

Notes from the FOREST



Lacawac
Sanctuary
Field Station and
Environmental Education
Center

Spring 2022
Newsletter

Reconstructing Climate Change and Ice Retreat at Lake Lacawac

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It's difficult to imagine Lake Lacawac covered by several-kilometer-thick ice today, but this was the reality for much of North America 25,000 years ago. At this time, glacial ice globally reached its maximum extent across the world, and eventually began to retreat (melt) back into the north. Parts of the US and the majority of Canada were covered by multiple ice sheets, with the largest of them - the Laurentide Ice Sheet - extending from Hudson Bay to as far south as the Midwest and Northeast US. While these ice sheets are now completely extinct, scientists are continually reconstructing them in great detail by examining the landforms and deposits (sediment and rocks) left behind within the landscape. But why does the reconstruction of a long dead ice sheet really matter in the modern day? Well, climate change is monitored and understood through the analysis of ice sheets, such as the Greenland and Antarctic Ice Sheets, and alpine glaciers in mountain regions. However, modern observational records of ice growth and retreat don't go that far back, so information from the decline of extinct ice sheets may shed some light on the timing of the current climate crisis. However, to ensure these large-scale ice sheet reconstructions are accurate, the behavior and timing of ice

movement and retreat on and around the margins of these extinct ice sheets needs to be further understood.

April Howden, a PhD student at Liverpool John Moores University (UK), is working to understand the timing and environmental effects of deglaciation of the Laurentide Ice Sheet within Northeast Pennsylvania (NEPA). When Laurentide ice was at its maximum extent, portions of northwest Pennsylvania and NEPA were covered by the southern margin of the ice sheet. As part of her undergraduate dissertation, April began work analyzing NEPA lake sediments in Luzerne County with researchers Kathryn Adamson (Manchester Metropolitan University), Tim Lane (Liverpool John Moores University) and Matt Finkenbinder (Wilkes University). At PhD level, this project has expanded to include multiple lakes across NEPA, starting with Lake Lacawac.

Global ice began to retreat from its maximum extent sometime between 25,000 to 19,000 years ago. As the ice melted and retreated further to the north, basins formed by glacial scouring and/or damming by glacial sediments created numerous lakes in NEPA. Lakes rapidly filled with sediment and meltwater as ice retreated further north. Since its initial formation, Lake Lacawac has continuously been infilled with sediments

and organic material washed in from the landscape. These sediments, when 'cored' (Fig. 1) and analyzed, can provide a detailed archive of environmental change.



Figure 1: Wilkes University undergraduate students Jessica Zajac and Erika Wintersteen holding a surface sediment core taken from the bottom of Lake Lacawac in October of 2021.

Analyzing these cores from top (the most recently deposited sediment) to bottom (the oldest) means that changes in sediment composition (i.e. concentration of mineral and organic material, etc.) can be traced throughout the record, reflecting changes in the landscape throughout time (Fig. 2). For example, glacial sediment deposited as the ice melted and retreated out of the catchment reflects an unstable landscape

with high mineral matter and little to no organic material. This is because a freshly deglaciated landscape is covered with loose geological materials, soils are not developed, and plants are not present on the landscape due to cold, windy, and dry climate conditions.

Alternatively, post-glacial and organic-rich sediments reflect a stable and well-vegetated landscape with a climate similar to today, long after ice has retreated. Temperature changes can be supported by other paleoclimate proxy datasets such as pollen assemblages, which provide insights to the

