<u>Loon Mortality on Bob Lake Community Based Research Project</u>
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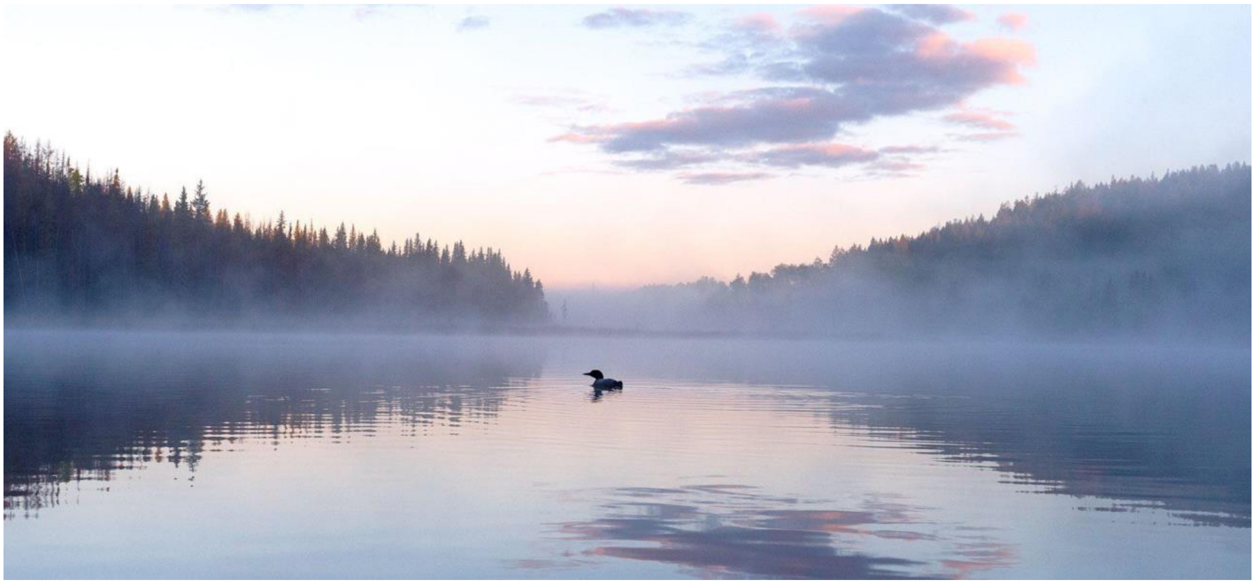

(Devokaitis, 2018).

Loons are an iconic image of Canada, if not especially Ontario. The common loon is in decline across all of Canada, due to a multitude of factors. Ecologically, loons are an important indicator of overall ecosystem health. They are a top-level predator that requires clear, clean lakes.

Introduction

Bob and Little Bob Lake are located just west of Minden, Ontario in Haliburton County. It is home to approximately 230 cottages and is considered “at capacity”. While most people visit throughout the year there are some permanent residents (Pyke, 2021). Both lakes feed into Gull Lake and are part of the Gull River watershed (The Gull Lake-Lake Plan Steering Committee, 2015). In recent years residents of these lakes have noticed a decline in loon chicks. While there are breeding pairs, very few chicks have been seen in the past couple of years leading residents to believe there may be an underlying issue.

