NORTHEASTERN ECOLOGY CONFERENCE

SEPTEMBER 28, 2019

LACAWAC SANCTUARY AND BIOLOGICAL FIELD STATION

PROGRAM SCHEDULE

8:30-9:30	**CONTINENTAL BREAKFAST**	**WATRES ENVIRONMENTAL EDUCATION CENTER**
9:30-10:00	**OPENING REMARKS** *Beth Norman*	**WATRES ENVIRONMENTAL EDUCATION CENTER**
10:00-11:00	**SESSION ONE** *Moderator: Dale Holen*	**WATRES ENVIRONMENTAL EDUCATION CENTER**
11:00-11:15	**BREAK**	
11:15-12:15	**KEYNOTE ADDRESS** *Charles Canham*	**WATRES ENVIRONMENTAL EDUCATION CENTER**
12:15-1:15	**LUNCH**	**LODGE DINING ROOM**
1:15-1:45	**POSTER SESSION**	**LODGE LIVING ROOM**
1:45-2:45	**SESSION TWO** *Moderator: David Byman*	**WATRES ENVIRONMENTAL EDUCATION CENTER**
2:45-3:00	**CLOSING REMARKS**	**WATRES ENVIRONMENTAL EDUCATION CENTER**
3:00	**GROUP PHOTO**	**LAKE LACAWAC STONE PATIO**
3:00	**FREE PADDLE, HIKING, LAB TOUR**	

WELCOME TO LACAWAC SANCTUARY

RESEARCH, EDUCATION, PRESERVATION

Lacawac Sanctuary is an independent, non-profit biological field station and nature preserve located in the Pocono Mountains of Northeastern Pennsylvania. Lacawac is a natural living laboratory for field-based research and education. Composed of 545 acres along the shore of Lake Wallenpaupack, Lacawac encompasses protected native terrestrial and aquatic ecosystems.

Lacawac Sanctuary has been a valuable research and education site since its founding in 1966, hosting renowned ecologists such as Drs. Ruth Patrick and Radclyffe Roberts. Scientists working at Lacawac have been extremely productive, publishing more than 130 peer-reviewed papers focused on research at Lacawac and breaking new ground in the fields of limnology and forest ecology. Research at Lacawac is increasing, particularly in the areas of automated data collection and sensors. Lacawac is becoming known as a "hub for EONs", or ecological observatory networks, and continues to host research in many areas of ecology and environmental science.

Lacawac is uniquely suited to provide research and education resources for university and college faculty. With on-site lodging, abundant classroom space, and an analytical laboratory, Lacawac is able to facilitate research groups and field classes.

2019 KEYNOTE ADDRESS

Charles Canham

Cary Institute of Ecosystem Studies

FORESTS ADRIFT: CURRENTS SHAPING THE FUTURE OF NORTHEASTERN TREE SPECIES

I will outline what my 40 years of research on forest dynamics leads me to believe about how both natural processes and myriad human impacts will determine the future of northeastern forests. This includes legacies that date back through centuries of past human activities, as well as the usual suspects of overabundant deer, air pollution, invasive species, forest pests and pathogens, and climate change. As the title alludes, there is lots to worry about, but I remain optimistic that the forests will remain afloat…

SESSION ONE

10:00 CHRISTOPHER DEMPSEY* – GANNON UNIVERSITY

RELATIVE IMPORTANCE OF PHOTODEGRADATION AND BIODEGRADATION OF TERRESTRIALLY DERIVED DISSOLVED ORGANIC MATTER ACROSS FOUR LAKES OF DIFFERING TROPHIC STATUS

Outgassing of carbon dioxide from freshwater ecosystems comprises 12-25% of the total carbon flux from watersheds. The processing of DOM in lakes by both biodegradation and photodegradation can result in the production of CO_2, but the relative importance of these two processes is poorly understood in lake ecosystems. Recent findings in Toolik Lake, suggest that up to 70% of DOM may be photodegraded. These results contrast with prior findings that biodegradation is the dominant pathway that converts DOM to CO_2. In this study, we collected terrestrially derived DOM from one subtropical and three temperate lakes ranging in trophic status to assess the relative importance of biodegradation and photodegradation in oxidizing DOM to CO_2. We measured changes in dissolved organic carbon concentration and quality, dissolved oxygen, and dissolved inorganic carbon in experiments from May-August, 2016. The results indicated that photodegradation was more important than biodegradation in all lakes, but the magnitude of the response varied with the trophic status of the lake. Less than 2% of the DOM pool was photomineralized to CO_2 and the bulk of the organic carbon remained unprocessed. A descriptive discriminant analysis allowed us to explore how lakes of varying trophic status responded to photodegradation. Changes in DOC concentration were more important in differentiating the two brown water lakes, whereas changes in SUVA320 differed more between the oligotrophic and eutrophic lakes. As increases in terrestrially-derived DOM continue to occur, understanding the fate of DOM degradation will aid in predicting both the contributions to carbon cycling as well as the consequences for lakes and their downstream ecosystems.

