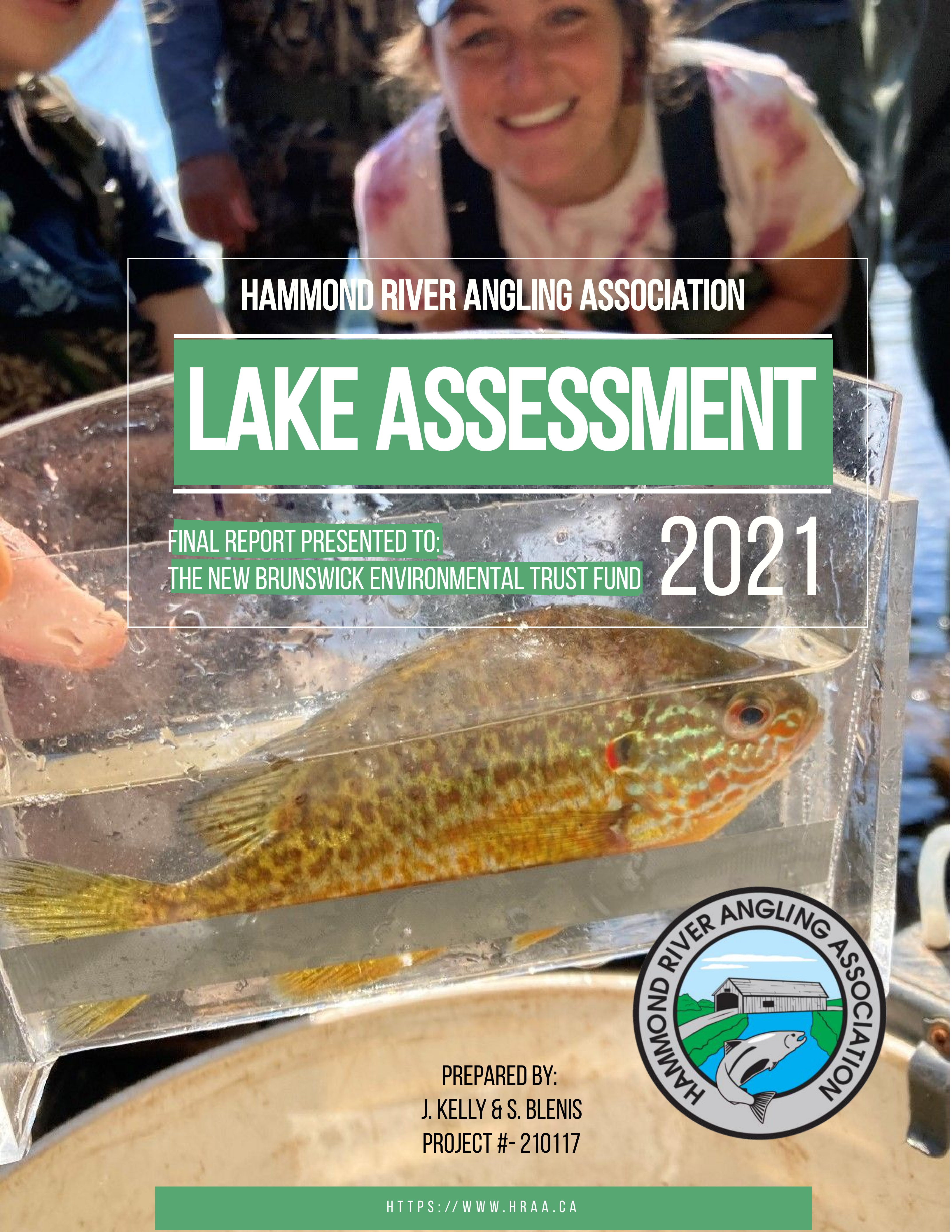

HAMMOND RIVER ANGLING ASSOCIATION

LAKE ASSESSMENT

FINAL REPORT PRESENTED TO:
THE NEW BRUNSWICK ENVIRONMENTAL TRUST FUND

2021

PREPARED BY:
J. KELLY & S. BLENIS
PROJECT #- 210117

FOREWORD

Founded in 1977, the Hammond River Angling Association's (HRAA) mandate is to protect and preserve the Hammond River watershed through education, conservation, and community interaction. This membership-based group is an affiliate of the Atlantic Salmon Federation, the NB Salmon Council, the New Brunswick Environmental Network and Watershed Caucus, the Saint John River Management Committee, and connects with many provincial watershed and environmental groups, community organizations and schools throughout New Brunswick.

The HRAA has engaged in many Atlantic salmon habitat and population enhancement programs since its inception. These programs include stocking fish, electrofishing for juvenile salmon, salmon spawning assessments, large-scale restoration projects and bank stabilization by tree planting. The HRAA also runs an environmental summer camp, a school education program and community education through volunteer activities that promote watershed stewardship.

The Hammond River watershed is located in southeastern New Brunswick and is a tributary of the Wolastoq-Saint John River. The Hammond River watershed has a total area of 513 km² with 561 segments of streams, surmounting a total of 461 km in length (Avg. 0.82±0.91 km) (DNR, 2009). Forest comprises 336 km² of the watershed while 64.9 km² is recognized for non-forest land use (DNR, 2009).

The Hammond River watershed is located on land that has never been ceded- the Mi'kmaq, in northern and eastern New Brunswick; the Wolastoqiyik (Maliseet), along the Saint John River Valley; and the Peskotomuhkatiyik (Passamaquoddy) in the St. Croix River watershed.

HRAA Conservation Center
Nauwigewauk,
New Brunswick

These three nations are part of the Wabanaki Confederacy, which also includes the Penobscot and Abenaki nations of Maine.

The Hammond River watershed is situated between Elsipogtog's land claim, filed in 2016, for the district of Siknuktuk, which encompasses 1/3 of the province of New Brunswick, along the Southeastern portion. The Hammond River watershed is also situated in a title claim that was launched in 2020 by the six Wolastoqey communities that make up Wolastoqey Nation New Brunswick. The Hammond River watershed is a tributary of the Wolastoq-Saint John River, meaning "the beautiful and bountiful river". Traditionally, the Hammond River was called Nuhwig'ewauk, a Maliseet name with a possible translation of "slow current".

Acknowledgements

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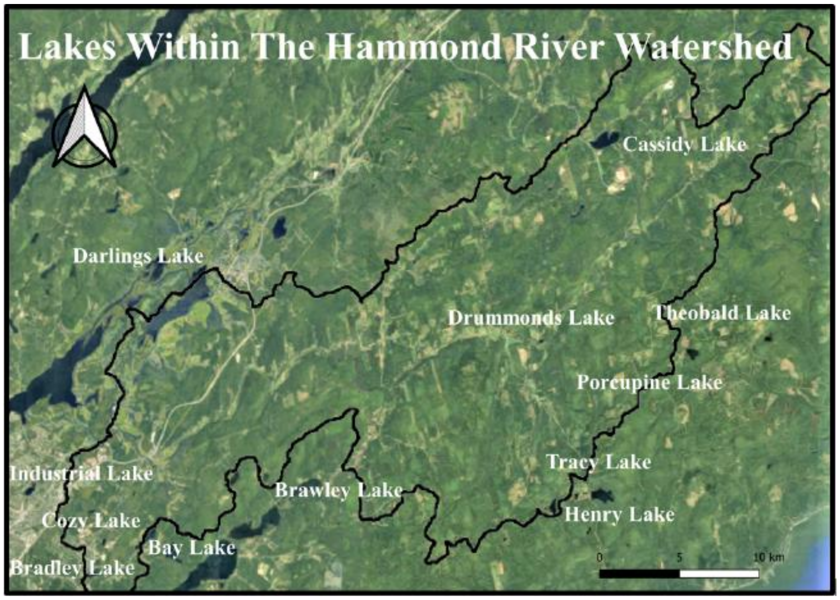
The New Brunswick Environmental Network and Watershed Caucus

Hammond River Angling Association's
Volunteers, Members, Staff, Board and Executive (Past and Present)
Thank you to all the landowners (past and present) who allow access onto their properties!

Project Overview



Spanning over 433km², the Hammond River Watershed is located in southeastern New Brunswick. The headwaters of the North Branch of the Hammond River is Cassidy Lake; the river then runs for 73.5km until it meets the Kennebecasis River, after passing the confluence at Darlings Lake. Most of the land within the watershed is privately owned, with dominant uses being in forestry, mining, and agriculture. Development in residential, commercial, and industrial sectors near the river continues to increase, particularly in the lower watershed. Development along waterbodies can negatively impact riparian vegetation, leading to increased sedimentation through bank erosion, loss of habitat and increased temperatures. A variety of other risks exist such as degradation of water quality and storage, and biodiversity loss due to wetland loss and pollution.

Since the creation of the Hammond River Angling Association in 1977, our lakes have almost completely been ignored. Any data involving these lakes is surface level in the best-case scenario, despite the influence that they have on the main stem of the river. It is because of this discrepancy in data that an entire image of the watershed cannot be sufficiently built.

The Hammond River hosts one of the few self-sustaining Atlantic Salmon populations, a species considered to be endangered and an important ecosystem indicator. While restoration and conservation of Atlantic Salmon populations continues to be a cornerstone of HRAA, the watershed also hosts wood turtles, brook trout, bald eagles, and many other species that are recognized as endangered or threatened by COSEWIC. The majority of the tributaries within the watershed trace their headwaters to lakes- a proper lake analysis is warranted to ensure that these lakes are creating positive cascading effects downstream, feeding into the riverine ecosystem, and supporting these rare and endangered species.

Residents and recreational users of the lakes are often unaware of many of the programs that HRAA has conducted to promote stewardship, which would be common knowledge among the public near the main stem of the Hammond River. There is a large, and very passionate, group of people that can be reached by the HRAA simply having a presence at these lakes through our assessments and other outreach activities such as Eurasian Water Milfoil education, fish composition study, cyanobacteria monitoring, and shoreline cleanup initiatives. It is our hope that our lake assessment may inspire residents to participate in the Department of Environment's Volunteer Lake Assessment Program.

It is paramount that our lakes do not remain neglected. The objective of the *Hammond River Lake Assessment 2021* is to examine and document the biological, chemical, and physical indicators of lake health in 10 lakes within the watershed. The HRAA hopes to continue monitoring these lakes in the future with priority efforts given to lakes deemed to require the highest amount of attention using the results of this project.

Importance of Lake Health

Lake ecosystems offer habitat for fish and waterfowl, preserve biodiversity, and influence the quality of watercourses below as well as many other ecosystem services. Healthily functioning lakes act to mitigate floods and droughts by storing and releasing large amounts of fresh water.

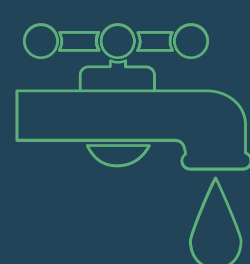
- Water purification and pollution control through absorption, filtering and dilution of nutrients, pollutants and other wastes.

In many cases lakes can be described as socio-ecological systems, referring to the important balance of interactions between humans and lake ecosystems. These interactions are particularly important as some lakes are a major contributor to local economy. Many lakes are seen as important cultural and historical bodies of water and are closely tied to their residents.

"When the ecological puzzle pieces of a lake come together and the lake is able to work as it should, the big picture is clear, we all stand to benefit from this important resource"

\- GNB, 2022

Lakes are important bodies of water for sightseeing, tourism, cottage & residential living as well as countless recreational activites



Lakes recharge groundwater supplies and can be used as municipal, agricultural and industrial water sources

Understanding Our Lakes

Littoral Zone

Nearshore zone where sunlight can penetrate to the bottom sediment and permit aquatic plant life. The littoral zone hosts the most diverse communities within lakes.

Limnetic Zone

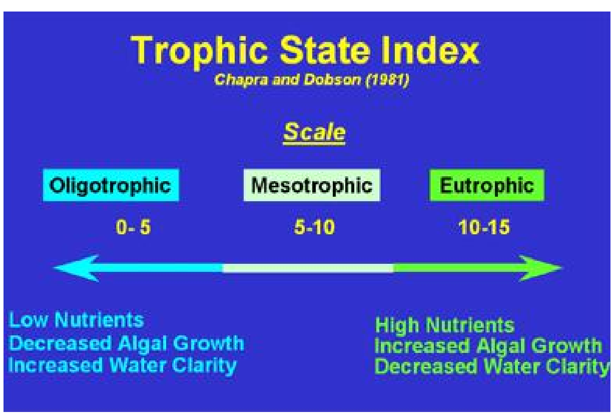
The limnetic zone alternatively is the zone where sunlight cannot penetrate to the bottom.

