



A Methodology for Citizen Scientist Water Quality Monitoring of Kettle Lakes

Heidi Cunnick,
MA Ecology, PhD Environmental Science
March 4, 2026

Kettle Lakes and Ponds Health and Monitoring, Overview

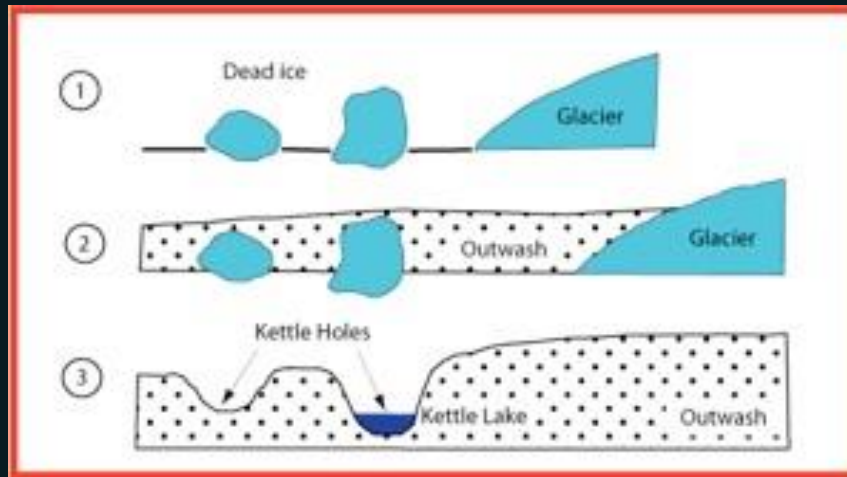
- About Kettle Lakes, Life Cycle, Turnover Ecosystem Services
- Monitoring Kettle Lakes
- Data and Trends, an example: Cream Hill Lake
- Lake Vegetation
- Starting a lake monitoring program
- Resources and Budget

Beyond Walden, The Hidden History of America's
Kettle Lakes and Ponds,
by Robert M. Thorson

“...(Lake) problems persist not because lake scientists don't know what to do but because they lack the background data to diagnose the problem, the money to fill the prescription...Future lake management will depend more on the efforts of private lake associations than top-down government regulations...”

Life Cycle of a Kettle Lake, Hole

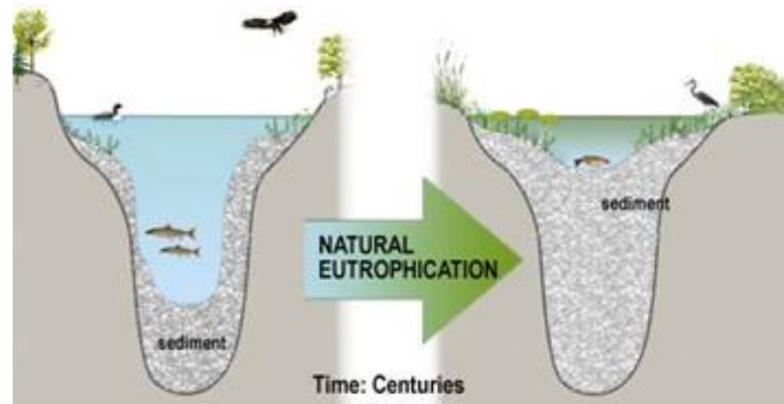
Glacial Fossils



Ecosystem Services of Kettle Lakes

- Ability to store water provides an important flood control mechanism
- May serve as an agricultural water source during drought
- KL filter water to improve water quality, particularly in agricultural catchments, and if there is a naturally vegetated buffer zone
- Habitat for many species often rare ones
- Food and water for animals
- Records of paleoclimates, used in climate research
- Recreational opportunities

Life Cycle of a Kettle Lake: Natural versus Cultural Eutrophication



Monitoring Kettle Lakes

What Data: CT Lake Health Categories

Table 3. Trophic classification criteria used by the Connecticut Experimental Agricultural Station (Frink and Norvell, 1984) and the CT DEP (1991)

Trophic Category	Total Phosphorus ($\mu\text{g} / \text{L}$)	Total Nitrogen ($\mu\text{g} / \text{L}$)	Summer Chlorophyll-a ($\mu\text{g} / \text{L}$)	Summer Secchi Transparency (m)
Oligotrophic	0 - 10	0 - 200	0 - 2	>6
Early Mesotrophic	10 - 15	200 - 300	2 - 5	4 - 6
Mesotrophic	15 - 25	300 - 500	5 - 10	3 - 4
Late Mesotrophic	25 - 30	500 - 600	10 - 15	2 - 3
Eutrophic	30 - 50	600 - 1000	15 - 30	1 - 2
Highly Eutrophic	> 50	> 1000	> 30	0 - 1

What Data: CT Lake Health Categories

Oligotrophic

High dissolved Oxygen

Clear Waters

Low nutrient load

Low sediment Load

Low to no invasive organisms

Mesotrophic

Eutrophic

Nitrogen & Phosphorus, Anthropogenic Sources:

- soil erosion
- fertilizers
- failing septic systems



When, Where, What and How to Sample

Lake Turnover

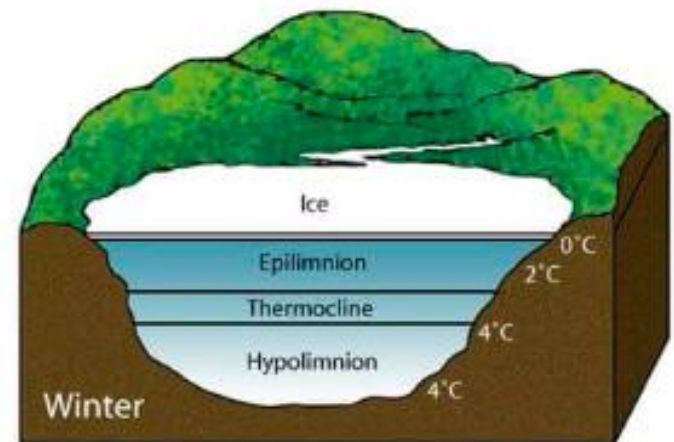
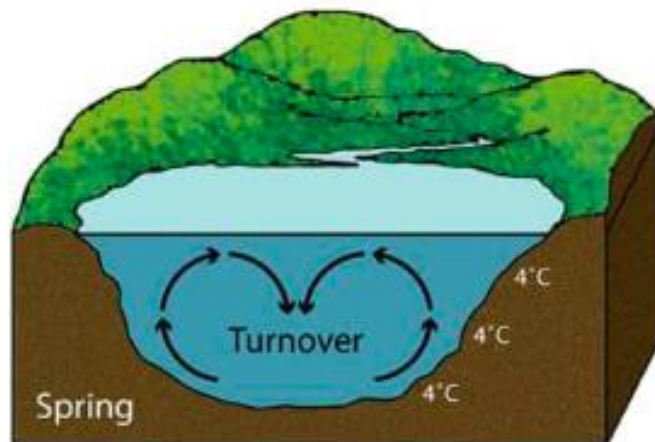
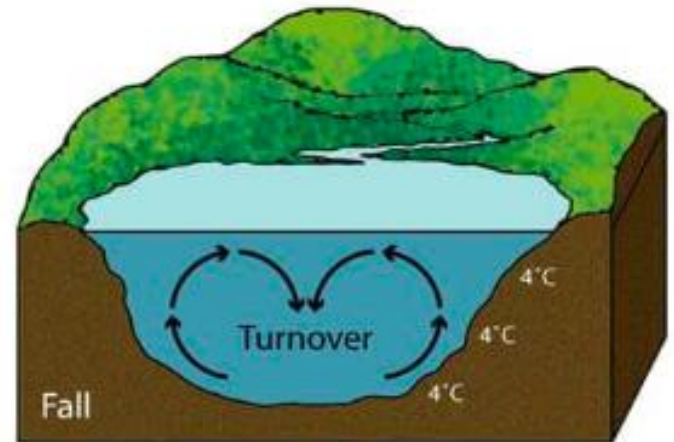
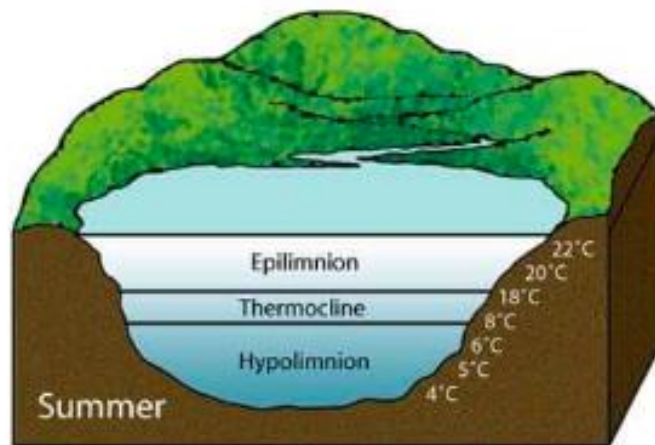


Image showing seasonal lake mixing, turnover, and stratification.