Co-authors: Jennifer Brentrup, Sarah Magyan, Lesley Knoll, Don Morris, Evelyn Gaiser, Hilary Swain, Mike Ganger, and Craig Williamson

10:15 LUKE GROFF – FRANKLIN & MARSHALL COLLEGE

CANNIBALISTIC COPEPOD CAPER: THE EFFECTS OF A CHANGING ENVIRONMENT ON ZOOPLANKTON PHENOLOGY

Climate change can modify normal seasonal patterns in ecosystems and, consequently, affect important life cycle events of organisms. This study investigates an unusual phenological pattern in the copepod *Hesperodiaptomus arcticus* in Opabin Lake, a glacially-fed system in the Canadian Rocky Mountains. This project built on the findings of Haley Plante '17 who demonstrated a striking biennial oscillation between exclusively adult stages and exclusively juvenile stages in *H. arcticus* and hypothesized that this pattern was a result of a two-year life cycle and cannibalism in the nutrient poor lake. To test this hypothesis, I performed a microcosm experiment and compared body sizes of *H. arcticus* across my study systems. I also utilized stable isotope analysis to assess the trophic position of adults relative to juveniles in Opabin and Zigadenus (where cycling occurs) in comparison to Annette (no cycling) and Moraine (no cycling) and adults relative to *Leptodiaptomus tyrelli* (a small food item for *H. arcticus*) in Redoubt. Results from these analyses provided preliminary support for the cannibalism hypothesis. Additionally, by adding life stage data for four additional lakes as well as updating previously analyzed lakes to include summer 2017 and 2018, I observed dampening of the cycling pattern in Opabin and hypothesized that this dampening could be caused by warming lake temperatures, earlier spring ice-off, reduced turbidity, and increased phytoplankton abundances.

10:30 JAMES DEARWORTH* – LAFAYETTE COLLEGE**

CALCIUM SIGNALS BY RETINAL GANGLION CELLS OF RED-EARED SLIDER TURTLES AT DIFFERENT LEVELS OF OXYGEN

Red-eared slider turtles are an invasive species. Reasons for their success in thriving are poorly understood but could include possession of nervous tissue that can survive environmental extremes, such as hypoxia. We developed an assay to measure activities of their retinal ganglion cells to test effects of varying levels of oxygen. Dissected retinas were treated with Fluo-4 indicator dye to detect intracellular calcium and imaged by confocal microscopy during white light stimulation periods. Measures were compared in Ringer baths with oxygen concentrations, which were based on those observed at sites surveyed in the Northeastern United States, including Lacawac Sanctuary: anoxic (0-2 mg/L), hypoxic (2-4 mg/L), and normoxic (8-10 mg/L). Varying effects of oxygen did indeed appear to affect calcium signals from cells. For example, the anoxic level had the highest number of cells, which did not respond to light stimulation, when compared to the other oxygen levels. Experiments are planned to compare results in retinas of other co-inhabiting indigenous species such as eastern painted turtles (*Chrysemys picta picta*). A better understanding of the mechanisms underlying the tolerance of red-eared slider turtles and other related turtle species to low oxygen could reveal novel approaches on how to enhance survival of human nervous tissue during strokes and other ischemic events.

Co-Authors: Erik M. Cannon, Cathryn L. Kubera, Megan B. Rothenberger, Rebecca A. LaRosa, Mitchel R. Mandel, Kofi Y. Boateng, Amy L. Scalera, Sofia A. Reitsma, Mitchell A. Campbell, Olivia C. Erdman, and Alexander N. Gordon-Sandweiss

10:45 DAVID BYMAN – PENNSYLVANIA STATE UNIVERSITY, DUNMORE

POPULATIONS OF SHORT-TAILED SHREW, RED-BACKED SALAMANDER AND EPIGEAL INVERTEBRATES AT 3 DIFFERENT SITES IN A HEAVILY DEER-BROWSED NORTHEASTERN U.S. FOREST.

