2020

Belgrade Lakes Common Loon Monitoring Summary Report

Long Pond, Lynch Cove Nest Raft, 2020

SUBMITTED TO:

Belgrade Lakes Association
137 Main Street, PO BOX 551
Belgrade Lakes, Maine 04918

SUBMITTED BY:

Lee Attix
Loon Conservation Associates
18 Merrymeeting Drive
Portland, Maine, USA 04103
(207-838-0359)

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Loon Conservation Associates is dedicated to the protection and welfare of loons through collaboration, education, and the implementation of successful conservation actions.

To obtain copies of this report contact:
Lee Attix, Director
Loon Conservation Associates
18 Merrymeeting Drive
Portland, ME 04103
(207) 838-0359
lcattix@gmail.com

1.0 EXECUTIVE SUMMARY

Supported by a second year of funding from the Belgrade Lakes Association (BLA), Loon Conservation Associates (LCA) and the BLA continued a collaborative study of common loons (Gavia Immer) on Great Pond and Long Pond in 2020. Loons are a key indicator of aquatic integrity for lakes, and this initiative provides an opportunity to confirm the current population status, identify major threats and create long-term, sustainable conservation solutions designed to aid the current population.

Engaging and educating local volunteers to conduct surveys with professional guidance was a key component of the project. Formal volunteer training was budgeted and scheduled for the spring, but Covid-19 concerns and state mandates required this to be postponed until a later date. Results published in this report are taken from data gathered by LCA and BLA members and volunteers.

In 2020, Great Pond and Long Pond were surveyed bi-weekly by LCA and alternatively by BLA volunteers. Based on well-defined criteria for an established loon territory, a total of 23 territorial pairs were documented and 10 of these pairs nested. From four successful nests, six chicks hatched and four survived to > six weeks of age – an age defined as fledging for modeling purposes. Overall productivity on Great Pond and Long Pond in 2020 was 0.17 fledged young per territorial pair.

Historically, nesting loons have benefited from the use of artificial nesting islands (rafts). Pairs nesting on rafts have had better success than pairs nesting naturally. In 2020, two new rafts were constructed by a volunteer and placed in occupied territories, bringing the total number of rafts deployed to four. Three rafts were placed on Long Pond (Beaver Cove, Lynch Cove and Tracy Cove) and one on Great Pond (Austin Bog). On Long Pond two of the rafts were used by nesting pairs (Beaver Cove & Lynch Cove), and both were successful (100%), hatching a total of three chicks. The raft on Great Pond was not used. Comparatively, there were a total of nine natural nest attempts on the two lakes and only two nests were successful (22%).

Banding (color-marking) loons is a key conservation measure for comprehensive population studies. Marked individuals can be tracked to gain further information on territory

boundaries, between-year territory fidelity, mate switching, estimated minimum and long-term survivorship, intra-seasonal movements, and recruitment. In 2020 a new banding initiative was launched, and seven loons were successfully captured and banded.

A camera was placed to monitor a new nesting raft in Lynch Cove, Long Pond, after the loons laid eggs and began incubating. No threats from predators were found during the incubation period, but human disturbance was documented just days before the eggs were due to hatch. This disturbance flushed the loon off the nest. The loon did return after the human disturbance and one egg did hatch.

In response to well documented issues of human disturbance of the nest raft in Tracy Cove, Long Pond, a new sign was placed there in 2020.

Significant findings/outcomes included:

- For the second consecutive year there was a significant discrepancy in the productivity of the loons on Great Pond and Long Pond. Both lakes had very low productivity overall. Great Pond fledged just one chick, while Long Pond fledged three.
- As in 2019, the 1997 W Boat Ramp, Long Pond, banded female was observed. She did not breed. She and an unbanded male did occupy and defend the same territory in lower Long Pond. This was the only banded loon confirmed on either pond.
- Nesting loons occupied the new raft in Lynch Cove, Long Pond, at the same time mallards were nesting there. Each species successfully hatched a chick(s).
- Although there were the same number of territorial pairs in 2020 as 2019 only 10 pairs nested in 2020, versus 14 in 2019.
- One adult mortality occurred. The specimen was collected and given to the Maine Department of Inland Fisheries and Wildlife for future necropsy.

2.0 INTRODUCTION

Loons were first banded in the Belgrade Lakes in 1997. The effort was funded as part of a Maine Department of Environmental Protection, Regional Monitoring and Assessment

Program (ReMAP). Ongoing monitoring and banding efforts were continued, sporadically, over the following decades, but were limited by a lack of funding.

Data gathered from the prior banding effort and occasional surveys provides some insight into the population status. Personal monitoring efforts conducted over the last two decades confirmed Long Pond has upwards of 10± territorial pairs of loons, with knowledge of at least six territories known on Great Pond. Casual evidence suggests the population is relatively stable, with annual fluctuations in productivity, typical of the species throughout their range. However, recent declines in chick numbers observed by local residents and seasonal camp owners has generated concern about the health of the population.

