# ABSTRACTS AND BIOGRAPHIES FOR PRESENTATIONS AT THE 21st ANNUAL CONFERENCE OF THE


**14-16 JANUARY 2020**

**The Crowne Plaza Hotel and Conference Center**
**Lake Placid, New York**

**Abstracts and biographies are listed in order of presentation at the conference**

# Tuesday, January 14, 2020

### *Special Session (Moderator: Cathy McGlynn)*



### *Workshops (Moderator: Chris Doyle)*



# Wednesday, January 15, 2020

### *Opening Session/Aquatic Plant Identification and Mapping (Moderator: Will Stevenson)*



### *Hazardous Algal Blooms (Moderator: Mark Heilman)*



### *Climate Change on Lakes and Aquatic Invasive Species Pathways (Moderator: Meg Modley)*

### *New Technology (Moderator: Bin Zhu)*



## Thursday, January 16, 2020

### *Hydrilla (Moderator: Chris Hanlon)*



### *Topics in Aquatic Vascular Macrophytes and Algae (Moderator: Emily Molden)*

## *Scientific Poster Session*



** Denotes a Student Presentation*

## Harnessing Subconscious Behavior

Ken Donnelly Beyond Attitude

**Abstract:** Understanding the difference between conscious and subconscious behavior is key to getting people to adopt new habits to prevent introduction and spread of invasive species. Subconscious behaviors do not require thought, even for rather complicated actions (like reaching out and grabbing a doorknob and twisting while walking). Conscious behaviors require thinking (like calculating a tip in a restaurant). Many communications and education programs focus on requiring people to think about their actions. But we can have more success if we can get them to act without thinking. This can be done if we take a different, more strategic approach to fostering new behaviors that will stop the introduction and spread of aquatic invasive species.

**Speaker Biographies:**

For over 25 years Ken Donnelly has worked with government and non-governmental organizations to foster positive individual behaviors, primarily in the areas of environment, health, transportation and occupational health and safety. For the past 10 years his primary focus has been the human dimensions of invasive species. For the past 20 years Ken has also trained people in behavior change principles in workshops across Canada, in the UK and in the Caribbean. Ken also publishes a free weekly electronic bulletin on behavior change, which has subscribers from around the world, and can be subscribed to at the website: www.beyondattitude.com.

## Human Dimensions of Aquatic Plant Management

Victor DiCenzo, Ph. D. SOLitude Lake Management

**Abstract:**
Aquatic plants serve important functions in aquatic ecosystems including production of oxygen, recycling nutrients, reducing turbidity, and providing food, spawning substrate, and habitat for invertebrates and fish. However, while anglers and hunters favor an abundance of aquatic plants in reservoirs, many lake users prefer little to no vegetation. This disparity in preference of aquatic vegetation challenges lake managers when developing management plans. However, determining the proper amount of aquatic plants is a value-laden judgement that confounds successful management and can result in stakeholder conflict. Decision makers must consider all stakeholders to better understand the breadth of preferences, attitudes, and opinions that exist. More importantly, stakeholders should be actively involved in developing aquatic plant management plans. Why should decision makers involve stakeholders? First, there is an inherent value in involving the public in decisions that affect them. Second, stakeholders may have unique contributions that could help inform decisions. Third, involved citizens are more likely to support decisions and facilitate implementation. Finally, research suggests that active stakeholder involvement has genuine influence on decisions and promote two-way communication and learning. The inclusion of human dimensions information is often necessary because conflict or disagreement exists in how aquatic plants should be managed. Including human dimensions opens up a variety of social science tools, human behavioral understandings, and public involvement processes that yield better information for decision making and hopefully more broadly accepted management decisions. Therefore, management cannot simply focus on ecological approaches when social conflicts arise.

**Speaker Biography:**
Vic DiCenzo is a fisheries biologist with Solitude Lake Management. Vic previously worked as a district fisheries biologist for 19 years in Virginia. Vic earned his Ph. D. from Virginia Tech, where his research focused on the human dimension aspect of trout management. During that time, he developed a passion for stakeholder engagement and involvement in management decisions. Vic hopes to broaden his research by involving stakeholders in complex aquatic plant management issues.

## Problems in taxa identification within the Potamogetonaceae

C. Barre Hellquist, Ph.D. Professor Emeritus Massachusetts, College of Liberal Arts

**Abstract:**
The genus Potamogeton identification continues to be a problem for the person identifying aquatic plants. The variability within a species makes it difficult to identify. No key developed can always lead to a correct identification. Closely related species can cause major problems especially when in the vegetative state. Name changes within the family have occurred, eg. Potamogeton versus Stuckenia. DNA results have led to some changes within the P. pusillus complex. DNA has also shown that the genus produces many hybrids leading to greater confusion. Very often it is next to impossible to determine parentage from appearance.

