Mooselookmeguntic Lake

Common Loon Population Survey and Management Report:

2001 SEASON FINAL REPORT

(BRI 2002-05)

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EXECUTIVE SUMMARY

We conducted loon productivity surveys on Mooselookmeguntic Lake in 2001, and managed the population using rafts to mitigate the effects of fluctuating water levels. The Mooselookmeguntic Lake water level measured 20.7 feet (full pond measures 20.5 feet) at Upper Dam on the date of the first survey on 23 May 2001, slowly decreasing until increasing fairly rapidly between 01 June and 07 June 2001. Water levels then remained relatively stable, decreasing slightly throughout July and August, resulting in a final reading of 16.05 feet. Loon productivity and surveys found 19 established territorial pairs on Mooselookmeguntic Lake this season, 14 of which nested. Three successful pairs produced four chicks lake wide, none of which fledged from the lake. Eight rafts were implemented in territories that were recommended in the 2001 Mooselookmeguntic Management Plan (Savoy et al. 2001 in prep.). One of eight (13%) rafts floated were used, indicating a gradual acclimation process towards raft use among Common Loons (*Gavia immer*). Predation was the largest cause for nest failures this season, responsible for 67% of the18 nest failures lake wide. Water level fluctuations were responsible for 16% (3/18) of lake wide nest failures. Five abandoned eggs were collected from four nests this season, four of which were found to be not assessable. The overall return rate for color-marked loons on Mooselookmeguntic in 2001 was 67%. Males had a lower return rate (50%) than did females (100%) this season, reflecting their increased mobility on the lake. Mean annual survivorship for the 6 eligible adult Common Loons on Mooselookmeguntic Lake in 2001 was 83%. Estimated minimum survivorship was higher for males than females, 100% and 67%, respectively. Fifty percent (2/4) of all chicks hatched on Mooselookmeguntic survived between 1-5 days, 25% (1/4) survived 5-15days, and the remaining 25% survived between 30-54 days of age. No chicks survived in 2001, reflecting similar productivity results to the only other loon monitoring years, 1995 and 2000, where no chicks were hatched in 1995 and one of the two chicks hatched in 2000 survived.

The productivity parameters, specifically, percent nesting success, hatch rates and fledge rates in 2001 were significantly lower than long-term means of Aziscohos and Flagstaff Lake. We feel that the overall productivity findings in 2001 reflect: 1) a gradual acclimation process towards raft use 2) a high level of predation pressure on natural nests 3) a significant unexplained negative impact on chick survival. 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 2001 and makes recommendations for the management of common loons during the 2002 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 regularly surveyed Mooselookmeguntic Lake to confirm the presence/absence of Common Loons and document their nesting activities from 23 May to 13 September 2001 (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 4. 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 2001 on Mooselookmeguntic Lake, Maine.

Month	Visit dates
May	23, 29, 30
June	5, 11, 15, 18, 19, 25,
July	3, 10, 12, 18, 23
August	16
September	13

TOTAL: 16 'visits'

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

Raft Implementation

In mid-May, BRI and FPL biologists floated new 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 vegetated 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 be dry and well above the water level. We monitored all rafts periodically for proper placement, buoyancy and sufficient nesting materials throughout the season. All rafts were pulled out of the water to a point that was above the highest possible waterline to dry for the winter (after all nesting activities ceased).
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

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

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 plastic 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 of 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 and those that had not been rolled were considered inviable and were collected, and placed in a labeled 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 – 2001 [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 8-10X binoculars. Bands are often visible above and below the water, depending on light conditions and wave action. The color combination seen in the field was recorded, and later referenced 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/early September 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 2001

We present productivity information for the Mooselookmeguntic Lake loon population for the 2001 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 (2001).
Territory-specific productivity details are summarized in Appendix 1 and The Qualitative Territory Summary.

19 Territorial Pairs
14 Nesting Pairs
21 Nesting Attempts
7 Renests
3 Successful Pairs
4 Chicks Hatched from all territories
0 Chicks Fledged from all territories
18 Nest Failures
10 (55%) Nest Failures due to unknown predation
1 (5%) Nest Failure due to avian predation
1 (5%) Nest Failure due to mammalian predation
3 (16%) Nest Failures due to water level increase
3 (16%) Nest Failure due to abandonment for unknown cause

Overall Lake-wide Productivity Summary

We observed 19 territorial pairs on Mooselookmeguntic Lake in 2001 (Table 2). Fourteen of the 19 territorial pairs nested, nesting attempts totaled 21 times lake-wide (Table 2). The 2001 nesting frequency was 73% (14 NP/19 TP). Three pairs (NE Cupsuptic, Echo Cove, and North Student's Island) were successful in hatching a total of 4 young, with no chicks fledging. This yielded a nesting success (SNP/NP) of 21%, and 0% chick survival. The hatch rates for both nesting pairs (H/NP) and territorial pairs (H/TP) are 0.28 (4/14) and 0.21 (4/19), while corresponding fledge rates (F/NP and F/TP) are 0.0 (0/14) and 0.0 (0/19).

Nest Failures

There were a total of 18 nest failures on Mooselookmeguntic Lake in 2001 (Table 2). Eighty-five percent (18/21) of the attempted nests failed. This is approximately 1.2 nest failures per nesting pair. Predation accounted for at least twelve of the 18 nest failures (66%), one of those failures (5% of all failures) to avian predators, one to a mammalian predator (5%), and the other ten (55%) to unknown predators. Three (16%) nest failures were attributed to water level fluctuations; all three (16%) due to a water level increase. Three (16%) nest failures were not fully understood and were designated as unknown.

Renests

Six of the 14 nesting pairs renested after the first nest failed (Shelter Island, Brandy Point, Sandy Cove, Student's Island, Richardstown, and South Toothaker). (Table 2). Only the Shelter Island Pair chose the same site for the renest as they did for the original nest (see discussion: Raft vs. Natural Sites: Renests and Qualitative Territory Summaries for details). None of the six pairs that attempted a renest were successful in hatching young. The South Toothaker territory supported three nesting attempts, all in different nest sites. Banded birds were not confirmed in the territory so it is uncertain if the same pair was involved with all three of the nesting attempts.