Great Pond and Long Pond are vulnerable to multiple anthropogenic stressors, coupled with the potential impacts of climate change. More information is needed on the individual performance (i.e., reproductive success) and specific movements of individuals to better understand the status of the population.

3.0 OBJECTIVES

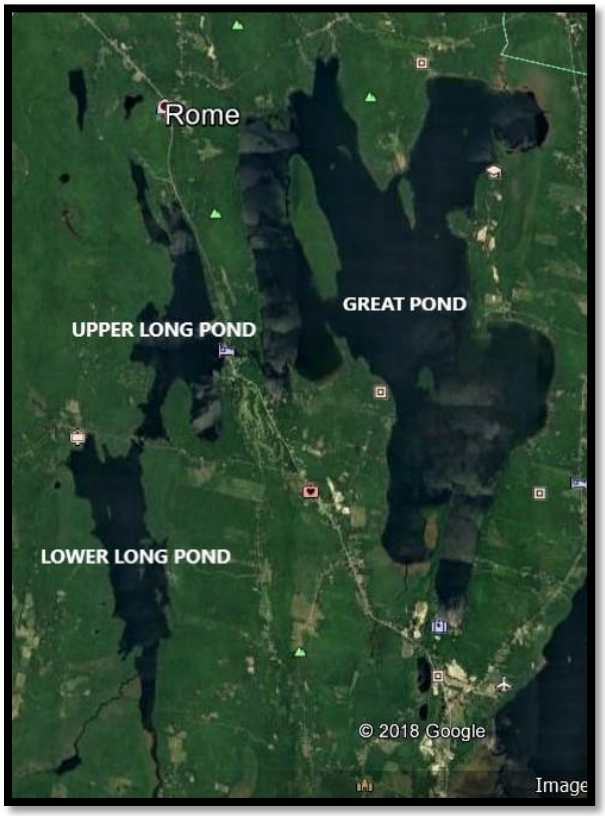
Collaborate with BLA to:

1. Conduct bi-weekly, comprehensive productivity surveys to identify territorial pairs, nesting pairs, nest success/failure, number of chicks hatched, and number of chicks fledged;
2. Consult on deployment and placement of artificial nesting rafts, where appropriate, to increase nest success rates, and minimize nest loss due to flooding and predation;
3. Engage and instruct citizen volunteers on the basics of conducting comprehensive loon breeding surveys, and
4. Re-introduce an active capture and banding program to better understand the status of the current loon population, and
5. Share all data acquired at both regional and national conferences to aid our understanding of the species status and trends over a wide geographical area.

4.0 STUDY AREA

This study is limited to the entirety of Great Pond and Long Pond, Kennebec County, Maine (Figure 1).

Figure 1. The Belgrade Lakes Study Area. Courtesy of Google Earth.



5.0 METHODS

5.1 GROUND SURVEYS

All known or potential loon territories and surrounding areas were surveyed by LCA and BLA volunteers using binoculars and/or a spotting scope, when needed. Surveys were conducted by boat, or alternatively from shore. Surveys began in May and concluded in August. Confirmed territories occupied by loon pairs were prioritized and surveyed bi-weekly at a minimum. To minimize impacts on the loons, surveys were conducted from the greatest distance possible. If nesting evidence was obscured by vegetation it necessitated searching for nest evidence by foot. All known nesting sites were checked regularly for nesting evidence.

Loon territories were delineated according to observed territorial behavior by a loon pair such as close physical association, and defensive posturing and calling along borders. Territories are used by pairs for feeding, resting, breeding, nesting and chick rearing, and are protected against incursion by other loons (and sometimes waterfowl) for a minimum of four weeks. Territories are used as a unit of reference in describing loon breeding activity and are recognized as being either *established* or *transitional*. Established territories have consistent occupancy for at least three seasons; transitional territories exhibit inconsistent occupation.

Nesting pairs were defined as those laying at least one egg; a nesting attempt was evidenced by a constructed nest dish or scrape with at least one egg present or fresh eggshell fragments. Successful nesting pairs hatched at least one chick. Causes of nest failure were attributed according to evidence observed.

Chicks hatched were recorded as those that hatched completely out of their eggs, not necessarily departing from the nest. For this report, we define the terms *chick* and *fledgling* as follows: *chicks* refer to loon young ≤ six weeks of age post-hatching and fledglings or "fledged young" refer to loon young > six weeks of age. Sub-adult loons in alternate plumage are recorded as immatures (ages 1-2). The number of loon chicks to survive past six weeks of age, were assumed to have fledged.