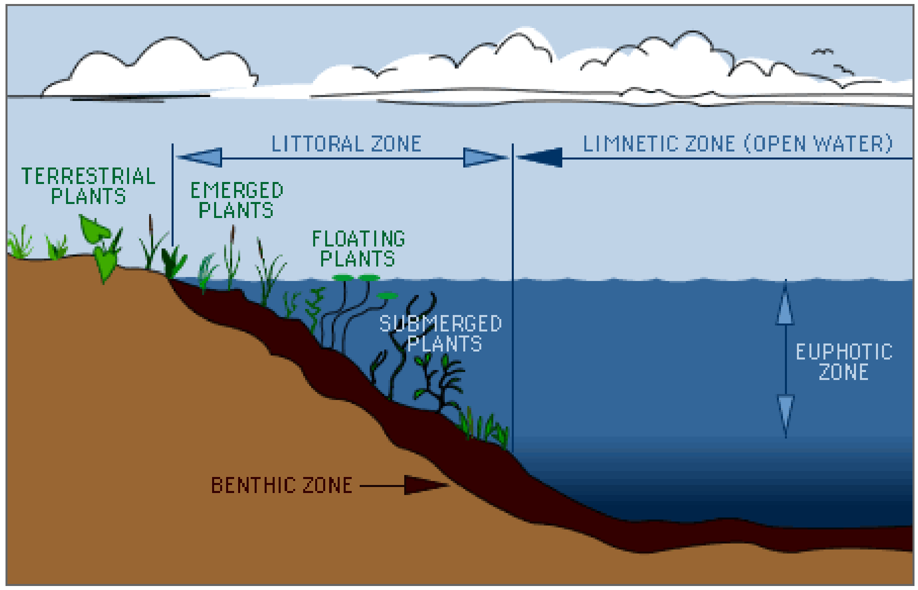
Euphotic Zone

The Euphotic Zone describes the between the surface of the water and the point where sunlight can no longer reach. Photosynthesis by photoplankton and absorption by organic matter and suspended particles limits the light pentration

Benthic Zone

Zone extending from the shoreline to the floor of the lake, plentiful with organisms interacting with the sediment. This zone is typically only a few centimeters in depth





"Classically Oligotrophic" lakes are deep, clear, unpolluted waters that tend to be as naturally occurring with no anthropogenic stressors that are thermally stratified with excellent physical-chemical characteristics for salmonids.

"Oligotrophic" refers to a lake in which primary productivity is at a low level due to a reduced quantity of nutrients, the water generally appears clear, and can support salmonids.

"Eutrophic" refers to a lake where primary productivity is very high because of an abundance of nutrients. Plants, algae, and microorganisms can then grow in large numbers, which animals can then feed on. Eutrophic lakes often have depleted oxygen due to algae and bacterial decomposers. Such lakes favor species such as catfish.

"Mesotrophic" lakes are lakes with an intermediate level of productivity. These lakes are commonly clear water lakes and ponds with beds of submerged aquatic plants and medium levels of nutrients.

"Dystrophic" lakes are generally shallow, warm, unstratified, brown or tannin in color, high in dissolved organic matter, with a pH of less than 5. These lakes tend not to support an abundance of aquatic life.

Each lake surveyed in this study was given a trophic status, based on the aforementioned parameters. This allows for a greater understanding on the overall health of the lakes within the Hammond River watershed.

Methodology

Beach Seining

In order to ensure that no undue stress is placed on the fish, staff begin by testing the water temperature. Provided that the water temperature is <22°C, staff began beach seining. A beach seine net is generally woven from rope or twine with mesh openings that are appropriate to the size of the fish you are trying to catch.

The net, approximately 10m in length, is suspended between two large, wooden poles. The net hangs horizontally in the water with weights added to the bottom side, and floatation buoys attached to the top side. These buoys will ensure that the top has buoyancy, while the weights will ensure that the bottom part of the net can sufficiently drag along the bottom of the waterway.

One field staff remains in the shallows near the shore, with the pole being pressed into the ground on a slight angle. A second staff member takes the other pole and walks out to the desired depth with the pole. In order to achieve a similar effort between sites, we seined for a total of three minutes, whereby both pole carriers walk together perpendicular to the shore and keeping the poles as close to the bottom of the water as possible. Once the three minutes have passed, the person in the deeper water will swing in to meet the person in the shallows in a semi-circular arch, bringing the poles together in the shallows. Caution is used to ensure that the weights drag slowly across the bottom of the water, ensuring no fish escape while the seine net is being closed.

Once the net has closed near the shore, staff carefully examine the contents. Fish are recorded, measured, and released as quickly and safely as possible. While the fish are being contained an aerator is installed into the holding bucket. It is critical to clean the seine net when travelling to new waterbodies, to ensure that you are not accidentally transferring aquatic invasive species from one waterbody to the next.

Methodology

Fyke Netting

In order to ensure that no undue stress is placed on the fish, staff begin by testing the water temperature. Provided that the water temperature is <22°C, staff will begin to set up the fyke nets.

A fyke net is comprised of three main parts- the funnel and side wings. The fyke net must have a live box at its downstream termination and tended at least once every 24hrs, and if it does not have live box, it must be checked hourly. The fyke net deployed in the Lake Survey had a live box at the downstream end, and its net length was 3.7m long with two 6m wings. Each wing and the downstream end are secured into the ground with a long piece of rebar, and the fyke net is set perpendicular to the shore.

Staff set up the fyke nets on the first day, and signs were posted along the shore, notifying the public that a net was placed in the water. The fyke nets also had identification tags secured on the shallow wing, to notify any governmental agencies of our permit to be performing this work. Staff returned the following day to check on the fykenets- the rebar is removed from the downstream end, allowing staff to carefully remove any fish that were caught in the live box.

Fish were recorded, measured, and released. It is critical to clean the fyke net when moving to new waterbodies to ensure that you are not accidentally transferring aquatic invasive species from one waterbody to the next.

Methodology

Minnow Traps

In order to ensure that no undue stress is placed on the fish, staff begin by testing the water temperature. Provided that the water temperature is <22°C, staff will begin to set up the minnow traps. ACAP Saint John provided the HRAA with several sets of minnow traps. The traps were built out of metal mesh conical wastebaskets, in which a 2" diameter hole is cut into the bottom of each wastebasket, and the metal is pushed inwards, to create a funnel. Each wastebasket is then zip tied to a second wastebasket, creating a trap that has two entrances, but no exits. Before the trap is closed, bait is placed into the trap. Staff then attached a rope with a colorful buoy and tied the rope onto the trap. At the beginning of each lake assessment, some of the minnow traps were thrown into the lake from shore and others were deployed in the middle of the lake via kayak. At the end of each lake assessment (approximately 2-3 hours later), the minnow traps were retrieved. Fish were counted, measured, and then the zip ties that were holding the two wastebaskets were cut to allow the fish to be returned to the water.

Methodology

Emergent and Submergent Macrophytes

Rake Method

To collect samples of near-shore submergent macrophytes, we used the rake method, an aquatic plant collection method using only a garden rake.

Measurements were marked from the head of the rake to the handle every 10cm to allow the user to record the depth of each sample. The head of the rake was divided into 4 equal parts and field teams were tasked with rating the abundance of each macrophyte collected. In order to ensure consistency across sites, the raking is performed for 1 minute.

Staff then examine the contents of the rake and begin to identify the type of aquatic plants that have been collected. This also provides an excellent opportunity to document any aquatic invasive species.

Once the aquatic plants have been identified, staff then tally up the number of species present in the waterbody. This allows for data collection on presence of species found at a site during raking; frequency of occurrence, and density ranking of each species found. The data collected assists with the overall understanding of the lake health, as macrophytes are important for fish and macroinvertebrate habitat; produce dissolved oxygen; and provide food for aquatic life.

Table 1 Definitions and examples of indices used to measure submersed aquatic vegetation with a rake

Index	Definition	Rating	Example ratings
Presence	Species found at site during raking.	0–1	0 = absent, 1 = present
Frequency of occurrence	The number of quadrats in which a species was recorded during raking.	0–6	0 = present in no quadrats 1 = present in one quadrat 6 = present in six quadrats
Density rating	Indicates percentage of rake teeth filled when raked at each quadrat.	0–5	0 = no plants, 1 = 1–20% teeth filled, 2 = 21–40% filled, 3 = 41–60% filled, 4 = 61–80% filled, 5 = 81–100% filled
Additive density rating (ADR)	The sum of the density ratings from the six quadrats.	0–30	1 = only one quadrat had plants; density rating was 1. 15 = species present in five quadrats; density rating was 3 in the five quadrats 30 = all six quadrats had plants; density rating was 5 for all quadrats

Methodology

Field Assessments

Measuring water quality with depth

We marked our YSI multiparameter field cable every 0.5 meters alternating between yellow and blue tape to its maximum length of 10 meters.

Thermocline

Temperature profile of the lake measured every 0.5 meters to a maximum of 10 meters

Dissolved Oxygen

Dissolved oxygen profile of the lake measured every 0.5 meters to a maximum of 10 meters

Halocline

Salinity profile of the lake measured every 0.5 meters to a maximum of 10 meters

Water Clarity

To measure water clarity, we asked different staff members drop a secchi disk with similar conditions then averaged our data per lake

pH

We recorded pH data of the surface of the water and at the bottom of the lake or to a maximum of 10 meters

Forest Cover Type

The vegetation surrounding the lake was given a percentage based on each of the following categories that were present;

- Softwood
- Hardwood
- Shrubs
- Moss/Ferns
- Grasses
- Bare

Substrate Type

Substrate of the lake shore was given a percentage based on each of the following categories that were present:

- Bedrock
- Boulder (>250mm)
- Rock (140-250mm)
- Cobble (30-130mm)
- Gravel (2-30mm)
- Sand (<0.06-2mm)
- Silt (<0.06)mm
- Clay
- Organic Material

Other Parameters Observed or Measured

- Observed water colour
- Human use (Residental and Recreational)
- Surrounding land usage
- Shoreline erosion
- Pollution
- Approximate depth
- Boat landings and floating rafts
- Any additional information available from having conversations with knowledgeable residents of the lake

Methodology

Water Chemistry

Water Quality Index

The Canadian Water Quality Index (CWQI) is an instrument used to communicate information to the public and authorities about water quality and its changes over time. To analyze our lake water quality data, we used the Canadian Water Quality Index Version 2.0 supplied by the Canadian Council of Ministers of the Environment (CCME). To summarize its capacity, data taken from field and laboratory results is uploaded into the CWQI and tested against exceedance limits specific to each parameter.

The overall health of the body of water is summarized with a value ranging 0-100 and given a rating, which can be found at the bottom of this page. The exceedance values used in our calculations are all publicly accessible Canadian water quality standards and can be found in the appendix of this report.
The parameters used in our CWQI calculations are listed below:

- Alkalinity (mg/L)
- Aluminum Total (mg/L)
- Antimony (ug/L)
- Chloride (mg/L)
- Copper Total (mg/L)
- Cadmium Total (ug/L)
- Chromium VI (ug/L)
- Iron Total (mg/L)
- Nickle (ug/L)
- Nitrogen Total (mg/L)
- Nitrate Total as N (mg/L)
- Dissolved Oxygen (ug/L)
- Lead Total (ug/L)
- pH (mg/L)
- Phosphorus Total (ug/L)
- Temperature (°C)
- Turbidity (NTU)
- Zinc Total (ug/L)

Rating	CWQI Values	Interpretive Description
Excellent	95-100	Water quality is protected with a virtual absence of threat or impairment; conditions very close to natural or pristine levels,
Good	80-94	Water quality is protected with only a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels,
Fair	60-79	Water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels,
Marginal	45-59	Water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels,
Poor	0-44	Water quality is almost always threatened or impaired; conditions usually depart from natural or desirable levels.

