COMMON LOON MONITORING SUMMARY REPORT

2019

Kezar Lake Watershed

KEZAR LAKE WATERSHED

Common Loon Monitoring Summary Report

SUBMITTED TO:
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Loon Conservation Associates (LCA) 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 grant from the Stephen & Tabitha King (STK) Foundation, Loon Conservation Associates (LCA) continued a collaborative study with the Kezar Lake Watershed Association (KLWA), conducting comprehensive common loon (*Gavia immer*) monitoring surveys in the Kezar Lake watershed. Loons are a key indicator of aquatic integrity for lakes. This initiative provides an opportunity to confirm the current population status, identify major threats and create long-term, sustainable conservation solutions that strengthen the current population.

Engaging and training local volunteers to conduct surveys with professional guidance from LCA was a key component of the project. More than 15 dedicated and passionate volunteers helped conduct over 450 independent surveys between May 15 and August 30, 2019. Results published in this report are taken from data gathered by LCA and KLWA members and volunteers.

In 2019, seven lakes were surveyed in the watershed. Based on well-defined criteria for an established loon territory, a total of 16 territorial pairs were documented, and 12 of these pairs nested. From seven successful nests, 10 chicks hatched and eight (80%) survived to > six weeks of age – an age defined as fledging for modeling purposes. Overall productivity in the Kezar Lake watershed in 2019 was 0.50 fledged young per territorial pair. This compares favorably the the 2018 productivity number of 0.33. The same number of chicks were hatched both years (10), however eighty percent of the chicks survived in 2019, versus fifty percent in 2018.

A cool, wet spring resulted in an above average initial water levels, together with an abundant black fly population. These two factors caused significant delays in nesting by established pairs, and there were two documented cases of nest abandonment. In both abandonment cases, field observations confirmed eggs left untended on rafts which were swarmed by hordes of black flies. During this time loon sightings were scarce, with most choosing to stay below water to avoid the biting insects. Photos and close-up field observations with binoculars confirmed the black flies remained attached to loon's heads and neck during dives.

Historically, nesting loons across their breeding range have benefited from the use of rafts, with a measurably higher success rate on rafts when compared to natural nests. In 2019, the same three nesting pairs as 2018 used rafts, and there was strong evidence and sightings of loons on two other rafts. Two of the three pairs on rafts were successful hatching one chick (66%), compared to 10 natural nests with five successes (50%).

Using traditional night-lighting techniques, a total of eight loons (four adults & four chicks) were captured and banded in 2019. Six of the loons were captured and banded on Kezar Lake and two were captured and banded on Trout Pond.

To enhance research of nesting loons, battery powered trail cameras were deployed on three nesting pairs; Kezar Lake, MB - Severance West and LB – Outlet River Marsh, and Trout Pond. The cameras successfully captured day and night images of incubation behaviors, disturbance, raccoon egg predation (Severance West), and successful chick hatching at Trout Pond.

Blood samples tested for mercury (Hg) levels in 2019 show high levels of mercury in an adult and a chick in the UB - Alaska Bay territory. Other samples showed moderately high mercury levels in the blood of adult males in the UB – Great Brook and MB – Fox Cove territories.

2.0 INTRODUCTION

Anecdotal evidence from casual surveys performed by KLWA members and volunteers over the past decade indicate the productivity of loons in the Kezar Lake watershed may be well below the 0.48 threshold needed to sustain a healthy loon population. Poor reproductive success is likely attributed to one or more causes, including; predation, human disturbance, water level fluctuation

impacts, as well as contaminants, including lead (Pb) and mercury (Hg), and wintering hazards such as commercial fishing nets and oil spills.

In the Kezar Lake watershed, successful breeding pairs have been confirmed historically on Kezar Lake, Horseshoe Pond and Heald Pond, and more recently on Tout Pond. Initial results from this study confirm high occupancy and nesting rates, with poor reproductive success in 2018 due to both nest failures and chick loss.

Because the loon breeding population in the Kezar Lake Watershed is small and 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 ensure long-term sustainability.