Development of New Territorial and Nesting Pairs

One new territory was established in the 2001 season – Echo Cove. Throughout the 2000 season, non-breeding loons were often observed foraging between Eagle Point and the Nursery territory. This season, a new pair of loons were observed nesting on a small island located between Eagle Point and Echo Cove. One chick was reported hatching from a Mooselookmeguntic Lake resident, however was never confirmed by a BRI biologist. Upon a follow-up investigation of the nest site, large amounts of eggshells and two membranes were located, indicating a successful hatch of two chicks. The loon pair was also observed on territory without any chicks, confirming the loss of chicks within the first few days of hatching. The individual who reported seeing the pair brooding the "small chick" was aware of the nest site and stated that this was the first year a loon pair had nested on that island.

Qualitative Territory Summary (Mooselookmeguntic Lake, 2001)

Reporting productivity data in a quantitative summarized form often inadvertently overlooks some important details. We report territory-specific information here in a qualitative descriptive format to minimize this potential loss of information. All territories and other areas of interest are listed from north to south. Territories with a "(R)" represent those in which a Raft was floated; all others display no raft "(nR)". Quantitative data about these territories (including specific dates) is found in Appendices 1-3.

Cupsuptic River (nR)

The banded Cold Brook male returned to the Cupsuptic River territory and paired with an unbanded female (The male was originally banded in the Cold Brook territory in 1996. This male was first confirmed in the Cupsuptic River territory in 2000). The pair was very mobile throughout the season, seen regularly in the Cold Brook territory. The pair built a nest at the north end of the Cupsuptic River (same location as the first nest site of 2000) during the middle of June. Eggs were never confirmed form this nest. The pair remained tight throughout the rest of the season. Nesting was not confirmed.

Cold Brook (R)

The Cold Brook territory did not contain a territorial pair this year. The Cupsuptic River pair was confirmed on the territory during the later part of May. A raft was floated at the northeast corner of the territory, because of historical nesting documented by Jeff Fair.

Birch Island (nR)

An unbanded pair occupied the territory this year. The pair nested on small island, which was also the site used in 2000, during the last week of June. The scrape nest was predated, most likely mammalian, within two weeks. Small pieces of eggshells were found near the nest site. The pair did not attempt a renest.

Northeast Cupsuptic (nR)

An unbanded pair occupied the territory and nested along the northeast shoreline, during the middle of June. A chick hatched during the first week of July. Confirmation of a second egg was not made. Small pieces of eggshells were collected from the nest, no membranes were found. The chick disappeared within the first week. The pair and chick were successfully captured (banded adults) on 7/12/01. The banded pair was frequently seen foraging within its territory. The banded male was observed among a group of four adult loons on Richardson Lake (Mill Brook territory) during the first week of September.

Blueberry Island (nR)

The banded Blueberry Island pair returned to their territory again this year, but did not attempt nesting. The banded pair remained tight throughout the season and were consistently observed foraging within their territory.

Oquossoc (nR)

An unbanded pair occupied the Oquossoc territory this year. A pair was consistently observed within the territory throughout the season, but did not attempt nesting.

Echo Cove (nR)

A new territory was formed here in 2001. An unbanded pair occupied and nested within the territory this year. The pair built a nest on a small island located off the point of Eagle Point (located on the west side of Mooselookmeguntic Lake, across from the Oquossoc territory). Two eggs were laid, both hatching during the middle of July. There were reports of a pair with one chick, around the time of hatching, in the Eagle Point area,

from a few different lake residents. Chicks were never observed, however two egg membranes and many pieces of eggshells were collected from the nest site, indicating a successful hatching of two chicks. Both chicks were disappeared within the first few days of hatching.

Nursery (nR)

An unbanded adult was occasionally observed foraging within the Nursery territory this year. A territorial pair was never seen in this territory. A raft was floated in early May and was later moved to the Lunch Island territory.

Lunch Island (nR)

An unbanded pair occupied the Lunch Island territory this year. The pair appeared interested in a small shrubby shoal during the middle of June. However, nesting evidence was not found on any survey visits. A raft was moved into the Lunch Island territory, from the Nursery territory, during this time period.

Shelter Island (nR)

An unbanded pair occupied the Shelter Island territory this year (the traditionally banded male did not return to the territory). The pair nested on the southern most island in their territory, in late May. The nest flooded due to drastic increases of water levels, caused by heavy rains in early June. The nest and one egg were found in 4-5 inches of water. The pair renested in the same location, at the end of June. The renest quickly failed from predation, most likely mammalian. Eggshells were found on land, a few feet from the nest. Numerous crayfish remains were also prominent in the area.

Farrington Island (nR)

An unbanded pair was regularly seen foraging around Farrington Island. Evidence of nesting was not found during survey visits.

Brandy Point (R)

An unbanded pair occupied the Brandy Point territory this year. The pair nested on the north side of the island located off of Brandy Point, during the middle of June. The nest was predated early in incubation, suspected by mammalian (found eggshells near the nest site). The pair renested along the northwestern shoreline of Brandy Point, in late June. The renest failed early in incubation from unknown predation. Eggshell fragments were found near the nest site.

Sandy Cove (nR)

An unbanded pair occupied the territory this year. However, an ABJ (adult banded as a juvenile) was observed among a group of adults in Sandy Cove. A raft was initially floated, but was not being used by the pair, so it was moved to the South Toothaker territory. The pair nested along the northern shoreline of the territory. A large bowl nest with two eggs was found between two pieces of dry-kie, in early June. The nest was predated approximately two weeks after the onset of incubation. It was predated from an unknown species. Small pieces of eggshells were found in the nest and larger pieces were found on land 8-10 feet from the nest. The pair renested shortly after, about 250-300 meters east of the first nest site. A small bowl nest with one egg was discovered during the first week of July. The renest failed within one week later, most likely from avian predation. Small pieces of eggshells and bird scat were found in the nest. Several feet from the nest site, two Herring Gulls (*Larus argentatus*) were observed feeding on fish.

Dam (nR)

An unbanded pair occupied the territory this year. The pair nested upon a small grassy shoal located near the north side of the channel markers. The nest was discovered in mid-June and failed early into incubation from unknown predation. Avian predation is however suspected due to bird scat found on the nest site and the consistent sighting of 25+ Ring-Billed Gulls (*Larus delawarensis*) upon the nesting shoal.

Dollar Island (nR)

An unbanded pair occupied the territory this year. The pair nested among grasses within a small cove, located on the southwest side of the territory. The nest containing one egg, failed early into incubation from an unknown cause. The egg nor eggshells were never recovered.