5.2 ARTIFICIAL NESTING ISLANDS

Rafts were floated in territories that met specific criteria for flotation; including knowledge of 1) wind and wave action patterns relative to each territory, 2) loon territorial boundaries and proximity to neighboring territories, 3) previous traditional and non-traditional nest site locations, 4) boat traffic patterns relative to the specific territory, and 5) shoreline activities.

5.3 LOON CAPTURE AND SAMPLE COLLECTION

Loons were captured using well-established night lighting and playback techniques (Evers 1993). Adult and juvenile birds were leg banded with USFWS aluminum bands and a unique combination of plastic colored bands, enabling identification of individual birds to be made from a distance in future observations. Chicks were not banded if their legs were too small to hold adult-size bands. All sampling was accomplished using non-lethal methods.

5.4 DEFINING REPRODUCTIVE SUCCESS

Reproductive success was evaluated according to four parameters; 1) nesting frequency, 2) hatching success, 3) chick survivorship, and 4) overall productivity. Nesting frequency was defined as the number of nesting pairs per total territorial pairs. This measure indicates the percent of the total potential breeding population that attempts to reproduce each season. The rate of success by these pairs, or hatching success, was measured through the number of chicks hatched by these pairs. Chick survivorship was defined as the number of chicks surviving divided by the number of chicks hatched. Overall productivity is a combination of the prior three parameters and measured through fledged young per territorial pair (CS/TP).

6.0 RESULTS

6.1 OVERALL STUDY AREA PRODUCTIVITY

During the 2020 field season, Great Pond and Long Pond were surveyed six times by LCA. Twenty-three territorial pairs were identified. Of the 23 pairs, 10 nested, and four successful nests hatched six chicks; four survived to fledge. This yielded a nesting frequency of 0.43, a hatching success of 0.60, and chick survival of 0.66. Overall productivity was 0.17 fledged young per territorial pair (Table 1).

Table 1. Common Loon Population and Productivity, Great Pond and Long Pond, 2020.

Population		*Reproductive Success*	
Territorial Pairs	23	Nesting Frequency	0.43
Nesting Pairs	10	Hatching Success	0.60
Chicks Hatched	6	Chick Survivorship	0.66
Chicks Surviving	4	Overall Productivity	0.17

6.1.1 GREAT POND PRODUCTIVITY

Twelve territorial pairs were identified on Great Pond. Of the 12 pairs, four nested, and one successful nest hatched one chick. The one chick survived to fledge. This yielded a nesting frequency of 0.33, a hatching success of 0.25, and chick survival of 1.00. Overall productivity was .083 fledged young per territorial pair (Table 2).

Table 2. Common Loon Population and Productivity, Great Pond, 2020.

Population		*Reproductive Success*	
Territorial Pairs	12	Nesting Frequency	0.33
Nesting Pairs	4	Hatching Success	0.25
Chicks Hatched	1	Chick Survivorship	1.00
Chicks Surviving	1	Overall Productivity	.083

6.1.2 LONG POND PRODUCTIVITY

Eleven territorial pairs were identified on Long Pond. Of the 11 pairs, six nested, and three successful nests hatched 5 chicks; three survived to fledge. This yielded a nesting frequency of 0.55, a hatching success of 0.83, and chick survival of 0.60. Overall productivity was 0.27 fledged young per territorial pair (Table 3).

Table 3. Common Loon Population and Productivity, Long Pond, 2020.

Population		*Reproductive Success*	
Territorial Pairs	11	Nesting Frequency	0.55
Nesting Pairs	6	Hatching Success	0.83
Chicks Hatched	5	Chick Survivorship	0.60
Chicks Surviving	3	Overall Productivity	0.27

