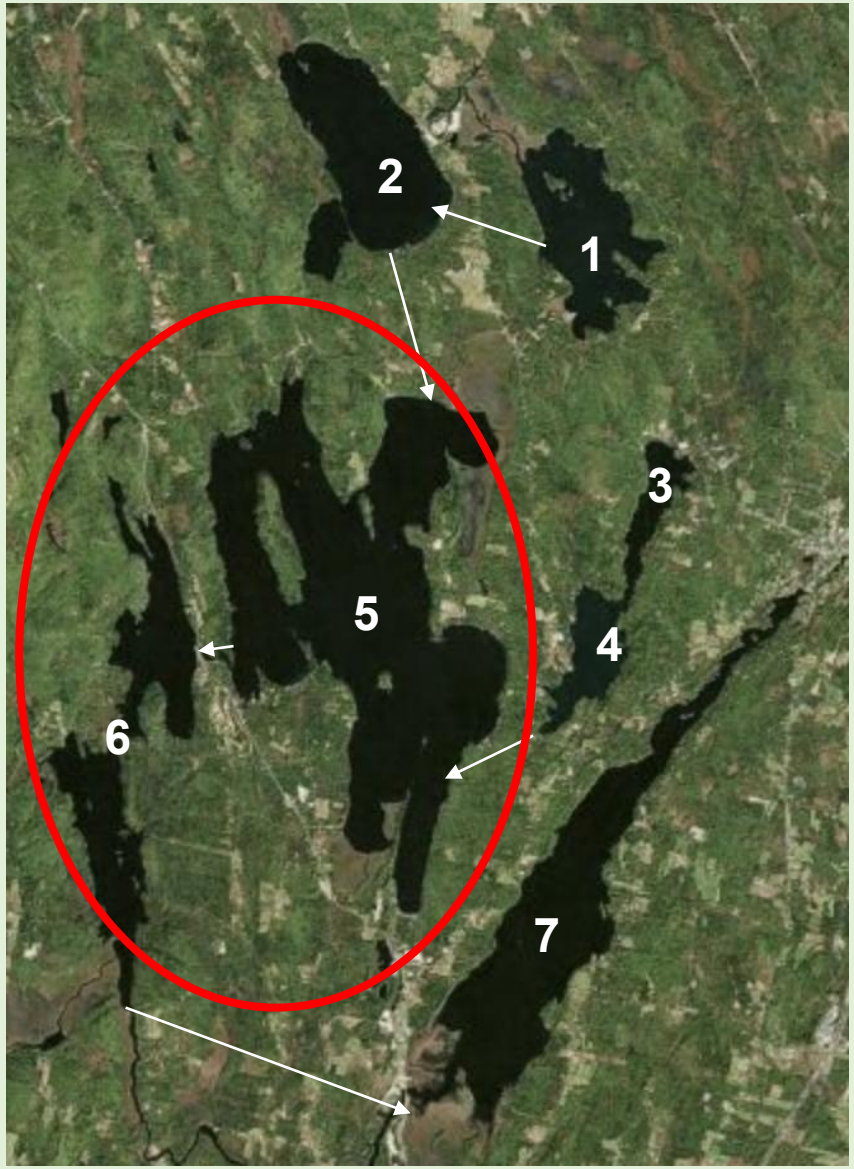
# Harnessing community science data to understand *Gloeotrichia* blooms in the Belgrade Lakes

Danielle Wain (7 Lakes Alliance)
Grady Florance (Colby College)
Adrian Gellert (Colby College)
Whitney King (Colby College)


