



2021

Belgrade Lakes Common Loon Monitoring Summary Report



Dick Greenan

Great Pond, Robbins Mill, 2021

SUBMITTED TO:

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SUBMITTED ON:

November 19, 2021

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

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1.0 EXECUTIVE SUMMARY

Supported by a third 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 2021. 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 is a key component of the project. Formal volunteer training was budgeted and scheduled for the spring, but Covid-19 concerns and availability/scheduling issues required it 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 2021, 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 13 of these pairs nested. From 10 successful nests 14 chicks hatched and eight survived to > six weeks of age – an age defined as fledging for modeling purposes. Overall productivity on Great Pond and Long Pond in 2021 was 0.35 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 2021, two new rafts were constructed by a volunteer and placed in occupied territories, bringing the total number of rafts deployed to six. Three rafts were placed on Long Pond (Beaver Cove, Lynch Cove and Tracy Cove) and three on Great Pond (Austin Bog, Horse Point and Robbins Mill). On Long Pond two of the rafts were used by nesting pairs (Tracy Cove & Lynch Cove), and both were successful (100%), hatching a total of three chicks. None of the rafts on Great Pond were used. Comparatively, there were a total of 11 natural nest attempts on the two lakes and eight nests were successful (73%).

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 2021 the capture and banding program was continued with great success. In two nights, 11 loons were captured and banded; five on Long Pond, including one chick, and six on Great Pond.

Significant findings/outcomes included:

- Three of four adult loons just banded in 2020 did not return or they lost their territory to other loons. This negatively affected productivity in two of the three territories these individuals previously occupied; Beaver Cove, Long Pond and Ram Island, Great Pond.
- For the first year since the study began in 2019 loons on Great Pond produced more chicks than the loons on Long Pond. Great Pond loons fledged five chicks and Long Pond loons fledged three.
- As in 2019 and 2020, the 1997 Long Pond, W Boat Ramp, banded female was observed. She was paired with an unbanded male in the same region of the lake. They did not nest.
- Nesting loons occupied the new raft in Lynch Cove, Long Pond for the second consecutive year and hatched two chicks. Prior to 2020 and 2021 there were no reports of successful nesting in Lynch Cove for at least a decade. Known nests on the mainland peninsula were continually lost to mammal predation.
- A male loon who was banded in 2008 in the Snake Point Cove territory of Great Pond was observed in the Otter Island territory with an unbanded female. Courtship behavior was observed, but they did not nest (Figure 1).

Figure 1. 2008 Great Pond, Snake Point Cove Male, Otter Island Territory, 2021.



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 $10\pm$ 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 (including Ingham Stream and Ingham Pond), Kennebec County, Maine (Figure 2).

Figure 2. 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 by LCA and BLA volunteers began in May and ended in August. Volunteers continued to conduct chick survival surveys well into the fall. 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 \leq 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) a history of nest failures due to predation and/or flooding, 2) wind and wave action patterns relative to each territory, 3) loon territorial boundaries and proximity to neighboring territories, 4) previous traditional and non-traditional nest site locations, 5) boat traffic patterns relative to the specific territory, and 6) shoreline activities.

5.3 LOON CAPTURE AND SAMPLE COLLECTION

Loons were captured using well-established night lighting and playback techniques. 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 2021 field season, Great Pond and Long Pond were surveyed six times by LCA. Twenty-three territorial pairs were identified. Of the 23 pairs, 13 nested, and 10 successful nests hatched 14 chicks; eight survived to fledge. This yielded a nesting frequency of 0.57, a hatching success of 1.08, and chick survival of 0.57. Overall productivity was 0.35 fledged young per territorial pair (Table 1).