6.2 Productivity and Nest Failure by Lake/Territory, 2020.

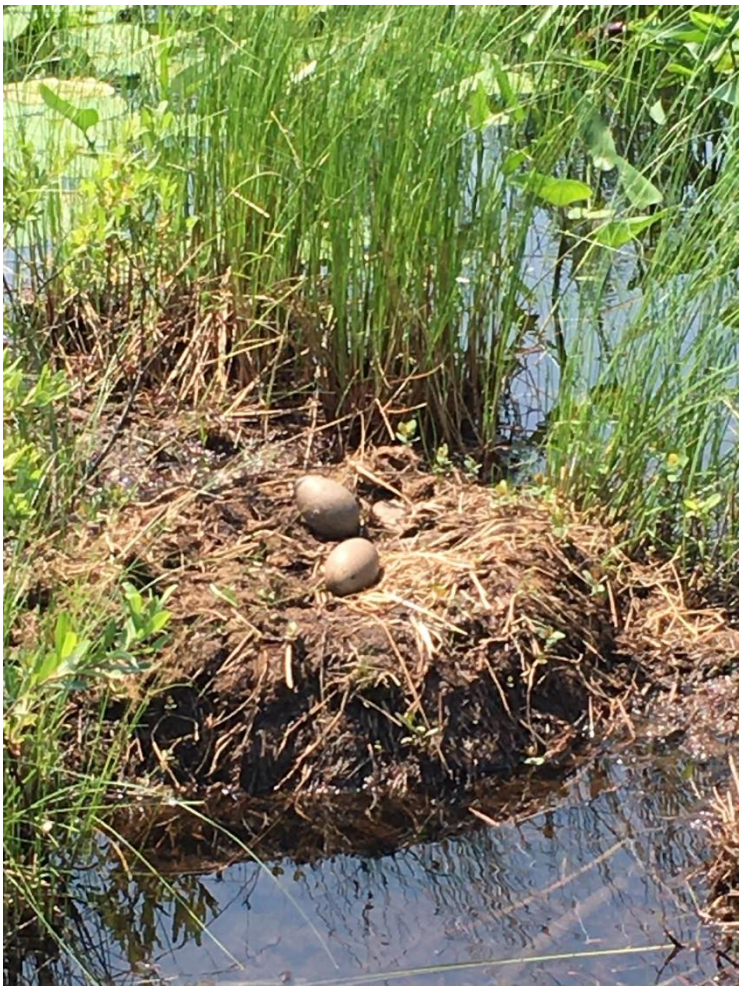
Productivity results were analyzed and documented by lake/territory, including nest failures. A total of eight nest failures were recorded. There was one confirmed case of mammalian predation, five cases of abandonment, and two unknown causes of failure. The nesting pair at Pine Island, Great Pond, failed twice, abandoning a single unhatched egg each time (Table 4, Figure 2).

Table 4. Productivity and Nest Failure Results by Lake/Territory, 2020.

Territory	TP*	NP*	CH*	CS*	NF*	CAUSE OF NEST FAILURE
GREAT POND:						
Marina	Y	Y	0	0	1	Eggs Abandoned Full Term
Finger Reef	Y	N	0	0	0	
Blueberry Island	Y	N	0	0	0	
Robbins Mill Stream	Y	N	0	0	0	
Crooked Island	Y	N	0	0	0	
Ram Island	Y	Y	1	1	0	
Chutes Island	Y	N	0	0	0	
Bear Springs	N	N	0	0	0	
Snake Point Cove	Y	Y	0	0	1	Eggs Abandoned Full Term
Horse Point	Y	N	0	0	0	
Pine Island	Y	Y	0	0	2	Eggs Abandoned
Austin Bog	Y	N	0	0	0	
Oak Island	Y	N	0	0	0	
LONG POND:						
Beaver Cove	Y	Y	2	2	0	
Tracy Cove	Y	N	0	0	0	
Lynch Cove	Y	Y	1	1	1	Mammalian Predation
Blueberry Island	Y	Y	0	0	1	Unknown
Castle Island	Y	N	0	0	0	
W Boat Ramp	Y	N	0	0	0	
Lost River	Y	Y	0	0	1	Eggs Abandoned Full Term
Graveyard	Y	Y	0	0	1	Unknown
SW Cove	Y	N	0	0	0	
Ingham Stream	Y	N	0	0	0	
Ingham Pond	Y	Y	2	0	0	

*TP = territorial pair, NP = nesting pair, CH = chick(s) hatched, CS = chick(s) surviving, NF = nest failure.

Figure 2. Abandoned Eggs, Lost River, Long Pond, 2020.



Population and productivity were mapped for each lake for location reference, confirmed occupation and reproductive success (Figures 3, 4).

Figure 3. Common Loon Population and Productivity, Great Pond, 2020. Courtesy of Google Earth.

