Northeast Aquatic Research

# North and South Riga Ponds 2022 Monitoring Report

**Prepared for the Mount Riga Association**

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# INTRODUCTION AND SYNOPSIS OF 2022 RESULTS

Volunteer monitors conducted the water quality monitoring at North Riga and South Riga lakes in 2022. North Riga Lake was only monitored twice, on June 26th and July 24th. The dissolved oxygen and temperature probe and logger was lost overboard during the July sampling, so dissolved oxygen and temperature profiles were not collected after that date. South Riga Lake was monitored monthly from May through August.

NEAR conducted aquatic plant surveys of the two lakes on August 31st.

**Clarity:** North Riga water clarity continues to show signs of long-term decline. Over the last several years, the Secchi disk depth has rarely exceeded 8 meters, while monitoring in 2007-2008 recorded only one clarity reading less than 8 meters. South Riga water clarity is also showing signs of worsening conditions, with the past three years having poorer clarity than all prior monitoring years.

**Dissolved Oxygen and Temperature:** South Riga reached a maximum temperature of ~25°C in late August. The lake experienced only a slight decrease in dissolved oxygen in July. In North Riga, the lake was fully oxygenated in late June, and temperature decreased steadily along the water column.

**Nutrients:** Total nitrogen and total phosphorus were elevated above their respective oligotrophic thresholds in select samples in both lakes. This is a serious concern because sources of nutrients to both lakes should be minimal, and yet phosphorus and nitrogen are increasing in both lakes. It is critically important to understand that once nutrients get into a lake they do not leave. Nutrients are not flushed from the lake over the dam. Instead, they become incorporated into the sediments, where they are then released each season.

**Aquatic Plants:** Both lakes contained a good variety of native aquatic plant species. Both lakes contained the Connecticut Endangered species *Potamogeton confervoides* (Tuckerman's pondweed) and *Sparganium fluctuans* (floating bur-reed). No invasive species were found in either of the lakes.

# MONITORING RESULTS

The lake data is assessed using the CT DEEP categorization of lakes, which is primarily based on the amount of phosphorus present in surface waters during summer conditions (**Table 1**). A trophic category is a means to classify the degree of plant and algae growth that occurs in a lake, which increases with overall water quality decline. Very clear water with no weeds or algae results from very low nitrogen and phosphorus conditions. These clear-water and low-nutrient lakes are considered oligotrophic. Lakes with excessive amounts of weeds and very green water resulting from high nutrient concentrations are eutrophic. **Table 1** shows lake Trophic Status. Target criteria are highlighted in blue: TP <10ppb, TN <200ppb, and Secchi >6m.

**Table 1 - Lake trophic categories and ranges of indicator parameters.**

| Category | T.P. (ppb) | T. Nitrogen (ppb) | Secchi Depth (m) | Chlorophyll (ppb) |
|---|---|---|---|---|
| **Oligotrophic** | 0 – 10 | 0 – 200 | 6+ | 0 – 2 |
| **Oligo-mesotrophic** | 10 – 15 | 200- 300 | 4 – 6 | 2 – 5 |
| **Mesotrophic** | 15 – 25 | 300 - 500 | 3 – 4 | 5 – 10 |
| **Meso-eutrophic** | 25 – 30 | 500 - 600 | 2 – 3 | 10 – 15 |
| **Eutrophic** | 30 – 50 | 600 - 1000 | 1 – 2 | 15 – 30 |
| **Highly Eutrophic** | 50 + | 1000 + | 0 – 1 | 30 + |

**Source = CT DEP 1982*

**Chlorophyll-a not included in testing because samples are very time-sensitive.*

## Water Clarity / Secchi Disk Depth

In 2022, the Secchi disk depths in North Riga were poor when compared against the long term data set, with measurements of 7.4 meters and 7.6 meters during the two sampling events (**Figure 1**, **Table 2**). Although these are slightly better clarity readings than 2021 during the same months, water clarity has historically been recorded between 8 – 10 meters.

This water clarity trend in North Riga is disturbing. In 2007-2008, only one value was less than 8m. Now, no clarity readings are better than 8m.

In South Riga, the Secchi disk was visible on the lake bottom in May and June. By early July however, water clarity had declined to approximately 5 meters. This is the first time on record that the Secchi disk has not been visible on the lake bottom in July. By late August, clarity had improved slightly, to approximately 5.5 meters. This is better than the August 2021 reading but ideally the Secchi disk should be visible on the lake bottom throughout the summer season.

In the nine years of water quality monitoring between 1955 and 2022, the Secchi disk has not been visible on the lake bottom on only four occasions, all four of which have been in the last three years, and two of which have occurred in 2022 alone. This is an evident and worrying sign that the water quality in South Riga is deteriorating.

**Figure 1. Historical Secchi disk depth measurements at North Riga and South Riga.**

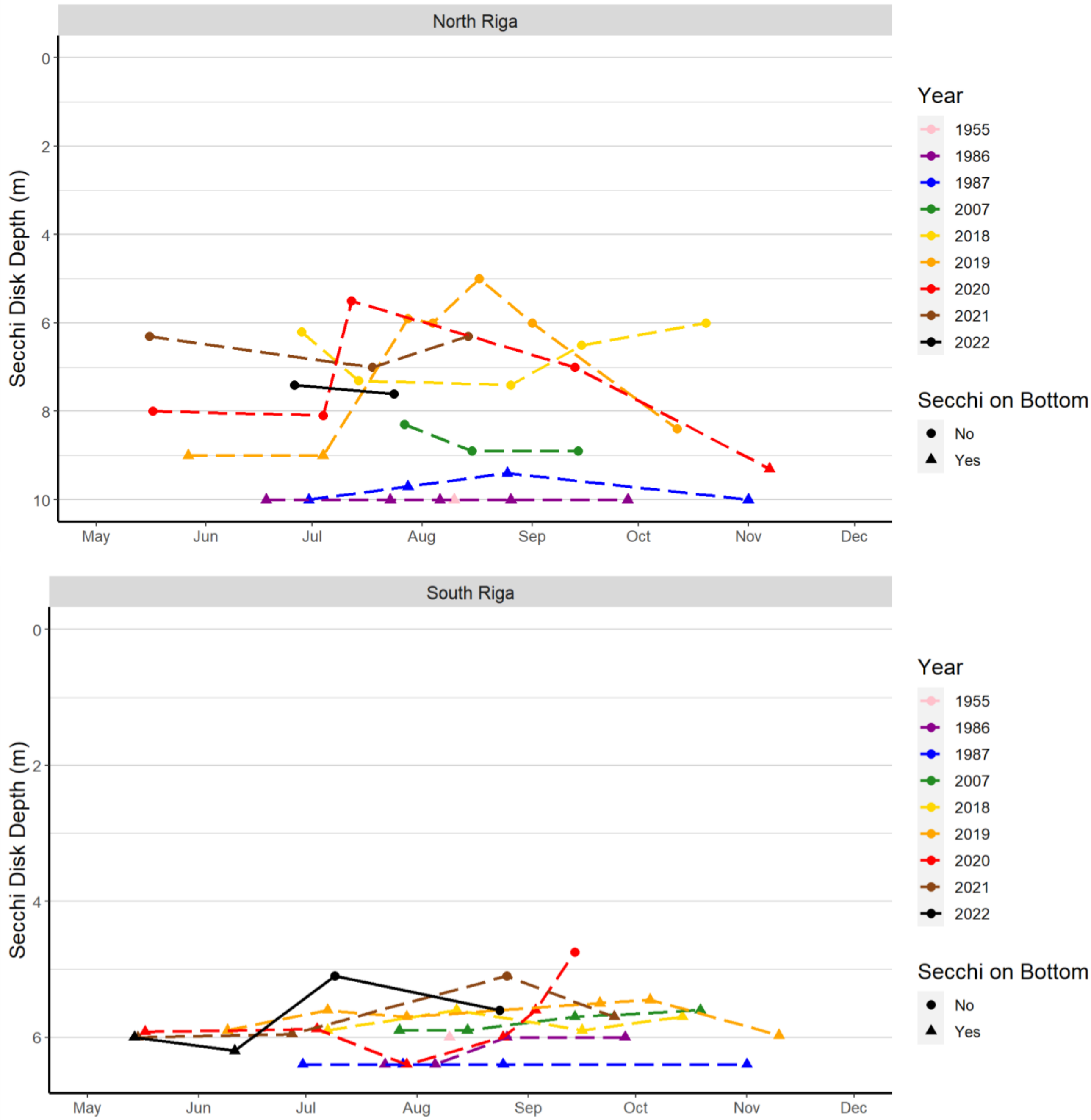



**Table 2. North Riga and South Riga Secchi disk depth measurements, 2022.**

| North Riga Secchi Disk Depths (m) | |
|---|---|
| 26-Jun | 24-Jul |
| 7.4 | 7.6 |

| South Riga Secchi Disk Depths (m) | | | |
|---|---|---|---|
| 14-May | 11-Jun | 22-Jul | 24-Aug |
| On bottom | On bottom | 5.1 | 5.6 |

