Mooselookmeguntic Lake

Common Loon Population Survey and Management Report:

2004 SEASON FINAL REPORT

(BRI 2005-02)

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EXECUTIVE SUMMARY

We conducted loon productivity surveys on Mooselookmeguntic Lake in 2004, and managed the population using rafts to mitigate the effects of fluctuating water levels. The Mooselookmeguntic Lake water level measured 1466.50 feet above sea level at Upper Dam on the date of the first survey on 20 May 2004, slowly increasing to a maximum reading of 1467.30 feet above sea level, measured on 29 May. Water levels then remained relatively stable, decreasing slightly throughout June, July, and August. Loon productivity and surveys found 20 established territorial pairs on Mooselookmeguntic Lake this season, 11 of which nested. Seven successful pairs hatched twelve chicks lake-wide, five of which survived to fledge from the lake. Eleven rafts were floated in 2004 with four (36%) of them being used. Annual raft occupancy continues to increase on Mooselookmeguntic Lake. We suspect nest predation was the largest cause for nest failures this season, responsible for 60% (3/5) of the five nest failures lake-wide, followed by nest abandonment (20%) and nest failure due to an unknown cause (20%). Two abandoned eggs were collected from the Birch Island territory this season. The overall return rate for color-marked loons on Mooselookmeguntic in 2004 was 60%. Males had a lower return rate (50%) than did females (75%) this season. Mean annual survivorship for the 10 eligible adult Common Loons on Mooselookmeguntic Lake in 2004 was 80%. Estimated minimum survivorship was higher for males than females, 80% and 75%, respectively. Forty-two percent (5/12) of all chicks hatched on Mooselookmeguntic survived to fledge. Six chicks disappeared between 0-7 days and 1 chick was struck by a motorboat and killed at approximately 28 days of age.

All productivity parameters in 2004 increased from levels observed in 2003. In comparison to the lake's 6-year means, rates for all productivity parameters observed in 2004 remained the same or are higher than the long-term averages. We feel that the overall productivity findings in 2004 reflect: 1) a gradual acclimation process towards raft use 2) a high level of predation pressure on natural nests. Because several of these findings warrant further investigation, we have specified recommendations in this report.

INTRODUCTION

About the study site

Mooselookmeguntic Lake is a 16,300- acre (6,520 ha) reservoir found in Adamstown, Rangeley, Rangeley Plantation, and Richardstown, Maine (Figure 2). These townships lie in the northwest portion of Maine. The reservoir is managed by FPL Energy Maine Hydro (FPL), through Upper Dam, located in Richardstown, Maine. Mooselookmeguntic Lake is fed mostly by Rangeley Stream, and the Kennebago and Cupsuptic rivers. The reservoir drains through Upper Dam, into Richardson Lake.

History and Purpose of Study

Due to the significant water level fluctuations on reservoirs during the nesting season, the Common Loon (*Gavia immer*) has been identified by the U.S. Fish and Wildlife Service, and other natural resource trustees, as a species to be evaluated in connection with the Federal Energy Regulatory Commission (FERC) licensing of certain reservoir projects. The Union Water Power Company obtained a FERC license and initiated a study to evaluate Common Loon populations, productivity, and the related effects of water level management in 1995 (Fair 1995). The following report summarizes BioDiversity Research Institute's Mooselookmeguntic Lake survey efforts in 2004 and makes recommendations for the management of common loons during the 2005 breeding season.

OBJECTIVES

1. To continue the existing loon-management and monitoring project on Mooselookmeguntic Lake. We will monitor and quantify loon nesting activities as well as the factors affecting the productivity of the current dynamic Common Loon population on Mooselookmeguntic Lake.

2. To implement and evaluate the effectiveness of artificial nesting islands (rafts), avian guards and signs within loon territories. We will make recommendations on the improvement, addition, removal, and placements of rafts and signage according to guidelines formulated in the management plan.

3. To evaluate between-year territory fidelity, mate fidelity and estimated minimum survivorship for color-marked loons on Mooselookmeguntic Lake.

4. To evaluate and identify key high-quality loon habitat on Mooselookmeguntic Lake using long-term territory reproductive success as an indicator.

5. To confirm chick survivorship by extending monitoring into late August/early September.

METHODS[1]

1. POPULATION AND NESTING SURVEYS

We conducted weekly surveys on Mooselookmeguntic Lake to confirm the presence/absence of Common Loons and document their nesting activities from 20 May to 26 August 2004 (Table 1). The bulk of the survey effort was concentrated on the Common Loon nesting onset and hatching period from May through July. Survey methods were consistent with those reported by Fair (1995) with additions to address objectives 2 through 5. We surveyed all known territories and surrounding areas on Mooselookmeguntic Lake from an 18' motorboat using 10X binoculars and occasionally a 15-45X spotting scope. Every effort was made to gather information from the greatest distance possible in order to minimize impacts on nesting and brooding activities. Since nesting evidence may be obscured by vegetation, it was often necessary to search for presence/absence of nest evidence by foot. We performed searches for evidence of natural nesting attempts by walking the perimeter of the available nesting habitat in loon territories. All known historical nesting sites previously reported by Jeff Fair and Bill Hanson were checked regularly for nesting evidence both above and below the waterline in response to fluctuating water levels.

TABLE 1: Lake Survey visit record for 2004 on Mooselookmeguntic Lake, Maine.

Month	Visit dates
May	20
June	3, 11, 14, 22, 29
July	8, 16, 22, 30
August	4, 11, 16, 18, 26

TOTAL: 15 visits'

2. LOON MANAGEMENT TOOLS: RAFTS, AVIAN GUARDS AND SIGNS

Raft Implementation

In mid-May, BRI and FPL biologists floated rafts constructed from cedar logs (nailed together using ~8 inch galvanized spikes) and plastic "mesh" fencing (attached using 1-1/2 inch galvanized fencing staples) similar to those described in Fair (1986) and Fair (1992a). We placed vegetation on the rafts, using material found in the general nesting area (sphagnum moss, grasses, and other vegetation). Common Loons typically build their nests from materials gathered from the immediate vicinity of the nesting site (McIntyre 1988). Nesting materials were built up to levels at which the eggs would remain dry and stay well above the water level. We monitored all rafts periodically for proper placement, buoyancy, and maintain sufficient nesting materials throughout the season. All rafts were pulled out of the water and placed above the highest possible waterline to dry for the winter (after all nesting activities ceased).

[1] Terms used in this report are defined in Appendix 4.

Raft positioning and location was determined by 1) knowledge of wind and wave action patterns relative to each territory, 2) knowledge of loon territorial boundaries and proximity to other territories (the importance of this point is addressed in the Discussion) 3) knowledge of previous traditional and non-traditional nest site locations and 4) knowledge of boat traffic patterns relative to the specific territory (This is important relative to the orientation of the avian guard, which obscures the view to/from the nest on two sides of the raft).

Avian Guards

Before raft floatation, we continued the practice of attaching (using staple-nails) avian guards made of metal fencing and camouflage mesh, to all rafts, as was initiated by Jeff Fair in 1988 (Fair 1992a). Avian guards are effective in lessening raft visibility and nest exposure from aerial predators and human lake users[2], which decreases flushing events and disturbances to nesting loons. Avian guards may therefore increase incubation time and hatching success of raft nesting loons. Camouflage mesh material was removed at the end of the season to avoid further degradation.

Signs

A few loon territories on Mooselookmeguntic Lake contain heavy human activity during the loons breeding season, which could potentially result in nest abandonment. Much of the disturbances are unintentional and may be avoided by placing informational signs both at the launch sites and at some nesting/brooding areas where deemed necessary. FPL Energy Maine Hydro distributes signs ("Loon Nesting Area Please Keep Away") for use in protecting these areas from human disturbances. The decision of whether or not to place a sign in a territory is often a difficult one based on their variable effectiveness as management tools. The character and type of lake users as well as the configuration of the territory and location of nest site will influence their efficacy. Sign placements are based on previous reports' recommendations, knowledge of typical lake use patterns, and previous site-specific nest failure history. Signs should not be implemented before nesting activity is found (and should therefore not be used for territorial pairs which do not attempt nesting), and should be taken down after nesting and/or brooding activities cease. They should also not be implemented in cases where it is determined that their cost (potentially attracting attention to a nest site) outweighs the benefit (notifying unsuspecting lake users to stay away).

3. ABANDONED EGG COLLECTION

We collected abandoned Common Loon eggs whenever possible to determine 1) egg viability as indicated by developmental stage and 2) egg mercury concentration. Information gathered from these analyses provides insight into causes of nest failure.

[2] Fair (1992) notes that avian guards may actually increase the visibility of rafts and will therefore increase the likelihood of human disturbance and resultant nest failure. We have found this to be the case on some territories, although we felt avian guards actually helped conceal rafts and potential nesting loons on Mooselookmeguntic territories.

Collection of Eggs

Loon eggs were not collected unless abandonment or failure could be confirmed beyond a reasonable doubt. We attempted to immediately collect abandoned eggs before they were predated or destroyed. When uncertainty existed in the determination of the absolute abandonment of the eggs by the adults, we gently penciled an "X" on the "upside" surface of the egg(s) in question. Eggs were checked no less than 24 hours later. Those that had not been turned by an incubating loon were considered inviable and were collected, placed in a labeled zip-lock plastic bag, and frozen until egg analysis.

