LOONS:

Old History and New Findings

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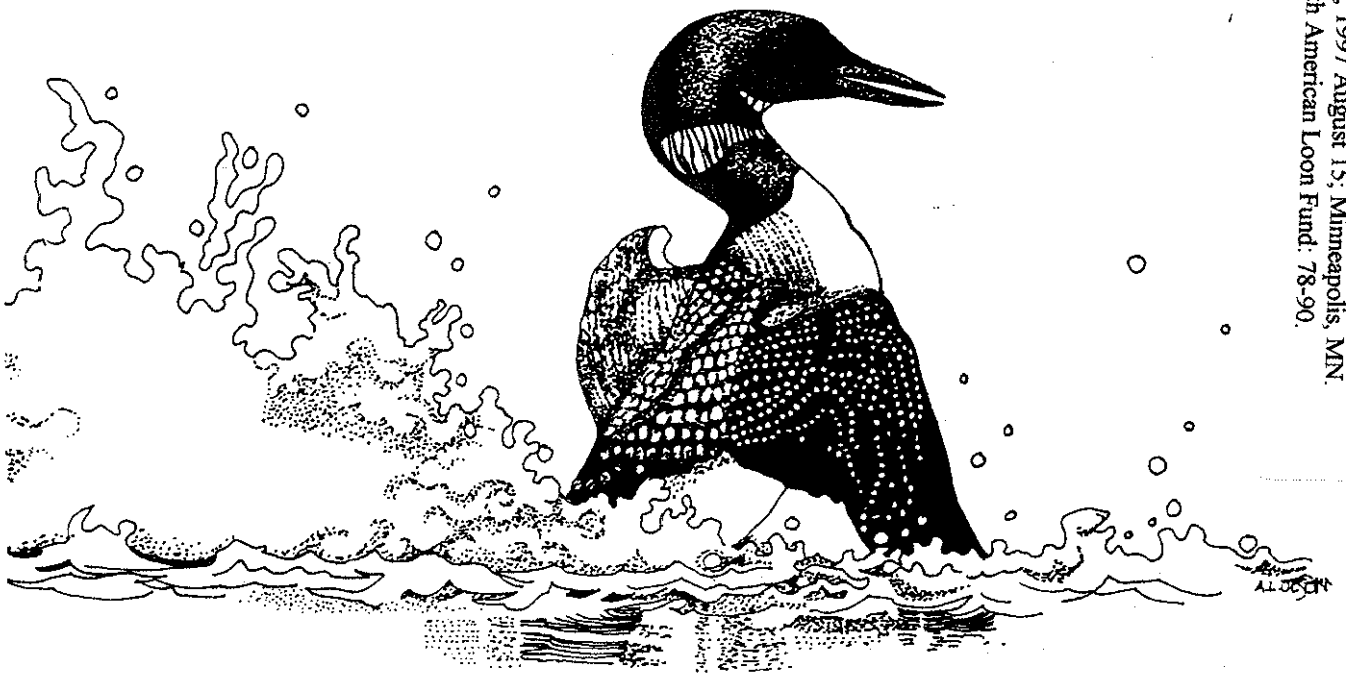

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PREFACE AND ACKNOWLEDGMENTS

This document showcases the burgeoning research on the Common Loon. Topics of the manuscripts range widely from parasites and disease, to behavior and population dynamics. There are many new technologies that ornithologists and wildlife biologists now use, including implementation of satellite transmitters to track inter-seasonal movements and use of computers to quantitatively differentiate vocalizations. Changes in loon research have also been dictated by the ability of biologists to capture and uniquely color-mark individuals for future identification. Information based on past speculation on certain life history traits and behaviors is now changing through observations of known loon individuals over time. Several of the following manuscripts document these changes.

In addition to the peer-reviewed manuscripts, reports by Canada and each of the 15 states with breeding loons are provided by the organization or agency charged with monitoring the status of its loon population. Preceding these reports is a geographic summary and overview of the present status of North America's breeding loons.

These new findings are bringing our knowledge about loons to new levels. This scientific base will understandably provide resource managers and policy makers with the tools to appropriately apply conservation measures to ensure that loons remain a viable part of our northern landscape.

Each of the 12 papers were peer-reviewed by two or more scientists with expertise in the relevant discipline. We thank the following for their thoughful comments which went far to improve these papers: Robert Askins, Luis Baptista, Jack Barr, Gerald Bartelt, Robert Beason, Donald Bruning, Neil Burgess, Mary Clench, Francesca Cuthbert, Jeff Fair, Donald Forrester, Mark Fuller, Donald Kroodsma, Scott Lanyon, Stuart Paulus, Walter Piper, William Seeger, Ken Stromberg, Jeffrey Walters, and Doris Watt.

We thank Anne Olson Bialke for her cover illustration. She spent her childhood with Minnesota loons, and she now watches and listens to loons in New York's Adirondack Park. Please check the back cover, because like loons in their aquatic settings, they may swim and call on one side of our canoe, and then dive and pop up on the other!