**Speaker Biography:**
Dr. C. Barre Hellquist (c.barre.hellquist@mcla.mass.edu) is professor emeritus of biology at Massachusetts College of Liberal Arts. His specialty is the Potamogeton and Nymphaea of North America and Australia. He is co-author of the Aquatic Plants of New England series and the two volume Aquatic and Wetland Plants of Northeastern North America. He has co-authored portions of the Flora of North America (Nuphar and Alismatidae), the Alismatidae for the Flora of China, the Jepson Manual of California, and the aquatics for the flora of the San Juan River Basin (four corners region of western U.S.). He has co-authored various articles on Australian water-lilies naming 8 species with the late Surrey Jacobs. He has recently been conducting field studies with his son, Dr. C. Eric Hellquist (SUNY-Oswego) on the aquatic flora of Yellowstone and Grand Teton National Parks.

## Aquatic Plant Workshop

The SOLitude Biology Team SOLitude Lake Management

**Abstract:**
Join the SOLitude Biology Team for two hours of aquatic plant observations and investigations. Following a short presentation on a featured aquatic plant group, at your own pace come explore dozens (last year we had over 70 different species) of aquatic plant samples collected during the 2019 field season throughout the Northeast. The previously frozen samples will be thawed and on display throughout this session, and throughout the Presidential Reception for late-comers to explore. Also, on hand will be numerous preserved plant samples and regionally appropriate taxonomic keys. There will be many aquatic plant experts in the room, so this is the perfect opportunity to ask questions and network with other industry folks. Returning this year will be the "unknown samples" table and of course the chance to win "fabulous prizes" by taking the aquatic plant quiz.

**Speaker Biographies:**
The SOLitude Biology Team is: Chris Doyle, CLM, Amanda Mahaney, Brea Arvidson, and Emily Mayer. All team members are aquatic biologists working for SOLitude Lake Management in the Northeast, focusing on aquatic plant surveys (and other biological surveys) and water quality monitoring programs.

## Using Sonar-Based Technology for Aquatic Invasive Species Early Detection and Waterbody Vulnerability Assessments

**Erin Vennie-Vollrath** **Adirondack Park Invasive Plant Program and The Nature Conservancy**
Ezra Schwartzberg, Adirondack Research
Janelle K Hoh, Adirondack Research

**Abstract:**
Allocating limited management resources to detect novel infestations of aquatic invasive species (AIS) within large, recreationally connected aquatic systems, like those found in the Adirondacks, is an ongoing challenge for natural resource managers. Beginning in 2018, The Nature Conservancy's Adirondack Park Invasive Plant Program contracted with Adirondack Research to advance sonar-based data collection and post-processing using C-Map BioBase to accurately map aquatic vegetation biovolume, bottom hardness, and bathymetry. The data provide detailed waterbody-specific characteristic information with increased accuracy and at reduced cost than top-water or diver-assisted surveys. We intend to utilize these data to develop geospatial vulnerability models of aquatic invasive plant establishment and spread for individual lakes to help target future early detection surveys and to direct regional AIS spread prevention measures. While this technology offers many opportunities, there are also challenges and limitations. We will discuss these in the context of our experiences using these tools.

**Speaker Biography:** Erin Vennie-Vollrath lives and works here in the Adirondacks. She leads the Adirondack Park Invasive Plant Program's early detection and monitoring programs for aquatic invasive species, manages volunteer groups and surveys, coordinates with partners in the region, and provides trainings and presentations to various stakeholder groups on aquatic invasive species issues. Erin moved to the Adirondacks in 2014 from Wisconsin where she received a B.S. in Zoology and an M.S. in Water Resource Management from the University of Wisconsin – Madison and then worked for the Department of Natural Resources on a variety of projects focused on aquatic invasive species.

## Evaluation of Machine Learning for Automation of Aquatic Plant Identification from Hydroacoustic Data

**Rob Richardson, Ph.D.** **North Carolina State University**
Andrew Howell, North Carolina State University
Ramon Leon, North Carolina State University
Scott Ferguson, North Carolina State University
Gregory Buckner, North Carolina State University

**Abstract:**
Resource managers commonly implement hydroacoustic technology within water body surveys for vegetation detection and quantification. Recent developments in data processing have allowed for rapid transformation of raw hydroacoustic data into heat maps for visualization of vegetation density. While this has greatly improved the ability of managers to track density of submersed vegetation, species identification must still be obtained by time consuming point intercept methods. Therefore, the objective of this project was to evaluate machine learning technologies for automated weed identification from hydroacoustic imaging. Geotagged hydroacoustic imagery of three aquatic plant varieties (Hydrilla, Cabomba, and Coontail) was collected and used to create a software pipeline for subsurface aquatic weed classification and distribution mapping. Employing deep learning, the novel software achieved a classification accuracy of 99.06% after training.