Methodology

Water Chemistry

Laboratory Analysis

Water samples were collected periodically and submitted to the Saint John Laboratory Services who analyzed the following :

- Total Coliforms (cfu/100ml)
- E. coli (cfu/100ml)
- Fecal Coliforms (cfu/100ml)
- Alkalinity (mg/L)
- Aluminum (mg/L)
- Ammonia (mg/L)
- Antimony (ug/L)
- Arsenic (ug/L)
- Cadmium (ug/L)
- Calcium (mg/L)
- Chloride (mg/L)
- Chromium VI
- Colour (TCU)
- Conductivity (uS/cm)
- Copper (ug/L)
- Fluoride (mg/L)
- Ca/Mg Hardness, as $CaCO_3$
- Iron (ug/L)
- Lead (ug/L)
- Magnesium (mg/L)
- Maganese (mg/L)
- Mercury (ug/L)
- Nickle (ug/L)
- Nitrate (mg/L)
- Nitrite (mg/L)
- pH
- Potassium (ug/L)
- Sodium (mg/L)
- Sulfate (mg/L)
- Total Kjeldahl Nitrogen (mg/L)
- Total Organic Carbon (mg/L)
- Total Phosphorus (mg/L)
- Total Suspended Solids (mg/L)
- Turbidity (NTU)
- Zinc (ug/L)

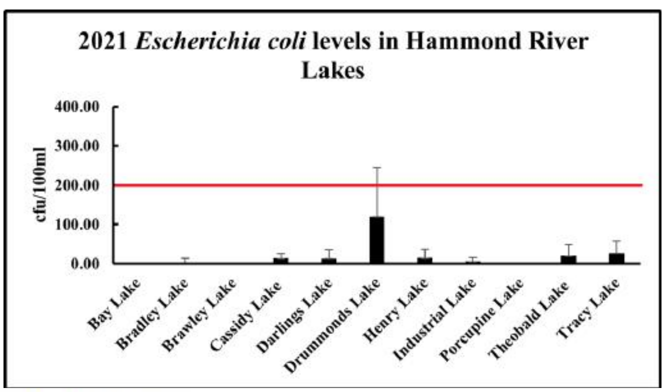
YSI Multiparameter Water Quality Meter

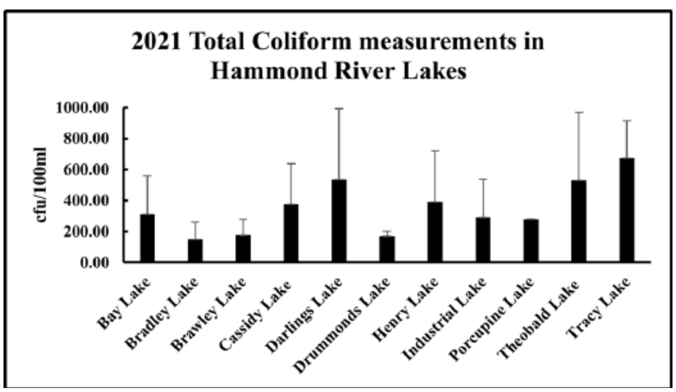
Upon each visit to a lake, in-field water quality measurements were taken using our YSI Multiparameter Water Quality Meter. Theis device has the capacity to measure the following :

- Conductivity (uS/cm)
- Dissolved Oxygen (mg/L)
- Water Temperature (°C)
- Air Temperature (°C)
- Salinity (ppt)
- pH
- Total Dissolved Solids (mg/L)
- Turbidity (FNU)

Results At A Glance

Lake Name	CCME WQI	WQI Category
Cassidy	94.3	GOOD
Henry	94.3	GOOD
Bradley	93.4	GOOD
Darlings	82.9	GOOD
Drummonds	82.1	GOOD
Theobald	75.4	FAIR
Industrial Pit	65.5	FAIR
Bay	68.4	FAIR
Tracy	63.3	MARGINAL
Brawley	42.6	POOR

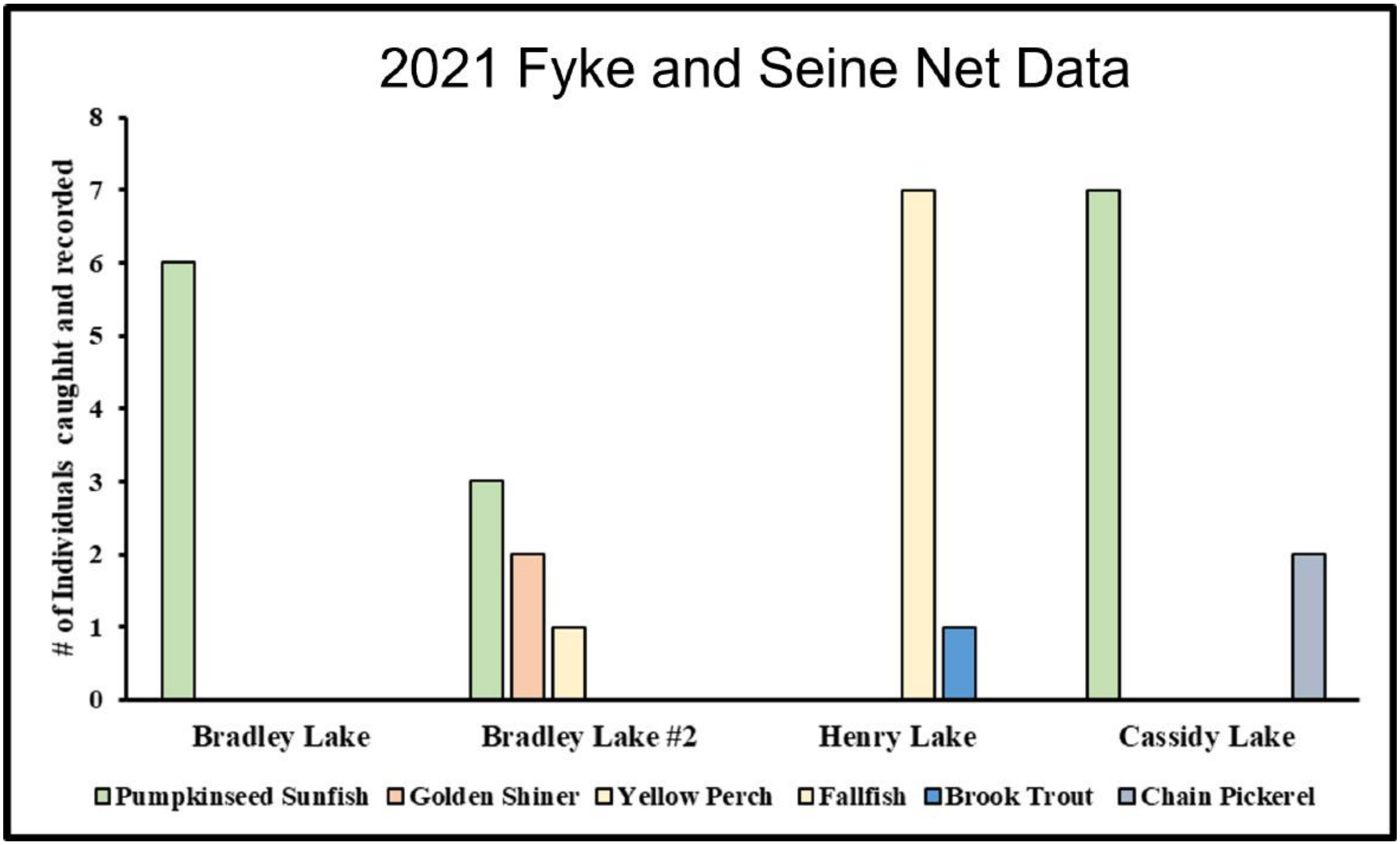




Secchi Disk Data

	Bradley Lake	Brawley Lake	Cassidy Lake	Drummonds Lake	Henry Lake	Industrial Lake	Tracy Lake
(n=28)							
Minimum	2.3	1.2	3.2	1.4	2.8	0.8	1.2
Maximum	3.2	1.3	3.8	1.6	3.1	0.9	1.4
Mean	2.666	1.275	3.5	1.525	2.93	0.825	1.325
Median	2.5	1.3	3.5	1.55	2.9	0.8	1.35

Results At A Glance



TRACY LAKE

Tracy Lake is located in the parish of Saint Martins, north of Hosford Lake and southeast of Handren Hill, and is in relative proximity to Porcupine Lake, and is a lake that is full of visual character.

Tracy Lake

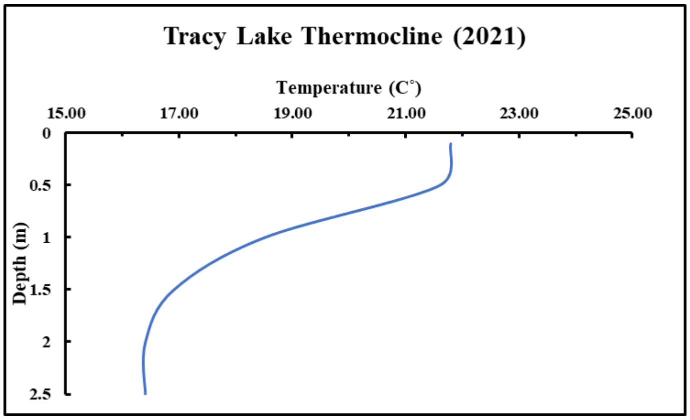
45.426461, -65.592684

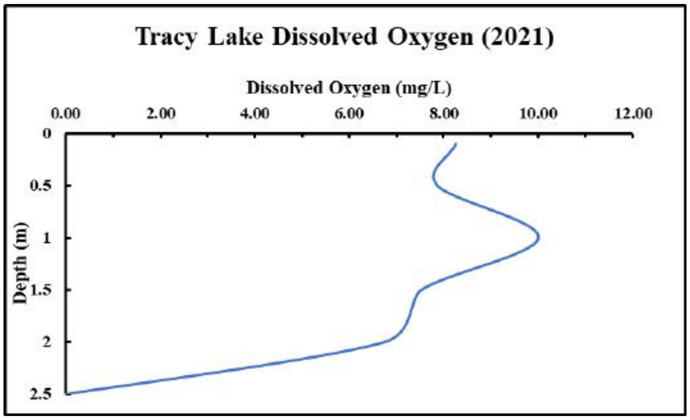
Tracy Lake is the headwaters of Isaac Brook. This lake has not yet been assessed by the Province of New Brunswick, and no historical HRAA data on Tracy Lake has been found, nor does it appear that Tracy Lake was ever part of a provincial stocking program.

Tracy Lake experiences very little anthropogenic stressors, with no residential dwellings or boat launches along its shoreline. The predominant land use in the general vicinity of the lake is forestry; however, the lake maintains an excellent riparian zone. The lake has one access road, which provides the ability to launch a boat, canoe, or kayak. Kayakers are in for a treat- the lake has many small islands and stunning scenery and makes for a beautiful day floating on the water.

Tracy Lake contains an abundance of aquatic vegetation, woody debris, and high beaver presence. The outflow of Tracy Lake contains a severely degraded culvert which is 100% obstructed due to beaver presence.

In the summer of 2020, HRAA field crews encountered a J.D. Irving Ltd worker who was installing a significantly smaller culvert. It was reported that the access road to a wood lot beyond Tracy Lake is repeatedly washed out due to the beavers and the degraded culvert. It is HRAA's belief that the culvert remediation that occurred on the access road is not sufficient (albeit a temporary solution to redirect water flow under the road). This may impact fish access to and from Tracy Lake into Isaac Brook, and the HRAA ranked this as a high priority for future outreach and landowner engagement during the *2020 Culvert Assessment.*





TRACY LAKE

Given the density of woody debris, HRAA determined to deploy minnow traps instead of seine netting. Minnow traps yielded pumpkinseed, dace, and small bullhead; however, there is a healthy abundance of brook trout within this lake, with many fish rising during the kayak survey.

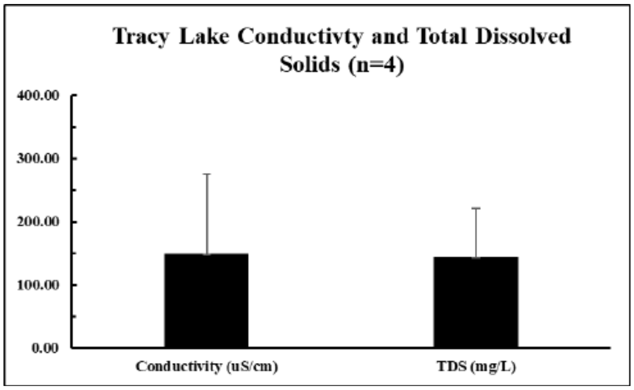
Despite the presence of fish, Tracy Lake received a water quality index score of 63.3, or “marginal”, with multiple exceedances that do not support aquatic life. During the peak summer months, dissolved oxygen was below adequate levels to maintain aquatic life, and water temperatures would also contribute to additional stress on fish species. Staff recorded multiple dead frogs, tadpoles, and minnows along the shoreline in August.

Tracy Lake’s outflow, Isaac Brook, contains higher concentrations of aluminum, iron, and manganese than other areas within the watershed. Manganese has been previously documented in the watershed in high concentrations in the headwaters in Markhamville (including the 1800’s manganese mine); however, the discovery of such high levels of manganese in Isaac Brook is a new discovery within the Hammond River watershed for the HRAA and may indicate a deposit in the Tracy Lake area. These exceedances are considered to be naturally occurring and not as a result of human pressure.

Given that Tracy Lake feeds into Isaac Brook, which subsequently feeds into Hanford Brook, this lake should be given high priority for future water quality monitoring and culvert remediation. Efforts need to be taken to ensure fish passage to and from the lake.