Table 1. Common Loon Population and Productivity, Great Pond and Long Pond, 2021.

| <i>Population</i> | | <i>Reproductive Success</i> | |
|-------------------|----|-----------------------------|------|
| Territorial Pairs | 23 | Nesting Frequency | 0.57 |
| Nesting Pairs | 13 | Hatching Success | 1.08 |
| Chicks Hatched | 14 | Chick Survivorship | 0.57 |
| Chicks Surviving | 8 | Overall Productivity | 0.35 |

6.1.1 GREAT POND PRODUCTIVITY

Thirteen territorial pairs were identified on Great Pond. Of the 13 pairs, seven nested, and six successful nests hatched eight chicks. Five chicks survived to fledge. This yielded a nesting frequency of 0.54, a hatching success of 1.14, and chick survival of 0.63. Overall productivity was 0.38 fledged young per territorial pair (Table 2, Figure 3).

Table 2. Common Loon Population and Productivity, Great Pond, 2021.

| <i>Population</i> | | <i>Reproductive Success</i> | |
|-------------------|----|-----------------------------|------|
| Territorial Pairs | 13 | Nesting Frequency | 0.54 |
| Nesting Pairs | 7 | Hatching Success | 1.14 |
| Chicks Hatched | 8 | Chick Survivorship | 0.63 |
| Chicks Surviving | 5 | Overall Productivity | 0.38 |

Figure 3. Nesting Loons, Great Pond, 2021.



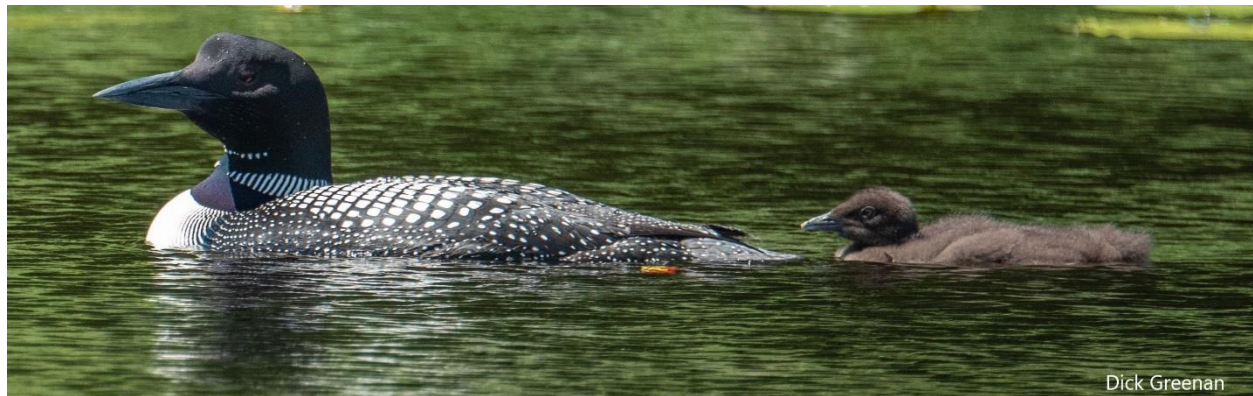
6.1.2 LONG POND PRODUCTIVITY

Ten territorial pairs were identified on Long Pond. Of the 10 pairs, six nested, and four successful nests hatched six chicks; three survived to fledge. This yielded a nesting frequency of 0.60, a hatching success of 1.00, and chick survival of 0.50. Overall productivity was 0.30 fledged young per territorial pair (Table 3, Figure 4).

Table 3. Common Loon Population and Productivity, Long Pond, 2021.

| <i>Population</i> | | <i>Reproductive Success</i> | |
|-------------------|----|-----------------------------|------|
| Territorial Pairs | 10 | Nesting Frequency | 0.60 |
| Nesting Pairs | 6 | Hatching Success | 1.00 |
| Chicks Hatched | 6 | Chick Survivorship | 0.50 |
| Chicks Surviving | 3 | Overall Productivity | 0.30 |

Figure 4. Adult and Chick, Ingham Pond, 2021.



6.2 PRODUCTIVITY AND NEST FAILURE RESULTS BY LAKE/TERRITORY, 2021.

Productivity results were analyzed and documented by lake/territory, including nest failures. A total of three nest failures were recorded. There was one confirmed case of mammalian predation and two unknown causes of failure (Table 4).

