2005 Azischohos Lake
Common Loon Population Survey
and Management Report

(REPORT BRI – 2006-16)

(FERC Project No. 4026)

Submitted to:

William Hanson
FPL Energy Maine Hydro
150 Main St.
Lewiston, Maine 04240

Submitted by:

Chris DeSorbo, Kate Taylor, Theresa Daigle, David Kramar, and David Evers
BioDiversity Research Institute
19 Flaggy Meadow Road
Gorham, ME 04038
Chris.DeSorbo@BRILoon.org

Submitted on:

December 2006
EXECUTIVE SUMMARY .................................................................................................................................................. 3
INTRODUCTION ............................................................................................................................................................. 3
About the Study Site ...................................................................................................................................................... 3
History And Purpose Of Study .................................................................................................................................. 3
OBJECTIVES .................................................................................................................................................................. 4

METHODS ........................................................................................................................................................................ 4
1. POPULATION AND NESTING SURVEYS .............................................................................................................. 4
2. LOON MANAGEMENT TOOLS: RAFTS, AVIAN GUARDS AND SIGNS ......................................................... 5
   Raft Implementation ..................................................................................................................................................... 5
   Avian Guards .............................................................................................................................................................. 5
   Signs ............................................................................................................................................................................ 5
3. ABANDONED EGG COLLECTION ...................................................................................................................... 6
   Egg Sample Analysis ................................................................................................................................................. 6
4. SURVEYING FOR MARKED INDIVIDUALS ....................................................................................................... 6

RESULTS AND DISCUSSION ........................................................................................................................................ 7
1. POPULATION AND NESTING SURVEYS: PRODUCTIVITY SUMMARY 2005 ............................................. 7
   Qualitative Territory Summary (Aziscohos Lake, 2005) ...................................................................................... 7
   Overall Productivity Summary ................................................................................................................................. 11
   Nest Failures ........................................................................................................................................................... 11
2. LOON MANAGEMENT TOOLS: RAFTS, AVIAN GUARDS AND SIGNS .................................................. 11
   Raft Implementation ................................................................................................................................................. 11
   Raft Maintenance ..................................................................................................................................................... 11
   Avian Guards .......................................................................................................................................................... 12
   Raft Vs. Natural Nest Site Summary ........................................................................................................................ 12
   Raft vs. Natural Nest Site Productivity ..................................................................................................................... 12
3. ABANDONED EGG COLLECTION AND ANALYSIS ..................................................................................... 13
4. SURVEYING FOR MARKED INDIVIDUALS .................................................................................................... 13
5. YEAR 2005 RECOMMENDATIONS .................................................................................................................. 13

LITERATURE CITED .................................................................................................................................................... 14

SUMMARY OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lake Survey Visit Record for 2005 on Aziscohos Lake, Maine</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Embryological development scale used for Common Loon eggs</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Common Loon Productivity and Nesting Summary (2005)</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>Common Loon Comparative Nesting Summary: Rafts vs. Natural Nests (2005).</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>Development of Collected Aziscohos Eggs, 2005</td>
<td>13</td>
</tr>
</tbody>
</table>

SUMMARY OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rangeley Lakes Region Study Area</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>Distribution of Common Loon Territories on Aziscohos Lake, 2005</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>Daily Reservoir Surface Elevations for Aziscohos</td>
<td>19</td>
</tr>
</tbody>
</table>

SUMMARY OF APPENDICES

<table>
<thead>
<tr>
<th>Appdx.</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Territory-Specific Productivity Summary</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Definition of Terms</td>
<td>21</td>
</tr>
</tbody>
</table>
SUMMARY OF MAPS

Map 1: Bosebuck, Sunday Pond and Little Magallaway territory nest site locations, 2005
Map 2: Twin Brook nest site location, 2005
Map 3: Camo Camp territory nest site location, 2005
Map 4: Hurricane and Raven territory nest site locations, 2005
Map 5: Hammel Brook territory nest location, 2005
Map 6: Buck Mountain nest site locations, 2005
Map 7: Big Brook territory nest site location, 2005
Map 8: South Hammond territory nest site location, 2005
Map 9: Tiger Gray territory nest site location, 2005
Map 10: Aldrich Brook territory nest site location, 2005
Map 11: Cold Brook territory nest site location, 2005
Map 12: Emery’s Misery territory nest site location, 2005
Map 13: Beaver Brook territory nest site location, 2005
Map 14: Dam territory nest site location, 2005
EXECUTIVE SUMMARY