Richardstown (R)

An unbanded pair occupied the territory this year. The pair nested on the traditional large rocky/sandy shoal site, located in the center of the cove. A raft was floated near the nesting shoal, but the pair chose to nest naturally. The first nest containing one egg, failed early into incubation from an increase in water levels during the end of May. The pair renested in the same location in mid-June. A small bowl nest was found near the waterline, containing one egg. Any increase in water levels would have certainly flooded the nest. In an effort to provide the pair with an adequate nest site, the raft was moved to the renest area and the nest with egg was placed onto the raft. From a distance, the pair was observed to see if they would begin incubating on the raft. The pair was investigating the nest site, but not observed on the raft. Upon a survey visit three days later, one egg was found abandoned on the raft. The pair had made a third nest about 15 feet from the raft, incubating the second egg from the renest. The third nest attempt site (containing the second egg from the renest) failed from unknown predation. Eggshells were found near the nest site.

North Student's Island (R)

An unbanded pair occupied the territory this year. A raft was floated in the back of the southern-most cove located in the territory. The pair nested on the raft, laying two eggs in late May; on of which hatched while second was collected intact on the nest. The chick disappeared at about three weeks of age.

Student's Island (R)

The banded female returned to the territory with an unbanded male this year. The pair nested on the backside of the small island located southeast of Student's Island. A scrape nest in the sand and eggshells several feet from the nest site were found early in June. It appeared as if the nest was predated from a mammal species. Scat, appearing to be raccoon (*Procyon lotor*), was found near the eggshell fragments. A raft was constructed and placed in the immediate area of their first nest site. A couple weeks later, the pair renested naturally on the smaller of the two islands located about 50 meters to the south of the initial nesting island. The second nest failed early into incubation, most likely from avian predation. These two small islands supported 5-10 nesting herring gulls. The loon pair's renest was about 5 feet from the gulls nesting sites.

East Toothaker (nR)

The traditionally banded Bemis male paired with an unbanded female, occupying the territory this year. The pair nested on the northwest side of the small traditional island, located east of Toothaker Island. A small bowl nest was found with one egg during the first week of June. The nest and egg were becoming saturated from wave action, due to its exposing location. In an effort to prevent nest flooding, many small rocks were placed a couple feet from the nest to form a barrier against the wave action. Upon a survey visit one week later, the egg was found predated. Eggshells were found several feet behind the nest site, appeared to have been a mammal species.

South Toothaker (R)

An unbanded pair occupied the territory this year. The pair nested upon a small grassy shoal located within a cove at the south end of Toothaker Island. A loon was observed incubating the nest with a Canada Goose (*Branta canadensis*) nesting at the opposite end (about 15 feet apart). Upon a survey visit one week later, the nesting shoal was submerged in several inches of water, flooding the loon and goose's nests. (The two loon eggs from this nest site were found intact three weeks later in the immediate area, submerged in two feet of water). In an effort to encourage renesting onto a raft, one was moved from the Sandy Cove territory and was placed near the first nest site of the South Toothaker territory. The pair renested naturally about two weeks later on the east side of the small

island located south of Toothaker Island. The nest was found predated, appeared to have been mammalian, one week later. In a third nesting attempt, the pair nested at the southern tip of the small island, laying one egg. This nest failed from an unknown cause. Eggs nor shells were never recovered.

Bemis (R)

An unbanded pair occupied the territory this year. A raft was floated within the traditional nesting area, along the channel located east of the Bemis Road. The pair nested naturally about ten feet from the raft. A large bowl nest with two eggs, were observed during mid-June. The nest failed a couple days before the predicted hatch date from an unknown cause. No sign of eggs or eggshells were found.

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

Raft Implementation

Ice out on Mooselookmeguntic Lake in the 2001 season was during the first week of May. This season we[3] floated, vegetated, positioned, and maintained 8 rafts in 8 loon territories (See Appendix 2 and territory maps for territory-specific information) on 23 May, 2001. The 2001 season marks the first time rafts were implemented on Mooselookmeguntic Lake. The territories receiving rafts in 2001 were those that were recommended in the 2000 Mooselookmeguntic Management Plan (Savoy et al. 2001 In Prep.). 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 were placed on all 8 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 2002 season's rafts.

Signs

Informational signs[4] were posted at the Cupsuptic River public launching facility in 2001. Signs were placed in an effort to increase awareness among lake users towards 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 2001 (Territory-specific nesting information is presented in Appendix 2 and the Qualitative territory summary).

[3] (Bill Hanson (FPL), Jeff Fair (Fairwinds), and Chris DeSorbo, Lucas Savoy (BRI)).
[4] Informational signs were constructed by Sharon Clarke (E-PRO) to be posted at all FPL managed reservoir public launch sites for the 2001 season.

TABLE 3: Common Loon Comparative Nesting Summary: Rafts vs. Natural Nests (2001)

Raft Sites: 8 rafts floated in 8 territories (out of a potential 19)
1 of 8 (12%) rafts used for nesting by loons
1 of 10 (10%) nesting attempts in raft-containing territories were on rafts
10 of 11 (total nat. attempts) (90%) natural nesting attempts were made on natural sites in territories w/ rafts

1 of 21 (5%) lake wide nesting attempts were on rafts
1 of 1 (100%) nesting attempts on rafts were successful
1 of 1 (100%) nesting attempts on rafts were 1st attempts
0 of 1 (0%) nesting attempts on rafts were 2nd attempts

1 of 4 (25%) chicks hatched (H) lake wide from raft nests
0 of 0 (0%) chicks fledged (F) lake wide from raft nests

Nest Failures: 0 nest failures on rafts

Natural Sites:

20 of 21 (95%) lake-wide nesting attempts were on natural sites
2 of 21 (9%) nesting attempts on natural sites were successful
14 of 21 (66%) nesting attempts on natural sites were 1st attempts
7 of 21 (33%) nesting attempts on natural sites were 2nd attempts
7 of 7 Renests were on natural nest sites
1 of 7 (14%) renests were on the same nest site as the 1st nest
0 of 7 (0%) renests switched from a raft site to a natural site
0 of 7 (0%) renests switched from a natural site to a raft site

3 of 4 (75%) chicks hatched (H) lake wide from natural nests
0 of 0 (0%) chicks fledged (F) lake wide from natural nests