Table 4. Productivity and Nest Failure Results by Lake/Territory, 2021.

| Lake/Territory | TP* | NP* | CH* | CS* | NF* | CAUSE OF NEST FAILURE |
|---------------------|-----------|-----------|-----------|----------|----------|-----------------------------|
| GREAT POND: | | | | | | |
| Marina | Y | N | 0 | 0 | 0 | |
| Finger Reef | Y | N | 0 | 0 | 0 | |
| Blueberry Island | Y | Y | 2 | 0 | 0 | |
| Robbins Mill Stream | Y | Y | 1 | 1 | 0 | |
| Crooked Island | N | N | 0 | 0 | 0 | |
| Ram Island | Y | N | 0 | 0 | 0 | |
| Otter Island | Y | N | 0 | 0 | 0 | |
| Chutes Island | Y | N | 0 | 0 | 0 | |
| Bear Springs | Y | Y | 1 | 1 | 0 | |
| Snake Point Cove | Y | Y | 2 | 2 | 0 | |
| Horse Point | Y | Y | 0 | 0 | 1 | Unknown, nest empty |
| Pine Island | Y | Y | 1 | 1 | 0 | |
| Austin Bog | Y | Y | 1 | 0 | 0 | |
| Oak Island | Y | N | 0 | 0 | 0 | |
| LONG POND: | | | | | | |
| Beaver Cove | Y | N | 0 | 0 | 0 | |
| Tracy Cove | Y | Y | 1 | 0 | 0 | |
| Lynch Cove | Y | Y | 2 | 1 | 0 | |
| Blueberry Island | Y | Y | 0 | 0 | 1 | Mammalian Predation |
| Castle Island | Y | Y | 1 | 1 | 0 | |
| W Boat Ramp | N | N | 0 | 0 | 0 | |
| Lost River | Y | N | 0 | 0 | 0 | |
| Graveyard | Y | N | 0 | 0 | 0 | |
| SW Cove | Y | Y | 0 | 0 | 1 | Unknown, egg found in water |
| Ingham Stream | Y | N | 0 | 0 | 0 | |
| Ingham Pond | Y | Y | 2 | 1 | 0 | |
| TOTALS: | 23 | 13 | 14 | 8 | 3 | |

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

Population and productivity were mapped for each lake for location reference, confirmed occupation and reproductive success (Figures 5, 6).

Figure 5. Common Loon Population and Productivity, Great Pond, 2021. Courtesy of Google Earth.



Figure 6. Common Loon Population and Productivity, Long Pond, 2021. Courtesy of Google Earth.



6.3 USE OF ARTIFICIAL NESTING ISLANDS (RAFTS)

Six artificial nests rafts were floated in 2021 and two were used (33.3%). Both pairs nesting on rafts successfully hatched a chick(s), (100%). In comparison, there were eleven natural nest attempts and eight were successful (73%), (Table 5, Figure 7).

Table 5. Comparative Loon Nesting Summary: Raft vs. Natural Nests, Great Pond and Long Pond, 2021.

| <i><u>Raft</u> Nests</i> | <i>2021</i> | <i><u>Natural</u> Nests</i> | <i>2021</i> |
|--|--------------------|--|--------------------|
| Number of Nest Attempts | 2 | Number of Nest Attempts | 11 |
| Number of Successful Nest Attempts | 2 | Number of Successful Nest Attempts | 8 |
| <i>Success Rate</i> | <i>100%</i> | <i>Success Rate</i> | <i>73%</i> |
| Chicks Hatched from Rafts | 3 | Chicks Hatched from Natural Sites | 11 |
| Total Chicks Hatched | 14 | Total Chicks Hatched | 14 |
| <i>Contribution to Productivity</i> | <i>21%</i> | <i>Contribution to Productivity</i> | <i>79%</i> |
| Total Chicks Fledged | 1 | Total Chicks Fledged | 10 |
| <i>Final Productivity*</i> | <i>9%</i> | <i>Final Productivity*</i> | <i>91%</i> |

* Percentage of total chicks fledged.