3.0 OBJECTIVES

Collaborate with KLWA to:

1. Conduct weekly, comprehensive productivity surveys to identify territorial pairs, nesting pairs, nest success/failure, number of chicks hatched, and number of chicks fledged;
2. Develop a color-banded population to determine demographic parameters of interest (individual reproductive performance, rate of return by adults to their breeding territory and mate fidelity) in breeding common loons in KLWA watershed;
3. 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;
4. Continue the use of nest monitoring cameras to better assess nest disturbance, nesting behaviors, and potential causes of nest failure, and
5. Collect Hg and Pb levels in breeding loons to evaluate contaminant risk.

4.0 STUDY AREA

This study is limited to lakes of appropriate size, and with suitable habitat in the Kezar Lake watershed in Oxford County, Maine (Figure 1). The specific lakes are: Kezar Lake, Horseshoe Pond, Farrington Pond, Cushman Pond, Heald Pond, Bradley Pond, and Trout Pond.

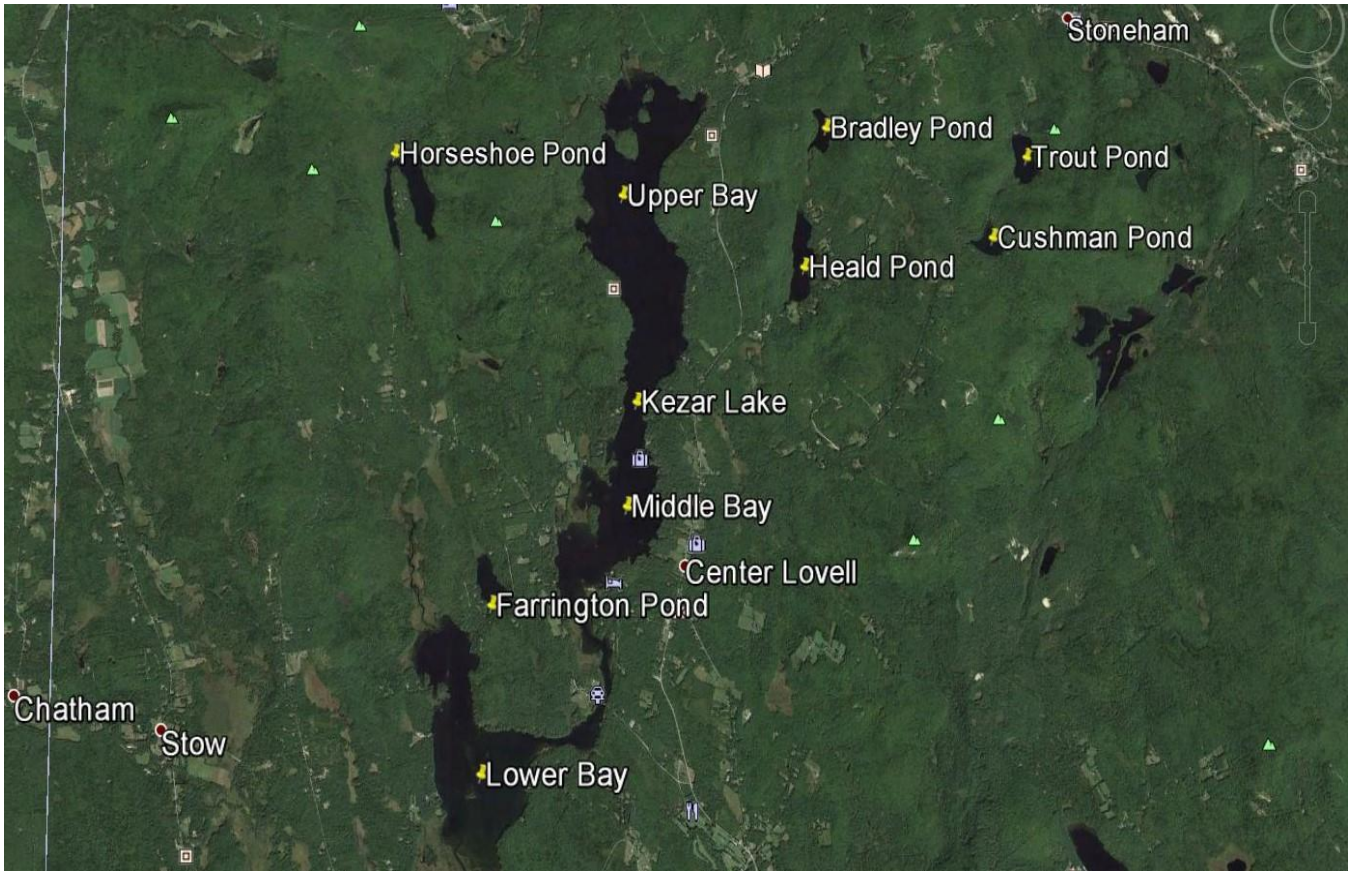

Figure 1. The Kezar Lake watershed study area, 2019. Courtesy of Google Earth Pro.

5.0 METHODS

5.1 GROUND SURVEYS

All known or potential loon territories and surrounding areas were surveyed by LCA and KLWA members, and volunteers, using binoculars and/or a spotting scope. Surveys were conducted by boat, or alternatively from shore. Surveys began in May and concluded in August. Lakes occupied by territorial pairs were prioritized and surveyed 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, defensive posturing, and calling along borders. Territories are used by pairs for feeding, resting, breeding, nesting and chick rearing. They are also protected by resident pairs 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)

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. Adult and juvenile birds were leg banded with U.S. Geological Survey (USGS) 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.

Captured loons were weighed, two second secondary feathers were collected by clipping at the base of the quill, and blood samples were taken from the metatarsal vein for contaminant analysis. All sampling was accomplished using non-lethal methods.

5.4 USE OF NEST CAMERAS

Two battery powered trail cameras (Browning Dark Ops HD Pro, Model # BTC-6HDP) were deployed by KLWA staff in 2019. One camera was used to monitor two nests on Kezar Lake; LB - Outlet River Marsh and MB - Severance West, The second camera monitored the nest on Trout Pond.