Nest Failures: 18 nest failures on natural Sites
1 of 18 (5%) nest failures on natural sites were due to avian predation
1 of 18 (5%) nest failures on natural sites were due to mammalian predation
10 of 18 (55%) nest failures on natural sites were due to unknown predation
3 of 18 (16%) nest failures on natural sites were due to water level increases
3 of 18 (16%) nest failures on natural sites was due to unknown cause

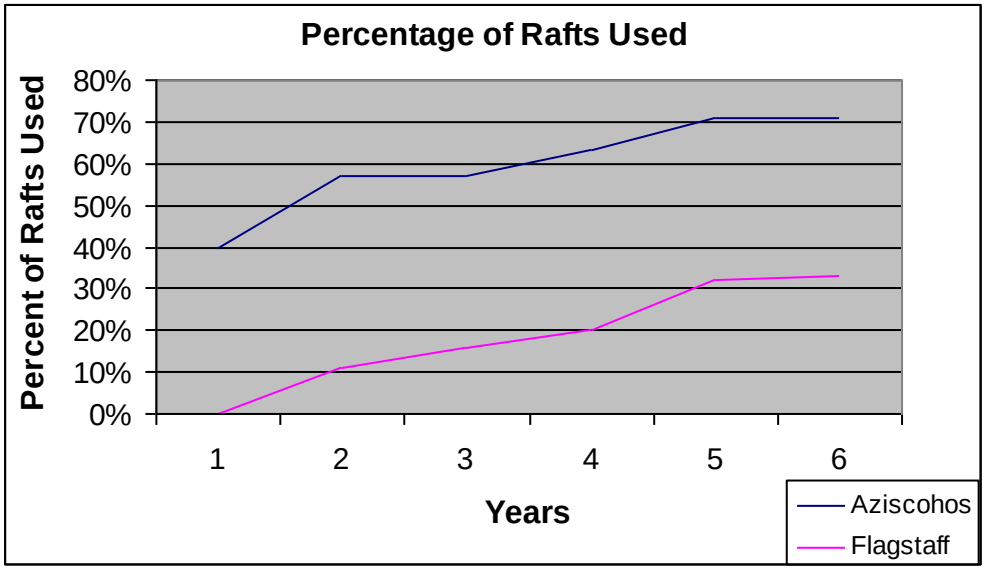
Raft vs. Natural Nest Site Productivity

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].

[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 did not substantially improve hatching success or productivity on Mooselookmeguntic Lake during the 2001 season. However, the one raft used was responsible for producing 25% of the hatched young on the lake.

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 nest 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 fifteen years (1987-2001) rafts have been floated on Aziscohos Lake, the percentage of raft use from each year has shown an increase or has remained stable during the first eight years (DeSorbo C.R. and Evers D.C. 2002). 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 (Yates et al. 2001) (Table 4).

Rafts vs. Natural Nest Sites: Failures

There were 18 nest failures on **natural sites** (100% of all failures). Sixty-six percent (12/18) of the failures on natural sites were due to predation: Five percent to avian predation, 5 % to mammalian predation, and 55% were due to unknown predation. Sixteen percent (3/18) of the nest failures on natural sites were due to water level fluctuations: 16% to water level increases. The remaining failure (16%) was designated as unknown.

There were no nest failures on **raft sites** (only one attempt was made on a raft and it resulted in a successful hatch).

Rafts vs. Natural Nest Sites: Renests

There were seven renests on Mooselookmeguntic Lake during the 2001 season. Five were in raft-containing territories (Brandy Point, Richardstown, South Toothaker (2), and Student's Island). All of the renest attempts were made on natural sites and in different locations from the initial nest site.

3. ABANDONED EGG COLLECTION AND ANALYSIS

Developmental stages of the following abandoned eggs collected in 2001 are listed[6]. The developmental stage could not be determined among four of the eggs collected in 2001 and one egg the development was evident.

	No. eggs collected	Dev. Stage[7]
N. Student's Island	1	n/a
Shelter Island	1	0
South Toothaker	2	n/a, n/a
Richardstown	1	n/a

4. SURVEYING FOR MARKED INDIVIDUALS

From 1996-2001, 13 adult and 4 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 recruitment rates, natal site fidelity, and year of first reproduction, many of which are necessary for modeling population trends.

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

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 4: Common Loon Between-Year Territory Fidelity on Mooselookmeguntic Lake.
Between-Year Territory fidelity of color-marked Common Loons on Mooselookmeguntic Lake from 1997 – 2001[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%
Totals	**17**	**10**	**27**	**13**	**6**	**19**	**76%**	**60%**	**70%**
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 2001, which yielded a 67% return rate for 2001 males and females combined. The return rate for males in 2001 was 50%, while females had a rate of 100%. The 2001 between-year territory fidelity for Mooselookmeguntic Lake males and combined sexes in 2001 is lower in comparison to New England comparisons (for partial lake territory type), however females in 2001 were noticeably higher than the New England comparison. The low return rate for males in 2001 reflects the displacement of the male from the Bemis territory (shifting to the East Toothaker territory) and the disappearance of the Shelter Island male.

The overall return rate for both sexes from 1997-2001 is 70%. The rate for males was 76%, and the rate for females was 60%. These totals are lower to their corresponding New England

[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).

averages, most likely reflecting a small sample size of banded loons on Mooselookmeguntic Lake. Seven of the nine (78%) adults color-marked on Mooselookmeguntic during the 1996 and 2000 season were banded in 1996. The other two adults were banded in 2000.

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 for the only territorial pair in which both adults were banded in 2001, the Blueberry Island pair. 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 not occur (0%) in the Blueberry Island territory this year. We cannot detect a mate switch in pairs with one or more unbanded individual. Three territories (Cupsuptic River, Shelter Island, and Student's Island) contained one banded individual in the pair during the 2000 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 13 adult Common Loons that have been banded on Mooselookmeguntic Lake before the 2001 nesting season (1996-2000), mean annual survivorship was 83%. Estimated minimum survivorship was higher for males than females, 100% for males, and 67% for females. Due to the limited number of adult loons available for the 2001 estimated minimum survivorship (6 adult loons seen on lake in 2000), of the one female not returning in 2001 (Shelter Island), weights heavily on the overall mean of female minimum survivorship. 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. One ABJ (adults banded as juveniles) was observed on Mooselookmeguntic Lake this season, potentially competing for a territory in the Sandy Cove area. It was a juvenile banded on Rangeley Lake in 1998.

5. 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 eight weeks of age. Again this season, we carried out our loon monitoring into late August/early September 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.