Populations of the Short-tailed Shrew (*Blarina brevicauda*), Red-backed Salamander (*Plethodon cinereus*) and epigeal invertebrates were censused in a forest heavily browsed by White-tailed Deer (*Odocoileus virginianus*). These animals are significant components of a predator-prey epigeal (soil-based) community. The three sites differed in degree of browsing intensity, sizes of openings in the tree canopy and the abundance of invasive ground cover species that deer don't consume. The data indicate that the level of browsing by deer of ground cover differentially affects the species of invertebrates consumed by the red-backed salamander and short-tailed shrew and the populations of those two vertebrate predators.

POSTER SESSION

JENNIFER CHANDLER – WEST CHESTER UNIVERSITY OF PENNSYLVANIA

PROBABILITY OF SPOTTED LANTERNFLY CAPTURE DEPENDS ON LIFE STAGE AND BAND TYPE

Spotted lanternfly (SLF), an invasive planthopper discovered in Pennsylvania in 2014, poses an economic threat to multiple industries, including grapes, fruit, and timber. Experts have suggested SLF may be captured using both commercial sticky bands and homemade duct tape traps, though they warn that duct tape may lose stickiness quickly. The purpose of this work was to determine if the probability of spotted lanternfly capture differs depending on life stage and on band type (duct tape vs. sticky band). We collected 2nd – 4th instar and adult SLF (N = 321), allowed them to walk onto either new duct tape or sticky bands, and recorded whether individuals escaped. Data were analyzed using Chi-square. Sticky bands are significantly more effective than duct tape in capturing SLF, accounting for 87% of the total number of captured individuals. Capture probability decreased with increasing life stage regardless of the material used. The proportion of 2nd – 4th instar individuals captured using sticky bands was relatively high, ranging from 62% in 4th instars to 79% in 2nd instars. However, only 16% of adults were captured using sticky bands. The proportion of individuals of all life stages captured using duct tape was lower than the proportion escaping. While 27% of 2nd instars were captured using duct tape, the percent captured decreased below 10% in later instars, and was 0% in adults. We do not recommend duct tape for SLF capture. Rather, efficacy will be greatest when sticky bands are deployed early in the season to capture young SLF.

Co-authors: Jessica Bickel, Matthew Desko, Carolyne Schiebel, Samantha Silverman

JESSICA SCHEDLBAUER – WEST CHESTER UNIVERSITY OF PENNSYLVANIA

CURRENT AND FUTURE CARBON STORAGE CAPACITY IN A SOUTHEASTERN PENNSYLVANIA FOREST

The carbon sink capacity of temperate forests is strong, though the future of this ecosystem service remains uncertain. The present study sought to quantify aboveground carbon accumulation and storage in a southeastern Pennsylvania forest fragment, while assessing whether carbon storage capacity will be supported in the future. Six 0.2 ha plots were censused in 2013 and 2018 to determine living tree carbon storage, dead wood carbon storage, and tree species composition. Three plots were in a 100-year-old forest, while the remainder were in a 200-year-old forest. Across forest ages, living tree carbon storage increased significantly over time ($p < 0.05$), though no change in dead wood carbon storage was detected. Living tree carbon storage and stem density were significantly higher in the younger forest ($p < 0.05$). The 200-year-old forest was characterized by a lack of small diameter stems (60 cm). Forest understories were dominated by American beech and Norway maple, two species with high deer browse resistance. Overall, there is evidence of high carbon storage capacity in living trees, though the currently small dead wood pool will increase in the future as many large trees die. Intervention will likely be required to augment regeneration and maintain the sink strength of the 200-year old forest. Further, both areas of the forest will benefit from Norway maple removal, given its strong competitive abilities. These findings are relevant to similar deciduous forest fragments throughout the region.

