FACTORS DETERMINING THE SUCCESS OF COMMON LOON NEST PLATFORMS ALONG THE AGUASABON RIVER, ONTARIO

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ABSTRACT

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When the Ministry of Mines, Northern Development, Natural Resources, and Forestry in Nipigon, Ontario realized that loon nests in lakes surrounding the Aguasabon River were being flooded, they built and placed multiple nesting platforms in Hays Lake, Long Lake, and Aguasabon Lake. The six platforms on Long Lake were monitored annually utilizing two boat surveys, one in June, and one approximately two weeks later in July. Loon sightings were recorded using a handheld GPS unit. Using ArcGIS Pro, I analyzed the area surrounding each recorded waypoint to the Ontario Forest Resource Inventory data surrounding the lake. Land classification (MNRCODE) attribute in FRI, stand tree height, tree species, and area were considered. The analysis determined that loons most commonly nest when water level reaches a stable point within the month of May. Loons are most likely to be sighted in areas surrounded by productive forest dominated by black spruce, poplar, and balsam fir trees. The lack of success observed on the installed platforms is largely based on poor placement and anchoring. Additionally, it is suggested that platforms be placed in areas where loon chicks have not previously been sighted, as loons may be struggling to find suitable nesting habitat within their territory.

Keywords: Forest Resource Inventory, Hays Lake, Long Lake, water levels

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INTRODUCTION

Natural and human driven changes have been impacting habitat for many species for decades. However, it is possible for humans to minimize our impact by creating alternative habitats to increase the chances of an animal's success. Examples include nest boxes, constructed wetlands and other areas that simulate natural habitat and provide a safe space for nesting. Shorelines are especially vulnerable to change. Rapid water rise, natural and accelerated by flow ramping to generate hydroelectricity, can lead to flooding of nesting habitats, which has a detrimental impact on species like the common loon (*Gavia immer*). In the case of the common loon, ramping is also known to negatively impact fish populations, its only prey source.

The common loon is monitored along the Aguasabon River in Terrace Bay, Ontario by the Ministry of Mines, Northern Development, Natural Resources and Forestry (MNRF) as part of the Ontario Power Generation (OPG) Effectiveness Monitoring Program. The river stretches 70 km from Chorus Lake to Lake Superior, with a major OPG hydroelectric generating station at Terrace Bay and several control structures to adjust river flows. The dam caused water level to fluctuate. In 2009, loons were observed being flooded out because of rising water levels, which led to the implementation of a loon monitoring program, wooden platforms that float at the surface of the lake were constructed and installed. These platforms are anchored, but it is possible for them to come loose and disappear as observed in 2015 and 2018. This observation, as well sinking platforms, led to the introduction of new platforms in 2019. The monitoring began in 2012 and is still occurring. This study examines data collected from loon nesting surveys between 2012-2019.

The OPG and MNRF are attempting to determine why loon nesting platforms installed along the Aguasabon River are largely unsuccessful. Evaluating specific habitat features such as water level rise surrounding loon nesting sites along the Aguasabon River is critical to determining influences on successful hatching of loon chicks. The objectives of this thesis are: (1) to describe areas where nesting platforms had the highest success rates, (2) to determine what lakeshore habitats are most associated with sighting adult loons, and (3) to interpret how water level rise might impact nesting. A guiding hypothesis is that egg laying and hatching are influenced by rising water levels and shoreline topography.

LITERATURE REVIEW

The Aguasabon River

The Aguasabon River is a 70 km long river with its terminus in Terrace Bay, Ontario within the Thunder Bay District of the MNRF. In 1945, industrial expansion led to the need for a generating station; the station was originally built by the Hydro-Electric Power Commission of Ontario and opened in 1948, when Long Lake was created. In April of 1999 the station was transferred to OPG (Ontario Power Generation 2007).

The Ideal Loon Nesting Habitat

Various factors influence the selection of a site where common loons will nest. Loons show a high level of fidelity to their breeding territory, with about 75% of pairs occupying the same area yearly. Even when a loon pair moves, it is normally within 7 km of their previous territory, and in the weeks after hatch, juveniles often stay within 18 km of their natal area (Hammond, Mitchell and Bissell 2011). Loons migrate to their breeding territory in early spring, shortly after ice begins melting on lakes. They protect their nesting site by using loud, yodeling calls (Kirschbaum and Rodriguez 2002). Because loons have poor locomotion on land, the location of nesting areas is near water or on islands, typically surrounded by low vegetation to provide cover (Audubon n.d.). Nest success is higher in areas with low visibility and good cover (Titus and VanDruff 1981). Being within 50 cm of the shoreline is optimal for water access so they can find food and easily escape predators; also, being 7 to 10 cm above the water's surface is preferred (Windels et al. 2013). It is also common for loons to build their nests near deep water so they can swim to and from it undetected by predators. Loons are strong swimmers but struggle to walk on land because their legs are so close to the back end of their bodies (Kirschbaum and Rodriguez 2002). Islands are an ideal location for loon nests since they have much lower disturbance and fewer terrestrial predators (Mathisen and McIntyre 1977). When islands are available, they are the preferred nesting location for over 80% of loons (Titus and VanDruff 1981).