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Judith W. McIntyre, Utica, New York
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October 2000

INTRODUCTION

Capture, marking and release of birds began at the end of the 19th century and has increased in application to better understand the natural history of birds. The method of leg banding (or "ringing" in Europe) is now widely accepted as the primary means for determining movements, longevity, and individual performance of birds. By recapturing birds or using remote identification methods through auxiliary marking techniques, investigators can follow individuals over time and even determine lifetime reproductive success (LRS). Although LRS studies are difficult (Newton 1992 identified only 23 major studies worldwide) shorter-term marking studies have provided extensive information for many bird species in North America.

Before 1989, capture and marking of Common Loons (*Gavia immer*) was relatively rare, especially compared to capture rates of other relatively common North American birds. In 1989, the U.S. Bird Banding Lab reported that only 922 Common Loons had been banded since initiation of the federal banding program. Because of minimal banding efforts, studies involving uniquely marked loons were rare before the 1990s (Sutcliffe 1979, McIntyre 1988, Strong 1988, Morse et al. 1993). Two exceptions were opportunistically captured loons banded during waterfowl capture efforts by the Minnesota Department of Natural Resources (Eberdhart 1984) and a small but relatively successful capture effort on the Turtle-Flambeau Flowage, Wisconsin (Belant et al.1991).

In 1989, a reliable and efficient method to capture adult and juvenile Common Loons provided access for wildlife biologists to monitor known individuals over time. The capture technique developed by Evers (1993), and later refined was extensively used by the coauthors and was responsible for the capture of 2,111 Common Loons from 1989-98. Of these uniquely marked loons, 621 adults and 544 juveniles are the basis for describing the population dynamics of the Upper Great Lakes breeding population of Common Loons. Sampling areas were scattered across this region from northeastern Minnesota into north-central Wisconsin, across Michigan's Upper Peninsula and into south-central Ontario.