Co-author: Sarah Polohovich

CHEYENNE MOORE – BUCKNELL UNIVERSITY

PRAIRIES IN PENNSYLVANIA? CONSERVATION OF STATE-THREATENED *BAPTISIA AUSTRALIS VAR. AUSTRALIS*

In Pennsylvania *B. australis var. australis* (L.) R. Br. (Fabaceae) is comprised of two metapopulations along four waterways: the Allegheny River, Youghiogheny River, Clarion River, and Red Bank Creek. Despite the location of these watersheds within the greater Ohio River drainage, there is still considerable distance between the metapopulations. Because of its limited distribution and small number of extant populations, *B. australis var. australis* is considered state-threatened in Pennsylvania. The riparian prairie habitat that Pennsylvania *Baptisia australis var. australis* is restricted to is also in decline and considered vulnerable in the state. My work carries with it two main objectives: 1) Better understand the ecology and natural history of these metapopulations, including assessment of the status of the species in the state, and 2) What is the genetic structure of known native populations and how does it relate to the spatial structure of subpopulations? This research utilizes tools such as aerial imagery, field surveys, and herbarium collections in to examine the natural history of the species. In addition, ddRAD is used to collect genetic data for use in population genetics analyses. I plan to synthesize these data to gain insight into the metapopulation dynamics of this riparian system. My research will inform the conservation status of *Baptisia australis var. australis* in Pennsylvania, and clarify lingering uncertainties about gene flow in riparian plant populations. The project seeks to combine field opportunities surveying rare plants with the Pennsylvania Natural Heritage Program and genetic work at Bucknell University to answer broader conservation questions.

RUBY FRIES – FRANKLIN & MARSHALL COLLEGE

SEASONAL PATTERNS OF WATER TRANSPARENCY IN MOUNTAIN LAKES WITH CONTRASTING CATCHMENTS

Water transparency plays an important role in lake ecosystems by controlling thermal structure and primary productivity. In turn, transparency is regulated by organic and inorganic inputs from the surrounding catchment. We examined temporal variation in transparency by measuring fluorescent dissolved organic matter (fDOM) and turbidity using high frequency sensors in four lakes in the Canadian Rocky Mountains. Sensors were deployed soon after ice off until mid-summer in 2018 and 2019. In both years, fDOM declined seasonally in Ptarmigan Lake but was generally higher 2019. In Smith Lake, fDOM peaked dramatically in 2019. The differences in these two lakes between years likely reflects higher precipitation in 2019. Glacially-fed Opabin Lake showed a rapid increase in turbidity in response to a single rain event in 2019. Zigadenus Lake is also glacially-fed but did not appear to be affected by increased rainfall in 2019. Instead, lower temperatures in 2019 decreased glacial meltwater inputs.

Co-author: Stephanie Liu

SESSION TWO

1:45 COLLEEN LAWLOR – FRANKLIN & MARSHALL COLLEGE

GENETIC IDENTIFICATION AND SPATIAL DISTRIBUTION OF DAPHNIA IN CANADIAN ROCKY MOUNTAIN LAKES

Patterns of spatial distribution among communities of organisms are affected by many different ecological variables. The distribution of Daphnia, a freshwater lake-dwelling zooplankton and a model organism for studying environmental change, exhibits an interesting yet poorly understood pattern in the Canadian Rocky Mountains for three reasons: (1) its dependence on ecological variables is unclear, (2) it is complicated by discordance between traditional morphological species identifications and more recent genetic ones, and (3) community structures are constantly changing due to continual hybridization and dispersal of the different species, which in this region include *D. pulex*, *D. pulicaria*, and *D. middendorffiana*. This study aims to resolve some of the uncertainty regarding Daphnia distribution in Canadian Rocky Mountain lakes by comparing DNA sequence data of the mitochondrial NADH dehydrogenase subunit 5 (ND5) locus from individuals isolated from fourteen lakes with varying ecological characteristics. Data from these ND5 sequences suggest that Daphnia in the Canadian Rockies are distributed primarily based on geographic location rather than environmental conditions. Although these results contradict many studies that indicate significant effects of ecological variables on Daphnia populations and distribution, additional research including a larger set of study lakes and additional genetic loci may generate results that are more consistent with these former studies as well as valuable insights into the spatial distribution of Daphnia species in the Canadian Rockies and beyond.

2:00 BETH NORMAN – LACAWAC SANCTUARY

WHAT ROLE DOES NITROGEN AVAILABILITY PLAY IN DETERMINING THE TROPHIC FATE OF LAKES APPROACHING AN ECOLOGICAL TIPPING POINT?