Nest Site Selection and Egg Dropping

Nest sites are traditionally selected by the male, but then the nest is built collectively by the male and female (Sjolander and Agren 1972). The nest is built using grasses, reeds, and twigs, and usually the same nest will be restored and used again year after year (Audubon n.d.). Loons will delay nesting until water levels stabilize and they have access to their previous nesting site (Windels et al. 2013). One study found that loons built their nests in a period of 20 minutes, and added to it as needed throughout the incubation period (Sjolander and Agren 1972). Courtship behaviors include bill dipping, where pairs repeatedly dip their bills up and down in the water, wing spreading, and racing each other across the surface of the water (Audubon n.d.). Female loons lay 1 or 2 eggs that are incubated for 26 to 29 days; the eggs are brown with dark brown spots, 8 cm long and 5.5 cm wide (Cornell Lab 2019). Females also play a greater role during the incubation of the egg(s), although at the beginning of the incubation period the male and female take turns incubating with rotations becoming less frequent closer to hatch (Sjolander and Agren 1972). Once hatched, loon chicks remain with the parents for a period of 12 weeks; after the first few days they rarely return to shore but spend the majority of their time swimming, diving, or riding on their parents' backs. Between 8 to 12 weeks, the loon chicks are able to fly and become independent of their parents (Kirschbaum and Rodriguez 2002).

Impact of Water Level and Ramping on the Common Loon

Loon nesting success is heavily determined by changing water levels, and rapid increases in water levels can lead to the flooding of loon nests (Windels et al. 2013). Loons are more likely to nest when water levels are close to their maximum, and nest success increases when water levels are stable. Water level fluctuations are the leading cause of low productivity in loons living in large lakes.

<u>Other Influences on Loon Nesting Success</u>

Other factors that influence nest success include predation from other birds and terrestrial egg predators such as raccoons (*Procyon lotor*). Bird predators include ravens (*Corvus corax*), bald eagles (*Hailiaeetus leucocephalus*), and gulls (Laridae; Windels et al. 2013). Not only are loon nests susceptible to predation by eagles, but even the presence of bald eagles in an area can cause loons to abandon their nests. A study in Wisconsin using nest platforms like those used in the Aguasabon River found that 32% of nest flushes were caused by the presence of bald eagles in the area (Piper et al. 2002). Because loons and eagles share similar breeding habitats, they often have high overlap in distribution (Cooley et al. 2019). In confrontations with minks, which are small, semi-aquatic carnivores, loons have been observed aggressively defending their nest by folding their wings against their body mimicking a penguin dance and pecking the mink aggressively (DeStefano and McCarthy 2011). Due to their defensive nature, nest predation most commonly occurs when loon nests are left unattended, it is believed that the benefit of protecting eggs outweighs the risk of severe parental injury (DeStefano and McCarthy 2011).

Other threats to loons include toxicity of lakes caused by lead and mercury, and human activities like recreational boating and fishing (Piper et al. 2002). Lead poisoning in loons is most commonly caused by shotgun pellets and sinkers, which are weights used to sink fishing lures (Locke et al. 1982). Mercury poisoning in loons occurs when surface runoff enters a lake, leading to the bioaccumulation and magnification of methylmercury as it climbs the food chain. Loons have the ability to demethylate the mercury through filtration in their liver and kidneys, as well as to eliminate it from their feathers (Mitro et al. 2008). In Atlantic Canadian provinces, loons with high levels of mercury had lower reproductive success, and loons in Ontario with high levels of mercury exposure laid eggs less frequently. Because mercury levels vary by location, it can be difficult to measure and compare their effects on different loon populations.

Platform Structures and Success

Loon nesting platforms are artificial nesting areas added to the natural nesting habitat of loons. When built and placed correctly, they can considerably improve the success of nesting loons by providing them a safe place to build their nest and lay eggs (Bird Studies Canada n.d.). Platforms can be constructed with wood or lighter materials such as PVC piping. It is recommended to place platforms where loon chicks have not previously been sighted, because nesting attempts may have been unsuccessful in the past due to absence of safe places. Some of the most important considerations when building and placing loon nesting platforms are buoyancy, anchoring, and habitat suitability. First, if the platform does not properly float due to its being too heavy, changes in water level are likely to cause the platform to sink too far down causing the platform and anything on it to sink, leading to a possible nest failure. Secondly, proper anchoring of the platform is critical because if it comes loose and begins floating away, the loons will likely be forced to abandon their nest. The Canadian Lakes Loon Survey (CLLS) recommends using two cement blocks for anchoring platforms attached at two opposite corners.

The first platform design I reviewed was that of the CLLS. Their recommendation is construction from cedar posts with the bark removed, over which a square sheet of mesh wire fencing is placed. The fencing is secured with galvanized spikes and fence staples, then wire anchor lines are attached to two opposite corners and cement blocks are added for the anchoring. Their recommended design used five cedar posts, four forming a square and one across the centre to increase buoyancy. It is important to place the wire fencing on the bottom of the logs and staple it every four inches, while ensuring there are no sharp ends that may cause injury to birds. When placing these platforms, sheltered areas from wind, waves and boat wake should be located. The wire mesh can be covered with natural vegetation such as grasses, sedges, and moss, with extra material that the loons could use when building their nest. Cinder blocks are ideally placed in water 1 to 2 m deep, and about 36 m from shore.

The next nesting platform design I looked at was made of PVC pipe and the design plans came from the Rideau Canal National Historic Site webpage (Watson n.d.). The PVC nests required 25 feet of 4-inch PVC piping, 4 PVC elbows, 2 PVC T-junctions, adhesive, 3 hardwood slats about 6 feet in length, 1 roll of wire fencing, 6 plastic jugs, well rinsed and not previously containing anything toxic (i.e., windshield washer fluid), 2 concrete blocks and 40 feet of nylon rope. Many of the same considerations were taken into in construction and nest placement as for the CLLS recommended platforms, including finding a sheltered area, but the Rideau Canal recommendation is for placing the platform no more than 18 m offshore (Figure 1). The PVC nest weighs considerably less than a nest constructed using cedar; therefore, they only require nylon rope to anchor to cement blocks.