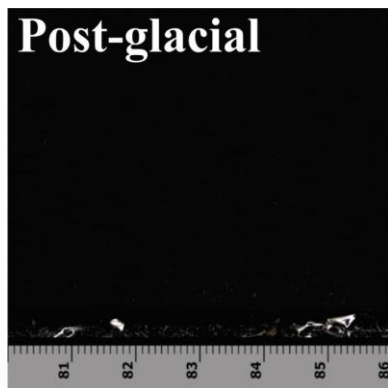
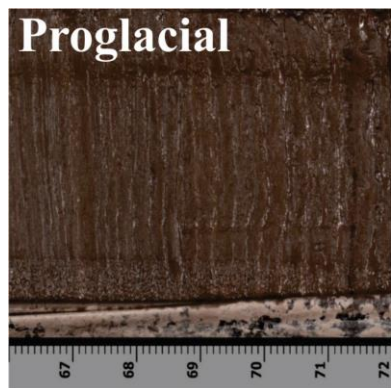


Figure 2: Images of sediment cores showing representative proglacial sediments (mm-scale layers and lighter-color due to high mineral matter and low organic matter) and post-glacial sediments (homogeneous and darker-color due to low mineral matter and high organic matter). Images are from Nuangola Lake in Luzerne County.

vegetation cover in the catchment and surrounding region. For example, if pollen from modern day tundra plants is found within the lower parts of the sediment, this will suggest that temperatures at the time of deposition were

much cooler than today. A later shift to boreal forest taxa (spruce trees) and later mixed deciduous forest will document climate warming and the transition to modern day conditions. Environmental changes will also be reconstructed using a variety of biological and geochemical proxy datasets, which will provide further insights into deglaciation and landscape development changes.

All these methods will be used to reconstruct a detailed picture of the local environment at Lake Lacawac over time through radiocarbon dating techniques. To do this, small 'macrofossils' (fossils visible to the naked eye) such as pieces of wood, charcoal, or seeds will be obtained from within the sediment. Living things such as plants and animals contain the radioactive isotope carbon-14 (^{14}C) which decays over thousands of years to stable nitrogen-14 (^{14}N). Using the known decay rate (or half-life) of carbon-14 of 5,730 years, and the concentration of carbon-14 in macrofossils from the cores, an age to depth model can be developed. The age to depth model will allow us to calculate the age for any depth in the core sequence, and therefore permit us to evaluate the timing and magnitude of climate and environmental changes over time.

At the end of the project, with dated sediment sequences from multiple sites in NEPA, it will be possible to detect changes in the climate and the landscape throughout time (Fig. 3) and gain a better insight into the timing of local ice sheet retreat. The composition of the sediment will reveal whether ice retreated fast or slow, and just how quickly the landscape was colonized with plants post-retreat. Ancient pollen identification will show what type of plants were on the landscape throughout time, and this will help to constrain changes in local temperature as time progressed. Overall, the project will provide a detailed record of local climate, therefore supporting larger reconstructions of the Laurentide Ice Sheet. These detailed records are therefore vital for our understanding of climatic, atmospheric and oceanic processes across the globe.