All three successfully hatching territories on Mooselookmeguntic Lake lost their young entirely before fledging (NE Cupsuptic, Echo Cove, and North Student's Island). The **Northeast Cupsuptic** pair was seen with one chick on the first survey visit following the hatch (chick age of approximately 4 days). Upon the next survey visit, 10 days later, the chick had disappeared. The **Echo Cove** pair was not confirmed with chicks, by a BRI biologist (heard rumors of a pair with two chicks in the Echo Cove area). Upon an investigation of the nest site, many eggshells and two egg membranes were found, indicating a successful hatch and then the disappearance of two chicks at a few days of age. The **North Student's Island** pair hatched one chick, which was last observed at a minimum of 23 days of age (3.3 weeks). In summary, 0% (0/4) of all chicks hatched did not survive. The chicks disappeared, from an unknown cause, between the minimum ages 3-23 days of age. The 25-year average for the entire NH population is a 76% chick survival rate (Taylor and Vogel in prep.). These findings suggest a significant impact on chick survival on Mooselookmeguntic Lake that warrants further investigation.

Evaluation of 2001 season

Results from 2001 illustrate the extremely low reproductive success on Mooselookmeguntic Lake. 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. Thirteen percent (1/8) of the rafts floated were actually used on Mooselookmeguntic during the initial season, 2001. Long-term data on similar reservoirs (Aziscohos 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) An extremely high level of predation upon nest sites, and overall predation pressure. Sixty-seven percent (12/18) nest failures on Mooselookmeguntic in 2001 were due to predation, 10 of which were considered unknown. A correlation between the increase of both Herring Gulls (*Larus argentatus*) and Ring-billed Gulls (*Larus delawarensis*) on Mooselookmeguntic Lake is possible. A large colony of nesting herring gulls (20+) and a smaller colony of nesting ring-billed gulls were observed on Mooselookmeguntic Lake this season.

3) Poor productivity, specifically in the number of chicks fledged from Mooselookmeguntic Lake during the 2000 and 2001 seasons. Chick survival on Mooselookmeguntic Lake in the 2000 and 2001 seasons has been extremely low (1 chick fledged during the 2000 and 2001 seasons combined). Similar situations have been reported on other reservoirs in recent years also (DeSorbo et al 2001) and (Yates et. al 2001). As discussed in Savoy et al (2001), 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.

6. YEAR 2001 RECOMMENDATIONS

Further Management Issues

Nest Predation: In 2001, ten of the twelve cases of nest predation were deemed as an unknown cause of failure. Similar cases have been reported on Aziscohos (DeSorbo and Evers 2001) and Flagstaff (Yates et. al 2001) lake for the 2001 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 one chick has been documented as fledging (2000) during three years (1995, 2000, and 2001) of intensive surveys on Mooselookmeguntic Lake. Similar situations have been reported previously on Aziscohos Lake (DeSorbo and Evers 2001) and Flagstaff Lake (Yates et al. 2001). 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 (In Press).Raft Management and Placement

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 2001.

Cold Brook: The Cold Brook area supported a pair during the 1996-1999 seasons, hatching chicks in 1996. The male occupying the territory during those years was observed as a territorial pair in the adjacent Cupsuptic River territory in 2000 and 2001 (nesting in 2000). The Cold Brook territory contains adequate nesting habitat and receives little human activity, making it a territory worth closely monitoring during the 2002 season.

Nursery: The Nursery area, located just north of the Lunch Island territory, supported a loon pair in 1995 and 2000. A single loon was frequently observed in the area during the 2001 season. It is a small territory, however containing suitable nesting habitat for loons, making it a worthwhile area to survey in 2002.

Sandy Cove: Sandy Cove is large cove, located along the western side of Mooselookmeguntic Lake. A territorial pair, occupying the northern side of the cove, has been frequently observed in 1995, 2000, and nesting in 2001. On a couple survey visits in 2001, adult loons were observed displaying territorial behaviors along the southern end of the cove. The Sandy Cove area could potentially support two territorial pairs in the future.

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 Mooselookmeguntic Lake loon population. Six of the 19 territories existing on Mooselookmeguntic Lake in 2001 contained at least one adult that was either previously banded or was banded in 2001. 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.

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[10]. 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.

Raft Management and Placement

Additional Rafts: We recommend the construction and floatation of *additional* rafts in the following three territories:

Dam
Dollar Island
Oquossoc

This would result in a total of 11 rafts floated out of the current 19 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

[10] The Shelter Island and Lunch Island pair historically nest on heavily disturbed islands. Nesting has not been documented in the Farrington Island territory, however, the only available island in their territory contains a few active campsites.

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Figure 2: Rangeley Lakes Study Area