Tracy Lake

45.426461, -65.592684



Macrophytes Commonly Found in Henry Lake

- Duckweed
- Burreed
- Cattails
- Native Milfoil
- Arrowhead Lily

HENRY LAKE

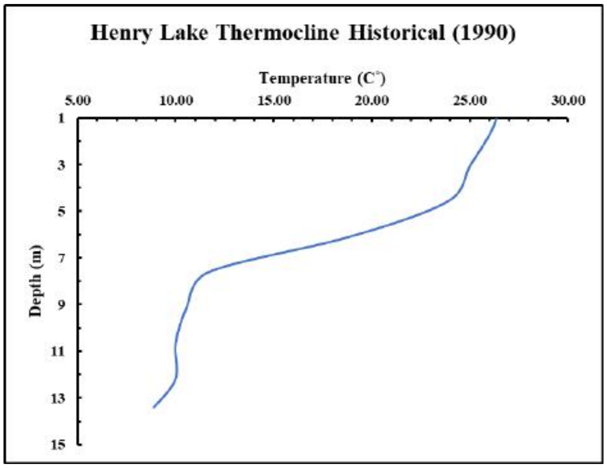
Henry Lake is a lake located just 8.2 kilometers from St. Martins, in Saint John County. In 1898, Henry Lake was a railway siding on the Hampton and St. Martins Railway, and lumber from the rail line can still be found in the lake today.

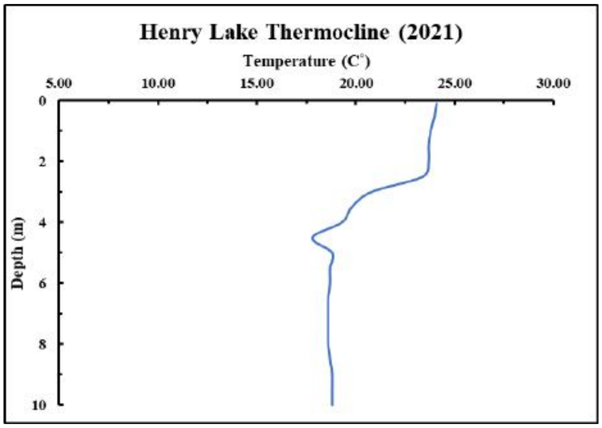
Henry Lake also sparked the interest of early prospectors to the region by boasting a spectacular iron seam running adjacent to the lake. Henry Lake is the headwaters for Monnett Brook and Porter Brook, which eventually join Hanford Brook before merging into the main stem of the Hammond River.

During site visits in 2021, HRAA staff noted that the Saint Martins Fire Department may be drawing water from the lake to fill their fire trucks. This is a common occurrence in many areas throughout the watershed (including in Scoodic Brook and South Lake), and given the overall size and depth of Henry Lake, it is not anticipated that this would negatively draw down lake levels; however, future conversations with the fire department should occur to ensure that they have the correct permit, and to avoid pumping from the lake during the peak summer months, if possible.

Henry Lake

45.407912, -65.613763





HENRY LAKE

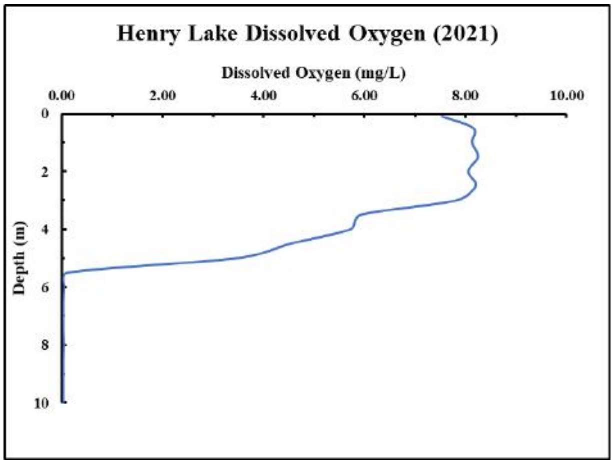
Large freshwater mussels can be found in abundance in this lake, indicating host fish species abundance and excellent water quality. Henry Lake and its mussel abundance will be included in an upcoming freshwater mussel investigation in 2022 to determine type and abundance of mussel within the lake.

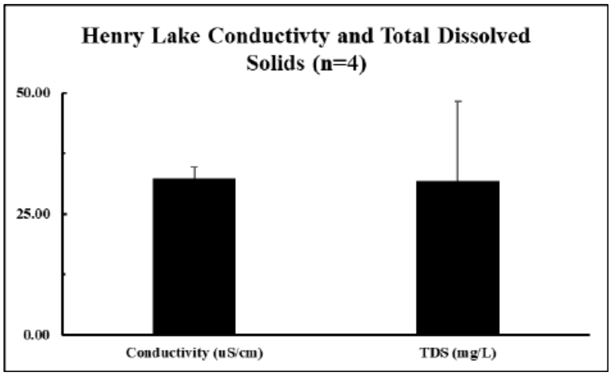
During the summer of 2021, HRAA staff engaged in numerous conversations with lake landowners. Many expressed interest in assisting with maintaining the lake's water quality; however, many expressed that they are not interested in a fish stocking program within the lake. Their concern is that if the lake became a provincially stocked lake, it would increase traffic and presence at the quiet, rural lake, which would ultimately lead to overfishing and littering. During the 2021 fish abundance survey in Henry Lake, it does not initially appear that Henry Lake would be a good candidate for future stocking initiatives, as it is already at, or near, carrying capacity of bullhead, shiner, fallfish, and brook trout.

Macrophytes Commonly Found in Henry Lake

- Burreed
- Yellow Water Lily
- Coontail

Henry Lake
45.407912, -65.613763





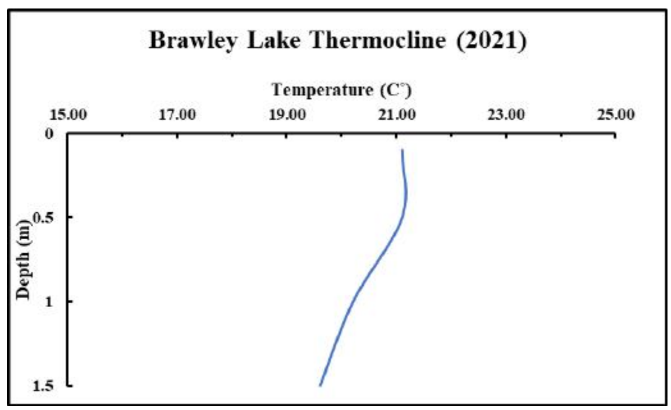
BRAWLEY LAKE

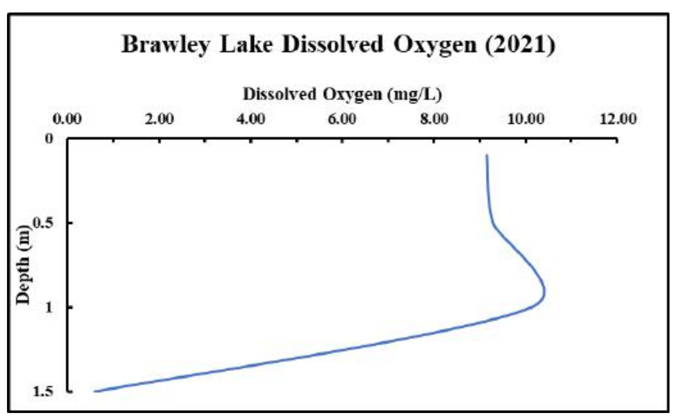
Located in Damascus in the mid-point of the watershed, Brawley Lake is the headwaters for Brawley Brook. While engaging in discussions with surrounding landowners, it was communicated to HRAA staff that Brawley Lake is a man-made lake, a remnant from a former strip mine; however, HRAA has yet to find additional information to support this.

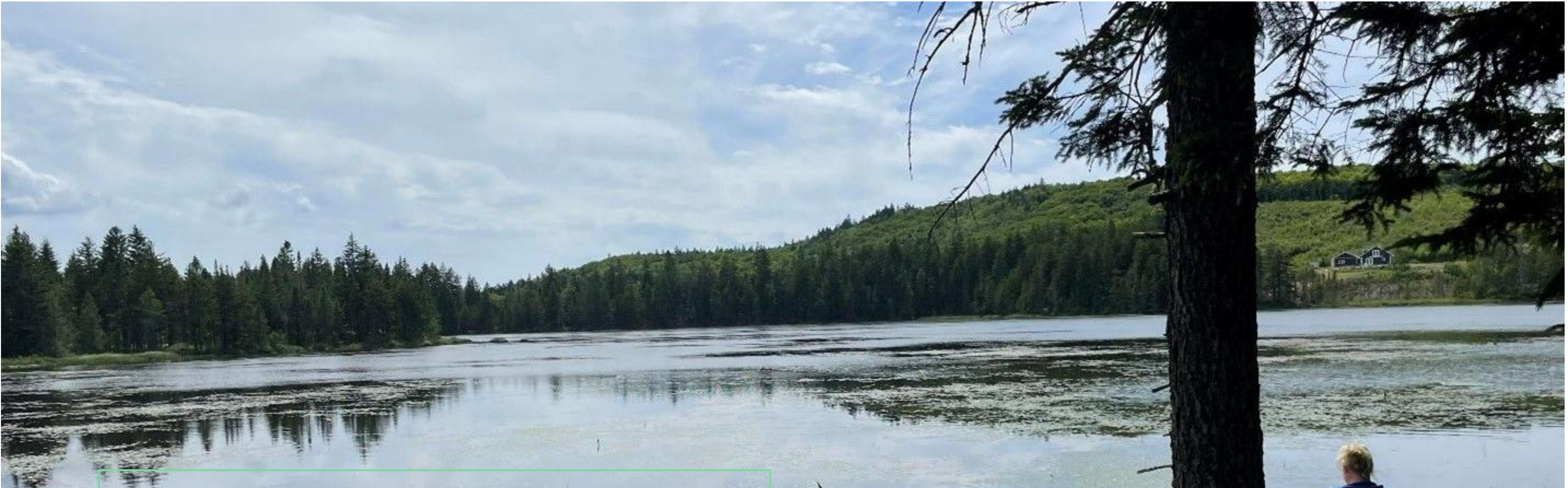
Brawley Lake faces lower anthropogenic stressors in comparison with other lakes in the watershed, and has few residential dwellings situated near its shoreline, with three seasonal camping sites. Only one dock was recorded during the kayak survey, and this lake experiences lower angling and boat presence. The lake has a high abundance of aquatic plants and submerged woody debris, with steep undercut banks, all of which provide decent fish habitat. There is a large wetland complex situated near the lake's outflow, and HRAA staff documented several intriguing wetland flora, including pitcher plants and lady slippers. This area would be an ideal candidate for an in-depth inventory of vascular and nonvascular plants.

Brawley Lake

45.421892, -65.808166



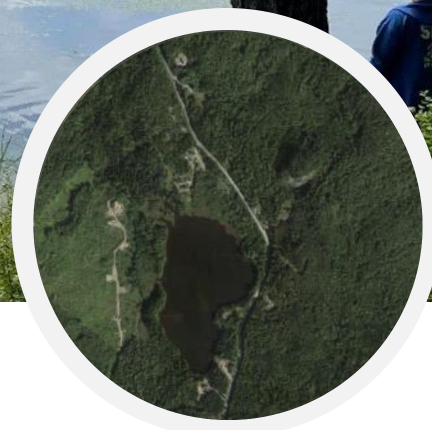




BRAWLEY LAKE

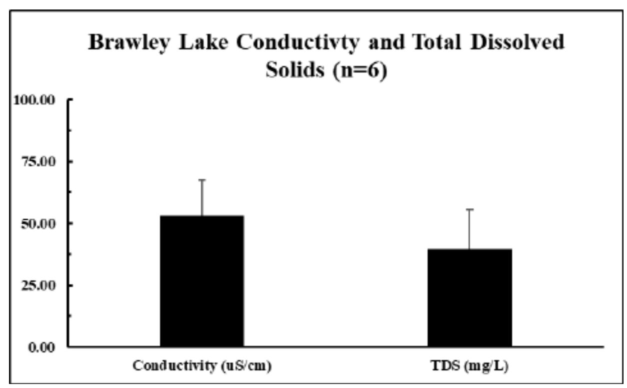
On the whole, Brawley Lake has remained little changed since its last documented survey in 1990. It still maintains its small size and shallow depths, with insufficient boat landings and public access. Fish were caught in minnow traps, seine net and gill net in the 1990 survey; in 2021, HRAA deployed minnow traps, and decided not to use the seine net, given the amount of woody debris in the water. The minnow traps yielded dace, and surrounding landowners reported catching trout and perch in the lake. Brawley Brook consistently yields juvenile smallmouth bass during electrofishing surveys, and it is possible there is a resident smallmouth bass population within Brawley Lake.

In the 1990 survey, Brawley Lake was classified as a eutrophic lake, typically shallow with abundant aquatic growth; waters may be homothermous if stratified oxygen deficiencies occur in the thermocline or hypolimnion; algal blooms common; warm water species dominate the fishery, and this is representative to the findings of the 2021 survey. It is recommended to continue water quality monitoring in this lake, particularly for potentially harmful cyanobacterial blooms.