The cameras were installed after nest building and incubation was confirmed. They were mounted on a metal pole driven into the bottom of the lake, approximately 10-20 feet from the nest. The cameras were programmed in motion detection mode, with a three-picture trigger and a one-minute delay between triggers. This setting was chosen to preserve battery life and memory.

5.5 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 PRODUCTIVITY

During the 2019 field season, seven lakes were surveyed in the Kezar Lake watershed. Sixteen territorial pairs were recorded occupying six of the seven surveyed lakes. Bradley Pond was the only

water body in the watershed that was unoccupied by a pair of loons. Of the 16 pairs, 12 nested, and seven successful nests hatched 10 chicks; eight survived to fledge. This yielded a nesting frequency of 0.75, a hatching success of 0.83, and chick survival of 0.80. Overall productivity was 0.50 fledged young per territorial pair (Table 1, Figure 2). A total of seven nest failures were recorded with two cases of abandonment (Kezar Lake, LB-Rock Island & UB-Great Brook), four cases of confirmed or suspected mammalian predation, and one unknown (Table 2). The nesting pairs at Kezar Lake, LB-Rock Island, and UB–Great Brook each renested after abandoning eggs. Each pair successfully hatched one chick on the second attempt.

These results included identification of a new territory on Kezar Lake (MB-Vinton's Cove). A nest was found by a local resident who notified LCA and KLWA. Historical information provided indicates this has been a territory for many years, previously unknown to the research team.

There was a high incidence of mammalian predation of nests along the west shore of Kezar Lake, Middle Bay. Both camera images and egg remains confirmed small mammal predation (Figure 3).

Table 1. Common Loon population and productivity, Kezar Lake watershed, 2019.

Population		**Reproductive Success**	
Territorial Pairs	16	Nesting Frequency	0.75
Nesting Pairs	12	Hatching Success	0.83
Chicks Hatched	10	Chick Survivorship	0.80
Chicks Surviving	8*	Overall Productivity	0.50*

* In November there was a quick freeze in the lower basin of Kezar Lake. Several loons (age unknown) were trapped for a period of time in open pockets of water. One successfully flew off. During this time an aerial drone with a camera captured images of two different piles of feathers and bones from large birds, species unknown. It's possible, and even likely that these remains were from loons killed by bald eagles foraging in the area. If they were 2019 chicks, overall productivity would be reduced.