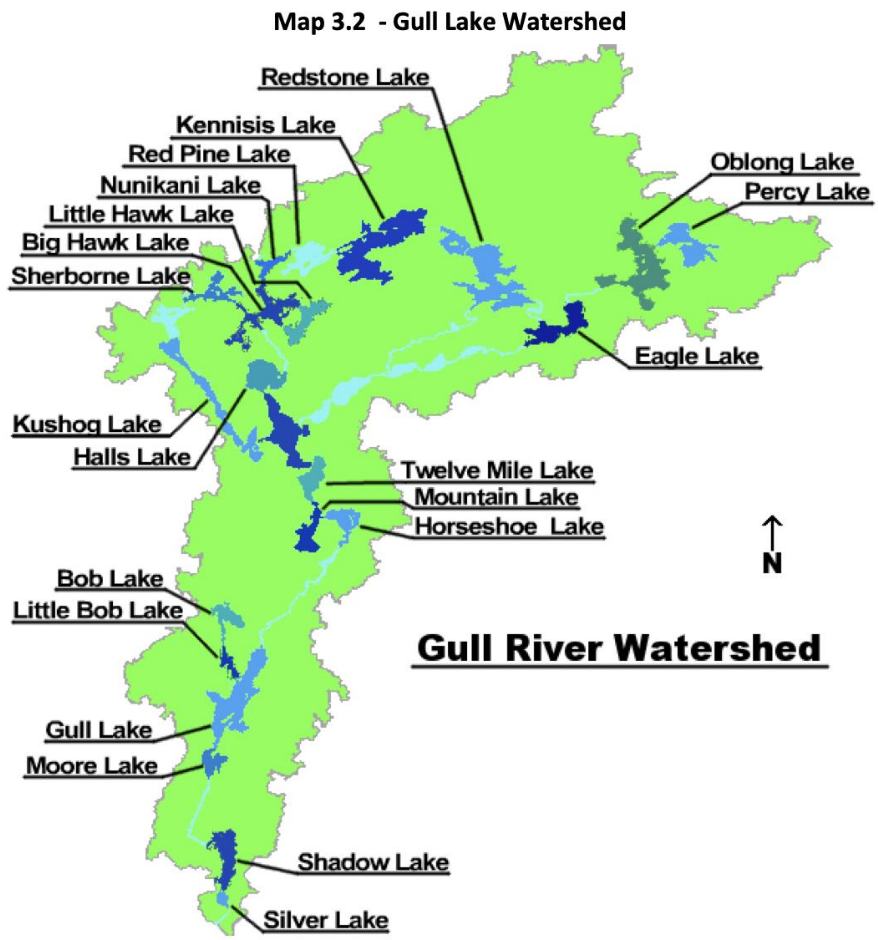

Figure 1: The Gull River Watershed.

Figure 1 displays the Gull River watershed which Bob and Little Bob Lake are part of. It is located in the upper reaches of the Trent River drainage basin. Each of the lakes upstream from Bob and Little Bob are controlled by a stop log outlet structure which the Trent Severn Waterway (TSW) controls to manage water flow in the Gull River and ultimately the Trent Canal. A significant tributary draining into Gull Lake is Bob Creek which drains through Bob and Little Bob Lake (The Gull Lake-Lake Plan Steering Committee, 2015).

What is the reproductive life cycle of loon communities?

Breeding

Loons live up to 30 years, usually mating for life or with a few partners (Burnett, 2022). Male and females build their nest over the course of a week in May/early June. If a bachelor male wishes, he may challenge the resident male for territory and, if wins, will acquire territory and mate. If a mated pair can defend their territory, they generally remain together for many years (Cornell Lab of Ornithology, n.d.).

Migration

Common loons will spend November to March in saltwater habitats close to the Pacific and Atlantic coastlines of North America. Their wintering range includes Newfoundland, the Aleutian Islands, The Gulf of Mexico, and Baja California. Spring migration starts in March and goes until June, with the biggest movements happening in April. The Great Lakes region sees a peak in loon migration in April. They often migrate in stages and will stop at larger lakes in the Great Lakes region (Similuk, 2020).

Hatching

Then the female will lay one or two eggs, taking about 4 weeks to hatch in late June or early July. Once hatched, the chicks are able to swim immediately and usually prefer to stay on the back of a parent in the water rather than in the nest. Hatching also occurs as a staggered event, with the first chick taking priority from the parents. The second chick is more of an insurance marker, should something happen to the first chick. It is not uncommon for the second chick to die, be eaten, or pestered by its sibling. After riding on their parents' backs for about two weeks, they begin to dive and develop independence. At four weeks they can hunt their own food and can be left alone by mom or dad. At 12 weeks they have fledged, are completely independent of their parents, and have the ability to fly for the upcoming Winter migration.

(Cornell Lab of Ornithology, n.d.; Bianchini et al, 2021, Loon Survey; Burnett, 2022).

Table 1. Nesting Facts from The Cornell Lab of Ornithology

Clutch Size:	1-2 eggs
Number of Broods:	1 brood
Egg Length:	3.5-3.5 in (8.8-9 cm)
Egg Width:	2.2-2.2 in (5.5-5.7 cm)
Incubation Period:	26-29 days
Nestling Period:	2 days
Egg Description:	Brown with dark splotches.
Condition at Hatching:	Covered with down, sooty black with a white belly. Able to swim and ride on parents’ backs within hours of hatching.