Figure 7. Loon Raft, Long Pond, 2021.



6.4 CAPTURE AND BANDING

In 2021, 11 loons were captured and banded; 10 adults and one chick (Table 6, Figure 8).

Table 6. Captured and Banded Loons, 2021.

| Territory | Band # | Year | Sex | Age* | Left Leg Top | Left Leg Bottom | Right Leg Top | Right Leg Bottom |
|------------------------|------------|------|-----|------|--------------|-----------------|---------------|------------------|
| L Pond, Castle Island | 0689-15360 | 2021 | F | ATY | Green | Red Stripe | Yellow | Silver |
| L Pond, Castle Island | 0689-15644 | 2021 | M | ATY | Orange | Red Stripe | Red Dot | Silver |
| L Pond, Castle Island | 0689-15634 | 2021 | UNK | HY | Yellow | Silver | White Dot | Orange |
| L Pond, Lynch Cove | 0689-15638 | 2021 | F | ATY | White | Yellow | Silver | Red Dot |
| L Pond, Lynch Cove | 0689-15626 | 2021 | M | ATY | Red Dot | Red | Silver | Red Dot |
| G Pond, Pine Island | 0689-09437 | 2021 | M | ATY | Green Stripe | Orange | Silver | Red Dot |
| G Pond, Robbins Mill | 0689-09439 | 2021 | M | ATY | Blue | Green | Red Dot | Silver |
| G Pond, Blueberry Isl. | 0689-09436 | 2021 | M | ATY | White | Red | Silver | Red Dot |
| G Pond, Blueberry Isl. | 0689-09428 | 2021 | F | ATY | Red Stripe | Green | Yellow | Silver |
| G Pond, Snake Pt. Cove | 0689-09426 | 2021 | F | ATY | Red | Green | Yellow | Silver |
| G Pond, Snake Pt. Cove | 0689-09422 | 2021 | M | ATY | Red Stripe | Yellow | Silver | Red Dot |

* ATY = adult, HY = chick.

Figure 8. Capture and Banding Loons, Long Pond, 2021.



6.5 BANDED LOON REOBSERVATIONS AND RECOVERIES

Loons were first banded on Great Pond and Long Pond in 1997. Between 1997 and 2020, 24 loons were banded (19 adults and five juveniles). In 2021, six banded individuals were confirmed on Long Pond and Great Pond (Table 7). All breeding loons were confirmed as either banded, with a positive confirmation or as unbanded (100% confirmation).

Table 7. Banded Loon Reobservations and Recoveries, 2021.

| Band # | Lake | Year | Sex | Age* | Original Territory | 2021 Territory | 2021 | 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 | Pine Island | NA | N | |
| 0559-61896 | Long Pond | 1999 | F | ATY | SW Cove | 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 |
| 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 | Lost River | Y | w/unbanded male |
| 0938-66612 | Long Pond | 2008 | U | HY | W Boat Ramp | NA | N | Deceased 2018 |
| 0938-66607 | Great Pond | 2008 | M | ATY | Snake Pt Cove | Otter Island | Y | |
| 0938-66603 | Great Pond | 2008 | U | HY | Snake Pt Cove | NA | N | |
| 0689-09482 | Long Pond | 2020 | F | ATY | Beaver Cove | Beaver Cove | Y | w/unbanded male |
| 0689-09476 | Long Pond | 2020 | M | ATY | Beaver Cove | NA | N | |
| 0689-09484 | Long Pond | 2020 | F | ATY | Ingham Pond | Ingham Pond | Y | |
| 0689-09487 | Long Pond | 2020 | M | ATY | Ingham Pond | Ingham Pond | Y | |
| 1238-04764 | Long Pond | 2020 | F | ATY | Lynch Cove | none | Y | open lake, group |
| 1238-04763 | Great Pond | 2020 | M | ATY | Ram Island | NA | N | |
| 0968-87783 | Great Pond | 2020 | U | HY | Ram Island | NA | N | |

*ATY = adult, HY = chick.