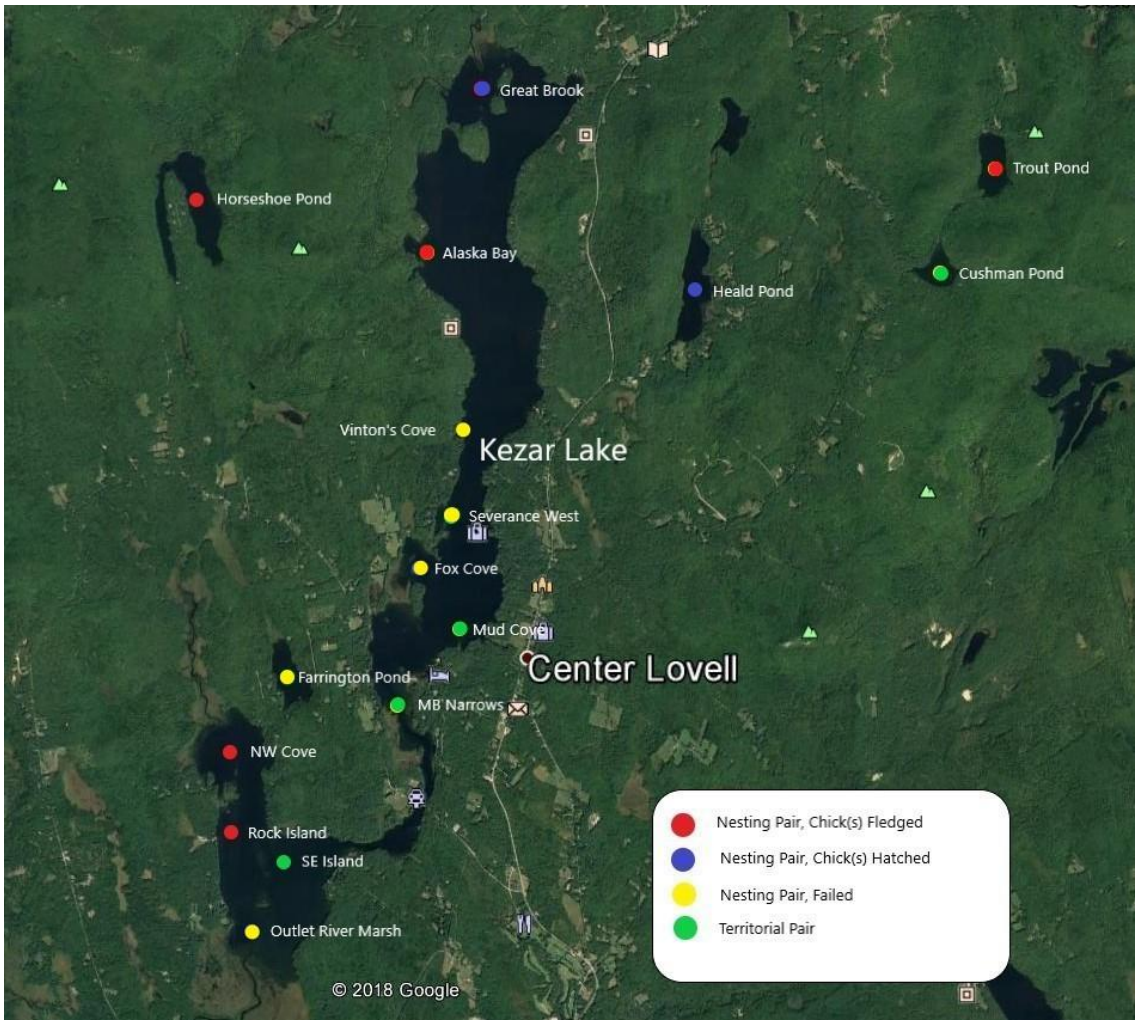

Figure 2. Common loon population and productivity, Kezar Lake watershed, 2019. Courtesy of Google Earth Pro.

Table 2. Productivity and nest failure by lake/territory, 2019.

