 1993
N. Wisconsin	Found	838-145-21	silver / red	white / white	adult	female	9	14 July 1993
N. Wisconsin	Frank	838-148-42	silver / red	red / green	adult	male	4.5	2 July 1993
N. Wisconsin	Frank	838-148-43	silver / yellow	yellow / blue	adult	female	6.5	2 July 1993
N. Wisconsin	French	618-111-61	blue / silver	green / blue	adult	male	10	17 July 1991
N. Wisconsin	French	618-111-62	blue / green	blue / silver	juvenile	unknown	3.75	17 July 1991
N. Wisconsin	French	838-147-19	Silver / Green	Yellow	Juvenile	Unknown	.5	7 July 1992
N. Wisconsin	French	838-147-20	Green / Silver	White	Adult	Male	9.5	7 July 1992
N. Wisconsin	French	838-147-21	Silver / Green	Red	Adult	Female	10	7 July 1992
N. Wisconsin	George	758-781-15	green / yellow	silver / blue	juvenile	unknown	3	22 July 1991
N. Wisconsin	George	758-781-16	yellow / green	silver / blue	juvenile	unknown	0	22 July 1991
N. Wisconsin	Gilmore	838-145-22	silver / yellow	white / white	adult	male	7.5	14 July 1993
N. Wisconsin	Gilmore	838-145-23	silver / red	blue / red	adult	female	6	14 July 1993
N. Wisconsin	Hancock	838-148-62	silver / yellow	blue / blue	adult	female	10	6 July 1993
N. Wisconsin	Hancock	838-148-63	silver/red	red / yellow	adult	male	5	6 July 1993
N. Wisconsin	Hasbrook	838-150-10	Red / Red	Blue / silver	Juvenile	Unknown	0	17 July 1992
N. Wisconsin	Hasbrook	838-150-11	White / Blue	Blue / Silver	Juvenile	Unknown	0	17 July 1992
N. Wisconsin	Hemlock	838-147-33	Green / Silver	Red / Yellow	Adult	Male	0.5	9 July 1992
N. Wisconsin	Hemlock	838-148-47	silver / yellow	green / white	adult	female	6	July 1993
N. Wisconsin	Hunter	838-145-67	silver / red	blue	adult	male	5	12 August 1993
N. Wisconsin	Hunter	838-145-66	silver / green	green / green	adult	female	3.5	12 August 1993
N. Wisconsin	Imogene	758-781-24	white / red	silver / blue	juvenile	unknown	1	25 July 1991
N. Wisconsin	Imogene	758-781-25	silver / blue	red / green	adult	female	10.5	25 July 1991
N. Wisconsin	Imogene	758-781-26	red / white	blue / silver	juvenile	unknown	1	25 July 1991
N. Wisconsin	Indian	758-781-28	silver / blue	yellow / red	adult	male	11	26 July 1991
N. Wisconsin	Indian	758-781-29	silver / blue	green / yellow	adult	female	10	26 July 1991
N. Wisconsin	Indian	758-781-39	red	green / silver	juvenile	unknown	2	26 July 1991
N. Wisconsin	Indian	838-145-43	silver / yellow	white / green	adult	female	5	20 July 1993
N. Wisconsin	Jag	618-111-77	blue / silver	white / green	adult	male	10	16 July 1991
N. Wisconsin	Jag	618-111-78	blue / silver	white / yellow	adult	female	10	16 July 1991
N. Wisconsin	Jag	618-111-79	–	silver / green	juvenile	unknown	0	16 July 1991
N. Wisconsin	Jay	758-781-40	red / white	green / silver	juvenile	unknown	4	28 July 1991
N. Wisconsin	Jag	838-145-13	silver / yellow	white / blue	adult	female	9.5	12 July 1993
N. Wisconsin	Jag	838-145-51		silver	juvenile	unknown	2	22 July 1993
N. Wisconsin	Jag	838-150-39	Red / Red	Silver / Green	Juvenile	Unknown	2	26 July 1992
N. Wisconsin	Jag	838-150-40	White / Red	Silver / Green	juvenile	Unknown	2	26 July 1992
N. Wisconsin	Jag	838-150-41	Silver / Green	Green / Red	Adult	Male	5	26 July 1992
N. Wisconsin	Kathan	838-145-24	silver / red	blue / blue	adult	male	5	15 July 1993
N. Wisconsin	Kathan	838-145-25	white / green	silver / yellow	juvenile	unknown	3	15 July 1993
N. Wisconsin	Kathan	838-145-26	silver / yellow	yellow / yellow	adult	female	6	15 July 1993
N. Wisconsin	Langeley	838-147-53	Yellow / White	Green / Silver	Juvenile	Unknown	1	15 July 1992
N. Wisconsin	Langeley	838-150-21	Green / Silver	Blue / Yellow	Adult	Male	10	20 July 1992
N. Wisconsin	Little Bass	758-781-32	silver / blue	white / yellow	adult	male	10	27 July 1991
N. Wisconsin	Little Bass	838-147-38	Silver / Blue	Blue / White	Adult	Female	9	11 July 1992
N. Wisconsin	Little Bass	838-147-39	White / Green	Silver / Blue	Juvenile	Unknown	3	11 July 1992
N. Wisconsin	Little Bearskin	618-111-49	blue	blue / silver	juvenile	unknown	3.2	10 July 1991
N. Wisconsin	Little Bearskin	618-111-50	blue / silver	yellow	adult	male	9	10 July 1991
N. Wisconsin	Little Bearskin	838-147-01	Blue / Silver	Green / White	Adult	Female	7	2 July 1992
N. Wisconsin	Little Bearskin	838-147-09	White / Red	Green / Silver	Juvenile	Unknown	3	13 July 1992
N. Wisconsin	Little Bearskin	838-147-50	Red / Red	Silver / Blue	Juvenile	unknown	1	15 July 1992
N. Wisconsin	Long	838-145-61	silver / red	red	adult	male	5	3 August 1993
N. Wisconsin	Long	838-145-62	silver/green	red / white	adult	female	2	3 August 1993
N. Wisconsin	Lumen	618-111-51	white	blue / silver	juvenile	unknown	2	19 July 1991
N. Wisconsin	Lumen	618-111-52	red	blue / silver	juvenile	unknown	2.5	19 July 1991
N. Wisconsin	Lumen	618-111-53	blue / silver	green	adult	female	9	19 July 1991
N. Wisconsin	Lumen	618-111-54	blue / silver	blue	adult	male	6	19 July 1991
N. Wisconsin	Lumen	838-145-63	silver / green	white / white	adult	female	4.5	3 August 1993
N. Wisconsin	McDonald	838-147-35	Blue	Silver / Blue	Juvenile	Unknown	1	11 July 1992
N. Wisconsin	McDonald	838-147-36	Silver / Blue	Blue / White	Adult	Female	4	11 July 1992
N. Wisconsin	McDonald	838-147-37	Red / White	Silver / Blue	Juvenile	Unknown	3	10 July 1992
N. Wisconsin	McDonald	838-150-23	Green / Silver	Yellow / Green	Adult	Male	9.5	21 July 1992
N. Wisconsin	McKinnley	838-145-16	silver / red	green / white	adult	male	8	13 July 1993
N. Wisconsin	McKinnley	838-145-17	red / green	silver / yellow	juvenile	unknown	3	13 July 1993
N. Wisconsin	Moon	838-150-24	Green / silver	Yellow / Blue	Adult	Male	10	21 July 1992
N. Wisconsin	Moon	838-150-25	Green / silver	White / Green	Adult	Female	4	21 July 1992
N. Wisconsin	Mosquito	838-145-14	silver / red	yellow / yellow	adult	female	4.5	13 July 1993
N. Wisconsin	Mosquito	838-145-48	green / white	silver / yellow	juvenile	unknown	3	21 July 1993
N. Wisconsin	Mosquito	838-145-49	silver / yellow	green	adult	male	2	21 July 1993
N. Wisconsin	Muskellunge	618-111-55	blue / white	blue / silver	juvenile	unknown	3.2	11 July 1991
N. Wisconsin	Muskellunge	618-111-56	blue / silver	red / white	adult	male	10	11 July 1991
N. Wisconsin	Muskie/Birch	838-147-26	Silver / Blue	Green / Blue	Adult	Male	3	7 July 1992
N. Wisconsin	Muskie/Birch	838-150-05	Blue / Blue	Blue / Silver	Juvenile	Unknown	3	16 July 1992
N. Wisconsin	Muskie/Birch	838-150-06	Silver / Blue	White / Blue	Adult	Female	4	16 July 1992
N. Wisconsin	Nineweb	758-781-35	green / silver	red	adult	female	9	26 July 1991
N. Wisconsin	Nineweb	758-781-36	green / silver	green	adult	male	10	28 July 1991
N. Wisconsin	Nineweb	758-781-37	green	green / silver	juvenile	unknown	1+	28 July 1991
N. Wisconsin	Nineweb	758-781-38	yellow	green / silver	juvenile	unknown	0.75	28 July 1991
N. Wisconsin	Nineweb	838-145-42	silver / red	blue / green	adult	male	7	20 July 1993
N. Wisconsin	Nineweb	838-145-44	silver / yellow	yellow / red	adult	female	9.5	20 July 1993
N. Wisconsin	North Bass	838-145-05	silver / yellow	green / green	adult	female	11.5	10 July 1993
N. Wisconsin	North Bass	838-147-22	Green / Silver	White / Yellow	Adult	Male	10	7 July 1992
N. Wisconsin	Oneida	838-148-51	silver / red	green / yellow	adult	male	11	6 July 1993
N. Wisconsin	Otto Mielke	838-148-49	silver / red	yellow / red	adult	male	3	5 July 1993
N. Wisconsin	Otto Mielke	838-148-50	silver / yellow	green / blue	adult	female	5	5 July 1993
N. Wisconsin	Pardee	838-147-40	Green / Silver	Blue / Blue	Adult	Female	1	11 July 1992
N. Wisconsin	Pardee	838-147-41	Green / Silver	White / White	Adult	Male	2	11 July 1992
N. Wisconsin	Perch	838-147-57	Yellow / Blue	Blue / Silver	Juvenile	Unknown	3	15 July 1992
N. Wisconsin	Perch	838-147-58	Blue / White	Silver / Blue	Juvenile	Unknown	3	15 July 1992
N. Wisconsin	Pin Cherry	758-781-30	green / white	silver / blue	juvenile	unknown	3	26 July 1991
N. Wisconsin	Pin Cherry	758-781-31	silver / blue	yellow / yellow	adult	female	10.5	26 July 1991
N. Wisconsin	Rainbow Flowage	618-111-58	silver / blue	white	adult	female	10	11 July 1991
N. Wisconsin	Rainbow Flowage	618-111-59	green	silver / blue	juvenile	unknown	3	11 July 1991
N. Wisconsin	Razorback	618-111-73	yellow / white	silver / blue	juvenile	unknown	3	15 July 1991
N. Wisconsin	Razorback	618-111-74	blue / silver	red / white	adult	male	9	15 July 1991
N. Wisconsin	Razorback	618-111-75	blue / silver	yellow / green	adult	female	10	15 July 1991
N. Wisconsin	Razorback	838-148-41	silver / red	red / red	adult	male	5.5	2 July 1993
N. Wisconsin	Roger	838-147-59	Red / Yellow	Blue / Silver	Juvenile	Unknown	0	16 July 1992
N. Wisconsin	Roger	838-147-60	Blue / Yellow	Blue / Silver	Juvenile	Unknown	0	16 July 1992
N. Wisconsin	Shallow	838-145-27	white / red	silver / yellow	juvenile	unknown	1.5	15 July 1993
N. Wisconsin	Shallow	838-147-31	Silver / Blue	Red / Red	Adult	Male	4	9 July 1992
N. Wisconsin	Shallow	838-147-32	Green / Silver	Yellow / Red	Adult	Female	9.75	9 July 1992
N. Wisconsin	Shallow	838-150-07	Red / Red	Silver / Blue	Juvenile	Unknown	0	17 July 1992
N. Wisconsin	See	838-150-19	Green / Silver	Green / Yellow	Adult	Male	3	20 July 1992
N. Wisconsin	Stone	838-145-07	silver / yellow	white / yellow	adult	female	6.5	1 July 1993
N. Wisconsin	Stone	838-147-17	Yellow / White	Silver / Blue	Juvenile	Unknown	5	6 July 1992
N. Wisconsin	Stone	838-147-18	Silver / Green	Blue	Adult	Male	5	6 July 1992
N. Wisconsin	Sugar Maple	758-781-27	silver / blue	green / red	adult	male	12	25 July 1991
N. Wisconsin	Sugar Maple	838-146-47	silver / yellow	yellow	adult	female	3	21 July 1993
N. Wisconsin	Sunset	838-145-18	red / blue	silver / red	juvenile	unknown	1	14 July 1993
N. Wisconsin	Sunset	838-150-16	Green / silver	Red / Red	Adult	Male	5	10 July 1992
N. Wisconsin	Sunset	838-150-17	Green / Silver	Red / Blue	Adult	Female	10	10 July 1992