**Speaker Biography:**
Dr. Richardson has responsibilities for aquatic and non-cropland weed science research and extension at North Carolina State University. Rob has been in his current position at NCSU for 12 years and serves on numerous invasive plant advisory committees across the US. He has served as President of the Aquatic Plant Management Society, North Carolina Vegetation Management Association, South Carolina Aquatic Plant Management Society, and North Carolina Weed Science Society. He also currently serves on the Weed Science Society Board of Directors and in the Plant Work Group for the Council for Agricultural Science and Technology.

## U.S. Geological Survey's Nonindigenous Aquatic Species (NAS) Program: Tools and Information for Researchers, Managers, and Stakeholders

**Ian Pfingsten** **U.S. Geological Survey**
Wesley Daniel, Matt Neilson, Amy Benson, Cayla Morningstar, Justin Procopio, and Jonathan Freedman; U.S. Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL 32653

**Abstract:**
The U.S. Geological Survey's Nonindigenous Aquatic Species program (NAS; https://nas.er.usgs.gov/) maintains a large database of spatially referenced biogeographic records of introduced freshwater and some marine species within the United States and its territories. In addition to providing public access to distribution maps of non-native aquatic species, the NAS program is focused on transitioning big data into actionable and smart data with the development of tools and maps for managers and stakeholders. Our oldest tool, the national NAS Alert System, provides a framework for the rapid dissemination of new invasions as they are incorporated into the NAS database and notifies registered users of new sightings as part of a national early detection/rapid response system. We recently (June 2018) incorporated an Alert Risk Map (ARM) for each new specimen in our Alert System showing the potential risk of spread into nearby reaches and waterbodies. In response to the tremendous flood event caused by Hurricane Harvey in 2017, we developed interactive Flood and Storm Tracker (FaST) maps to show potential spread of non-native aquatic species due to flooding across drainage divides. Since the 2017 hurricane season, we produced FaST maps for eight flood-related events. In 2019, we released two new tools: (1) an impacts table listing documented impacts (ecological, economic, and human health) caused by 100 priority species found in the southeastern U.S., and (2) an online tool to Screen and Evaluate Invasive and Non-native Data (SEINeD) that checks publicly uploaded occurrence datasets against our native ranges and returns to users the native status for each occurrence in their datasets.

**Speaker Biography:** Ian has spent over four years working with non-native aquatic plants for the US Geological Survey on the Nonindigenous Aquatic Species database. He previously worked in Orange County, FL lakes collecting water quality data for the Environmental Protection Division in between spending time in Oregon and Florida monitoring rare plant populations. Ian got a BS in Biology at the University of Central Florida and an MS in Botany at Oregon State University.

## Solid Phase Adsorption Toxin Trackers (SPATTs) and Diffusive Gradients in Thin Films (DGT) Samplers for Characterizing Cyanotoxins in Freshwater

**Kurt Carpenter** **Oregon Water Science Center, Portland, OR** .
Jennifer Graham, New York Water Science Center, Troy, NY
Guy Foster, New York Water Science Center, Troy, NY
Haley Olds, Upper Midwest Water Science Center, Middleton, WI
Victoria Christensen[3], Upper Midwest Water Science Center, Middleton, WI
Elisa D'Angelo, University of Kentucky, Lexington, KY

**Abstract:**
Harmful algal blooms (HABs) are often associated with cyanotoxins that can be ephemeral, fluctuating widely depending on the time of day, light, and water and wind currents. Solid Phase Adsorbent Toxin Trackers (SPATTs) and Diffusive Gradients in Thin Films (DGT) Samplers concentrate cyanotoxins from the water over time, capturing events including blooms, reservoir releases, and stormflows that may be missed with discrete sampling. SPATTs and DGT devices hold small adsorbent resin beads that bind with cyanotoxins dissolved in water. Initial testing of DGT showed great promise for microcystins, with a 7-day deployment detection limit of 0.05 ug/L in water, which is lower than many ELISA methods. A 2016-18 study in Oregon's Willamette Basin found one or more (up to 4) cyanotoxins in 82% of 125 SPATT samples from reservoirs, rivers, and drinking-water intakes. Microcystins and anatoxin-a were most frequently detected, occurring in about 60% of samples, with 75% and 83% detection, respectively, in 36 samples from drinking water intakes. Two new USGS studies were initiated in 2019 in New York's Finger Lakes Region, the Hudson River, and other locations in New Jersey, North Dakota, Minnesota, and Wisconsin. SPATTs were deployed to complement collection of discrete cyanotoxin data and other water quality data to provide early indicators of cyanotoxin occurrence. At several locations, SPATTs and DGT samplers are being evaluated side-by-side to assess and compare these methods. These studies demonstrate the utility of passive samplers for detecting and characterizing cyanotoxins in freshwater.