Egg Sample Analysis

For each egg, we measured and recorded the length, width, volume (through water displacement), and weight for each egg. Evidence of external damage was noted. Eggs were then cut open, their contents were rated for embryological development (based on the scale below), and contents were placed in sterile I-Chem® jars. Egg contents were analyzed for mercury concentration using cold vapor atomic absorption, and eggshells were archived.

Embryological development scale used for Common Loon eggs

NA (not assessable): Developmental stage could not be determined. Contents were gray or yellowish-tan in color and typically had a foul smell. A darker color suggested some degree of development had occurred, whereas a yellow homogeneous liquid may be sifted through and if no dark spots or hardened areas were found we classified the egg as infertile (0).

0: No development was evident. Egg had a yellow/orange or yellow/tan yolk (intact or broken down into a liquid). A translucent jelly-like mass surrounded the yolk sac and showed no sign of embryonic development (e.g. mass not dark or hardened).

1: Embryo was viable (length was up to 1.5 cm). The jelly like mass (embryo) was dense and hardened. Small dark (red) eyespots may be visible at this stage.

2: Developing embryo (length was 1.5 – 2.0) has an apparent central nervous system. Cranial development and visible eyes are apparent. Feathers are absent.

3: The embryo shows advanced development (length was 2-3 cm). Bill was developed (e.g. egg tooth present but soft). Legs and wings were visible but not fully developed. Some feathers were present (first seen in tail).

4: The fully developed embryo was completely covered by feathers. Appendages were completely developed. Vent, preen gland was visible. A small portion of yolk sac remained attached to belly.

4. SURVEYING FOR MARKED INDIVIDUALS

We surveyed for color-marked loons that were captured on Mooselookmeguntic Lake from 1996 – 2004 [using a night-lighting technique described in Evers (1993) and Evers (2001)] to gain further information on territory boundaries, between-year territory fidelity, mate switching, estimated minimum survivorship, intra-seasonal movements, and recruitment. Each captured individual was custom fitted in the field with one or two bands on each leg (one USFWS band plus 1-3 color bands per bird), which are then observed opportunistically during surveys using a pair of 10X binoculars. Bands are

often visible above and below the water, depending on light conditions and wave action. The color combination observed in the field was recorded, and later referenced to a color banded loon ID list to confirm the individual(s). We also recorded the location and general behavior of both banded and unbanded individuals at the time of observation.

5. LATE-SEASON CHICK MONITORING AND OVERALL CHICK SURVIVAL

We carried out our loon monitoring into late August in an attempt to confirm juvenile survival past the six-week period and to gain insight into seasonal movements. To do this, we calculated minimum chick survival – the calculated difference (in days) between the date on which a chick was last observed and the date on which a chick was first observed or estimated to hatch.

RESULTS AND DISCUSSION

1. POPULATION AND NESTING SURVEYS: PRODUCTIVITY SUMMARY 2004

We present productivity information for the Mooselookmeguntic Lake loon population for the 2004 season. We summarize overall lake-wide productivity, nest failures, renests, the development of new territorial pairs, and the development of new nesting pairs. Territory-specific productivity data is summarized in Appendix 1 and the Qualitative Territory Summary.

TABLE 2: Common Loon Productivity and Nesting Summary (2004).
Territory-specific productivity details are summarized in Appendix 1 and The Qualitative Territory Summary.

20 Territorial Pairs
11 Nesting Pairs
12 Nesting Attempts
1 Renests
7 Successful Pairs
12 Chicks Hatched from all territories
5 Chicks Fledged from all territories
5 Nest Failures
- 3 (60%) Nest Failures due to unknown predation
- 1 (20%) Nest Failures due to unknown causes
- 1 (20%) Nest Failures due to abandonment from an unknown cause

Overall Lake-wide Productivity Summary

We observed 20 territorial pairs on Mooselookmeguntic Lake in 2004 (Table 2). Eleven of the 20 territorial pairs nested and nesting attempts totaled 12 times lake-wide (Table 2). The 2004 nesting frequency was 55% (11 NP/20 TP). Seven pairs (Blueberry Island,

Oquossoc, North Student's Island, Lunch Island, Shelter Island, Dam, and Bemis) were successful in hatching a total of 12 young, five of which survived to fledge. This yielded a nesting success (SNP/NP) of 64%, and 42% chick survival. The hatch rates for both nesting pairs (H/NP) and territorial pairs (H/TP) are 1.09 (12/11) and 0.60 (12/20), while corresponding fledge rates (F/NP and F/TP) are 0.45 (5/11) and 0.25 (5/20).

Nest Failures

There were a total of 5 nest failures on Mooselookmeguntic Lake in 2004 (Table 2). Forty-two percent (5/12) of the attempted nests failed. This is approximately 0.45 nest failures per nesting pair. Three (60%) nest failures were attributed to nest predation by an unknown source. One (20%) nest failure was not fully understood and was designated as unknown and one (20%) failure was due to nest abandonment from an unknown cause.

Renests

Only one of the 11 nesting pairs (Richardstown) renested after the first nest failed (Table 2).

Development of New Territorial and Nesting Pairs

All 20 of the territorial pairs observed in 2004 occupied traditional territories, designated by Fair (1995), Bill Hanson (FPL), and BRI.

Qualitative Territory Summary (Mooselookmeguntic Lake, 2004)

Cupsuptic River (R) and Cold Brook (R)
The banded male returned with an unbanded female in 2004. The pair occupied both traditional territories of Cold Brook and Cupsuptic River. The pair was frequently observed in both areas, but did not attempt to nest.

Birch Islands (nR)
The banded male from the Northeast Cupsuptic territory returned to the Birch Island territory with an unbanded female in 2004. The pair nested on the territory's historic nesting island, laying 2 eggs. Both eggs were abandoned in the nest due to an unknown cause. Both eggs were collected for sample analysis.

Northeast Cupsuptic (nR)
An unbanded pair occupied the territory this season. The pair appeared "nesty" on multiple surveys during the middle of June. The pair was frequently observed near large grass clumps along the southeastern shoreline. During this time period the water levels on Mooselookmeguntic increased and flooded the grassy areas. This increase in water levels may have deterred nesting activity.

Blueberry Island (nR)
The banded male returned to the territory with an unbanded female this season. The pair nested in a new location this year. The nest was situated on the west side of the small located approximately 75 meters from the historical site. The pair laid one egg and successfully hatched the chick. The chick was observed on the last survey visit and was approximately 9 weeks of age.

Echo Cove (nR)
An unbanded pair occupied the territory this season. The pair was consistently observed but did not attempt to nest.

Oquossoc (nR)
An unbanded pair occupied the territory this season. The pair nested on a large hummock in the back of the territory's cove. The pair laid two eggs and appeared to have successfully hatched both chicks. The chicks were never observed, but the presence of eggshells in the nest near the time of the suspected hatch date indicates the chicks hatched and disappeared within the first few days following the hatch.

Nursery (nR)
The banded female from 2002 returned to the territory with an unbanded male in 2004. The pair was observed building a nest on the backside of the large island but did not complete the nest and appeared not to lay any eggs. The reason for the nest abandonment is unknown. The pair was regularly observed but did not attempt to nest again this season.

Lunch Island (R)
The banded pair from 2003 returned to the territory this season. The pair nested on the raft, laying 2 eggs and successfully hatched both chicks. Both chicks were observed with the adults at approximately 1-2 days of age and disappeared a few days later. An adult Bald Eagle was frequently observed in the territory and may have predated the chicks.

Shelter Island (R)
An unbanded pair occupied the territory in 2004. The raft from Brandy Point was floated near the territory's recent nesting locations this season. The pair nested on the raft and successfully hatched two chicks. One chick disappeared at approximately 1 week of age. The other chick survived and was observed on the last survey visit conducted on 8/26/2004 and was approximately 7 weeks of age.

Farrington Island (nR)
An unbanded pair occupied the territory this season. The pair was consistently observed but did not attempt to nest.

Brandy Point (nR)
An unbanded pair occupied the territory this season. The pair was consistently observed but did not attempt to nest. The raft was moved to Shelter Island in the beginning of the season.

Sandy Cove (nR)
An unbanded pair occupied the territory this season. The pair nested on the northwestern shoreline. The nest attempt failed due to an unknown cause. A loon was observed sitting on the nest and on the following survey a week later the nest was abandoned with no signs of eggs or eggshells. The pair did not attempt to renest.

Dam (R)
An unbanded pair occupied the territory this season. The pair nested on the raft and successfully hatched two chicks. One chick was recovered dead in the territory at approximately 4 weeks of age. The chick had a large laceration to the body and appeared to have been hit by an outboard motor prop. The other chick survived and was observed on the last survey visit conducted on 8/26/2004 and was approximately 8 weeks of age.

Dollar Island (R)
An unbanded pair occupied the territory this year. The pair nested on a large island, located in the back of the cove (same island as the 2002 nest site). The nest contained two eggs, which were later predated. Small pieces of eggshells and egg content were found near the nest site.

Richardstown (R)
An unbanded pair occupied the territory this year. The pair nested on the traditional sandy shoal site. The pair attempted two nests, both resulting in nest failure, presumably from predation. Eggshell fragments from each attempt were found near the nests.

North Student's Island (R)
The banded female from 2001 returned with an unbanded male this season. The pair nested on the raft and successfully hatched two chicks. Both chicks survived and were observed on the last survey visit conducted on 8/26/2004. The chicks were approximately 7 weeks of age.