Lake Name	Territory	TP*	NP*	CH*	CF*	NF*	Cause of Nest Failure
Kezar Lake	LB - NW Cove	Y	Y	2	2	0	
Kezar Lake	LB – Rock Island	Y	Y	1	1	1	Abandoned - Black Flies
Kezar Lake	LB – Outlet River Marsh	Y	Y	0	0	1	Abandoned
Kezar Lake	LB – SW Island	Y	N	0	0	0	
Kezar Lake	MB - Narrows	Y	N	0	0	0	
Kezar Lake	MB – Blueberry Island	N	N	0	0	0	
Kezar Lake	MB – Mud Cove	Y	N	0	0	0	
Kezar Lake	MB – Fox Cove	Y	Y	0	0	1	Mammalian Predation
Kezar Lake	MB – Severance West	Y	Y	0	0	1	Mammalian Predation
Kezar Lake	MB – Vinton's Cove	Y	Y	0	0	1	Unknown Predation
Kezar Lake	MB – Alaska Bay	Y	Y	2	2	0	
Kezar Lake	MB – Great Brook	Y	Y	1	0	1	Abandoned – Black Flies
Farrington Pond	Farrington	Y	Y	0	0	1	Unknown
Horseshoe Pond	Horseshoe	Y	Y	1	1	0	
Cushman Pond	Cushman	Y	N	0	0	0	
Bradley Pond	Bradley	N	N	0	0	0	
Heald Pond	Heald	Y	Y	0	0	0	
Trout Pond	Trout	Y	Y	2	2	0	

TP = territorial pair, NP = nesting pair, CH = chick(s) hatched, CF = chicks fledged, NF = nest failure

Figure 3. Mammalian predation, Kezar Lake, MB – Fox Cove, 2019.

6.2 USE OF ARTIFICIAL NESTING ISLANDS (RAFTS)

A total of 10 rafts were floated in the watershed – Kezar Lake (7), Horseshoe Pond (1), Cushman Pond (1), Trout Pond (1). On Kezar Lake, two of the seven rafts were used for nesting (29%), and the raft on Horseshoe Pond was used. The raft on Trout Pond was not used. A total of three chicks were hatched from rafts (30% of total hatches) on these two water bodies. Two of the eight chicks which fledged (25% of total chicks fledged) were hatched on rafts (Table 3).

Table 3. Comparative loon nesting summary: raft vs. natural nests, 2019.

Raft Nests	**2019**	**Natural Nests**	**2019**
Number of Nest Attempts	4	Number of Nest Attempts	10
Number of Successful Nest Attempts	3	Number of Successful Nest Attempts	6
Success Rate	**75%**	**Success Rate**	**60%**
Chicks Hatched from Rafts	3	Chicks Hatched from Natural Sites	7
Total Chicks Fledged	2	Total Chicks Fledged	6
Contribution to Productivity*	**25%**	**Contribution to Productivity***	**75%**

** Percentage of total chicks fledged.*

6.3 CAPTURE AND BANDING

In 2019, a total of eight loons were captured and banded; two adults and four chicks on Kezar Lake and two adults on Trout Pond (Table 4).

Table 4. Common loons captured and banded, Kezar Lake watershed, 2019.

Lake Name	Territory	Band #	Year	Sex	Age*	Left Leg Top	Left Leg Bottom	Right Leg Top	Right Leg Bottom
Kezar	NW Cove	0938-78850	2019	UNK	HY	Yellow Stripe	Green	Green Dot	Silver
Kezar	NW Cove	0649-08855	2019	UNK	HY	Red Stripe	White	Green Dot	Silver
Kezar	Alaska Bay	0649-08853	2019	UNK	HY	Green	Red	Silver	Green Dot
Kezar	Alaska Bay	0938-78831	2019	M	ATY	Yellow Stripe	White	Green Dot	Silver
Kezar	Alaska Bay	1118-15849	2019	F	ATY	Yellow Dot	Red	Green Dot	Silver
Kezar	Rock Isl.	1118-15844	2019	UNK	HY	Red Stripe	White	Red	Silver
Trout Pond	Trout	1118-15842	2019	M	ATY	Orange Stripe	Green	Red	Silver
Trout Pond	Trout	0938-78836	2019	F	ATY	Yellow Stripe	Green	Silver	Red

* HY = hatch year, ATY = adult

6.4 CONTAMINANT ANALYSIS

Results reported here include all samples obtained in 2019. 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. Loons 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. The extremely high Hg category is based on in-field observable impacts on loons and other birds (Evers et al. 2008). The high and extremely high categories therefore have Hg at levels of concern (Table 5).