**Speaker Biography:** Kurt Carpenter is a Research Hydrologist with the USGS Oregon Water Science Center in Portland Oregon where he has conducted research on cyanobacteria, harmful algal blooms, and impacts on drinking water resources and aquatic life since 1992. He is currently collaborating with other researchers with the NY Water Science Center on a study characterizing CyanoHABs in the Finger Lakes Region where cyanotoxins are being monitored with both discrete samples and passive sampling methods.

## Using Advanced Technologies for HAB Monitoring and Water Supply Response in New Jersey

**Heather Desko** **New Jersey Water Supply Authority**
Victor Poretti, NJ Department of Environmental Protection
Robert Schuster, NJ Department of Environmental Protection
Heather Heckathorn, United States Geological Survey NJ Water Science Center

**Abstract:**
Cyanobacteria blooms have plagued several New Jersey water bodies in 2019. Through partnerships with state and federal agencies, the New Jersey Water Supply Authority utilizes advanced technologies to monitor water quality for potential cyanobacteria activity. These technologies include fixed wing aircraft remote sensing and continuous water quality sensors with real-time access. The Authority uses these technologies in conjunction with traditional water quality monitoring, including grab samples and hand-held meters, in order to develop a response strategy for cyanobacteria blooms in the context of water supply management. This presentation will discuss the technology use in several NJ water bodies, including Spruce Run Reservoir, Manasquan Reservoir, and Lake Hopatcong, and cover the 2019 blooms and water supply response in Spruce Run and Manasquan Reservoirs.

**Speaker Biography:** Heather Desko is a Senior Watershed Protection Specialist for the New Jersey Water Supply Authority. She joined the Authority in 2009, after serving as an AmeriCorps NJ Watershed Ambassador for the Lower Raritan Watershed. Heather manages the Authority's water monitoring programs, aquatic invasive species projects, community rain barrel and rain garden programs, and River-Friendly Business and School certification programs. She is a member of the New Jersey Water Monitoring Council, where she chairs the Decontamination Protocols Workgroup. Heather received both her BA in Environmental Science and MA in Energy and Environmental Analysis from Boston University in 2008.

## Advancing Strategies for Controlling Harmful Algal Blooms

West Bishop, Ph.D. SePRO Corporation

**Abstract:**
With apparent increases in large-scale cyanobacterial blooms, novel management approaches are needed to improve management and restore the uses of the water resource. Toxic cyanobacteria pose significant risks to the ecological system due to the potential production of numerous types of toxins (e.g. neurotoxins, hepatotoxins, dermatoxins). Humans and wildlife associated with the water are exposed to these toxins in many ways such food chain accumulation, water supply, aerosolization and recreational contact. Acknowledging the multiple toxins, both currently described and yet to be characterized, numerous exposure routes, and potential for significant impacts on humans/ wildlife; direct management is critical if a bloom is discovered. Often there are concerns over applying USEPA approved algaecides to these blooms due to the release (or potential) of these toxins. Even though many toxins are already found in the dissolved state, will be innately released, and total toxin increases exposure potential, applied management is still restricted. The objectives of this presentation are to cover some novel approaches for mitigating toxic cyanobacterial blooms both proactively and reactively as well as address the toxins present.

**Speaker Biography:**
West Bishop received a BS from Western Michigan University in 2006, MS from Clemson University in 2010, and Ph.D. from North Carolina State University in 2016. The focus of his research has been on efficient management of noxious algae and water quality improvement. West is a certified lake professional through NALMS and has presented at numerous professional conferences and contributed many articles to peer-review and other literature. West has been with SePRO Corporation over eight years as the Algae Scientist and Water Quality Research Manager.

## Climate Change and Your Lake: What You Need to Know

Ken Wagner, Ph.D. Water Resource Services

**Abstract:**
Climate change is real; we can debate the causes, but it has always existed and is being strongly manifested globally today. Focusing on slight changes in average temperature is misleading; the biggest danger is in variability, which increases with increasing average. Greater variation means higher highs and lower lows and will make detecting trends harder and require more data over an extended time period to document. This causes delays in perception of the problem and action to counter it. Increasing frequency of extreme events includes larger storms that affect water quality and habitat and longer droughts that impact water quantity. Increasing temperature at the sediment-water interface increases oxygen demand at a potentially alarming rate; loss of oxygen has as much impact on water quality and biological integrity as any factor influencing lakes. Warmer water favors cyanobacteria and faster growth by vascular plants. Longer growing seasons allow greater expansion by invasive plant species. We cannot control climate change in our lifetimes, but we can take steps to adjust to it. Key steps include more detention capacity, better control of nutrient loading and availability, provision of oxygen to offset losses from increased temperature, and application of plant management techniques. The need for lake management will increase with increasing temperature, but the techniques needed, intensity of need, timing and application frequency will vary over space and time, making lake management a more complicated proposition.