Figure 1. Nesting platform created using PVC pipe, the cinder block on top is used to test buoyancy (Watson n.d.).

The third platform design I reviewed is like the first design from the CLLS, utilizing cedar logs, wire fencing and vegetation, but the Island Nature Trust in Prince Edward Island took their platforms one step further. Due to the high eagle presence in the area, the group built a mesh arch over the top of their platform to protect the loons from carnivorous birds that would attack from above (Russell 2019). They also placed their platform in an area where it is not visible from the roadway as an effort to further protect the loons (Figure 2).

Figure 2. Loon platform built by the Island Nature Trust on DeRoche Pond in PEI that features a mesh arch over top to protect loon nests from aerial predators (Russell 2019).

Loon Chicks

Loon chicks hatch covered in down and, unlike their parents, they can walk normally on land until about three weeks old. In their early developmental stages, they ride around on their parents' backs, rarely returning to shore after hatching. Once their down feathers dry, they are able to enter the water and swim (Titus and VanDruff 1981). If a loon chick falls into the water prior to the down's drying period, it likely will not survive; this issue sometimes occurs when nest sites are along eroded shoreline. They reach fledging age at twelve weeks old, at which point they can fly and capture fish independently (Kirschbaum and Rodriguez 2002). Chicks younger than two weeks old are classified as young, whereas chicks older than four weeks are considered old.

Parents with young chicks spend a large majority (over 80%) of their time within 20 m of their chicks, and parents with older chicks spend considerably less time within 20 m of them (less than 66%). Parents with young chicks are much more likely to remain close to their chicks when defending them from a predator (Jukkala and Piper 2015). When parents make distress calls indicating a threat is in the area, chicks will often hide along the shoreline vegetation (Strong and Bissonette 1989). After fledging, loon chicks often occupy lakes that resemble their natal territory but must make decisions when choosing habitat between food availability and risk of predation (Hoover et al. 2020).

MATERIALS AND METHODS

The Nipigon MNRF surveys of loon nesting took place between 2012 and 2021, with two surveys taking place each year, except in 2012 and 2015, when only one survey was completed. The surveys were timed with the loon breeding season and aimed to observe loon reproduction by locating nesting territory of adults, then returning to look for adults with chicks. The first survey was often conducted in June, and the second survey was conducted two weeks after, normally in July.

A survey is defined as a boat trip following the south half of the Long Lake shoreline, except in 2016 and 2018 when the north side of the lake was sampled. Two members of the team drove the boat at approximately 60 km/h, stopping when a loon was sighted. They remained about 200 m away from the loon and recorded a waypoint; they also recorded the number of loons, their ages, and whether or not chicks were observed. In all years except 2013, surveys were completed by heading up one side of the lake, then returning down the other (Figure 3). In 2013, a zigzag pattern was used, but the adjusted pattern was ineffective, because all loons were observed along the shoreline.

Due to the presence of a hydroelectric generating station operated by Ontario Power Generation nearby, water loggers were present throughout Long Lake. These water loggers took readings once daily all year long providing an insight to what time of year water levels were changing. In 2013, five nesting platforms were constructed by students at the Terrace Bay High School; three were placed in Long Lake, one on Hays Lake, and one on Aguasabon Lake. In 2019, five more platforms were built.

The data provided by the MNRF included one shapefile for each survey with waypoints representing various species, including loons, loon chicks, eagles (*Haliaeetus leucocephalus*), bank swallows (*Riparia riparia*), and kingfishers (*Megaceryle alcyon*). When the waypoint was marked as either a loon or loon chick the habitat surrounding it was extracted from the dataset. All shapefiles provided by the MNRF represented surveys on Long Lake only; no data was sent from surveys on Hays Lake or Aguasabon Lake.

For each year of surveys, waypoints were numbered from north to south (Figure 6). Around each waypoint, a 500-m buffer was created in ArcGIS Pro using the Buffer tool. Each of the survey shapefiles were displayed with he Kenogami Forest’s most recent Forest Resource Inventory (FRI) data layer, which was downloaded from Ontario GeoHub. A buffer of 500 m was chosen to ensure that the dominant forest type on the surrounding shoreline was captured. A 50 m buffer was also created surrounding the