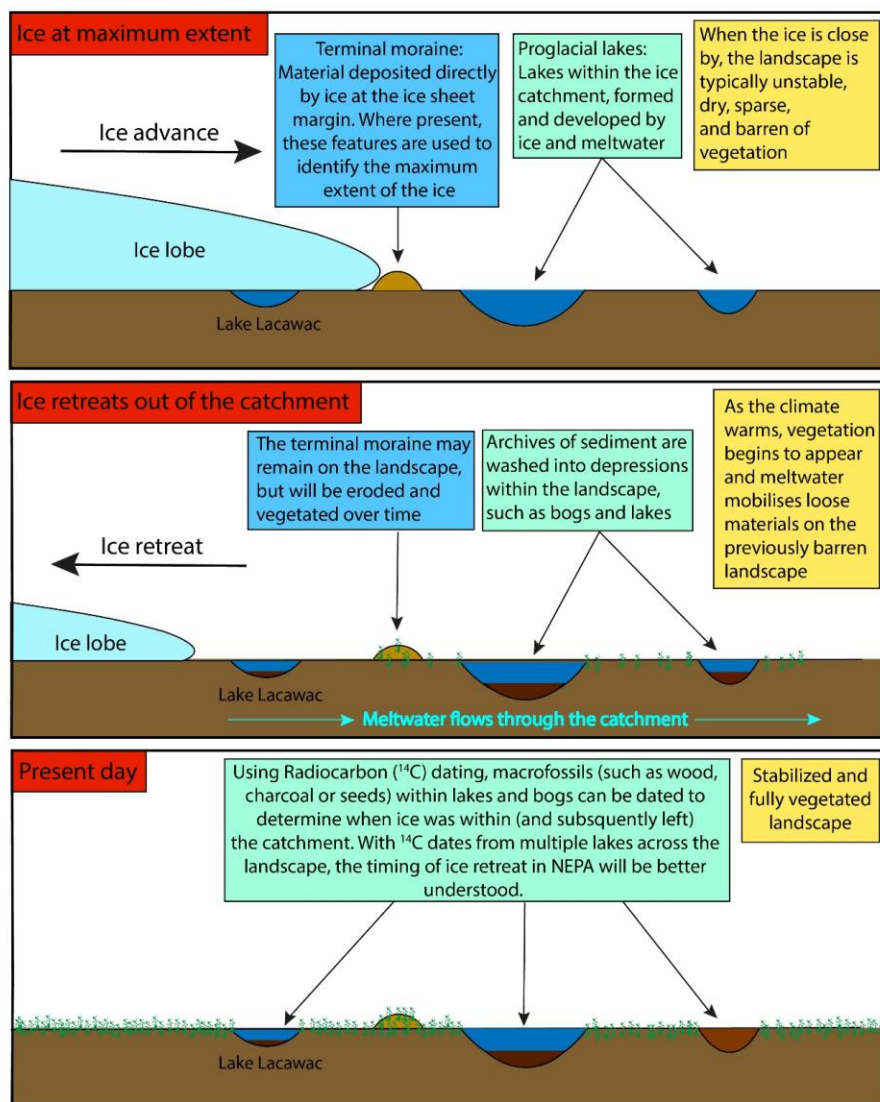


Figure 3: Conceptual diagrams of ice sheet advance and retreat. The terminal moraine refers to a feature deposited by ice directly at the margin at the beginning of retreat. Imagine Lake Lacawac is the leftmost lake, once covered by glacial ice. As ice retreated northward (to the left) with increasing temperatures, the lake was exposed and filled with sediments transported by glacial meltwater. If several of these lakes and the terminal moraine are dated, this will tell a detailed story of glacial retreat throughout time.

Water Quality Monitoring in Action: Lake Wallenpaupack in 2021

2021 marked the third year of PLEON's community-led water quality monitoring program on Lake Wallenpaupack. This program trains volunteers as community scientists in order to collect water quality data from many locations around the lake over many time points. These data can then be used to identify pristine or problem areas and identify changes in water quality over time.

Thank you to our 2021 volunteers: Bill Baines, Betina Bonsall, Aiden Bouchard, Vera Demchenko, Naomi Drucker, Owen Gillespie, Charles Green, the Heck Family, Shelly and Wes Hume, Carol Kuhn, Bill Leishear, Karen Mayer, Val Pate, Dave Savage, Cara Schweitzer, Mary Beth and John Secoy, Reilly Seeley, Rick Shema, Jennifer Slade, Melanie Stockwell, Sarah Strause, and Merrilee and Mike Ulisny. Thanks also to the 2021 PLEON and Lacawac undergraduate student interns who assisted with this project including Tyler Johnson (Oklahoma State University), Matthew Simms (University of Scranton), Meghan Corridoni (Bloomsburg University), Erin Gingrich (Bloomsburg University), and Seth Franklin (Bloomsburg University) and to the scientists who participated in the 2021 Data Wrap Up including Dr. Sarah Princiotta (Penn State), Dr. Janet Fischer (Franklin & Marshall College), Dr. Elizabeth Carroll (Holy Family University), Lisa Borre (Cary Institute of Ecosystem Studies), and Nick Spinelli (Lake Wallenpaupack Watershed Management District).