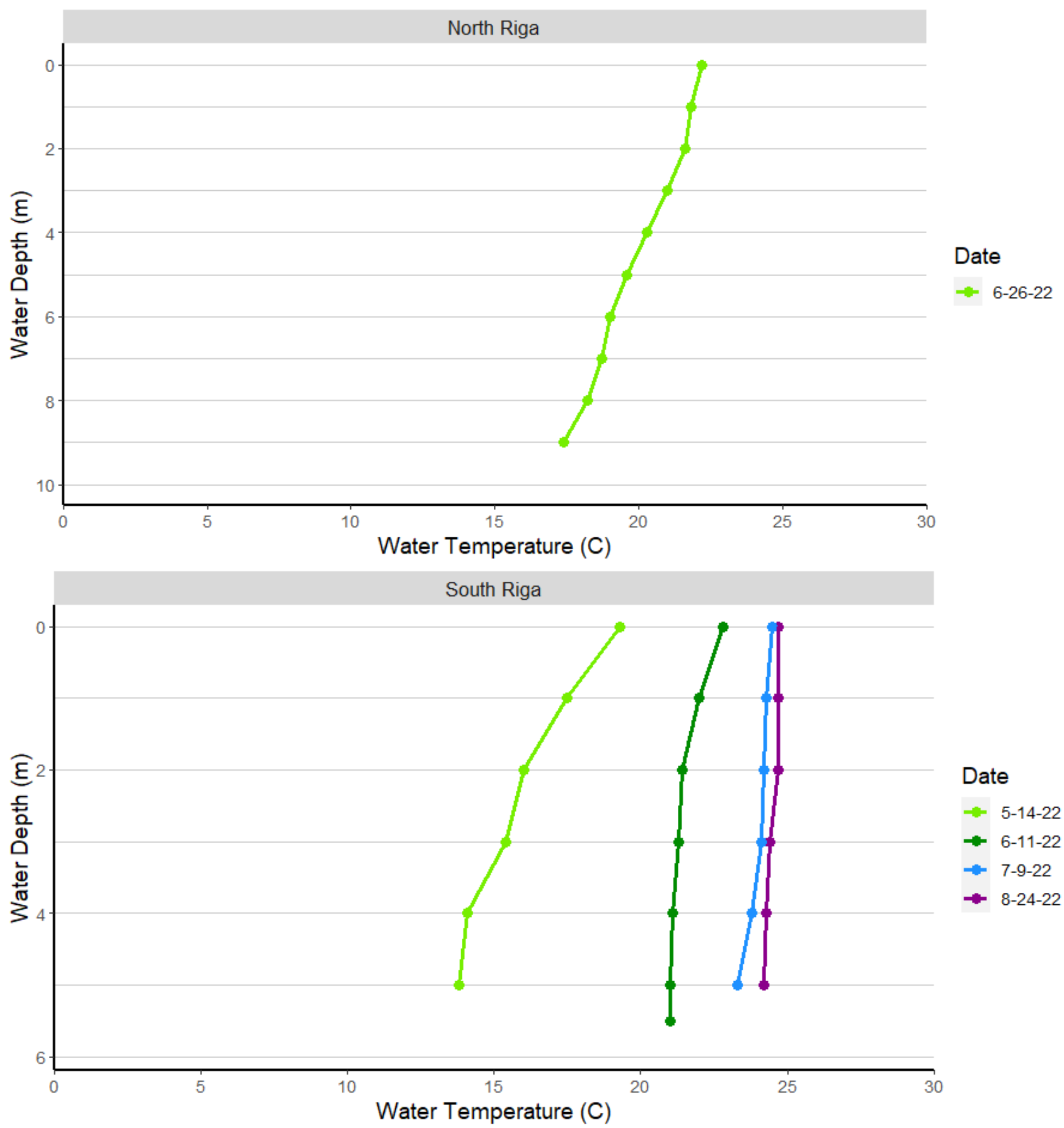
## Water Temperature

Water temperature in lakes and ponds in the northeast follows a seasonal pattern of warming and cooling. As the sun's rays penetrate the water column during the summer, the water warms; but the depth extent of this warming is dependent on the water's clarity. Clearer water allows for more sunlight penetration and deeper water column warming.

Only one water temperature profile was collected from North Riga in 2022, so we cannot analyze the change in temperature and possible thermal stratification formation during the season. The June profile shows a steady decrease in temperature between the surface and bottom water (**Figure 2**).

In South Riga, the bottom water remained cool in May, but it is evident that the water column was warming steadily. The June, July, and August temperature profiles show a well-mixed water column, with a maximum recorded water temperature of approximately 25°C in late August.

**Figure 2. Temperature profiles at North Riga and South Riga, 2022.**



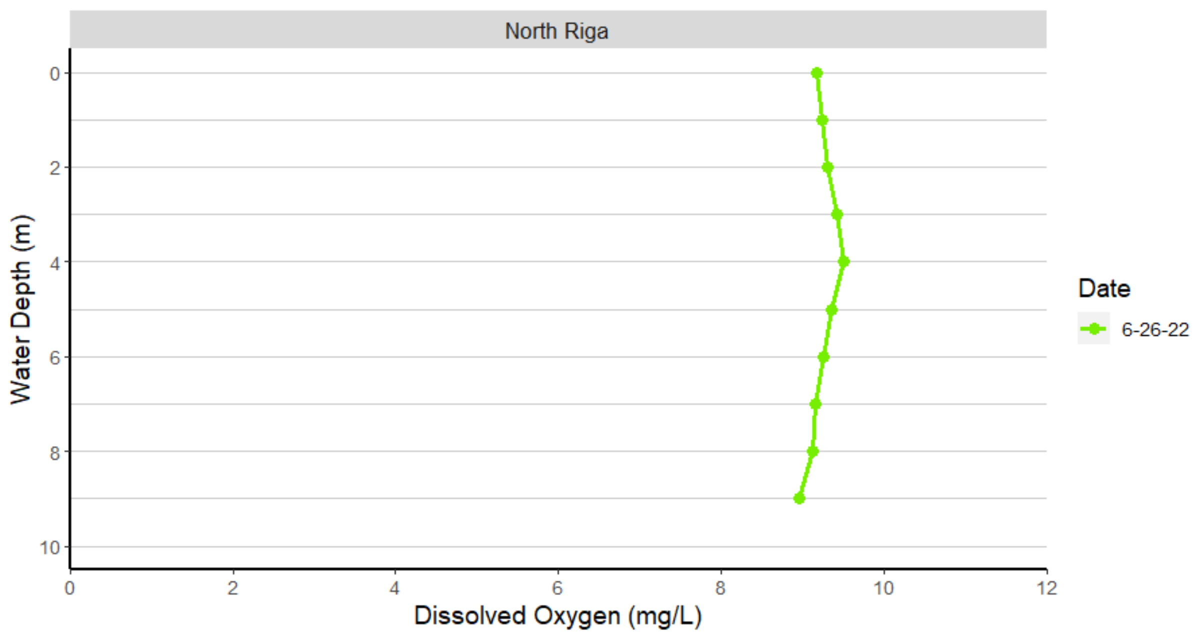
## Dissolved Oxygen

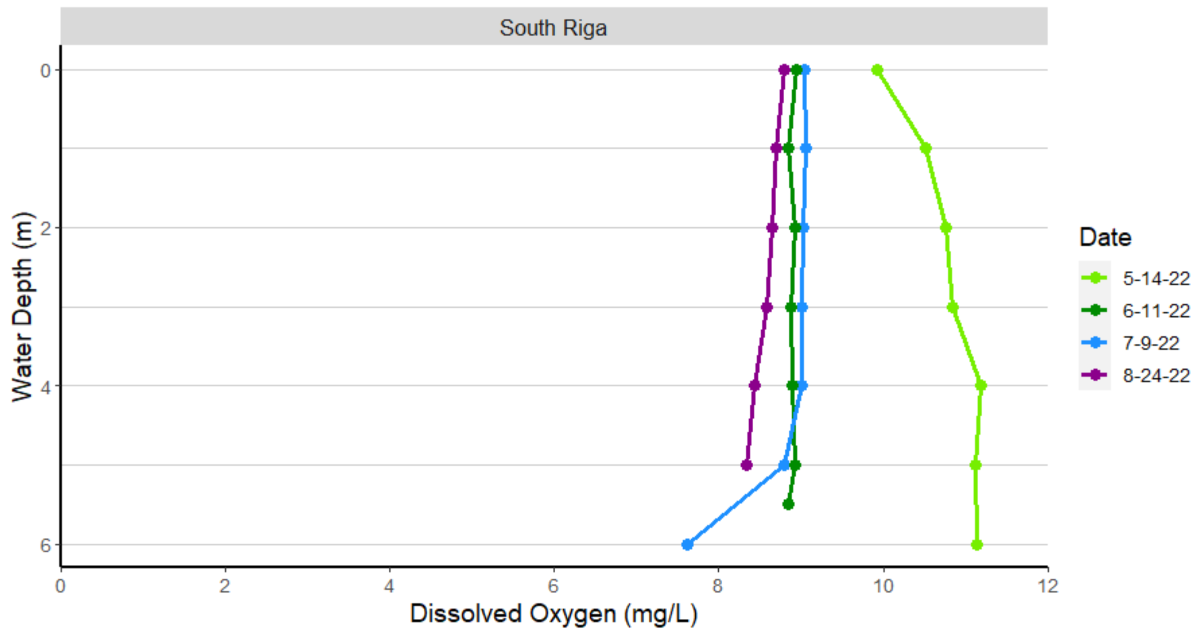
Dissolved oxygen (DO) in a lake is essential to aquatic organisms. At the surface of the lake, the water is in contact with the air, and atmospheric oxygen is dissolved into the water as a result of diffusion and wind mixing. As water mixing takes place, the dissolved oxygen is circulated throughout the water column. The decomposition of rooted aquatic plants and algae by bacteria requires dissolved oxygen (Biological Oxygen Demand) and can deplete the oxygen levels in the bottom waters below the thermocline. This phenomenon can lead to anoxic (<1 mg/l of DO) conditions in the deeper waters. Water that is anoxic (devoid of oxygen) is not suitable for fish and other aerobic aquatic organisms. When the water at the bottom of a lake is anoxic, nutrients trapped in the sediment at the lake bottom are released into the water through a process known as internal loading.