Aziscohos Lake’s surface elevation is controlled by the Aziscohos Dam, which is licensed as Federal Energy Regulatory Commission (FERC) Project No. 4026-002ME. Article 33 under this license requires surveys of Aziscohos Lake’s loon population in order to evaluate the necessity and feasibility of the use of artificial nesting islands. BioDiversity Research Institute conducts surveys and oversees management of loons on Aziscohos Lake. The number of territorial pairs increased from 18 pairs in 2004 to a high of 20 pairs in 2005. Eight-five percent (17) of these pairs nested with 19 nest attempts recorded lake-wide. Seven nests were abandoned due to unknown reasons. Of successful 20 hatches, 12 chicks survived to fledge.

INTRODUCTION

About the Study Site

In 1911, the Aziscohos Dam was built on the Magalloway River in northwestern Maine (Figure 1). The impoundment was built with the intention of increasing water storage in the Upper Androscoggin Storage System. The water was regulated to supply a steady flow year round for downstream mills, which used mechanical waterpower. The existing river, riparian zones and upland were transformed into an 11.53 square-mile (7378-acre) impoundment that extended across sections of three townships (Parkertown, and Lynchtown and Lincoln). A hydroelectric facility was built in 1984 and became commercially operational in 1985.

At present, a 21-mile long lake exists with various shoreline substrates ranging from boulders at the south end to granular sand towards the north end. The impoundment also contains habitat for several lacustrine wildlife species, including the Common Loon. As a consequence of water level management operations, water level fluctuations frequently occur within the loon’s nesting period. These fluctuations can affect loon nesting habitat and nesting success.

History And Purpose Of Study

During the licensing of the new hydroelectric facility installed at the existing dam in 1984, the Androscoggin Reservoir Company (ARCO) and Aziscohos Hydro Company, Inc. conducted numerous environmental studies. These studies revealed that water level fluctuations during the summer were negatively impacting the nesting success of Common Loons. ARCO and Aziscohos Hydro Company, Inc. submitted a report and management plan to the Federal Energy Regulatory Commission (FERC). FERC approved the loon management plan and incorporated it into article 33 of FERC License No. 4026-002ME (Fair 1986). ARCO was required to survey the loon population in order to evaluate the necessity and feasibility of the use of artificial nesting islands on Aziscohos Lake. It was also required to submit a report that would “draw up full recommendations for an implementation plan for the manufacture, placement, and maintenance of artificial nesting islands determined necessary” (Fair 1986). Since 1987, Common Loon population on Aziscohos Lake have been surveyed and managed using artificial nesting islands by Jeff Fair [consulting biologist, Fairwinds Wildlife Services (FWS)] and Bill Hanson (Senior Biologist, then Central Maine Power Co.) in accordance to the FERC order. In 1999, FPL Energy Maine Hydro (FPLE) became a partial owner of the Aziscohos Dam and assumed responsibility for the project. BioDiversity Research Institute (BRI) has been responsible for conducting loon surveys, management, and the preparation of this annual report annually since 1999. BRI biologists worked with Jeff Fair and Bill Hanson (FPLE
Senior Biologist) to ensure thorough standardization of survey techniques and definitions to minimize observer bias during the transition period. This long-term cooperative initiative between ARCO, FPL, FWS and BRI has resulted in one of the most thoroughly and well-studied loon populations in the U.S.

OBJECTIVES

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

2. To deploy artificial nesting islands (rafts) with avian guards in loon territories. We recommend improvement, addition, removal, and/or placement of rafts according to guidelines formulated in the management plan.