Through the hard work of the 2021 volunteers, we were able to collect water temperature, water clarity, water color, algae abundance, and nutrient data from 29 sites periodically from June through September 2021. These sites were spread around the Wallenpaupack shoreline (Figure 1). The 2021 data are still being analyzed, but here are a few main findings thus far:

There was no sustained lake-wide algal bloom in 2021. Volunteers collected water samples from their sites every other week. PLEON scientists collected the algae from these samples onto a filter and extracted and quantified chlorophyll a, a green pigment found in algal cells. Chlorophyll

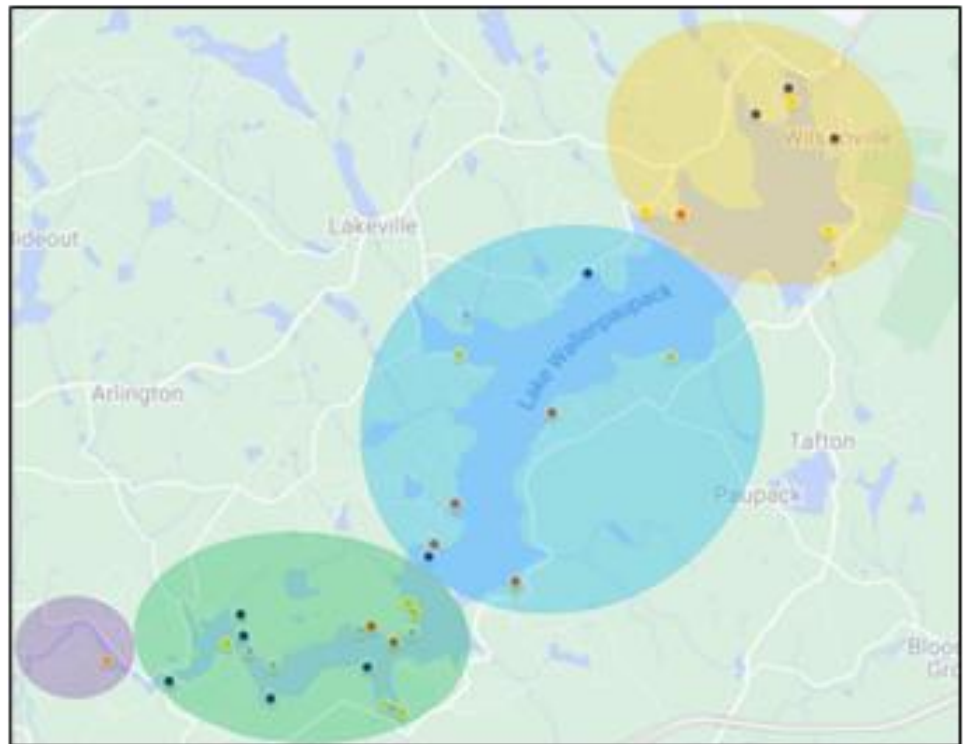


Figure 1: Wallenpaupack sampling sites in Northeast (yellow ellipse), Mid-lake (blue ellipse), Southwest (green ellipse), and River (purple ellipse) sections. Blue, yellow, and red dots show locations of sites added in 2019, 2020, and 2021, respectively. Gray dots are sites from which data are no longer collected.

concentration is a proxy for algal abundance. According to chlorophyll data, a lake-wide algal bloom was observed in both 2019 and 2020 starting in mid-July and lasting through the sampling period. However, a similar bloom did not occur in 2021 (Figure 2).

Many factors contribute to algal dynamics in lakes including temperature, nutrient availability, the amount of precipitation, and even winter conditions such as the duration of ice cover, and it can be difficult to determine which caused a specific bloom, or lack thereof. The amount of rainfall and several severe storms that occurred in the summer of 2021 may have affected algae populations.