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General Locale	Name	USFWS	BL	LL	Age	Sex	Blood	Date
N. Wisconsin	Tamarack	838-150-36	Silver	Red / Yellow	Adult	Female	10	24 July 1992
N. Wisconsin	Tamarack	838-150-37	Green / Silver	White / Blue	Adult	Male	10	24 July 1992
N. Wisconsin	Trilby	838-150-08	Silver / Blue	Green / Green	Adult	Male	10	17 July 1992
N. Wisconsin	Trilby	838-150-09	Silver / Blue	White / White	Adult	Female	3	17 July 1992
N. Wisconsin	Vicks	838-145-60	silver / green	blue / blue	adult	female	4	3 August 1993
N. Wisconsin	Wabasso	618-111-57	blue / silver	white	adult	female	11	11 July 1991
N. Wisconsin	Wabasso	618-111-62	white	silver / blue	juvenile	unknown	3	12 July 1991
N. Wisconsin	Wabasso	838-148-46	green / blue	silver / blue	juvenile	unknown	2.5	5 July 1993
N. Wisconsin	Wabasso	838-150-12	Blue / Red	Silver / Blue	Juvenile	Unknown	[illegible]	16 July 1992
N. Wisconsin	Washburn	618-111-46	blue / silver	red	adult	male	5	9 July 1991
N. Wisconsin	Washburn	618-111-47	yellow	blue / silver	juvenile	unknown	3	9 July 1991
N. Wisconsin	Washburn	618-111-48	green	blue / silver	juvenile	unknown	3	9 July 1991
N. Wisconsin	Washburn	838-145-29	yellow / red	silver / red	juvenile	unknown	3	17 July 1993
N. Wisconsin	Washburn	838-147-02	Silver / blue	White / Red	Adult	Female	9	3 July 1992
N. Wisconsin	Washburn	838-147-51	Green / Red	Silver / Blue	Juvenile	Unknown	1.5	16 July 1992
N. Wisconsin	Washburn	838-147-52	Green / Yellow	Green / Silver	Juvenile	Unknown	1.5	15 July 1992
N. Wisconsin	West Plum	838-148-44	silver / yellow	white / red	adult	female	10	2 July 1993
N. Wisconsin	West Plum	838-148-45	silver / red	blue / yellow	adult	male	6	2 July 1993
N. Wisconsin	Wharton	618-111-76	blue / silver	green / red	adult	male	10	15 July 1991
N. Wisconsin	Wharton	758-781-33	green / silver	red / yellow	adult	female	10	26 July 1991
N. Wisconsin	Wharton	758-781-34	white	silver / white	juvenile	unknown	4	27 July 1991
N. Wisconsin	Whitefish	758-781-22	red / green	Blue / silver	juvenile	unknown	3	24 July 1991
N. Wisconsin	Whitefish	758-781-23	silver / blue	red / yellow	adult	male	1	24 July 1991
N. Wisconsin	Whitefish	838-145-50	silver / yellow	white / green	adult	female	6.5	21 July 1993
N. Wisconsin	Wildcat	838-150-26	Green / Silver	Blue / Green	Adult	Male	5	21 July 1992
N. Wisconsin	Wildcat	838-150-27	Green / Silver	Green / Green	Adult	Female	7	21 July 1992
N. Wisconsin	Wildcat	838-150-28	Yellow / Blue	Silver / Blue	Juvenile	Unknown	3	21 July 1992
N. Wisconsin	Wilson	618-111-87	blue / silver	white / red	adult	male	9	16 July 1991
N. Wisconsin	Wilson	618-111-88	blue / silver	blue / yellow	adult	female	10	16 July 1991
N. Wisconsin	Wilson/Deer	838-145-52		silver	juvenile	unknown	3	26 July 1990
N. Wisconsin	Wilson/Deer	838-147-23	Blue / Red	Green / Silver	Juvenile	Unknown	1.5	7 July 1992
N. Wisconsin	Wilson/Deer	838-147-24	Blue	Green / Silver	Juvenile	Unknown	1.5	7 July 1992
N. Wisconsin	Window Pane	838-145-01	silver / yellow	blue / red	adult	female	2	8 July 1993
N. Wisconsin	Window Pane	838-145-34	red / yellow	silver / yellow	juvenile	unknown	2.5	18 July 1993
N. Wisconsin	Window Pane	838-145-35	white / yellow	silver / red	adult	male	6	18 July 1993
N. Wisconsin	Window Pane	838-145-36	green / white	silver / red	juvenile	unknown	3	18 July 1993
N. Wisconsin	Wishow	838-147-29	–	Green / Silver	Juvenile	Unknown	2	6 July 1992
N. Wisconsin	Wishow	838-147-30	Green / Silver	–	Adult	Male	4.5	8 July 1992
N. Wisconsin	Wishow	838-150-14	Red / Green	Silver / Blue	Juvenile	Unknown	1.5	16 July 1992
N. Wisconsin	Wolf	838-145-16	silver / yellow	red / white	adult	male	10	13 July 1993
North Country	Dummer	838-148-97	yellow / white	orange / silver	juvenile	unknown	1.5	23 August 1993
Ontario	Barnum	838-146-12	Yellow	Tan / Silver	Juvenile	Unknown	3	4 August 1992
Ontario	Harrette	838-147-72	Tan / Silver	Green / green	Adult	Female	8	27 July 1992
Ontario	Barrette	838-147-73	Tan / Silver	Red	Juvenile	Unknown	2.5	27 July 1992
Ontario	Barrette	838-147-74	Tan / Silver	Yellow	Adult	Male	5	27 July 1992
Ontario	Beaver	838-147-89	Yellow / Green	Tan / Silver	Juvenile	Unknown	4	30 July 1992
Ontario	Beaver	838-147-90	Green / Red	Tan / Silver	Juvenile	Unknown	4	30 July 1992
Ontario	Centere	838-147-96	Red / Blue	Tan / Silver	Juvenile	Unknown	2	1 August 1992
Ontario	Contau	838-148-10	Red / Red	Silver / Tan	Juvenile	Unknown	4.3	3 August 1992
Ontario	Contau	838-148-11	Red / Green	Silver / Tan	Juvenile	Unknown	4	3 August 1992
Ontario	Cooper	838-148-25	Tan / Red	Tan / Silver	Juvenile	Unknown	2.75	7 August 1992
Ontario	Cooper	838-148-26	Tan / Green	Tan / Silver	Juvenile	Unknown	2.4	7 August 1992
Ontario	Cooper	838-148-27	Silver / Tan	Red / Yellow	Adult	Male	8	7 August 1992
Ontario	Dessert	838-147-93	Blue / Blue	Tan / Silver	Juvenile	Unknown	3	31 July 1992
Ontario	Dessert	838-147-94	Tan / Silver	Tan / Blue	Adult	Unknown	10	31 July 1992
Ontario	Dessert	838-147-95	Blue / Green	Tan / Silver	Juvenile	Unknown	5	31 July 1992
Ontario	Four Mile Lake	838-148-08	Blue / Tan	Tan / Silver	Juvenile	Unknown	2	2 August 1992
Ontario	Four Mile Lake	838-148-09	Tan / Silver	–	Adult	Female	[illegible]	2 August 1992
Ontario	Fox	838-148-28	Green	Silver / Tan	Juvenile	Unknown	3	7 August 1992
Ontario	Fox	838-148-29	Tan / Silver	Tan / Red	Adult	Male	1.5	7 August 1992
Ontario	Julian	838-147-69	Tan / Silver	Red	Adult	Female	2	27 July 1992
Ontario	Julian	838-147-70	Tan / Silver	Yellow	Adult	Male	3	27 July 1992
Ontario	Julian	838-147-71	Blue	Tan / Silver	Juvenile	Unknown	4	27 July 1992
Ontario	Kashabog	838-147-79	Tan / Silver	Blue	Adult	Female	6	28 July 1992
Ontario	Kashabog	838-147-80	Tan / Silver	Blue / Red	Adult	Male	10	28 July 1992
Ontario	Kashabog	838-147-81	Tan	Tan / Silver	Juvenile	Unknown	4	28 July 1992
Ontario	Kashabog	838-147-82	Blue / Red	Tan / Silver	Juvenile	Unknown	5	28 July 1992

General Locale	Name	USFWS	BL	LL	Age	Sex	Blood	Date
Ontario	Kashabog-Mac Bay	838-147-75	Tan / Silver	Green	Adult	Female	10	28 July 1992
Ontario	Kashabog-Mac Bay	838-147-76	Tan / Silver	Tan	Adult	Male	10	28 July 1992
Ontario	Kashabog-Mac Bay	838-147-77	Red	Tan / Silver	Juvenile	Unknown	1.5	28 July 1992
Ontario	Kashabog-Mac Bay	838-147-78	Green	Tan / Silver	Juvenile	Unknown	4	28 July 1992
Ontario	Kennisis	838-148-14	Tan / Silver	Yellow / Red	Adult	Male	7	4 August 1992
Ontario	Kennisis	838-148-15	–	Silver / Tan	Juvenile	Unknown	1	4 August 1992
Ontario	Kushog	838-148-13	Silver / Tan	Tan	Adult	Male	7	4 August 1992
Ontario	Limerick	838-147-98	Yellow / Tan	Tan / Silver	Juvenile	Unknown	2.5	1 August 1992
Ontario	Limerick	838-147-99	Blue / Yellow	Tan / Silver	Juvenile	Unknown	4	1 August 1992
Ontario	Little Silver	838-147-88	Yellow / Red	Tan / Silver	Juvenile	Unknown	3	30 July 1992
Ontario	Ox Tounge	838-148-19	Tan / Silver	Green / Red	Adult	Female	10	5 August 1992
Ontario	Ox Tounge	838-148-20	Silver / Tan	Red	Adult	Male	10	5 August 1992
Ontario	Ox tounge	838-148-21	Yellow	Silver / Tan	Juvenile	Unknown	3	5 August 1992
Ontario	Paudash	838-148-02	Green / Blue	Tan / Silver	Juvenile	Unknown	3	2 August 1992
Ontario	Paudash	838-148-03	Yellow / Yellow	Tan / Silver	Juvenile	Unknown	2.5	2 August 1992
Ontario	Paudash	838-148-05	Tan / Silver	Red / Red	Adult	Male	8.5	2 August 1992
Ontario	Prospect	838-148-30	Tan	Silver / Tan	Juvenile	Unknown	3.5	7 August 1992
Ontario	Prospect	838-148-31	Silver / Tan	–	Adult	Male	8	7 August 1992
Ontario	Riddell	838-147-97	Red / Tan	Tan / Silver	Juvenile	Unknown	3.5	1 August 1992
Ontario	Round	838-148-23	Silver / Tan	Blue	Adult	Male	10	5 August 1992
Ontario	Round	838-148-24	Silver / Tan	Green	Adult	Female	11	5 August 1992
Ontario	Sharbot-Gracie Is.	838-147-85	Green / Yellow	Tan / Silver	Juvenile	Unknown	5	29 July 1992
Ontario	Sharbot-Gracie Is	838-147-86	Red / Green	Tan / Silver	Juvenile	Unknown	4	29 July 1992
Ontario	Sharbot-Gracie Is.	838-147-87	Tan / Silver	Red / Blue	Adult	Male	8	29 July 1992
Ontario	Sharbot-Rider Is.	838-147-83	Tan / Silver	Blue / Yellow	Adult	Male	10	28 July 1992
Ontario	Sharbot-Rider Is.	838-147-84	Red / Yellow	Tan / Silver	Juvenile	Unknown	4	28 July 1992
Ontario	Spring	838-148-00	Green / Green	Tan / Silver	Juvenile	Unknown	3	1 August 1992
Ontario	Spring	838-148-01	Red / Red	Tan / Silver	Juvenile	Unknown	3	1 August 1992
Ontario	Sydennam-Eel Bay	838-147-91	Tan / Silver	Green / Yellow	Adult	Male	-	30 July 1992
Ontario	Sydennam-Eel Bay	838-147-92	Yellow / Blue	Tan / Silver	Juvenile	Unknown	4	31 July 1992
Ontario	Tasso	838-148-16	Red	Silver / Tan	Juvenile	Unknown	2.5	4 August 1992
Ontario	Tasso	838-148-17	Blue	Silver / Tan	Juvenile	Unknown	0	4 August 1992
Ontario	Tasso	838-148-18	Silver / Tan	Yellow	Adult	Female	7	4 August 1992
Ontario	Four Mile Lake	838-148-07	Yellow / Yellow	Tan / Silver	Juvenile	Unknown	4	2 August 1992
Ottawa NF	Cisco	758-781-19	silver / blue	yellow / white	adult	female	10	23 July 1991
Ottawa NF	Cisco	758-781-89	Silver / Green	Red / Red	Adult	Female	5	6 July 1992
Ottawa NF	Clark-north	618-111-98	blue / silver	red / blue	adult	female	10	20 July 1991
Ottawa NF	Clark-north	618-111-99	blue / silver	blue / blue	adult	male	10	20 July 1991
Ottawa NF	Clark-north	758-782-00	Silver / Green	White / green	Adult	Female	6	12 July 1992
Ottawa NF	Clark-southwest	618-111-95	–	silver / blue	juvenile	unknown	1	19 July 1991
Ottawa NF	Clark-southwest	618-111-96	blue / silver	red / red	adult	female	10	19 July 1991
Ottawa NF	Clark-southwest	618-111-97	blue/silver	blue / red	adult	male	10	19 July 1991
Ottawa NF	Clearwater	758-781-20	silver / blue	red / white	adult	female	10	23 July 1991
Ottawa NF	Clearwater	758-781-21	white / red	blue / silver	juvenile	unknown	1	23 July 1991
Ottawa NF	Clearwater	758-781-83	Silver / Green	Yellow / Blue	Adult	Male	10	3 July 1992
Ottawa NF	Clearwater	838-145-84	white / silver	yellow / yellow	adult	male	11	28 July 1993
Ottawa NF	Clearwater	838-145-85		silver	juvenile	unknown	1.5	28 July 1993
Ottawa NF	County Line	758-781-82	Silver / Green	Yellow / Red	Adult	Male	8	3 July 1992
Ottawa NF	County Line	758-781-98	Silver / Green	Green / White	Adult	Female	10	9 July 1992
Ottawa NF	County Line	758-781-99	Green / Yellow	Silver / Green	Juvenile	Unknown	3	6 July 1992
Ottawa NF	Crooked-north	758-781-84	Silver / Green	White / Red	Adult	Female	6	4 July 1992
Ottawa NF	Crooked-north	758-781-85	Silver / Green	Yellow / Green	Adult	Male	10	4 July 1992
Ottawa NF	Deadman's	758-781-10	silver / blue	yellow	adult	female	10	21 July 1991
Ottawa NF	Deadman's	758-781-11	silver / blue	–	adult	male	11	21 July 1991
Ottawa NF	Dinner	758-781-95	Blue / Yellow	Silver / green	Juvenile	Unknown	2.5	6 July 1992
Ottawa NF	Dinner	758-781-96	Silver / Green	Blue / White	Adult	Male	9	6 July 1992
Ottawa NF	Helen	758-781-88	Silver / Green	Green / Yellow	Adult	Male	10	5 July 1992
Ottawa NF	Honeysuckle	838-148-36	silver / red	white / red	adult	female	6	27 June 1993
Ottawa NF	Honeysuckle	838-148-37	silver / yellow	blue / yellow	adult	male	7.5	27 June 1993
Ottawa NF	Imp	838-148-39	silver / red	red / blue	adult	male	10	25 June 1993
Ottawa NF	Imp	838-148-40	silver / yellow	yellow / green	adult	female	8.5	25 June 1993
Ottawa NF	Langford	758-781-17	red	silver / blue	juvenile	unknown	2.5	22 July 1991
Ottawa NF	Langford	758-781-18	silver / blue	green / white	adult	male	10	22 July 1991
Ottawa NF	Langford/L. Lang.	758-781-90	Green	Silver / Green	Juvenile	Unknown	3	7 July 1992
Ottawa NF	Langford/L. Lang.	758-781-91	Silver / Green	Red / blue	Adult	Female	2.5	7 July 1992
Ottawa NF	Little Duck	618-111-91	white / green	blue / silver	juvenile	unknown	3.5	19 July 1991
Ottawa NF	Little Duck	618-111-92	blue / silver	green / green	adult	male	4	19 July 1991