6.6 CONTAMINANT ANALYSIS

Lab analysis for contaminant levels in loons is not being conducted in 2021. Lab results for both mercury (Hg) and lead (Pb) contaminants have been analyzed since loons were first banded in 1997. The results over the past 23 years, including recent samples from 2020, show only low and moderate levels of these contaminants in both blood and feathers. These results do not indicate any levels of concern at this time.

6.7 MORTALITIES:

One adult loon died and was recovered from Great Pond, Pinkham Cove. An examination of the carcass by volunteers did not uncover any obvious signs of injury. The carcass was turned over to the Maine Department of Inland Fisheries and Wildlife for future necropsy.

One deceased chick was recovered from Long Pond, Lynch Cove. The chick carcass was turned over to Biodiversity Research Institute for future necropsy at their Portland, Maine lab.

7.0 DISCUSSION

In 2021, 23 of 25 known territories (92%) were occupied by loon pairs. This continued high occupancy rate demonstrates a strong breeding base in numbers, with potential to sustain a healthy breeding population. Most of the high-quality nesting habitat is occupied on both lakes, but some suitable habitat remains where new territories could possibly emerge in the future.

Nesting conditions were favorable in 2021. Water levels during nesting remained fairly consistent. No nests were lost due to flooding, which is often a cause of loon nest failures. Seventy-seven percent of nest were successful (10 of 13). This high rate of nesting success is a significant factor contributing to increased productivity. The overall nesting success number of 1.08 CH/NP (Table 1) is the highest number since the project began in 2019.

Another factor which helped productivity increase in 2021 was a rebound in the number of nesting pairs. The number of nesting pairs in 2021 was 13 compared to 10 nesting pairs in 2020.

The 2021 overall productivity of 0.35 CH/TP remains low, and well below the established sustainable population threshold of 0.48 CH/TP. Looking at 2019 (0.35) and 2020 (0.17) productivity, no single year approaches 0.48 CH/TP. While these productivity numbers are concerning, multi-year studies, typically no less than five years in duration are required to adequately assess the population status.

Based on the findings from the first three years of the project, artificial nest rafts have been highly effective. When loons use them, they have successfully hatched a chick(s) every time (100%), although the chicks have not always survived to fledge. Overall contributions to increased productivity are currently limited by usage rates (33%), with only two of six rafts used in 2021. Over time it is reasonable to expect usage rates to increase to 50% or greater. This will require close monitoring of nesting behaviors and tweaking of nest raft placement, design, etc. Introducing additional new rafts, if circumstances are appropriate, can help increase nesting success rates over time.

Human disturbance of both nesting loons and loons on the lakes has been observed and documented. Maps contained in this report help to inform the public about occupied loon territories. With more knowledge and education, it is hoped the public will avoid disturbing nesting loons and exercise caution when boating in these areas of the lakes.

When used appropriately, signs can be used as a valuable education and conservation tool. Well-thought out and strategic usage of signage can help to reduce disturbance issues. Signs have been utilized broadly, often as part of well-developed conservation programs throughout common loon breeding ranges.

Tracking movements, territory and mate fidelity, and long-term survival of banded loons is key to understanding the dynamics of the local population. For populations to thrive, long-term survival and mate fidelity are critical factors. 2021 monitoring confirmed low territorial/mate fidelity amongst loons just banded in 2020. Three of four territories surveyed did not have the same loons, based on careful band identification. This reinforces the value of continuing to band more loons in future years, and closely monitor their survival and movements.

In the first three years, this project demonstrated the effectiveness of collaboration between trained professional researchers and volunteer citizen scientists. Significant progress was made recruiting new volunteers in 2021, but 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 2022:

- 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.
- Continue the strategic use of artificial nest rafts to aid productivity. When circumstances are appropriate, look to introduce new rafts into territories where nesting pairs are struggling to nest successfully.
- 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.