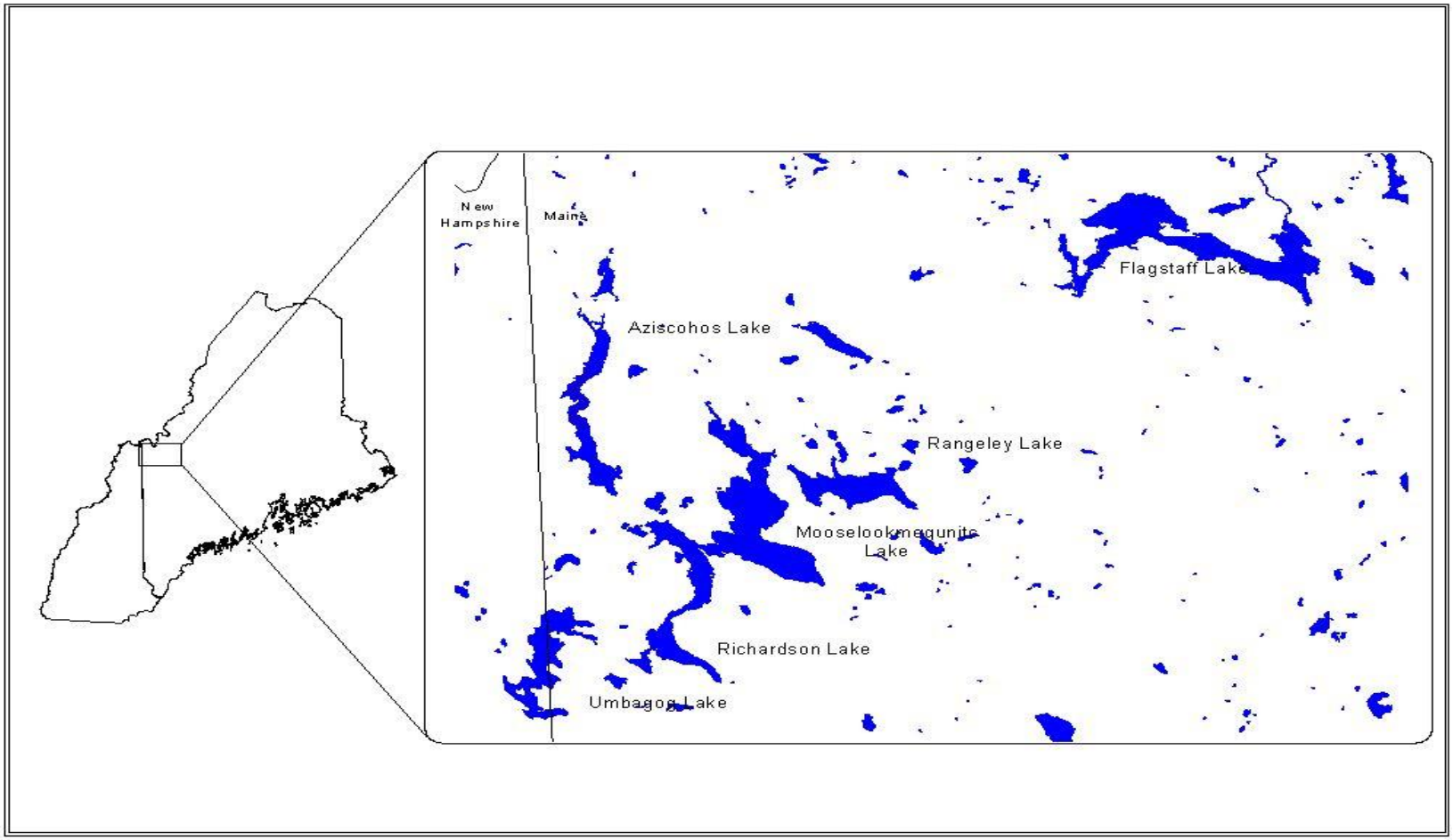


Figure 3: Distribution of Common Loon territories on Mooselookmeguntic Lake, 2001

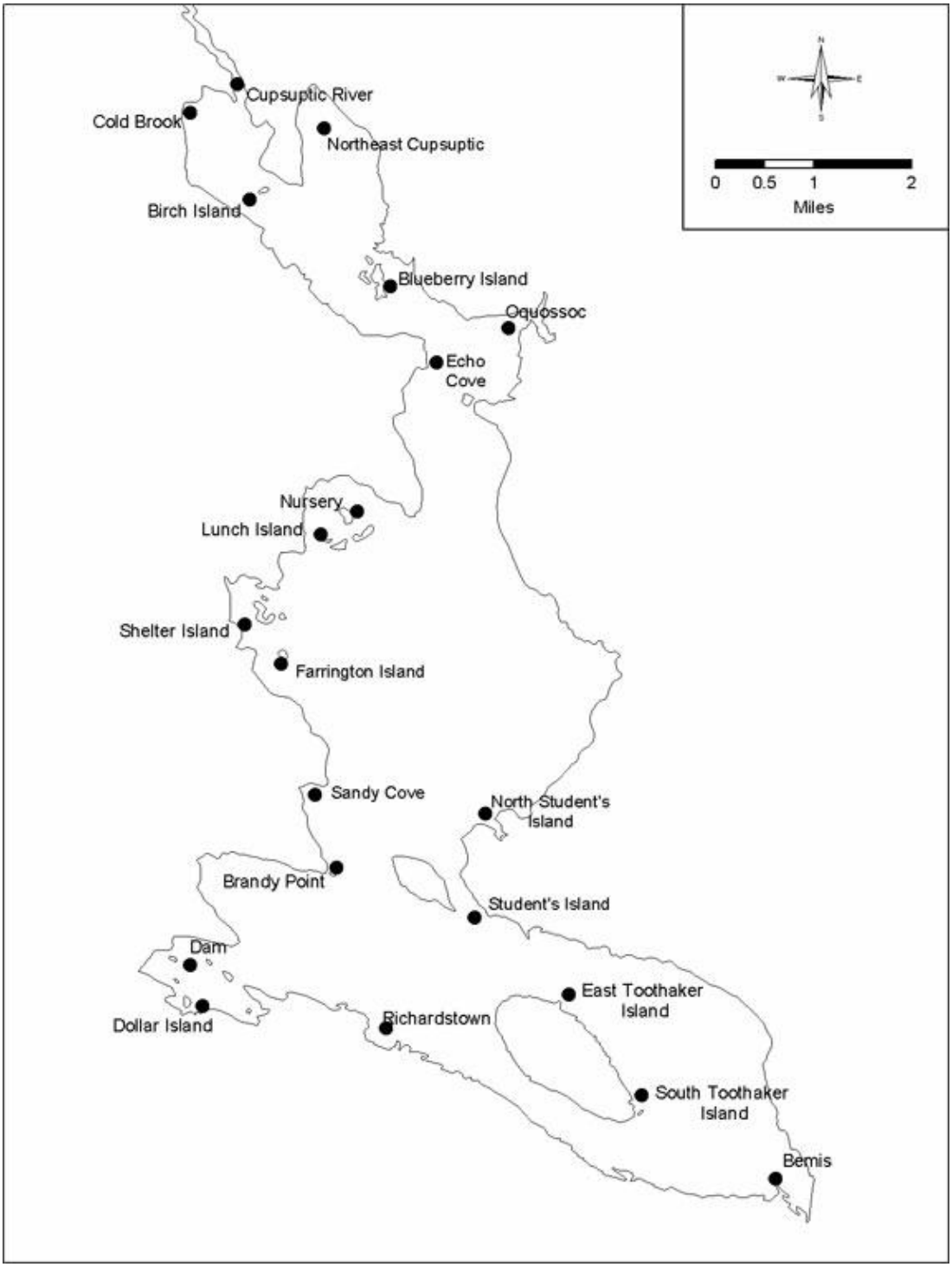
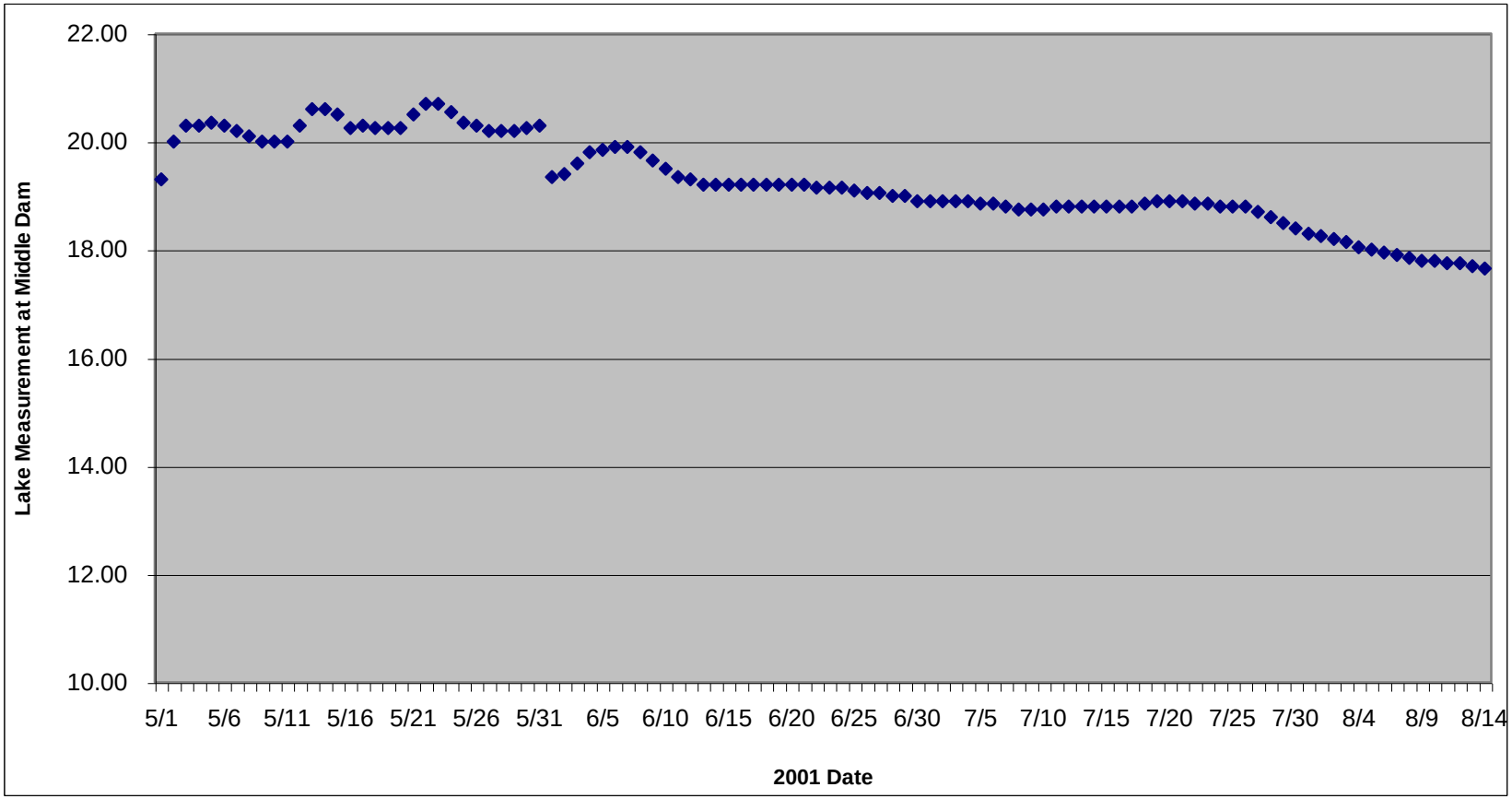