METHODS

1. POPULATION AND NESTING SURVEYS

We surveyed Aziscohos Lake to confirm the presence/absence of loon pairs and documented nesting activities from 18 May through 17 August (Table 1). Survey methods were consistent with those used in previous (Fair 1986, 1999) and ongoing studies throughout the Northeast (DeSorbo et al. In Press). The bulk of the survey effort was concentrated on loon nesting onset and hatching period in June and July. We surveyed all known territories on Aziscohos Lake from 14-18’ motorboats using 10X binoculars and 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 conduct nest searches by foot. We performed searches by walking the perimeter of the available nesting habitat in loon territories. All known historical nesting sites previously reported during historical surveys 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 Aziscohos Lake, 2005

<table>
<thead>
<tr>
<th>Maine Month</th>
<th>Visit Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>18, 20, 26</td>
</tr>
<tr>
<td>June</td>
<td>1, 10, 17, 19, 23, 24</td>
</tr>
<tr>
<td>July</td>
<td>1, 6, 13, 22, 28</td>
</tr>
<tr>
<td>August</td>
<td>7, 16</td>
</tr>
</tbody>
</table>

TOTAL: 16 visits

A nest categorized as a "fail" included evidence as to the cause of the failure if it could be reported with certainty. Causes of failure include:

1 Terms used in this report are defined in Appendix 2.
Avian predation: characterized by a small hole in the egg.
Mammalian predation: characterized by smashed eggs/eggshells, tracks around nest, and/or scat.
Water level rise: increase in lake level causing nest floods. Eggs washed off nests, or eggs still in nest, chilled in standing water.
Water level fall: decrease in lake level causing eggs to be stranded in unreachable nests.
Human disturbance: human intrusion, human related activities.
Loon disturbance: loon intrusion.
Never hatched: loons remaining on nest past normal incubation times (27-30 days).
Unknown: cause unknown.

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

Raft Implementation

In early May, BRI and FPL biologists floated rafts constructed from cedar logs nailed together using ~8 inch galvanized spikes. Plastic “mesh” fencing was affixed to the log framework with 1-1/2 inch galvanized fencing staples similar to those described in Fair (1986) and Fair (1992a). We placed vegetation consisting of material found in the general nesting area (sphagnum moss, grasses, and other vegetation) for use as nesting material. Loons typically build their nests from materials gathered from the immediate vicinity of the nest site (McIntyre 1988). Nesting materials were built up to levels at which the eggs would remain dry and be well above the water surface. We monitored all rafts periodically for proper placement, buoyancy, and sufficient nesting materials throughout the season. After nesting, all rafts were pulled out of the water to a point that was above the highest waterline to dry for the winter. 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, 3) knowledge of previous traditional and non-traditional nest site locations, and 4) knowledge of boat traffic patterns relative to the specific territory.

Avian Guards

Avian guards made of metal wire and camouflage mesh were attached 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 users2, which decreases flushing events and disturbances to nesting loons. Avian guards may therefore increase incubation time and hatching success for raft nesting loons. The orientation of the avian guard is ideally situated to obscure the view to and from the nest. The camouflage mesh material was removed at the end of the season to avoid further degradation.

Signs

Signs can be used to decrease human-caused nest failures. Many of these disturbances are unintentional and may be avoided by placing informational signs both at the launch sites and/or at nesting and brooding areas where deemed necessary. FPL distributes signs (“Loon Nesting Area

---

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 nesting loons in several Aziscohos territories.
Please Keep Away”) for use in protecting sensitive areas from human disturbances. The decision to place a sign in a territory is based on an understanding of typical use patterns, previous reports’ recommendations, and knowledge of site-specific nest failure history. The configuration of the territory itself and location of a nest will also influence the efficacy of sign use. Signs were not used where it was determined that their potential to attract attention to a nest site outweighed the benefit. Signs are not used prior to nesting activity and are taken down after nesting and/or brooding activities have ceased.

3. ABANDONED EGG COLLECTION

We opportunistically collected abandoned loon eggs to determine 1) egg viability as indicated by developmental stage and 2) egg mercury concentration. Whole eggs were collected only when it was certain they had failed. Collection of eggs from nests occurred when birds were observed to be off-nest for over 24 hours. If an egg was cold or obviously addled, it was marked with an "X" in pencil. If the "X" was in the same position the following day, indicating the egg had not been turned, it was collected. Collected eggs were placed in a labeled zip-lock plastic bag, and frozen until egg analysis.