Table 5. 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 and 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

6.4.1 BLOOD

Blood Hg results are reported in parts per million (ppm) wet weight (ww). Mercury levels in the blood of the four adult loons sampled ranged from 1.633 to 3.947 ppm (ww), and the mercury level in the blood of the three chicks ranged from 0.146 to 0.404 (Table 6). Five of the samples fell within the low or moderate risk ranges for reduced nesting success and lower chick survival. The samples from the adult male and the chick from Alaska Bay both fall into the high range.

Table 6. Results of Hg in blood (ppm, ww), 2019.

Date Collected	Lake	Territory	Sex	Age*	Blood Hg (ppm, ww)
8/1/2019	Kezar	Alaska Bay	M	ATY	3.947 high
8/1/2019	Kezar	Alaska Bay	F	ATY	1.828
8/1/2019	Trout	Trout	M	ATY	2.183
8/1/2019	Trout	Trout	F	ATY	1.633
8/29/2019	Kezar	NW Cove	U	HY	0.287
7/8/2018	Kezar	Alaska Bay	U	HY	0.404 high
7/24/2018	Kezar	Rock Island	U	HY	0.146

* HY = hatch year, ATY = adult

6.4.2 FEATHER

Feather Hg results are reported in parts per million (ppm), fresh weight (fw). Mercury levels in the feathers of the four adults ranged from 11.672 to 18.845 ppm (fw) (Table 7). The levels all fall within the moderate risk range for reduced nesting success. Chick feathers were not sampled.

Table 7. Results of Hg in feathers (ppm, fw), 2019.

Date Collected	Lake	Territory	Sex	Age*	Feather Hg (ppm, fw)
8/1/2019	Kezar	Alaska Bay	M	ATY	16.930
8/1/2019	Kezar	Alaska Bay	F	ATY	11.672
8/1/2019	Trout	Trout	M	ATY	16.080
8/1/2019	Trout	Trout	F	ATY	18.845

* ATY = adult

6.5 BANDED LOON REOBSERVATIONS AND RECOVERIES

Loon banding efforts began in 2017 on Kezar Lake. In 2019, all of the adult loons banded in 2017 and 2018 (nine) returned. All nine banded loons occupied their original territories. In four territories where both male and female are banded, pairs remained together (Table 8). There were no recoveries of banded loons from the Kezar Lake watershed.

Table 8. Banded loon reobservations and recoveries, Kezar Lake watershed, 2019.

Lake Name	Band #	Year	Sex	Age*	2019 Return	Original Territory	2019 Territory
Kezar	0938-03351	2017	M	ATY	Y	Great Brook	Great Brook
Kezar	0938-61715	2017	U	HY	N	Alaska Bay	NA
Kezar	0649-08855	2018	M	ATY	Y	NW Cove	NW Cove
Kezar	0938-78850	2018	F	ATY	Y	NW Cove	NW Cove
Kezar	1118-15844	2018	M	ATY	Y	Rock Island	Rock Island
Kezar	1118-15849	2018	F	ATY	Y	Rock Island	Rock Island
Kezar	0938-78831	2018	M	ATY	Y	Fox Cove	Fox Cove
Kezar	1118-15849	2018	F	ATY	Y	Fox Cove	Fox Cove
Horseshoe	1118-15842	2018	M	ATY	Y	Horseshoe	Horseshoe
Horseshoe	0938-78836	2018	F	ATY	Y	Horseshoe	Horseshoe

* HY = hatch year, ATY = adult

6.6 RESULTS OF NEST CAMERAS

The camera at Kezar Lake, Severance West captured images of a Raccoon who flushed the incubating adult the night of July 1, and consumed the eggs (Figure 4). Field observations indicated these loons were incubating as early as June 13, but eggs weren't laid until much later (false incubation). The raccoon actually visited the nest and it was initially believed there were two raccoon predations. This camera allowed researchers to correctly determine there was only one.