**Speaker Biography:** Dr. Wagner holds degrees from Dartmouth College and Cornell University, with his Ph.D. earned in Natural Resource Management in 1985. He has 40 years of experience working on a variety of water resources assessment and management projects, focusing mainly on lakes. In 2010 he started Water Resource Services, a small company with a focus on water supply protection and lake management consulting. He is a former President of the North American Lake Management Society and Editor in Chief of Lake and Reservoir Management, a peer-reviewed journal. He is a member of APMS and a former director of NEAPMS.

## Pathways of Invasion: Recreational Boater Activity, Aquatic Invasive Species Distribution, and Landscape Level Connectivity to Inform Management and Prevention in New York State

**Michale Glennon** **Paul Smith's College - Adirondack Watershed Institute**
Dan Kelting, Director, Paul Smith's College - Adirondack Watershed Institute
Eric Paul, Stewardship Program Director - Paul Smith's College Adirondack Watershed Institute

**Abstract:**
Aquatic resources are vital to the economy and ecology of the Adirondack Park and require significant investments of time and resources for detection, management, and prevention of aquatic invasive species (AIS). Since 1989, the Adirondack Watershed Institute has worked to protect water quality in northern New York state via water quality monitoring, aquatic invasive species monitoring and management, environmental science and data analysis, and broad public outreach and education. AWI's Stewardship Program is the primary vehicle for spread prevention, achieved through education, outreach, and direct engagement with recreational boaters, thought to represent the primary means by which aquatic invasive species are dispersed and spread among waterways. Longstanding investment in the region has resulted in a wealth of long-term and broad-scale data that can be used to better understand the factors that influence both the ability of invasive species to reach new areas and those which influence the likelihood of their successful establishment. We have found that a number of factors influence the levels of recreational boating activity (i.e., propagule pressure) among lakes including lake size, access features, and connections to other waterways. We have also found that some of these same factors influence the likelihood of establishment (i.e., invasibility) of AIS including Eurasian watermilfoil. A combined analysis of these two axes of invasion risk has allowed us to identify the connections and most likely pathways of spread between established AIS populations and uninvaded waterways in the Adirondacks and Northern New York and to prioritize spread prevention efforts in the region.

**Speaker Biographies:** Michale is the Science Director for the Paul Smith's College Adirondack Watershed Institute and am engaged in research ranging from issues of residential development to recreation ecology to climate change. I previously spent 15 years as the Director of Science for the Adirondack Program of the Wildlife Conservation Society. At AWI, I work to shape our science program, provide research opportunities for students, and champion our work in order to enhance the use of science in the management and stewardship of the Park. I have a B.S. from Dartmouth, and M.S. and Ph.D. from SUNY-ESF.

## Efficacy of Boat Stewards and NYS Regulations at Enhancing Visitor Adoption of AIS Prevention Strategies

**Dan Kelting** **Paul Smith's College - Adirondack Watershed Institute**
Michale Glennon, Paul Smith's College - Adirondack Watershed Institute

**Abstract:**
Boat steward programs have emerged as the strategy of choice over the past decade to decrease the spread of aquatic invasive species (AIS) in New York State via the vector of overland transport of recreational watercraft. The New York State AIS Management Plan released in 2015 maintained that effective prevention strategies would include education and outreach components and called for the "immediate action" of expanding boat steward programs. Despite significant investments in boat steward programs, research on visitor engagement as part of aquatic invasive species management is fairly new and identifying ways to engage more effectively remains an issue. This study investigated the responses of visitors encountered in a landscape-scale boat inspection program with regard to AIS prevention steps required to comply with New York State regulations. Researchers assessed the extent of and variables associated with self-reported visitor adoption of "Clean, Drain, Dry/Treat" AIS spread prevention procedures using an existing dataset containing 19 years of records of visitor responses from more than 60 boat launches across the Adirondack region in northern New York State. Analysis also include comparison of visitor responses before and after the passage of the New York State AIS Transport Law (6 CRR-NY § 576.3) in 2016. This presentation will report the results of these analysis as well as recommendations for follow up research and engagement to increase the effectiveness of boat steward programs.

**Speaker Biography:**

## Chemical- Free Algae Mitigation with Air Nanobubbles

**Christian Ferrence** **Moleaer**
Andrea White

**Abstract:**
The use of air nanobubbles to mitigate and manage algae in surface waterbodies is a promising, new area of research that provides a novel, chemical-free solution to waterbody management. The neutral buoyancy, Brownian motion, and oxidative impact of nanobubbles has led to the successful management of algae in numerous waterbodies where traditional aeration and chemical treatments have failed. This presentation will include a case study where air nanobubbles were used to treat cyanobacteria in water collected from Lake Elsinore, CA. Lake Elsinore has been historically vulnerable to algae blooms and routinely issues recreational advisories due to dangerous levels of cyanotoxins. In this test, algae and toxin samples collected from a drum of Lake Elsinore water circulated with air nanobubbles was compared to samples collected from a drum of Lake Elsinore water circulated without nanobubbles. Data from this test shows that within 4 hours, the control drum experienced a 7.5% increase in cyanobacteria and a 31.5% increase in microcystin while the drum that received nanobubbles indicated 40% reduction of cyanobacteria with a minimal increase in microcystin. Based on these results and more than 200 field observations, the latest understanding of nanobubble treatment of algae is that nanobubbles provide a multifaceted solution to algae treatment. Upon introduction of air nanobubbles, immediate lysis of algae occurs through oxidation and long-term algae mitigation is achieved through enhanced aeration and reduced sediment nutrient cycling.