Egg Sample Analysis

Collected eggs were measured for length, width, volume (through water displacement), and weight. Evidence of external damage was noted. Eggs contents were rated for embryological development and contents were placed in sterile I-Chem® jars (Table 2). Egg contents were analyzed for mercury concentration using cold vapor atomic absorption, and the eggshells were archived.

Table 2. Embryological development scale used for Common Loon eggs

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA (not assessable)</td>
<td>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).</td>
</tr>
<tr>
<td>0:</td>
<td>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).</td>
</tr>
<tr>
<td>1:</td>
<td>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.</td>
</tr>
<tr>
<td>2:</td>
<td>Developing embryo (length was 1.5 – 2.0) has an apparent central nervous system. Cranial development and visible eyes are apparent. Feathers are absent.</td>
</tr>
<tr>
<td>3:</td>
<td>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).</td>
</tr>
<tr>
<td>4:</td>
<td>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.</td>
</tr>
</tbody>
</table>

4. SURVEYING FOR MARKED INDIVIDUALS

We surveyed for color-marked loons to gain further information on territory boundaries, between-year territory fidelity, mate switching, estimated minimum survivorship and intra-seasonal movements. Loons were captured and banded using a night-lighting technique described in Evers (1993) and Evers (2001). Captured birds were banded for individual identification using unique combinations of color-marked bands and numbered USFWS aluminum bands. Prior to release, each
bird was weighed, two second secondary feathers were removed at the base of the quill, and blood samples were taken from the metatarsal vein for contaminant analysis.

Bands were observed opportunistically during surveys using 10X binoculars or spotting scopes. 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 against a color band identification list to confirm the individual(s). Location and general behavior of both banded and unbanded individuals were also recorded at the time of observation.

RESULTS AND DISCUSSION

1. POPULATION AND NESTING SURVEYS: PRODUCTIVITY SUMMARY 2005

This report includes a qualitative survey of each territory including breeding status, dates of nest initiation, hatching, nest failures, chick loss, presence of color-marked individuals, and other relevant information. A summary of lakewide loon reproductive success is provided and includes breeding status, hatching success, population trends, management efforts, and banding. Territory fidelity is discussed through summaries of the marked loon population on Aziscohos Lake. Maps were created for territories with nesting pairs (Figure 2). Quantitative territorial data is summarized in Appendix 1. We conclude the discussion with recommendations for the 2006 breeding season.

Qualitative Territory Summary (Aziscohos Lake, 2005)

In addition to reporting productivity data in a quantitative form, we summarize territory-specific information to provide additional qualitative data collected during the field season. All territories and other areas of interest are listed from north to south. Territories displaying a “R”, represent those in which a raft was floated; all others display no raft, or “nR”.

Little Magalloway (nR)

The Little Magalloway territory was occupied by the Little Magalloway male (2002) and a female with a single silver band (848-047-27) on the left leg. This female was originally banded as a juvenile from the Hurricane territory. A nest with a single egg was discovered on the historic nesting island on 5/26 and a second egg was laid shortly thereafter. The pair successfully hatched two chicks between 6/20 and 6/26 with one chick surviving to fledge.

Nest location: N 45.11403 W 71.01311.

Sunday Pond (R)

The banded Sunday Pond pair occupied this territory in 2005. The pair laid one egg on the raft between 5/26 and 6/1. Eggshell fragments on the nest as well as the behavior of the adults suggested that the chick hatched, however this was never confirmed.

Raft Location: N 45.10726 W 70.99958.
Twin Brook (R)

The Twin Brook territory was occupied by the banded Twin Brook pair. The YS was heavily faded and replaced with an orange dot. Two eggs were laid between 5/26 and 6/1. The nest was abandoned for unknown reasons and both eggs were collected. Between 6/11 and 6/19 the pair renested laying two eggs. This nest attempt was successful and both chicks hatched between 7/11 and 7/19 with one surviving to fledge.