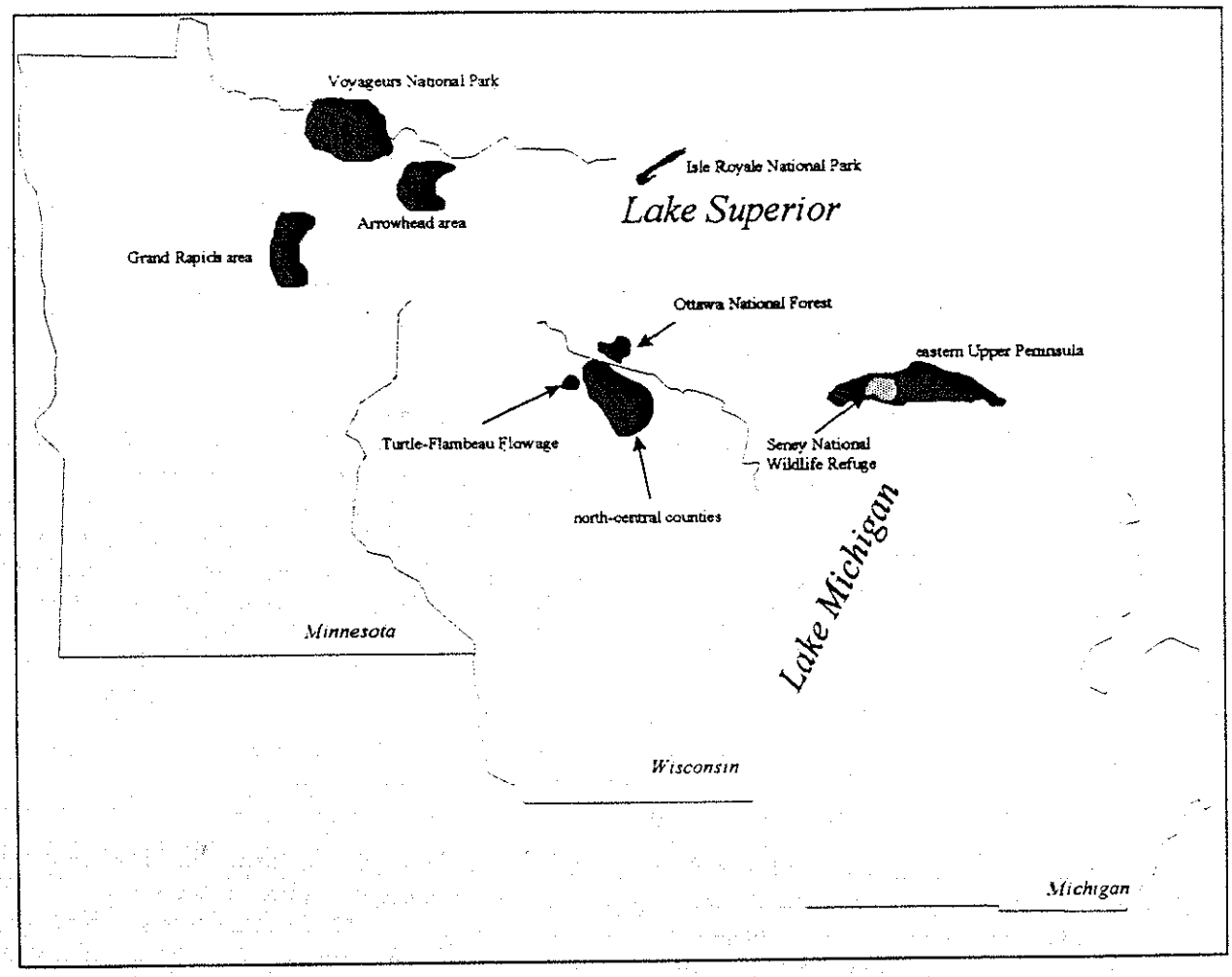
STUDY AREA

Much of the upper Great Lakes Region study area is part of the Canadian Shield, while along the eastern and southern fringes sedimentary bedrock forms the landscape (Albert *in* Evers 1997). The acidic soils derived from silica-rich bedrock are most representative of the Upper Great Lakes. These soils are less suitable for agriculture and therefore most areas have remained forested and are now publicly owned by federal and state agencies.

The study areas were primarily chosen within these protected areas. However, they are representative of the region's waterscape and likely provide an accurate sampling of the breeding loon population (Figure 1). Evers (2000) estimated the current U.S. Upper Great Lakes population at 6,100 nesting pairs. The eight upper Great Lakes Region study sites were distributed from north-central Minnesota to the eastern Upper Peninsula. Loons were banded in two other areas (Arrowhead area in Minnesota and southeastern Ontario) but subsequent monitoring efforts were minimal. A total of 286 loon territories found on 180 lakes were monitored between 1989 and 1998.

The eastern Upper Peninsula is a large, five-county area with extensive tracts of public lands, including the Hiawatha National Forest, Seney National Wildlife Refuge, and Lake Superior National Forest. These protected areas provide an important refuge for breeding loons. The Hiawatha National Forest is a 348,000 ha area divided into western and eastern units and bordered by Lake Superior to the north and Lakes Michigan and Huron to the south.

Figure 1. Map of the Upper Great Lakes study areas.



The Seney National Wildlife Refuge (NWR) lies in the east-central portion of the Upper Penisula and contains 21 artificially-controlled pools, totaling around 9,000 ha (7,000 acres). Most pools are concentrated in the eastern one-third of the refuge. These pools range in size from 11-364 ha and are relatively shallow, averaging less than 1 m in depth and reaching a maximum depth of 2-2.5 m along the dikes. They have sandy bottoms, with mean pH levels from May through October between 7.2-8.3. Mean turbidity for pools with nesting pairs is 9 +/- 5 FTU (range 0-24 FTU) while pools unoccupied by nesting pairs have a turbidity greater than 28 FTUs. The surrounding topography is flat with large

emergent wetland areas interspersed with forested sandy, red pine (*Pinus resinosa*) ridges. Between 14-16 pools have established loon territories.

Two designated study areas are in the western Upper Peninsula, Isle Royale National Park (NP) and Ottawa National Forest (NF). Ottawa NF is a 386,000 ha area located at the western end of the Upper Peninsula. Two districts in the Forest have one of the highest densities of nesting loons in Michigan (Watersmeet and Bessemer). Situated in the south-central part of the Watersmeet District is the Sylvania Wilderness Area, an 8,500 ha roadless area containing 20+/- lakes suitable for nesting loons.

Isle Royale NP is in Lake Superior, 118 km northwest of Michigan's Keweenaw Peninsula. It is a roadless archipelago comprised of more than 200 islands and encompassing 544 sq. km. Bordered by 740 km of Lake Superior shoreline and containing more than 50 interior lakes, Isle Royale provides ample breeding habitat for the Common Loon. This is a unique area as it contains the only breeding population of loons using the Great Lakes shoreline for nesting. The long protected coves characteristic of the eastern end afford suitable nesting habitat. Although wave action is reduced in these areas, major seiches ranging from 10-60cm can inundate nests (Fettig 1991, Fettig and Kreumanker 1991).

In Wisconsin, we captured loons in a four-county area in the north-central part of the state (Vilas, Oneida, Forest, and Iron counties) in cooperation with the Wisconsin Department of Natural Resources and George Mason University. Over 800 lakes provide habitat for a dense breeding loon population. Few lakes are large enough for occupancy by more than one pair. This area has many low pH lakes that are associated with high mercury levels, prompting several studies (e.g., Meyer et al. 1995, Meyer et al. 1998).

The Turtle-Flambeau Flowage is a 7,700 ha reservoir created in 1926 and is a study site in Iron County treated separately from other lakes in the area. It is a circumneutral, turbid lake with an average depth of 3 m and maximum depth of 16 m. Only 5% of the shoreline is developed. The breeding loon population has been well studied since 1985 (Belant and Anderson 1991, Belant et al. 1991, Paruk 1999).