Student's Island (R)
An unbanded pair occupied the territory this season. The pair was consistently observed but did not attempt to nest.

East Toothaker (nR)
The female banded in the Bemis territory in 1996 paired with an unbanded male this season. The pair was consistently observed but did not attempt to nest.

South Toothaker (R)
An unbanded pair occupied the territory this year. The pair was consistently observed but did not attempt to nest.

Bemis (R)
An unbanded pair occupied the territory this season. The pair nested in the territory's historical nesting area located in the marshy channel across the Bemis Track Road. The pair appeared successful in hatching young, however the chicks were not observed. Small pieces of eggshell fragments were found in the nest near the time of the expected hatch date. It appears young were hatched and disappeared within the first few days following the hatch.

2. PRODUCTIVITY SUMMARY (2004) COMPARISON TO LONG-TERM MEANS (1995 and 2000-2004)

Twenty of the 21 (95%) historical territories observed on Mooselookmeguntic Lake over the period of this study supported territorial pairs (TP) in 2004. The Cupsuptic River territory has historically supported a territorial loon pair but did not in 2004. A single pair occupied both the traditional Cold Brook and the Cupsuptic River territories. Following the initial year (1995) of loon productivity monitoring on Mooselookmeguntic Lake the annual number of territorial pairs on Mooselookmeguntic has remained relatively stable (Table 3). Territorial pair occupancy in 2004 (20) is consistent with loon densities observed in the past five years.

Table 3. Common Loon productivity on Mooselookmeguntic Lake 1995 and 2000-2004.

Year	TP	NP	SNP	CH	CS	NP/TP	SNP/NP	CH/NP	CS/NP	CS/TP	CS/CH
1995	14	4	0	0	0	29%	0%	0.00	0.00	0.00	0%
2000	20	10	1	2	1	50%	10%	0.20	0.10	0.05	50%
2001	19	14	3	4	0	74%	21%	0.29	0.00	0.00	0%
2002	19	12	3	3	3	63%	25%	0.25	0.25	0.16	100%
2003	19	10	5	6	2	53%	50%	0.60	0.20	0.11	33%
2004	20	11	7	12	5	55%	64%	1.09	0.45	0.25	42%
Total	**111**	**61**	**19**	**27**	**11**	**55%**	**31%**	**0.44**	**0.18**	**0.10**	**41%**

All reproductive parameters recorded on Mooselookmeguntic Lake in 2004 have remained the same or increased in comparison to the lake's 6-year averages (Table 3). The most notable changes occur among the nesting success parameters. Overall nesting success on Mooselookmeguntic has continued to increase every year and the percent nesting success in 2004 (64%) is considerably higher than the 6-year average (31%). This change is the direct result of the continual increase in the raft use by nesting pairs on Mooselookmeguntic. As a result, the hatch rate (CH/NP) has dramatically increased over the 6-year period. The hatch rate in 2004 (1.09) is considerably higher than the 6-year average (0.44). While chick survival parameters have slightly increased in recent years they still remain well below long-term averages observed in New Hampshire (Taylor and Vogel 2001) and Vermont loon populations. Also, all of the long-term reproductive means for Mooselookmeguntic are lower than levels recorded on neighboring Richardson Lake over the same 6-year period (Savoy 2004a). Overall productivity on Mooselookmeguntic (CS/TP) in 2004 (0.25) is higher than the lake's long-term average (0.10) but is well below New Hampshire's 25-year average (0.52) (Taylor and Vogel 2001) and Vermont's long-term rate (0.84) (Hanson et al. 2001). This is related to the low chick survival rate (CS/CH) observed on Mooselookmeguntic Lake in recent years. The chick survival rate in 2004 was 42%, which is slightly higher than the 6-year average (41%). Chick survival rates found on Mooselookmeguntic are well below the long-term averages found in New Hampshire (77%) and Vermont (85%). While reproductive parameters related to hatching success are continuing to increase on Mooselookmeguntic, overall productivity and other parameters related to chick survival remain lower than comparison New England loon data and other reservoirs in the Rangeley Lakes area.

3. LOON MANAGEMENT TOOLS: RAFTS, AVIAN GUARDS AND SIGNS

Raft Implementation

This season we[3] floated, vegetated, positioned, and maintained 11 rafts in 11 loon territories (See Appendix 2 and territory maps for territory-specific information) on 20 May. The raft from Brandy Point was moved to the Shelter Island territory. All rafts were pulled out of the water in late August above the highest possible water level to dry over the winter.

Avian Guards

Avian guards, consisting of a wire frame and camouflage mesh material (see Avian Guards depiction in the Methods section), were placed on all 11 rafts this season. Upon pulling the rafts above the water line in late August, all of the camouflage material was removed and will be re-used for the 2005 season's rafts.

[3] (Bill Hanson (FPL), Kyle Murphy (FPL), Lucas Savoy (BRI)).

Signs

Informational signs[4] were posted at the Cupsuptic River public launching facility in 2004. The signs were placed in an effort to spark awareness among lake users toward the presence of nesting loons and their need for a minimally disturbed nesting area.

Raft Vs. Natural Nest Site Summary

This section is intended to provide the information necessary to evaluate the effectiveness of rafts as a management tool. We compare productivity, renests, and nest failures between loon pairs choosing raft and natural nest sites in 2004 (Territory-specific nesting information is presented in Appendix 2 and the Qualitative territory summary).

TABLE 4: Common Loon Comparative Nesting Summary: Rafts vs. Natural Nests (2004)

Raft Sites: 11 rafts floated in 11 territories (out of a potential 20)
4 of 11 (36%) rafts used for nesting by loons
4 of 8 (50%) nesting attempts in raft-containing territories were on rafts
4 of 8 (total nat. attempts) (50%) natural nesting attempts were made on natural sites in territories w/ rafts

4 of 12 (33%) lake-wide nesting attempts were on rafts
4 of 4 (100%) nesting attempts on rafts were successful
4 of 4 (100%) nesting attempts on rafts were 1st attempts
0 of 4 (0%) nesting attempts on rafts were 2nd attempts

8 of 12 (67%) chicks hatched (H) lake-wide from raft nests
4 of 5 (80%) chicks fledged (F) lake-wide from raft nests

Nest Failures: 0 nest failure on rafts

Natural Sites:

8 of 12 (67%) lake-wide nesting attempts were on natural sites
3 of 8 (38%) nesting attempts on natural sites were successful
7 of 8 (88%) nesting attempts on natural sites were 1st attempts
1 of 8 (12%) nesting attempts on natural sites were 2nd attempts

Renests: 1 renest on natural sites

4 of 12 (33%) chicks hatched (H) lake-wide from natural nests
1 of 5 (20%) chicks fledged (F) lake-wide from natural nests

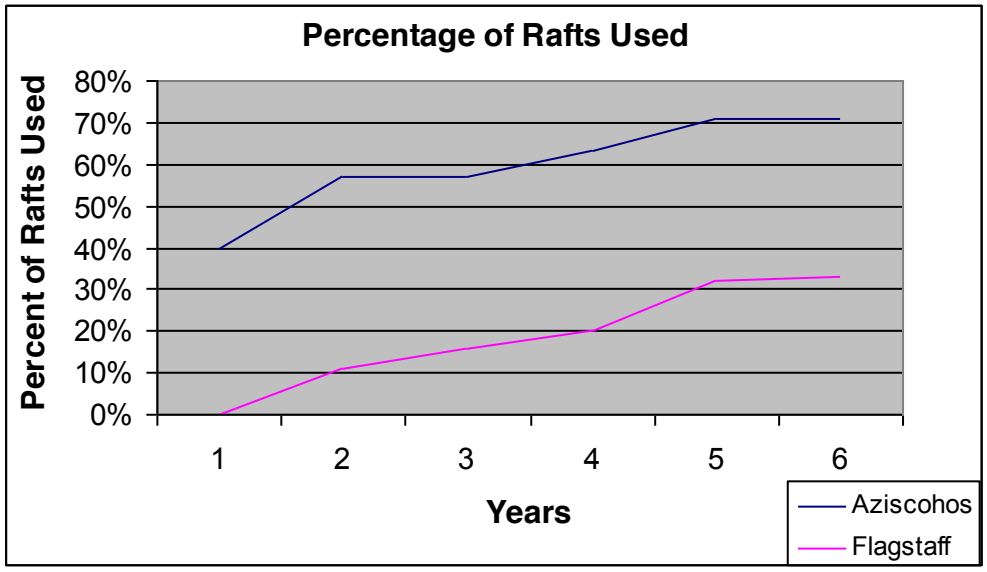
Nest Failures: 5 nest failures on natural sites
3 of 5 (60%) nest failures on natural sites were due to unknown predation
1 of 5 (20%) nest failures on natural sites were due to unknown cause
1 of 5 (20%) nest failures on natural sites were due unknown abandonment

[4] Informational signs were constructed by Sharon Clarke (E-PRO) to be posted at all FPL managed reservoir public launch sites for the 2003 season.

Raft vs. Natural Nest Site Productivity

Rafts have been proven to be a successful management tool in increasing loon productivity and substantially enhancing water bodies with significant fluctuations in water levels (Fair and Poirier 1992, Merrie 1996). Water level fluctuations do not appear to impact nesting activities of raft-nesting loons as long as the rafts are properly placed and maintained throughout the season. Initial findings on Aziscohos Lake indicate that rafts are significantly improving productivity in both the short and long-term basis on Aziscohos Lake under the current water level management practices. Raft-selecting territorial pairs yielded a H/territory years value of 0.79, while the value for natural nest-selecting pairs is 0.25 (DeSorbo and Evers 2000, BRI, unpublished data)[5].