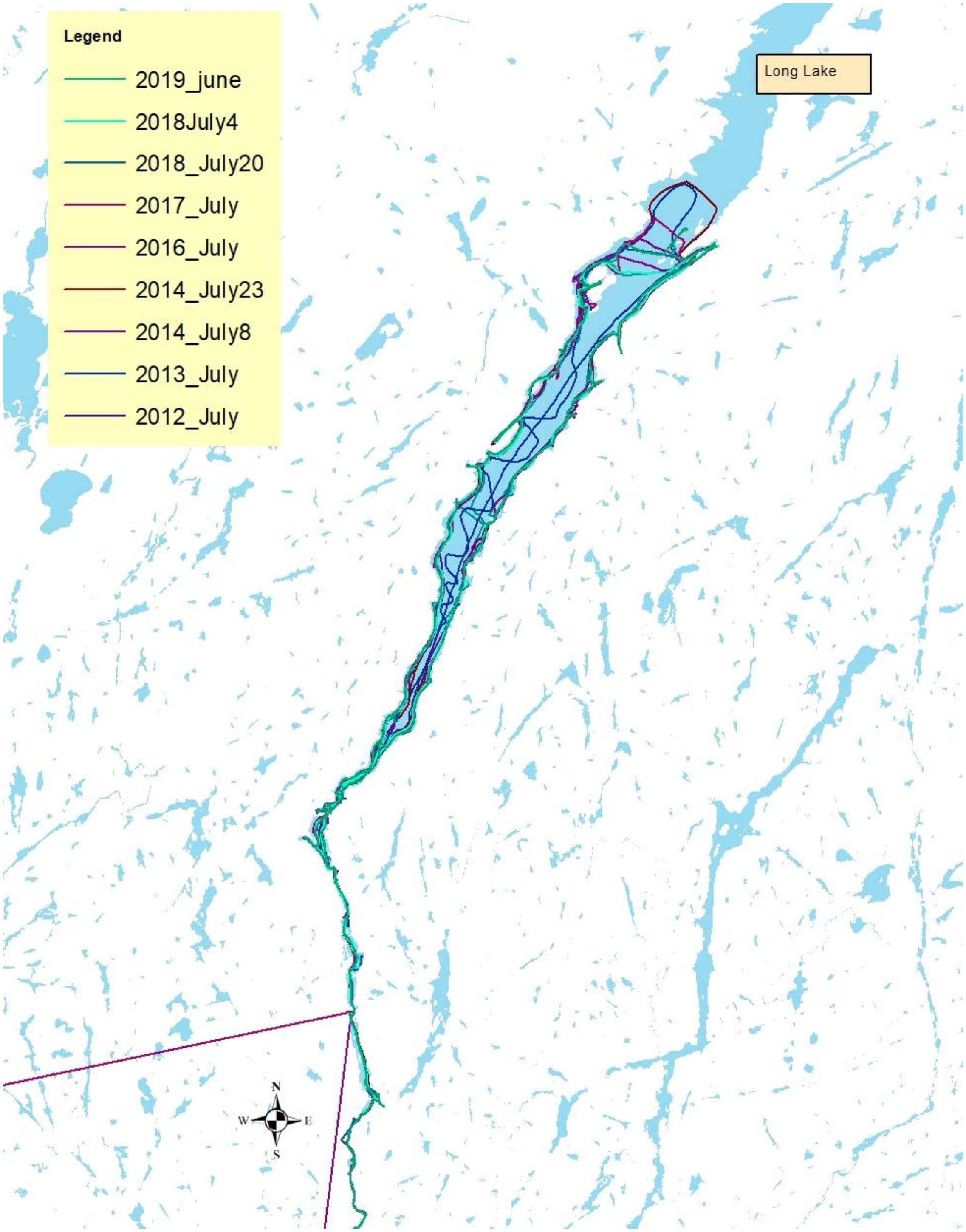

Figure 3. Survey lines for Loons on Long Lake between 2012 and 2019 (Tyhuis 2019).

shoreline of Long Lake, this buffer created a reference area that was used to calculate the percentage of each land classification. For each waypoint corresponding to a loon sighting, the MNRCODE (a land classification), HT (tree height), and SPC (a dominant forest tree species code) were recorded for the dominant polygon within the buffer (Appendix 1). The dominant polygon was the polygon that overlapped the buffer on each waypoint the most. To report the tree records, all loon sightings across all surveys were summed.

RESULTS

Surveys were completed twice yearly except for 2012 and 2015 where only one was completed. Chicks were sighted during surveys in 2012, 2013, 2014, 2016, 2019, 2020, and 2021 (Table 1). Loons were most likely to be sighted in productive forest and on islands; in both cases these are the land classes where loon sightings occurred frequently in the data (Table 2). Two additional loon sightings occurred on rock and unclassified land. Loon platforms along Long Lake were only used once, in 2020 (Table 3). Tree heights around loon sightings ranged from 3 m to 31 m. Species composition for most of the forest surrounding loon sightings was mostly upland spruce, mixed poplar or balsam fir (Table 4). Most of the loon sightings were in close proximity of the shoreline (Figure 6).

The water level data in Long Lake as tracked by OPG water loggers from 2012 to 2020 shows that water level fluctuated between 311 and 313 m. In the year chicks where chicks were successfully sighted water level rose sharply during May, when water level rose early, in April, or late in June chicks were not sighted (Figure 7).