Appendix I Summary of Common Loons banded, 1987-93

General Locale	Name	USFWS	BL	LL	Age	Sex	Blood	Date
Ottawa NF	Little Duck	618-111-93	blue / silver	red / yellow	adult	female	10	19 July 1991
Ottawa NF	Little Oxbow	758-781-94	Silver / Green	green / blue	Adult	Male	2	7 July 1992
Ottawa NF	Little Oxbow	838-148-35	silver / red	yellow / blue	adult	female	4	26 June 1993
Ottawa NF	Long	618-111-94	blue / silver	blue / green	adult	male	10.5	19 July 1991
Ottawa NF	Long	758-781-12	green / red	blue / silver	juvenile	unknown	4	22 July 1991
Ottawa NF	Long	758-781-13	silver / blue	yellow / white	adult	female	11	22 July 1991
Ottawa NF	Long	758-781-14	green / blue	blue / silver	juvenile	unknown	4	22 July 1991
Ottawa NF	Long	758-781-97	Yellow / Red	Silver / Green	Juvenile	Unknown	2	9 July 1992
Ottawa NF	"Loon Pond"	618-111-69	white / yellow	blue / silver	juvenile	unknown	[illegible]	18 July 1991
Ottawa NF	Loon Pond	618-111-90	blue / silver	yellow / red	adult	male	10.5	18 July 1991
Ottawa NF	Loon Pond	838-148-38	silver / yellow	blue / green	adult	female	3	28 June 1993
Ottawa NF	Marion	758-781-87	Silver / Green	Blue / Yellow	Adult	Male	7	6 July 1992
Ottawa NF	Marion	758-878-88	Silver / Green	White / Yellow	Adult	Female	2.5	6 July 1992
Ottawa NF	Ormes	758-781-92	Silver / Green	White / blue	Adult	Male	9	7 July 1992
Ottawa NF	Ormes	758-781-93	Silver / Green	Blue / Red	Adult	Female	10	7 July 1992
Ottawa NF	Redbeat	618-112-00	silver / blue	red	adult	female	10	21 July 1991
Ottawa NF	Redbeat	758-781-08	-	blue / silver	juvenile	unknown	3.5	21 July 1991
Ottawa NF	Redbeat	758-781-09	white / white	blue / silver	juvenile	unknown	3	21 July 1991
Ottawa NF	Snap Jack	838-150-03	Silver / Green	Red / Yellow	Adult	Male	1.5	12 July 1992
Ottawa NF	Snap Jack	838-150-04	Silver / Green	Blue / Green	Adult	Female	3	12 July 1992
Ottawa NF	Thousand Island	758-781-43	white / white	green / silver	juvenile	unknown	4	29 July 1991
Ottawa NF	Thousand Island	758-781-44	green / silver	yellow / white	adult	male	10	29 July 1991
Ottawa NF	Thousand Island	758-781-45	green / white	green / silver	juvenile	unknown	4	29 July 1991
Ottawa NF	Thousand Island	838-150-01	Silver / Green	Red / Green	Adult	Male	10	12 July 1992
Ottawa NF	Thousand Island	838-150-02	Silver / Green	Yellow / Yellow	Adult	Female	7	12 July 1992
Seney NWR	A-2 Pool	758-781-01	green	silver / yellow	juvenile	unknown	0	15 July 1989
Seney NWR	A-2 Pool	758-781-06	silver	yellow	adult	female	0	23 July 1989
Seney NWR	A-2-C-2 Pool	838-147-62	Green	Yellow / Silver	Juvenile	Unknown	3	18 July 1992
Seney NWR	B Pool-north	838-147-61	Silver / Yellow	Red	Adult	Male	10	18 July 1992
Seney NWR	B Pool-north	838-147-68	Yellow / Silver	White / White	Adult	Female	9.5	24 July 1992
Seney NWR	B Pool-north	838-150-91	Red / Green	Yellow / Silver	Juvenile	Unknown	4	18 August 1992
Seney NWR	B Pool-south	618-111-13	blue	yellow / silver	Juvenile	unknown	0	18 July 1990
Seney NWR	B Pool-south	618-111-45	blue / white	yellow / silver	juvenile	unknown	+	7 July 1991
Seney NWR	B Pool-south	758-235-06	green / red	silver	juvenile	unknown	0	6 July 1988
Seney NWR	B Pool-south	758-781-02	yellow / silver	green	adult	male	0	18 July 1989
Seney NWR	C-3 Pool	618-111-16	green / yellow	yellow / silver	juvenile	unknown	0	20 July 1990
Seney NWR	C-3 Pool	618-111-17	green / blue	yellow / silver	juvenile	unknown	0	20 July 1990
Seney NWR	C-3 Pool	618-111-37	yellow / silver	red / white	adult	female	9	30 June 1991
Seney NWR	C-3 Pool	618-111-38	yellow / silver	blue / white	adult	male	8	30 June 1991
Seney NWR	C-3 Pool	758-781-05	yellow / silver	blue	adult	female	0	23 July 1989
Seney NWR	C-3 Pool	758-781-71	green / green	yellow / silver	juvenile	unknown	3.5	10 August 1991
Seney NWR	C-3 Pool	838-148-64	yellow / silver	blue / yellow	adult	male	3.5	13 July 1993
Seney NWR	D Pool	618-111-18	yellow / silver	green / white	adult	male	no	21 July 1990
Seney NWR	D Pool	618-111-25	green / white	yellow / silver	juvenile	unknown	0	20 August 1990
Seney NWR	D Pool	618-111-26	red / blue	yellow / silver	juvenile	unknown	0	20 August 1990
Seney NWR	D Pool	758-781-03	silver	red	adult	female	0	22 July 1989
Seney NWR	D Pool	838-148-89	red / yellow	yellow / silver	juvenile	unknown	1.5	24 August 1993
Seney NWR	D Pool	838-148-90	blue / green	yellow / silver	juvenile	unknown	1	24 August 1993
Seney NWR	E Pool-east	618-111-15	yellow / silver	white	adult	female	0	6 July 1990
Seney NWR	E Pool-east	618-111-19	red	yellow / silver	juvenile	unknown	0	24 July 1990
Seney NWR	E Pool-east	758-235-10	green / red	silver	juvenile	unknown	0	10 July 1988
Seney NWR	E Pool-east	838-147-66	Yellow / Silver	Yellow / Red	Adult	Male	10	24 July 1992
Seney NWR	E Pool-east	838-148-61	red	silver / yellow	juvenile	unknown	3.5	30 July 1993
Seney NWR	E Pool-east	838-150-92	Red / Yellow	Yellow / Silver	Juvenile	Unknown	0	18 August 1992
Seney NWR	G Pool	618-111-14	yellow / silver	blue / white	adult	female	0	10 July 1990
Seney NWR	G Pool	618-111-20	yellow	yellow / silver	juvenile	unknown	0	25 July 1990
Seney NWR	G Pool	618-111-21	white	yellow / silver	juvenile	unknown	0	25 July 1990
Seney NWR	G Pool	758-235-03	green / red	silver	juvenile	unknown	0	7 July 1987
Seney NWR	G Pool	758-235-04	green / red	silver	juvenile	unknown	0	6 July 1987
Seney NWR	G Pool	758-235-08	blue / yellow	silver	adult	male	0	9 July 1988
Seney NWR	G Pool	758-781-09	green / red	silver	juvenile	unknown	0	9 July 1988
Seney NWR	G Pool	838-148-62	white	silver / blue	juvenile	unknown	1	30 July 1993
Seney NWR	G Pool	838-151-00	yellow / silver	white / green	adult	female	10	13 July 1993
Seney NWR	G/E Pool-west	838-147-67	Yellow / Silver	Yellow	Adult	Female	4.5	24 July 1992
Seney NWR	G/E Pool-west	838-150-90	White / Blue	Yellow / Silver	Juvenile	Unknown	4	12 August 1992
Seney NWR	M-2 Pool	758-235-01	green / red	silver	juvenile	unknown	0	6 July 1987
Seney NWR	M-2 Pool	758-235-05	green / red	silver	juvenile	unknown	0	7 July 1988
Seney NWR	M-2 Pool	758-235-07	green / red	silver	juvenile	unknown	0	8 July 1988
Seney NWR	T2-West Pool	758-781-78	Yellow / silver	Red / Yellow	Adult	Male	10	23 June 1992
Seney NWR	T2-West Pool	838-148-59	yellow / silver	red / red	adult	female	2	30 July 1993
Superior NF	Whiteface Reservoir	838-150-89	Silver	--	Adult	Male	6	9 August 1992
Superior NF	Whitewater-south bay	838-150-93	Silver / White	White	Adult	Male	10	9 August 1992
Turtle-Flambeau	Merkle	838-145-05	silver / yellow	red / blue	adult	female	11.5	9 July 1993
Turtle-Flambeau	Trude-east	838-145-12	red / white	silver / red	juvenile	unknown	2	13 July 1993
Turtle-Flambeau	Beaver Creek	838-145-55	silver / red	green	adult	female	5.5	29 July 1993
Turtle-Flambeau	Beaver Creek	838-145-56	silver / yellow	white	adult	male	6	29 July 1993
Turtle-Flambeau	Beaver Creek	838-145-57		silver	juvenile	unknown	1.5	29 July 1993
Turtle-Flambeau	Big Island Bridge	758-781-41	green / silver	yellow / white	adult	female	11	26 July 1991
Turtle-Flambeau	Blaire	618-111-63	blue / silver	yellow / white	adult	male	9.5	14 July 1991
Turtle-Flambeau	Fisherman's Landing	618-111-64	blue / silver	green / white	adult	female	12	14 July 1991
Turtle-Flambeau	Fisherman's Landing	618-111-65	blue / silver	blue / white	adult	male	12	14 July 1991
Turtle-Flambeau	Fisherman's Landing	618-111-66	red	silver / blue	juvenile	unknown	1.5	14 July 1991
Turtle-Flambeau	Fourth of July Slough	838-145-53	silver / yellow	blue	adult	female	3	29 July 1993
Turtle-Flambeau	Fourth of July Slough	838-145-54	silver / red	yellow	adult	male	6	29 July 1993
Turtle-Flambeau	Horseshoe Bay-south	618-111-72	green / green	blue / silver	juvenile	unknown	3	15 July 1991
Turtle-Flambeau	Horseshoe Bay-south	838-147-08	Silver / Blue	Red / Blue	Adult	Male	10	4 July 1992
Turtle-Flambeau	Horseshoe Bay-south	838-147-09	silver / Blue	Yellow / Blue	Adult	Female	10	4 July 1992
Turtle-Flambeau	Horseshoe Bay-south	838-150-31	Green / Green	Silver / Blue	Juvenile	unknown	4.6	22 July 1992
Turtle-Flambeau	Horseshoe Bay-west	838-145-64	silver / green	yellow / white	adult	female	5	11 August 1993
Turtle-Flambeau	Horseshoe Bay-west	838-145-65	red / red	silver / yellow	juvenile	unknown	1	11 August 1993
Turtle-Flambeau	Horseshoe Bay-west	838-145-66	green / white	silver / green	juvenile	unknown	2	11 August 1993
Turtle-Flambeau	Murray's Landing	618-111-67	green / white	blue / silver	juvenile	unknown	3	14 July 1991
Turtle-Flambeau	Murray's Landing	618-111-68	blue / silver	Green / yellow	adult	female	10	14 July 1991
Turtle-Flambeau	Murray's Landing	838-147-03	Silver / Blue	Blue / Green	Adult	Male	75	3 July 1992
Turtle-Flambeau	Murray's Landing	838-150-32	Blue / Green	Silver / Blue	Juvenile	Unknown	4	23 July 1992
Turtle-Flambeau	Narrows	838-147-16	Silver / Green	Yellow	Adult	Male	5	6 July 1992
Turtle-Flambeau	North Bonie	838-147-05	Silver / blue	White / Green	Adult	Male	10	4 July 1992
Turtle-Flambeau	North Bonie	838-147-06	Silver / Blue	Blue / Yellow	Adult	Female	.5	4 July 1992
Turtle-Flambeau	North Bonie	838-150-33	Green / Silver	Green / White	Adult	Male	10	23 July 1992
Turtle-Flambeau	North Bonie	838-150-34	Blue / Yellow	Silver / Blue	Juvenile	Unknown	3	23 July 1992
Turtle-Flambeau	Rat	838-145-58	silver		adult	male	4.5	29 July 1993
Turtle-Flambeau	Rat	838-145-59	silver / yellow	green / yellow	adult	female	6	29 July 1993
Turtle-Flambeau	Snoose Alley	838-147-15	Blue / Silver	–	Adult	Female	10	5 July 1992
Turtle-Flambeau	Snoose Alley	838-150-29	Yellow / Yellow	Silver / Blue	Juvenile	Unknown	4	22 July 1992
Turtle-Flambeau	South Bonie	838-147-04	Silver / Blue	Yellow / Green	Adult	Female	.3	4 July 1992
Turtle-Flambeau	South Bonie	838-150-36	White / Blue	Silver / Blue	Juvenile	Unknown	4	23 July 1992
Turtle-Flambeau	Springstead Landing	838-147-12	-	Silver / Blue	Juvenile	Unknown	5	6 July 1992
Turtle-Flambeau	Springstead Landing	838-147-13	Green / Silver	Blue	Adult	Female	9	5 July 1992
Turtle-Flambeau	Springstead Landing	838-147-14	White	Silver / Green	Juvenile	Unknown	0	5 July 1992
Turtle-Flambeau	Springstead Landing	838-150-30	Green / Silver	Green / Blue	Adult	Male	3	22 July 1992
Turtle-Flambeau	Sturgeon Bay	838-147-10	Yellow / Red	Silver / Blue	Juvenile	Unknown	0	5 July 1992
Turtle-Flambeau	Sturgeon Bay	838-147-11	Silver / blue	Blue / red	Adult	female	2.5	5 July 1992
Turtle-Flambeau	Swimmer's Island	618-111-69	green / yellow	blue / silver	juvenile	unknown	4	15 July 1991
Turtle-Flambeau	Teal Bay	618-111-70	yellow / green	blue / silver	juvenile	unknown	4	15 July 1991
Turtle-Flambeau	Teal Bay	618-111-71	blue / silver	red / green	adult	male	10	15 July 1991
Turtle-Flambeau	Trude-east	838-147-66	Silver / Blue	Blue / Blue	Adult	Unknown	6.5	15 July 1992
Turtle-Flambeau	Trude-west	618-111-80	blue / silver	yellow / yellow	adult	female	10	16 July 1991
Turtle-Flambeau	Trude-west	758-781-42	red	silver / green	juvenile	unknown	2.5	26 July 1991
Voyageur's NP	Namakan-Blind Ind.	838-150-87	Red / Red	Silver / White	Juvenile	Unknown	4.4	2 August 1992
Voyageurs NP	Ek Lake	838-150-86	Silver / White	Yellow / None	Adult	Male	9.6	8 August 1992
Voyageurs NP	Ek Lake	838-150-87	Silver / White	Blue	Adult	Female	5.6	8 August 1992
Voyageurs NP	Ek Lake	838-150-88	Red / Blue	Silver / White	Juvenile	Unknown	3.6	8 August 1992
Voyageurs NP	Kabetogama-Narrows	838-148-70	silver	red / red	adult	male	3	6 August 1993
Voyageurs NP	Kabetogama-Narrows	838-148-71	silver	white / green	adult	female	1	8 August 1993
Voyageurs NP	Kabetogoma-Cutover Is.	838-150-83	Silver / White	Blue / White	Adult	Male	3.4	5 August 1992
Voyageurs NP	Kabetogoma-Ek Bay	838-150-84	Silver / White	White / White	Adult	Male	2	5 August 1992
Voyageurs NP	Namakan-Blind Ind.	838-150-58	Silver / White	Red / Green	Adult	Female	9.5	2 August 1992
Voyageurs NP	Namakan-Blind Ind.	838-150-59	Yellow / Green	Silver / White	Juvenile	Unknown	0	2 August 1992
Voyageurs NP	Namakan-Old Dutch	838-150-61	Silver / White	Green / Green	Adult	Male	6.2	2 August 1992
Voyageurs NP	Namakan-Old Dutch	838-150-62	Blue / Yellow	Silver / White	Juvenile	Unknown	4.25	2 August 1992
Voyageurs NP	Namakan-Old Dutch	838-150-63	White / Yellow	Silver / White	Juvenile	Unknown	4	2 August 1992
Voyageurs NP	Namakan-Old Dutch	838-150-85	Silver / White	Red	Adult	Female	7.2	5 August 1992
Voyageurs NP	Namakan-Williams	838-150-60	Silver / White	Yellow / Green	Adult	Male	6	2 August 1992
Voyageurs NP	Rainy-Black Bay-n	838-148-74	silver	blue / green	adult	female	6.5	9 August 1993