Figure 1. Percentage of rafts used during the initial six years of implementation on Aziscohos and Flagstaff Lake.



Our long-term loon monitoring data suggests that the loon's initial selection of a raft as a nesting site is a gradual acclimation process. Lake-wide raft use on Aziscohos and Flagstaff Lake increased 17% and 11%, respectively, from the initial year of floatation to the second. Of the seventeen years (1987-2003) rafts have been floated on Aziscohos Lake, the percentage of raft use from each year has shown an increase or has remained relatively stable during the first eight years. In comparison, Flagstaff Lake has shown an increase in raft use during all five years of intensive loon monitoring (1995, 1997-2001) following raft implementation in 1995 (BRI unpubl. data, 1987-2001) (Table 4).

[5] Data for this analysis was categorized by nest site selection. Territories were categorized as natural or raft if >50% of nesting attempts were on that site. Territories were not used if they represented less than 3 years of data.

Rafts vs. Natural Nest Sites: Failures

There were 5 nest failures on **natural sites** (100% of all failures). Sixty percent (3/5) of the failures on natural sites were due to unknown predation. Twenty percent (1/5) of nest failures on natural sites were due to abandonment for an unknown cause and twenty percent (1/5) failed from unknown causes.

There were no nest failures on a **raft sites** this season.

Rafts vs. Natural Nest Sites: Renests

One of the nesting pairs on Mooselookmeguntic Lake attempted to renest during the 2004 season. The renest was on a natural site.

4. ABANDONED EGG COLLECTION AND ANALYSIS

Developmental stages of the two abandoned eggs collected in 2004 are listed[6]. Both eggs were collected from the same clutch in the Birch Island territory. Both eggs did not contain any signs of development.

	No. eggs collected	Dev. Stage[7]
Birch Island	2	0, 0

5. SURVEYING FOR MARKED INDIVIDUALS

From 1996-2004, 23 adult and 11 juvenile Common Loons have been captured, sampled, and uniquely color-marked on Mooselookmeguntic Lake. Color-marking individuals enables us to positively distinguish between neighboring pairs, properly delineate territorial boundaries and common feeding areas, and makes counts more accurate by eliminating incidences of double-counting individuals or pairs. It also provides us with information on inter-seasonal movements, between-year territory fidelity, mate switching, estimated minimum survival, individual behavior, and loon social dynamics (Evers 2001), and links local breeding populations to key winter habitat. Many of these findings can then be related to productivity. If a catastrophic event on wintering habitat caused mortality of much of the current Mooselookmeguntic Lake population, it would only be detected the subsequent year when those banded individuals did not return. Findings by Evers (2000) indicate that mate switches, which would be initiated by such an event, could reduce loon's likelihood to nest by as much as 83%, thereby affecting annual productivity totals. We feel that a marked loon population provides useful tools with which we can detect and explain population trends and abnormalities. In addition, the color-marking of juveniles has provided biologists with crucial information on loon

[6] Further details on individual nest failure causes and abandonment are presented in the Qualitative Territory Summary.
[7] Egg developmental codes explained in Methods.

recruitment rates, natal site fidelity, and year of first reproduction, many of which are necessary for modeling population trends.

Between-Year Territory Fidelity

Between-year territory fidelity is a reflection on various complex factors, such as territory quality, frequency of nest failures, individual fitness, and population pressures such as conspecific intrusions. We have monitored between-year territory fidelity for all territories with banded loons on Mooselookmeguntic Lake since 1997. Return rate information is biased towards successfully nesting pairs due to limitations of the capture technique with non-breeders. More information is needed to determine site fidelity of unsuccessfully nesting loons and non-breeders.

TABLE 5: Common Loon Between-Year Territory Fidelity on Mooselookmeguntic Lake. Between-Year Territory fidelity of color-marked Common Loons on Mooselookmeguntic Lake from 1997 – 2004[8] by sex.

	Total No. Marked			Total No. Returning			Percent Return		
Year	M	F	Both	M	F	Both	M	F	Both
1997	4	3	7	3	1	4	75%	33%	57%
1998	3	3	6	3	1	4	100%	33%	67%
1999	3	1	4	3	1	4	100%	100%	100%
2000	3	1	4	2	1	3	67%	100%	75%
2001	4	2	6	2	2	4	50%	100%	67%
2002	5	4	9	3	4	7	60%	100%	78%
2003	5	4	9	4	2	6	80%	50%	67%
2004	6	4	10	3	3	6	50%	75%	60%
Totals	**33**	**22**	**55**	**23**	**15**	**38**	**70%**	**68%**	**69%**
NE Ave.[9]	227	192	419	182	162	344	80%	84%	82%

We present information on the yearly proportions of color-marked individuals returning to their original territories on Mooselookmeguntic Lake after wintering on the ocean (Table 5). All marked individuals did not return to their respective original territories in 2004, which yielded a 60% return rate for 2004 males and females combined. The return rate for males in 2004 50%, while females had a rate of 75%. The 2004 between-year territory fidelity for Mooselookmeguntic Lake combined sexes, males and females in 2004 is lower in comparison to New England averages (for partial lake territory type). The low return rate for males in 2004 reflects the disappearance of the male from the

[8] Values given represent loon return-years. Beginning-of-the year eligibility in calculating return percentages for marked loons does not include individuals (1) found off their original territory or outside of other territories with banded loons and (2) that were "gone" the previous year (either known dead or missing). Should a loon be found that was previously in either of these categories it is then eligible at the beginning of the year. 3) Individuals that did not return for two consecutive years were assumed to be elsewhere or dead, in which case they were not included for subsequent years' total of marked individuals.
[9] New England averages for between-year territory fidelity on partial lake territories (Evers 2001).

North Student's Island territory and the territory switch of the male from the Northeast Cupsuptic and Nursery territories.

The overall return rate for both sexes from 1997-2004 is 69%. The rate for males was 70%, and the rate for females was 68%. These totals are lower to their corresponding New England averages, most likely reflecting a small sample size of banded loons on Mooselookmeguntic Lake. Seven of the 13 (54%) adults color-marked on Mooselookmeguntic during the 1996 and 2001 season were from 1996.

Mate-Switching Activities

The monitoring of mate switching among individuals offers insights into loon population pressures, social interactions, and their effects on nesting activities. We monitored mate switching among the four territorial pairs banded prior to the 2004 season (Blueberry Island, North Student's Island, Nursery, and Lunch Island). Detailed information on mate switching is also listed by territory in the Qualitative Territory Summary. Mate switching activities are likely to affect productivity parameters. Current findings indicate that loons are more likely to switch mates subsequent to a nest failure (Evers 2000). These studies also indicate that males are 40% less likely to nest immediately after a mate switch, while females are 83% less likely to mate after a switch. Gathering information on this parameter provides helpful insights on nesting activities and overall productivity of the population in comparison with other populations. An increase in the number of switches on Mooselookmeguntic Lake may also be indicative of pressures exerted by an increasing buffer population. Activities that increase incidence of nest failures (i.e. water level fluctuations, human disturbance) are also likely to increase the incidence of mate switching among those individuals that fail. This would likely impact productivity. It is for this reason that we believe it is valuable to monitor mate switching among surveyed pairs.

Mate switching did occur (75%) in three of the four eligible pairs in 2004. The banded male from the North Student's Island territory and the female from the Blueberry Island territory did not return in 2004. The banded male from the Nursery territory returned but did not reside in the Nursery territory. We cannot detect a mate switch in pairs with one or more unbanded individual. Three territories (Cold Brook, Student's Island, and East Toothaker) contained one banded individual in the pair during the 2004 season.

Estimated Minimum Survivorship

Confirmations of the annual return of individuals to a lake are often our best indication of loon survivorship. It is intrinsically linked to between-year territory fidelity given that most individuals confirmed to the lake are confirmed on territory, but it gives a different perspective in that it counts the total number of banded individuals on a lake, regardless of their location or status.

Of the 10 eligible adult Common Loons that have been banded on Mooselookmeguntic Lake before the 2004 nesting season (1996-2003), mean annual survivorship was 80%.

Estimated minimum survivorship was higher for males than females, 80% for males, and 75% for females. A higher density of adult and juvenile loons banded on Mooselookmeguntic Lake would give a more accurate assessment of the estimated minimum survivorship for the Mooselookmeguntic loon population.

Recruitment

Recruitment data for the Mooselookmeguntic Lake loon population can only be gathered by color-marking and observing the returns of juveniles. No ABJ's (adult banded as juvenile) were observed on Mooselookmeguntic Lake this season. However, three ABJ's were observed on Mooselookmeguntic Lake in the 2002 season. A juvenile banded in the Shelter Island territory in 1996, was observed in adult plumage in the Oquossoc/Blueberry Island common area. This bird was not a breeding adult in 2002, but could potentially be competing for a territory in 2004. The remaining two individuals were also in adult plumage, observed in the Farrington Island/Nursery common area. Unfortunately, both of these individuals could not be positively identified. Each bird contained a single silver band on their left leg and a single blue alpha-numeric band on their right leg, indicating that they were both banded as juveniles. Without capturing the individual, it is near impossible to determine which alpha-numeric code was used on the blue band. Upon referencing our banded bird list, it was determined that these two individuals are one of five possible birds listed below (Table 6).