Water clarity has been influenced by algal abundance over the last 3 years. Now that we have three years of data, we can begin to look at some broader trends, including how big of an impact algae are having on the clarity of Lake Wallenpaupack. Community scientists measured Secchi depth to assess water clarity. Secchi depth is measured by lowering a black and white disk straight down into the water. The depth at which the disk just disappears from view is the Secchi depth. Clear water will have a deeper Secchi

depth while murky water will have more shallow Secchi depths.

Algal abundance is one factor that can decrease water clarity. Over the 3 years of this program, there appears to be a negative relationship between Secchi depth and chlorophyll a concentration. Looking at a plot of these variables (Figure 3), sites with high chlorophyll concentrations (or more algae) tend to have shallow Secchi depths, or less clear water. This suggests that algal abundance is decreasing water clarity. However, this plot also shows a wide range of Secchi depths at sites with lower chlorophyll concentrations. This suggests that Wallenpaupack is not always clear when algal abundance is low. Something else is affecting water clarity, perhaps sediments or dissolved materials in the water.

The full 2021 Water Quality in Action Report will be available on the PLEON website soon. We are also looking for volunteers to collect data in 2022! The program requires sampling from the same location(s) every Saturday during June, July, and August. Sampling methods are easy to learn and are appropriate for school age children and adults of all ages. This program makes a

great summer school science project or a citizen science participation badge.

Here is how to join:

Attend one of the training workshops hosted by Lacawac Sanctuary. Workshops include a brief introduction to lake ecology, instructions on how to use the Lake Observer app, and hands-on training in proper sampling methods. Workshops are held at Lacawac Sanctuary. Each participant will receive a sampling kit following the training. If you have participated previously and already have a kit, PLEON will provide you with a "kit refill", which includes a 2022 sampling schedule and clean bottles, labels, and baggies for water sample collection. The training workshops are free of cost. We kindly suggest a \$50 donation for new kits and a \$15 donation for kit refills. Donations help offset the cost of sample analysis.

2022 Training Workshop Schedule:

Saturday, May 21st, 9 am to 11 am
 Sunday, May 22nd, 3 pm to 5 pm
 Saturday, May 28th, 9 am to 11 am
 Friday, June 3rd, 5 pm to 7 pm

The PLEON 2021 Water Quality in Action Program was financed in part by a grant from the Community Conservation Partnerships Program Environmental Stewardship Fund under the administration of the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation and Conservation administered through the Pennsylvania Environmental Council's Pocono Forests and Waters Conservation Landscape Mini Grant Program.



Additional funding was provided by the Robert H. Spitz Foundation administered by the Scranton Area Foundation.

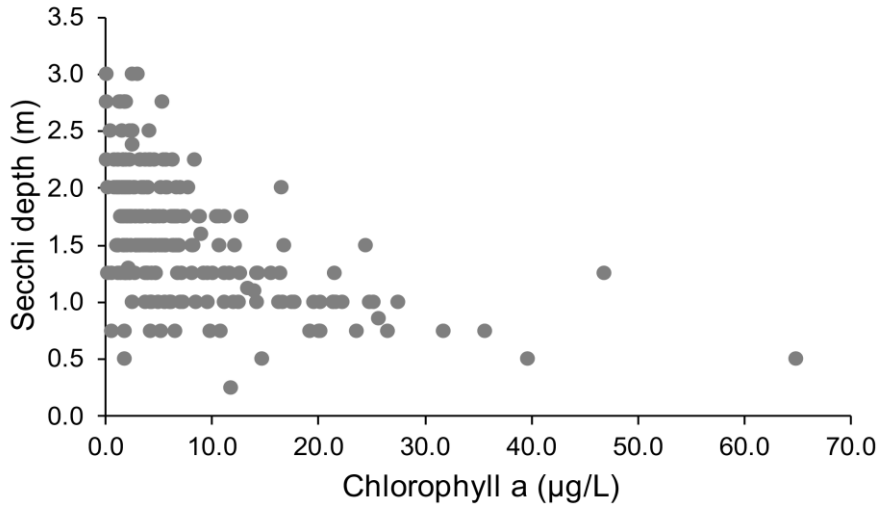


Figure 1: Relationship between chlorophyll a and Secchi depth at all sites monitored in 2019-21.