Colby

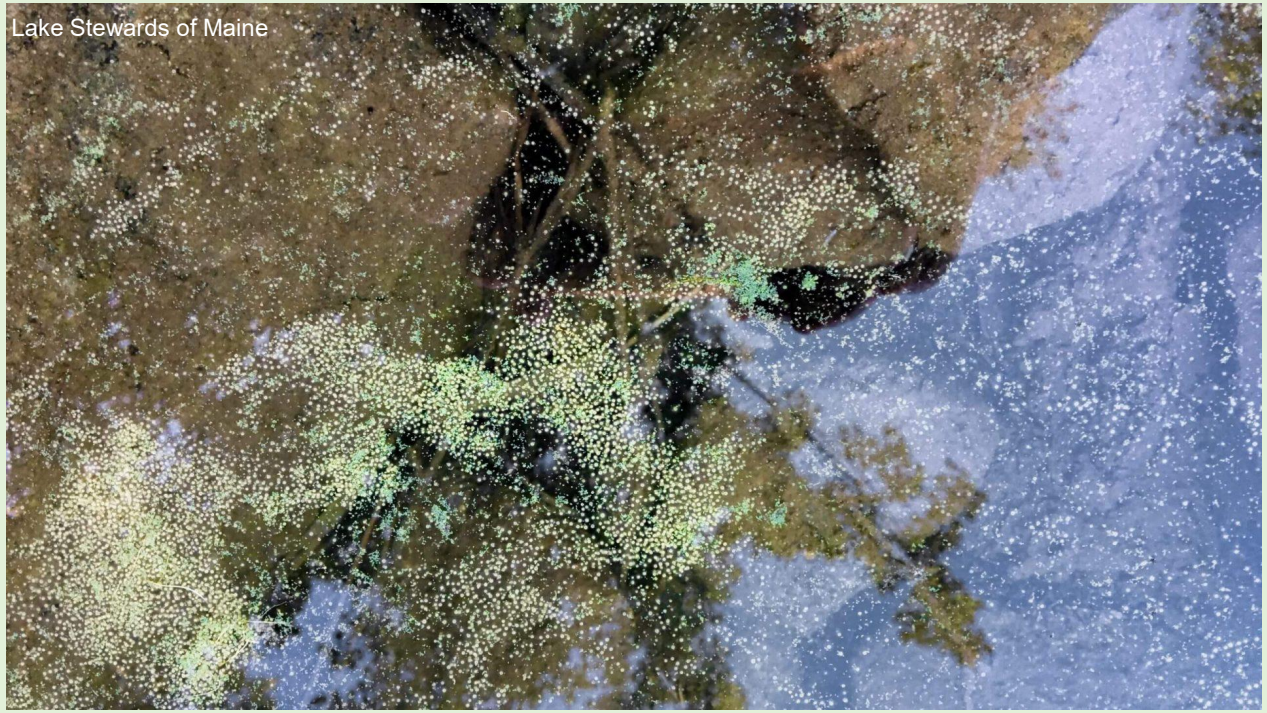
# Great Pond and Long Pond are part of the Belgrade Lakes chain




| | Great | Long-North | Long-South |
|---|---|---|---|
| Surface Area ($km^2$) | 33 | 5.1 | 4.1 |
| Mean Depth (m) | 6.3 | 7.5 | 7.5 |
| Max Depth (m) | 21 | 19 | 32 |
| Residence Time (yrs) | 1.9 | 0.4 | 0.3 |
| Mean SDT (m) | 6.1 | 6.3 | 6.0 |
| Mean TP (ppb) | 8.9 | 7.7 | 7.4 |

Considered mesotrophic lakes by Maine DEP trophic state definitions

# Both lakes suffer from blooms of *Gloeotrichia*




In North America, Gloeo appears in relatively clear lakes during late summer and fall

- *Gloeotrichia* (Gloeo for short) is a large (~2 mm) colonial cyanobacteria
- Beyond being a nuisance, Gloeo can also cause some lake users to get itchy skin when they go swimming
- On other lakes, we get whole lake cyanobacteria blooms of other genuses; on Great and Long Pond, we get local blooms of Gloeo, mostly on the shoreline.
- Gloeo can produce toxins, but studies on Great Pond and Long Pond have not detected levels of concern (Carey et al. 2012)

# Gloeo life cycle creates challenges for observations

- The colonies develop in lake sediments in the spring, recruiting phosphorus from the sediments for growth

- Light at the sediments is required for their growth (which is why clearer lakes are susceptible in the presence of phosphorus laden sediments)