Raft Location: N 45.09644 W 70.97741

Bosebuck (nR)

The Bosebuck territory was occupied by the banded Bosebuck male (1996) and the banded Little Magalloway female (1997). A natural nest was established between 7/1 and 7/6 on the traditional nesting island. The nest failed between 7/6 and 7/13 due to unknown causes.

Nest location: N 45.09704 W 70.992721

Camo Camp (R)

The banded Camo Camp pair occupied this territory in 2005. Between 5/26 and 6/1, the pair began incubating two eggs on the raft. Two chicks hatched between 6/26 and 7/1, with a single chick surviving at the end of the season.

Raft Location: N 45.09568 W 70.99606

Raven (R)

The Raven territory was occupied by the banded Raven pair. The pair laid two eggs between 5/20 and 5/26 on the raft and successfully hatched two chicks between 6/20 and 6/26. Only one chick survived to fledge.

Raft Location: N 45.08471 W 70.98854.

Hurricane (R)

The Hurricane territory was occupied by the banded Hammel female (1996) and the banded Hurricane male (2004). The pair laid two eggs between 6/10 and 6/19 on the raft. Local camp owner Dick Rowdin believed he had saw the pair with a chick once during the hatch window (7/10-7/19), but this could not be confirmed. The second egg was found cracked on the nest containing a partially formed chick. This was not collected due to the amount of maggots.

Raft Location: N 45.08134 W 70.98618

Hammel Brook (R)

The Hammel Brook territory was occupied an unbanded male and an unconfirmed female. The pair laid two eggs between 6/10 and 6/19 on the raft located in the traditional Hammel Brook cove site. The pair successfully hatched two chicks between 7/10 and 7/19 with both surviving to fledge.
The Buck Mountain territory was occupied by the banded Buck Mountain female and an unbanded male. The pair laid two eggs between the first and 10th of June and successfully hatched one chick between 7/1 and 7/10 from the raft. A second egg was collected from the nest. The Buck Mountain chick survived to fledge.

Raft Location: N 45.0858 W 70.98449

Yukon (nR)

While a territorial pair was not present in Yukon, two loons were occasionally observed. These birds were likely the adults from the Hammel and Big Brook territories.

Big Brook (R)

The Big Brook territory was occupied by the banded Big Brook female (1995) and an unbanded male. Although a raft was floated in this territory, the pair nested naturally between 5/24 and 6/1 and hatched a single chick between 6/24 and 7/1. Despite an intensive search, the nest site was never located. The pair was also documented across the lake near Metallak Island on several occasions.

Meadow Brook (nR)

The Meadow Brook territory was occupied by an unbanded pair. The historic nesting locations were underwater due to high water levels on the reservoir this year. The pair did not to nest.

North Hammond (R)

The North Hammond territory was occupied by a single adult female. This female was identified as the South Hammond female (Left Leg: R/B and Right Leg: B/S). An unbanded juvenile loon was also observed for approximately 2 weeks in this territory.

South Hammond (R)

The South Hammond territory was occupied by an unbanded male and the banded Hammond female (2002). The pair laid two eggs between 6/1 and 6/1 on the raft. Two chicks successfully hatched between 7/1 and 7/11 with one surviving to fledge.

Raft Location: N 45.02995 W 71.03333

Lincoln Brook (nR)

The Lincoln Brook territory was occasionally occupied by a pair of non-territorial adults

Aldrich Brook (R)

The Aldrich Brook territory was occupied by an unbanded pair in 2005. This pair nested on the raft between 6/11 and 6/17. The nest was found abandoned on 7/28 and a single egg was collected. The cause of the abandonment could not be determined, but the nest was overincubated.
Tiger Gray (R)

The Tiger Gray territory was occupied by an unbanded pair in 2005. The pair laid two eggs between 5/26 and 6/1 on the raft. One chick successfully hatched between 6/26 and 7/1 and the second egg was collected. The chick survived to fledged.

Raft Location: N 45.02287 W 71.01991

Cold Brook (R)

The banded Cold Brook pair occupied this territory in 2005. The pair was nesting on the raft by 6/10 and incubated through the first week in August when the nest was found empty and abandoned.