Figure 4. Raccoon egg predation, Kezar Lake/MB - Severance West, 2019.

The nesting pair at Trout Pond faced threats from predators, as well. The camera captured images of a mink visiting the nest the night of July 5, causing the incubating adult to leave the nest (Figure 5). The eggs survived this threat.

Figure 5. Mink threat Trout Pond nest, 2019.

Despite the mink threat and several other disturbance threats, the Trout Pond nest hatched two chicks the morning of July 11 (Figure 6).

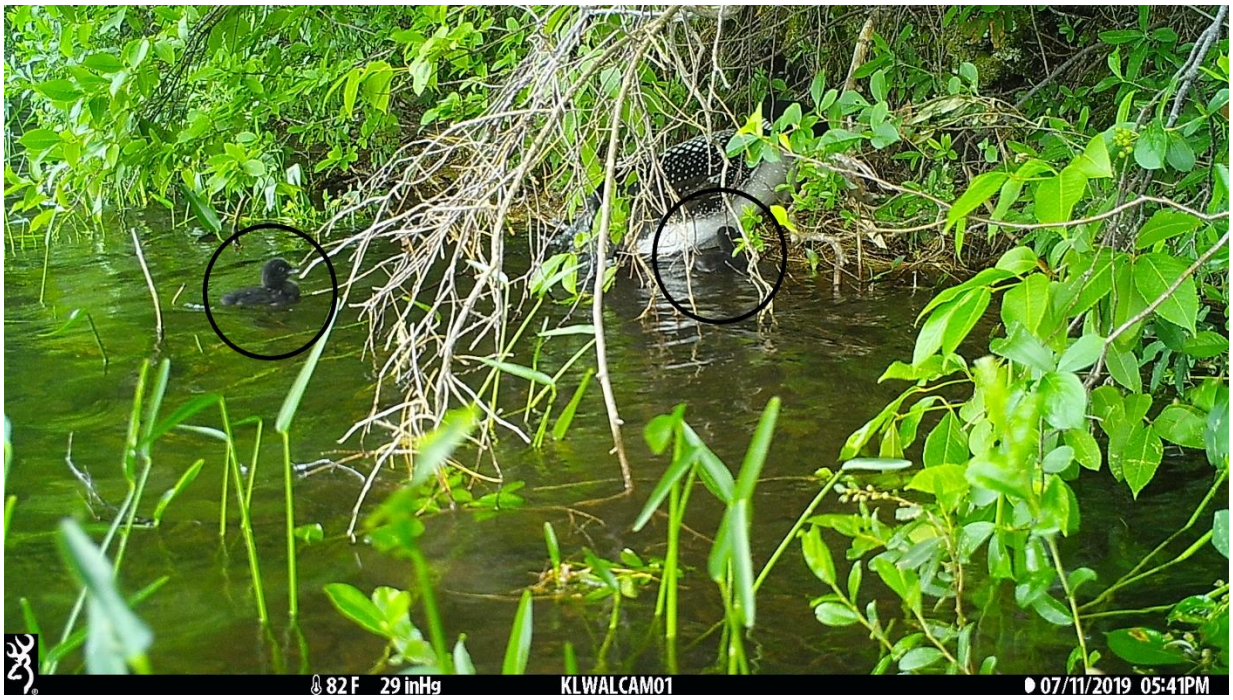

Figure 6. Two chicks in the water, Trout Pond, 2019.

7.0 DISCUSSION

In 2019, six of seven lakes (86%) in the Kezar Lake watershed were occupied by loon pairs, equaling the population occupancy from 2018. This high occupancy rate demonstrates a strong breeding base in numbers, with potential to sustain a healthy breeding population. Bradley Pond in Lovell remained the only lake unoccupied by a pair of loons, although it has an adequate fish population and good nesting habitat. Vinton's Cove in the Middle Bay of Kezar Lake was a new territory identified by the project.