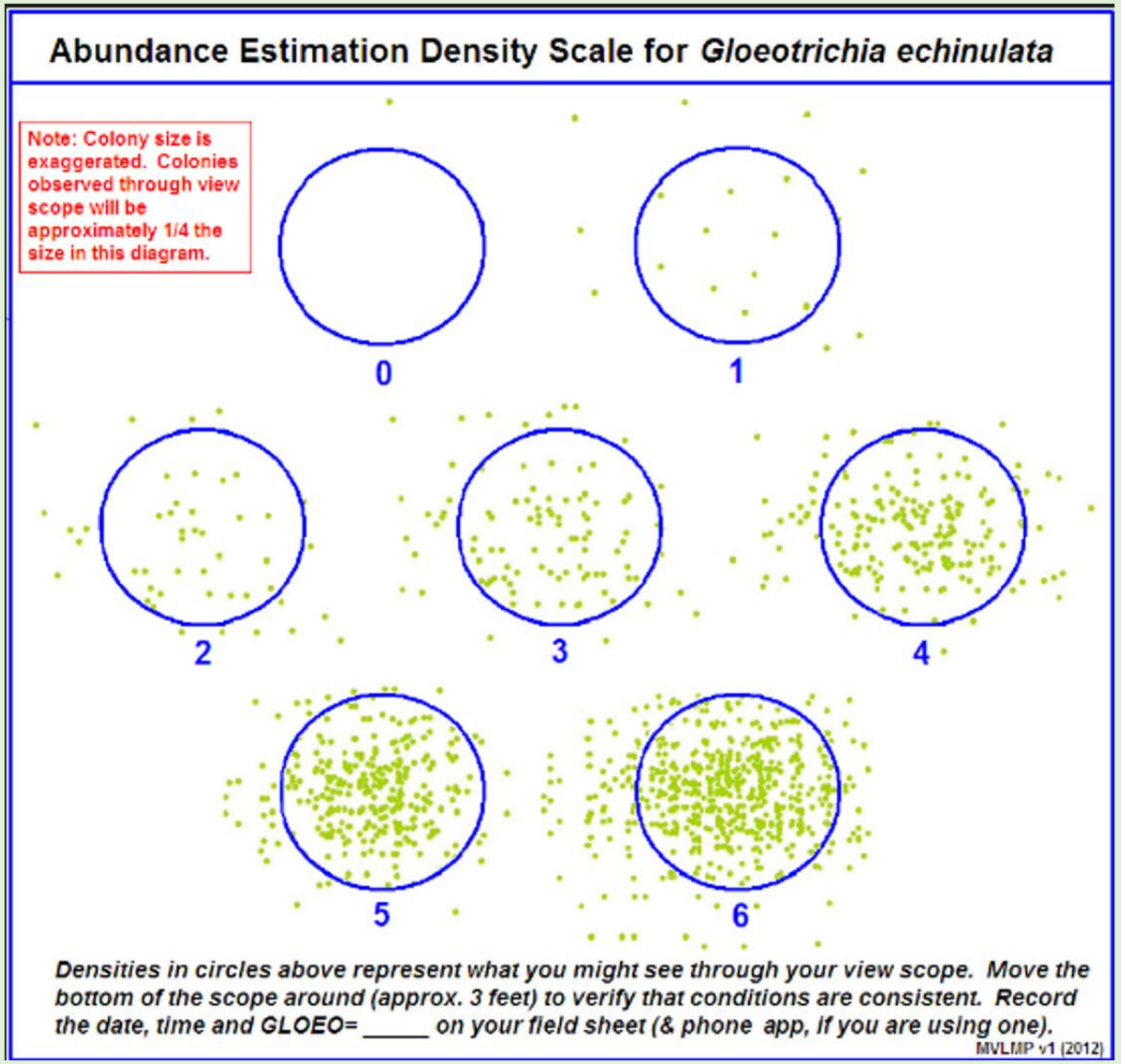
- Once the right conditions are met, the colonies form gas vesicles which allow them to float to the surface, where colonies continue to grow and divide

- Once at the surface, the colonies can be distributed horizontally by wind driven currents

- Spatiotemporal variability makes observing and predicting Gloeo blooms difficult!
- Deep hole sampling misses shoreline accumulations
- Weekly or biweekly shoreline sampling can miss peaks in concentrations

# Since 2005, BLA volunteers have observed Gloeo at their docks


Training session at 7 Lakes in 2023 run by Maine DEP



# Volunteers observe Gloeo density several times per week

**7 LAKES ALLIANCE**
**2023 Volunteer Gloeotrichia Observation Program**
**Observation Data Sheet**

| Item | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Lake: | | | | | | | | |
| 2 | Station ID #: | | | | | | | | |
| 3 | Volunteer's name | | | | | | | | |
| 4 | Volunteers phone | | | | | | | | |
| 5 | Volunteer's e-mail | | | | | | | | |
| 6 | Station Description | | | | | | | | |
| 7 | Scope? Y/N | | | | | | | | |