Source: National Geographic Society

When: Consistency in Dates

April 15

May 15

June 15

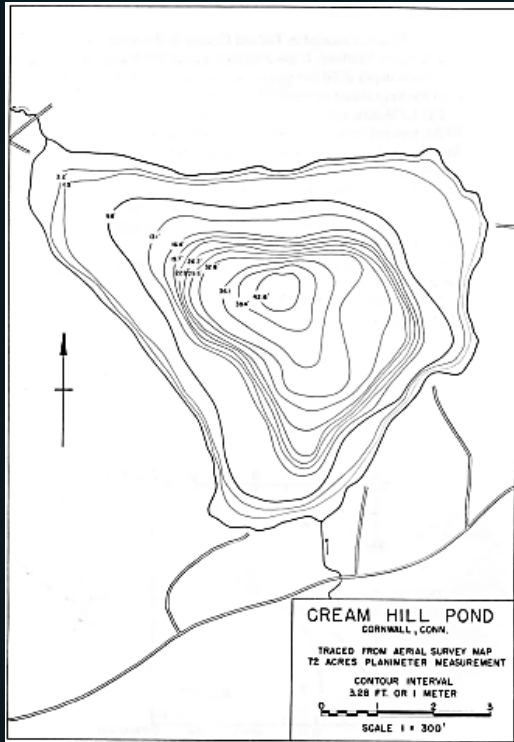
July 15

August 15

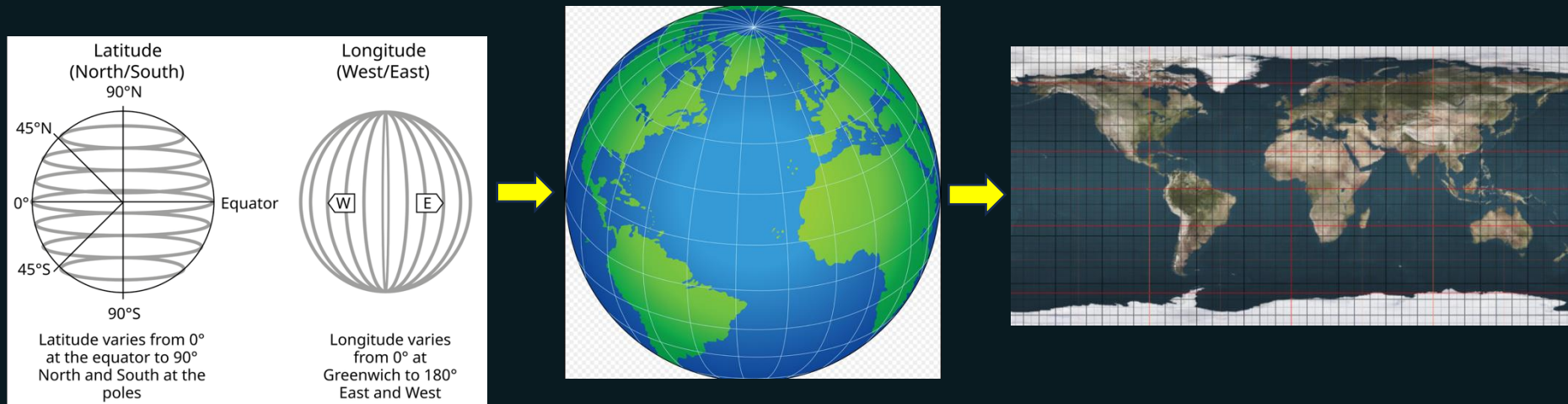
Sept 15

Oct 15

Where: At maximum depth, consistency in location

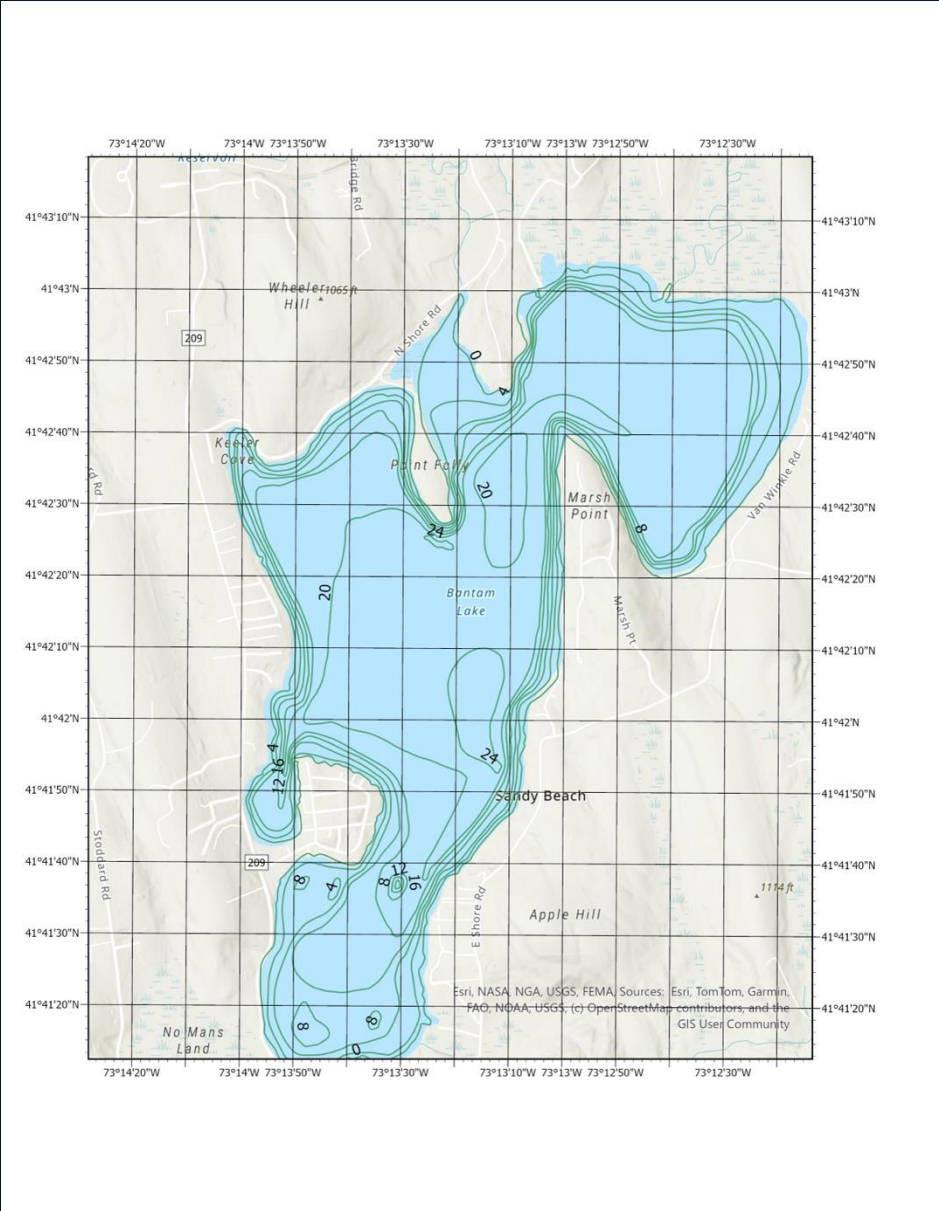


Finding maximum depth, a word of caution:
latitude and longitude are transformed from the
earth's sphere onto a planar grid, using
mathematical models.



https://en.wikipedia.org/wiki/Geographic_coordinate_system#/media/File:Earthmap720x360_grid.jpg

Bantam Lake Bathymetry from Uconn's GIS site



If you don't deploy a buoy, you'll need a GPS unit to row out to the same spot. You'll also need an anchor.

OUTDOOR RECREATION / HANDHELDS

eTrex[®] 22x

Rugged Handheld GPS

PART NUMBER 010-02256-00

\$199.99 USD

4 interest-free payments or as low as \$19/mo with [affirm](#). [See if you qualify.](#)

Altimeter and Compass [?](#)

YES

NO

Available to ship in 1-3 business days.