General Locale	Name	USFWS	BL	LL	Age	Sex	Blood	Date
Voyageurs NP	Rainy-Black Bay-n	838-148-66	white / yellow	silver	juvenile	unknown	1	11 August 1993
Voyageurs NP	Rainy-Brule Narrows	838-150-64	Silver / White	Red / Red	Adult	Unknown	10	3 August 1992
Voyageurs NP	Rainy-Brule Narrows	838-150-65	Silver / White	Blue / Green	Adult	Male	10	3 August 1992
Voyageurs NP	Rainy-Dove Bay-n	838-148-82	yellow / blue	silver	juvenile	unknown	1	10 August 1993
Voyageurs NP	Rainy-Dove Bay-n	838-148-83	silver	green /blue	adult	female	3	10 August 1993
Voyageurs NP	Rainy-Dove Bay-n	838-148-84	silver	white / white	adult	male	1.5	10 August 1993
Voyageurs NP	Rainy-Dove Bay-s	838-148-74	silver	yellow / blue	adult	male	11	10 August 1993
Voyageurs NP	Rainy-Drywood Is.-n	838-150-78	Silver / White	White / Blue	Adult	Unknown	[illegible]	4 August 1992
Voyageurs NP	Rainy-Drywood Is.-nw	838-148-69	red / yellow	silver	juvenile	unknown	3	9 August 1993
Voyageurs NP	Rainy-Drywood Is.-nw	838-148-67	silver	yellow / yellow	adult	female	3	11 August 1993
Voyageurs NP	Rainy-Drywood Is.-nw	838-150-79	Silver / White	Red / White	Adult	Male	10	4 August 1992
Voyageurs NP	Rainy-Drywood Is.-nw	838-150-80	Green / White	Silver / White	Juvenile	Unknown	1.5	4 August 1992
Voyageurs NP	Rainy-Drywood Is.-w	838-148-72	green / white	silver	juvenile	unknown	2.5	9 August 1993
Voyageurs NP	Rainy-Drywood Is.-w	838-148-73	white / white	silver	juvenile	unknown	2	9 August 1993
Voyageurs NP	Rainy-Frazer Bay	838-148-75	silver	red / white	adult	female	6	10 August 1993
Voyageurs NP	Rainy-Frazer Bay	838-148-76	yellow / yellow	silver	juvenile	unknown	3.5	10 August 1993
Voyageurs NP	Rainy-Frazer Bay	838-148-77	white / green	silver	juvenile	unknown	3.5	10 August 1993
Voyageurs NP	Rainy-Harrison Bay	838-150-81	Silver / White	Yellow / White	Adult	Female	10	4 August 1992
Voyageurs NP	Rainy-Harrison Bay	838-150-82	Silver / White	Blue / White	Adult	Male	6	4 August 1992
Voyageurs NP	Rainy-Lost Bay-mid	838-150-70	Silver / White	Yellow / Blue	Adult	Male	7	3 August 1992
Voyageurs NP	Rainy-Lost Bay-mid	838-150-71	Red / White	Silver / White	Juvenile	Unknown	3.5	3 August 1992
Voyageurs NP	Rainy-Lost Bay-mid	838-150-72	Silver / White	Green / White	Adult	Female	1	3 August 1992
Voyageurs NP	Rainy-Lost Bay-upper	838-148-88	silver	green / yellow	adult	male	3.5	11 August 1993
Voyageurs NP	Rainy-Neil Point	838-150-73	Red / Yellow	Silver / White	Juvenile	Unknown	4	4 August 1992
Voyageurs NP	Rainy-Neil Point	838-150-74	Silver / White	Green / Blue	Adult	Unknown	10	4 August 1992
Voyageurs NP	Rainy-Snag Is.	838-148-79	yellow / green	silver	juvenile	unknown	1	10 August 1993
Voyageurs NP	Rainy-Snag Is.	838-148-80	silver	green / white	adult	female	0	10 August 1993
Voyageurs NP	Rainy-Snag Is.	838-148-81	silver	white/red	adult	male	2.5	10 August 1993
Voyageurs NP	Rainy-Sobolesky Bay	838-150-66	Silver / White	White / Green	Adult	Male	10	3 August 1992
Voyageurs NP	Rainy-Sobolesky Bay	838-150-67	Silver / White	Red / Blue	Adult	Female	10	3 August 1992
Voyageurs NP	Rainy-Sobolesky Bay	838-150-68	Green / Green	Silver / White	Juvenile	Unknown	2.5	3 August 1992
Voyageurs NP	Rainy-Sobolesky Bay	838-150-69	Blue / Blue	Silver / White	Juvenile	Unknown	4	3 August 1992
Voyageurs NP	Rainy-Tango Bay	838-150-75	Silver / White	Blue / Blue	Adult	Male	3	4 August 1992
Voyageurs NP	Rainy-Tango Bay	838-150-76	Red / green	Silver / White	Juvenile	Unknown	3.4	4 August 1992
Voyageurs NP	Rainy-Tango Bay	838-150-77	Yellow / Blue	Silver / White	Juvenile	Unknown	1.4	4 August 1992

General Locale	Name	USFWS	BL	LL	Age	Sex	Blood	Date

Appendix II. Status of known Common Loon nesting pairs for the eastern Upper Peninsula, Michigan for 1990-93.