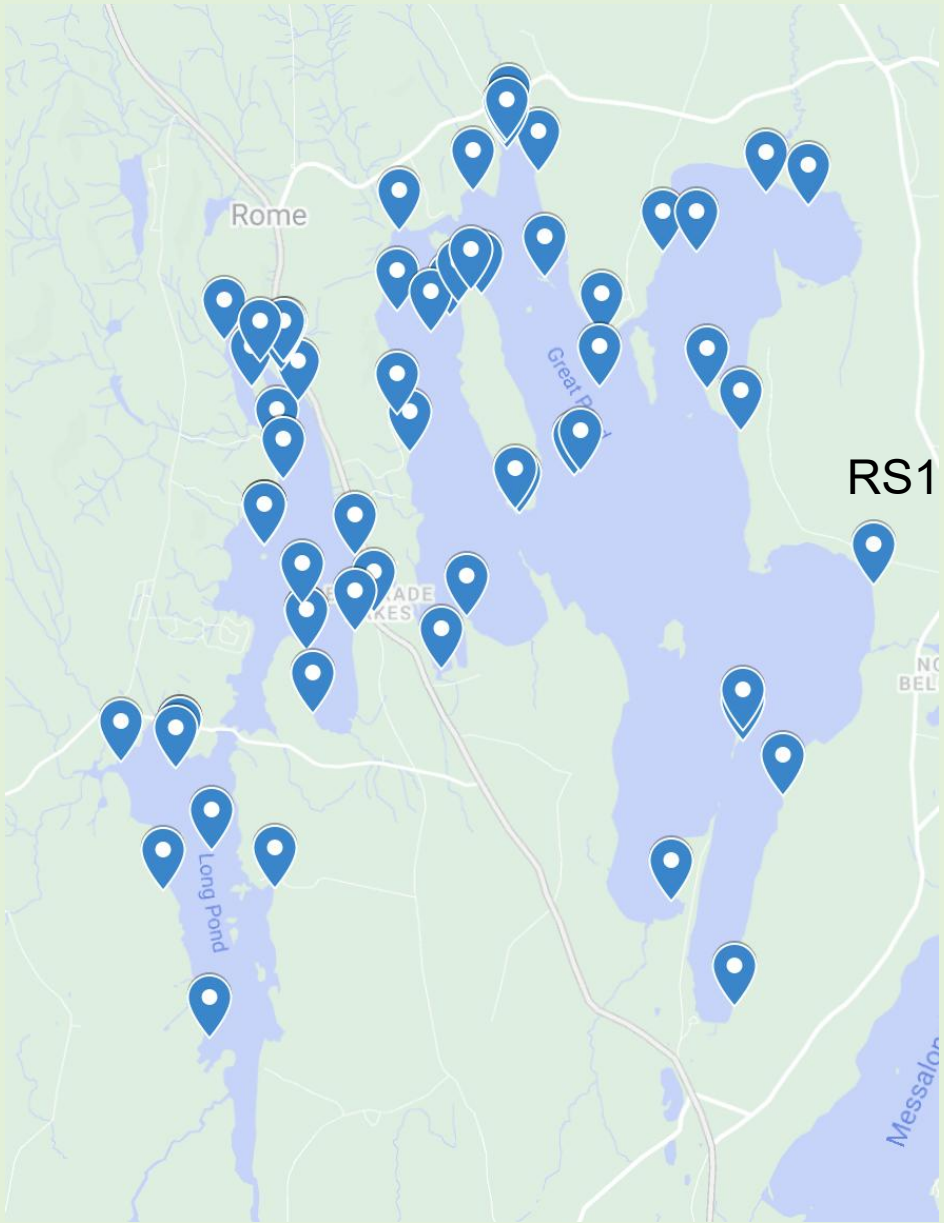
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|
| | Observation Date | Observation | Wind | Wind | Cloud | Water | Gloeo | Enjoyment | Comments |
| | (mm/dd/yy) | Time | Speed | Dir. | Cover | Temp | Density | Impact | (Unusual Conditions and |
| | | (military) | (MPH) | (1-8) | (B,C,O) | deg F or C | (0-6) | (0-5) | other Water Observations) |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**Notes:**

**#6 Station Description:** Describe station as dock, shoreline, boat, etc.;distance from shore; cove vs. open water, water depth, sandy or rocky bottom, etc.
**#7 Scope:** Please indicate if you use an AquaScope for your measurements
**#9 Observation Time** in Military Hours (24-hour clock 00:00 to 23:59)
**#11 Wind Direction** 1=N, 2= NE, 3 = E, 4=SE, 5= S, 6=SW, 7=W, 8= NW
**#12 Cloud Cover:** B= Bright Sun, C= Partly to Mostly Cloudy, O = Overcast - sky completely covered by clouds
**#13 Water Temperature is Optional** - if you take measurement, indicate if it is in Fahrenheit (F) or Centigrade (C)
**#14 Gloeotrichia Density** Based on Gloeotrichia target diagram (Bouchard Scale)
**#15 Enjoyment Impact:** 0 = no impact to 5 = severe. (3 =one or more family members would hesitate to swim due to observed gloeotrichia)
**#16 Comments - Optional** - Indicate unusual conditions,dense blooms elsewhere in area, severe weather, other water conditions