ADD TO CART



Deploying a buoy saves time



A2 Buoy - Forrest Green - 14.5"Dia x
19.5"L

Item ID: PLY A2FOREST

\$73.60

Qty: 1

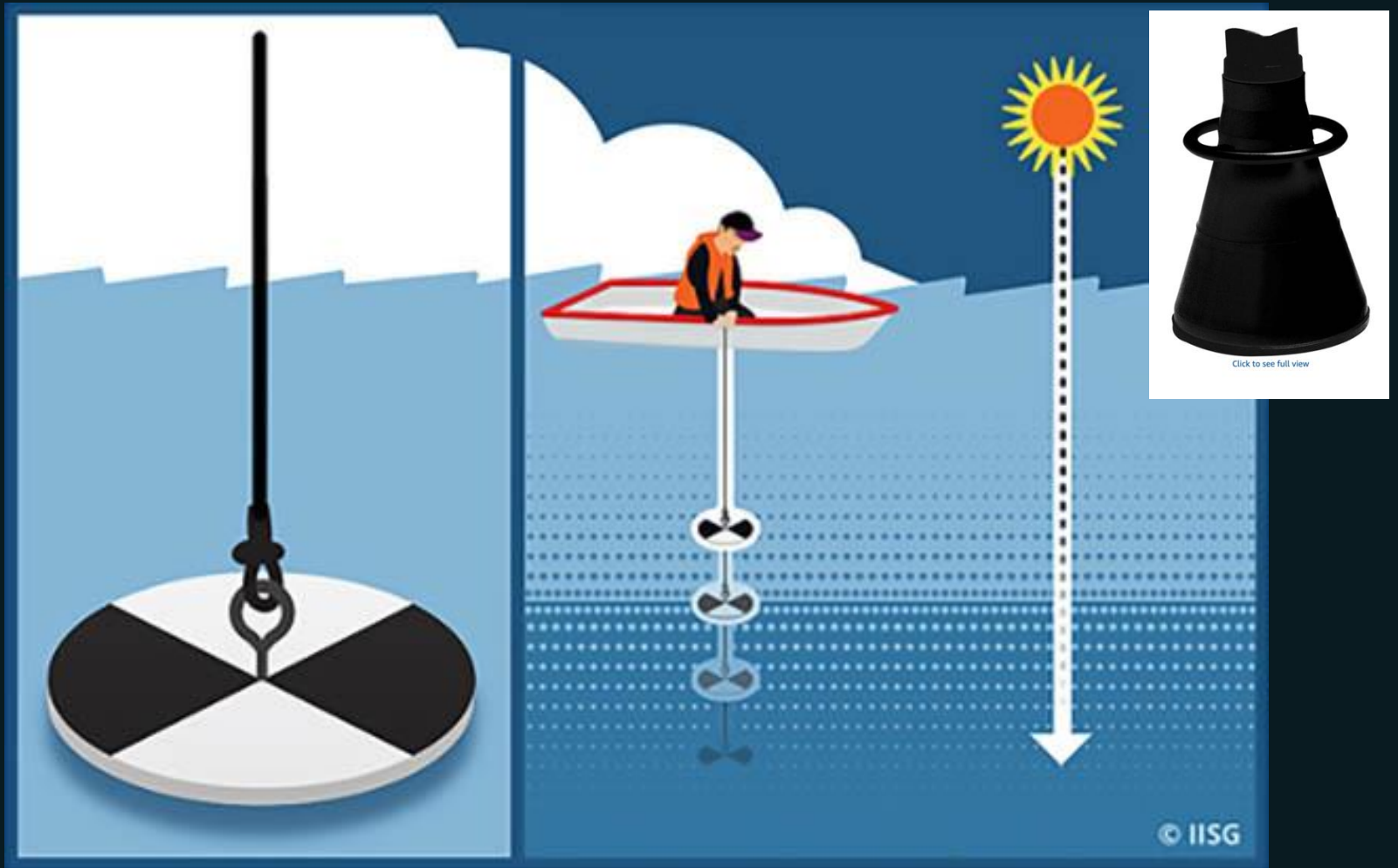
Special Order Only

\$73.60

Should Ship in 6-9 days

What Data and How?

Secchi Disk Transparency and Depth



https://limnolan.org/wp-content/uploads/2023/06/Secchi_Disk_JoelDavenport.jpg

Dissolved Oxygen Meter, Probe, 5-meter line Temperature and Oxygen Profiles, Dissolved Oxygen, Conductivity Profiles



Van Dorn Water Sampler: Horizontal, Messenger, 5-meter cable. Samples taken 1 meter below the surface and 1 meter above the floor



Lab Analysis (U Conn CESE):
Phosphorus and Nitrogen
Cations and Chloride
pH
Chlorophyll-*a*