Figure 4: Daily Reservoir Water Levels on Mooselookmeguntic Lake (May 1 – August 15, 2001)



Appendix 1: Territory-Specific Productivity Summary (Year 2001 Season)**.**
For all recognized territorial pairs on Mooselookmeguntic Lake in 2001.

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	Cause of Nest Failure #1*	Cause of Nest Failure #2*	**Total Pop (Adults+Chicks (F)+Imm)**	
Cupsuptic River	1	0	0	0	0	0	~	~	~	**2**	
Cold Brook	0	0	0	0	0	0	~	~	~	**0**	
Birch Island	1	1	1	0	0	0	?	UP	~	**2**	
NE Cupsuptic	1	1	1	1	0	1	2	~	~	**2**	
Blueberry Island	1	0	0	0	0	0	~	~	~	**2**	
Oquossoc	1	0	0	0	0	0	~	~	~	**2**	
Echo Cove	1	1	1	2	0	1	2	~	~	**2**	
Nursery	0	0	0	0	0	0	~	~	~	**1**	
Lunch Island	1	0	0	0	0	0	~	~	~	**2**	
Shelter Island	1	1	2	0	0	0	?,?	I	UP	**2**	
Farrington Island	1	0	0	0	0	0	~	~	~	**2**	
Brandy Point	1	1	2	0	0	0	2,?	MP	UP	**2**	
Sandy Cove	1	1	2	0	0	0	2,1	UP	UP	**2**	
Dam	1	1	1	0	0	0	~	UP	~	**2**	
Dollar Island	1	1	1	0	0	0	1	U	~	**2**	
N. Student's Island	1	1	1	1	0	1	2	~	~	**2**	
Student's Island	1	1	2	0	0	0	?,1	UP	AP	**2**	
Richardstown	1	1	2	0	0	0	1,2	I	UP	**2**	
East Toothaker	1	1	1	0	0	0	1	UP	~	**2**	
South Toothaker	1	1	3	0	0	0	2,?,1	I	UP	**2**	*U
Bemis	1	1	1	0	0	0	2	U	~	**2**	
FINAL TOTALS	**19**	**14**	**21**	**4**	**0**	**3**	**n/a**	**n/a**	**n/a**	**39**	

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

M = Mammalian Predation
A = Avian Predation
I = Increase in Water Level
D = Decrease in Water Level
U = Unknown UP = Unknown Predation
AB = Abandonment for Unknown Cause
R = Egg thought to have rolled out of nest
HD = Human Disturbance

Appendix 2: NESTING SUMMARY: RAFTS VS. NATURAL SITES

For all recognized territorial pairs on Mooselookmeguntic Lake in 2001.