- Program started as a BLA-DEP-BRCA (now 7 Lakes) initiative
- Some evolution of the data sheets over time, but generally similar data has been collected over the past two decades
- Most significant shift was 2023, when we moved from 0-5 scale to the 0-6 scale used across the state

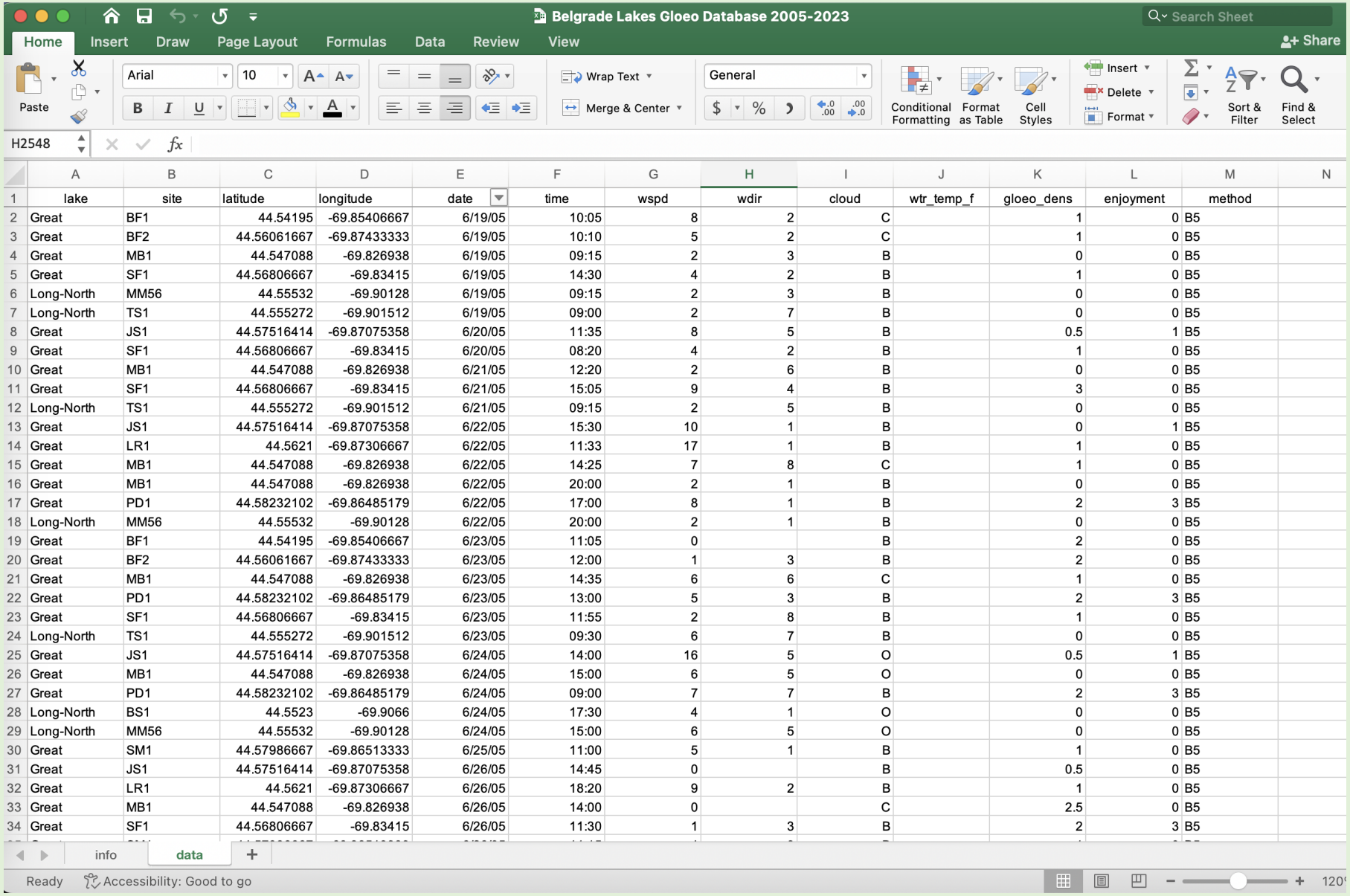
# There have been 72 sites across Great Pond and Long Pond




| Lake | No. of Sites | No. of Observations |
|---|---|---|
| Great | 46 | 3756 |
| Long-North | 18 | 885 |
| Long-South | 8 | 593 |

1021 observations by one individual!