<u>What are optimal conditions for loon habitats and nests?</u>

Habitat

Common loons live across most of Canada except for southern parts of the prairie provinces, the high Arctic, and the most heavily populated areas of the south. During the breeding months which are April to October, loons can be found in open wetlands to Boreal lakes, they prefer lakes that are 24 ha or larger in size and wetlands of at least 10 ha of open water so they have higher chances of attracting a partner. Loons also require clear water since they rely heavily on their eyesight for hunting fish. They also prefer lakes that are dotted with small islands and have irregular shorelines with coves (Similuk, 2020). When looking for a nesting location the male loon will select the resting site. They look for a protected, quiet, hidden spot of a lakeshore. Since loons can not walk on land well nests are built close to a bank often with steep drop off that will allow the loon to access the nest from underwater. The male and female loon will build the nest together in May or early June and it typically takes them a week. The nest is created by compiling dead plant materials such as marsh grasses that grow along the shoreline. Once finished one of the loons sits on top of the nest and shapes the interior to the contours of its body. The finished nest is about 22 inches wide (Cornell Lab of Ornithology, n.d.).

<u>What is their food source? Is it abundant or affected?</u>

Diet

Loon diets consist primarily of fish, specifically perch and sunfish in north lakes (Cornell Lab of Ornithology, n.d.). They also consume yellow perch, pumpkinseed, and bluegill because their erratic swimming style is easier for the loons to catch (Loon Preservation Committee, n.d). Loons typically eat fish that are 10-70 grams, with adults eating approximately 2 pounds of fish daily. Small fish are an important food source for chicks and without them, these chicks are less likely to survive and leave the lake (Similuk, 2020). However, if fish are scarce or the water is too murky to fish then loons will feed on leeches, snails, insect larvae, and crustaceans (Cornell Lab of Ornithology, n.d.).

Loons hunt by catching fish underwater but if particularly large (250-300 grams occasionally) they will impale the fish numerous times before attempting to swallow it (Adirondack Center for Loon Conservation, n.d.). They feed their chicks small minnows, sunfish, crayfish, and other small organisms until they are old enough to catch small prey at 4-6 weeks old. By the time they are juveniles with immature feathered plumage, they can eat fish up to a few inches in length.

<u>Do loons have predators? When do they experience predation, and by which animals?</u>

Predators

Loon eggs: Bears, crows, ravens, eagles, gulls, and racoons.
Chicks: Bald eagles, snapping turtles, large fish (eg. Bass), and other loons.
Adults: Bald eagles, ospreys, and occasionally otters.
(Adirondack Center for Loon Conservation, 2022).

<u>Positive Indicators</u>

Eagles and Cormorants

Sometimes thought to be a problem, there is actually a positive correlation between Eagle and Cormorant presence and the number of six-week-old loon young survival. Lakes with Bald Eagles and Double-crested Cormorants provide better breeding habitats for loons, most likely due to high numbers of fish.
(Bianchini et al, 2021, Loon Survey; Adirondack Center for Loon Conservation 2022).

<u>What are threats to loon habitat and mortality, for both adults and eggs/chicks? (e.g development, human communities, pollution, predation)?</u>

Acid rain

Although acid rain may only be occurring for a short amount of time, its after effects can remain present for decades. Many lakes affected by acid rain can remain too acidic to support acid-sensitive organisms despite restoration efforts. Re-acidification can also occur with variations in lake water levels such as water drawdown which causes the sediments to be exposed and allows for the oxidation of sulphur and metals which are then mobilized into the lake. The issue this poses for loon is the supply of fish. Natural fish recolonization is not possible without linkages between water bodies with fish source populations and previously acidified lakes. Lower fish abundance results in food shortages for chicks and increases chick mortality since fish are an important food source for growing chicks. Therefore loon productivity is impacted by lake acidification as it reduces their primary food source and this is even more devastating on small lakes which support fewer fish (Bianchini et al, 2021, Loon Survey).

Mercury

This is a toxic metal that alters the animal's behaviour, increasing lethargy and resulting in less defence of territory, incubating eggs, and feeding chicks. Mercury affects chicks by creating weaker immune systems, making them worse at avoiding predators and taking fewer energy-saving rides on the backs of adults (Bianchini et. al. 2021).

Mercury has 3 major forms, with methylmercury being the one of most concern. The negative effects of mercury are increased when waters are more acidic, through a process called 'methylation" (this is because more methylating bacteria are more abundant & active in acidic waters). Therefore, the increasing acid rain and climate change effects will play an important role in how mercury is transferred throughout the environment in the future (this information comes from a conversation with Dr. Brendan Hickie).