The bulk of the U.S. Great Lakes breeding loon population occurs in northern Minnesota (Evers 2000). Two study areas were sampled to represent this area: Voyageur's National Park (VNP) and the Grand Rapids area in Itasca County. VNP was established in 1975 and contains nearly 89,000 ha of protected area with 30 lakes, including four large reservoirs (Rainy, Kabetogama, Namakan, and Sand Point). The reservoirs comprise 39% of the total park area and 96% of the total water area. Annual summer water level fluctuations cause widespread nest failures for the loon population (Reiser 1988) and apparently create a large population sink. The Grand Rapids region has another dense concentration of nesting pairs. Primary study lakes include Pokegama (5,140 ha), Wabana (850 ha), Bass (1,012 ha) and Deer (1,578 ha). Each lake has multiple loon territories. Pokegama and Deer shorelines are over 50% developed while Wabana and Bass are less than half developed.

Loons were also captured on small lakes in south-central Ontario in 1992 and in Minnesota's Arrowhead region from 1997-98, but because we did not closely monitor these marked individuals they are only included with the banding results.

METHODS

Evers (1993) described the basic capture technique for adult loons accompanied by their chicks. Night-lighting techniques and playback recordings were essential. Since then, this technique has been refined to capture adult loons in a wide variety of weather conditions, ambient lighting, and lake types. Capture efficiency is highest (>90%) for adults accompanied by young chicks (<5 weeks), in flat water conditions, and with little ambient lighting. Loons are held for an average of 30 minutes. During that time a custom-sized; colored leg band is fitted around the loon's tarsus. One to three color bands and an U.S. Fish and Wildlife Service numbered band provides a dual system of identification. Six different colors along with engraved stripes, spots, and alpha-numeric codes provide several thousand combinations for remotely distinguishing individuals.

The unique color band combination allows accurate identification of individuals. Band colors are most easily read when raised above the water surface during loon foot waggling, stretching, and preening behaviors. Color bands can also be made determined underwater with optimal lighting and water conditions or by the observer gaining a higher vantage point. Most individual identification was made within 0.5-2.0 hours of observation with a 30-60x spotting scope.

Data on adult return rates were recorded primarily from ice-out to late May. During our study, far less than 1% of color-marked adults lost any color bands and no loons lost all color bands. Recaptured adults (n=281) exhibited either no or very minimal band wear on the tarsi. Monitoring of marked individuals typically continued throughout the summer for each study site to determine reproductive success, rate of mate and territory switching, and the return of adults banded as juveniles (ABJs). The summer monitoring intensity varied from high (nearly daily coverage), to moderate (weekly coverage), and low (monthly coverage). The information subsequently gathered from each site relates to coverage intensity (Table 1). Adults found on nearby territories are not included in return rate calculations until they have returned to their new territory for a second year. This protocol avoided bias in survey effort.

TABLE 1. Annual summary for types and coverage of data collected by study site

State	Study Site	Banded	Returns	Productivity*	Coverage**
Michigan (MI)	Seney NWR	1987-98	1990-98	1987-98	High
	Eastern Upper Peninsula	1990-96	1991-98	1990-96	Low
	Ottawa NF	1991-98	1992-98	1985-98*	Low
	Isle Royale NP	1991-98	1992-98	1990-98	Mod-High
Wisconsin (WI)	Turtle-Flambeau Flowage	1991-96	1992-97	1985-96*	Low-High
	North-central counties	1991-98	1992-97	1992-97*	Mod-High
Minnesota (MN)	Grand Rapids area	1992-98	1993-98	1992-98	Mod
	Voyageurs NP	1992-97	1993-98	1979-98*	Mod
	Arrowhead area	1997-98	1997-98	none	Low
Ontario (ON)	South-central	1992	1993,96	none	Low

* Coverage intensity is based on a daily (high), weekly (moderate), and monthly (low) basis.

** Productivity data were collected by biologists with BioDiversity Research Institute (BRI) and collaborators as part of various monitoring programs.

Territory type was classified for each pair monitored. Territorial pairs defend a defined area of a waterbody against conspecifics during the breeding season for more than four consecutive weeks (Olson and Marshall 1952). Established territorial holders do not allow intruding loons to remain within their territory. Pairs that laid at least one egg were designated as nesting. Successful pairs hatched at least one chick. Small chicks were designated as five weeks or less and were characterized by retaining some brown, downy plumage on the head, neck and back. Because true fledging rates are difficult to determine and juvenile mortality is minimal after two weeks we define large chicks as those that are older than five weeks to indicate juvenile survival. The N/T ratio (e.g., nesting pairs/territorial pairs) was used as a standard for describing the number of territorial pairs that lay an egg while F/T and F/N ratios (i.e., number of fledged young by territorial and nesting pair, respectively) indicate two ways to measure chick survival.

RESULTS

Banding and resighting

Recovery and resighting data from 1,165 loons banded in the upper Great Lakes Region from 1989-1998 provided insight into the loon's life history. A similar ratio of the number of marked males (327 or 53%) vs. females (294 or 47%) and adults (621 or 53%) vs. juveniles (544 or 47%) minimized age-sex biases during interpretation. Among study site effort varied considerably (Table 2).