**Speaker Biography:** Christian Ference is an Application Engineer at Moleaer, Inc based in Los Angeles, CA. Christian's research focuses on the use of nanobubbles for treating algae, algae toxins, and improving aquatic environments. Outside of aquatic management, his research focuses on the unique properties of nanobubbles and their application in a variety of markets. Christian earned his B.S. in Chemical Engineering and M.S. in Environmental Engineering from the University of Pittsburgh

## Preliminary Evaluation of Nannobubblers to Improve Water Quality and Reduce Cyanobacteria Blooms

Patrick Goodwin, CLM Aquatic Systems, Inc.

**Abstract:**
Nannobubbler seems to be the new buzz word in our industry, but what is a nanobubbler, and how does it work to improve water quality and reduce cyanobacteria blooms? How does it compare to other technologies in our industry and where is it best utilized? This presentation attempts to answer those questions by presenting the current peer-review literature regarding nanobubble technology and provides two case studies where nannobubblers were used to improve water quality and reduce cyanobacteria blooms.

**Speaker Biography:**
Patrick is a research scientist for Aquatic Systems Inc., a Florida based lake management company with 11 offices throughout the state. He also works for Vertex Water Features Inc., an international aeration company that designs and manufactures aeration systems for variously sized waterbodies. Patrick has over 7 years experience directly with aeration systems two of which were part of his M.S. thesis. Patrick has a B.S. from the University of North Florida in biology and M.S. in lake management from the State University of New York. Patrick is a certified lake manager.

## Monoecious Hydrilla Management in Lake Waccamaw: A Program Summary

**Erika Haug, Ph.D.** **North Carolina State University**
Kara Foley, North Carolina State University
Andrew Howell, North Carolina State University
Tyler Harris, North Carolina State University
Steve Hoyle, North Carolina State University
Robert Richardson, North Carolina State University

**Abstract:**
Lake Waccamaw is a 9,000-acre shallow natural bay lake in located in Southeastern North Carolina. This unique system supports a highly diverse community of native plant and animal species, including several endemic and rare species. In the early fall of 2012, an infestation of monoecious hydrilla was confirmed in the lake. Immediately following this discovery, a technical advisory committee was formed, and a point intercept and sonar survey of the entire lake was conducted. Results of this survey indicated 608 acres of hydrilla and 3,600 acres of native vegetation. Selective herbicide treatments were initiated in 2013. Fluridone herbicide treatments along with intensive monitoring have been performed annually since the initiation of this program. Hydrilla biomass and frequency of occurrence has declined since the initiation of the program. Hydrilla tuber densities remained relatively consistent until 2018 when no tubers were observed despite an increase in sampling intensity. An overview of the program and collected data on native and invasive plant species will be discussed.

**Speaker Biography:**
Erika completed a Bachelor of Science degree in Biology at McGill University in Montreal, QC. She has worked in the public, private, non-profit and academic sectors of aquatic plant management. Most recently, Erika completed her PhD in Fisheries, Wildlife and Conservation Biology at North Carolina State University under the direction of Dr. Robert Richardson.

## Hydrilla in the Connecticut River: What's going on, anyway?

**Gregory Bugbee** **Connecticut Agricultural Experiment Station**
Nicholas Tippery University of Wisconsin

**Abstract:**
Hydrilla (*Hydrilla verticillata*) is among the most troublesome invasive aquatic plants in Florida and many other southern states. It crowds out native vegetation, harms fisheries, limits recreation, impedes navigation, and reduces property values. Following reports of hydrilla occurring in the southern portion of the Connecticut River, a task force was formed by the Northeast Aquatic Nuisance Species Panel (NEANS). The task force comprised over 30 experts and performed a survey of the river from central Vermont/New Hampshire to southern Connecticut in 2018 and 2019. No hydrilla was found in the New Hampshire/Vermont portions of the river with the northern-most sightings occurring in southern Massachusetts. From the Connecticut border south, hydrilla became common. Portions of the river and its coves downstream from Hartford were choked with the weed. The densest beds occurred on shallow shoals and in protected coves. In some coves, hydrilla spread out over the surface making access by survey boat impossible. Finding such dense stands in a northern state is alarming. Furthermore, the Connecticut River hydrilla is far more robust than that seen elsewhere in the State. This could be a result of river flow, nutrients, or genetics. With funding from NEANS, the CT River hydrilla underwent genetic testing. The results suggested that the CT River hydrilla is very different than that known to grow in the USA. It also appears to be globally unique and therefore we don't have an exact fix on where it may have come from. It shares the most similarity with hydrilla found in Europe, Japan and Korea. More information is needed including whether the hydrilla is monoecious or dioecious, what if any kinds of flowers it produces, and whether it produces seeds, tubers, and/or turions.