# This community driven approach has created a unique database



Belgrade Lakes Gloeo Database 2005-2023

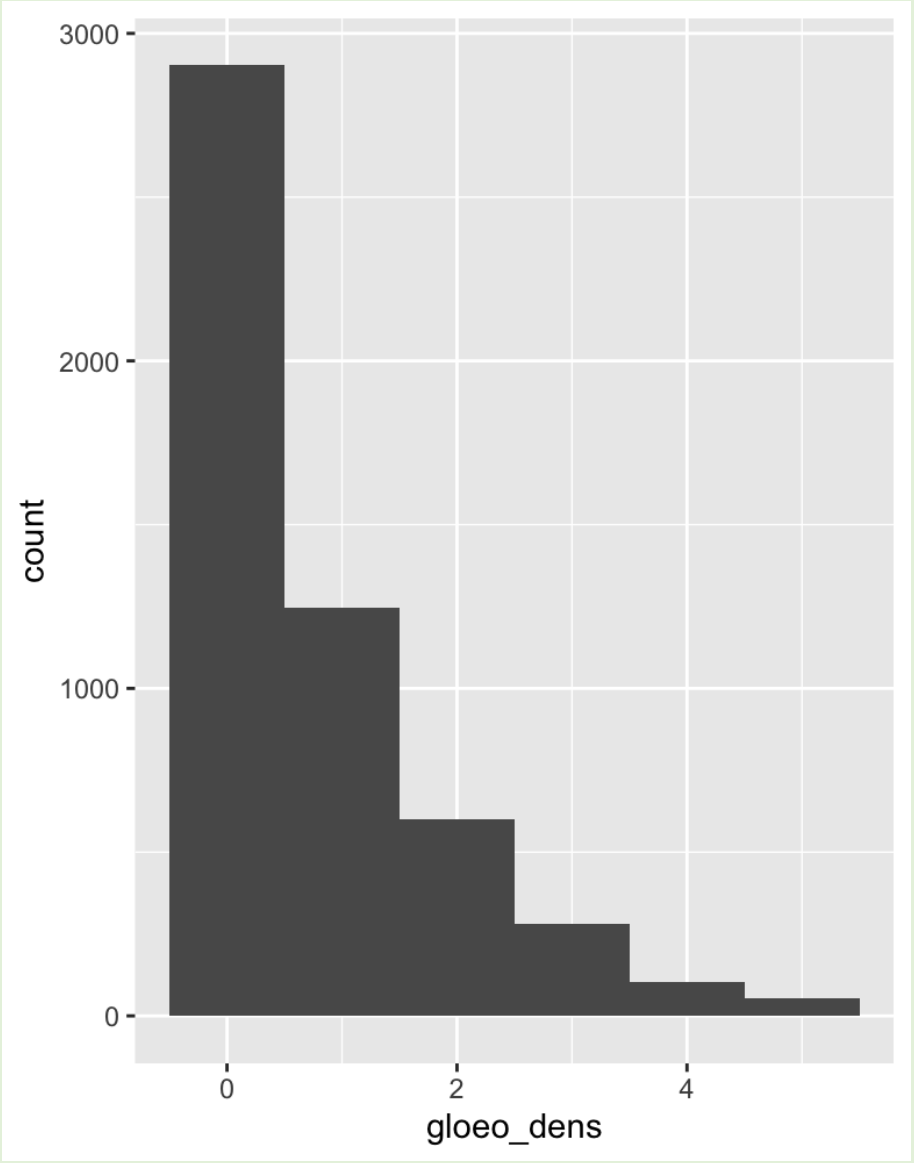
| lake | site | latitude | longitude | date | time | wspd | wdir | cloud | wtr_temp_f | gloeo_dens | enjoyment | method |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Great | BF1 | 44.54195 | -69.85406667 | 6/19/05 | 10:05 | 8 | 2 | C | | 1 | 0 | B5 |
| Great | BF2 | 44.56061667 | -69.87433333 | 6/19/05 | 10:10 | 5 | 2 | C | | 1 | 0 | B5 |
| Great | MB1 | 44.547088 | -69.826938 | 6/19/05 | 09:15 | 2 | 3 | B | | 0 | 0 | B5 |
| Great | SF1 | 44.56806667 | -69.83415 | 6/19/05 | 14:30 | 4 | 2 | B | | 1 | 0 | B5 |
| Long-North | MM56 | 44.55532 | -69.90128 | 6/19/05 | 09:15 | 2 | 3 | B | | 0 | 0 | B5 |
| Long-North | TS1 | 44.555272 | -69.901512 | 6/19/05 | 09:00 | 2 | 7 | B | | 0 | 0 | B5 |
| Great | JS1 | 44.57516414 | -69.87075358 | 6/20/05 | 11:35 | 8 | 5 | B | | 0.5 | 1 | B5 |
| Great | SF1 | 44.56806667 | -69.83415 | 6/20/05 | 08:20 | 4 | 2 | B | | 1 | 0 | B5 |
| Great | MB1 | 44.547088 | -69.826938 | 6/21/05 | 12:20 | 2 | 6 | B | | 0 | 0 | B5 |
| Great | SF1 | 44.56806667 | -69.83415 | 6/21/05 | 15:05 | 9 | 4 | B | | 3 | 0 | B5 |
| Long-North | TS1 | 44.555272 | -69.901512 | 6/21/05 | 09:15 | 2 | 5 | B | | 0 | 0 | B5 |
| Great | JS1 | 44.57516414 | -69.87075358 | 6/22/05 | 15:30 | 10 | 1 | B | | 0 | 1 | B5 |
| Great | LR1 | 44.5621 | -69.87306667 | 6/22/05 | 11:33 | 17 | 1 | B | | 1 | 0 | B5 |
| Great | MB1 | 44.547088 | -69.826938 | 6/22/05 | 14:25 | 7 | 8 | C | | 1 | 0 | B5 |
| Great | MB1 | 44.547088 | -69.826938 | 6/22/05 | 20:00 | 2 | 1 | B | | 0 | 0 | B5 |
| Great | PD1 | 44.58232102 | -69.86485179 | 6/22/05 | 17:00 | 8 | 1 | B | | 2 | 3 | B5 |