The 621 adult loons captured and marked occupied 286 designated territories on 180 lakes (Table 3). Loons have three distinct types of territories (Table 3). Multiple-lake territories include at least one other lake, in addition to the natal lake, that is used by the territorial pair for foraging. Lake size of multiple-lake territorial pairs (11%, n=32) that were confirmed through field observations of marked individuals was 32-148 ha. Whole lake territories are areas where pairs restrict their breeding season activities to the natal lake and other established breeding pairs are not present. Of the 286 territories monitored, 43% (n=122) were whole lake territories. Finally, partial lake territories occur on larger lakes containing two or more pairs. This type of territory accounted for 46% (n=132) of the pairs studied.

TABLE 2. Capture and color-marking effort by study site. 1989-1998

State	Study Site	Adult Male	Adult Female	Adult Total	Juvenile Total	Total
MI	eastern Upper Peninsula	19	15	34	26	60
MI	Seney NWR	10	14	24	39	63
MI	Ottawa NF	28	26	54	27	81
MI	Isle Royale NP	15	16	31	43	74
MN	Voyageurs NP	36	27	63	42	105
MN	Grand Rapids area	42	36	78	36	114
MN	Arrowhead area	11	10	21	19	40
ON	south-central	15	9	24	36	60
WI	north-central counties	131	120	251	253	504
WI	Turtle-Flambeau Flowage	20	21	41	23	64
	TOTAL	327	294	621	544	1165

Reproductive measurements

Reproductive success was monitored for eight of the study sites, although monitoring efforts were not equal across all sites (Table 1). Color-marked individuals as well as neighboring territory holders were typically monitored for adult and ABJ site fidelity and reproductive success. For example, in the Ottawa National Forest, 24 territories had color-marked loons although an average of 37 territories were monitored for nine years. However, because we did not distinguish whether these target territorial pairs laid eggs, two types of categories, nesting and successful pairs, were not complete (Table 4).

TABLE 3. Upper Great Lakes study sites and characterization of Common Loon territory, 1989-98.

State	Study Site	Whole	Partial	Multiple	Lakes	Territories
MI	eastern Upper Peninsula	5	6	5	14	16
MI	Isle Royale NP*	1	16	0	2	17
MI	Ottawa NF	7	8	9	21	24
MI	Seney NWR	7	4	2	11	13
MN	Grand Rapids area	7	31	1	15	39
MN	Voyageurs NP	1	39	1	6	41
WI	North-central counties	94	4	12	108	110
WI	Turtle-Flambeau Flowage	0	24	2	3	26
	Total	122	132	32	180	286
	(Total %)	43%	46%	11%		

* Most of the loon territories monitored at Isle Royale NP are within coves and bays of Lake Superior

Although individual reproductive success of color-marked loons was not determined, mean density and reproductive success of loons nesting at four study sites allows comparison of Upper Great Lakes breeding productivity (Table 4) to that of other breeding populations in North America. On average, the total breeding population at the Michigan study sites was 81 territorial pairs/year. These birds fledged an average of 55 juveniles/year. Territorial pairs nested 59-92% of the time. Reproductive success (measured as number of chicks greater than five weeks of age) ranged from 0.51-0.79 juveniles per territorial pair or 0.77-0.87 juveniles per nesting pair.

TABLE 4. Size of monitored breeding population (mean +/- sd) and reproductive success (mean +/- sd) for four Michigan study sites, 1987-98.

Study Site	Territorial Pairs	Nesting Pairs	Successful Pairs	# small chicks	# large chicks	N/T ratio	F/T ratio	F/N ratio
e. Upper Pen.	19.0+/-3.6	11.2+/-1.2	-	-	9.7+/-1.8	0.59	0.51	0.87
Isle Royale NP	15.7+/-1.4	14.5+/-1.2	9.0+/-3.2	-	12.3+/-4.8	0.92	0.79	0.85
Ottawa NF	37.4+/-2.3	-	-	-	27.2+/-7.0	-	0.76	-
Seney NWR	9.2+/-2.2	7.0+/-1.7	5.0+/-1.4	6.7+/-2.3	5.4+/-2.4	0.76	0.59	0.77
					MEAN	0.76	0.66	0.83

1 N/T ratio is the number of nesting pairs divided by the number of territorial pairs
2 F/T ratio is the number of large chicks divided by the number of territorial pairs
3 F/N ratio is the number of large chicks divided by the number of nesting pairs

Territory Fidelity

Between 1990-98, the return rate of marked adults to a territory was determined at eight study sites (Table 5). Territory fidelity ranged from 66-86% and differences between sexes were not significant within study sites ($p<0.05$) and overall ($p<0.001$). Based on 1,183 color-marked adults potentially returning to their previous year's territory, 958 or 81% were re-observed at the territory they occupied the previous year. The remaining 19% of adults not re-observed at their previous year's territory were frequently found elsewhere one to four years later.