**Speaker Biography:**
Gregory Bugbee is an Associate scientist at the Connecticut Agricultural Experiment Station, New Haven, in the Department of Environmental Sciences. He is the principal investigator in the Invasive Aquatic Plant Program. He has led aquatic plant surveys of over 250 Connecticut lakes and ponds and directed research projects on invasive aquatic plant control statewide.

## Investigating the Success of Dioecious *Hydrilla verticillata* in Northern Climates*

**Kara Foley** **North Carolina State University**
Rob Richardson, North Carolina State University
Ramon Leon, North Carolina State University

**Abstract:**
North Carolina State University researchers have recently identified a population of dioecious *Hydrilla verticillata* (Hydrilla) in Philpott Lake, an Army Corps of Engineers' reservoir project located in Patrick County, Virginia. Previous studies that have examined the environmental constrictions on dioecious Hydrilla growth and spread have suggested that the conditions at Philpott Lake should not be conducive to successful establishment and longevity of a dioecious Hydrilla population. Controlled condition studies were developed to compare the phenology of Virginian and Floridian dioecious Hydrilla under differing environmental pressures. First, the sprouting success of vegetative propagules from the two representative populations was examined along a temperature gradient. Then, sprouted tubers were planted in outdoor mesocosms where the phenology of the Florida and Virginia dioecious Hydrilla was compared in dissimilar climates. Tubers produced by southern populations of dioecious Hydrilla sprouted in significantly cooler water temperatures than tubers produced by northern populations of dioecious Hydrilla ($p < 0.0015$; $\alpha = 0.05$). Preliminary data collected also suggests that there may be differences in the timing of tuber and biomass production between the two populations which ultimately could have implications on its future spread throughout the United States.

**Speaker Biography:**
Kara earned a B.S. in Environmental Science from the University of New Hampshire in 2016. As an undergrad, she studied bioaccumulation of cyanotoxins in freshwater ecosystems with Dr. James Haney at the UNH Center for Freshwater Biology. In May 2016, she began an internship with the New Hampshire Department of Environmental Services' Exotic Species Program where she fell in love with the aquatic plant management field. She is currently working on her master's degree at North Carolina State University under the direction of Dr. Rob Richardson.

## Comparison of Hydro-acoustics, Aerial Photo Interpretation, Rake Sampling and Diver Survey on Quantifying Changes in Aquatic Plants

Bin Zhu, Ph.D. University of Hartford

**Abstract:**
To monitor changes of aquatic plants or assess the effectiveness of a plant-control/removal management strategy, quantification of aquatic plants is essential. In order to quantify the plant changes, common methods including hydroacoustics, aerial photo interpretation, rake sampling and diver survey are often used. This study uses case studies in two bayments of Lake Ontario and Cayuga Lake, Skaneateles Lake and Oneida Lake in New York to quantify changes in aquatic plants and compare the results from different survey methods. How to quantify aquatic plants will be reported and advantages and disadvantages of each survey method will also be discussed.

**Speaker Biography:**
Bin Zhu is an Associate Professor of Biology and Director of Environmental Studies Program at the University of Hartford in Connecticut. He received his Ph.D. in biology and MPA from Syracuse University. Dr. Zhu was a post-doctoral associate at Cornell University and a research scientist at the Finger Lakes Institute. His research focuses on ecology and management of invasive species and assessment of water quality using physical, chemical and biological parameters. He has published a number of articles in scientific journals such as Aquatic Botany, Ecosystems, Fisheries, Freshwater Science, Journal of Aquatic Plant Management, Journal of Great Lakes Research and Journal of Plant Ecology. Currently he is also an Associate Editor for Journal of Aquatic Plant Management and Journal of Plant Ecology. He serves at the NEAPMS board as chair of the scholarship committee.