The June North Riga dissolved oxygen profile showed a slight increase in DO between 2 and 4 meters (**Figure 3**). This can be indicative of increased phytoplankton activity at this depth. DO slowly decreased below 4 meters, though the bottom water was still well-oxygenated.

In South Riga, DO increased between the top and bottom of the water column in May because colder water can hold more dissolved oxygen. The dissolved oxygen concentration remained fairly consistent from June through August, with a small but sharp decrease in DO in the bottom meter of water in July.

**Figure 3. Dissolved oxygen profiles at North Riga and South Riga, 2020.**






## Total Phosphorus

Ideally, total phosphorus concentrations should remain below 10ppb in North Riga and South Riga, placing the lake in the oligotrophic category.

In North Riga in June, TP was elevated above the 10ppb threshold at the middle of the water column (**Figure 4**, **Table 3**). By July, TP was elevated at all three sampling depths. Because water samples were only collected on two dates, it is not possible to compare 2022 nutrient concentrations to prior years.

In South Riga, TP remained below the 10ppb threshold in May and June. The July 1m sample was just over the threshold, at 11ppb. By August, both the top and middle water column samples were 14ppb. With the exception of the August top and middle water samples, TP in South Riga was relatively good in 2022, particularly compared to the elevated concentrations that were recorded in 2019 and 2020.

**Figure 4. Total phosphorus concentrations at North Riga and South Riga, 2018-2022.**

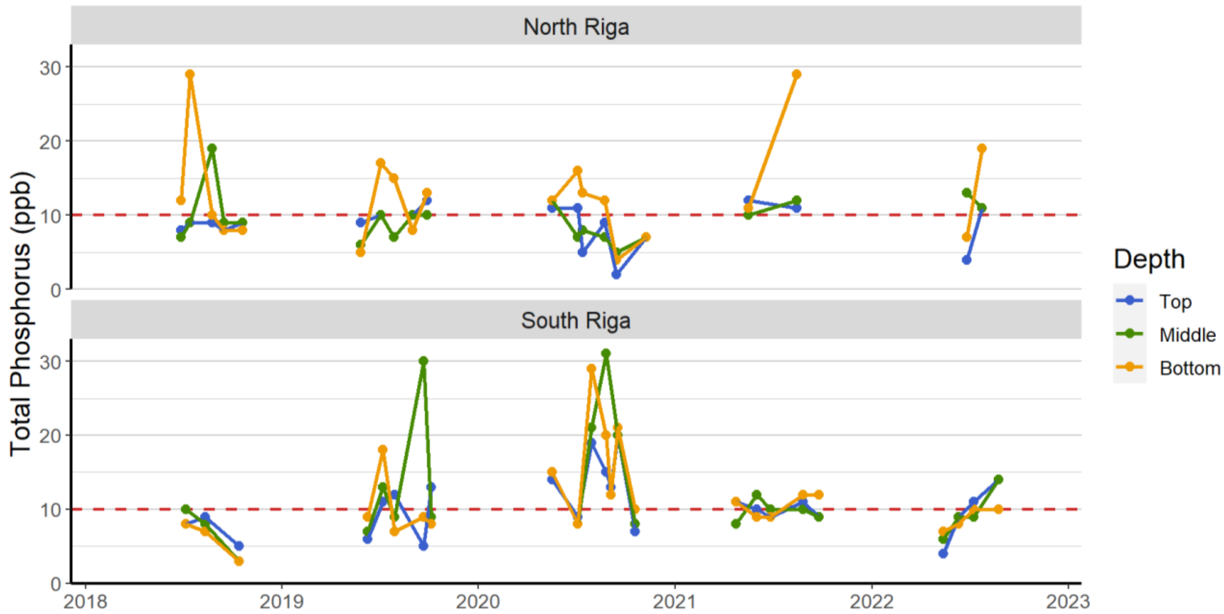



**Table 3. Total phosphorus concentrations at the top, middle and bottom depths at North Riga and South Riga, 2022.**

| North Riga Total Phosphorus (ppb) | | |
|---|---|---|
| | **26-Jun** | **24-Jul** |
| **Top** | 4 | 11 |
| **Middle** | 13 | 11 |
| **Bottom** | 7 | 19 |

| South Riga Total Phosphorus (ppb) | | | | |
|---|---|---|---|---|
| | **14-May** | **11-Jun** | **9-Jul** | **24-Aug** |
| **Top** | 4 | 9 | 11 | 14 |
| **Middle** | 6 | 9 | 9 | 14 |
| **Bottom** | 7 | 8 | 10 | 10 |

## Total Nitrogen

Total nitrogen (TN) includes fractions of nitrate, ammonia, and organic components. Ideally, TN should remain below 200ppb, placing the lakes in the 'oligotrophic' category. (**Figure 5**, **Table 4**).

In North Riga, the June middle water column sample had a concerningly high TN concentration of 431ppb. This is the first time since 2018 that a water sample from North Riga has exceeded 200ppb. The remaining June and July water samples were below the 200ppb threshold.

In South Riga, only the May 1m sample exceeded the 200ppb threshold. The remaining samples ranged from 114ppb to 174ppb of total nitrogen.

**Figure 5. Total nitrogen concentrations at North Riga and South Riga, 2018-2022.**

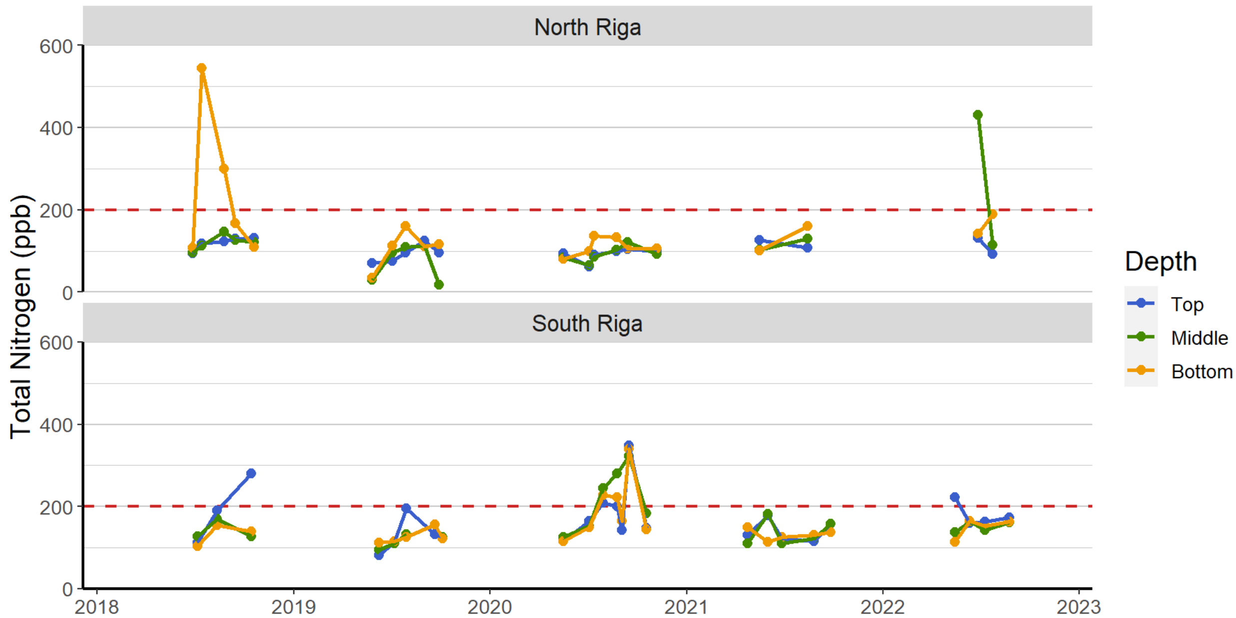



**Table 4. Total nitrogen concentrations at the top, middle and bottom depths at North Riga and South Riga, 2022.**

| North Riga Total Nitrogen (ppb) | | |
|---|---|---|
| | **26-Jun** | **24-Jul** |
| **Top** | 131 | 93 |
| **Middle** | 431 | 115 |
| **Bottom** | 141 | 189 |

| South Riga Total Nitrogen (ppb) | | | | |
|---|---|---|---|---|
| | **14-May** | **11-Jun** | **9-Jul** | **24-Aug** |
| **Top** | 222 | 160 | 163 | 174 |
| **Middle** | 138 | 163 | 142 | 161 |
| **Bottom** | 114 | 165 | 153 | 163 |