Brawley Lake

45.421892, -65.808166



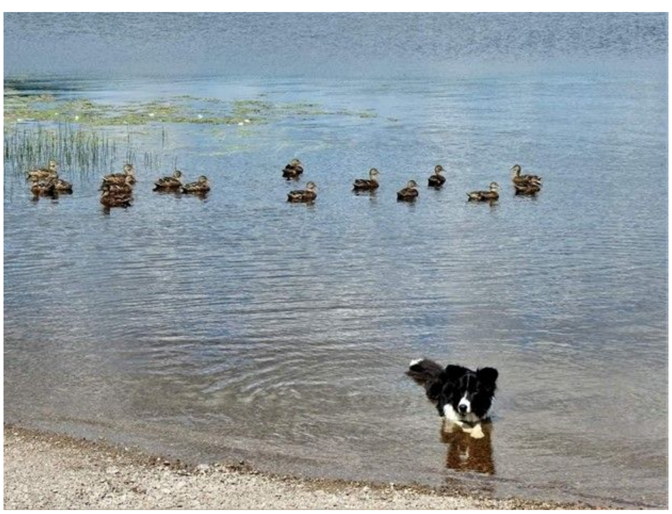
Macrophytes Commonly Found in Brawley Lake

- Ribbonleaf Pondweeed
- Arrowhead Lily
- White Water Lily
- Bullrush Cattail

Cassidy Lake

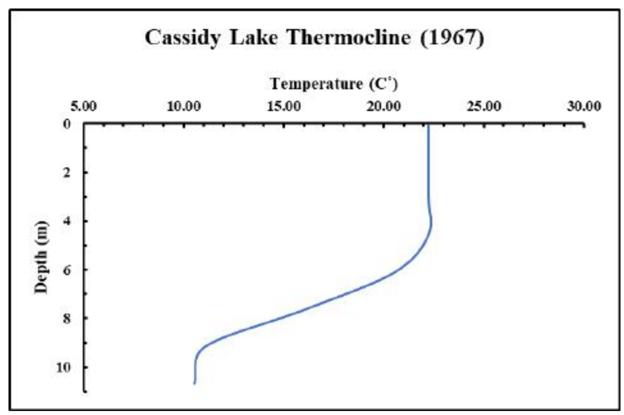
Cassidy Lake is situated along the North Branch of the Hammond River and is part of the headwaters of the Hammond River. It is located within the rural community of Clover Hill near the village of Norton. It has an approximate length of 2km by 1.5km wide, with a maximum depth of 30ft, making it one of the largest lakes in the watershed.

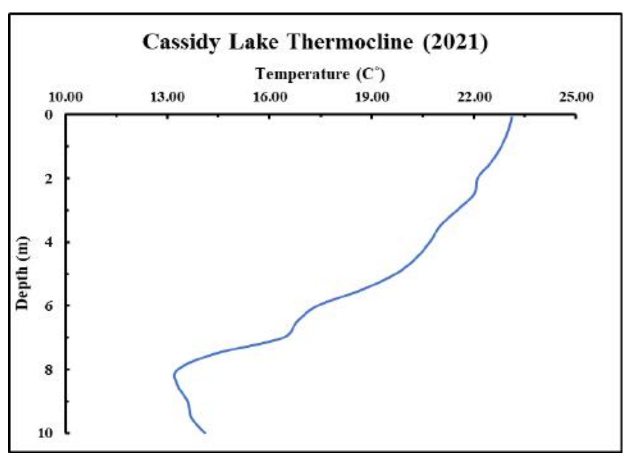
Originally called "DeForest Lake", it was later named "Cassidy Lake" after settler Francis Edward Cassidy, and remnants of his homestead can still be found in the area. Prospectors in the 1800s uncovered many economic minerals in this region: salt, potash, copper, gold, gypsum, zinc, manganese, and bog manganese. The more recent mining operations include a silica quarry to the north of Cassidy Lake and a potash mine to the Southeast of the lake. Mining is ongoing at Atlantic Silica Inc, where workers at the silica quarry excavate a quartz-rich, unconsolidated sand, and gravel deposit, and process the silica locally. The potash mine produced ore between 1985 and its closure in 1997, when severe underground flooding caused the mine to close.



Cassidy Lake

45.580164, -65.578727





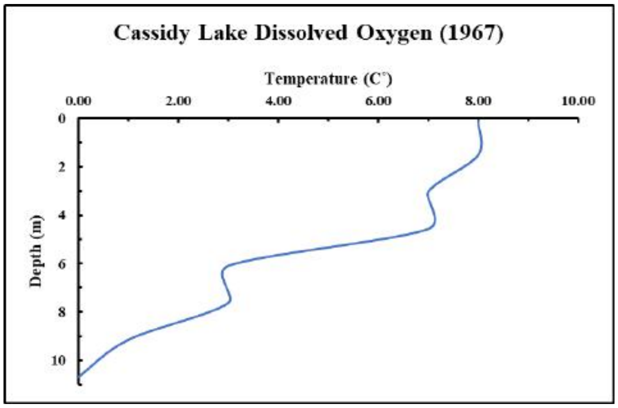
Cassidy Lake

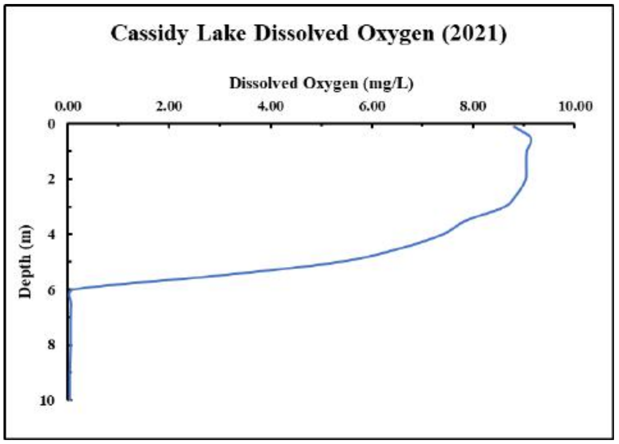
In the early 1940's, the Sussex Branch of the New Brunswick Fish and Game Protective Association began advocating for the eradication of nuisance fish from Cassidy Lake, in an attempt to restore brook trout populations. In 1948, it was decided to use Cassidy Lake as a test site for a new eradication chemical, Fish-Tox, and a barrier dam was installed at the outlet of the lake. It was determined that 640lbs of the poison, in paste form, would be required to treat the shallow eastern portion of the lake, and an additional 3,000lbs of the poison was subsequently applied to the western portion of the lake. Within 30 mins after the application, it was documented that many fish within the lake became distressed, and many American eels were documented attempting to escape the lake by slithering onto dry land. While the original plan was to document the number and species of fish that were killed, the overall fish kill was too great to count for the amount of people that were assisting in the undertaking. It was recommended to continue this effort the following year; however, HRAA staff have yet to uncover additional details regarding the historic poisoning of Cassidy Lake.

In 1976, Cassidy Lake was stocked with splake and tiger trout in an attempt to boost the socio-economic recreational fisheries within the Hammond River watershed. It had been documented that Cassidy Lake's water temperatures and lower dissolved oxygen levels were not sustainable for brook trout, and that hybrid species may have a better chance of survival. Splake fish are a hybrid fish of male brook trout with female lake trout, and tiger trout are a hybrid of a brown trout with a brook trout, both of which are sterile. This stocking practice continued until the mid 1990's and was considered a relatively successful put and take stocking program.

Cassidy Lake

45.580164, -65.578727



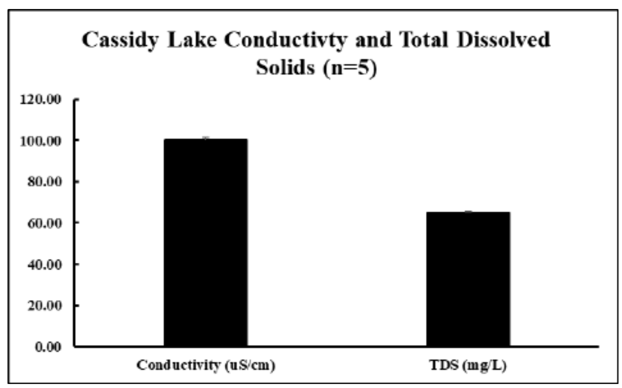


Cassidy Lake

By 1978, the HRAA undertook a hydrological assessment of the Hammond River watershed to determine if certain areas would be suitable for a delay flow, in order to increase cold-water discharge in the peak summer months. It was determined that Cassidy Lake would be a suitable lake for this undertaking in comparison with other lakes within the watershed, and HRAA staff built a dam to slow the flow into the receiving environment, which was later upgraded. To date, this dam is no longer providing a delay in flow; however, remnants can still be found of this dam at the outlet.

Today, Cassidy Lake remains an angling and recreation hotspot within the watershed. Residential buildings have increased along the lake's shoreline, as well as the addition of a religious summer camp, Camp Tulakadik, and Portage Atlantic, a youth drug addiction and rehabilitation center. Cassidy Lake experiences high boat traffic and is an excellent site to launch an in-depth Clean, Drain Dry campaign, to ensure that aquatic invasive species do not enter this lake.

Cassidy Lake
45.580164, -65.578727



Macrophytes Commonly Found in Cassidy Lake

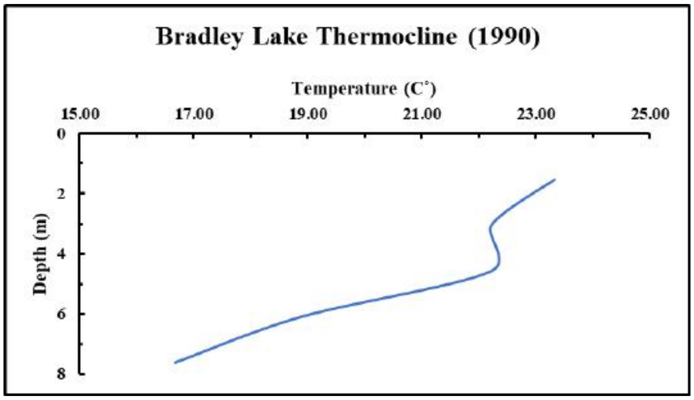
- Burreed Cattail
- White Water Lily
- Yellow Water Lily

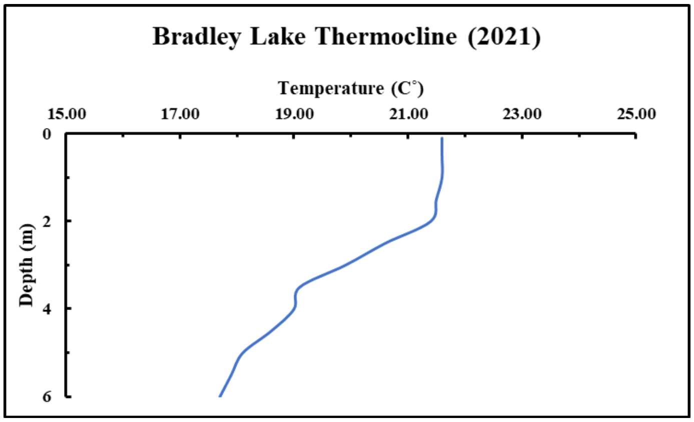
BRADLEY LAKE

Bradley Lake is situated in French Village in the lower portion of the watershed, just outside of the town of Rothesay. There are 2 interconnected lakes that make up the Bradley Lake area, joined by a short tributary.

Bradley Lake
45.376573, -65.923820

During a preliminary site visit in 2020, HRAA staff spoke with a landowner, who described an industrial dumping operation into the lake that occurred in the early 1990's. According to this landowner, it made the lake toxic, and resulted in fish kill. This landowner also related that after the fish kill incident, the lake became overpopulated with Brown Bullhead. Staff have yet to find any supporting evidence of this report; however, the search for additional information is on-going. During the 2021 survey, staff did indeed document bullhead within the lake, as well as chain pickerel, pumpkinseed sunfish, golden shiner, yellow perch, and banded killifish.