| Long-North | MM56 | 44.55532 | -69.90128 | 6/22/05 | 20:00 | 2 | 1 | B | | 0 | 0 | B5 |
| Great | BF1 | 44.54195 | -69.85406667 | 6/23/05 | 11:05 | 0 | | B | | 2 | 0 | B5 |
| Great | BF2 | 44.56061667 | -69.87433333 | 6/23/05 | 12:00 | 1 | 3 | B | | 2 | 0 | B5 |
| Great | MB1 | 44.547088 | -69.826938 | 6/23/05 | 14:35 | 6 | 6 | C | | 1 | 0 | B5 |
| Great | PD1 | 44.58232102 | -69.86485179 | 6/23/05 | 13:00 | 5 | 3 | B | | 2 | 3 | B5 |
| Great | SF1 | 44.56806667 | -69.83415 | 6/23/05 | 11:55 | 2 | 8 | B | | 1 | 0 | B5 |
| Long-North | TS1 | 44.555272 | -69.901512 | 6/23/05 | 09:30 | 6 | 7 | B | | 0 | 0 | B5 |
| Great | JS1 | 44.57516414 | -69.87075358 | 6/24/05 | 14:00 | 16 | 5 | O | | 0.5 | 1 | B5 |
| Great | MB1 | 44.547088 | -69.826938 | 6/24/05 | 15:00 | 6 | 5 | O | | 0 | 0 | B5 |
| Great | PD1 | 44.58232102 | -69.86485179 | 6/24/05 | 09:00 | 7 | 7 | B | | 2 | 3 | B5 |
| Long-North | BS1 | 44.5523 | -69.9066 | 6/24/05 | 17:30 | 4 | 1 | O | | 0 | 0 | B5 |
| Long-North | MM56 | 44.55532 | -69.90128 | 6/24/05 | 15:00 | 6 | 5 | O | | 0 | 0 | B5 |
| Great | SM1 | 44.57986667 | -69.86513333 | 6/25/05 | 11:00 | 5 | 1 | B | | 1 | 0 | B5 |
| Great | JS1 | 44.57516414 | -69.87075358 | 6/26/05 | 14:45 | 0 | | B | | 0.5 | 0 | B5 |
| Great | LR1 | 44.5621 | -69.87306667 | 6/26/05 | 18:20 | 9 | 2 | B | | 1 | 0 | B5 |
| Great | MB1 | 44.547088 | -69.826938 | 6/26/05 | 14:00 | 0 | | C | | 2.5 | 0 | B5 |
| Great | SF1 | 44.56806667 | -69.83415 | 6/26/05 | 11:30 | 1 | 3 | B | | 2 | 3 | B5 |

- New volunteers are trained by the Maine DEP regularly
- Challenge: Definitively identifying Gloeo as opposed to other particles in the water leads to uncertainty in density observations