## Inlets

One sample was collected from the North Riga inlet during the June 26th sampling. This inlet had a total nitrogen concentration of 214ppb, and a total phosphorus concentration of 13ppb (**Table 5**). These values are higher than most in-lake TP and TN results from 2022. TN in the inlet should not exceed 200ppb, and TP should be closer to 4ppb. However, one sample is not enough to determine the impact of this inlet on the lake's water quality. Samples need to be collected monthly from all inlets to North Riga and South Riga to better understand the nutrient load.

**Table 5. Total nitrogen and total phosphorus concentrations in the North Riga inlet on 6/26/22.**

| | TN | TP |
|---|---|---|
| **6/26/2022** | 214 | 13 |

## Aquatic Plants

15 aquatic plant species were recorded in North Riga during the August 31st, 2022 aquatic plant survey (**Table 6**). Six species were dominant, meaning they were present at greater than 20% frequency (**Figure 6**). This is a high number of dominant species, suggesting no one species is outcompeting others. *Lobelia dortmanna* (water lobelia) was particularly abundant, present at 67% of the survey waypoints, but is not a species that is known to become a nuisance or outcompete other species.

Two Connecticut state-listed Endangered species, *Sparganium fluctuans* (floating bur-reed) and *Potamogeton confervoides* (Tuckerman's pondweed), were present in North Riga (**Figure 7**). Sparganium fluctuans was abundant, present at 37% of the survey waypoints, though the individual plant beds were sparse. *Potamogeton confervoides* was found near the mouth of the North Riga inlet and in one location on the eastern shoreline.

21 species were recorded in South Riga, along with filamentous algae. Four species were dominant, with *Utricularia purpurea* (Purple bladderwort) being the most abundant, present at 63% of waypoints (**Figure 8**). *U. purpurea* can become a nuisance, growing in large, dense beds that hinder recreational activities. However, the species has not yet reached a level of concern in South Riga.

The same two state-listed Endangered species that were present in North Riga were also present in South Riga. *Potamogeton confervoides* was abundant, present at 24% of survey waypoints. *Sparganium fluctuans* was present at 6% of survey waypoints, mainly located within the lake's coves (**Figure 9**).

Filamentous algae was present in a few areas along the shoreline of South Riga, mainly within the lake's coves (**Figure 10**). Filamentous algae is indicative of elevated nutrient concentrations in these areas, possibly from inlets in the vicinity.

No invasive aquatic plant species were found in either of the lakes in 2022.

**Table 6. Aquatic plants in North Riga and South Riga Lakes, August 31st, 2022.**

| North Riga | | |
|---|---|---|
| Species | % Frequency | Avg. Density |
| *Lobelia dortmanna* | 67 | 15 |
| *Sparganium fluctuans* | 37 | 13 |
| *Eleocharis acicularis* | 33 | 48 |
| *Nuphar variegata* | 29 | 11 |
| *Utricularia purpurea* | 29 | 21 |
| *Emergent Sparganium* | 22 | 15 |
| *Eriocaulon aquaticum* | 16 | 17 |
| *Myriophyllum humile* | 10 | 59 |
| *Nymphaea odorata* | 10 | 32 |
| *Potamogeton confervoides* | 6 | 40 |
| *Fontinalis sp* | 4 | 15 |
| *Elatine sp* | 2 | 5 |
| *Emergent eleocharis* | 2 | 40 |
| *Potamogeton bicupulatus* | 2 | 10 |
| *Utricularia minor* | 2 | 5 |

| South Riga | | |
|---|---|---|
| Species | % Frequency | Avg. Density |
| *Utricularia purpurea* | 63 | 38 |
| *Chara sp* | 55 | 21 |
| *Potamogeton confervoides* | 24 | 9 |
| *Eriocaulon aquaticum* | 21 | 16 |
| *Nuphar variegata* | 15 | 14 |
| *Emergent Sparganium* | 15 | 14 |
| *Nitella sp* | 12 | 24 |
| *Eleocharis robbinsii* | 11 | 30 |
| *Lobelia dortmanna* | 9 | 16 |
| *Nymphaea odorata* | 9 | 10 |
| *Elatine sp* | 8 | 12 |
| *Eleocharis acicularis* | 8 | 17 |
| *Sparganium fluctuans* | 6 | 11 |
| *Myriophyllum humile* | 5 | 14 |
| *Potamogeton epihydrus* | 5 | 25 |
| *Potamogeton natans* | 5 | 32 |
| *Filamentous algae* | 3 | 6 |
| *Isoetes sp* | 2 | 7 |
| *Eleocharis sp.* | 2 | 8 |
| *Brasenia schreberi* | <1 | 5 |
| *Fontinalis sp* | <1 | 10 |
| *Ludwigia sp* | <1 | 5 |

**Figure 6. Dominant aquatic plants in North Riga Pond, August 31, 2022.**

8-31-22 North Riga: Water Lobelia *(Lobelia sp)*

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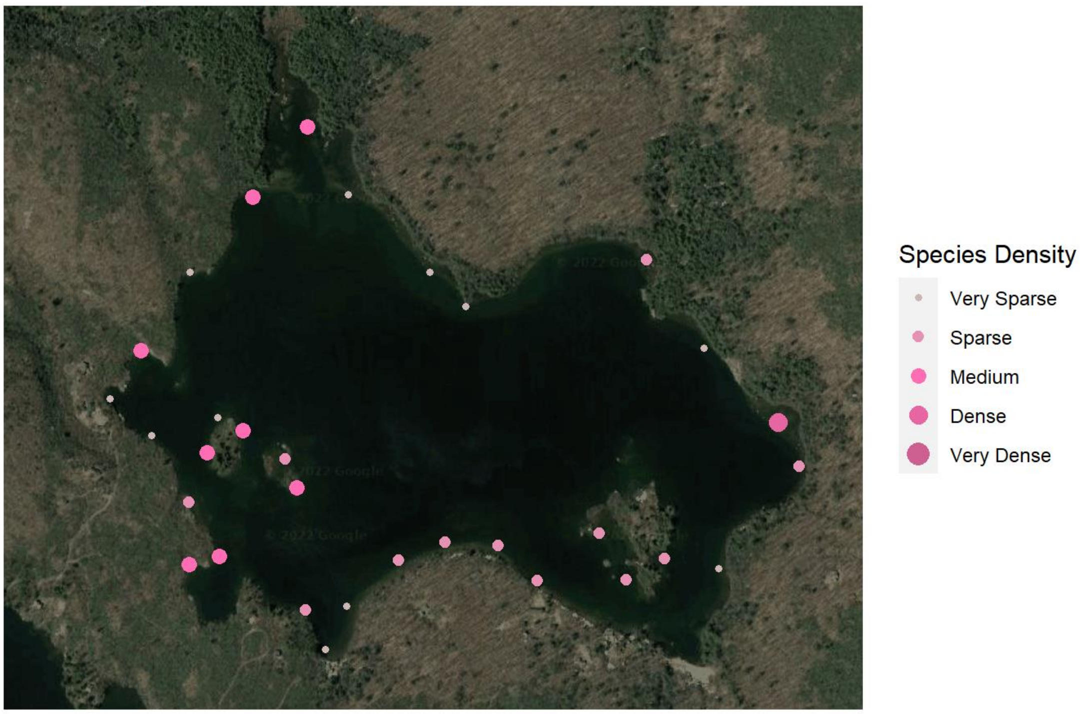