Table 6. List of possible ABJ's observed on Mooselookmeguntic Lake, 2002.

Band #	Lake/territory	Year of Capture	Right Leg Code[10]
898-098-37	Aziscohos – Sunday Pond	1999	Blue
898-098-79	Flagstaff – Meyers	1999	Blue "K6"
938-063-19	Rangeley – Greenvale Cove	2000	Blue "Y17"
938-063-23	Rangeley – Greenvale Cove	2000	Blue "N71"
938-063-29	Richardson – Rocky Cove	2000	Blue "C17"

Recoveries

Two loons banded on Mooselookmeguntic Lake between 1996-2004 have been recovered/re-observed, consisting of one adult male and one adult female (Table 6). The Student's Island and Bemis loons were recovered/re-observed in coastal areas, providing valuable insight into wintering areas of the Mooselookmeguntic Lake loon population.

Table 7. Recoveries of banded birds from Mooselookmeguntic Lake, 1996-2004.

Band #	Territory Banded	Year Banded	Age - Sex	Recovery Location	Recovery Season/Year
898-053-13	Student's Island	1996	A – M	Martinsville, NJ	Summer, 1997
848-048-98	Bemis	1996	A – F	Plainfield, CT	Spring, 2004

[10] All bands placed on the right leg were a single blue band consisting of a highlighted white alpha-numeric code.

6. LATE-SEASON CHICK MONITORING AND OVERALL CHICK SURVIVAL

Since nesting activities are typically concluded by the early fall, survey efforts are usually not carried out past this point in the season. For the most part, the productivity parameters for the population can be accurately collected using this survey schedule. The one exception, however, has been the number of chicks fledged (F). Once a loon chick reaches the age of six weeks, it's chances of survival on its natal lake increase dramatically. Typically, loon surveys calculate the number of chicks fledged as being the number of chicks surviving past six weeks of age. Again this season, we carried out our loon monitoring into late August in order to: 1) confirm juvenile survival past the six-week period and 2) determine where and how long juveniles remain on/in their natal lake/territory in the fall. As juvenile loons get older, they become more mobile and are difficult to confirm. Territory-specific chick survival and confirmation dates are listed by territory in the Qualitative Territory Summary, while the hatch windows used in these calculations can be found in Appendix 3.

Two of the seven (29%) successfully hatching territories on Mooselookmeguntic Lake fledged 100% of their young. The **North Student's Island** pair hatched two chicks and was observed brooding both chicks during the last survey visit, conducted on 26 August (chicks were 7+ weeks of age at this point). The **Blueberry Island** pair hatched a chick during late June. The pair and chick were observed on the last survey visit conducted on 26 August (chick was 9+ weeks of age).

In summary, 42% (5/12) of all hatched chicks survived to fledge in 2004. The 25-year average for the entire NH population is a 76% chick survival rate (Taylor and Vogel in prep.).

Evaluation of 2004 season

Results from 2004 indicate an increase in overall reproductive success of loons on Mooselookmeguntic Lake compared to the lake's previous year's productivity. However, reproductive parameters are well below long-term means observed in stable and recovering loon populations in New England. Rather than being related to a single factor, we feel that this season's results are directly influenced by a combination of the following factors acting on the Mooselookmeguntic Lake loon population:

1) A gradual acclimation process towards raft use. Thirty-six percent (4/11) of the rafts floated were actually used on Mooselookmeguntic during this season. Long-term data on similar reservoirs (Aziscohos, Richardson, and Flagstaff) show a gradual acceptance of rafts by loons. Loons tend to nest on permanent familiar objects. The implementation of a raft within a loon's territory maybe considered unfamiliar and for the most part will remain unused until the structure is viewed as a permanent object.

2) A high level of predation upon nest sites, and overall predation pressure. We suspect eighty percent (4/5) of all nest failures on Mooselookmeguntic in 2004 were due to

predation. A correlation between the increase of both Herring Gulls (*Larus argentatus*) and Ring-billed Gulls (*Larus delawarensis*) on Mooselookmeguntic Lake could possibly be made. A large colony of herring gulls (20+) nesting near the Blueberry Islands were present in 2004. The smaller colony of nesting ring-billed gulls that were observed on Mooselookmeguntic Lake the previous seasons, nested in smaller numbers (5+) in 2004. 3) Poor productivity, specifically in the number of chicks fledged from Mooselookmeguntic Lake during the 2000-2004 seasons. For the most part, reproductive parameters associated with chick survival are substantially lower than levels observed on similar reservoirs. Similar situations have been reported on other reservoirs in recent years also (Savoy et al. 2002), (Savoy et al. 2003), and (Yates et al. 2002). As discussed in Savoy et al. (2003a), poor productivity in fledging could reflect pressures exerted on the population by increased avian and mammalian predators, contaminants, variables related to habitat quality, or conspecific density-dependence and warrant further investigation. The effects of water levels on productivity parameters related to fledging are not fully understood. We have made recommendations to further address these concerns in this report.

7. YEAR 2005 RECOMMENDATIONS

Raft Management and Placement

Additional Rafts: We recommend the construction and floatation of an *additional* raft in the Northeast Cupsuptic territory.

This would result in a total of 12 rafts floated out of the current 20 occupied territories on Mooselookmeguntic Lake. The future addition of rafts in a few more different territories could potentially be a productive measure, as the nesting patterns on Mooselookmeguntic Lake are better understood.

Posting Signs at the Mooselookmeguntic Public Launching Facilities

Mooselookmeguntic Lake provides a popular recreational site for fishing, boating, and camping throughout the loon's breeding season. This makes, in particular, the Lunch Island, Shelter Island, and Farrington Island territories susceptible to nest failure from human disturbance[11]. Many human disturbances are unintentional and may be avoided by placing informational signs both at the launch sites and at some nesting/brooding areas where deemed necessary. The decision of whether or not to place a sign in a territory is often a difficult one based on the fact that it's effectiveness is often variable depending on the lake users and situation. Our recommendations are based on knowledge of typical lake use patterns and previous site-specific nest failure history. FPL Energy Maine Hydro distributes informational signs at boat ramps and campgrounds.

[11] The Shelter Island and Lunch Island pairs historically nest on heavily disturbed islands.

Surveying for new Nesting and Territorial Pairs

If new pairs become established on Mooselookmeguntic Lake, it is likely that they may move into presently vacant but previously occupied areas or areas in which individuals are occasionally observed. We recommend close monitoring of the following areas in addition to all of the territories recognized in 2004.

Color-Marking Individuals

We recommend the continuation of capture and marking efforts in order to add to and maintain current information on the recruitment, between-year territory, mate switching and estimated minimum survivorship on the Mooselookmeguntic Lake loon population. Four of the 20 territories existing on Mooselookmeguntic Lake in 2004 contained a banded pair (Blueberry Island, Shelter Island, Lunch Island, and Dam) that was either previously banded or was banded in 2004. Five territories (Cold Brook, Birch Island, North Students, East Toothaker, and Nursery) contained only one marked adult, banded prior to the 2004 season. We feel color-marking loons in all of the existing areas on Mooselookmeguntic would be helpful, allowing us to distinguish between proximate territorial pairs, properly delineate territory boundaries, and detect further mate switches.

Further Management Issues

Nest Predation: In 2004, forty-two percent (5/12) of nest attempts resulted in failure. Of the 5 nest failures, three were determined to be a result of predation and 1 was classified as a nest failure from an unknown cause. However, we suspect the nest attempt failed from predation. As a result, we suspect 80% (4/5) of all nest failures were attributed to predation. Similar cases have been reported on neighboring Richardson Lake (Savoy et al. 2004) during the 2004 season. In an effort to increase productivity, we recommend further actions be implemented in order to document the causes of some of these unexplained nest failures. We recommend that stills hot (e.g. TrailMaster™) or video cameras be mounted at a minimum of three target nest sites on Mooselookmeguntic Lake. High-risk nest sites will be chosen based on nest failure history, predator presence, and known human activity at specific known nest sites within loon territories.

Chick Survival: Only eleven chicks have been documented as fledging ((0) 1995, (1) 2000, (3) 2002, (2) 2003, and (5) 2004) during six years (1995, 2000-2004) of intensive surveys on Mooselookmeguntic Lake. Similar situations have been reported previously on Richardson (Savoy et al. 2002), Aziscohos (Savoy et al. 2003), and Flagstaff (Yates et al. 2002). Further investigation is necessary to explain and document the causes for the low chick survival on Mooselookmeguntic Lake. We recommend: 1) subcutaneously implanting radio transmitters in < 7 d old loon chicks to better understand the causes for chick mortality. Studies on loon populations in the Midwest have found no adverse impacts on loon behavior and survival using this technique (K. Kenow, pers. comm.). Implanted individuals will be followed regularly in addition to existing survey work; 2) subcutaneously implanting satellite transmitters in loon chicks > 50 d old in order to further confirm chick survival past the point of fledging from the natal lake and 3)

establish the location of wintering areas associated with the Mooselookmeguntic Lake population to ascertain potential impacts from potential catastrophic events, such as oil spills. Techniques used will be according to Kenow et al. 2002.