May and early June found abundant black flies in the watershed. Swarming black flies kept loons diving and distracted, and likely caused abandonment of loons nesting on rafts and delayed nesting. Traditional shoreline nest locations were unavailable due to the high water levels, and this likely caused delayed nesting, as well. Nest activity picked up significantly the week of June 10, which coincided with the die off of black flies, and somewhat lower water levels.

Peak nesting occurred between June 10 and July 15. During that period water levels continued to decline, and flooding was not a threat to natural nests. Twelve of the 16 pairs (75%) in the watershed nested. There were a total of 14 nest attempts. Seven of these nest attempts failed (50%). Predation was the cause of four nest failures, with two cases of abandonment, and one unknown failure. These findings indicate there is a robust population of natural predators, and close monitoring of nest disturbance in future years is extremely important.

The 2019 productivity of .050 CH/TP is slightly above the established sustainable population threshold of 0.48 CH/TP, and significantly better than 2018 CH/TP of .035. It's important to note that loon productivity is subject to significant year-to-year fluctuations, and one year is not indicative of

longer-term trends. Multi-year studies, typically no less than five years in duration are required to adequately begin to assess the population status.

Ten artificial nest platforms (rafts) were initially introduced in the watershed in 2014, with the hope of increasing nest productivity. In 2014 – 2017, none of the rafts were used. Three nesting pairs used rafts in 2018, and the same three rafts were used in 2019. Two of these pairs were successful hatching chicks. In addition, loons were observed on the raft at Cushman Pond, and a nest bowl was formed on the raft at Kezar Lake, MB - Fox Cove, indicating loons were likely on that raft. This is a positive sign for getting more rafts used by the population in future years. Rafts eliminate the threat of nest failure due to fluctuating water levels and reduce the threat from mainland predators. These results clearly demonstrate the value of rafts in boosting the productivity of nesting loons.

Samples analyzed for Hg contamination showed high levels of mercury in the adult male and chick occupying the Kezar Lake, MB – Alaska Bay territory. Prior research has shown possible negative impacts on reproduction at these levels. Short-term results from this study do not demonstrate any apparent negative impacts on reproductive success. The individuals with the highest mercury (Alaska Bay, male & Great Brook, male) have each hatched and fledged a chick(s) two of the last three years.

Inexpensive trail cameras have proven to be a valuable tool to document the events and behaviors during the incubation period of nesting loons. Depending on individual circumstances, they are usually installed after incubation has begun, and they are tolerated without any negative impacts or recorded cases of abandonment. In 2019, both cameras provided valuable evidence of nest events, including; egg laying, predation, disturbance and successful chick hatching. If more cameras are purchased and utilized in the future, causes of nest failure can be monitored more closely, possibly leading to future conservation actions designed to reduce the number of nest failures.

In its second year, this project demonstrated the effectiveness of collaboration between trained professional researchers and volunteer citizen scientists. Following successful models in other regions, researchers train volunteers who perform field surveys both independently and jointly. This unique partnership allows for the development of sustainable conservation efforts, and 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 2019:

- 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.
- Focus on band return identification to verify color-marked individuals have returned, the status of territory fidelity, and individual productivity.
- Expand the use of nest monitoring cameras, as circumstances allow.
- Further develop the engagement and skills of citizen science volunteers and seek to expand the volunteer base.
- Continue to capture and band loons through traditional night capture of pairs with chicks.
- Maintain ongoing monitoring of contaminants (Hg & Pb) and look for avenues to include cyanobacteria testing as part of routine health evaluations.
- Continue to engage and inform the local community about loons in the watershed through all available media.

- Continue strategic use and monitoring of artificial nesting platforms (rafts). Focus on locations where territorial pairs have been confirmed for multiple years, where a raft has a likelihood of enticing successful nesting. Review nesting platform locations, annually, and make strategic relocations as circumstances dictate. Specifically; move a raft to Vinton's Cove, and place it near the 2019 nest site, improve vegetation and cover on many rafts, especially Kezar Lake, MB - Fox Cove, and Cushman Pond rafts.

9.0 ACKNOWLEDGMENTS

LCA wishes to acknowledge the Kezar Lake Watershed Association and its members, and especially Heinrich Wurm, and all the dedicated volunteers who passionately gave hundreds of hours of volunteer time to help make this project a huge success in its first year.

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