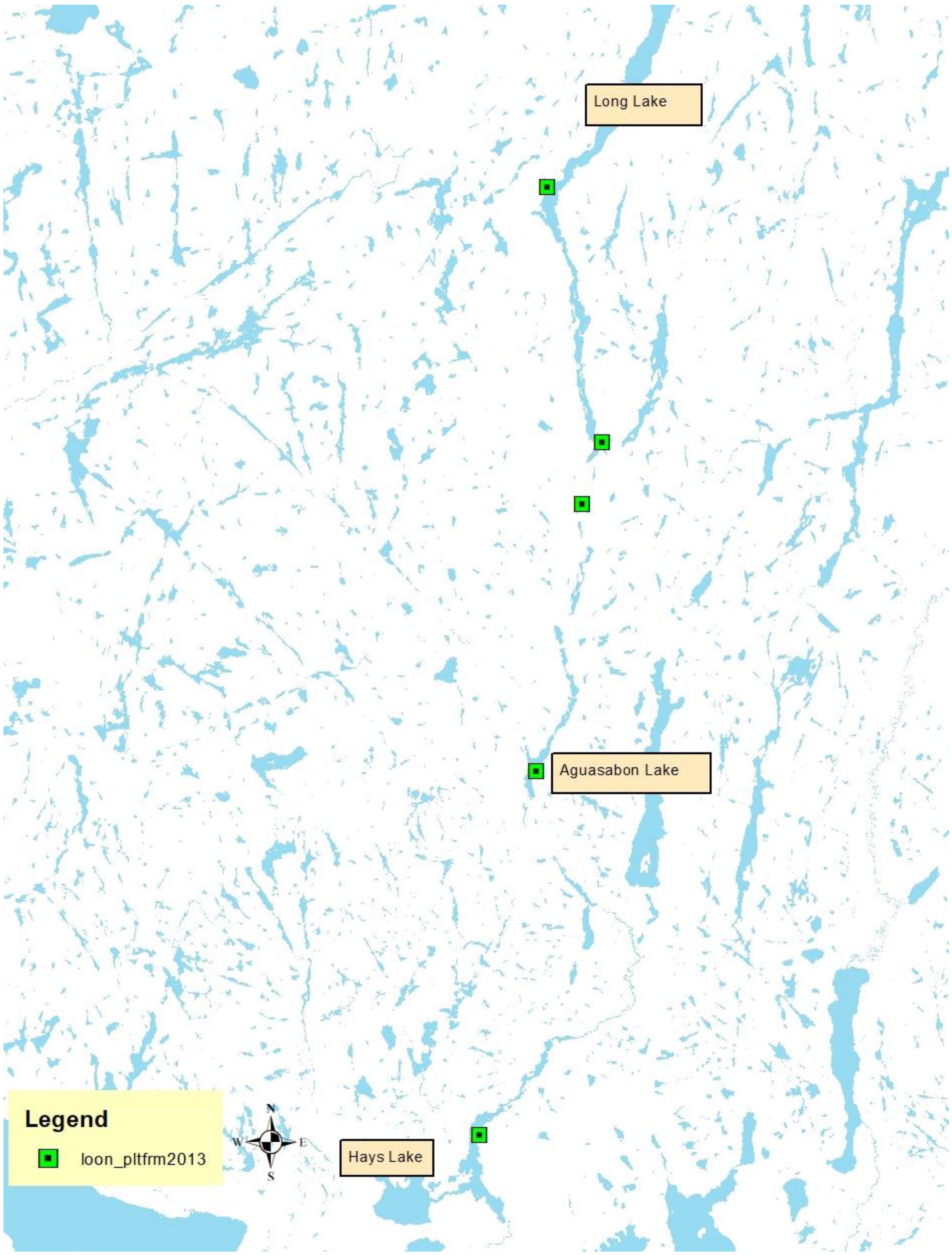

Figure 4 Locations of nesting platforms placed in 2013 (Tyhuis 2019).

Figure 5. Nesting platform on Hays Lake in 2013 (Tyhuis 2019).

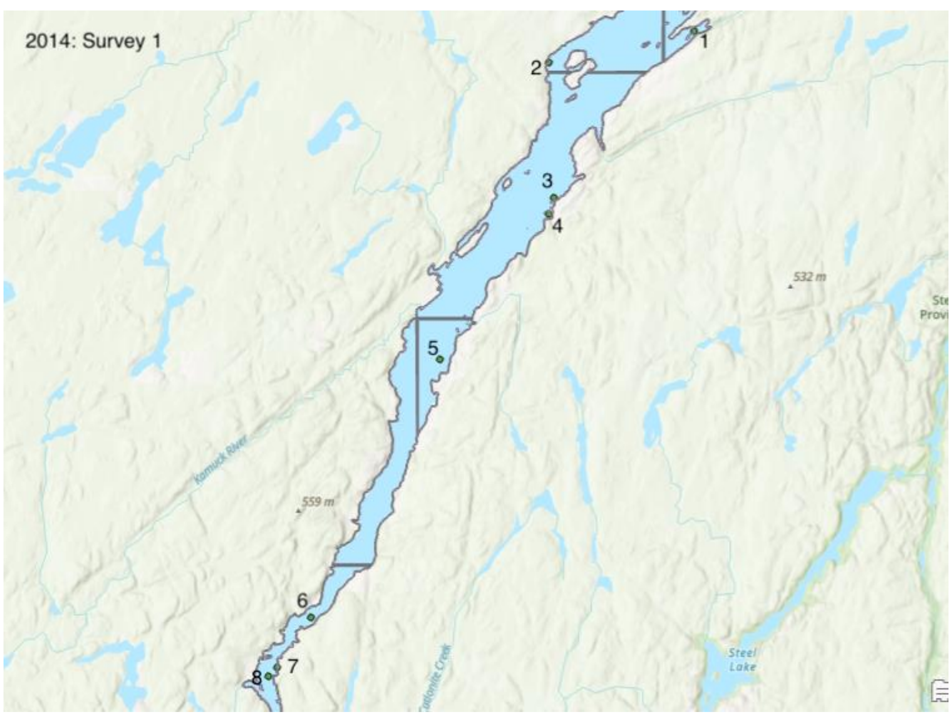

Figure 6. Screenshot showing how the waypoints in each shapefile were numbered from north to south.

Table 1. Survey dates and number of loon sightings on Long Lake (2012-2019)

Year	First Survey		Second Survey		
	Date	Adults	Date	Adults	Chicks
2012	N/A*		20-Jul	18	1
2013	17-Jul	36	09-Aug	28	1
2014	08-Jul	12	23-Jul	21	2
2015	26-Jun	19	N/A*		
2016	29-Jun	5	19-Jul	17	2
2017	23-Jun	23	17-Jul	3	0
2018	04-Jul	3	20-Jul	24	2
2019	27-Jun	2	15-Jul	7	0
2020	N/A*		17-Jul	14	2
2021	N/A*		23-Jul	15	1

*in years with N/A survey was not completed

Table 2. Land classification within the buffered area along the shoreline

Classification	Area (ha)	Percent of reference area	Number of loon sightings	Percent of all loon locations
Island	64	0	4	2
Lake	13632	43	0	0
River	187	1	0	0
Productive Forest	17019	54	152	96
Treed Muskeg	3	0	0	0
Open Muskeg	192	1	0	0
Brush/Alder	71	0	0	0
Rock	44	0	1	1
Unclassified	559	2	2	1

Table 3. Observations of loons by year for the six platforms deployed on Long Lake (Source: Tyhuis 2019).