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Figure 2: Rangeley Lakes Study Area

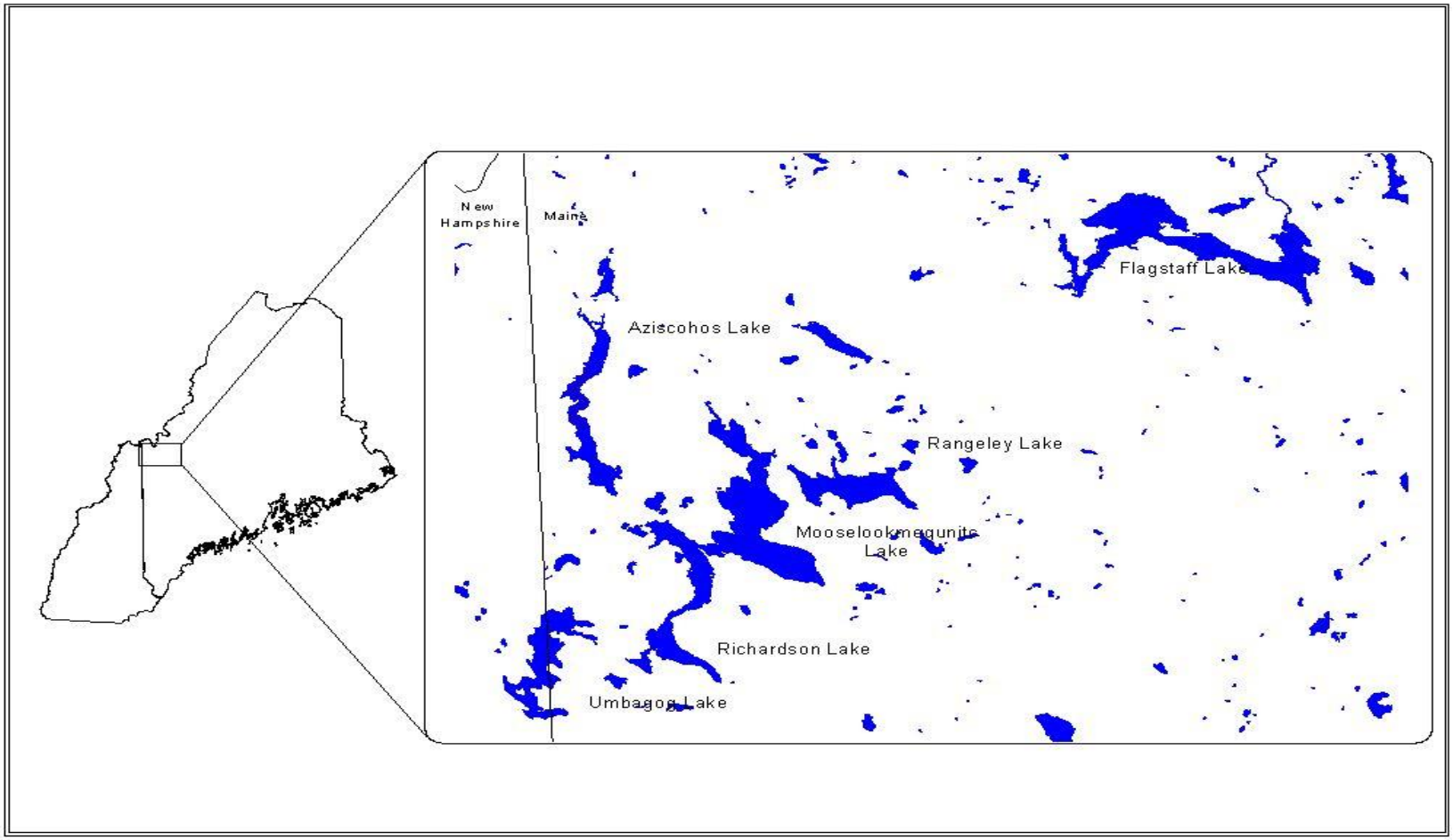


Figure 3: Distribution of Common Loon territories on Mooselookmeguntic Lake, 2004

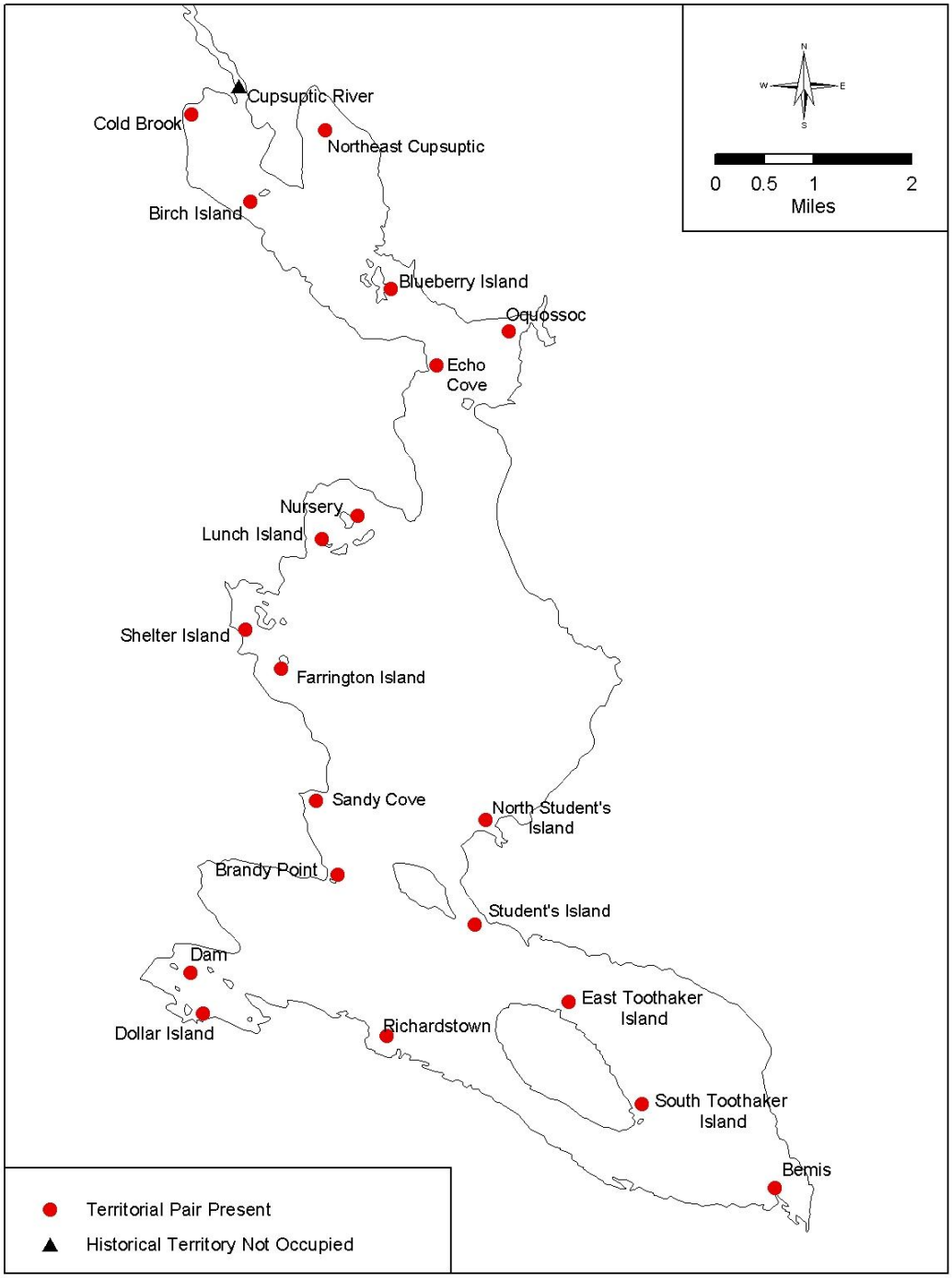
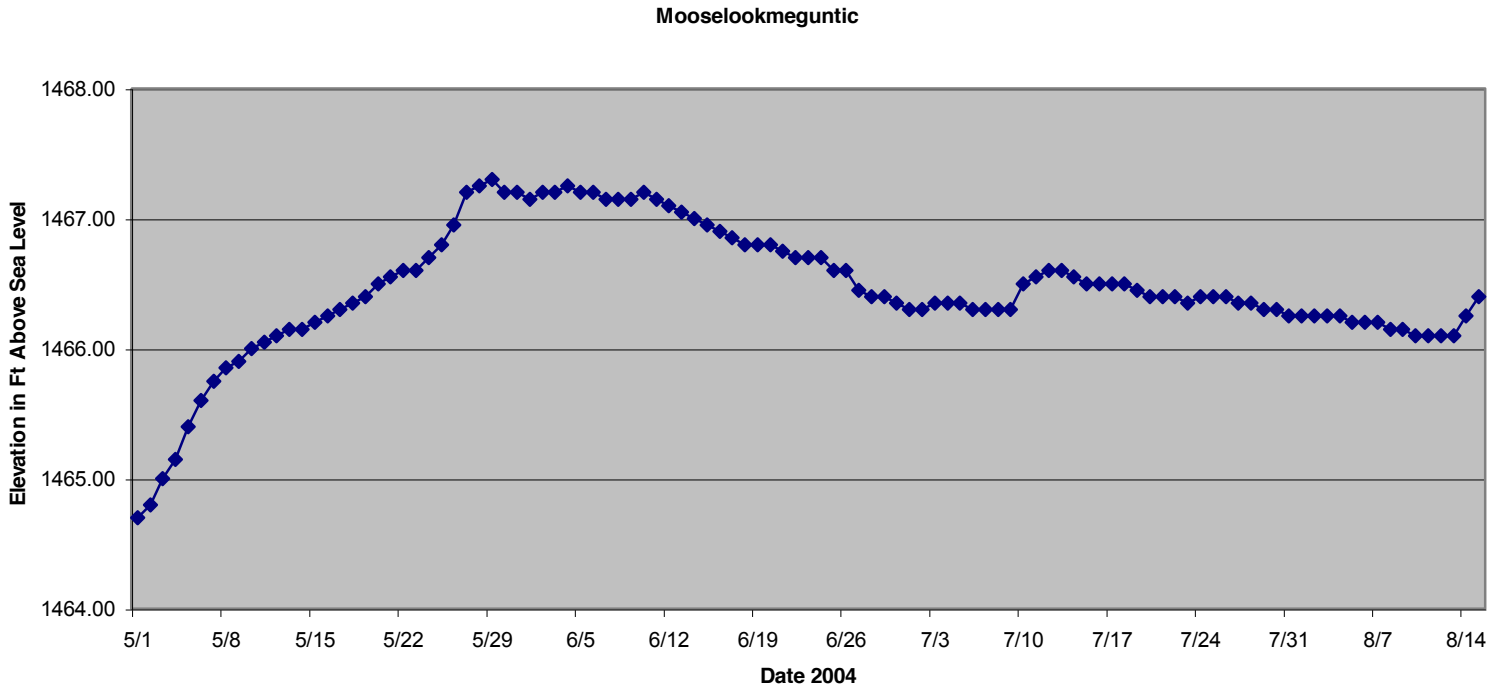