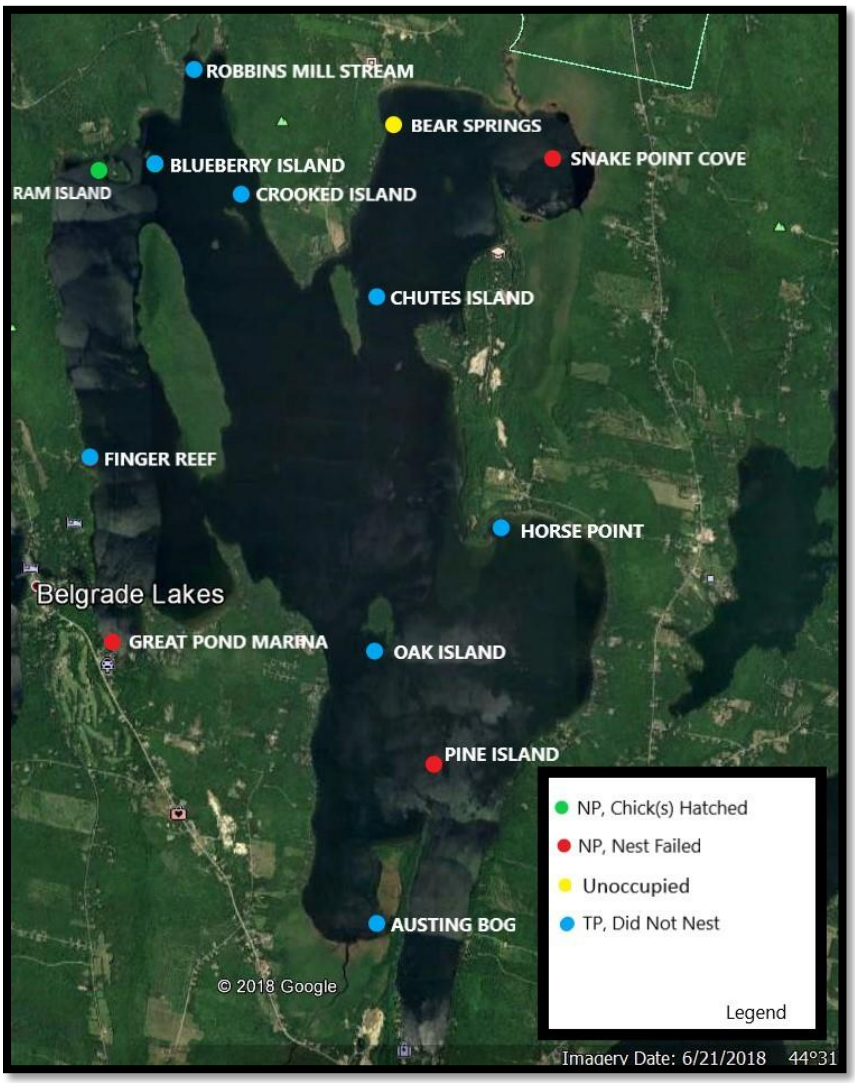
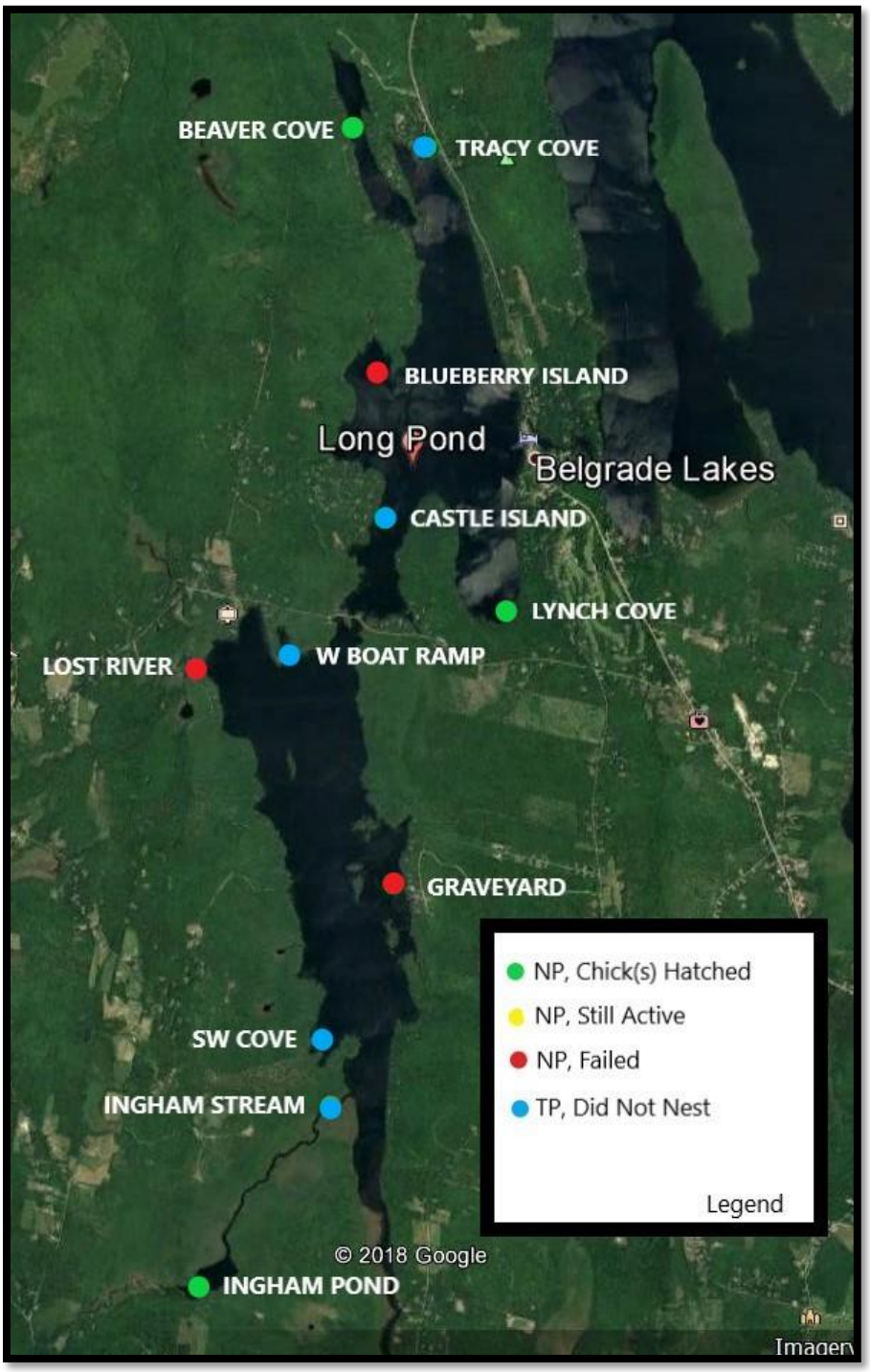