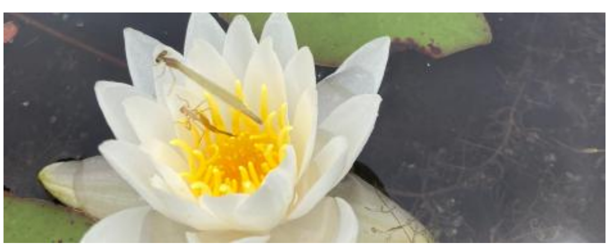




BRADLEY LAKE

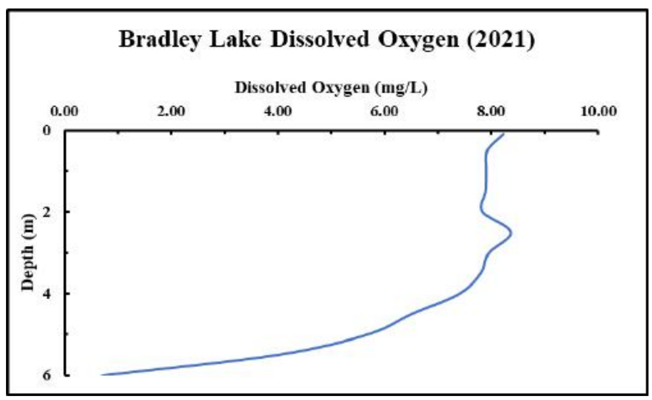
- Bradley Lake maintains one of the highest densities of residential dwellings surrounding the lake within the watershed with a grand total of 33 docks and 4 rafts documented during the 2021 field season. During the investigation in the conjoining tributary between the two Bradley Lakes, HRAA noted that either the current, or previous, landowner had deposited a vast amount of debris over a bank behind their house, much of which is depositing into the lake or its conjoining tributary.

Bradley Lake received the second highest overall water quality index ranking of 94.4, or "Good" in comparison with all other lakes surveyed within 2021. It is also interesting to note that the lake's outlet, Bradley Brook, also ranked fairly high in the water quality index ranking in a separate water quality monitoring project, *Maintaining Water Quality Data While Adapting to Climate Change*, with a score of 93.4 or "good" at the outflow point, and 83 or "good" at the confluence point of the brook with the main stem river. Given the high density of residential houses, Bradley Lake should be top priority for future water quality monitoring to ensure that it does not exceed recommended levels of phosphorus, nitrate, and nitrate, as well as annual aquatic invasive species monitoring given the high boat traffic within this lake. It is anticipated that the community surrounding Bradley Lake will be receptive to additional information packages and engagement with the HRAA, as many of the landowners were intrigued by HRAA's investigation into the lake, and enjoyed the opportunity to watch and question throughout the season during the lake survey, many of whom requested a copy of this final report. .



Bradley Lake

45.376573, -65.923820

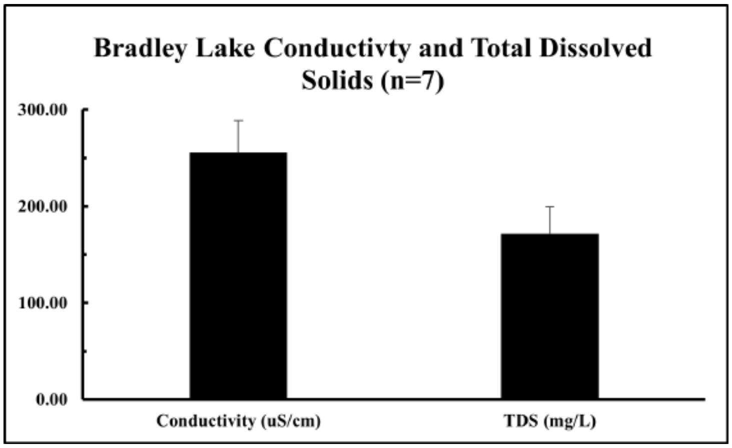


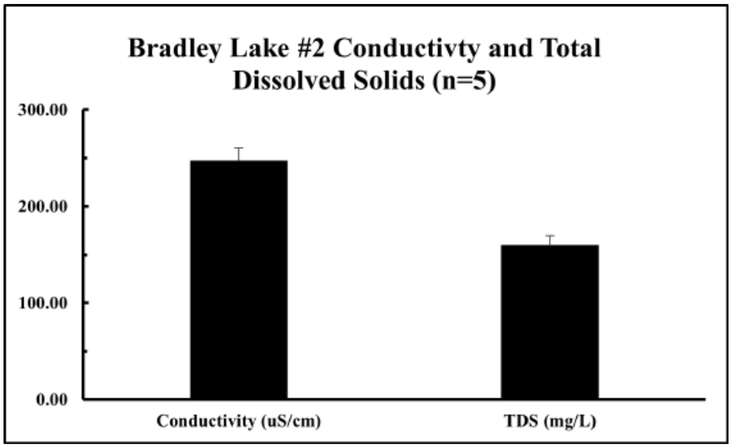
Macrophytes Commonly Found in Bradley Lake

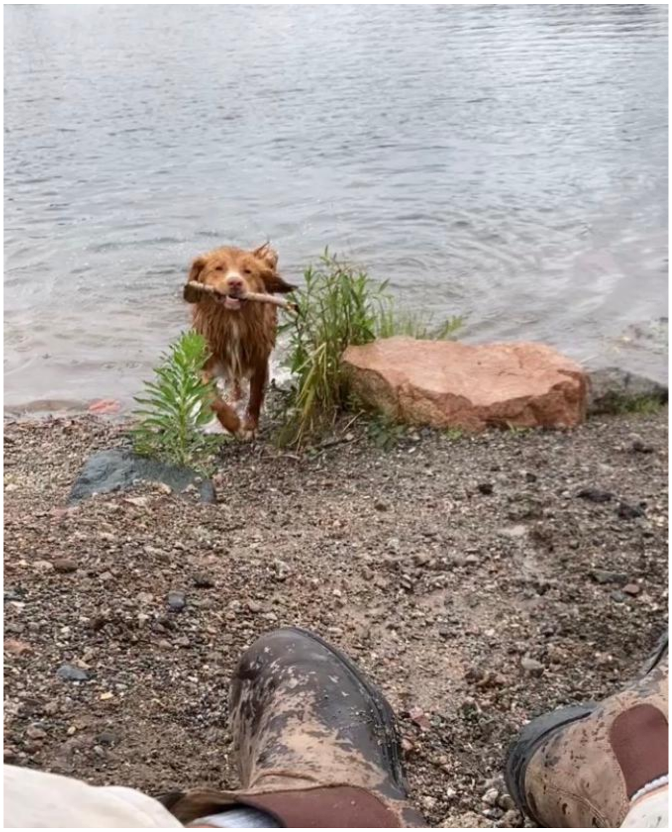
- White Water Lily
- Burreed
- Coontail

BRADLEY LAKE

Bradley Lake
45.376573, -65.923820







PORCUPINE LAKE

Located in the East Fundy drainage area in the parish of Saint Martin, Porcupine Lake is the headwaters for Hanford Brook. Porcupine Lake can best be described as a wilderness lake, with limited access and natural beauty; canoeing, hiking and camping may be possible (albeit somewhat difficult to access). The area surrounding Porcupine Lake experiences no human development aside from forestry; however, the lake itself maintains a beautifully vegetated riparian area.

Porcupine Lake

45.444447, -65.575651

Adventurous anglers may be rewarded for their efforts accessing Porcupine Lake, as this area has historically produced brook trout. Porcupine Lake is featured in the New Brunswick Backroads Mapbook and is described as a “tiny lake found east of Hanford Brook that contains relatively small brook trout. Rough forest roads web the vicinity of the lake’s shoreline”.

During the 2021 field survey, HRAA staff documented the remnants of a makeshift dock, two plastic worm containers, and several beer cans, indicating that this lake has been used for angling. It was very unfortunate to document litter in this area, as the lake and its surroundings are almost untouched, natural beauty. All garbage was removed from the site by HRAA staff, with the exception of the large blue barrels that were being used as a dock system. These could be retrieved in the future, provided staff have access to an ATV to assist with their removal.

Given its remote nature and extremely limited access (older forest roads have since become overgrown), HRAA staff were limited in their ability to include Porcupine Lake in a high-frequency water quality sampling regime. As a result, this lake did not have enough data points to calculate its water quality index score. Very little historical information has been gathered on Porcupine Lake, with one Fishery Patrol Report from 1985 indicating that the lake is approximately 4.5 hectares in size with a maximum depth of approximately 3 meters, 30% of the shoreline is acquired with the remainder being owned by J.D. Irving Ltd, and brook trout were documented within the lake.

The lake contains excellent gravel substrate for salmonid spawning and habitat, and the lake is surrounded by a very large wetland complex before feeding into the Hanford Brook. Hanford Brook is one of the largest, and most significant, contributors to the overall health and salmonid sustainability within the Hammond River watershed, making its headwaters at Porcupine Lake of equal importance. In the fall of 2021, HRAA submitted a proposal to the Habitat Stewardship Program to delineate the wetland complex surrounding Porcupine Lake, including a vascular and nonvascular plant inventory, migratory marsh bird survey, and acoustic bat monitoring program. It is anticipated that this area encompassing the upper portion of Hanford Brook and Porcupine Lake contain a plethora of rare or endangered species.

DRUMMOND'S LAKE

Drummond's Lake is a private lake in the rural community of Upham. In 2018, a gypsum mine was proposed for the area and triggered an Environmental Impact Assessment (EIA). Ultimately, the project was given the green light to proceed; however, many residents had environmental concerns, with a particular focus on Drummond's Lake, which was not included as part of the scope of the EIA.

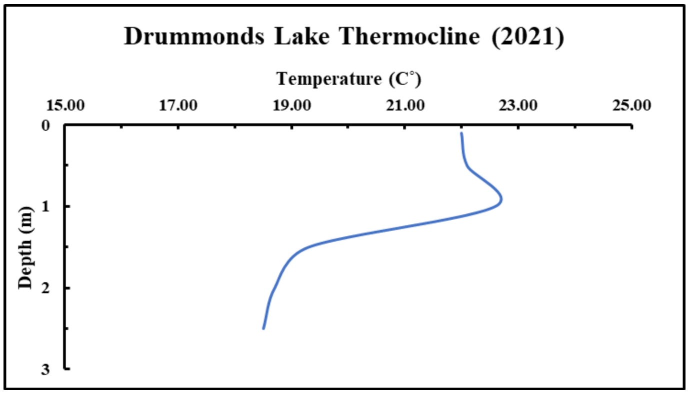
Drummond's Lake is the headwaters for multiple surrounding wetland areas and flows into Watercourse 3 East in relation to the Upham East Gypsum Mine. Drummond's Lake can be characterized as a gypsum sinkhole lake, and there are several areas of exposed gypsum. Given the fragile nature of gypsum and the complexity of groundwater movement between the lake and the mining site, HRAA was determined to collect baseline data on the lake in the event that any negative impacts may occur as a result of the mining operation.

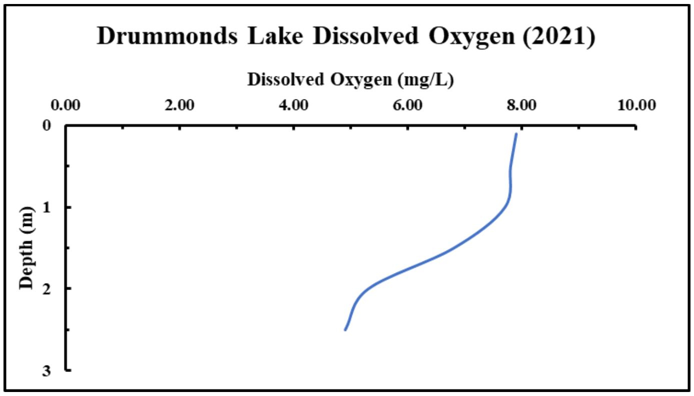
Given its geological significance, Drummond's Lake has a high potential of being a "calcareous hotspot" and may house multiple rare and endangered species. In order to secure the highest amount of quality data concerning this lake, the HRAA partnered with the Atlantic Canada Conservation Data Center to perform an ecological inventory of Drummond's Lake.

On June 18th, 2021 Sean Blaney and Colin Chapman of the ACCDC surveyed 6.2km with a priority on lake shore and wetland communities most likely to host rare species. 342 species were recorded, 262 being vascular plants, 48 bird species and 32 species belonging to other taxonomic groups.