TABLE 5. Territory fidelity of adult loons, 1990-98, in the Upper Great Lakes Region

		Total # of marked			Total # returning			Percent Return		
State	**Study Site**	**M**	**F**	**Both**	**M**	**F**	**Both**	**M**	**F**	**Both**
MI	Seney NWR	66	62	128	57	53	110	86	86	86
WI	north-central cos.*	175	141	316	153	120	273	87	85	86
MI	Isle Royale NP	43	55	98	37	46	83	86	84	85
MI	Ottawa NF	88	102	190	71	84	155	81	82	82
MI	eastern UP	47	37	84	35	30	65	75	81	77
MN	Voyageurs NP	83	62	145	65	45	110	78	73	76
MN	Grand Rapids area	44	38	82	32	29	61	73	76	74
WI	Turtle-Flambeau	57	50	107	37	34	71	65	68	66
	TOTAL	671	566	1183	498	460	958	81	81	81

* Includes up to 1996.

Territory fidelity did vary by territory type (Table 6). Adults were more likely to return to their previous territory if each individual was part of the sole pair on the lake. Fidelity for whole-lake territories was nearly equal between males and females ($p>0.05$). Unlike whole-lake territories, territorial pairs that used multiple lakes did significantly differ between sexes ($p>0.05$). Lower territory fidelity was found on large waterbodies where territorial pairs were frequently adjacent to each other without physical boundaries.

Mate Fidelity and Switching

The frequency of mate switching determined for one study site, the Seney NWR, was 19% (n=134 pairings by marked individuals). Further analysis of other sites will provide more confidence in the rate of mate switching, differences between sexes, and triggers related to frequency.

Natal Site Fidelity

Adults-banded-as-juveniles (ABJs) generally return to their natal lake area after three to five years (n=27, mean was 4.4 +/-1.4 years, range was 3-8 years of age at first reobservation). The fidelity of ABJs to their natal sites ranged from one to 64 km with a mean of 13 km (n=27). Although returning ABJs were found interacting with their parents, no pairing was observed. Study sites with the number of associated ABJs are Seney NWR (7), north-central counties of Wisconsin (7), Isle Royale NP (6), Ottawa NF (3), Turtle-Flambeau Flowage (2), Voyageurs NP (1), and Grand Rapids area (1). Based on recent evidence of these 27 returning ABJs the average first year breeding was seven years (n=7 individuals that initiated breeding, range is 5-11 years).

TABLE 6. Rate of return for adult loons by territory type, 1990-98 in the Upper Great Lakes Region

Territory Type	M	F	Both	M	F	Both	M	F	Both
Whole Lake	433	416	849	364	352	716	84	85	84
Multiple Lake	49	52	101	35	42	77	71	81	76
Partial Lake	184	150	334	134	108	242	73	72	72

A total of 35 loons (17 adults and 18 banded as juveniles) were reobserved outside the Upper Great Lakes breeding range. Of these, 72% were from coastal areas during the winter (December-April), 11% from coastal summer areas for one-year-olds, 6% of mid-migrant adults, and 9% of mid-migrant juveniles.

DISCUSSION

The Common Loon inhabits lakes in forested regions of Canada, Alaska and the northern tier of the contiguous United States. The upper Great Lakes breeding population is at the southern periphery of this range and is in an area of high human development and recreational use. Although <1% of North America's breeding loon population is in the upper Great Lakes (Evers 1999), the loon's high public profile and recognition as an indicator of aquatic integrity (e.g., Evers et al. 1998), makes this region an important study area for improving public awareness for the species and the lake ecosystems it inhabits.

The 621 adult and 544 juvenile loons uniquely color-marked from 1989-98 constitute a small percentage of the upper Great Lakes breeding population. However, the eight study sites include a wide range of lake habitats and therefore most likely provide a relatively accurate picture of loon population dynamics for the region. These waterbodies varied in size from a 32 ha beaver pond (Ottawa NF) to 910 square km Rainy Lake (Voyageurs NP) and in depth from an average of one meter (in Seney NWR) to over one hundred meters (in Lake Superior at Isle Royale NP). Shoreline development and recreational use also varied tremendously from wilderness lakes with virtually no human disturbance to lakes with fully developed shoreline and heavy recreational use.

Although reproductive success was monitored for many of the color-marked adults, individual efforts are not quantified here. The nesting-territorial pair ratio was determined for three sites in Michigan and varied from 59% (eastern Upper Peninsula) to 92% (Isle Royale NP). These were the only sites where we could definitively confirm presence and absence of eggs for the entire population of monitored pairs. Hatching success was difficult to verify unless daily observations were made.

We primarily measured reproductive success for these sites by determining the presence of large chicks (i.e., >5 weeks). The number of juveniles surviving per nesting pair ranged from 0.77 to 0.87 and for each territorial pair ranged from 0.51 to 0.79. McIntyre (1988) summarized 24 productivity databases from North American loon populations and found a mean of 0.60 chicks surviving per territorial pair. The 22-year statewide database of New Hampshire's increasing breeding population showed a mean of 0.77 chicks/nesting pair and 0.53 chicks surviving per territorial pair (Taylor and Vogel 2000). Based on these comparative databases it appears that breeding loons in the Great Lakes' study sites had typical reproductive success and were therefore a fair representation of this species' population dynamics.

Adult territory fidelity was determined within eight Great Lakes' study sites. However, because the capture of adult loons is biased toward adults successfully producing at least one young, our territory fidelity rates primarily represent established and productive adults. Unsuccessful territorial or non-territorial adults may comprise up to 46% of an entire summer loon population (Taylor and Vogel 1999) while Croskery (1990) found a similar trend in the size of the nonbreeding population in northwestern Ontario. He found 49% of the 254 loon territories monitored over a four-year period failed to produce young.