Platform location	Year deployed	2013	2014	2015	2016	2017	2018	2019	2020	2021
Lower	2013	NO	NO	NO	NO	NO	NO	NO	NO	NO
Catlonite	2013	NO	NO	NO	NO	NO	NO	NO	NO	NO
Lodge West	2013	NO	NO	NO	NO	NO	GONE			
Lodge East	2019								YES	NO*
Halfway East 1	2019								NO**	
HalfwayEast2	2020									NO*

*all material was washed off the platform

**platform came loose and was anchored on shore away from the original site

Table 4. Leading tree species and average tree heights in 500-m buffer areas surrounding loon sightings

Tree species	Loon Sighting Occurrences	Average height (m)
Balsam Fir	34	11.4
White Birch	10	14.3
Cedar	1	11
Jack Pine	10	11.5
Poplar	36	21
Black Spruce	60	15

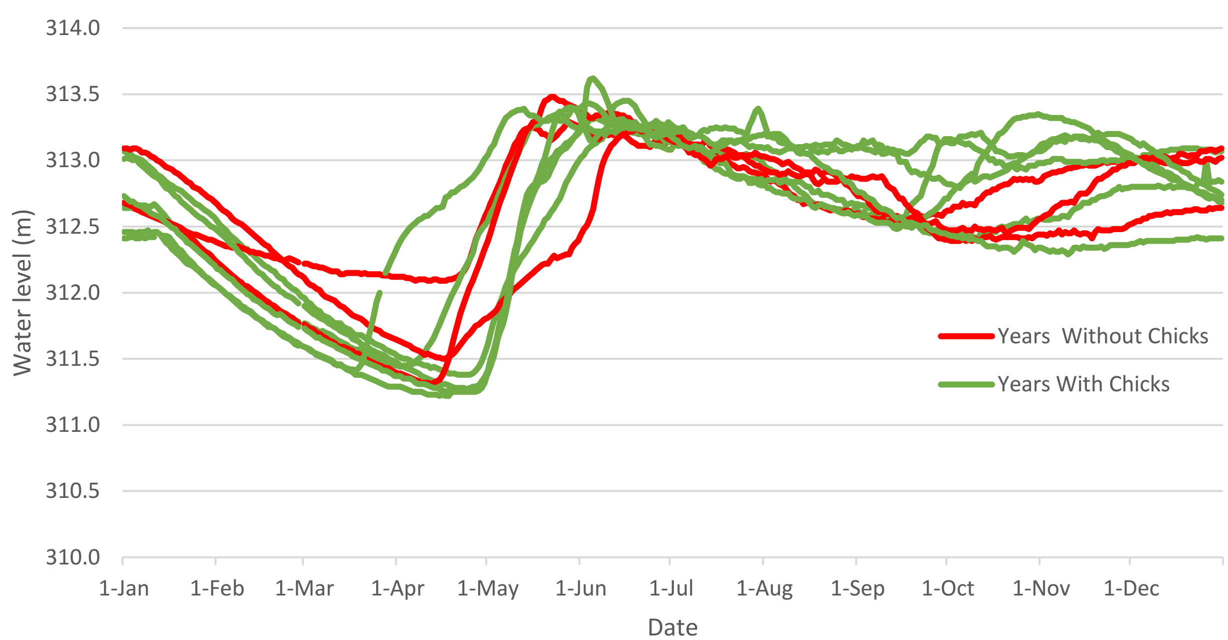

Figure 7. Water levels in Long Lake from 2012 to 2020

DISCUSSION

Loons along the Aguasabon River and smaller surrounding lakes are generally not using the nesting platforms installed by the MNRF. On Long Lake, the six nesting platforms installed have been used only one time. The platforms are failing largely because of poor anchoring causing them to float away, or in the case of the platforms on the eastern part of the lake, they are becoming flooded causing all the vegetation to wash off. Despite the lack of success using the platforms, loons are still successfully nesting in the general area with chicks being sighted during surveys in 2012, 2013, 2014, 2016, 2018, 2020, and 2021. The majority of the loon sightings with chicks fall along or within proximity to the shoreline. This pattern aligns with typical loon habitat and lake characteristics, which allow for search for food in shallow areas, while the deepest part of the lake is normally in the middle (Strong and Bissonette 1989).

The tree species nearest the shoreline most commonly associated with loon sightings were black spruce, white birch, poplar, cedar, jack pine, and balsam fir. Black spruce was the leading species, followed by poplar and balsam fir. A large portion of the habitat surrounding loon sightings is upland spruce forest. Mixed poplar stands were also present surrounding the shoreline, with an average height of 21 m. The presence of tall poplars and black spruce would provide optimal nesting habitat for birds of prey such as eagles that are a threat to loons, but this seemed to have limited impact on the success of sighing adult loons as they make up over half of the leading species surrounding loon sightings.

CONCLUSION

Loons are commonly sighted in areas surrounded by productive forest. However, there was no significant trend in tree height where loons were sighted, as it ranged from areas with trees as short as 3 m, to areas with large poplars over 30 m tall. Observations of eagles seemed to have limited impact on the success of loon chicks in this area.