The concentration of dissolved organic matter (DOC) is increasing in many lakes in the Northern Hemisphere, a phenomenon called lake browning. Lake browning may alter lake ecosystems in fundamental ways, including decreased transparency, extended periods of deep-water anoxia, and increased phosphorus (P) loading. These interrelated factors have the potential to push historically clear water lakes past an ecological tipping point. We investigated the role of nitrogen (N) availability on the trophic fate of lakes as browning-induced anoxia increases internal P loading to a point where phytoplankton will no longer be limited by P availability. Specifically, we hypothesized three potential outcomes depending on N availability: (i) P loading in low N lakes will favor N-fixing cyanobacteria, leading to a mixotrophic, green-brown state, (ii) P loading in high N lakes will stimulate phytoplankton production, also leading to a mixotrophic, green-brown lake, and (iii) P loading in intermediate N lakes will induce N limitation, but fixation will be inhibited by the presence of DIN, leading to a dystrophic, brown lake with low productivity. We tested these predictions using an in-situ bioassay bag experiment where phytoplankton communities from a clear water lake were exposed to the P and DOC concentrations predicted by modeling to shift limitation across a gradient of N availability. Preliminary results showed an increase in phytoplankton biomass at high N concentrations after 6 days of incubation. We did not find evidence of limitation by N or P at any of the levels of N enrichment.

Co-authors: Colleen Lawlor, Craig Williamson, Kevin Rose

2:15 DALE HOLEN – PENNSYLVANIA STATE UNIVERSITY, DUNMORE

STOMATOCYST MORPHOTPYE AND ENCYSTMENT RATES IN *OCHROMONAS PINGUIS*, A MIXOTROPHIC CHRYSOPHYTE

Under controlled laboratory conditions *Ochromonas pinguis* Conrad produced, albeit at a low rate, a stomatocyst morphotype that was heavily ornamented with lunate ridges of varying lengths and heights and a wide secondary collar with a 1 µm pore often observed plugged. The cylindrical collar was complex with a wide concave annulus and a mean height of 2.48 ± 0.28 µm. The stomatocyst size ranged from 17.4 – 19.2 µm (length) x 15.7 – 16.9 µm (width). To determine if the low rate of encystment was typical or whether specific stressors or population size might enhance the rate at which resting cysts are produced *O. pinguis* was subjected to various physical and chemical conditions in batch cultures. The treatments included N and P limitation, short day length, added bacteria in the light and the dark and temperature. Except for growth in continuous darkness, all treatments resulted in growth of the flagellate and stomatocyst formation. The encystment frequency however was minimal in all cases with on average 0.002 – 0.01% of the population undergoing cyst formation.

2:30 EMILY RUSSAVAGE – WILKES UNIVERSITY

COMPARISON OF THREE CANOPY COVER ESTIMATION TECHNIQUES IN LONG ISLAND CENTRAL PINE BARRENS

Light availability controlled by forest canopy openness (CO) has a causal relationship with understory plant growth and tree species recruitment into forest canopy, thus plant and forest community composition. Understanding changes in light availability in forest understories is important for forest managers to produce appropriate management strategies. At a subset of 28 permanent forest health monitoring (FHM) plots established in 2005-2006, we characterized canopy cover in 2019 using the following three independent methods that varied in complexity, time required for each reading, and cost: (1) hemispherical photography (HP), (2) spherical crown densiometer, and (3) the AccuPAR LP-80 ceptometer. We conducted an ANOVA and simple regression analyses to determine that no statistically significant differences existed amongst CO measurements provided by the three different tools. Our analyses suggest that forest managers can save costs by avoiding expensive methods when tools that are cheaper may suffice in the open ecosystem of pine barrens.

2:45 NED FETCHER – WILKES UNIVERSITY

TREE GROWTH AND RECRUITMENT IN THE EASTERN DEER EXCLOSURE AFTER 24 YEARS

In 1994, a deer exclosure was established in hemlock-dominated forest south of Heron Pond. Diameter at breast height (DBH) was measured for most of the trees within the exclosure in 1995, 1999, 2012, and 2019. DBH and basal area (BA) of red oak (*Quercus rubrum*), chestnut oak (*Quercus prinus*), and white pine (*Pinus strobus*) increased slightly, while that of red maple (*Acer rubrum*) and hemlock (*Tsuga canadensis*) was unchanged. Recruitment was low, with few individuals in the smallest size classes.

** Recipient of a Robert Estabrook Moeller Research Fellow Award from Lacawac Sanctuary*

*** Lacawac Sanctuary Consortium member institution*