Figure 4. Common Loon Population and Productivity, Long Pond, 2020. Courtesy of Google Earth.



6.3 USE OF ARTIFICIAL NESTING ISLANDS (RAFTS)

Four artificial nests rafts were floated in 2020 and two were used (50%). Both pairs nesting on rafts successfully hatched a chick(s), (100%). In comparison, there were nine natural nest attempts and two were successful (22%). Three of four chicks fledged were hatched from rafts (75%), (Table 5, Figure 5).

Table 5. Comparative Loon Nesting Summary: Raft vs. Natural Nests, Great Pond and Long Pond, 2020.

***Raft* Nests**	***2020***	***Natural* Nests**	***2020***
Number of Nest Attempts	2	Number of Nest Attempts	9
Number of Successful Nest Attempts	2	Number of Successful Nest Attempts	2
Success Rate	***100%***	***Success Rate***	***22%***
Chicks Hatched from Rafts	3	Chicks Hatched from Natural Sites	3
Total Chicks Hatched	6	Total Chicks Hatched	6
Contribution to Productivity	***50%***	***Contribution to Productivity***	***50%***
Total Chicks Fledged	3	Total Chicks Fledged	1
Final Productivity*	***75%***	***Final Productivity****	***25%***

* Percentage of total chicks fledged.

Figure 5. Loon Raft, Lynch Cove, Long Pond, 2020.

6.4 CAPTURE AND BANDING

In 2020, seven loons were captured and banded; six adults and one chick (Table 5).

Table 5. Captured and Banded Loons, 2020.

Territory	Band #	Year	Sex	Age	Left Leg Top	Left Leg Bottom	Right Leg Top	Right Leg Bottom
L Pond, Beaver Cove	0689-09476	2020	M	ATY	Red	Green	Orange	Silver
L Pond, Beaver Cove	0689-09482	2020	F	ATY	Orange	Red	Silver	Orange
L Pond, Ingham Pond	0689-09487	2020	M	ATY	Yellow Stripe	Red	Silver	Orange
L Pond, Ingham Pond	0689-09484	2020	F	ATY	Green	Red Stripe	Orange	Silver
L Pond, Lynch Cove	1238-04764	2020	F	ATY	Green	Orange Stripe	Silver	White Dot
G Pond, Ram Island	1238-04763	2020	M	ATY	Red	Yellow Stripe	White Dot	Silver
G Pond, Ram Island	0968-87783	2020	UNK	HY	Silver		Red Stripe	

6.5 BANDED LOON REOBSERVATIONS AND RECOVERIES

Loons were first banded on Great Pond and Long Pond in 1997. Between 1997 and 2008, 17 loons were banded (13 adults and four juveniles). In 2020, one banded individual was confirmed on Long Pond (Table 6). All breeding loons were confirmed as either banded, with a positive confirmation or as unbanded (100% confirmation).

Table 6. Banded Loon Reobservations and Recoveries, 2020.