Mercury can enter water bodies through the combustion of fossil fuels that make its way into lakes and runoff as atmospheric deposition (rain, snow, dry particles), or from direct sources of industrial waste, mining or naturally occurring from rock weathering (Water Science School, 2018; Bianchini et al, 2021, Loon Survey).

Studies have also shown that mercury concentrations increase due to artificial dams, which is a relevant characteristic of Bob and Little Bob Lake (Ecke, et. al., 2017). This is because these impoundments enhance microbial activity and oxygen depletion (Roy, et. al., 2009). Higher methylation rates occur due to increased bacterial activity promoted by the submersion of organic matter (Roy, et. al., 2009). Many studies have found that beaver ponds affect concentrations of organic carbon, mercury, biota, sediment and hydrological properties, all of which are comparable to artificial dams in terms of effects (Ecke, et. al., 2017). In some cases, artificial dams may have stronger effects when it comes to aspects such as migrating fish as they are permanent, while beaver dams are frequently damaged or destroyed (Ecke, et. al., 2017).

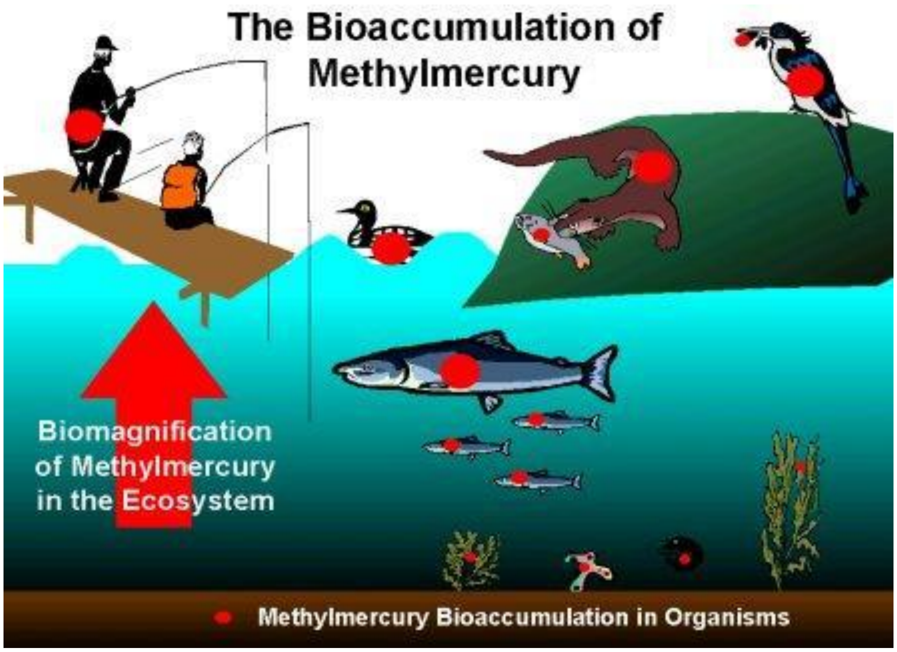

Figure 2. Bioaccumulation of Methylmercury diagram (Environment and Climate Change Canada, 2013).

The largest reason for the increase in mercury is most likely due to atmospheric emissions from East Asia that offsets the reductions that North America had made since the 1970s (Gandhi, et. al., 2015). The United Nations Environment Programme (UNEP) has been working on this issue since 2003, attempting to negotiate with nations. The Minamata Convention on Mercury from 2013 is one such example of a global effort to reduce mercury emissions, although it was hardly set into place by 2015, as many global efforts take time (Gandhi, et. al., 2015).

<u>Trends of Mercury:</u>

One study from 2015 projected that in Ontario, mercury levels are set to rise significantly by 2050. This study demonstrates that the following fish will have particular increases in mercury:

- 60% to >98% for Walleye
- 44% to 59-70% for Northern Pike and,
- 70% to 76-92% for Lake Trout (Gandhi, et. al., 2015).

Although not the direct food source of loons, it is important to remember that loons are also consuming smaller fish that these fish also consume. For example, Walleye also consume white and yellow perch, so then the bioaccumulation will be of similar value (Ontario Walleye Fishing, 2017). Although these projections are quite terrifying, I checked with a professor of environmental chemistry here at Trent (Dr. Brendan Hickie) and he said that these can be fairly inaccurate predictions.