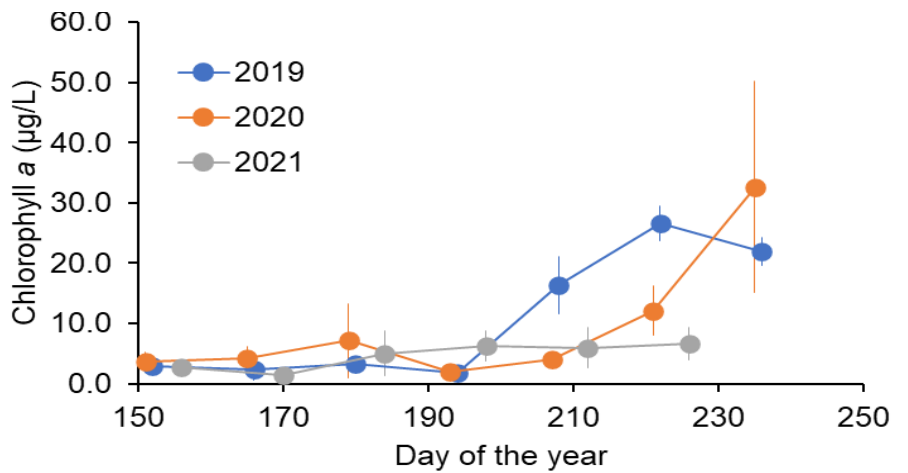


Figure 2: Chlorophyll a concentrations during the summer of 2019, 2020, and 2021. Symbols are averages of all sites with standard deviations. Note that the number of sites sampled varies among dates.

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What's Going on in Environmental Education?

Lacawac is continually adapting with the changing times. We are happy to report that our school programs are increasing once again and we welcomed a record number of students to Lacawac last fall as Covid 19 restrictions were lifted. Teachers were excited to be able to give their students expanded opportunities like environmental education field trips at Lacawac. We look forward to providing more classroom programs and field trips this spring.



Here is a little more on the various field trip experiences we offer. For first through third grade we offer a comprehensive standards based classroom program followed by a field trip to Lacawac.

CSI (Critter Science Investigations) - Habitats and Adaptations Field Trip
Students use clue bags to investigate an animal's habitat needs and its adaptations using skulls, fur, foot and scat molds.

Students problem solve to identify the animal and where it lives.

Amazing Adaptations Field Trip
Students participate in activities to discover tricks animals use to survive. They search for critters and play an interactive predator/prey game to understand the importance of camouflage in a forest habitat.

High School students on the other hand design investigations, participate in collecting field data, and learn about the current research happening in the forest and aquatic habitats at Lacawac.

Advanced Forest Ecology Field Trip
Students participate in data collection for current research to study the effects of deer populations in and out of the deer enclosure. Students analyze forest data and make predictions about the correlation between the deer population and birds, mammals, ground cover and canopy.

Advanced Water Ecology – Making Connections through Inquiry Field Trip
Students analyze data and test water samples brought to the classroom and design a field investigation. At Lacawac, student teams perform their investigation, analyze the collected data, and share their findings in a simulated dissertation presentation.

Summer is a busy time and we are once again offering a full line-up of all of our camps. We will offer six different day camps over 8 weeks for children ages 5 – 12. We continue to offer a fun camp experience in a safe environment. Each camp fosters a non-competitive atmosphere where each child

SUMMER CAMP 22

can learn and grow in a safe space with caring and qualified counselors. We are also offering our week-long resident camp, Conservation Leadership Academy. Students ages 13 – 17 stay in the historic lodge and spend the week immersed in hands-on science with local conservation professionals. For more information on our summer camp schedule visit:

<https://www.lacawac.org/summer-camps.html>.