				Adults				Territories				Nests				Chicks			
Location	County	Lake (T.R.S)	Lake size	1990	1991	1992	1993	1990	1991	1992	1993	1990	1991	1992	1993	1990	1991	1992	1993
Seney NWR	Scho	A-2 Pool (45N 14W 23)	282	2	2	0	2	1	1	0	1	1	1	0	1	0	0	0	0
private	Scho	Anna Louise (43N 13W		2	2	2	2	1	1	1	1	1	0	0	0	2	0	0	0
Seney NWR	Scho	B-Pool north (45N 13W 29)	243	0	0	2	2	0	0	1	1	0	0	1	1	0	0	1	1
Seney NWR	Scho	B-Pool-south (45N 13W 29)	243	2	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0
Hiawatha NF	Scho	Big Island (44N 18W 3)	130	2	2	2	2	1	1	1	1	1	1	0	0	1	0	0	0
private	Mac	Big Manistique (43N	10,130	5	7	6	4	2	2	1	2	2	2	0	1	2	3	0	2
Lake Superior SF	Mac	Big Manistique-River	–	2	2	2	2	0	1	1	1	0	1	0	1	0	0	0	1
Hiawatha NF	Alge	Big Twin/Als (45N,19W 23	60/25	1	1	1	2	1	1	0	1	1	0	0	1	1	0	0	0
Hiawatha NF	Scho	Boot (45N 17,10W 28,29)	108	0	2	--	2	0	1	--	1	0	--	--	1	0	--	--	0
Hiawatha NF	Mac	Brevoort (42N 5W many)	4,230	2	4	4	2	1	2	1	1	0	1	1	0	0	1	0	0
Hiawatha NF	Alge	Bunting (45N 20W 27)	60	2	2	2	2	1	1	1	1	1	1	1	1	2	2	1	0
Seney NWR	Scho	C-2 Pool (45N 14W S23)	501	0	0	2	2	0	0	1	1	0	0	1	0	0	0	1	0
Seney NWR	Scho	C-3 Pool (45N 15W	702	2	3	3	2	1	1	1	1	1	1	0	1	2	2	0	2
Lake Superior SF	Chip	Camp 10 Lake (48N 7W 11)		--	--	2	2	--	--	1	1	--	--	1	0	--	--	1	0
private	Chip	Caribou (42N 3E 25 36)	825	2	4	2	2	1	2	1	1	1	1	1	1	1	2	1	2
Hiawatha NF	Chip	Carp (44N 6W 27)	560	0	2	1	--	0	1	0	--	0	1	0	--	0	1	0	--
Michigan Nature Assoc.	Scho	Cedar (43N 13W 32,33)	110	--	2	2	2	--	1	1	1	--	1	1	1	--	0	1	1
Lake Superior SF	Chip	Cranberry (41N 3E 1 2)	70	2	2	--	2	1	1	--	1	1	1	--	1	2	1	--	1
Lake Superior SF	Luce	Culhane (50N 8W 30,31)	98	2	2	1	2	1	1	0	0	0	1	0	0	0	1	0	0
Lake Superior SF	Scho	Cusino (47N 16W 23 24)	140	2	2	3	2	1	1	1	1	0	1	0	0	0	0	0	0
Seney NWR	Scho	D-Pool (45N 13,14W 20 30)	197	2	2	3	2	1	1	1	1	1	0	1	1	2	0	0	2
Escanaba River SF	Alge	Dorsey (46N 22W 33)		--	2	--	2	--	1	--	1	--	1	--	1	--	2	--	2
Lake Superior SF	Scho	Driggs (47N 15W many)	178	2	2	0	2	1	1	0	1	0	1	0	0	0	2	0	0
Seney NWR	Scho	E-Pool-east (45N 13W 19,20)	490	2	2	2	2	1	1	1	1	1	1	1	1	1	0	1	1
Hiawatha NF	Mac	East (43N 4W 9,10,15,16)	995	9	9	7	7	3	3	3	3	3	2	3	3	3	0	3	3
private	Scho	Ford (43N 13W 3)	60	2	1	2	2	1	0	1	1	1	0	1	1	0	0	1	0
Hiawatha NF	Chip	Frenchman (44N 6W many)	220	2	3	2	2	1	1	1	1	0	1	1	1	0	1	1	0
Seney NWR	Scho	G Pool (45N 14W 24)	202	2	2	2	2	1	1	1	1	1	0	1	1	2	0	1	2
Lake Superior SF	Scho	Gemini (47N 16W 4,9,10)	120	2	2	2	2	1	1	1	1	0	1	0	1	0	0	0	0
private	Scho	Gulliver (41N 14W	837	2	3	0	--	1	1	0	--	0	1	0	--	0	1	0	--
Lake Superior SF	Luce	Halfway (47N 10W 17)		2	2	2	2	1	1	1	1	1	1	0	1	0	2	0	0
Hiawatha NF	Mac	Hay (41N 4W 15,22)	445	2	1	--	--	1	0	--	--	1	0	--	--	1	0	--	--
Hiawatha NF	Chip	Highbanks (46N 5W 24)	19	2	2	1	0	1	1	0	0	0	1	0	0	0	1	0	0
Hiawatha NF	Chip	Hulbert (45N 6,7W many)	--	2	3	3	2	1	1	1	1	1	1	1	0	0	2	1	0
Lake Superior SF	Scho	Island (43N 16W 14,15)	107	0	--	0	2	0	--	0	1	0	--	0	1	0	--	0	0
Lake Superior SF	Scho	Kennedy (44N 13W 13,14)	131	0	2	2	2	0	1	1	1	0	1	0	0	0	2	0	0
Hiawatha NF	Alge	Little Round (45N 20W	24	0	2	2	2	0	1	1	1	0	0	1	1	0	0	1	1
Lake Superior SF	Alge	Long (47,48N 16W 4,33)	117	3	2	2	2	1	0	1	1	0	0	1	1	0	0	1	1
Seney NWR	Scho	M-2 Pool (44, 45 N 14W	863	2	2	2	0	1	1	1	0	1	1	1	0	0	0	2	0
Lake Superior SF	Scho	Marblehead (42N 15W	125	2	0	0	--	1	0	0	--	1	0	0	--	2	0	0	--
Lake Superior SF	Luce	Murray (47N,11W,16 17)	92				2				1				1				2
Lake Superior SF	Alge	Nevins (48N 16W 36)	276	2		2	2	1	--	1	1	1	--	1	0	2	--	--	0
Lake Superior SF	Alge	Nugent (48N 15W 28)		3	0	--	2	0	0	--	1	0	0	--	1	0	0	--	0
Hiawatha NF	Alge	Perch (46N 19W 8,17)	124	2	2	2	2	1	1	1	1	1	1	1	1	0	0	1	1
Lake Superior SF	Luce	Pike (49N 9W 14,15)	292	4	4	3	2	2	2	1	1	2	1	1	1	0	2	1	1
Lake Superior SF	Luce	Pretty L. area (T49N 11W 34)		--	--	3	--		--	1	--	--	--	1	--	--	--	0	--
Hiawatha NF	Alge	Ready (45N 19W 29 32)	66	2	2	2	2	1	1	1	1	0	0	1	0	0	0	1	0
Hiawatha NF	Chip	Rice Lakes (45N,5W 8)	-	--	--	2	0	--	--	1	0	--	--	1	0	--	--	1	0
private	Mac	S. Manistique (43 44N 12W	4,001	4	2	6	4	2	2	2	2	1	1	2	2	2	2	3	4
Hiawatha NF	Scho	Sand (45N 17W	106	0			2	0	--		1	0	--	--	1	0	--	--	0
Drummond Is	Chip	Scammon Cove (41N 6E 13)	-		2	--			1			--	1	--	--	--	1	--	--
Hiawatha NF	Alge	Sixteen-Mile(45N,20W many)	442	3	3	2	2	0	0	1	1	0	0	0	1	0	0	0	1
Lake Superior SF	Luce	Sleeper (46N 10W 33,34)		2	2	1	2	1	1	0	1	1	1	0	0	1	1	0	0
Lake Superior SF	Scho	Smith (43N 15W 17,18,19)		0	2		2	0	1	--	1	0	1	--	1	0	2	--	1
Lake Superior SF	Mac	Strouble (43N 7W 4,5,8,9)	319	2	4	2	4	1	2	1	2	0	2	1	1	0	3	0	2
Hiawatha NF	Chip	Sylvester Imp (45N 3W	-	2	2	2	2	1	1	1	1	1	1	--	1	1	1	--	1
Seney NWR	Scho	T 2 Pool-West (44N		0	0	2	2	0	0	1	1	0	0	1	1	0	0	0	1
Hiawatha NF	Scho	Triangle (44N 18W 36)	166	2	0	0	2	0	0	0	1	0	0	0	1	0	0	0	1
Pictured Rocks NL	Alge	Upper Shoe	31	--	2	2	2	--	1	1	1	--	1	0	0	--	2	0	0