Rather, it may be more relevant to look at other sources which have found that mercury levels have plateaued in Loon populations after 2010 when emissions reduced, with a bit of a 'lag time' so to speak between the emission decrease and decrease in Loon populations. This study looked at male and female Loon blood and feathers across 116 lakes from 1998-2016, finding that these populations have benefitted from control of mercury emissions, although there was a large 'lag time' (Schoch, et. al., 2019).

Water levels

Loons are sensitive to fluctuations in water levels since they build nests within 50cm of the water's edge and 7cm - 10cm above the water's surface at the initiation. Therefore sudden or large increases in water levels cause nest flooding; leading to chilled eggs, failed hatching, and nest abandonment (Adirondack Center for Loon Conservation, 2022). A decrease in water levels can also create a larger distance between the nest and the shoreline which exposes obstacles and steep slopes that affects the success of the nest. It can also create sharp veritcal raises to the nest which often results in nest abandonment. Loons occupy their breeding territories in late April to early May and will begin creating their nest but they will delay nest building until fluctuating water levels allow access to their traditionally used nest site. Nesting loons can respond to gradual fluctuations such as ≤15 cm over several days, by building up the edges of the nest with more material (Windels et al, 2013).

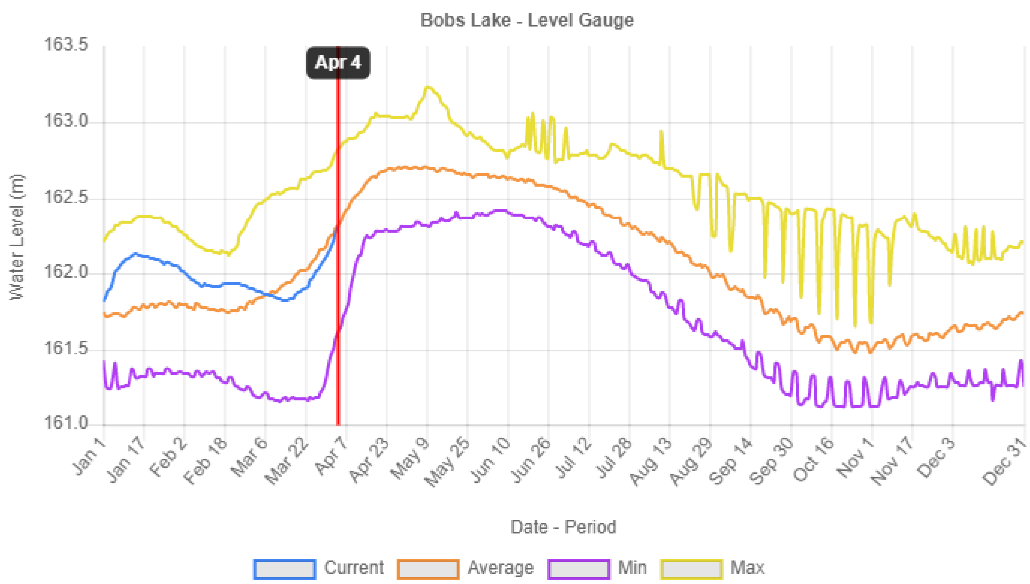

Figure 3: This line graph shows the current, average, minimum, and maximum water levels (m) for Bobs Lake in 2023 so far and predicted (Greater Bobs and Crow Lakes Association, 2023).

Bob and Little Bob Lake are located on the Trent-Severn Waterway system in which the water levels are constantly changing. Parks Canada is responsible for releasing the water through the Bolingbroke dam at the northern end of Bobs Lake. Therefore Parks Canada provides water level monitoring data on the lake (Figure 3) which is updated daily. This site can be accessed here: https://bobsandcrowlakes.ca/water-levels/ and can be used to monitor water levels and compare with loon behaviour on the lake.

Currently, in the spring when ice is about to go out, the water levels are typically fairly low. Residents will put logs in the dams of feeder lakes in order to raise water levels and pull ice away from the shoreline.

If the spring time is rainy and water needs to be slowed down to assist with high water levels further down the water chain then the water rises significantly where the logs were put. In mid-May full logs are put in the water and levels rise even further. Since Bob and Little Bob lakes are feeder lakes the water must be kept high in order to feed water into the Trent system and provide water for the locks.