Raft Location: N44.99599 W 71.0128

Emery’s Misery (R)

The banded Emery's Misery pair occupied this territory in 2005. The pair nested on the raft between 5/26 and 6/1 and successfully hatched two chicks between 6/26 and 7/1. Neither of the chicks survived. Shortly after their hatch, two adult eagles were seen on multiple occasions in the territory.

Raft Location: N 44.98021 W 71.01956

Grove (nR)

The Grove territory was occasionally occupied by two unbanded and non-territorial adults. No raft was deployed in the Grove territory this season.

Beaver Brook (R)

The Beaver Brook territory was occupied by the banded Beaver Brook male and an unbanded female. Between 5/26 and 6/10, the pair laid a single egg on the raft. By 6/17, the nest had failed and the egg was gone. The pair renested on the raft between 6/23 and 7/1, laying two eggs. The second nest attempt successfully hatched two chicks between 7/22 and 7/28. Only one chick survived to fledge from this territory.

Raft Location: N 44.95162, W 70.96616

Beaver Island (nR)

An unbanded pair occupied the Beaver Island territory in 2005 and did not nest. The pair stayed close to the small island east of the larger island on the Beaver Brook side of the lake. Several nest searches were conducted but a nest was never found.

Dam (R)

The Dam territory was occupied by the banded Dam male and the Beaver Brook female (1997). The pair laid a single egg on the raft between 6/1 and 6/10 and successful hatched a chick between 7/1 and 7/10. This chick survived to the end of the season. The female from this territory was recaptured to replace missing bands on both the right and left leg.
Raft Location: N 44.95162 W 70.99695

Schist Cove (nR)

An unbanded adult occupied the Schist Cove territory and was paired with banded adult only identified as having single silver and white band. No nesting attempts were documented.

**Overall Productivity Summary**

We observed 20 territorial pairs on Aziscohos Lake in 2005 (Table 3). Eighty-five percent of pairs nested (17) with 19 nesting attempts recorded lakewide including 2 renests. Twelve pairs were successful in hatching a total of 20 young, with 12 of these surviving to fledge. This yielded a nesting success of 71% (12 SNP/17 NP), and 60% chick survival. The hatch rate for nesting pairs (H/NP) was 1.18 and 1.00 for territorial pairs (H/TP). Corresponding fledge rates (F/NP and F/TP) in 2005 were 0.71 (12/17) and 0.60 (12/20).

**Nest Failures**

Seven nest failures were recorded on Aziscohos Lake in 2005 (Table 3). Thirty-seven percent (7/19) of the attempted nests failed. This is a rate of 0.41 failures per nesting pair. Two nests failed due to over-incubation; all other nest failures this year were not fully understood and therefore designated as unknown abandonments.

**Table 3. Common Loon Productivity and Nesting Summary (2005).**

<table>
<thead>
<tr>
<th>20 Territorial Pairs (TP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 Nesting Pairs (NP)</td>
</tr>
<tr>
<td>19 Nesting Attempts (including 2 renests)</td>
</tr>
<tr>
<td>12 Successful Pairs (SP)</td>
</tr>
<tr>
<td>20 Chicks Hatched from all territories (CH)</td>
</tr>
<tr>
<td>12 Chicks Fledged from all territories (F)</td>
</tr>
<tr>
<td>7 Nest Failures - (5: 71%) due to unknown causes, 2 of 7 nest failures (29%) were due to over-incubation</td>
</tr>
</tbody>
</table>

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

**Raft Implementation**

BRI and FPLE biologists reinforced, vegetated, positioned, and maintained 16 rafts in 16 loon territories (See Appendix 1 and territory maps for territory-specific information) on 23 and 29 May 2005. All rafts were pulled out of the water in early September above the highest possible water level to dry over the winter.

**Raft Maintenance**

All rafts were noted to be in good condition during the 2005 season.
Avian Guards

Avian guards were used on all rafts this season. Upon pulling the rafts above the water line in September, all of the camouflage material was removed, and will be re-applied to the rafts deployed next season.

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 2005. Territory-specific nesting information is presented in Appendix 1 and the Qualitative Territory Summary.