Figure 4: Daily Reservoir Water Levels on Mooselookmeguntic Lake (May 1 – August 15, 2004)



Appendix 1. Territory-Specific Productivity Summary.
For all recognized territorial pairs on Mooselookmeguntic Lake in 2004.

Territory	Territorial Pairs (TP)	Nesting Pairs (NP)	Total No. Nesting Attempts (eggs laid)	Total Chicks Hatched on Terr. (H)	No. Chicks in August (F)	Successful Pairs (>/= 1 Chick hatched)	No. Eggs in Nest. N1,N2, N3	Cause of Nest Failure #1*	Cause of Nest Failure #2*	**Total Pop (Adults+Chicks (F)+Imm)**
Cold Brook	1	0	0	0	0	0	0	~	~	**2**
Birch Island	1	1	1	0	0	0	2	AB	~	**2**
Northeast Cupsuptic	1	0	0	0	0	0	0	~	~	**2**
Echo Cove	1	0	0	0	0	0	~	~	~	**2**
Blueberry Island	1	1	1	1	1	1	1	~	~	**3**
Oquossoc	1	1	1	2	0	1	2	~	~	**2**
Nursery	1	0	0	0	0	0	0	~	~	**2**
Lunch Island	1	1	1	2	0	1	2	~	~	**2**
Shelter Island	1	1	1	2	1	1	2	~	~	**3**
Farrington Island	1	0	0	0	0	0	0	~	~	**2**
Brandy Point	1	0	0	0	0	0	0	~	~	**2**
Sandy Cove	1	1	1	0	0	0	?	U	~	**2**
Dam	1	1	1	2	1	1	2	~	~	**3**
Dollar Island	1	1	1	0	0	0	2	UP	~	**2**
Richardstown	1	1	2	0	0	0	?,?	UP	UP	**2**
North Student's Island	1	1	1	2	2	1	2	~	~	**4**
Student's Island	1	0	0	0	0	0	~	~	~	**2**
East Toothaker	1	0	0	0	0	0	~	~	~	**2**
South Toothaker	1	0	0	0	0	0	~	~	~	**2**
Bemis	1	1	1	1	0	1	1	~	~	**2**
FINAL TOTALS	**20**	**11**	**12**	**12**	**5**	**7**	**n/a**	**n/a**	**n/a**	**45**

Explanation of Table Characters

* = see individual territory for specific details
~ = N/A
U = information unknown
1? = at least one egg, unconfirmed 2nd

A = Avian Predation

U = Unknown

Intr = Intrusion

Appendix 2: NESTING SUMMARY: RAFTS VS. NATURAL SITES

For all recognized territorial pairs on Mooselookmeguntic Lake in 2004.

	Natural Sites			Raft Sites			
	2004			2004			
	No. Nesting Attempts on Natural Sites	No. Chicks Hatched From Nat. Sites	No. Chick Fledged From Nat. Sites	No. Rafts Floated	No. Nesting Attempts on Rafts	No. Chicks Hatched from Rafts	No. Chicks Fledging from Rafts
Cupsuptic River	0	0	0	1	0	0	0
Cold Brook	0	0	0	1	0	0	0
Birch Island	1	0	0	0	0	0	0
Northeast Cupsuptic	0	0	0	0	0	0	0
Echo Cove	0	0	0	0	0	0	0
Blueberry Island	1	1	1	0	0	0	0
Oquossoc	1	2	0	0	0	0	0
Nursery	0	0	0	0	0	0	0
Lunch Island	0	0	0	1	1	2	0
Shelter Island	0	0	0	1	1	2	1
Farrington Island	0	0	0	0	0	0	0
Brandy Point	0	0	0	0	0	0	0
Sandy Cove	1	0	0	0	0	0	0
Dam	0	0	0	1	1	2	1
Dollar Island	1	0	0	1	0	0	0
Richardstown	2	0	0	1	0	0	0
North Student's Island	0	0	0	1	1	2	2
Student's Island	0	0	0	1	0	0	0
East Toothaker	0	0	0	0	0	0	0
South Toothaker	0	0	0	1	0	0	0
Bemis	1	1	0	1	0	0	0
FINAL TOTALS	**8**	**4**	**1**	**11**	**4**	**8**	**4**

Explanation of Table Characters

* = see individual territory details ~ = N/A

Appendix 3: Nesting Activity Dates in Relation to Water Level. (Year 2004 Nesting Season)

Territory	On the Nest Window		Hatch Window		Nest Failure Window	
	Nest 1	Nest 2	Nest 1	Nest 2	Nest 1	Nest 2
Birch Island	6/23 – 6/29 (N) 1466.70 – 1466.40	-	-	-	7/9 – 7/16 1466.30 – 1466.50	-
Blueberry Island	5/31 – 6/1 (N) 1467.20 – 1467.15	-	6/27 – 6/29 1465.95 – 1466.40	-	-	-
Oquossoc	6/1 – 6/10 (N) 1467.15 – 1467.20	-	6/30 – 7/8	-	-	-
North Student's	5/21 – 6/3 (R) 1466.55 – 1467.20	-	6/30 – 7/8 1466.35 – 1466.30	-	-	-
Lunch Island	6/4 - 6/14 (R) 1467.25 – 1467.00	-	6/30 – 7/8 1466.35 – 1466.30	-	-	-
Shelter Island	5/21 – 6/3 (R) 1466.55 – 1467.20	-	6/30 – 7/8 1466.35 – 1466.30	-	-	-
Sandy Cove	6/15 – 6/22 (N) 1466.95 – 1466.70	-	-	-	6/22 – 6/29 1466.70 – 1466.40	-
Dam	5/21 - 6/3 (R) 1466.55 - 1467.20	-	6/22 – 6/29 1466.70 – 1466.40	-	-	-
Dollar Island	6/15 - 6/22 (N) 1466.95 – 1466.70	-	-	-	6/22 – 6/29 1466.70 – 1466.40	-
Richardstown	6/4 – 6/14 (N) 1467.25 – 1467.00	6/22 – 6/29 (N) 1466.70 – 1466.40	-	-	6/4 – 6/14 1467.25 – 1467.00	6/22 – 6/29 (N) 1466.70 – 1466.40
Bemis	6/4 – 6/14 (N) 1467.25 – 1467.00	-	7/9 – 7/16 1466.30 – 1466.50	-	-	-

All windows (Onset, Hatch, Nest Failure) are defined by survey visits in combination with site evidence and obvious weather events. They do not necessarily reflect actual survey dates. (R) = Raft was used for nesting by loons. (N) = Natural nest site was used for nesting by loons. Water levels given represent lake levels measured daily at Upper Dam. Mooselookmeguntic Lake Full Pond = 20.5 feet.

Appendix 4: DEFINITION OF TERMS[4]

Artificial nesting island – A man-made, floating platform for use as an alternate nesting site for common loons as described by the New Hampshire Loon Preservation Committee (LPC)(Fair 1989) and in some cases adapted to prevent avian egg predation through the addition of a cover described by Fair (1992). Artificial nesting islands were first developed and employed as a common loon research tool by McIntyre (1977) in a different form, later improved for management use by LPC. The term "raft" is synonymous with "artificial nesting island" in this report.

Avian guard – A camouflage mesh cover that is attached to artificial nesting islands with the intent of minimizing the visibility of the nest and eggs from avian predators and boat traffic.

Between-year territory fidelity – The return of an established territory holder to its previously occupied territory.

Breeding Adults – Established territory holders, and those with transitional territories that attempted breeding

Buffer Population – Encompasses non-territory holders and those with transitional territories that are not breeding

Chick survival – Number of loon chicks fledged divided by the number of loon chicks hatched; often expressed (x 100) as a percentage.

Chicks fledged – Number of loon chicks to survive past eight weeks of age were assumed to have fledged.

Chicks hatched – Number of chicks hatched completely out of their eggs, not necessarily departing from the nest.