8-31-22 North Riga: Floating Bur-reed *(Sparganium fluctuans)*

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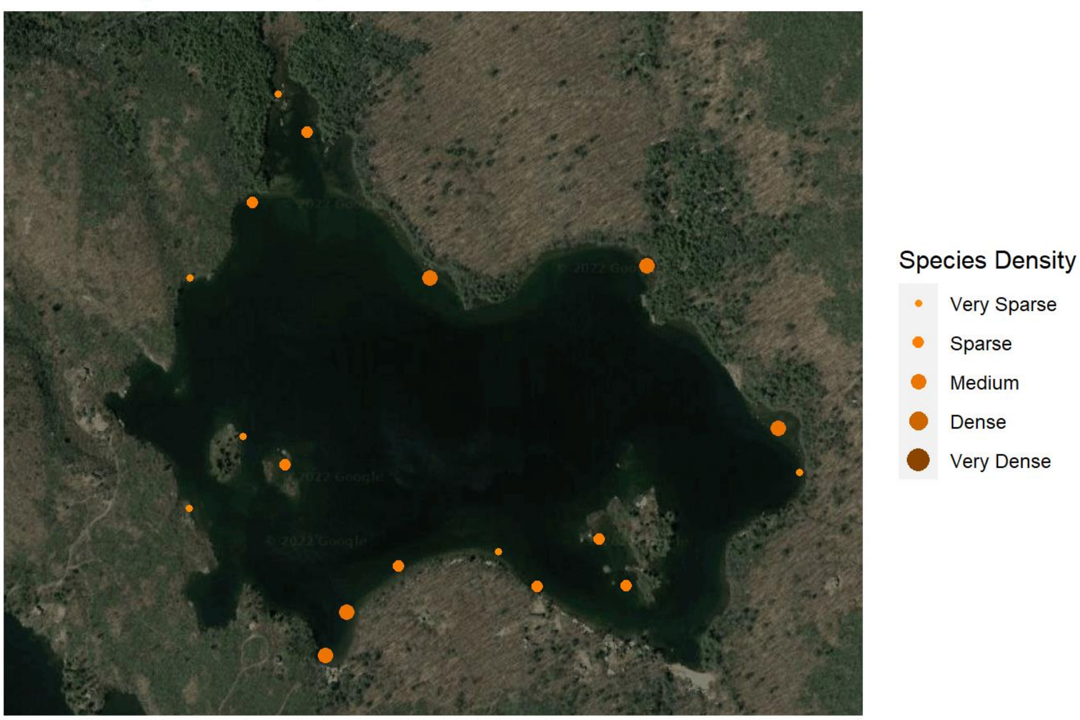

8-31-22 North Riga: Needle Spikerush *(Eleocharis acicularis)*

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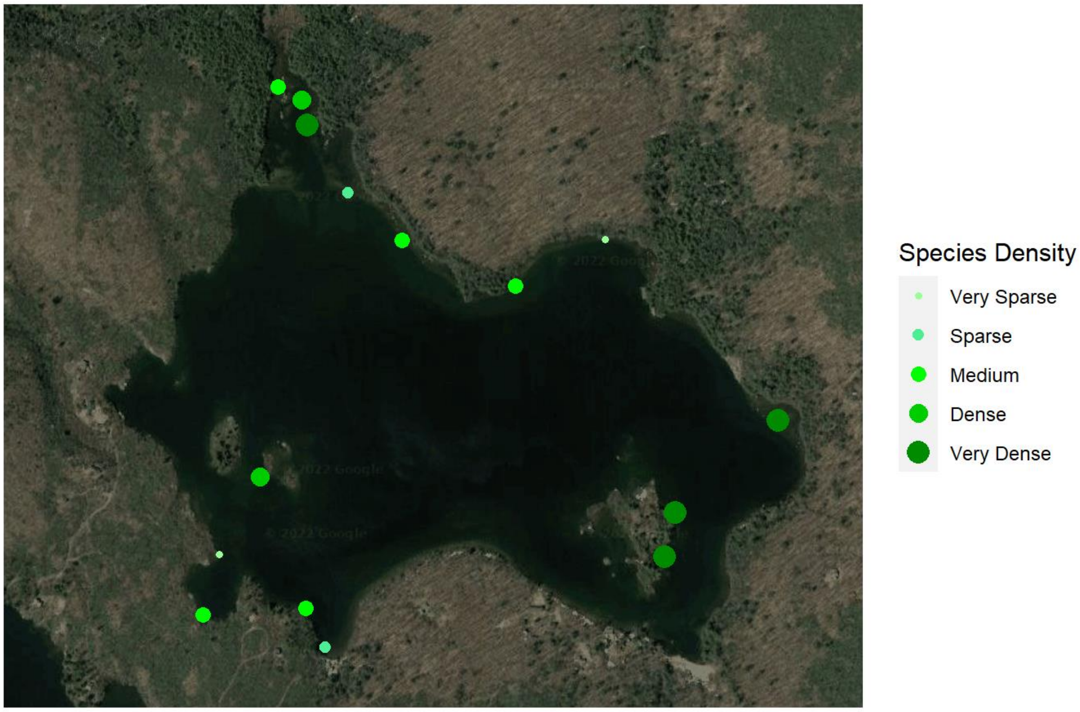


8-31-22 North Riga: Yellow Pond-lily *(Nuphar variegata)*

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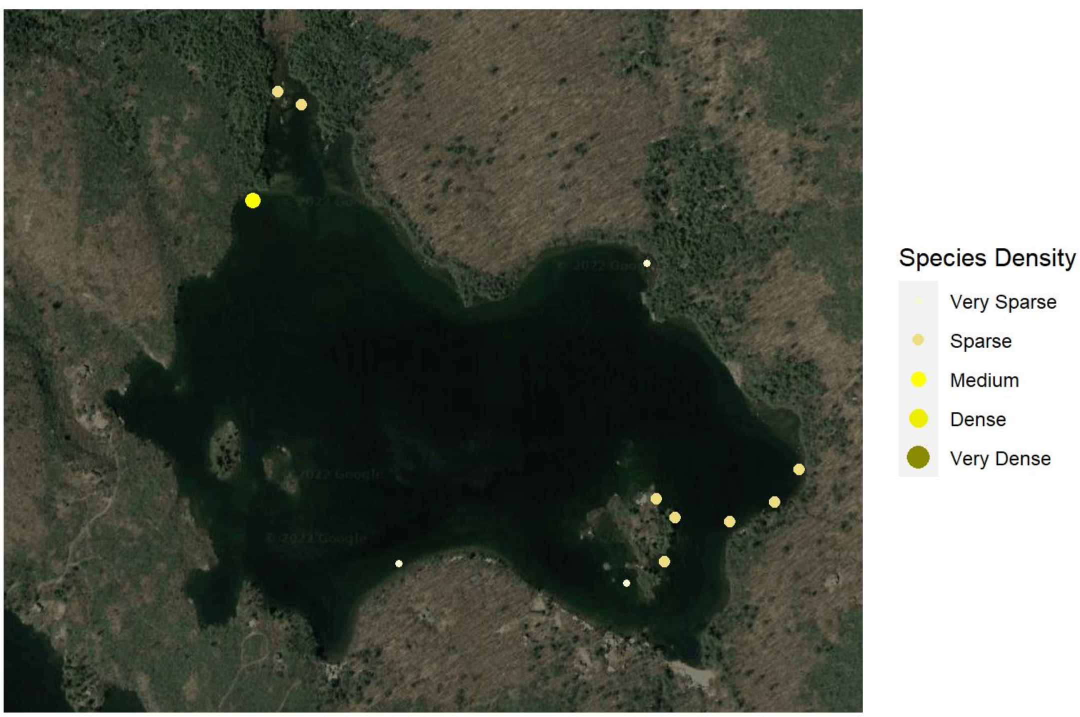

## 8-31-22 North Riga: Purple Bladderwort *(Utricularia purpurea)*

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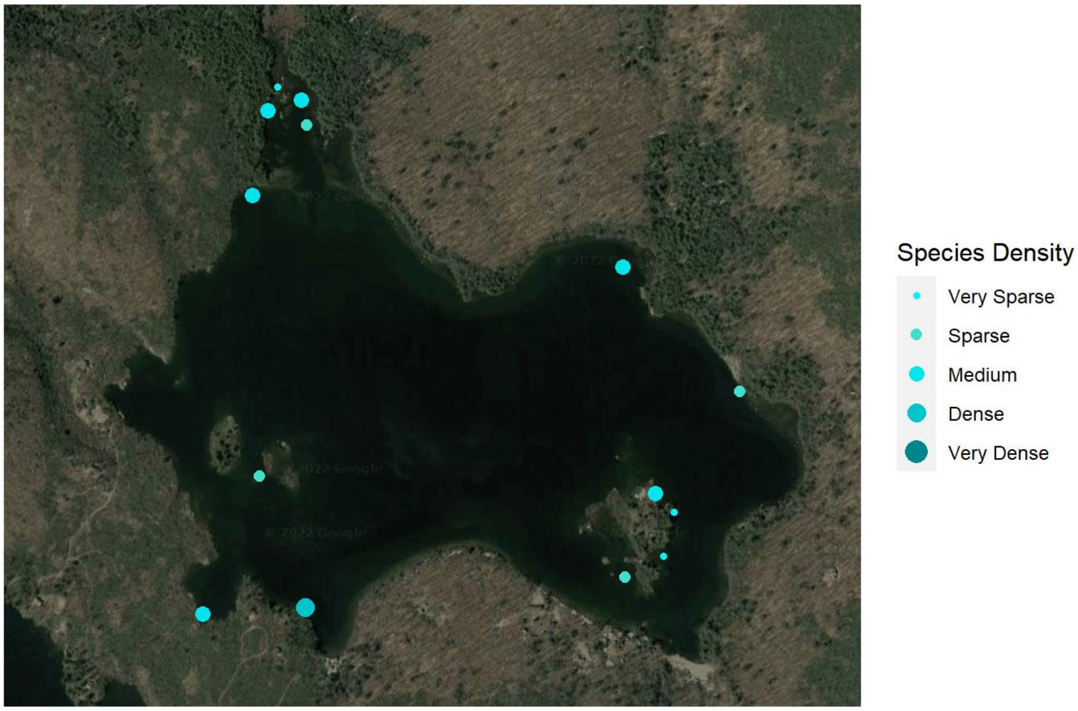