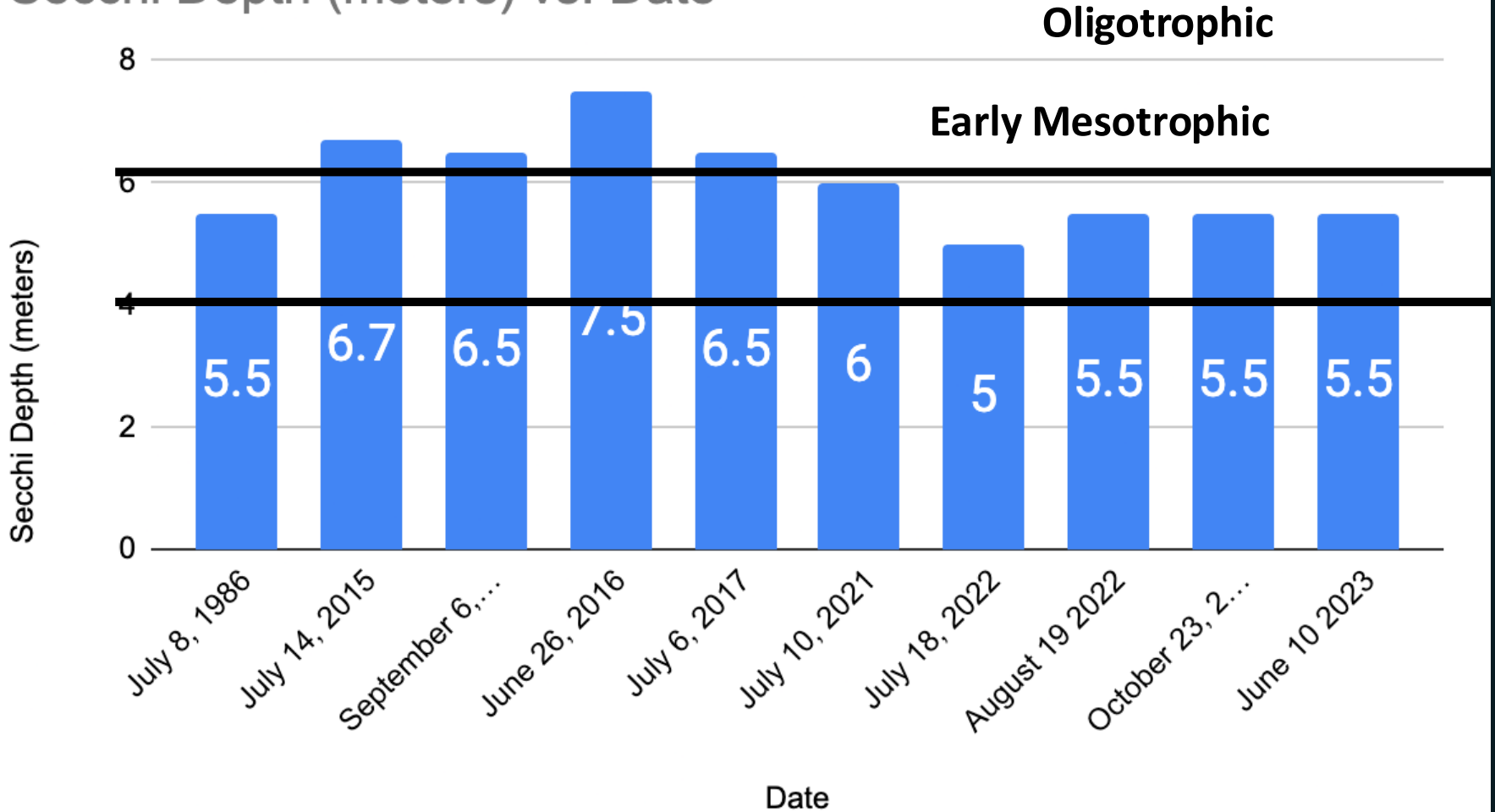
Data and Trend Analysis

Logging your Data

Cream Hill Lake			Date / Time			
			Total Depth:		Secchi:	
Depth	Temp	DO	DO	Cond	SPC	pH
(m)	(°C)	mg/L	%	μS/cm	μS/cm	SU
0.5						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						

Secchi Disk Measurements

Secchi Depth (meters) vs. Date



Temperature of the water column

**Temperature
June 16, 2023**

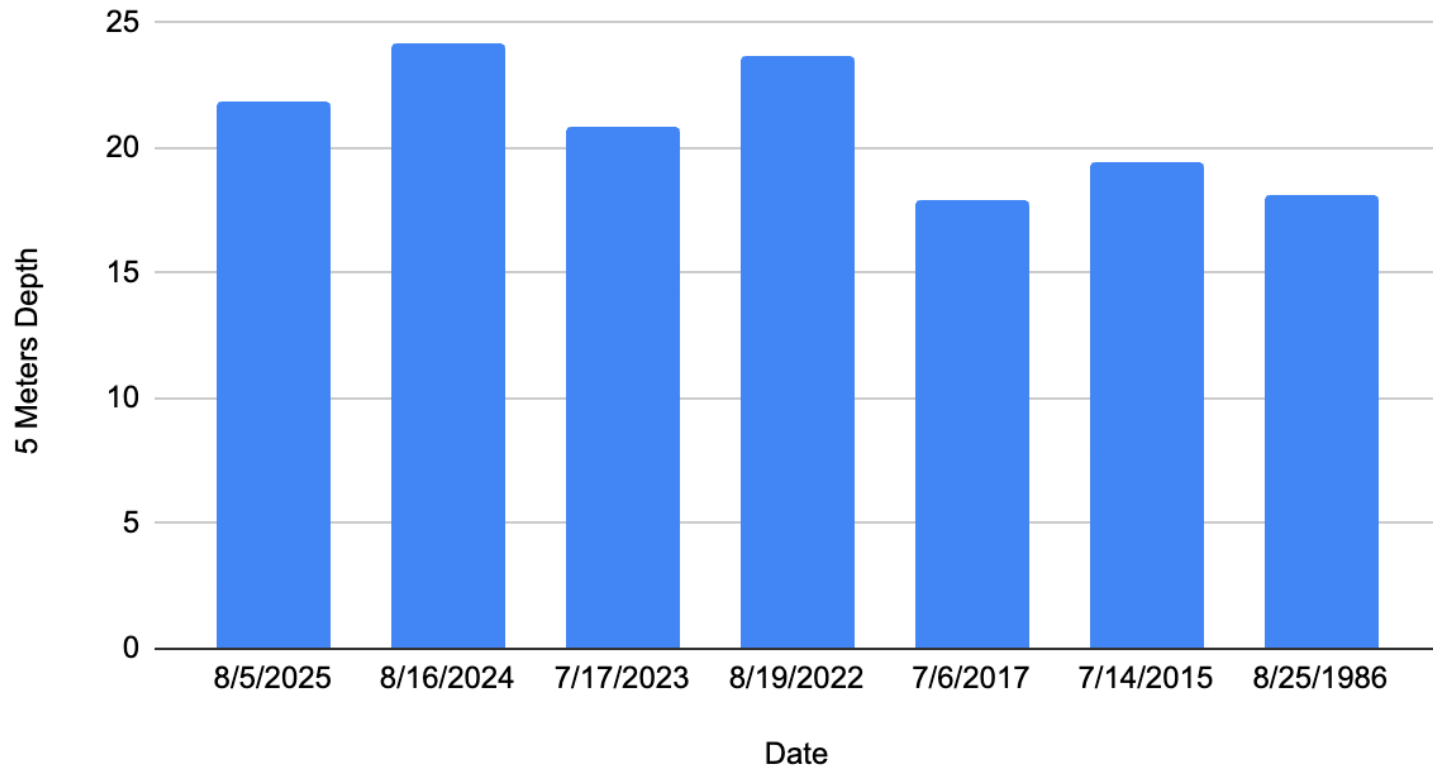
Depth	T(C)
1	19.4
2	19.3
3	19.2
4	18.5
5	16.0
6	14.1
7	14.2
8	11.6
9	11.8