Established Territory – Paired adults found on territory for at least three consecutive weeks for three consecutive years

Estimated minimum survivorship – The known rate of return for adult loons during the breeding season.

Fledge rate – Number of chicks fledged divided by either the number of nesting pairs (F/NP) or territorial pairs (F/TP). Also referred to in this report as "fledging success." F/NP is a representation of the total number of chicks fledged relative to pairs that attempted to nest, F/TP is a representation of the number of chicks fledged relative to all of the territorial pairs within a given subpopulation – including those territorial pairs that did not nest.

[4] Terms and definitions are taken from Fair (1992a) and Evers (2001).

Hatch rate – Number of chicks hatched divided by the number of nesting pairs (H/NP) or territorial pairs (H/TP) of a given or study-area population. H/NP is a representation of the total number of chicks hatched relative to pairs that attempted to nest (also referred to as "hatching success"), H/TP is a representation of the number of chicks fledged relative to all of the territorial pairs within a given population – including those territorial pairs that did not nest. Use of hatch rates in comparisons between populations or time periods allows comparison of productivity between lakes and populations prior to effects of chick mortality.

Hatch window – The time, often expressed by a "window" of dates, when an egg(s) hatches.

Individual performance – Tracking the reproductive success of marked individuals over time.

Long-term productivity – a measure of productivity taking into consideration the number of years the territory has existed or has been monitored. Calculated by dividing the number of chicks hatched divided by the number of years during which the parameter was measured. This measure is analyzed by territory and nest site selection in Appendix 4.

Loon – Common Loon (*Gavia immer*); no other loon species nested in the study area during the report period.

Loon return-year – A measure of loon site fidelity that represents the number of years the loon group in question (M, F, or both) returned as a territorial pair to the territory from which it was originally banded. Every year a banded individual is eligible to return is a potential return-year.

Mate fidelity – The known pairing of an adult with the previous years' mate

Mate switching – The known change of mates within or between years

Multiple lake territory – Paired adults using two or more lakes during a breeding cycle to provide the required resources. Multiple-lake territories are only those that require flight to access another lake.

Natal site fidelity – the known return of an individual banded as a juvenile

Nest attempt – Presence or evidence of any loon nest constructed or scraped that contained eggs, evidence of eggs, or constructed on a site where a previous nest contained eggs; this excludes copulatory platforms and nests of uncertain origin.

Nest failure – Any nest attempt that fails to completely hatch or at least one egg.

Nest Onset – The time, often expressed as a "window" of dates, during which a nesting pair lays eggs in a nest.

Nest success – Any nest attempt in which at least one chick completely hatches from its egg.

Nesting frequency – Number of nesting pairs divided by the number of territorial pairs in a given population or study area; often expressed (x 100) as a percentage. Nesting frequency is an index of the portion of a population attempting reproduction on a given year or time period.

Nesting pair (NP) –A territorial loon pair, which undertakes one or more nesting attempts on a given year. All territorial pairs are considered potential nesting pairs. Nesting pairs comprise a subset of territorial pairs.

Nesting season – That part of the year encompassing early reproductive behavior on the breeding grounds through late hatching of chicks. Nest building may begin prior to complete ice-out of aquatic systems in Maine and New Hampshire and hatches may occur as late as mid August in western Maine (Fair unpubl. Data) Nesting season varies from year to year and across latitudes and from lake to lake. Nesting season varies from year to year and across latitudes and from lake to lake. On Aziscohos Lake during this study period, nesting season may be generally defined as May 15 – August 5.

Nesting success – The rate of nest success by pairs; number of loon pairs hatching at least one chick divided by total number of pairs exhibiting at least one nesting attempt; usually expressed (x 100) as a percentage.

Non-breeding adults – Territorial and non-territory holders (e.g. floaters) that did not breed that year

Partial lake territory –Paired adults sharing a lake with other established territory holders. Common foraging areas used by non-breeding adults frequently exist.

Production – The absolute number of chicks fledged (surviving to migrate) within a given time period by a given loon population.

Productivity – The number of fledged chicks divided by the number of territorial pairs in a given population, expressed as number of chicks per territorial pair. Less thorough studies have reported productivity in terms of number of chicks (sometimes young chicks) per known nesting pair, not recognizing non-nesting and unsuccessful pairs, and chick mortality on the breeding lake. Certain ecological studies have reported loon productivity in chicks per water surface area. Productivity here reflects the total population of territorial (potential breeding) pairs, nesting frequency, nesting success, and chick survival, and is therefore a more precise and thorough reflection of the reproduction rate of the entire population.

Raft – Artificial nesting island for loons.

Raft use by loons – a raft is considered used by loons during any nesting season in which one or more nest attempts are made on that raft; may be expressed for a given study area as number of rafts exhibiting one or more nest attempts divided by number of rafts deployed that year; may be expressed (x 100) as a percentage.

Renest – Any nest attempt by a pair subsequent to its original nest attempt on a given year.

Successful nest – Any nest attempt resulting in at least one chick hatching completely out of its egg, though it may never depart the nest dish.

Successful nesting pair (SNP) – A loon pair that hatches at least one loon chick completely out of its egg on a given year, regardless of failures of former nests that year.

Territorial pair (TP) – A loon pair which exhibits territorial and paired behavior including territorial defense gestures, male yodeling, and close physical association within a defined territory during the nesting season; all nesting pairs are considered territorial pairs. Not all territorial loon pairs nest every year.

Territory – An area of still water used by a bonded pair of common loons for feeding, resting, breeding, nesting, chick rearing that is behaviorally protected against incursion by most other loons (and sometimes waterfowl) for a minimum of 4 weeks. Loon breeding activities were formerly described with reference to loon pairs, about under light of new evidence of infidelity among individuals of loon pairs, the territory has become the more certain and useful unit of reference in describing loon breeding activity and rates. Territories are recognized as being either "established" or "transitional." Long term monitoring will be necessary in order to classify a territory into one of these territory subgroups.

Territorial persistence – The tendency for territorial pair to remain present within their territory throughout the season. Measured by the length of time a pair remains on territory throughout the year.

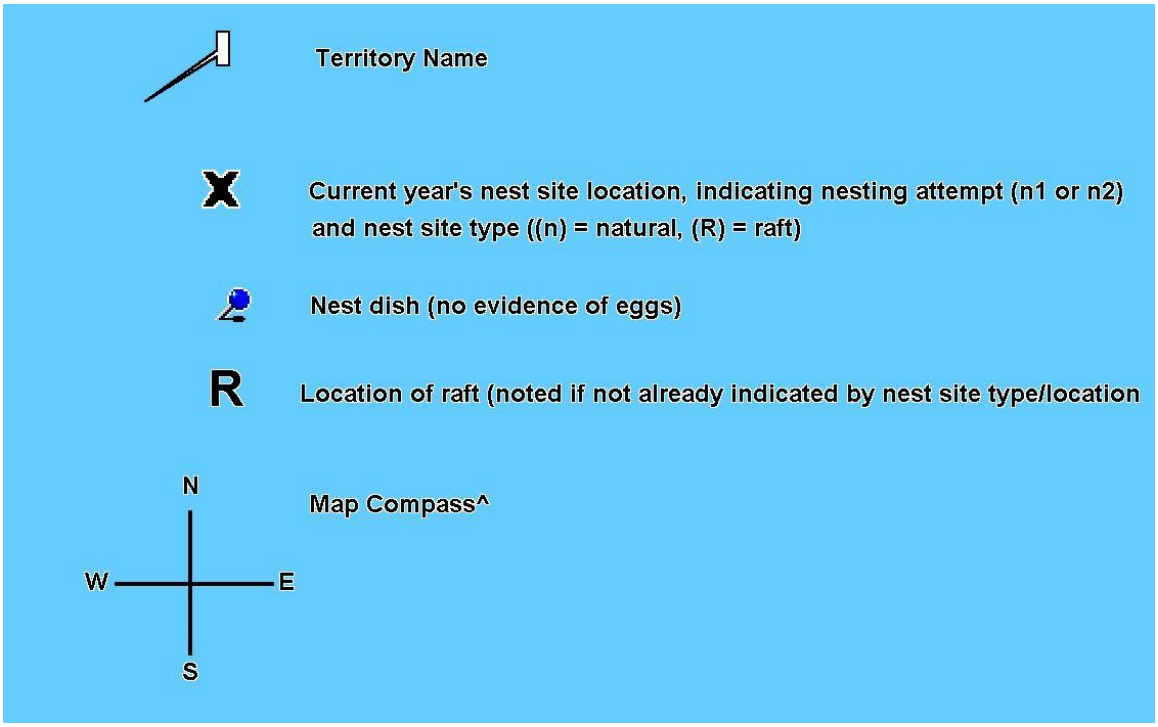
Territory years - The number of years a territory has been surveyed. Used as the denominator of the long-term hatch rate productivity measure.

Total production – The total number of loon chicks fledged lakewide during the year of time period described; lakewide production.

Transitional territory – Paired adults found on a territory for less than three consecutive weeks and/or less than three consecutive years

Whole lake territory – One pair of adults is restricted to one lake for the entire breeding cycle. The territory may or may not encompass the entire lake, however, a second pair is not established.

MAP LEGEND



^ Individual maps do not display a compass. True north is at the top of the page for all maps.

2004
Mooselookmeguntic Lake Common Loon Population Survey and Management Report

(REPORT BRI – 2005-02)

(Upper Dam Project)

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