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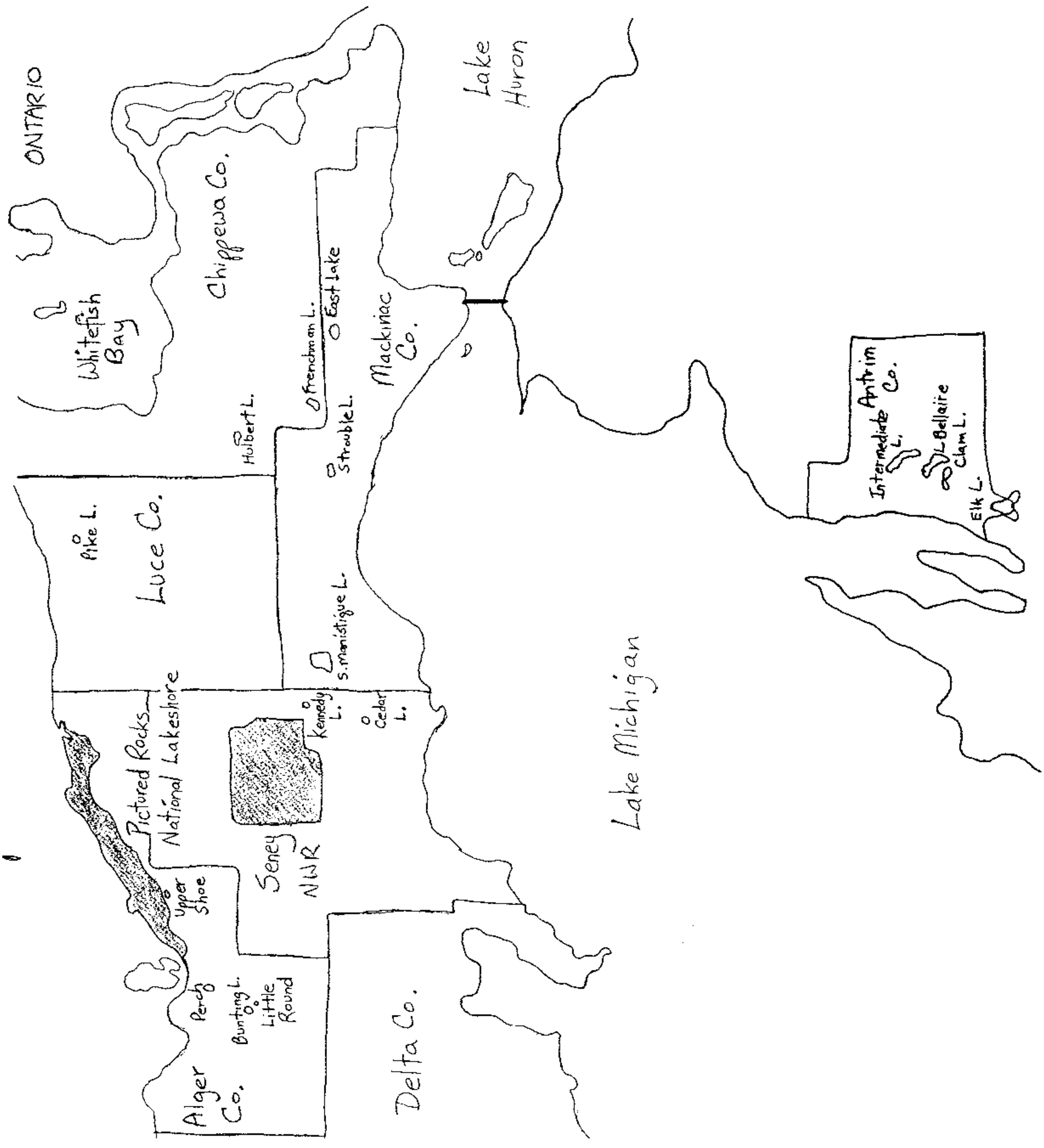
Location	County	Lake (T,R,S)	Lake size	Adults 1990	Adults 1991	Adults 1992	Adults 1993	Territories 1990	Territories 1991	Territories 1992	Territories 1993	Nests 1990	Nests 1991	Nests 1992	Nests 1993	Chicks 1990	Chicks 1991	Chicks 1992	Chicks 1993
Hiawatha NF	Alge	Ackerman (45N 20W 3)	14	-	2	-	2	-	1	-	0	-	0	-	0	-	0	-	0
Hiawatha NF	Alge	AuTrain Lake (45N,20W,6,7)	830	1	2		2	0	1	-	0	0	0	-	0	0	0	-	0
Hiawatha NF	Alge	AuTrain R. Bas (40N,20W 6)	-	0	0		2	0	0	-	1	0	0	-	0	0	0	-	0
Hiawatha NF	Alge	Bar (44N 19W 2)	60	0	0		-	0	0		-	0	0	-	-	0	0		-
Hiawatha NF	Alge	Big Twin/Als (45N,19W 23	60/25	1	1	1	2	1	1	0	1	1	0	0	1	1	0	0	0
Hiawatha NF	Alge	Blue (44N 19W 35,36)	-	-	0		-	-	0	-	-	-	0	-	-	-	0		-
Hiawatha NF	Alge	Bunting (45N 20W 27)	60	2	2	2	2	1	1	1	1	1	1	1	1	2	2	1	0
Hiawatha NF	Alge	Cook (44,45N 20W 2,35)	126	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Alge	Corner (43N 19W 31)	144	0	0	-	-	0	0	-	-	0	0	-	-	0	0	-	-
Hiawatha NF	Alge	Doe (43N 19W	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Alge	Fish (44N 19W 11 12)	-	0	0	0	-	0	0	0	-	0	0	0		0	0	0	-
Hiawatha NF	Alge	Furnace (47N 19W 29)		-	0		2	-	0	-		-	0	-	-	-	0	-	-
Hiawatha NF	Alge	Hovey (45N 19W 17,20)	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Alge	Island (45N 19W 26)	33	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Alge	Little Round (45N 20W	24	0	2	3	2	0	1	1	1	0	0	1	1	0	0	1	1
Hiawatha NF	Alge	Lost (45N 19W 14,15)	106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Alge	McComb (44N 19W	59	0	0	0		0	0	0	-	0	0	0		0	0	0	-
Hiawatha NF	Alge	McNeil (45N 19W 13,24)	39		2	0	-	-	1	0		-	0	0	-	-	0	0	-
Hiawatha NF	Alge	Mirror (45N 19W 21 28)	37	0	2	-	2	0	1		0	0	0	-	0	0	0	-	0
Hiawatha NF	Alge	Moccasin (44N 19W 1)	77	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Alge	Muddy/Grimes (45N 19W	36/32	1	2	1	1	0	1	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Alge	Murray Bay (47N 19W many)	-	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Alge	Otter-north (45N 19W 7)	31	3	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Alge	Otter-south (45N 19W 7)	34	0	0	0	-	0	0	0		0	0	0	-	0	0	0	-
Hiawatha NF	Alge	Paquette (44,45N 20W many)	36	0	0			0	0	-	-	0	0	-	-	0	0	-	-
Hiawatha NF	Alge	Perch (46N 19W 8,17)	124	2	2	2	2	1	1	1	1	1	1	1	1	0	0	1	1
Hiawatha NF	Alge	Powell (T45N 19W 11)	69	-		0	0	-	-	0	0	-	-	0	0	-	-	0	0
Hiawatha NF	Alge	Ready (45N 19W 29,32)	66	2	2	2	2	1	1	1	1	0	0	1	0	0	0	1	0
Hiawatha NF	Alge	Sixteen-Mile(45N,20W many)	442	3	2	2	2	0	0	1	1	0	0	0	1	0	0	0	1
Hiawatha NF	Alge	Swede (46N 19W 23)		1	0		0	0	0		0	0	0	-	0	0	0	-	0
Hiawatha NF	Alge	Temple (T44N 19W 34)	16			0		-		0	-	-	-	0		-	-	0	-
Hiawatha NF	Alge	Thornton (T44N R19W	29				0				0				0				0
Hiawatha NF	Alge	Tie (44N 19W 23)	54	2	1	0		0	0	0		0	0	0	-	0	0	0	-
Hiawatha NF	Alge	Wheelbarrow (45N 20W 25)	53	3	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Chip	Arbutus (45N,5W, 3,10	14			0				0		-		0		-		0	-
Hiawatha NF	Chip	Big Betchler (45N 5W	85	2	2		0	1	1		0	0	0		0	0	0		0
Hiawatha NF	Chip	Camp 10 Pond (44N 5W,23)		-	-	0	-	-	-	0				0		-	-	0	
Hiawatha NF	Chip	Carp (44N 6W 27)	560	0	2	1		0	1	0		0	1	0		0	1	0	-
Hiawatha NF	Chip	Deerfoot (45N 6W 14,23)	33			0	0		-	0	0		-	0	0	-	-	0	0
Hiawatha NF	Chip	Frenchman (44N 6W many)	220	2	3	2	2	1	1	1	1	0	1	1	1	0	1	1	0
Hiawatha NF	Chip	Highbanks (46N 5W 24)	19	2	2	1	0	1	1	0	0	0	1	0	0	0	1	0	0
Hiawatha NF	Chip	Hulbert (45N 6,7W many)	-	2	3	3	2	1	1	1	1	1	1	1	0	0	2	1	0
Hiawatha NF	Chip	Little Betchler (45N 4W 15)	14	0	0			0	0			0	0		-	0	0	-	-
Hiawatha NF	Chip	Monocle (47N 3W 11,14)	146	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Chip	Pendills (47N 4W 25,26)	230	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0
Hiawatha NF	Chip	Pratt Lake (47N 6W 35 36)	230	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Chip	Rice Lakes (45N 5W,8)	-	-	-	2	0	-	-	1	0	-	-	1	0	-	-	1	0
Hiawatha NF	Chip	Soldier (46N 5W 25)	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Chip	Spectacle(47N, 3W,many)	84	-		0	0	-	-	0	0	-		0	0	-	-	0	0
Hiawatha NF	Chip	Stump (46N,5W,24)	41		-	0	0	-	-	0	0	-	-	0	0	-		0	0
Hiawatha NF	Chip	Sylvester Imp (45N 3W		2	2	2	2	1	1	1	1	1	1		1	1	1	-	1
Hiawatha NF	Chip	Walker (45N 5W S6,7)	16	-	-	1	0	-	-	0	0	-		0	0	-	-	0	0
Hiawatha NF	Chip	Wegwaas (44N 6W 25,26)	160	2	2	2	-	0	1	0	-	0	0	0	-	0	0	0	-
Hiawatha NF	Delt	Camp-7 (42N 18W 3,4,9,10)	60	0	-	-	1	0	-	-	0	0	-		0	0	-		0
Hiawatha NF	Delt	Eva (43N 18W 33)	30	0	-		-	0	-	-	-	0	-	-	-	0	-	-	-
Hiawatha NF	Delt	Gooseneck (42N 18W 3,4)	139	0	-		-	0	-	-	-	0	-	-	-	0	-	-	-
Hiawatha NF	Delt	Upper 18-Mile (43N,20W 20,	38	2	-	-	-	1	-	-	-	0	-	-	-	0	-	-	-
Hiawatha NF	Mac	Brevoort (42N 5W many)	4,230	2	4	4	2	1	2	1	1	0	1	1	0	0	1	0	0
Hiawatha NF	Mac	Chain (40N,4W,11,12)	324	-		0	-	-	-	0	-	-	-	0	-	-	-	0	-
Hiawatha NF	Mac	Cranberry (41N 4W 21)	-	0	0	-	-	0	0	-	-	0	0	-	-	0	0	-	-
Hiawatha NF	Mac	East (43N 4W 9,10,15 16)	995	9	9	7	7	3	3	3	3	3	2	3	3	3	0	3	3

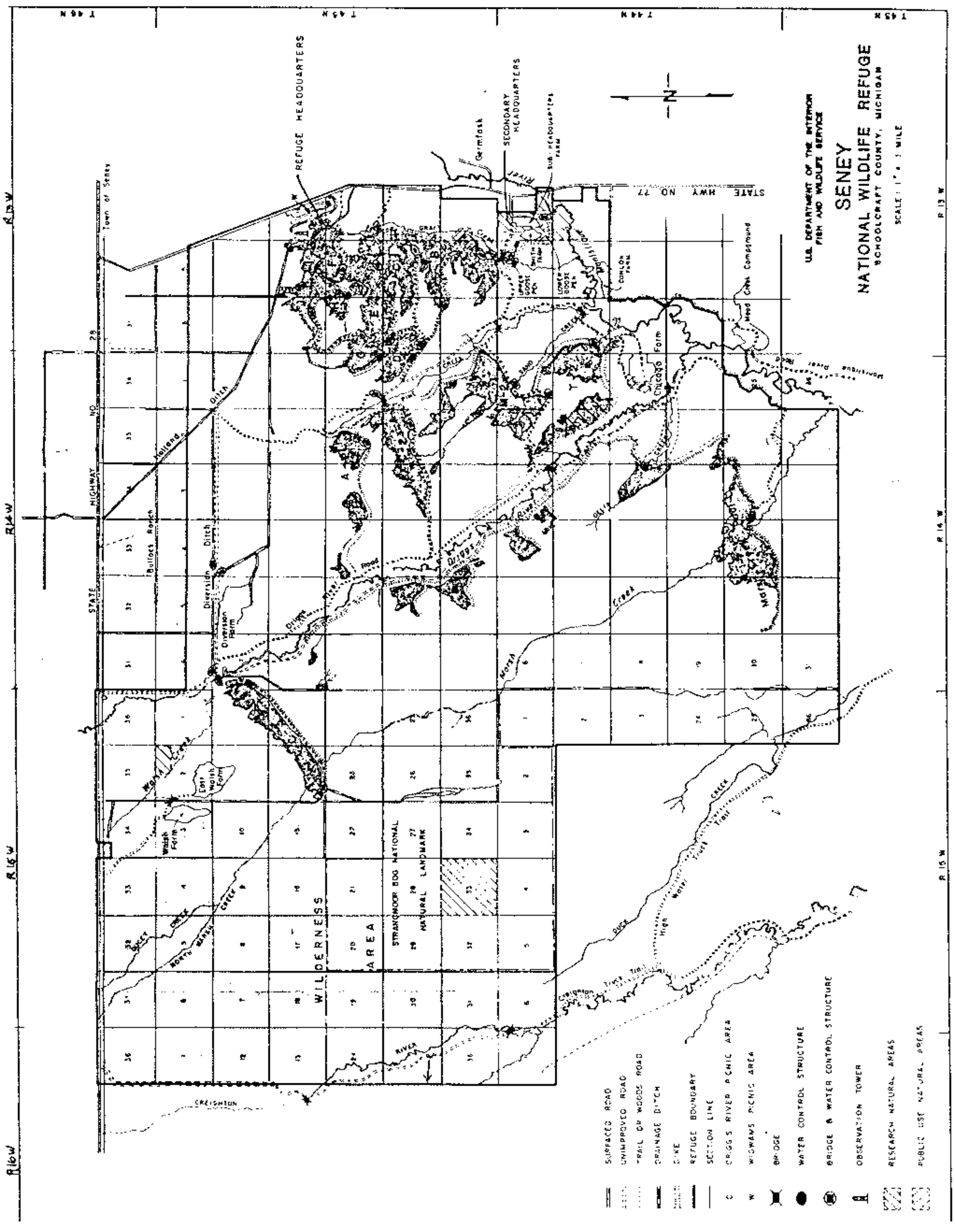
Appendix III. Summary of lakes surveyed and the associated status of loons in the Hiawatha National Forest, 1990-93.

Location	County	Lake (T.R.S)	Lake size	Adults 1990	Adults 1991	Adults 1992	Adults 1993	Territories 1990	Territories 1991	Territories 1992	Territories 1993	Nests 1990	Nests 1991	Nests 1992	Nests 1993	Chicks 1990	Chicks 1991	Chicks 1992	Chicks 1993
Hiawatha NF	Mac	Gamble (41N,4W,36)	71	--	--	0	-	--	--	0	-	--	--	0	-	--	-	0	--
Hiawatha NF	Mac	Hay (41N 4W 15,22)	445	2	1	--		1	0			1	0	--	--	1	0	-	--
Hiawatha NF	Mac	Martin(40N,4W,3,4,9)	114	--	-	0	-	--	--	0	-	--	--	0	-	-		0	--
Hiawatha NF	Mac	Round (41N 5W 12)	600	0	0	0	-	0	0	0		0	0	0	--	0	0	0	--
Hiawatha NF	Mac	Satago (42N 4W 36)	--	0	0	--		0	0	-	--	0	0		--	0	0	-	--
Hiawatha NF	Mac	Silver (40N 4W 4,9)	45	--	0	0			0	0		-	0	0	-	-	0	0	--
Hiawatha NF	Scho	Bass (43N 17W 31,32)	294	0	-	0	0	0	-	0	0	0	-	0	0	0		0	0
Hiawatha NF	Scho	Beaton (44N 17W 3)	46	0	0		0	0	0	--	0	0	0	--	0	0	0	--	0
Hiawatha NF	Scho	Big Island (44N 18W 3)	130	2	2	2	2	1	1	1	1	1	1	0	0	1	0	0	0
Hiawatha NF	Scho	Big Murphy (43N 17W 8 17)	145	1	--	0		0	-	0		0	--	0	--	0	--	0	--
Hiawatha NF	Scho	Blush (44N 18W 13,24)	93	-	0		--	--	0	-	-	-	0		--	--	0	--	--
Hiawatha NF	Scho	Boot (45N 17,10W 28,29)	108	0	2	--	2	0	1	--	1	0	--	--	1	0	--	--	0
Hiawatha NF	Scho	Clear (45N 17W 33,34)	82	3	3	2	3	0	0	0	0	0	0	0	0	0	0	0	0
Hiawatha NF	Scho	Colwell (44N 17W 9)	148	0			0	0	--	-	0	0	--	-	0	0	--	--	0
Hiawatha NF	Scho	Cookson (44N 18W 21)	55	0		--	0	0	--	-	0	0	-	-	0	0	--	--	0
Hiawatha NF	Scho	Crooked (44N 17W 15)	190	0		-	0	0	--	--	0	0	--	--	0	0	--	--	0
Hiawatha NF	Scho	East (44N 17W 27)	55	0	--	-	-	0	--		-	0		-		0	--	--	--
Hiawatha NF	Scho	Grassy (44N 18W 8,9,17)	176	0	0	--	0	0	0		0	0	0	--	0	0	0	--	0
Hiawatha NF	Scho	Herman (44N 18W 4,5)	85	0	0	0	-	0	0	0	--	0	0	0		0	0	0	--
Hiawatha NF	Scho	Ironjaw (43N,18W,27,28	62	0				0	-		-	0	-	-	--	0	--	--	--
Hiawatha NF	Scho	Lily (45N 17W 21)	144	4	2		0	0	1		0	0	0	-	0	0	0	--	0
Hiawatha NF	Scho	Little Bass (44N 17W 32,33)	160	-		0				0	-	--		0	--	--	--	0	--
Hiawatha NF	Scho	Little Murphy (43N 7W	12	0	-	--	--	0	--			0			-	0	--	--	--
Hiawatha NF	Scho	Mckeever (T44N R18W	140				2				1				0				0
Hiawatha NF	Scho	Ostrander (44N 18W 31)	54		0	-			0	-		--	0	-		--	0	--	--
Hiawatha NF	Scho	Pete's (44N 18W 7,8)	194	2	0		0	1	0		0	0	0		0	0	0		0
Hiawatha NF	Scho	Red (44N 18W 17,18,20,21)	39	0			0	0	--		0	0	--		0	0			0
Hiawatha NF	Scho	Rim/Hub (44N 18W 24)	16.10	0	0			0	0		-	0	0	-		0	0	--	--
Hiawatha NF	Scho	Sand (45N 17W	106	0	--	--	2	0	-		1	0		-	1	0	--	--	0
Hiawatha NF	Scho	Steuben (44N 17W 15 22)	138	0			1	0			0	0	--		0	0	--		0
Hiawatha NF	Scho	Swan (44N 18W 32,33)	46		0				0	--	-		0	--		-	0		--
Hiawatha NF	Scho	Tom's (44N 18W 32)	23	-	0		-	--	0				0	--	--	--	0	--	--
Hiawatha NF	Scho	Triangle (44N 18W 36)	166	[illegible]	0	0	2	0	0	0	1	0	0	0	1	0	0	0	1