Before the second Gull River flooding a number of years ago, more logs were put into feeder lake dams and down the chain as soon as melt began to raise water levels. It is speculated that the practice has changed to offset personal property damage caused by ice melt and ice damns. Residents on the lake have observed that loons would come to lay eggs when the water was at its highest and therefore would not get flooded out later as water levels did not fluctuate to heights so late as they do now (B. Brouwers, personal communication, March 15th, 2023).

Early Spring Temperatures

According to CLLS data, cooler April temperatures result in fewer young per pair than warmer temperatures. This is most likely due to blackfly abundance and ice-off timing.

-Ice-off timing

When ice lasts longer it forces loons to arrive later and shortens their breeding season. This can also affect fish abundance (due to the suffocation of fish from less dissolved oxygen).

-**Blackflies**

With cooler temperatures, streams where blackflies hatch take longer to dry up and therefore create more blackfly abundance, while also increasing the lifespan of the adults. The “Loon Black Fly” (*Simulium annulus)* feeds almost exclusively on loons when they are incubating their nests and can be so bad that it forces them to abandon their site. Some may successfully re-nest later in the season but it lowers productivity. (Bianchini et al, 2021, Loon Survey).

Lead

Loons typically ingest lead through the consumption of a fish that has the tackle still hooked within it. This lead is degraded by the loon’s gizzard, then passes into the bloodstream and organs, poisoning the bird (*Lead poisoning in Loons*, n.d.). Within Canadian waters, an estimated 125-187 million lead sinkers are deposited annually, with about half of this in Ontario. Of 215 dead loons collected in Canadian waters, 23% died from lead poisoning (Twiss & Thomas, 1998). Most articles on Ontario loon-lead relationships are from the ’90s, while more recent studies from 2017 in New Hampshire, USA have shown that lead is the leading cause of loon mortality (Grade, et. al., 2017). While lead fishing gear is banned within Canada’s national parks and wildlife areas, it is still legal elsewhere (Ministry of Natural Resources, n.d.). An overview of legislation from the 1998 article details that Ontario has the legislative capacity to ban lead and suggests that a nationwide ban should occur under the authority of the Canadian Environmental Protection Act (Twiss & Thomas, 1998).

Human disturbance

- **Shoreline Development:** Increased shoreline development can mean less habitat available for loons to nest on. Development activities on lakes have been implicated in decreased numbers of breeding loons and reduced loon breeding success (Loon Preservation Committee, n.d). While development does effects the loons it is primarily based on the clustering of development areas. It seems that the amount of development is not as important to loons as the placement of these developed areas. The clustering of development on one part of the lake will allow the loons to nest in areas away from human disturbances (Spilman et al., 2014).

- **Fireworks:** The use of fireworks around loon nesting areas has created a concern that these loud displays will cause behavioural impacts on the loons. This could include abandoning nests and/or chicks as well as abandoning the area all together. A study in New Hampshire looked into this and they found fireworks did not cause loon nest failure or abandonment however, this does not mean that it can not happen (Loon Preservation Committee, 2016).

- **Boat wake:** The way that boaters make their way around the lakes can impact loon habitat and hunting conditions by creating two issues: nest flooding and unclear water. Rolling waves created by watercrafts erode the shoreline where loons build their nests and can cause these nests to become flooded which causes the loon to abandon it. Frequent near shore passages by boats are capable of disturbing loons to the point they abandon their nests. These waves also stir up sediment and can create murky water conditions which cause loons to be unable to see underwater and therefore unable to hunt (Eberhardt, 2022).

What can be done?

Calm Boating near Shorelines: Wakes can wash out nests or separate chicks from their parents.

Play smart: Operate play/wake boats only in water that is at least 8 m (24 feet) deep, which helps prevent sedimentation, protect wildlife, and make for a better wake.

Stay away from Loons and other wildlife when on the lake (boats, canoes, kayaks…etc)

Keep natural shorelines (‘natural’ meaning with native wetland plants, the original vegetation..etc).

Be lead-free: Loons consume lead by eating fish that have lead gear still lodged in them. Usually, loons die from lead poisoning as a result. Anglers are encouraged to request lead-free alternatives.

Don’t discard: Many wildlife, including loons, can die from becoming entangled in fishing lines or consuming plastics, metals, tackle…etc. These should be disposed of properly.

Don’t feed nest predators, such as racoons or gulls.

Prevent Water Level Stress: Try to reduce water level changes in the loon breeding season (May to July). High water can flood eggs in late June, or early July. Low water prevents adults from returning.