## 8-31-22 North Riga: Emergent Rush *(Sparganium sp)*

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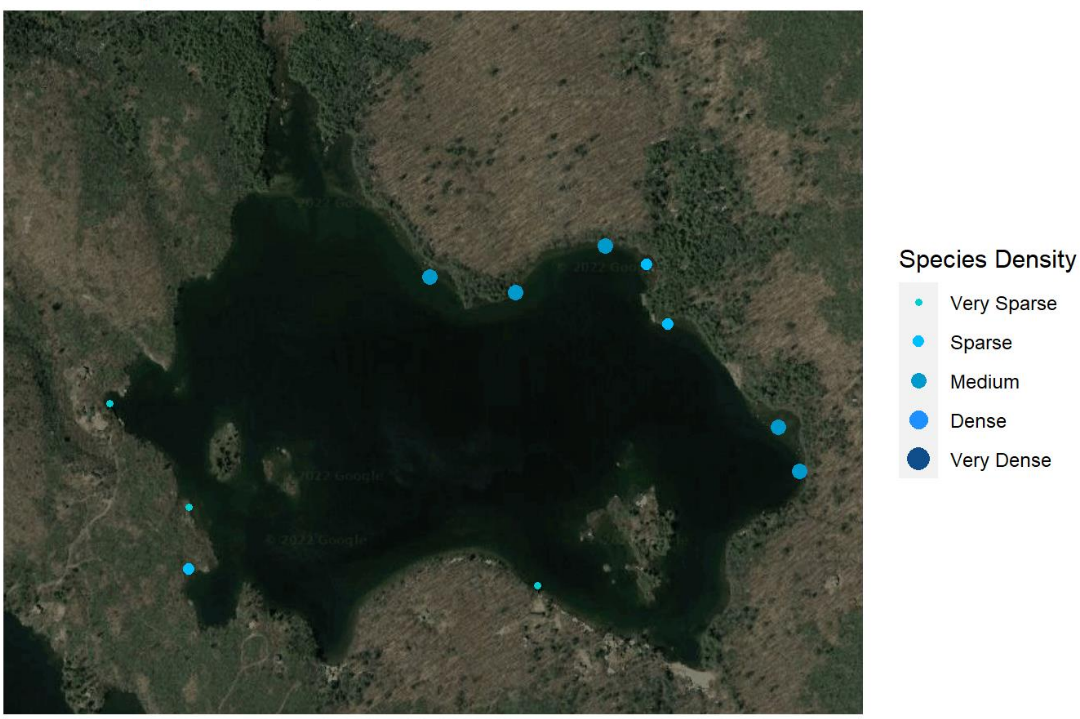


**Figure 7. Locations of *Potamogeton confervoides* in North Riga Lake, August 31st, 2022.**

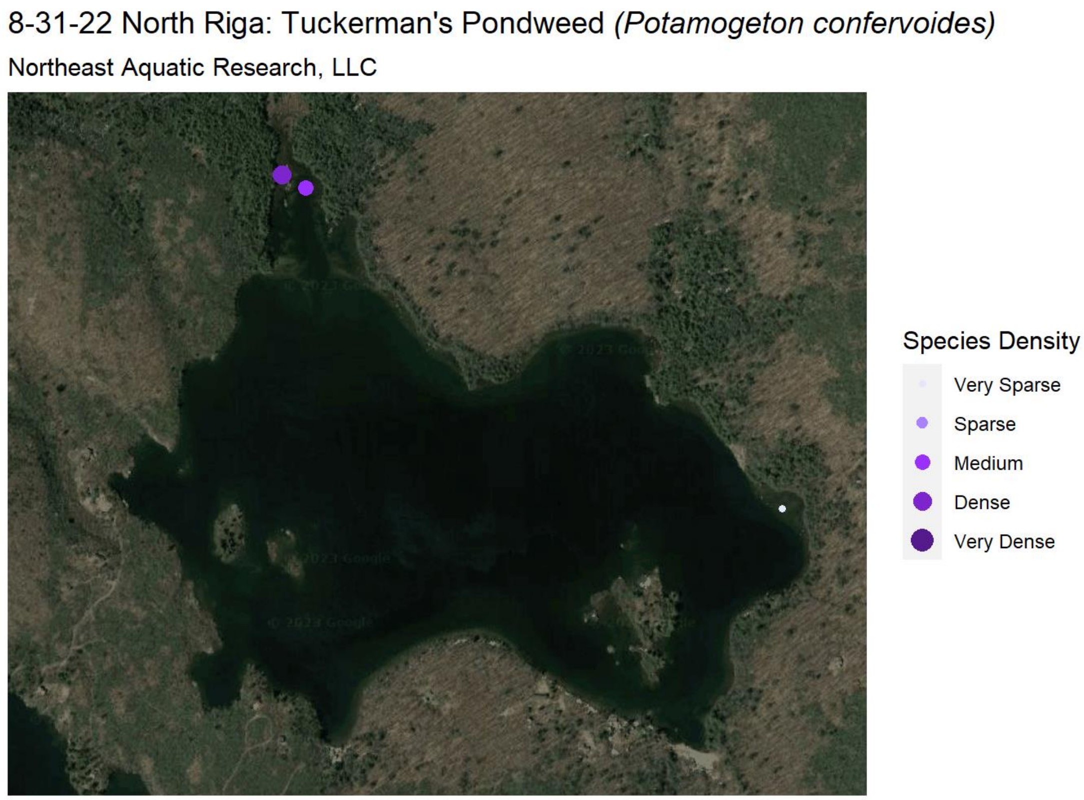
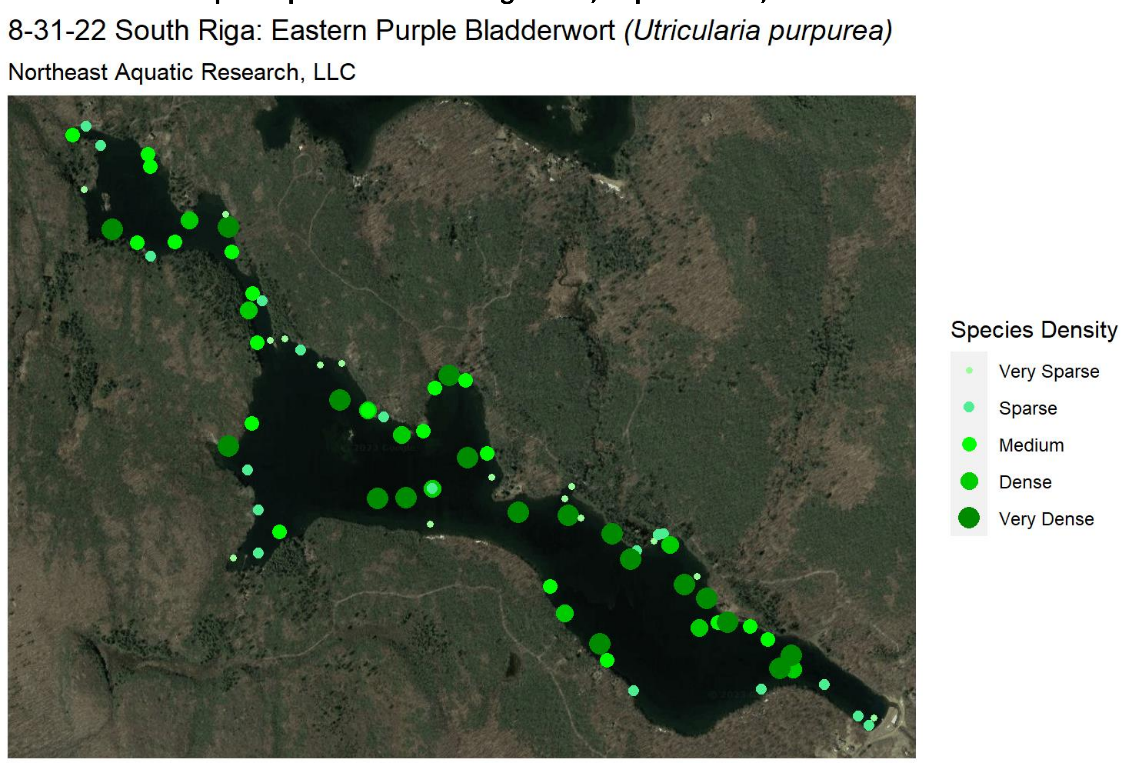