Volunteering Opportunities-

Make a Difference

Thank you to all of the volunteers that have been helping at Lacawac! Our trails, gardens, deer fences, and buildings are all in much better shape because of you. Check out the volunteer opportunities available; Adopt-a-Trail, Garden Club, Deer Fence Monitor, and more. If you are interested in becoming part of our volunteer team please fill out the application on our website.

<https://www.lacawac.org/volunteer.html>

A collage for 'LAKE APPRECIATION DAYS' featuring various activities like 'Ask a Lake Scientist Lunch', 'Paddle on Lake Lacawac', and 'Identify aquatic plants'. The background is a scenic view of a lake with lily pads and a boat. The text 'SAVE THE DATE...' is at the top left, and 'LAKE APPRECIATION DAYS JULY 16-17, 2022 LACAWAC SANCTUARY' is at the bottom. The collage includes several hexagonal images: a scientist at a table, a person paddling a canoe, a close-up of aquatic plants, a person hunting for insects, a person sitting on a bench, and a person holding a net.

Upcoming Events:

Volunteer Work Day!

Volunteer Workday

Saturday, April 9th - 9:00 am - 12 Noon

Spring clean-up and site project help is needed.

Trails need to be cleared, leaves need to be raked away from the buildings, fencing needs to be removed, plus much more. All ages welcome. Snacks and drinks will be provided! Meet at the Environmental Education Center. Rain date April 10. **Registration suggested.**



Full Moon Hike

Saturday, April 16th - 6:30 pm

Join Environmental Educator, Jamie Reeger, for a guided hike on the trails at Lacawac. As our eyes adjust to the fading light we'll look and listen for the nocturnal awakening. We will hike to the shores of Lake Wallenpaupack to watch the full moon rise. This is a strenuous 3-mile hike, please be prepared and dress accordingly. watch the moon rise over Lake Lacawac. Meet at the Environmental Education Center. Donations suggested.

Registration Required.



Bird Walk at Lacawac

Saturday, May 7th - 8:00 am

Join Northeast PA Audubon Society's expert birders for a walk through the Sanctuary. We will explore the area looking for birds setting up their nests as well as migrants just passing through on their way farther north. Bring binoculars if you have them. Meet at the Environmental Education Center. Donations suggested. **Registration required.**



Evening Paddle on Lake Lacawac

Monday, May 16th - 7:00 pm

Enjoy a quiet evening on the lake as the sun sets. Listen to the birds, search for the carnivorous sundew plant, and watch as the light changes across the lake. Paddle and safety instructions will be given prior to launching.

Meet at the dock. \$10.00/person.

Registration limited and required.



Foraging in the Forest

Saturday, June 4th - 9:00 am

Join renowned herbalist Nathaniel Whitmore, for a walk around Lacawac looking for perennial vegetables, medicinal herbs, mushrooms, and all the edibles in the forest. The forest has sustained our ancestors for generations. Learn how you can add some unusual options to your garden repertoire. Meet at the Environmental Education Center. \$5.00 per person.

Registration required.

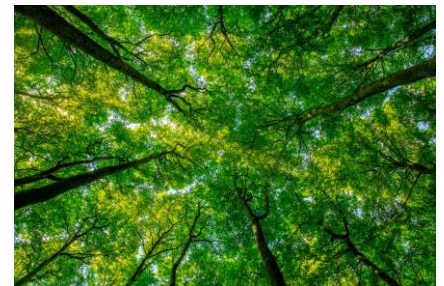


Morning Paddle on Lake Lacawac

Saturday, June 18th - 9:00 am

Enjoy a quiet morning on the lake after a short introduction about the ecological features and the research being conducted on the lake. Learn why this is the most pristine lake in North America. An identification scavenger hunt will be available to interested participants. Paddle and safety instructions will be given prior to launching. Meet at the dock. \$10.00/person.