Drummonds Lake

45.486287, -65.620767





DRUMMOND'S LAKE

3 Species at Risk were found :

- Barn Swallow (*Hirundo rustica*)
- Bobolink (*Dolichonyx oryzivorus*)
- Yellowbanded Bumblebee (*Bombus terricola*)

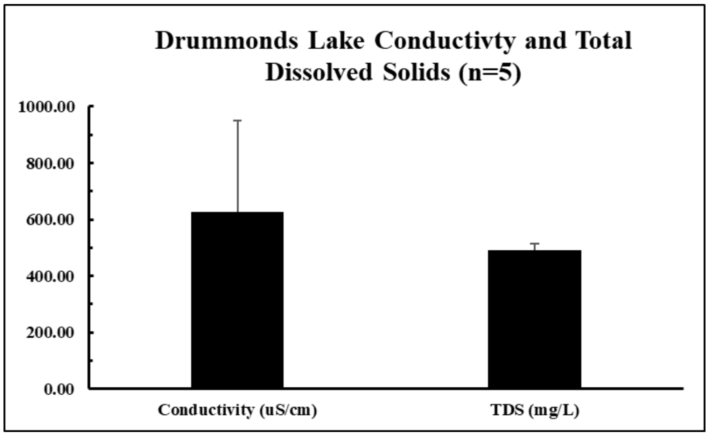
And another 2 vascular plant species and 1 bird species of provincial conservation concern were recorded :

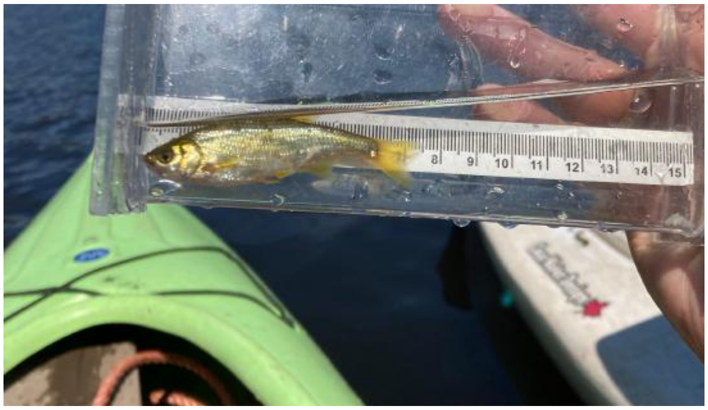
- Turkey Vulture (*Cathartes aura*)
- Ivy-leaved Duckweed (*Lemna trisulca*)
- Purple-veined Willowherb *(Epilobium coloratum)*

Drummond's Lake received an overall water quality index score of 82.4 or "good"; however, it contained the highest levels of *E. coli* and fecal coliforms out of all lakes assessed within the 2021 survey. It is currently believed that these higher bacterial levels are as a result of wildlife (particularly geese) that call the lake home. There are no permanent residential dwellings on Drummond's Lake, with only a seasonal camping area. Access to the lake is private, and angling pressure has been determined to be very low as a result.

Drummonds Lake

45.486287, -65.620767





RENFORTH PIT LAKE

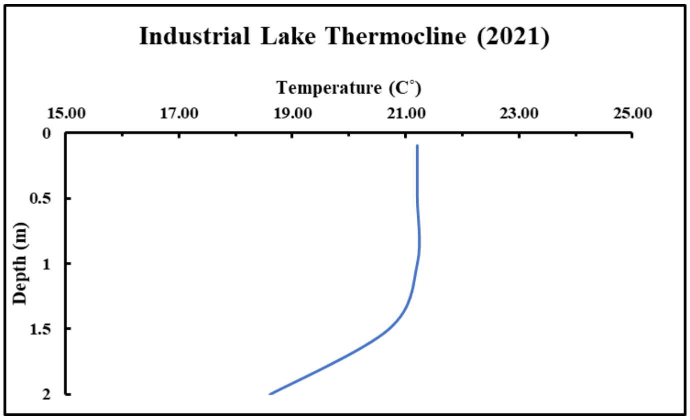
- Located in the industrial zone in the lower portion of the watershed, Renforth Pit Lake flows into Palmer Brook, and it visually appears to be the most stressed lake within the watershed. It is located near a large lumber operation.

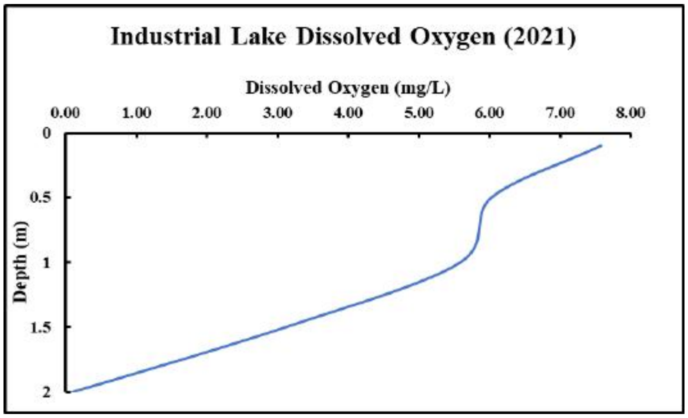
It is unclear if this lake has ever been stocked, but it is doubtful that this lake provides acceptable fish habitat. Given surrounding industrial activity, it is recommended that HRAA include an extremely vigorous water quality sampling program, including organic and inorganic parameters, and expanding to include microplastics, BTEX and hydrocarbons. There is a large amount of lumber (organic) debris in the lake; however, there are multiple long lengths of plastic pipe, roofing shingles, metal, and other sorts of garbage in the lake.

The steep slope along the northern bank is experiencing a fair degree of erosion, and heavy rain events are depositing high levels of sediment into the lake. There is minimal vegetation surrounding the lake's edges, and summer water temperatures are high due to lack of crown closure and shade.

Renforth Pit Lake

45.430417, -65.925145





RENFORTH PIT LAKE

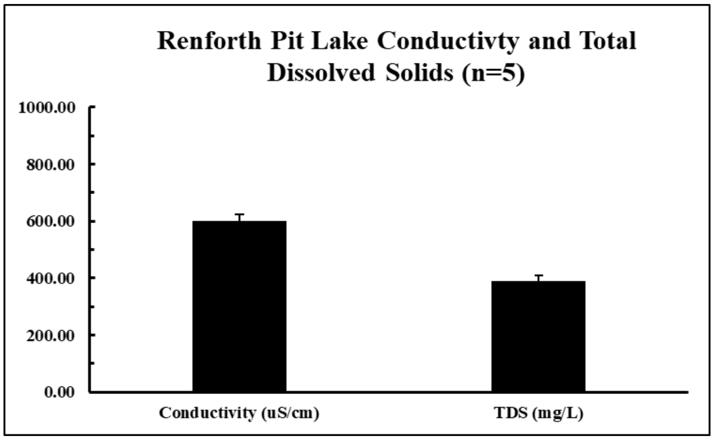
In 2008, HRAA created a project titled *Adult Education and Outreach: Integrating Community Stakeholders* (Executive Director Tom Benjamin). Throughout the spring of 2008, Palmer Brook, one of the Hammond River's few "C" Class brooks, continued to run brown with run-off from industrial sites upstream. On April 29th, landowners, stakeholders, and government representatives from DFO, DENV, DNR, and municipal officials from the Town of Quispamsis attended the Palmer Brook Stakeholders meeting. Two major sources of sedimentation on Palmer were identified, and major work by landowners, HRAA volunteers, and High School Students was underway. Renforth Pit Lake was one of the main sources of sedimentation running into Palmer Brook. Action instigated by DENV resulted in landowner's major renovation of the site, and coupled with planting by HRAA volunteers, resulted in new fish and wildlife habitat instead of causing a net detrimental effect to wildlife. There is a solid area of successful riparian vegetation surrounding the outflow tributary of this lake, and there is still an HRAA Riparian Restoration sign in the area, 12 years later.

During the 2021 field season, HRAA staff had conversations with workers on the industrial site surrounding the lake. It was reported to HRAA that one worker believed there to be goldfish residing in the lake. The HRAA deployed multiple minnow traps in an attempt to support or refute the goldfish claim; however, the minnow traps only yielded hefty brown bullhead. If this claim is indeed true, it has the potential for disastrous ecosystem implications, particularly if goldfish were able to exit the lake and enter Palmer Brook and its historic salmon holding pool. It is recommended that HRAA reach out to the genomics lab at the University of New Brunswick to determine if they have the ability to perform environmental DNA analysis to determine presence or absence of goldfish within this lake.

Renforth Pit Lake

45.430417, -65.925145

There has been a significant shift in the land surrounding the overflow culvert; it would be reasonable to believe that this site is continuing to deposit large amounts of sediment into Palmer Brook, based on the eroding slopes surrounding the lake. The lake's overall water quality score was 65.5 or "Fair"; however, further sampling should occur (particularly with the aforementioned parameters). Conversations with the landowner should be resumed, especially concerning the inorganic debris that is entering the lake. Taking a cue from past HRAA executive, a Palmer Brook Stakeholders Meeting should happen again in the near future.



THEOBALD LAKE

Theobald Lake is located off the Vaughan Creek Road in the Caledonia Highlands Mountain range of the watershed, and this lake is the headwaters for the Jenny Lind Brook and the Irish River. Theobald Lake is the focal point of HRAA's 2020 proposal for a Protected Natural Area, which received preliminary approval in 2021 to become a Candidate Protected Natural Area.

Theobald lake has a surface area of 26.92 hectares, a perimeter of 3.1 km, a volume of 430,469.46m^3, and a maximum depth of 3m and the lake is approximately 313m above sea level. Based on topographic maps, Theobald Lake lies on the same contour line as the head of the Jenny Lind Brook (HRAA, 1988). In the late 1970's, HRAA performed a hydrological survey to determine if redirecting the outflow from Theobald Lake into the Jenny Lind Brook would assist with overall flow into the Hammond River; however, it was determined that this would have negative environmental impacts on the Irish River, and redirection of flow was aborted.

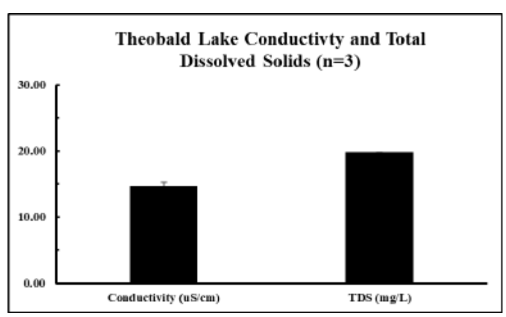
Between 2014-2016, Theobald Lake was stocked with 3,770 native brook trout, and the lake is open for ice fishing in the winter. The provincial fish stocking program subsequently experienced a variety of setbacks post-2016, and stocking of Theobald Lake came to a halt until the fall of 2021 where it was slated for restocking. Theobald Lake is a medium-sized, high elevation body of water that provides vital habitat for aquatic and terrestrial organisms, and is a prized destination for hikers, bikers, and anglers.

During the lake assessment in the fall of 2021, HRAA staff were extremely disappointed to see notification signs posted for aerial glyphosate spraying on a clear cut approximately 800 meters from Theobald Lake, bordering on the outflow wetland complex of the Jenny Lind Brook. This was particularly disheartening, given the hard work of staff to promote this area as a Protected Natural Area. In the future, it is recommended to test the lake, wetland, and brook for the presence of glyphosate, and to investigate the potential negative implications this may have on the ecosystem.

Theobald Lake
45.479947, -65.520082

Theobald Lake received an overall water quality index score of 76.1 or "fair", with exceedances recorded of trace metals. It is believed that these are naturally occurring, as the Caledonia Highlands are mineral-rich. Additionally, one incidental report includes that Theobald Lake may be (in whole or in part) a man-made lake and a remnant of a former strip mine. While HRAA have yet to find substantiating documentation to support this claim, it may explain why the lake contains higher levels of iron, aluminum, and copper.

Theobald Lake, with its beautifully treed canopy, stores large amounts of water and releases it during shortages. This beautiful lake is helping to replenish groundwater and surface water, both to the Jenny Lind Brook, and to the Irish River. Its outflow of the Jenny Lind Brook feeds into the large Hanford Brook sub-catchment, giving the lake high priority for future water quality monitoring programs. Geothermal Imaging and a groundwater mapping investigation would be of high interest and use in the future for HRAA, to determine the overall impact that Theobald Lake has on the Hammond River watershed.



DARLINGS LAKE

Darlings Lake is located below the mouth of the Hammond River and receives inflow from the Kennebecasis River. The lake is surrounded by Darlings Island and Nauwigewauk, and is approximately 640 hectares in size, making it one of the largest lakes within the Hammond River watershed. Darling's Lake is a tidal freshwater lake on the eastern side of Darling's Island located at the head of Kennebecasis Bay and adjacent to the Kennebecasis River. The lake is fed at its northern tip by a tributary of the Kennebecasis river and empties into the Hammond River through a shallow (~1 m deep depending on tidal stage) channel to the South. Much of Darling's Lake is a shallow water habitat ~1-2 m in depth with dense macrophyte cover extending to near the surface; however, the southern reach of the lake is characterized by a section of moderate depth (5-6m) with rock/mud substrate (Andrews, 2019).

Darlings Lake contains a plethora of fish species, including yellow and white perch, chain pickerel, smallmouth bass, brook trout, pumpkinseed and redbelly sunfish, and striped bass. In 2012, the Committee on the Status of Endangered Wildlife in Canada listed the Saint John River Striped Bass as endangered as part of the Bay of Fundy Designatable Unit, and Darlings Lake represents a critical overwintering habitat for this fish species. In a 2019 study, including tissue sampling and genomic analysis, it was determined that the striped bass in Darlings Lake are from the Shubenacadie River population. Striped Bass that were tagged within the Saint John River originated from three different populations of origin including the Shubenacadie River, Nova Scotia (n=9; 21%), United States populations (n=3; 7%) and a group matching the genotype of native Saint John River Striped Bass (n=26; 62%) (Andrews, 2019).