	Natural Sites			Raft Sites			
	2001			2001			
	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	0	0	0	0
NE Cupsuptic	1	1	0	0	0	0	0
Birch Island	1	0	0	0	0	0	0
Oquossoc	0	0	0	0	0	0	0
Echo Cove	1	2	0	0	0	0	0
Lunch Island	0	0	0	1	0	0	0
Shelter Island	2	0	0	0	0	0	0
Farrington Island	0	0	0	0	0	0	0
Brandy Point	2	0	0	1	0	0	0
Sandy Cove	2	0	0	0	0	0	0
Dam	1	0	0	0	0	0	0
Dollar Island	1	0	0	0	0	0	0
Richardstown	2	0	0	1	0	0	0
North Student's Island	0	0	0	1	1	1	0
Student's Island	2	0	0	1	0	0	0
East Toothaker	1	0	0	0	0	0	0
South Toothaker	3	0	0	1	0	0	0
Bemis	1	0	0	1	0	0	0
FINAL TOTALS	**20**	**3**	**0**	**7**	**1**	**1**	**0**

Explanation of Table Characters

* = see individual territory details ~ = N/A

Appendix 3: Nesting Activity Dates in Relation to Water Level. (Year 2001 Nesting Season)

Territory	Nesting Onset Window		Hatch Window		Nest Failure Window	
	Nest 1	Nest 2	Nest 1	Nest 2	Nest 1	Nest 2
Birch Island	6/19 – 6/26 (N) 19.20 – 19.05	-	-	-	6/26 – 7/10	-
NE Cupsuptic	6/5 – 6/18 (N) 19.85 – 19.20	-	7/8	-	-	-
Echo Cove	6/25 – 6/26 (N) 19.10 – 19.05	-	7/22 – 7/23	-	-	-
Shelter Island	5/23 – 5/30 (N) 20.70 – 20.25	6/15 – 6/25 (N)	-	-	5/30 – 6/5	6/25 – 7/3
Brandy Point	6/11 – 6/15 (N) 19.35 – 19.20	6/25 – 7/3 (N)	-	-	6/15 – 6/25	6/25 – 7/3
Sandy Cove	5/30 – 6/5 (N) 20.25 – 19.85	6/25 – 7/3 (N)	-	-	6/15 – 6/25	7/3 – 7/12
Dam	6/18 – 6/25 (N) 19.20 – 19.10	-	-	-	6/25 – 7/3	-
Dollar Island	6/18 – 6/25 (N) 19.20 – 19.10	-	-	-	6/25 – 7/3	-
Richardstown	5/23 – 5/30 (N) 20.70 – 20.25	6/11 – 6/15 (N)	-	-	5/30 – 6/5	6/18 – 6/25
North Student's	5/30 – 6/5 (R) 20.25 – 19.85	-	6/25 – 7/3	-	-	-
Student's Island	6/5 – 6/11 (N) 19.85 – 19.35	6/18 – 6/25 (N)	-	-	6/5 – 6/11	6/25 – 7/3
East Toothaker	5/30 – 6/5 (N) 20.25 – 19.85	-	-	-	6/5 – 6/11	-
South Toothaker	? – 5/30 (N) ? – 20.25	6/15 – 6/25 (N)	-	-	5/30 – 6/5	6/15 – 6/25
Bemis	6/5 – 6/18 (N) 19.85 – 19.20	-	-	-	7/12 – 7/18	-

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.

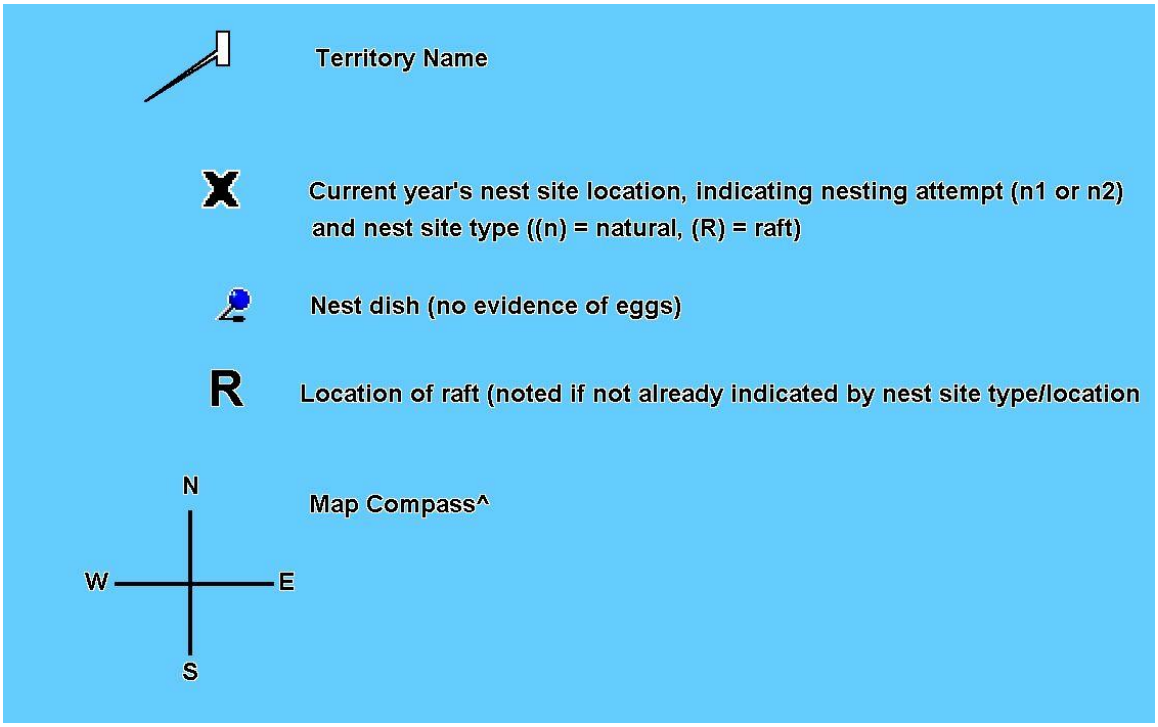
Territory years - The number of years a territory has been surveyed. Used as the denominator of the long-term hatch rate productivity measure.

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.

Mooselookmeguntic Lake
Common Loon Population Survey
and Management Report:

2001 Season

(REPORT BRI – 2002-05)

(Upper Dam Project)

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