Registration limited and required.



Forest Bathing Walk

Wednesday, July 13th - 7:00 pm

Join Certified Forest Therapy Guide Steve Ruelke for a walk in the woods and an immersion practice called Forest Bathing. In the 1980s Japanese scientists began searching for ways to minimize all the negative impacts that urbanization was having on individuals and society as a whole. They discovered that a two-to three-hour immersion in which one relaxes and breathes in the natural chemistry of a forest, can lower blood pressure, reduce stress levels, improve mood, increase restfulness, and boost one's immune system. They called this practice "Shinrin-yoku" which literally translates "forest bath," the art of taking in the atmosphere of the forest. Meet at the Environmental Education Center. **Registration required.**

For more information on our 2022 programs and to REGISTER visit:

www.lacawac.org/programs.html



**A special occasion to raise funds for our
preservation and education mission!**

Thursday June 16, 2022

6:00-8:00 pm

\$45 per person

Hors D'oeuvres by The Mustard Seed Cafe, open bar and smart casual attire.
The charitable contribution for the event is \$25 per reservation and will benefit
education in the local community.

Purchase Tickets at: www.lacawac.org/cocktails-for-conservation.html

Ticket sales are limited. No Refunds Available.



BECOME A LAKE SCIENTIST

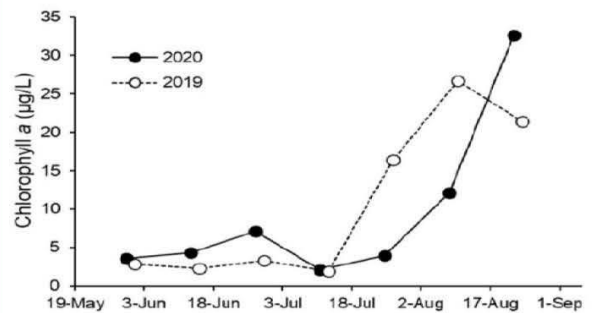
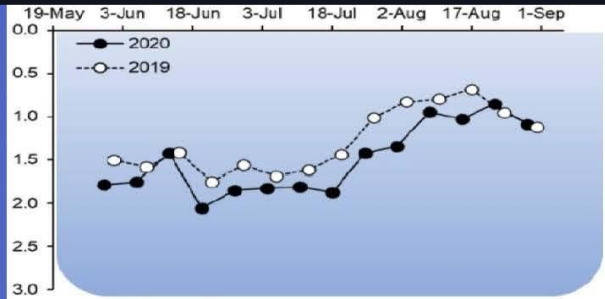
JOIN PLEON'S HANDS-ON,
COMMUNITY-LED LAKE
WALLENPAUPACK MONITORING
PROGRAM

BE AN ENVIRONMENTAL
STEWARD BY MEASURING
WATER QUALITY FROM YOUR
WALLENPAUPACK BOAT OR
DOCK

**Working together, community
scientists help understand how and
why Wallenpaupack water quality
changes over space and time.**

The PLEON Wallenpaupack Community Water Quality Monitoring Program is looking for volunteers! Participating is easy:

- Attend a training workshop to learn how to collect water quality data and to receive a sampling kit
- Sample from your dock or boat once a week during the summer
- Enter your data into the mobile app
- See your data and all the results at the Fall Discussion forum



Appropriate for school-age
children as well as adults. Great
for science projects!

2022 training schedule:

May 21st, 9 am to 11 am

May 22nd, 3:00-5:00 pm

May 28th, 9 am to 11 am

June 3rd, 5 pm to 7 pm

Register at

www.lacawac.org/citizen-science.html

Trainings held at Lacawac

Sanctuary:

94 Sanctuary Rd, Lake Ariel PA

18436

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to our sponsors

2022

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