One of the limitations of this study was the assumptions made when waypoints within a shapefile were unlabelled, additionally, I lacked survey data for parts of some years. Ultimately reviewing this data again when the Kenogami FRI package is updated to include more specific fields would be recommended. Additionally, much of the literature I reviewed suggested placing loon nesting platforms where loon chicks had not previously been sighted, so this could be taken into consideration during future placement of platforms.

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APPENDIX

Appendix 1. Table showing analysis of each waypoint recorded by a handheld GPS unit during MNRF surveys from 2012 to 2021.

Year	Survey	Loon Location	MNR Code	HT	Species	Area
2021	1	1	300	31	PO98 BW1	200108.2075
		2	300	17	SB48 PJ3 PO1	303314.1921
		3	300	11	PJ7 PO2 SB 1	456078.7781
		4	300	23	BW5 PO4 SW1	195772.6070
		5	62	0	N/A	845.508718
		6	300	14	SB4 PO2 BW2 CE1	428253.2071
		7	300	5	PJ6 PO2 BW1 SB1	592416.0739
		8	300	22	PO5 SB2 BW2	209923.7903
		9	300	10	BW5 SB2 SW2	245933.3876
		10	300	19	PO4 SW3 BW2	344397.5102
		11	300	14	SB4 BW3 PO1 SW1	440157.7421
		12	300	14	SB4 BW3 PO1 SW1	440157.7421
		13	300	0	SB0	5029878.14124
		14	300	0	SB0	5029878.14124
		15	300	9	BW8 PO2	28487.1531

2020	1	1	300	14	SB4 PO2 BW1 CE1	428253.207142
		2	300	17	SB4 PO2 BW1 SW1	364066.475085
		3	300	10	BW4 PO3 SB2	436030.1727
		4	300	18	SB4 BW2 PJ2	501160.790428
		5	300	0	SB0	62613263.2687
		6	300	0	SB0 (Upland Spruce)	5029878.14124
		7	Bank Swallow			
		8	Bank Swallow			
		9	Bank Swallow			
		10	Bank Swallow			
		11	Bank Swallow			
		12	Kingfisher			

		13	Bank Swallow			
		14	300	10	SB4 BW3 SW2	524622.5889
		15	300	7	B6 SB4	238653.920543
2019	1	1	62	0		51955.5825
		2	300	17	SB5 SW2 BW1 PJ1 PO1	448185.8488
		3	300	10	PO7 BW2 PJ1	745328.864234
		4	Bank Swallow			
		5	Bank Swallow			
		6	300	0	SB0	5029878.14124
		7	Bank Swallow			
		8	300	0	SB0	5878709.31799
		9	300	30	PO0	348392.776673

		10	Bank Swallow			
		11	300	10	B4 S3 BW2 SW1	524622.588935
	2	1	62	0		11122100.1777
		2	300	23	PO5 SB2 SW1	216760.974512
		3	300	17	SB4 PO2 BW1 SW1	364066.475085
		4	300	22	PO6 BW1 SB1	394724.297619
		5	300	15	PJ6 PO2 SB2	272103.988769
2018	1	1	317	0	Upland Spruce	3101755.90578
		2	Pelicans			
		3	317	0	Upland Spruce	117135.248679
		4	300	12	SB6 PO2 BW1	151392.2272
		5	300	22	PO3 BW2 SB2 SW1	146144.2136
		6	300	19	PJ7 SB3	411377.4841
		7	300	15	SB5 PO3 BW1 SW1	911941.1932

	8	300	23	PO5 BW3 SB1 (Mixed Poplar)	558890.852067
	9	300	18	PO3 SB3 BW2	392194.2081
	10	300	22	PO4 SB3 BW2	416593.837025
	11	300	22	PO5 BW2 SB2 (Mixed Poplar)	660286.6808
	12	300	19	PO6 BW1 SW1	172165.923313
	13	300	14	BW6 PO2 BW1 SB1	268300.0774
	14	300	23	PO5 BW3 SB2	221073.8532
	15	300	10	B4 PO3 BW2 SB1	274167.2707
	16	300	14	B7 BW2 PO1	297849.1099
	17	300	16	SB6 B2 BW1 SW1	233841.4921
	18	300	16	B3 BW2 PO2 SB2 SW1	578898.0027
	19	300	12	SB5 PO3 B2	1741002.7273
	20	300	11	CE4 SB4 B2	329885.3828
	21	300	9	B7 BW1 SB1 SW1	835649.1943
	22	300	17	SB4 B3 PJ2 PO1	303314.2192
2	1	300	15	SB4 B3 PJ2 BW1	565755.3518
	2	300	11	PJ7 PO2 SB1	456078.7781
	3	300	15	PO7 BW1 PJ1 SW1	308457.0785

4	300	23	BW5 PO4 SW1	195772.6070
5	300	17	PO8 BW2	1084900.4651
6	300	10	B5 BW2 SB2 SW1	245933.3876
7	300	0	SB0	62613263.2687
8	300	0	SB0 (Upland Spruce)	62613263.2687
9	300	0	SB0	62613263.2687
10	300	0	SB0	62613263.2687
11	300	14	B4 SB3 BW1 PO1 SW1	440157.7421
12	300	14	B4 SB3 BW1 PO1 SW2	440157.7421
13	300	0	SB0	5029878.1412
14	300	21	BW6 PO4	148113.9884
15	300	30	PO0	348392.7767
16	300	23	PO5 B3 BW1 SW1	590194.8335
17	300	0	SB0	5203100.0200
18	300	9	B8 PO2	81241.6021
18	300	9	B6 SB2 BW1 SW1	1176268.9369
20	300	9	B6 SB2 BW1 SW2	1176268.9369