Band #	Lake	Year	Sex	Age	Original Territory	2020 Territory	2020	Notes
0848-04699	Long Pond	1997	M	ATY	W Boat Ramp	NA	N	
0898-05397	Long Pond	1997	U	HY	W Boat Ramp	NA	N	
0898-05395	Long Pond	1997	F	ATY	Twin Islands	NA	N	
0559-61756	Great Pond	1997	M	ATY	Pine Island	NA	N	
0848-04785	Great Pond	1997	F	ATY	Pins Island	NA	N	
0559-61896	Long Pond	1999	F	ATY	Southwest	NA	N	
0559-61871	Long Pond	1999	M	ATY	Twin Islands	NA	N	
0938-03338	Long Pond	1999	U	HY	Twin Islands	NA	N	
0898-09873	Long Pond	2000	F	ATY	Beaver Cove	NA	N	
0938-30822	Long Pond	2003	M	ATY	Beaver Cove	NA	N	Deceased 2005
0938-30886	Long Pond	2003	M	ATY	Lynch Cove	NA	N	Deceased 2006 - BAEG
0938-03384	Long Pond	2003	F	ATY	Lynch Cove	NA	N	
0938-66608	Long Pond	2008	M	ATY	W Boat Ramp	NA	N	
0938-66613	Long Pond	2008	F	ATY	W Boat Ramp	W Boat Ramp	Y	W/ unbanded male
0938-66612	Long Pond	2008	U	HY	W Boat Ramp	NA	N	Deceased 2018
0938-66607	Long Pond	2008	M	ATY	Snake Point Cove	NA	N	
0938-66603	Long Pond	2008	U	HY	Snake Point Cove	NA	N	

6.6 CONTAMINANT ANALYSIS

All blood and feather samples collected were processed and analyzed at Biodiversity Research Institute's (BRI) laboratory in Portland, Maine.

To assess the potential impacts of mercury (Hg) and lead (Pb) on loons, known baseline effects levels can be separated into risk categories based on studies from BRI and their collaborators.

Low risk indicates background Hg concentrations that have no known impact on wildlife. Loon territories that fall within the moderate risk category have elevated Hg concentrations but their impact levels on individuals remain undetermined. Loons that are in the high risk category are exposed to toxic levels of environmental Hg that statistically show physiological, behavioral, and reproductive impacts (Evers et al. 2008). The high category therefore has Hg at levels of concern (Table 7).

Table 7. Risk categories for assessing Hg and Pb impacts, reported as parts per million (ppm) in wet weight (ww) for blood and egg, and fresh weight (fw) for feathers, for the common loon.

Contaminant Matrix	Low	Moderate	High	Endpoint	Reference
Mercury (Hg)					
Adult (blood)	0 to 1.0	1.0 to 3.0	> 3.0	40% fewer fledged young	Burgess and Meyer 2008; Evers et al. 2008
Adult (feather)	0 to 9.0	9.0 to 40.0	> 40.0	Significant asymmetry	Evers et al. 2008
Juvenile (blood)	0 to 0.1	0.1 to 0.3	> 0.3	Lower survival	Evers et al. 2010; unpubl. data
Egg	0 to 0.7	0.7 to 1.3	> 1.3	Significantly smaller egg and reduced hatchability	Evers et al. 2003
Lead (Pb)					
Blood	0 to 0.12	0.12 to 0.24	> 0.24	Probable death	Franson et al. 2003; BRI unpubl. data

6.6.1 BLOOD

Blood Hg results are reported in parts per million (ppm) wet weight (ww). Mercury levels in the blood of the six adult loons sampled ranged from 0.856 to 1.452 ppm (ww). (Table 8). All of the samples fell within the low or moderate risk ranges for negative impacts.

Table 8. Results of Hg in blood (ppm, ww), 2020.

Date Collected	Territory	Sex	Age	Blood Hg (ppm, ww)
7/21/2020	Long Pond, Beaver Cove	M	ATY	1.288
7/21/2020	Long Pond, Beaver Cove	F	ATY	0.930
7/21/2020	Long Pond, Ingham Pond	M	ATY	1.452
7/21/2020	Long Pond, Ingham Pond	F	ATY	0.856
8/20/2020	Long Pond, Lynch Cove	F	ATY	1.096
8/20/2020	Great Pond, Ram Island	M	ATY	1.191

6.6.2 FEATHER

Feather Hg results are reported in parts per million (ppm), fresh weight (fw). Mercury levels in the feathers of the six adults ranged from 4.400 to 12.677 ppm (fw) (Table 8). The levels all fall within the low or moderate risk range for negative impacts.

Table 8. Results of Hg in feathers (ppm, fw), 2020.

Date Collected	Territory	Sex	Age	Feather Hg (ppm, fw)
7/21/2020	Long Pond, Beaver Cove	M	ATY	10.548
7/21/2020	Long Pond, beaver Cove	F	ATY	4.400
7/21/2020	Long Pond, Ingham Pond	M	ATY	11.675
7/21/2020	Long Pond, Ingham Pond	F	ATY	10.718
8/20/2020	Long Pond, Lynch Cove	F	ATY	8.083
8/20/2020	Great Pond, Ram Island	M	ATY	12.677

6.7 MORTALITIES:

One adult loon died and was recovered from Long Pond, Tracy Cove on July 9, 2020. An examination of the carcass by volunteers did not uncover any obvious signs of injury. The dead loon was turned over to the Maine Department of Inland Fisheries and Wildlife for future necropsy, with hopes of determining the cause of death.