Adult site fidelity for the Great Lakes region is 81% and does not differ between sexes ($p>0.05$). However, we documented significant inter-site differences ($p<0.01$). This variation appears to be related primarily to territory type rather than geographic-specific influences. Adults residing on whole lake territories are significantly ($p<0.05$) more faithful to their territories (84%) than their counterparts on multiple-lake (76%) and partial lake (72%) territories (Table 6). Seney NWR, Isle Royale NP, and north-central Wisconsin are primarily comprised of whole lake territories (85-86% territory fidelity) while the eastern Upper Peninsula and Ottawa NF have more multiple-lake loon territories (77-82% territory fidelity). Unlike the similarities of male and female territory fidelity for study sites and whole or partial lake territory types, we found a significant difference ($p<0.05$) in territory fidelity between the sexes for pairs maintaining multiple-lake territories (71% for males and 81% for females). This difference is likely because males guarding multiple-lake territories are more susceptible to intruding males usurping them (Piper et al. 1997). Adult territory fidelity was lowest on larger lakes where pairs occupy only part of the lake and physical boundaries are minimal (72% territory fidelity). Rates of successful intrusion appear to be highest on these territory types and are potentially related to the presence of neighboring common feeding areas harboring unsuccessful and non-breeding adults.

The remaining marked breeding adults not faithful to their previous year's territory fall into three categories: (1) those that shifted territories, (2) displaced breeders that wander and do not establish territories, and (3) adult mortality. Determining the movements of marked adults in each study site was not possible because of logistical limitations. Our best information was from Isle Royale NP, north-central Wisconsin, and Seney NWR. Monitoring at these sites indicates that approximately 8% of the adults shift territories to adjacent territories or up to 12 km distant. Another three to four percent wander and do not establish territories for one to four years, while the remaining three to four percent of the color-marked adults were not reobserved in subsequent years and represent the maximum annual adult mortality.

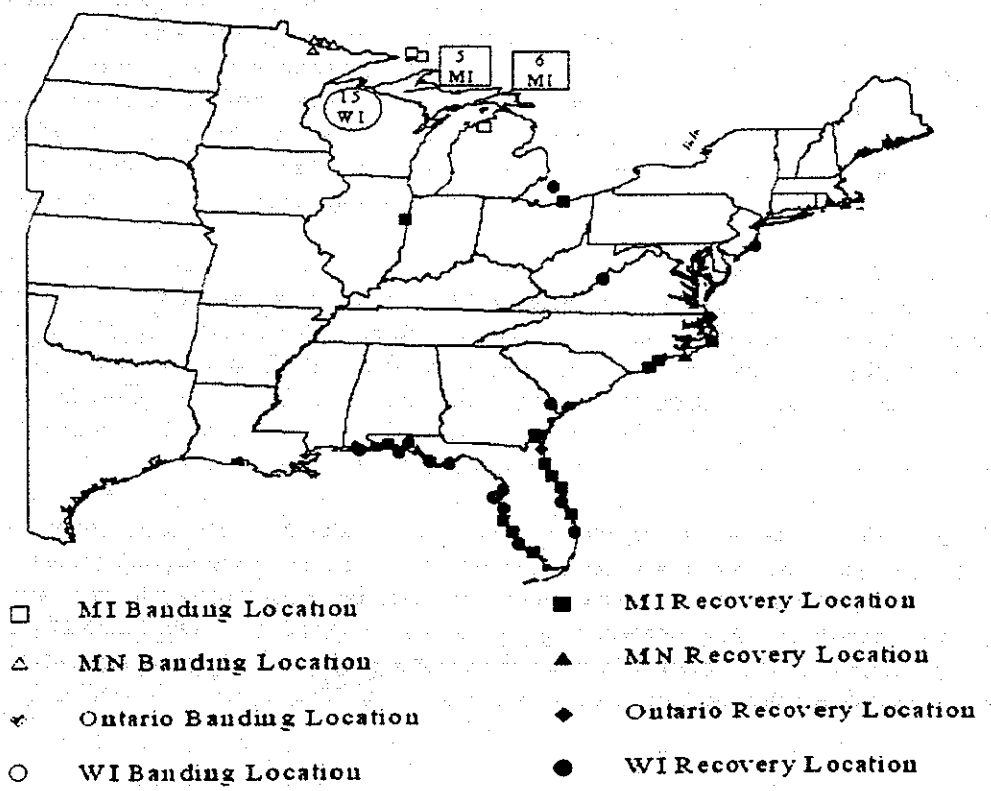
Limited recovery data suggest that most juvenile loons that leave their natal lake migrate to ocean wintering areas and typically remain on the ocean for the next two and one half years. Seven banded juveniles (Michigan-2, Minnesota-1, Ontario-1, and Wisconsin-3) were found one year later summering (June through August) in Alabama (1) and Florida (3) north along the mid-Atlantic Seaboard (North Carolina-2 and New Jersey-1). One- and two-year old loons are known to remain on the ocean and move along North America's mid-Atlantic coast (McIntyre 1988).