Appendix IV. Map of the eastern Upper Peninsula and the northern Lower Peninsula, Michigan.

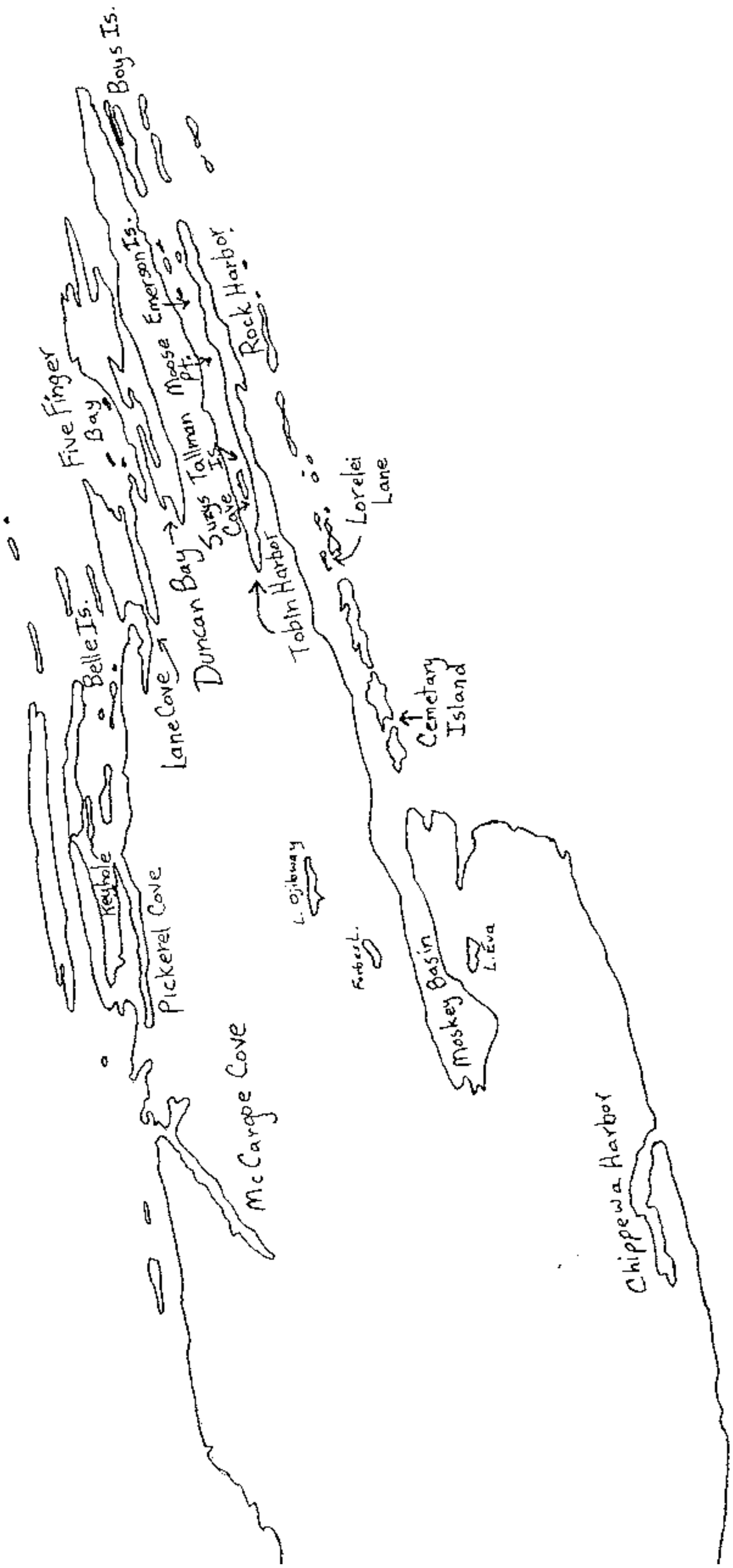


Appendix V. Map of the Seney National Wildlife Refuge, Michigan.

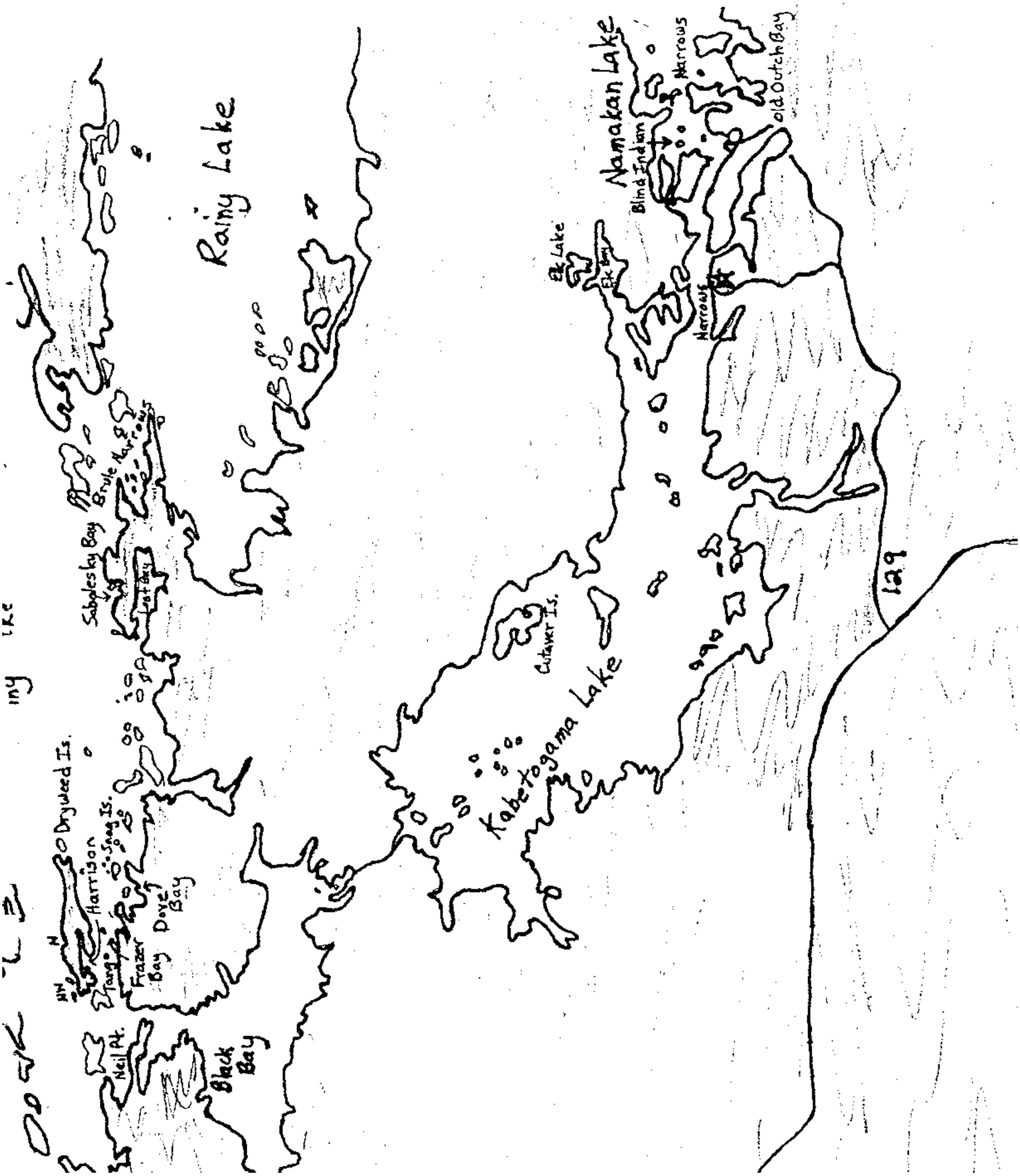


Appendix VI. Map of the Watersmeet Ranger District, Ottawa National Forest, Michigan.

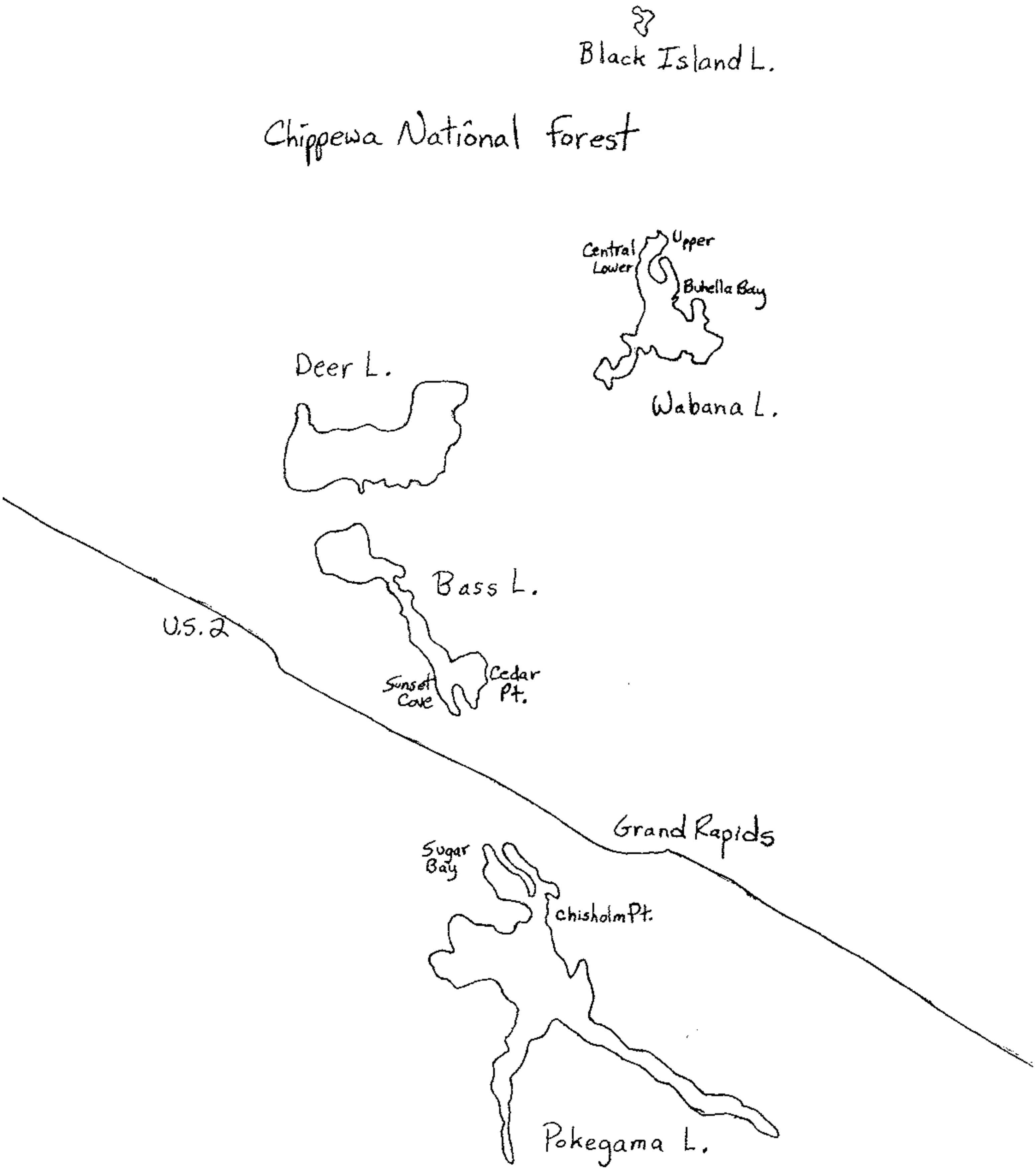
Appendix VII. Map of Isle Royale National Park, Michigan.