7.0 DISCUSSION

In 2020, 23 of 24 known territories (96%) were occupied by loon pairs, with some additional, suitable habitat available for occupation by new pairs. This continued high occupancy rate demonstrates a strong breeding base in numbers, with potential to sustain a healthy breeding population.

Nesting conditions were favorable in 2020. Water levels during nesting remained fairly consistent. No nests were lost due to flooding, which is often a cause of loon nest failures. The number of nesting pairs was down when compared to 2019, with just ten of the 23 pairs on the two ponds nesting (43%). Monitoring surveys during the prime nesting period of May/June found large rafts of loons in open water, not in territory. This helps explain the

reduction in nest attempts and the corresponding drop in overall productivity, although there is no apparent cause for this behavior.

Eight of 12 confirmed nest attempts failed (75%). This high failure rate was another significant cause of extremely low productivity. Determining the cause of nest failure is important when evaluating current productivity, and equally as important when considering future conservation measures to improve productivity.

The 2020 overall productivity of 0.17 CH/TP is extremely low, and well below the established sustainable population threshold of 0.48 CH/TP. In 2019 the result was 0.35 CH/TP. Although both years fall below 0.48 CH/TP, loon productivity is subject to significant year-to-year fluctuations, and these results may not indicate this is a long-term trend. Multi-year studies, typically no less than five years in duration are required to adequately assess the population status.

Two nest rafts were introduced many years ago on Long Pond, and two new rafts were placed in the study area in 2020. Reproductive success from those territories has been monitored closely. It is likely the reproductive success exceeds the success rate of pairs nesting naturally on the ponds. Many current territories lack natural nesting islands, requiring loons to nest on the mainland, which increases the risk of failure from mammalian predators, and loss due to flooding events. There are suitable spots for placement of additional nest rafts in some territories, should circumstances warrant (successive years of natural nest failure). This conservation measure requires a serious commitment to construct, maintain, deploy, and remove rafts, annually, and in a timely manner.

When used appropriately, signs can be used as a valuable education and conservation tool. They have been utilized broadly, often as part of well-developed conservation programs throughout common loon breeding ranges. After many instances of nest disturbance by boaters in Tracy Cove, Long Pond, a new warning sign was placed there in 2020.

Tracking the movements, territory and mate fidelity, and long-term survival of banded loons is key to understanding the dynamics of the local population. Launching a new banding initiative in 2020 was a key action, allowing for more informed evaluation of the movements, territory fidelity, and long-term survival of the local loon population.

First-year lab results of samples analyzed for mercury (Hg) show only low and moderate levels in both blood and feathers. These results do not indicate any levels of concern at this time.

In the first two years, this project demonstrated the effectiveness of collaboration between trained professional researchers and volunteer citizen scientists. More dedicated volunteers are needed to help assure the overall success of the project, and its' sustainability in the future. Formal training and education modeled after successful programs in other regions will be an important next step, whenever circumstances change to allow safe group gatherings again. This unique partnership allows for the development of sustainable conservation efforts, which in turn provides valuable information to local communities and scientists concerned about the health of loon populations.

8.0 RECOMMENDATIONS

Common loons have responded well to dedicated human conservation measures designed to either stabilize a population or help a population rebound. However, these actions were implemented after years of research needed to accurately verify the status of the population, and identify past and present stressors, which may have led to population declines.

LCA recommends the following actions for 2021:

- With professional guidance, continue to use standardized survey methods to collect data on the number of territorial pairs, nesting pairs, location of nests, chicks hatched, and those surviving >six weeks of age.
- If volunteers can be identified and trained to help deploy, maintain, monitor and remove new nest rafts, potential territories to consider include; W Boat Ramp, Long Pond, and Chutes Island, Horse Point and Finger Reef, Great Pond. This should not be implemented if suitable volunteers cannot be recruited.
- Expand the use of nest monitoring cameras (trail cameras), as circumstances allow to better understand the causes of nest disturbance and failure.

- Further develop the engagement and knowledge of citizen science volunteers by conducting formal classroom and field training, and seek to expand the volunteer base.
- Repeat capture and banding of loons through traditional night capture of adults with chicks, allowing individual identification and tracking of movements and survival over time.
- Continue to engage and inform the local community about loons on Great Pond and Long Pond through all available media.
- Increase outreach and education efforts to communicate and reduce threats from human nest disturbance, fishing line entanglement, boat wakes, etc. Specific steps could include signage at any nests where disturbance has been documented with any frequency, general education signage at boat launches, and installment of containers for disposing of fishing line.

9.0 ACKNOWLEDGMENTS

LCA wishes to acknowledge the Belgrade Lakes Association and its' members, especially Dick Greenan, and all the volunteers who participated in field surveys.

10.0 LITERATURE CITED

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