Upon the return of an ABJ, the average dispersal distance from the natal lake was 13 km and ranged up to 60 km. Some individuals did not breed (defined as a member of a pair that lays eggs) until 10 and 11 years of age. Mean first-year breeding appeared to be considerably later than previous predictions (e.g., Parker 1987). Continued monitoring of ABJs will increase the sample size of this cohort to better define the relationship of dispersal distances, breeding age, and reproductive success with individual fitness and age/sex variations.

Of the six migrant loons reobserved, three were juveniles. These young-of-the-year, banded in north-central Wisconsin and western Michigan area, were found later that fall (October-November) in northern Lake Michigan. Of the hundreds of marked adult loons migrating across the eastern United States, only three were reobserved, indicating little time spent in transition between breeding and staging or wintering areas. One transitional male was banded in the eastern Upper Peninsula and found dead on 9 December on Lake Erie near Cleveland, Ohio, while a female banded in north-central Wisconsin was found over two years later in Warm Springs, Virginia on 28 November. The only spring loon migrant was an adult female banded in Ottawa NF and found six years later (4 May) at Surf City, North Carolina.

Winter recoveries (December through April) were primarily from the Gulf Coast shoreline, between Gulf Shores, Alabama southeast to Macro Island, Florida (n=14), while seven loons were reobserved on the east coast from Miami Beach north to St. Augustine, Florida. Two winter recoveries outside these areas are (1) an adult female banded at Voyageurs NP and found on 11 January 1998 at Cape Lookout, North Carolina and (2) an adult male banded in northcentral Wisconsin and found on 1 December at Fripp Island, South Carolina.

FIGURE 4. Distribution of migrant and winter recoveries of Common Loons banded on their breeding lakes in the Upper Great Lakes Region, 1990-98.



Because pressures on lakes are ever increasing, loon nesting and nursery options are reduced, loon mortality related to anthropogenic forces grows, and water quality diminishes. Loon pairs and populations in the United States and southern Canada are stressed by the changes in their aquatic environments. Naturally, their fitness and resiliency is likely declining, exposing breeding populations to chronic or catastrophic environmental stressors such as contaminant poisoning (e.g., mercury (Alexander 1991, Evers et al. 1998), weather events, winter oil spills (Clapp et al. 1982.), and disease. For these and other reasons, the importance of monitoring breeding populations in the Great Lakes region is increasingly evident. Although major changes in the loon's breeding numbers, distribution, and reproductive success can be detected through traditional survey programs, the color-marking of individuals and subsequent monitoring will provide the data needed to make informed decisions before crisis situations are reached.

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habitat through the placement of artificial nesting platforms and sign buoys to reduce human disturbance. In 1999, 13 of the 33 breeding pairs nested on nesting platforms. Four of these pairs nested for the first time in at least the past 15 years. Hydroelectric companies and other regulatory agencies continued their efforts to stabilize water levels during the nesting period. A sinker exchange program and an educational campaign about the dangers of lead sinkers and jigs was conducted through a cooperative effort with the National Wildlife Federation, Silvio Conte National Wildlife Refuge, VFWD, VINS, Vermont Audubon, and U.S. Fish and Wildlife Service. Volunteers and lake residents were more involved in monitoring breeding and territorial lakes and educating people about appropriate boating behavior when near nest sites and loon families. VFWD game wardens and biologists and Vermont State Park personnel also provided much assistance to the VLRP.

Threats to Loons

Fishing gear and the actions of people continue to be sources of mortality of Vermont's loons. Lakeshore owners and volunteers reported several cases of harassment of loons this year, two of which caused the deaths of a breeding adult and a chick. A breeding adult was shot on Long Pond in Westmore, and a chick was purposely snagged with a fish hook on Coles Pond in Walden. Concerned citizens and VFWD game wardens contributed greatly in stopping and reducing harassment on several other ponds. The VLRP captured and released an adult loon entangled in monofilament fishing line on Seymour Lake. Lake residents' prompt reporting of the entangled loon allowed for a quick response while the bird was still healthy. Three adult loons died of various caused including injuries to a wing, pneumonia, and unknown causes. A loon chick on Green River Reservoir had fishing line and a lure wrapped loosely around the base of the bill. After several failed capture attempts, the chick freed itself from the fishing gear.

Mercury Research

For the second year in Vermont, loons on several lakes were captured, color-banded, and had blood and feather samples taken for mercury contaminant analysis. Abandoned eggs were also sampled for mercury. This research was part of a study assessing contaminants in the Common Loon population throughout North America. From sampling efforts in 1998, mercury levels were low in loons captured on three ponds. However, mercury levels in eggs collected in 1997 and 1998 were high enough to potentially reduce survival of the eggs on four of 15 ponds. Breeding loons on these ponds will be carefully monitored in the future. This research is being conducted by researchers from BioDiversity Research Institute, the U.S. Fish and Wildlife Service, the U.S. Geological Survey, VINS, and VFWD.