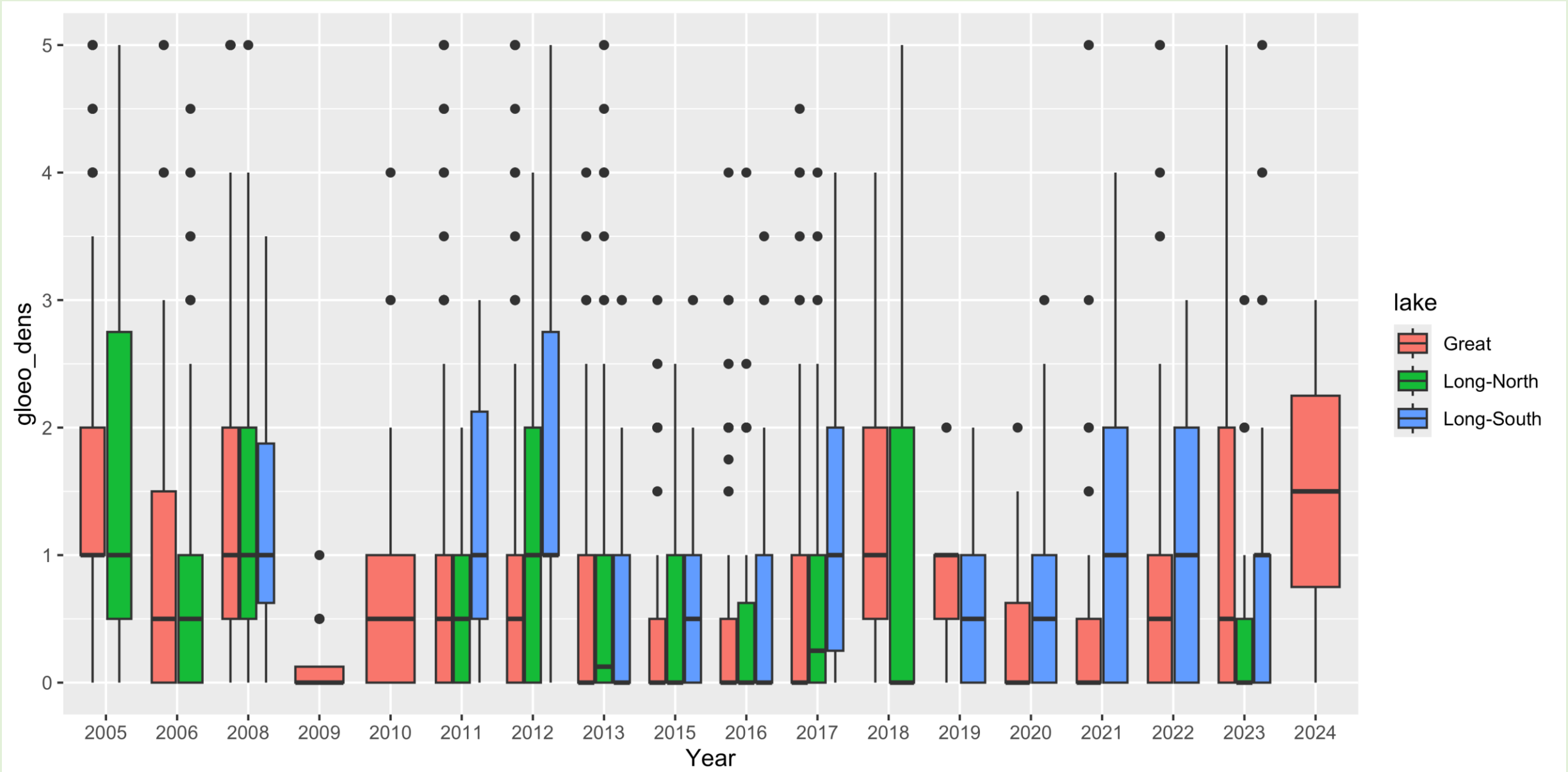
# Now how can we use all this data to understand Gloeo blooms?

Statistical approaches present challenges

Surmountable challenges, but makes simpler statistical techniques inappropriate



# But here are some basic stats anyway



## Summary

- Gloeotrichia is hard to capture by typical routine monitoring programs because of its spatiotemporal heterogeneity
- A community science initiative in the Belgrade Lakes region has provided data that covers some of the gaps
- This unique dataset has challenges (uncertainty in estimates, uneven distribution of measurements, zero-heavy statistical distribution
- But we can still use this data to test hypotheses on bloom drivers