**Figure 8. Dominant aquatic plants in South Riga Lake, September 3, 2021.**



8-31-22 South Riga: Muskgrass sp. *(Chara sp.)*

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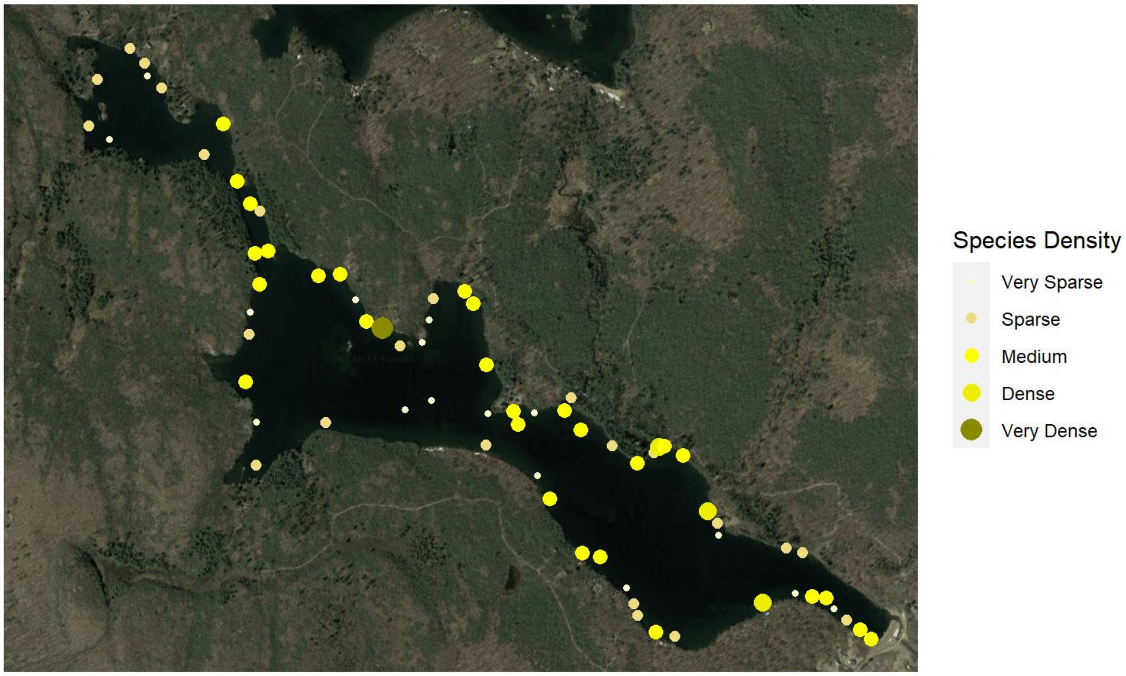


8-31-22 South Riga: Tuckerman's Pondweed *(Potamogeton confervoides)*

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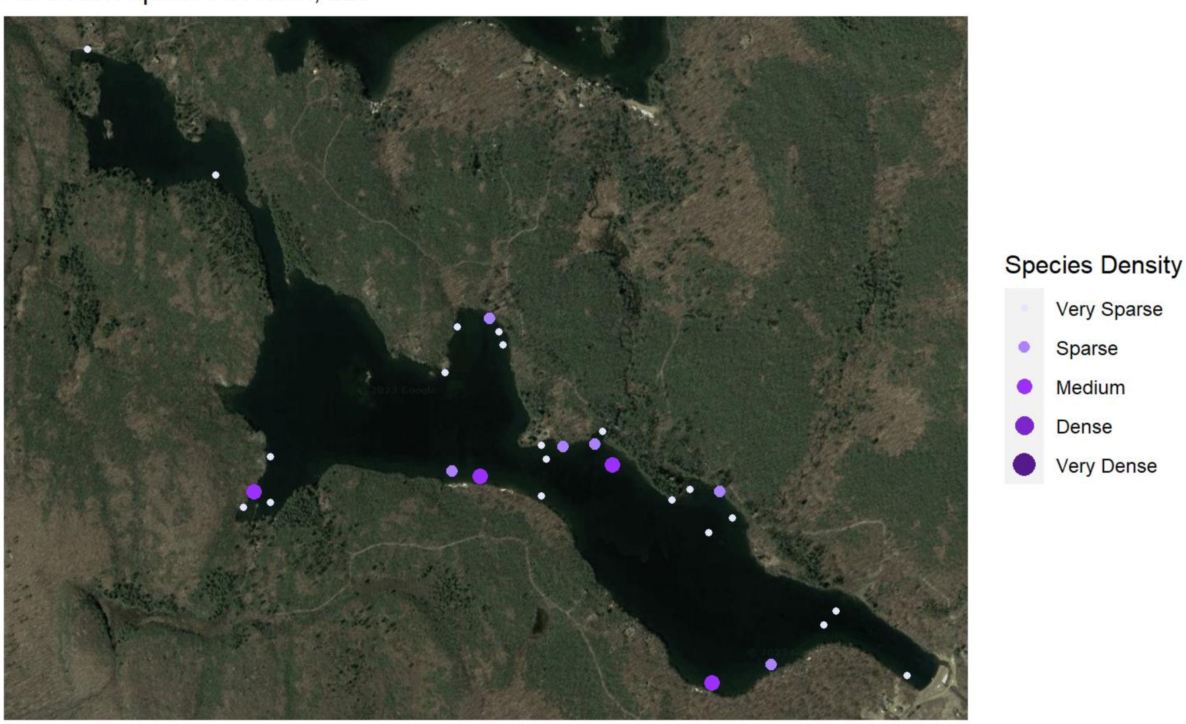