**Temperature
October 23, 2022**

Depth	T(C)
1	12.7
2	12.6
3	12.5
4	12.5
5	12.5
6	12.4
7	12.3
8	12.2
9	12.2

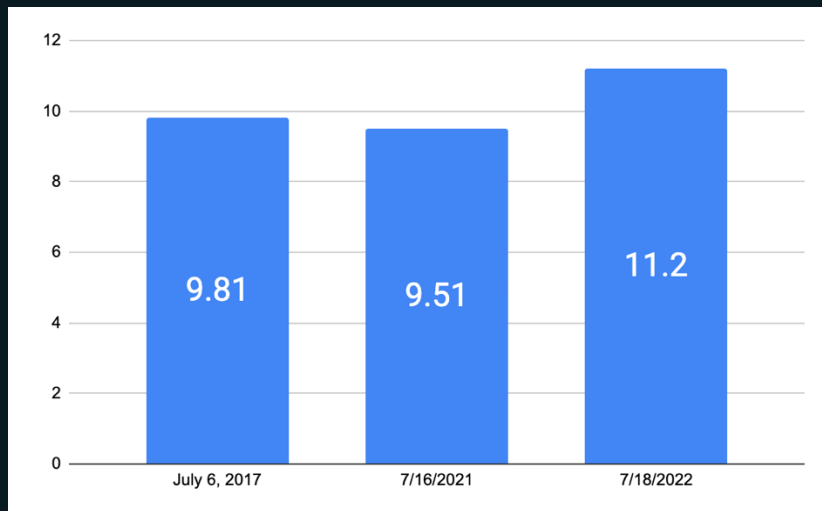
Temperature over time , 5 meters depth

Temperature July 1986 - 2025



Dissolved Oxygen over time, 5 meters depth

July

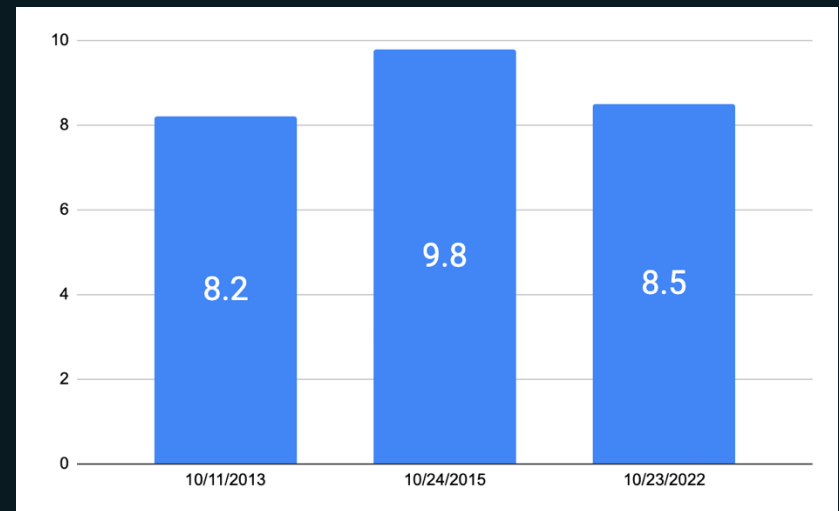


2017

2021

2022

October



2013

2015

2022

Sample Analysis


Uconn Center for Environmental Science and Engineering

UCONN | UNIVERSITY OF CONNECTICUT

INSTITUTE OF THE ENVIRONMENT AND ENERGY
Center for Environmental Sciences and Engineering

Home Environmental Laboratories ▾ Initiatives ▾ For Clients ▾ Business Office Contact ▾

Search this site... 🔍



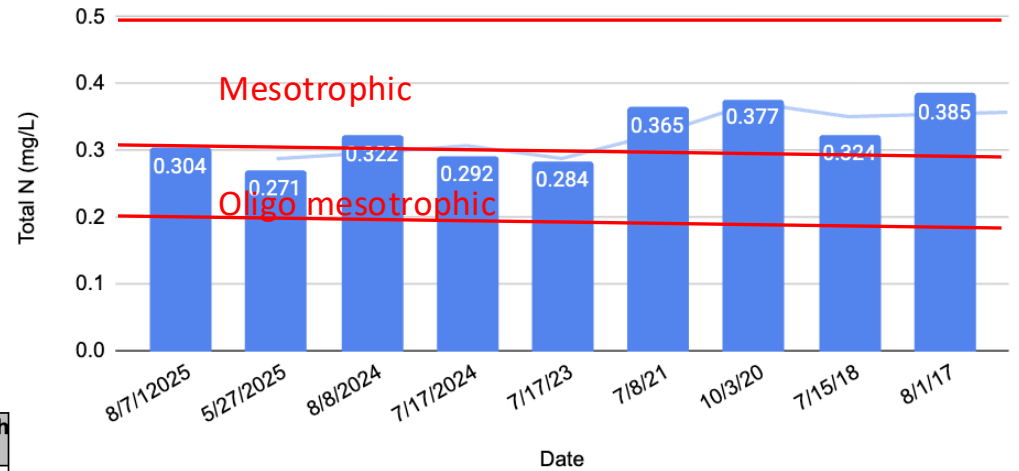
For Clients: Submissions

The Center for Environmental Sciences and Engineering (CESE) at the University of Connecticut is a full-service research and analytical chemistry facility, supporting the needs of academic, government, commercial, and non-profit organizations.