Environmental Work: Try to reduce acid acidification, air pollution, and water quality issues.

Educate others: Inform lake associations, put up signs in sensitive areas to keep wake down, inform anglers about lead tackle and fishing line debris..etc.

(Birds Canada, & Canadian Lake Loon Survey, n.d.).

Artificial Nesting Platforms (ANPs):

After speaking with many different people, nesting structures do appear to be an option for providing habitat and are currently being done on a number of lakes within the Haliburton region, such as Miskwabi or Winona (there is also a cottage association for these lakes if contacts are desired). A more specific example is the floating loon nesting platform on Lake Kushog in 2014, which was placed due to fluctuating water levels. This worked well until boaters and a kayaker had to be told to stay away because they were causing stress. Signage helped people to understand that even kayaking close to the nest was extremely stressful for the parents. This is important to keep in mind with any nesting platform, as it will only be successful if they are given space.

Loons like to live on clean, clear lakes with minimal disturbance and shallow nursery areas (such as wetlands). If the loons on Bob and Little Bob Lake appear to be losing their nests due to water level changes, shoreline development, or predation then building a nesting structure is a valuable potential solution. Platforms can be anchored to the bottom, but are able to float and change with water levels (Collins, 2015). It is key to remember that these platforms can also make loons *more* visible to predators so it is best to create them in areas with shade or surrounding vegetation, such as the native Blue Flag Iris (Figure 4; Figure 5; Collins, 2015).

Erica LeMoine, Loon Watch Program Coordinator for the *Sigurd Olson Environmental Institute* in Wisconsin suggests that you have 3 unsuccessful years of nesting attempts before making an ANP (Collins, 2015). The following questions provided by this institute can help to determine whether an ANP may not be the best option for Bob and Little Bob Lake:

- Do loons produce chicks on your lake once every 3 years?
- Do your loons successfully nest on a nearby lake?
- Are there natural nesting locations on your lake that could be enhanced?
- Are you unsure about how loons are using your lake (feeding, nesting, etc.)?

(Collins, 2015).

These questions will require research to fully answer and provide the best information on whether an ANP is the best option.

Here are some resources to get you started on learning more about nesting platforms:
Factsheet: https://view.publitas.com/birds-canada-gykxaz9yrrpp/cllsloonplatform-2022-ed/page/1
Guidelines for constructing and deploying an ANP: https://birdscanada.org/wp-content/uploads/2020/02/ConstructionGuidelines.pdf?_ga=2.62229935.246204741.1680448300-1724599211.1680448300

ARTIFICIAL NESTING PLATFORM – Natural plantings camouflage this man-made loon nest, which is anchored in the lake so it doesn't float away.

Figure 4. Example of an Artificial Nesting Platform (Collins, 2015).

Figure 5. Blue Flag Iris. (Minnesota Wildflowers, 2023).

<u>Suggestions for the future:</u>

1. Test mercury levels and detect possible sources: The testing of mercury is much more complicated than simply testing the water. I would suggest that you contact the Water

Quality Centre at Trent University to conduct a more thorough investigation of the mercury content in your lake. Here is a helpful link: https://www.trentu.ca/wqc/

2. Test water acidification and possible sources.
3. Monitor water levels near loon nests; contact government officials on water level adjustments/changes. For more information, here is the contact information for Parks Canada Trent Severn Waterway: 705-750-4900. Email: pc.trentsevern.pc@canada.ca.
4. Test water clarity: A water clarity test is quite simple. You can complete it in three steps using a secchi disk: 1) Lower the disk slowly into the water in a sunny area, not shaded by the boat or by you, letting it drop straight down. 2) Once you can't see it any longer, raise it back up a little bit until you can see it again, and then lower it back to the point where you can't view it any more. 3) Grab rope at the water to mark your spot. Record your readings in meters. Since this is a visual test, round to the closest tenth of a meter (Water rangers, 2022). Now there is no exact measure of what water clarity level loons need. However, this method can help determine if the water is consistently considered unclear then hunting conditions for the loon may not be ideal.
5. Increase awareness of loon population decline: Educating people about an issues can inspire them to help. By educating the residents of these lakes about threats to loons such as litter or boat wake they may be more careful of their actions since they understand how they impact the loons. I would suggest that you apply signage in areas where they are particularly vulnerable, as this has worked on Miskwabi to an extent.

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