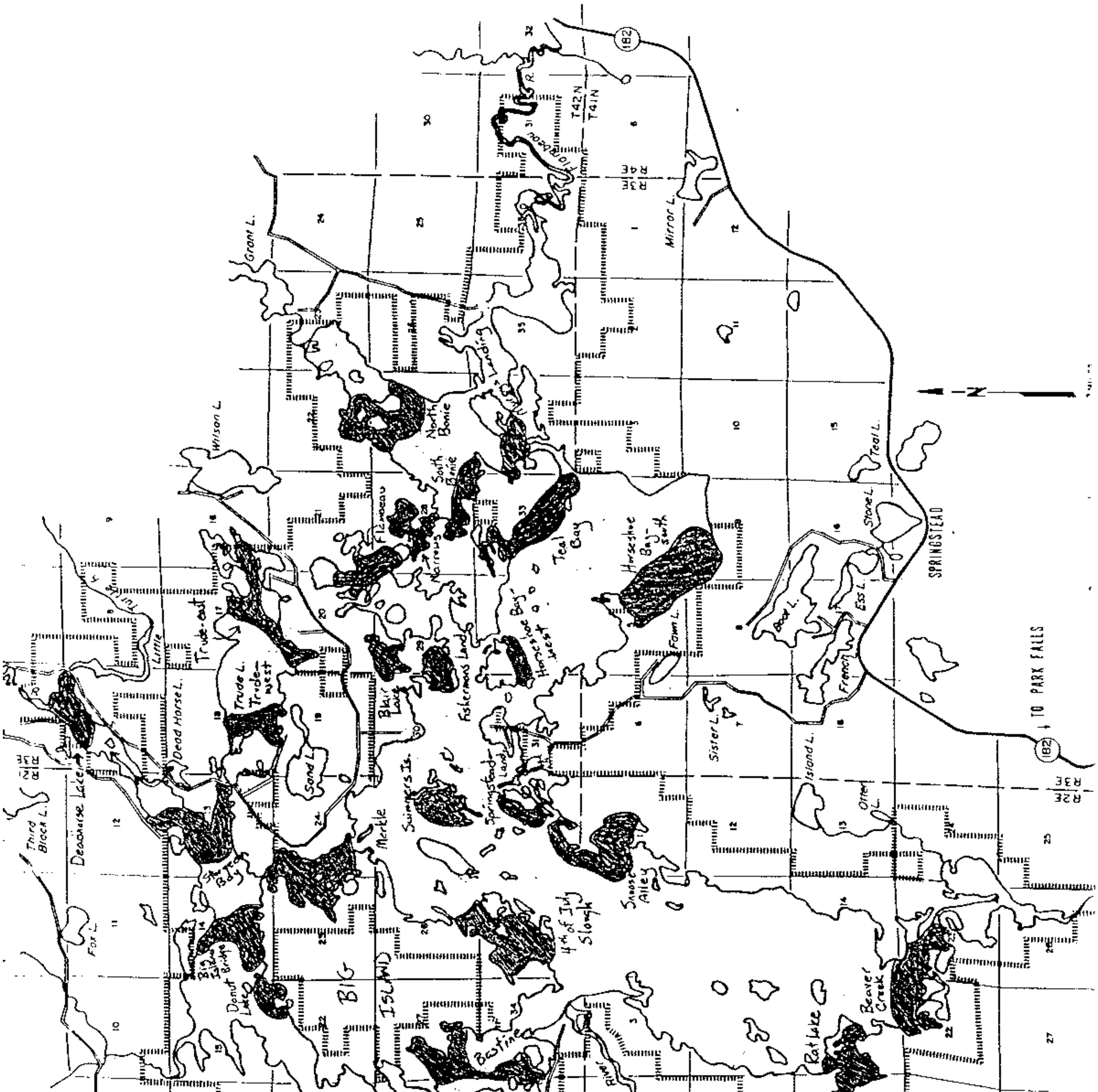
Appendix XIII. Map of Voyageurs National Park, Minnesota



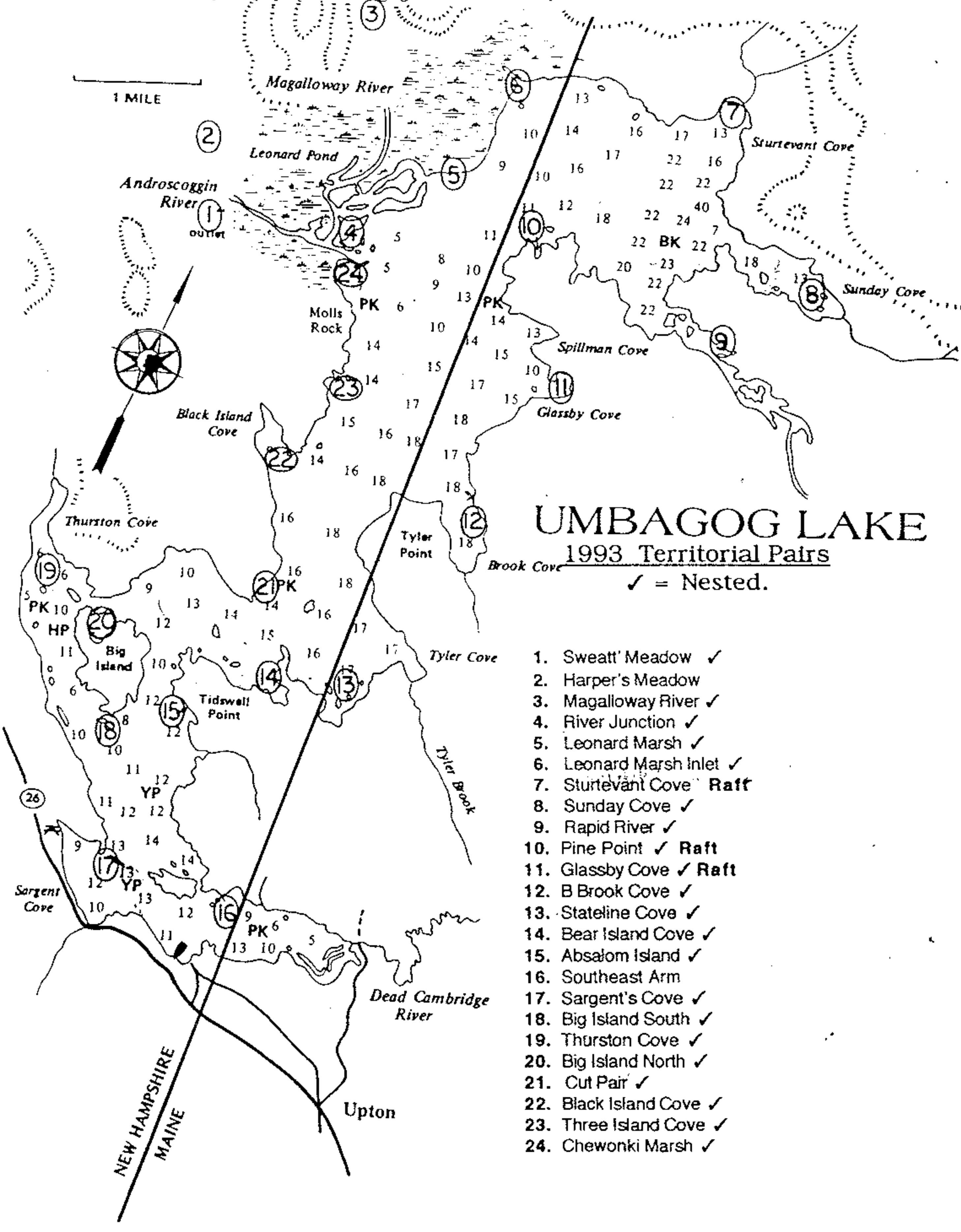
Appendix IX. Map of the Grand Rapids area, Itasca County, Minnesota.



Appendix X. Map of the Turtle-Flambeau Flowage, Wisconsin.



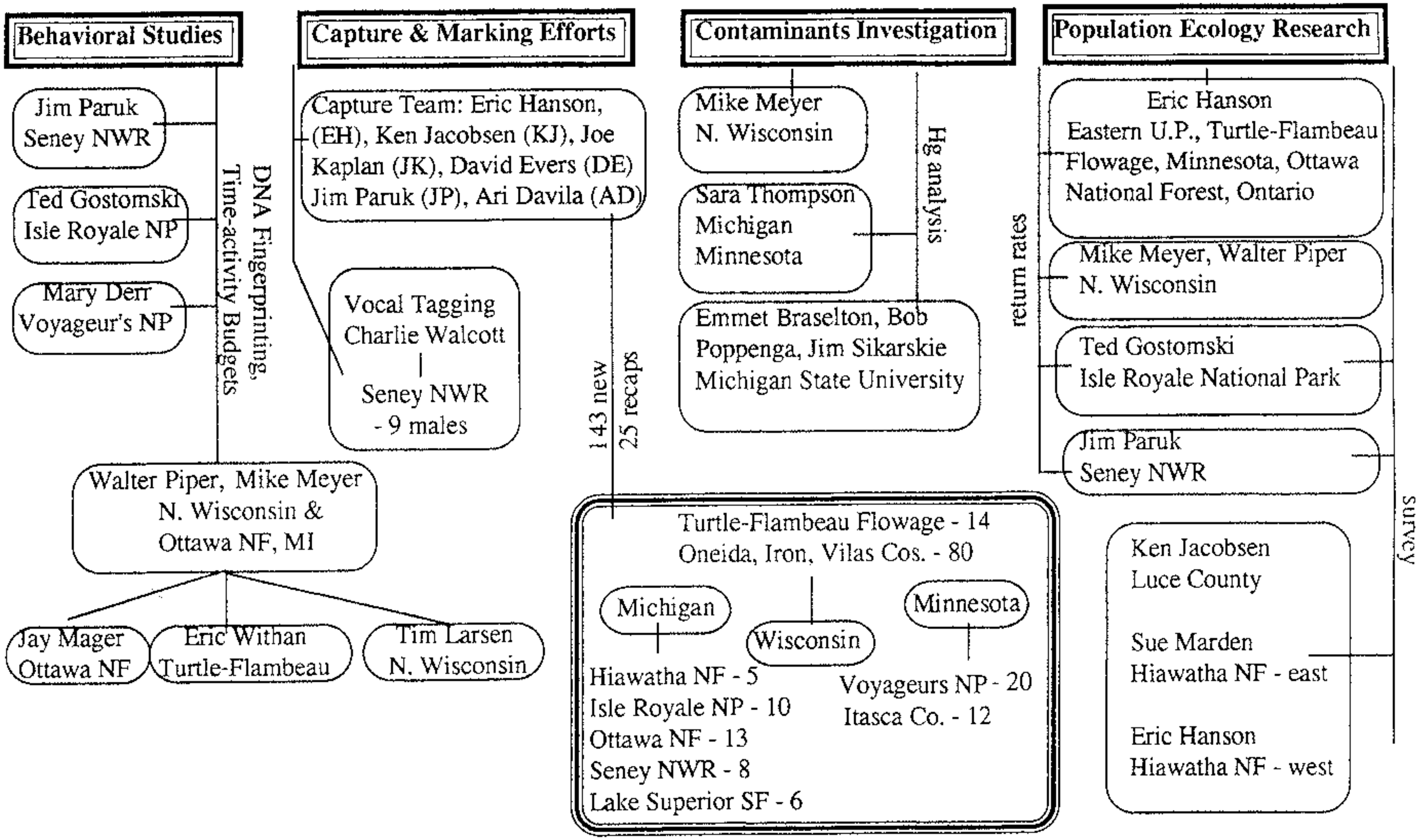
Appendix XI. Map of the Lake Umbagog area, New Hampshire.



Appendix XII. Flowchart of the actual 1993 field season.

Northern Great Lakes
Common Loon Monitoring Program — 1993

David Evers - Whitefish Point Bird Observatory (906-492-3596)



1993 Capture Schedule: June 23 to 29, eastern UP (EH, KJ, JK, DE, JP, AD); Team I for July 1 to 29, northern Wisconsin (EH, JK, KJ) and Ottawa NF (DE, EH, KJ, JK); Team II for June 30 to July 23, eastern UP (DE, JP, AD); July 30 to August 3, Isle Royale NP (DE, EH, JK, KJ); August 4 to 6, Grand Rapids/Itasca County, Minnesota (DE, EH, JK, KJ); August 7 to 13, Voyageurs NP (DE, EH, JK, KJ).

Appendix XIII. Flowchart of the projected 1994 field season.