<table>
<thead>
<tr>
<th>Raft Sites:</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 rafts floated in 16 territories (out of a potential 24)</td>
</tr>
<tr>
<td>14 of 16 (88%) rafts floated were used</td>
</tr>
<tr>
<td>2 renests occurred on rafts for a total of 16 nest attempts on rafts out of 19 total nest attempts (84%)</td>
</tr>
<tr>
<td>1 of 6 natural nesting attempts were made on natural sites w/ rafts</td>
</tr>
<tr>
<td>10 of 16 (63%) nesting attempts on rafts were successful</td>
</tr>
<tr>
<td>14 of 16 (88%) nesting attempts on rafts were 1st attempts</td>
</tr>
<tr>
<td>2 of 16 (13%) nesting attempts on rafts were 2nd attempts</td>
</tr>
<tr>
<td>17 of 20 (85%) chicks hatched (H) lakewide from raft nests</td>
</tr>
<tr>
<td>10 of 12 (83%) chicks fledged (F) lakewide from raft nests</td>
</tr>
</tbody>
</table>

Nest Failures: 6 nest failures recorded on rafts
4 of 6 (67%) nest failures on rafts were not fully understood and were designated as unknown abandonments.
2 of 6 (33%) nest failures on raft were due to eggs never hatching (over-incubation)

<table>
<thead>
<tr>
<th>Natural Sites:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 of 19 (16%) lakewide nesting attempts were on natural sites</td>
</tr>
<tr>
<td>2 of 3 (67%) nesting attempts on natural sites were successful</td>
</tr>
<tr>
<td>3 of 3 (100%) nesting attempts on natural sites were 1st attempts</td>
</tr>
<tr>
<td>3 of 20 (15%) chicks hatched (H) lakewide from natural nests</td>
</tr>
<tr>
<td>2 of 12 (17%) chicks fledged (F) lakewide from natural nests</td>
</tr>
</tbody>
</table>

Nest Failures: 1 nest failure recorded on natural sites
1 of 1 (100%) nest failure on natural sites was not fully understood and was designated as an unknown abandonment

Raft vs. Natural Nest Site Productivity

Rafts were instrumental in increasing productivity on Aziscohos Lake in 2005. As demonstrated in other studies (Fair and Poirier 1992, Merrie 1996) loon productivity can be substantially enhanced on waterbodies with significant water level fluctuations with rafts. 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.
In total, 16 rafts were floated with 14 being used as nesting platforms. Lakewide, 74% (14/19) of all nesting attempts were on rafts. Eighty-three percent (10/12) of successful nesting pairs on Aziscohos Lake used raft sites. Conversely only 17% percent (2/12) of successful pairs used natural nest sites. Eighty-five percent (17/20) of the chicks hatched were from rafts. Rafts significantly improve productivity in both the short and long-term basis, under the current water level management practices (Table 4).

3. ABANDONED EGG COLLECTION AND ANALYSIS

Two of the five eggs collected in 2005 were found to be inviable. The Aldrich Brook egg was viable, containing an embryo in an advanced stage of development. The Buck Mountain egg was had a viable embryo but was still in the early stages of development. The development of one egg (Tiger Gray) could not be determined (Table 5).

Table 5. Development of Collected Aziscohos Eggs, 2005

<table>
<thead>
<tr>
<th>Territory</th>
<th>No. eggs collected</th>
<th>Dev. Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldrich Brook</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Buck Mountain</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Tiger Gray</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Twin Brook</td>
<td>2</td>
<td>0,0</td>
</tr>
</tbody>
</table>

4. SURVEYING FOR MARKED INDIVIDUALS

From 1994-2004, 42 adult and 34 juvenile loons (not including recaptures) have been captured, sampled, and uniquely color-marked on Aziscohos Lake. In 2005, 18 loons were captured, including 16 adults and 2 juveniles. Twelve of these adults were recaptures. Color-marking individuals enables the distinction of neighboring pairs and individuals, proper delineation of 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, loon social dynamics (Evers 2001), and links local breeding populations to key winter habitat. Many of these findings can then be related to productivity.

5. YEAR 2005 RECOMMENDATIONS

1. Evaluate Raft Condition Before Next Nesting Season. We do not recommend addition of, or changes in placement of rafts within loon territories at this time. At present, all rafts appear to be in good condition and do not require replacement or maintenance beyond that caused by normal wear.