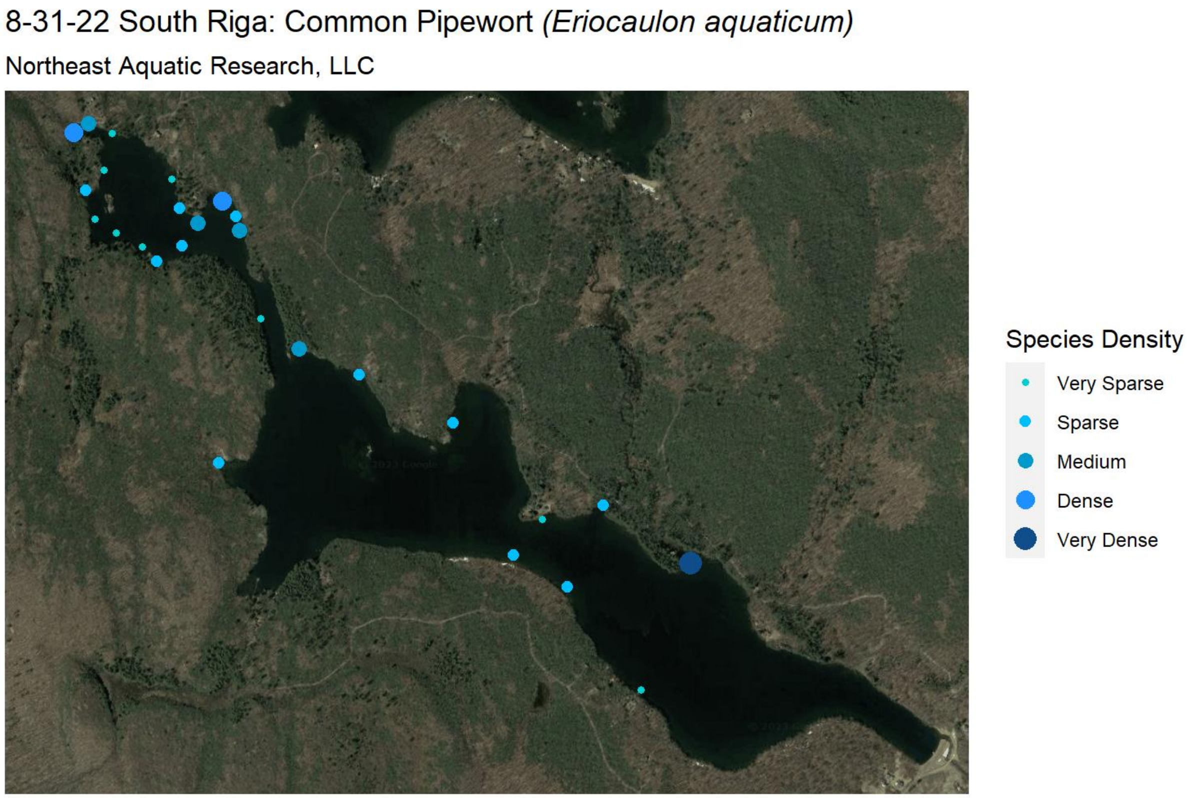



**Figure 9. Locations of Sparganium fluctuans in South Riga Pond, August 31st, 2022.**

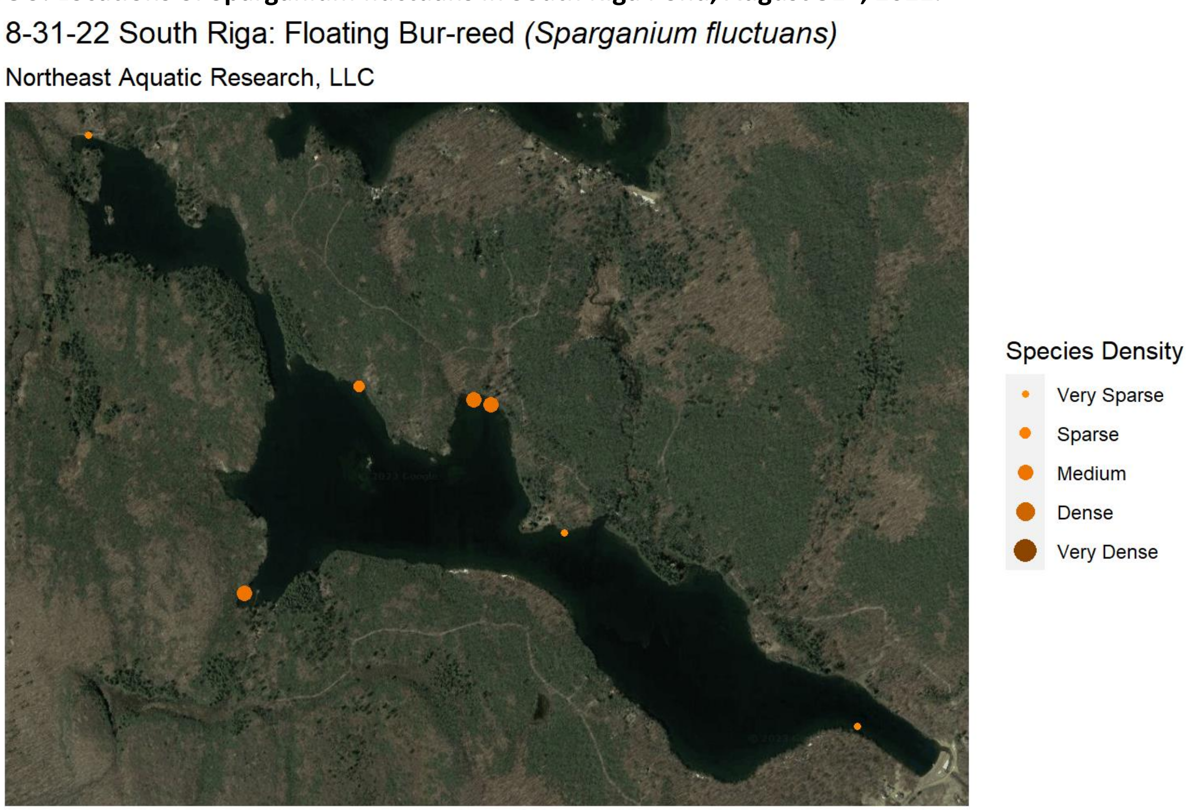
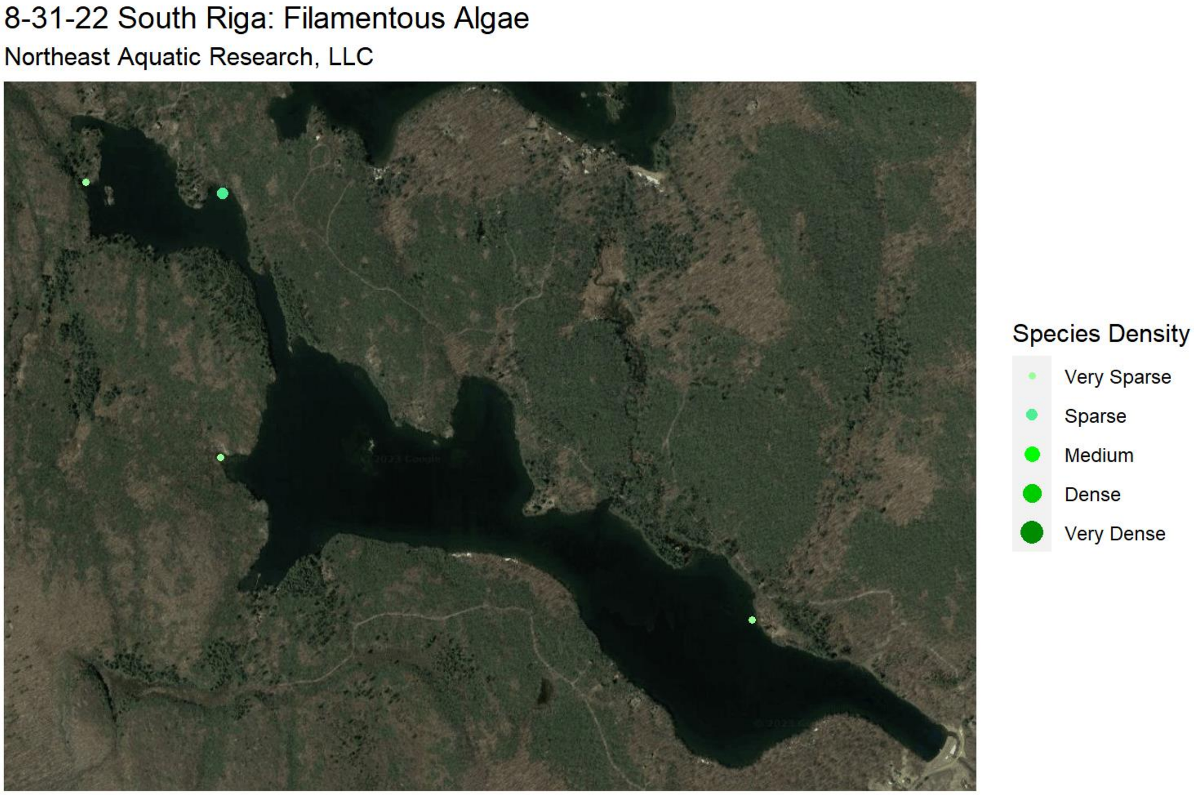


**Figure 10. Locations of Filamentous Algae in South Riga Pond.**




## Suggested 2023 Actions

1. **Improve the consistency of in-lake water quality monitoring**. Monitoring should be conducted from May through October, to track the full extent of seasonal fluctuations, including peak extent of anoxic water, best and worst seasonal clarity, and peak nutrient concentrations. It is important to collect all sampling parameters (water clarity, profiles, and water samples) each month. The limited monitoring events in North Riga in 2022 make it impossible to fully ascertain the lake condition but it is clear that the water quality of both lakes is deteriorating. **We cannot provide recommendations for remediation until we have more data.**

2. The last volunteer monitor training was conducted in 2018. We want to make sure that data is being collected correctly so that the results are reliable. We would also like the opportunity to speak directly to the volunteer monitors to convey the importance of consistent, regular monitoring. Therefore, we would like to conduct a training in late spring/early summer 2023.

3. Mount Riga Lakes, Inc. should invest in a continuous data logger set-up in both lakes to better track the oxygen and temperature dynamics at the lake bottoms, between volunteer monitoring events. These systems can also be paired with a water level data logger to track water level fluctuation throughout the season. Continuous water level data would provide a good understanding of the

quantity of water reaching the lakes after rainfall events, which translates to greater understanding of watershed nutrient dynamics.

4. Collect inlet samples from all flowing inlets once per month from May through October to assess watershed nutrient loading. The samples should be tested for total phosphorus, total nitrogen, and nitrate nitrogen. All shoreline areas where filamentous algae is indicated in **Figure 10** should be inspected for inlets and seeps.
5. Conduct late-summer full-lake aquatic plant surveys at the two lakes to document the presence and abundance of aquatic plant species in the lake and to search for invasive species.
6. The Riga Lakes residents should discuss watershed protection efforts, including limiting development, road maintenance to prevent erosion, onsite wastewater updates for local camps, and potential in-lake management efforts.
7. Both ponds should be sampled for Giardia in 2023, near drinking water intakes. Ideally, testing should occur once per month, but at least 3 times in 2023 to provide a baseline. We recommend testing both ponds once in the spring, once in August, and once immediately following a large rain event.
8. Any water pulled from the pond for drinking purposes should be filtered. Pond water can contain parasites and bacteria that are hazardous to humans. Parasites and bacteria can concentrate in one area (i.e., if there is a dead animal in the water) and so testing at one site may not pick up issues in another area of the pond. Many lake water filters are available for purchase online.
9. All near-lake septic systems should be inspected to determine whether nutrients are leaching from the septic systems into the lakes.