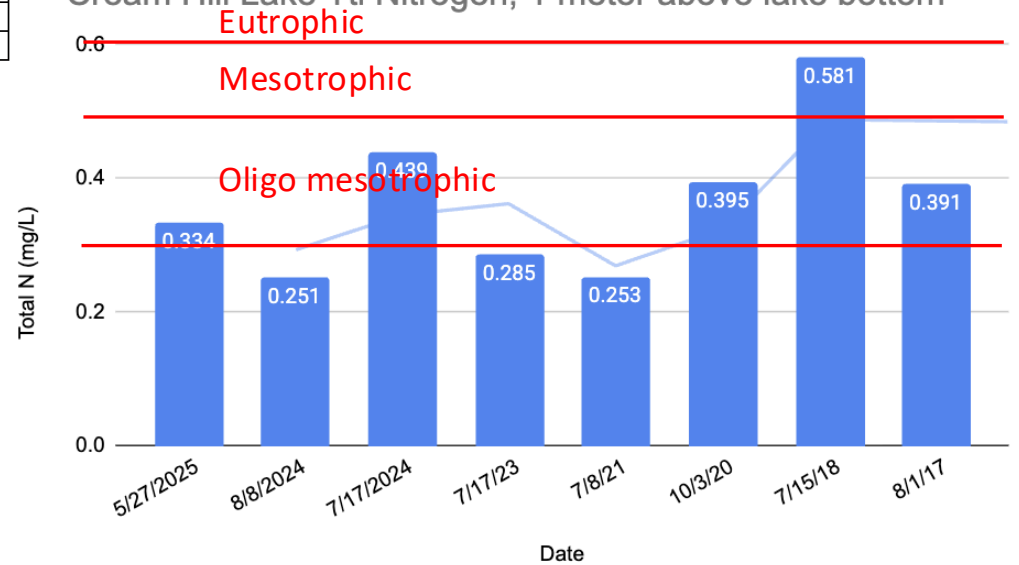
Nitrogen

Category	T.P. (ppb)	Chlorophyll a (ppb)	T. Nitrogen (ppb)	Secchi Depth (m)
Oligotrophic	0.000 – 0.010	0 – 2	0.0 – 0.2	6+
Oligo-mesotrophic	0.010 – 0.015	2 – 5	0.2- 0.3	4 - 6
Mesotrophic	0.015 – 0.025	5 – 10	0.3 - 0.5	3 - 4
Meso-eutrophic	0.025 – 0.030	10 – 15	0.5 - 0.6	2 - 3
Eutrophic	0.030 – 0.050	15 – 30	0.6- 1.0	1 - 2
Highly Eutrophic	>0.050	30+	>1.0	0 - 1