2. Continue Surveying for New Nesting and Territorial Pairs. This year a pair did occupy an area (Schist Coves) suggested in previous reports to be most likely sites for future territorial pair occupancy. We recommend the continued surveying of the following areas: (1) Lincoln Brook and Aldrich camp, (2) Schist Cove, (3) the “Magalloway Pool” – north of the east entrance to Sunday
pond in the Magalloway River, and (4) the upper Little Magalloway River (north of the Little Magalloway territory).

3. **Continue Color-Marking Individuals.** The Aziscohos Lake loon population represents one of the most well-studied populations of loons in North America due to a high proportion of banded loons and intensive survey / management efforts since 1986. We recommend the continuation of color banding efforts on Aziscohos Lake to better understand recruitment, between-year territory, mate switching and estimated minimum survivorship.

**LITERATURE CITED**


Figure 1: Rangeley Lakes Study Area
Figure 2: Distribution of Common Loon territories on Aziscohos Lake, 2005
Figure 3: Daily Reservoir Water Level for Aziscohos Lake, 2005
### Appendix 1: Territory-Specific Productivity Summary (Year 2005 Season).

<table>
<thead>
<tr>
<th>Territory</th>
<th>Territorial Pairs (TP)</th>
<th>Nesting Pairs (NP)</th>
<th>Total No. Nesting Attempts (eggs laid)</th>
<th>Total Chicks Hatched on Terr. (H)</th>
<th>No. Chicks in August (F)</th>
<th>Successful Pairs (&gt;/= 1 Chick hatched)</th>
<th>Cause of Nest Failure #1</th>
<th>Cause of Nest Failure #2</th>
<th>Raft Floated</th>
<th>Raft Used</th>
<th>Total Pop (Adults+Chicks (F)+Imm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little Magalloway</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Sunday Pond</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>UNK</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Twin Brook</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>UNK</td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Bosebuck</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>UNK</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Camo Camp</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Raven</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Hurricane</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>UNK</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Hammel Brook</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Buck Mountain</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Yukon</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Big Brook</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Meadow Brook</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>North Hammond</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>South Hammond</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Tiger Gray</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Aldrich Brook</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NH</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Cold Brook</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>UNK</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Emery’s Misery</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Grove</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beaver Brook</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>NH</td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Beaver Island</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dam</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Lincoln Brook</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schist Cove</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Final Totals</strong></td>
<td><strong>20</strong></td>
<td><strong>17</strong></td>
<td><strong>19</strong></td>
<td><strong>20</strong></td>
<td><strong>12</strong></td>
<td><strong>12</strong></td>
<td></td>
<td><strong>6</strong></td>
<td><strong>16</strong></td>
<td><strong>14</strong></td>
<td><strong>52</strong></td>
</tr>
</tbody>
</table>

**Nest Failure Codes**
- **AP** = Avian predation
- **MP** = Mammalian predation
- **WLI** = Water level rise
- **WLF** = Water level fall
- **HD** = Human disturbance
- **LD** = Loon disturbance
- **NH** = Never hatched
- **UNK** = Unknown
Appendix 2: DEFINITION OF TERMS

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.

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

3 Terms and definitions are taken from Fair (1992a) and Evers (2001).
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 1. Little Magalloway, Sunday Pond and Bosebuck territory nest site locations, 2005.
Map 2. Twin Brook territory nest site location, 2005.
Map 3. Camo Camp territory nest site location, 2005.
Map 4: Hurricane and Raven territories nest site locations, 2005.
Map 5: Hammel Brook territories nest site locations, 2005.

Hammel Brook
Map 6: Buck Mountain territory nest site location, 2005.
Map 7: Big Brook territory nest site location, 2005.
Map 8. South Hammond territory nest site location, 2005.
Map 10: Aldrich Brook territory nest site location, 2005.
Map 11: Cold Brook territory nest site location, 2005.
Map 12: Emery’s Misery territory nest site location, 2005.
Map 13: Beaver Brook territory nest site location, 2005.
Map 14: Dam territory nest site location, 2005.