Darlings Lake

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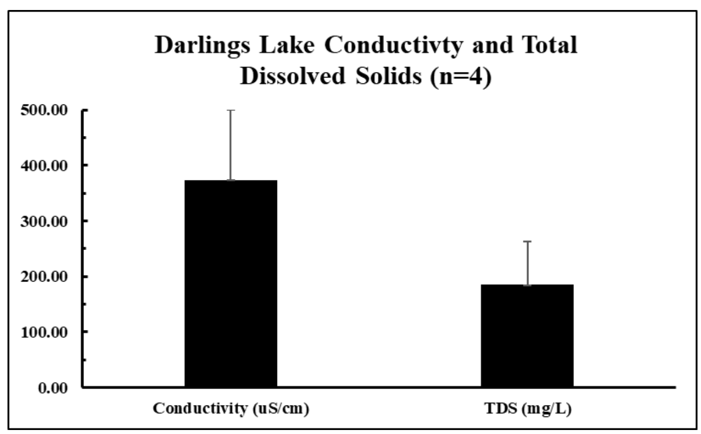

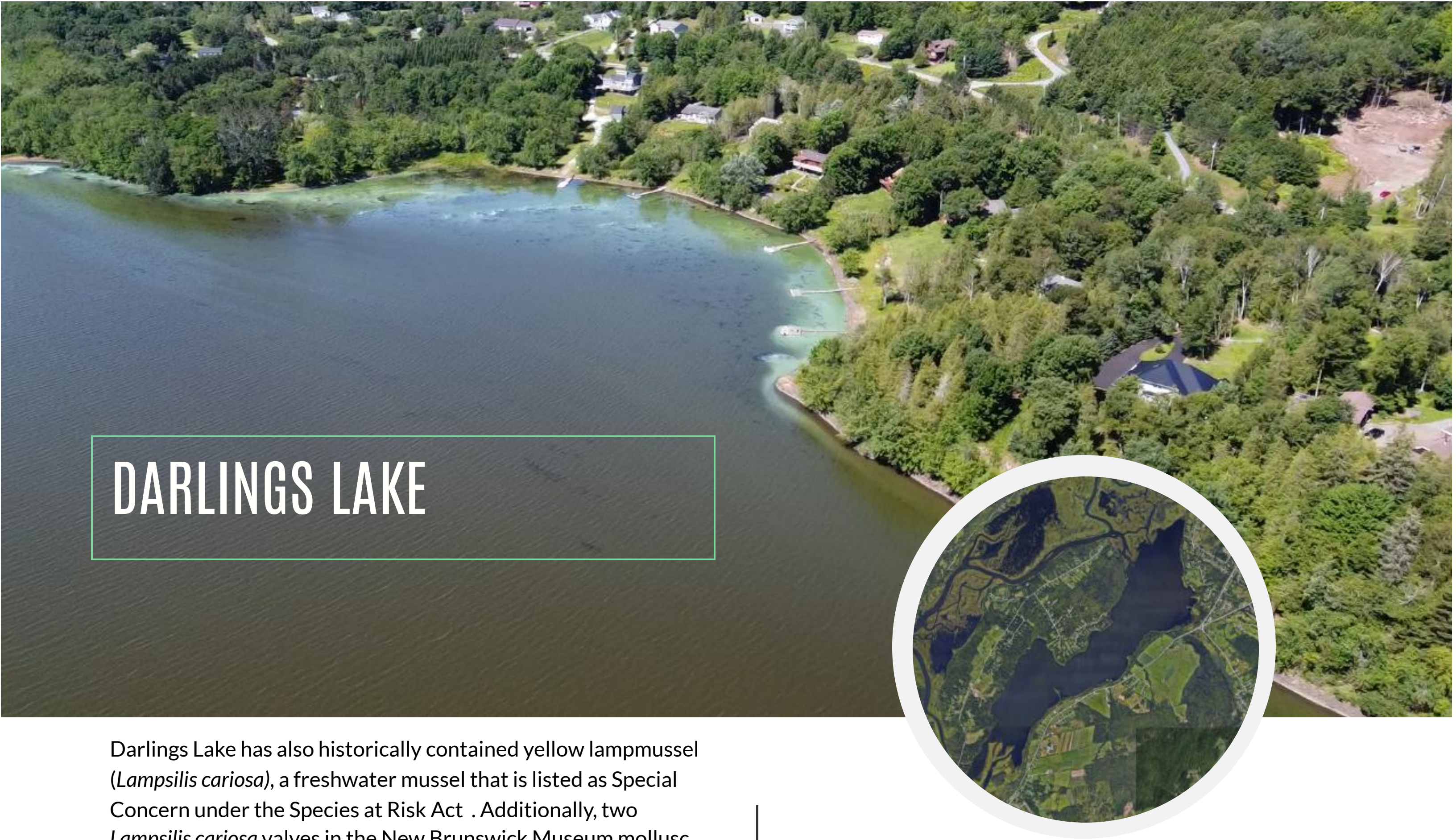

DARLINGS LAKE

Darlings Lake has also historically contained yellow lampmussel (*Lampsilis cariosa*), a freshwater mussel that is listed as Special Concern under the Species at Risk Act . Additionally, two *Lampsilis cariosa* valves in the New Brunswick Museum mollusc collection were taken at Darlings Lake on the Kennebecasis River, probably between 1895-1900. Mussel surveys in 2001 and 2002 failed to record yellow lampmussel from the Kennebecasis River. Likewise, species specific searches of several km of Darlings Lake shoreline in 2002 were also unsuccessful. Sabine et al. note that although the portion of the Saint John River between the lower limits of the current range of L. cariosa and the mouth of the Kennebecasis River appears to be too brackish to support the species; the disappearance of the Yellow Lampmussel from the Kennebecasis River itself would represent a considerable reduction in the range of the species in New Brunswick, and hence in the extent of occurrence and the area of occupancy (Sabine et al, 2004).

While Darlings Lake contains interesting aquatic species, it is also host to several issues. In June of 2021, HRAA staff were contacted by a Darlings Island resident with a suspected report of a cyanobacteria bloom. HRAA staff performed a visual inspection and notified the Department of Environment and the Department of Health. Upon further investigation, it was indeed confirmed that Darlings Lake was experiencing a wide-spread cyanobacterial bloom, and the lake was placed on the public advisory list where it will remain indefinitely. The original proposal for HRAA's *Lake Survey* included microcystin testing- we are very grateful that the New Brunswick Environmental Trust Fund financially supported this aspect of the project in particular! In conversations with Department of Health representatives, it was determined that the early stage of the bloom was indeed producing harmful toxins. The HRAA then tested two sampling sites within the lake 3 times throughout the remainder of the summer; however, all further testing came back negative for microcystins.

Darlings Lake
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DARLINGS LAKE

Under certain conditions – warm, shallow, slow-moving water, lots of sunlight and a lot of nutrients feeding the algae can clump together to form a "bloom." Nutrients such as nitrogen and phosphorus are present in all water ecosystems and are needed for plant and animal life, but an overabundance of them can lead to blooms. Nutrients can enter a water body from various sources, including municipal and residential development, from agriculture and forestry practices, or from point sources such as municipal and industrial effluents. The HRAA received many concerns from residents of Darlings Lake to investigate the cause of the bloom in further detail, many of whom suspected that liquid manure runoff or sewage from the town of Hampton's lagoon may be triggering factors. HRAA arranged a site visit with the town of Hampton to discuss their wastewater treatment facility, whose effluent eventually makes its way into Darlings Lake. Up to 11,000 homes can be handled by the treatment facility, and they only have 1500 homes currently using their facility. The rest of the surrounding homes are on private septic tank systems, which gives the lagoon extra capacity. The lagoon was dredged for the first time between 2017 and 2018. New aerator blowers & equipment were installed. The dredging operation only took 2 days to complete, and very minimal sludge was dredged. The lagoon is separated into 3 different separating areas (with rubber curtains). The other areas are just finishing ponds, which allow additional separation. The lagoon has a clay liner, which should never need replaced. The Town of Hampton was also very forthcoming with their water quality monitoring and provided HRAA a copy of their results from June and July, in which no exceedances were occurring in the effluent. Given this investigation, it is not currently believed that the lagoon is having a triggering impact on the cyanobacteria bloom in Darlings Lake.

In 2022, HRAA submitted a proposal to the New Brunswick Environmental Trust Fund to focus on water quality monitoring and microcystin sampling specifically within Darlings Lake. In partnership with ACAP Saint John, HRAA deployed a passive monitoring device and HOBO data logger to collect additional data on the bloom; however, we are still awaiting results.

Darlings Lake

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Given the bloom that occurred in 2021, HRAA staff did not perform the same survey methods that occurred in other lakes within the watershed.

Darlings Lake is also host to another problem- it contains a high density of the aquatic invasive species, Eurasian Water Milfoil (EWM). EWM is harmful because it settles to the bottom and decomposes, using up dissolved oxygen in the water and reducing oxygen concentrations in the lake. This can kill certain fish species, further decreasing biodiversity. It forms thick mats in shallow areas of a lake, quickly growing and spreading to block sunlight, killing off native aquatic plants that fish and other underwater species rely on for food and shelter. EWM may also be a triggering factor increasing the cyanobacterial bloom in Darlings Lake. Unfortunately, the spread of EWM is not limited to Darlings Lake- patches have been recorded in the outflow of the lake, in shortnose sturgeon overwintering habitat. Further investigation into remediation techniques is warranted, particularly given its potential negative impact on shortnose sturgeon habitat. Darlings Lake also experiences very high boat traffic, increasing the potential to further spread EWM into other waterbodies. In partnership with the Kennebecasis Watershed Restoration Committee and the New Brunswick Invasive Species Alliance, the HRAA is committed to engaging landowners in the Clean, Drain, Dry program. Darlings Lake should be considered the top priority for future work on lakes within the Hammond River watershed.

Project Deliverables

Protecting Our Environment

- Monthly Water Quality Samples (3 months in 10 lakes)= 30 samples total
- Microcystin Samples= 6 samples total
- Land Use Surveys= 10 total
- Macrophyte Survey= 10 total
- Substrate and Fish Habitat Survey= 10 total
- Trophic Status Survey= 10 total
- Fyke Net Survey= 4 total
- Beach Seine Survey= 6 total
- Minnow Traps (3 traps in 10 lakes)= 30 total
- Shoreline Cleanup= 2 events
- SPATT Collectors Deployed= 2 total
- Online Lake Survey for General Public+ 32 respondents
- Ecological Inventory Research= 1 survey of Drummond's Lake
- Pamphlets for General Public= distributed 50
- Social Media Engagement= 16 posts all containing the ETF logo, reaching a total of 58,888 people (most popular posts were cyanobacteria education, which reached 43,561 people; and the post on Eurasian watermilfoil and the importance of Clean, Drain, Dry, which reached 8,841 people!)
- 1 Interview with CBC on Cyanobacteria Bloom in Darlings Lake
- Created 1 YouTube Video on Cyanobacteria Education= 1,100 views; footage was subsequently incorporated into the Fifth Estate's Program, "New Brunswick's Mystery Illness: The Anxiety for Answers", which reached 280,000 views on YouTube

Conclusion

The results of this project can be viewed as a steppingstone for future investigations into the lakes within the Hammond River watershed. This represented the first time in HRAA's history that lakes have been explored, and the results of this project will indeed assist with future prioritization of projects in our area.

The sheer size of assessing a lake with consideration to logistical limitations allowed for our team to only scratch the surface of what each of these lakes had to offer. With future projects involving our lakes, it would be optimal to focus on fewer lakes, and fewer categories, allowing HRAA to dive deeper into each lake and its biological and chemical components.

Through this project, HRAA field staff determined that when using the WQI calculator to analyze our data, it would be beneficial to take into consideration the natural conditions of the lake that are seen as exceedances within the calculations. These natural conditions (i.e.: trace metals) can be misinterpreted as an anthropogenically caused issue wherein actuality these conditions have persisted for thousands of years naturally.

We have determined that overall, the lakes sampled within this survey in the watershed are in good health. Theobald Lake, Tracy Lake, and Porcupine Lake contain the fewest anthropogenic stressors and have the potential to yield rare and endangered flora and fauna. In the future, it is recommended to perform additional ecological inventories within and around these lakes. Brawley Lake, Drummond's Lake, Renforth Pit Lake, and Henry Lake are at medium-risk of human-related water quality and land use stressors and should be monitored regularly to ensure there are no extreme changes. Cassidy Lake and Darlings Lake should be the top priorities for future monitoring programs. Cassidy Lake is the headwaters of the Hammond River watershed and maintaining good water quality in this lake will be vital to the overall survival of the main stem Hammond River. Darlings Island is currently facing major issues with cyanobacterial blooms and aquatic invasive species, and it will be paramount to continue to educate the public, maintain water quality sampling, and investigate eradication techniques to assist with its remediation.

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