Cream Hill Lake, Total Nitrogen, 1 meter below lake surface



Cream Hill Lake Ttl Nitrogen, 1 meter above lake bottom



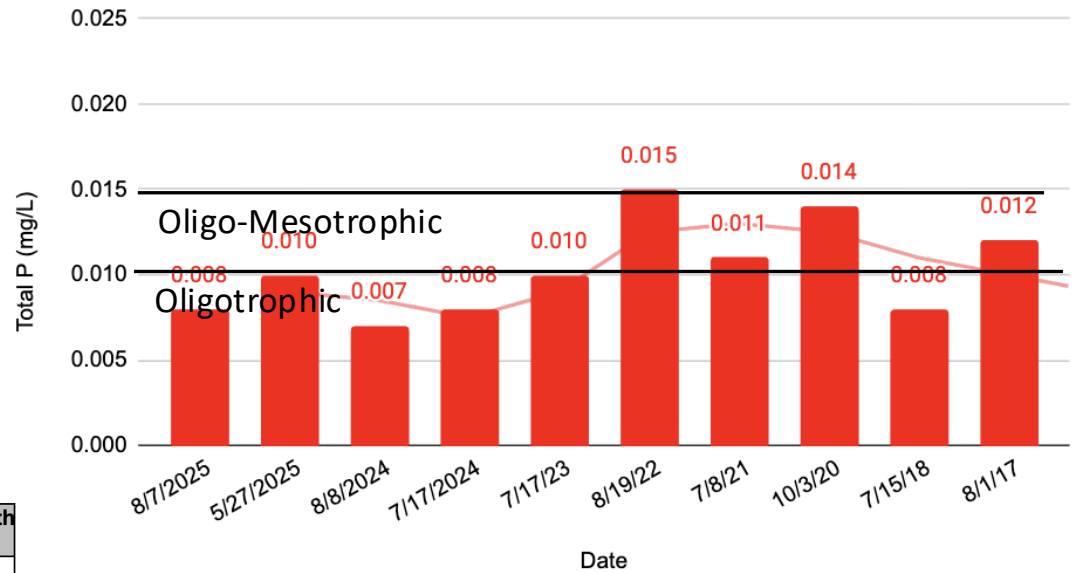
Phosphorus

mesotroph

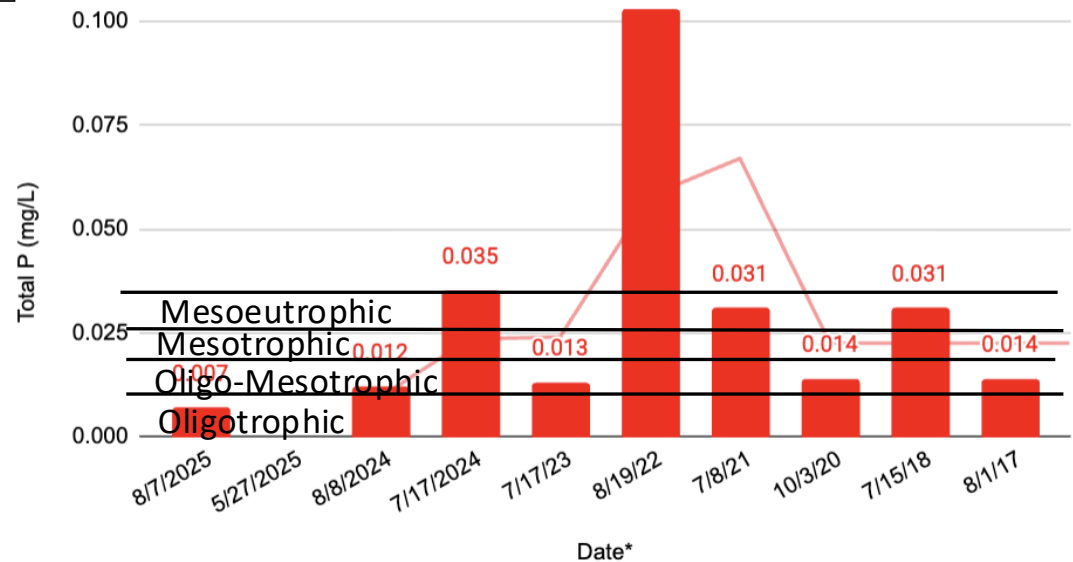
mesotroph

Category	T.P. (ppb)	Chlorophyll a (ppb)	T. Nitrogen (ppb)	Secchi Depth (m)
Oligotrophic	0.000 – 0.010	0 – 2	0.0 – 0.2	6+
Oligo-mesotrophic	0.010 – 0.015	2 – 5	0.2- 0.3	4 - 6
Mesotrophic	0.015 – 0.025	5 – 10	0.3 - 0.5	3 - 4
Meso-eutrophic	0.025 – 0.030	10 – 15	0.5 - 0.6	2 - 3
Eutrophic	0.030 – 0.050	15 – 30	0.6- 1.0	1 - 2
Highly Eutrophic	>0.050	30+	>1.0	0 - 1

Cream Hill Lake, Total Phosphorus 1 meter below lake surface



Cream Hill Lake, Total Phosphorus 1 meter above lake bottom



Vegetation

A healthy assemblage of native plants is the lake's first defense against invasion



American Burr Reed

Value: removes nitrogen and phosphorus runoff from the water. I

A Sampling of a CT Lake's Native Plants and their value

Smooth Value: Branching stems offer grazing for fish. Waterfowl feed on elodea and eat invertebrates living on elodea.

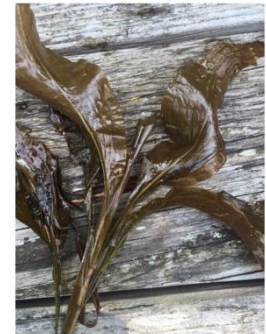


Chara vulgaris, muskgrass

Value: Waterfowl food, and fish habitat and food, young trout, bass.

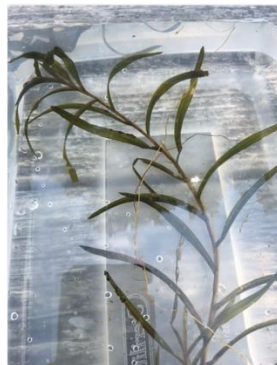
Aquatic Plants of the Northeast
https://hrnerr.org/wpcontent/uploads/2023/11/AquaticPlantIDGuide_07252023-1.pdf

Wild celery or eelgrass .
Value: A primary source of food for waterfowl, in particular canvasback ducks. Provides good cover and feeding opportunities for small fish.



Bigleaf Pondweed Broad leaves offer shade and grazing for fish. Nutlets valuable waterfowl food.

Clasping leaf pondweed Value: produces a fruit important for a variety of ducks and geese. Leaves and stems are colonized by invertebrates and provide cover for fish.



Potamogeten robinsii
The predominant plant in the lake

Ribbon leaf pondweed. Liming experiments suggest that it is sensitive to severe acidification. A poor disperser relative to many other aquatic plants occurring in Connecticut lakes.





OAIS

Office of Aquatic Invasive Species

Connecticut Agricultural Experiment Station

Formerly the Invasive Aquatic Plant Program

[About](#) | [Employment](#) | [In the News](#) | [Legislation](#) | [Program History](#) | [Advisories](#)

***New* CT AIS Web App**

In 2002, scientists at the Connecticut Agricultural Experiment Station (CAES) began surveying Connecticut lakes and ponds for invasive aquatic plants and investigating novel management options.

Surveillance focuses on both invasive and native vegetation to quantify the effects of invasive species on aquatic ecosystems. This research allows us to track the spread and record the arrival of invasive aquatic plants. Surveys also provide baseline information to determine if the frequency and magnitude of invasions may be related to water chemistry, sediment type, boat launches, watershed development and climate change. Management studies include tests on the effectiveness of herbicides, mechanical removal,

In Summary
How to Care for Your Kettle Lake

Work with your Local Officials

- Ask your Board of Selectpersons to set up a Task Force
- This gives the Task Force legitimacy. And potentially funding
- Cost today is around ~\$3600 total

Protect your lake in advance

- Get a baseline measurement; measure for trends.
- Check for a vegetation buffer?
- Is there point pollution?
- Educate your town representatives and citizens about caring for your lake
- Look for individuals on the lake willing to help fund the lake study

What to do if your data tell you your lake is in trouble?

Contact a professional limnologist. But now armed with an understanding of your lake, that limnologist is better able to help and you are better able to interpret their recommendations

Concluding, summary of how to start a lake task force?

- Ask your selectperson to form a town sponsored task force
- Reach out to the community and local schools to find volunteers
- Purchase Equipment
- Set up your Data Book
- Go forth and measure!

Thank you

Questions?

Resources

Dissolved Oxygen Meters:

<https://www.fishersci.com/shop/products/ysi-pro2030-field-dissolved-oxygen-conductivity-meter/15177622#?keyword=>

<https://www.fishersci.com/shop/products/kto-hq1130-ldo10101-field/502062940#?keyword=>

Van Dorn water sampling kit. <https://yoursciencehub.com/alpha-bottle-kit-2-2l-horizontal-acrylic.html>

Secchi Disk <https://www.forestry-suppliers.com/c/secchi-disks/18-157-858?page=1>

Buoy <https://www.fisherliessupply.com/polyform-us-a-series-buoys-fenders/13814852>

Aquatic Plants of the Northeast https://hrnerr.org/wpcontent/uploads/2023/11/AquaticPlantIDGuide_07252023-1.pdf

Lake Bathymetry https://cteco.uconn.edu/guides/Elevation_Contour_Lake_Bathymetry.htm

U Conn Lab <https://environmental-sciences-engineering.center.uconn.edu/for-clients/>

Aquascope https://www.tacklewarehouse.com/Nuova_Rade_Aqua_Scope_Jointed_Bathyscope_Orange/descpage-NUOVAA.html

Reading recommendation, Beyond Walden, The Hidden History of American's Kettle Lakes and Ponds, by Robert M. Thorson