		21	300	11	B6 BW1 PO1 SB1 SW1	286393.0022
2017	1	1	62	0		51955.5825
		2	300	9	B7 BW1 SB1 SW1	835649.4194
		3	300	23	PO5 B2 SB2 SW1	216760.9745
		4	300	16	PO6 BW3 PJ1	624002.6169
		5	300	12	PJ5 SB3 PO2	462778.5522
		6	300	17	PO8 BW2	1084900.4651
		7	300	18	SB4 B2 BW2 PJ2	501160.7904
		8	300	0	SB0	62613263.2687
		9	300	0	SB0	62613263.2687
		10	300	14	B4 SB3 BW1 PO1 SW1	440157.7421
		11	300	14	B4 SB3 BW1 PO1 SW1	440157.7421
		12	300	0	SB0	5029878.141
		13	300	27	PO7 BW3	861687.3842
		14	300	0	SB0	5029878.141
		15	300	0	SB0	5029878.141
		16	300	10	B4 SB3 BW2 SW1	524622.5889
	2	1	300	17	PO8 BW2	1084900.465

		2	300	10	PO7 BW2 PJ1	745328.8642
		3	300	14	B4 SB3 BW1 PO1 SW1	440157.7421
		4	300	0	SB0	5029878.141
2016	1	1	300	17	SB4 B3 PJ2 PO1	303314.2192
		2	300	17	SB4 B2 SW2 BW1 PO1	408929.7326
		3	300	14	B4 SB3 BW1 PO1 SW1	440157.7421
		4	Bank Swallow			
		5	Bank Swallow			
		6	Bank Swallow			
		7	Bank Swallow			
		8	300	13	SB6 B2 BW1 PO1	472515.4222
		9	300	15	PJ6 PO2 SB2	272103.9888
	2	1	300	17	SB4 B2 SW2 BW1 PO1	408929.7326
		2	300	22	PO6 SB3 B1	126750.4393
		3	300	18	SB4 2BW B2 PJ2	501160.7904

		4	300	10	B5 BW2 SB2 SW1	245933.3876
		5	300	11	B6 SB3 SW1	517670.534
		6	300	19	B4 PO3 SW2 BW1	344397.5106
		7	300	11	B4 BW2 PO2 SB2	428717.1576
		8	300	14	B4 SB3 BW1 PO1 SW1	440157.7421
		9	300	0	SB0	5878709.318
		10	300	0	SB0	5203100.02
		11	300	7	B6 SB4	238653.9205
		12	300	15	SB4 B3 SW2 PO1	321506.9065
		13	300	15	SB4 B3 SW2 PO1	321506.9065
2015	1	1	300	3.1	PO6 BW3 B1	905300.5103
		2	300	12	PJ5 SB3 PO2	462778.5522
		3	300	17	SB5 BW2 B1 PJ1 PO1	448185.8488
		4	300	10	BW4 PO3 SB2 B1	436030.1727
		5	300	11	B6 SB3 SW1	517679.534
		6	300	0	SB0	5878709.318
		7	300	30	PO0	348392.7767
		8	300	23	PO8 BW1 SB1	387263.9209
		9	300	0	SB0	5203100.02
		10	300	0	SB0	5203100.02
		11	300	9	B6 SB2 BW1 SW1	1176268.937

		12	300	9	B6 SB2 BW1 SW1	1176268.937
		13	300	10	B4 BW2 SW2 PO1 SB1	1185599.983
		14	300	13	BW4 SB3 PO2 B1	270560.9356
		15	313	0	NA	75639.88694
		16	300	17	PO8 BW1 SB1	113615.0134
2014	1	1	300	17	SB4 B3 PJ2 PO1	303314.2192
		2	300	31	PO9 BW1	200108.2075
		3	300	10	PJ8 PO2	699593.4156
		4	300	10	BW4 PO3 SB2 B1	436030.1727
		5	300	0	SB0	62613263.27
		6	300	22	PO6 B2 BW1 SB1	394724.2976
		7	300	10	B4 SB3 BW2 SW1	524622.5889
		8	300	10	B4 SB3 BW2 SW1	524622.5889
	2	1	300	15	B4 SB4 BW1 PJ1	499394.6045
		2	300	15	B4 SB4 BW1 PJ1	499394.6045
		3	300	14	SB7 BW1 PJ1 PO1	270565.5741
		4	300	31	PO9 BW1	200108.2075
		5	300	22	PO6 SB3 B1	126750.4393
		6	300	17	SB4 B2 PO2 BW1 SW1	364066.4751
		7	300	18	SB4 B2 BW2 PJ2	501160.7904
		8	300	0	SB0	62613263.27

		9	300	0	SB0	62613263.27
		10	300	8	PO5 PJ3 BW2	175449.4148
		11	300	23	PO8 BW1 SB1	387263.9209
		12	300	10	B4 SB3 BW2 SW1	524622.5889
		13	300	15	SB4 B3 SW2 PO1	321506.9065
2012	1	1	Cabin			
		2	300	5	PJ6 PO2 BW1 SB1	592416.0739
		3	Eagle Nest			
		4	300	0	SB0	62613263.27
		5	300	11	B4 BW2 PO2 SB2	428717.1576
		6	Swallow			
		7	300	0	SB0	5029878.141
		8	300	13	SB8 PJ2	444945.3744
		9	300	23	PO5 B3 BW1 SW1	590194.8335
		10	300	0	SB0	5203100.02