## Evaluation of Selected Algaecides on *Lyngbya wollei* Control*

**Emily Vulgamore** **North Carolina State University**
Erika Haug, Ph.D., North Carolina State University
Rob Richardson, Ph.D., North Carolina State University

**Abstract:** Lyngbya wollei is a filamentous, freshwater cyanobacterium capable of forming hazardous mats of nuisance proportion; such infestations pose a threat to water functionality and aesthetics. The benthic alga establishes and overwinters at the sediment-water interface. By summer, proliferation can lead to a dense and malodorous entanglement of filaments that obstructs waterways and alters drinking water taste and quality. The presence of this alga often equates to a decline in ecosystem health, property value, and recreational profit. This research evaluates 12 algaecides, alone and in combination, as chemical control options for populations of *L. wollei* in Lake Gaston, North Carolina/Virginia. Samples of lake water and *L. wollei* were collected from an untreated cove on Lake Gaston and transported to North Carolina State University. In an incubator set to field conditions (27℃, natural light, 14-hour light/8-hour dark photoperiod), filaments were homogenized, suspended in 35mL of triple-filtered lake water, and allowed a 10-day growth period prior to treatment. Six replications of pre-harvest controls, treatment controls, and treatments were assessed and compared after a 48-hour treatment exposure time. Results to discuss include metrics of cellular viability, growth, transformation, and fragmentation, and sheath degradation. The results of this study will be used to recommend algaecides for operational treatments on *L. wollei* in Lake Gaston and other impacted water bodies. It will also serve as a comparative basis for future research with increased biomass/biovolume and exposure time. Such information on the dynamics of *L. wollei* will be useful in optimizing management techniques.

**Speaker Biography:** Emily received her Bachelor of Science degree in Biology from the University of New Hampshire in May of 2017. She interned with the New Hampshire Department of Environmental Services from May 2016-February 2018. Emily began work on her Master's degree in Crop and Soil Science at North Carolina State University in August of 2018 under the direction of Dr. Rob Richardson.

## Management of Water Chestnut

**Lynde Dodd** **U.S. Army Corps of Engineers**
Chris Mudge, U.S. Army Corps of Engineers
Nancy Rybicki, U. S. Geological Survey
Mark Heilman, SePRO Corporation

**Abstract:**
Invasive aquatic plant, water chestnut (Myrtales: Lythraceae: Trapa), continues to be problematic in the Northeastern United States. Two species of Trapa are currently naturalized in the NE - T. natans and the newly identified, cryptically introduced, T. bispinosa var. iinumai. Numerous programs support control of water chestnut across the NE, specifically Lake Champlain, Hudson River watershed, Finger Lakes Regions, Connecticut River watershed, and others. Current research by the US Army Corps of Engineers' Aquatic Plant Control Research Program is investigating management strategies implemented for water chestnut that involve herbicide and mechanical control strategies. This work entails herbicide screening trials to evaluate products with known and unknown activity on both water chestnut species and an evaluation of seed bank response to water chestnut management on current populations of both water chestnut species exposed to varying degrees of mechanical and herbicide control strategies ranging from no management to extensive, multiple year control efforts. Results of the herbicide trials and preliminary results for the seed bank evaluation will be discussed.

**Speaker Biography:**
Lynde Dodd is a Research Biologist with the U.S. Army Corps of Engineers' Engineer Research and Development Center. Her work includes researching invasion and restoration ecology, invasive species management and aquatic ecosystem restoration with emphasis in native aquatic and riparian species suitability and restoration implementation techniques.

## Treatment Timing and Application Method to Effectively Control Monoecious Hydrilla Including Tubers

**Justin Nawrocki, Ph.D.** **Territory Manager, UPL NA**
Clyde Smith, Technical Development Manager, UPL NA.

**Abstract:**
Dioecious hydrilla was introduced to the United States in the 1950s and has been the target of control efforts for several decades. Monoecious hydrilla was introduced to the United States in the 1980s. While monoecious and dioecious hydrilla share many common characteristics, they are two separate biotypes with unique and reproducible physiological characteristics. Monoecious hydrilla has been to able to exploit a niche in the northern tier states to become a management problem. Endothall herbicide has been used for decades to control dioecious hydrilla in the southern climates but biotype differences dictate a different approach to control monoecious hydrilla. Beginning with a demonstration in 2014, Endothall has been used in a multi-year program to address monoecious hydrilla in parts of the Erie Canal in New York State. Focusing on maintaining concentration and exposure times, the Endothall program has succeeded in decreasing the frequency of monoecious hydrilla while increasing occurrence of native plants. New research with Endothall indicate effective control may be due to herbicide translocation and retention within the plant. More work is needed to determine the movement of Endothall within the plant and if this information will help us formulate new strategies for control applications.

**Speaker Biography:**

## POSTER: Non-Target Impacts of Hydrilla and Lyngbya Treatments on Waterwillow (*Justicia americana*)

**Jens Beets** **University of North Carolina State**
Emily Vulgamore, University of North Carolina State
Erika Haug, University of North Carolina State
Robert Richardson, University of North Carolina State

**Abstract:**
Best management practices in aquatic plant management call for the selective control of nuisance species, while limiting impacts to beneficial native species. Waterwillow (Justicia americana) is a desirable native plant species in North Carolina Piedmont reservoirs. Monoecious hydrilla (Hydrilla verticillata) is a non-native nuisance invasive species in many reservoirs and readily infests waterwillow populations. Lyngbya (Lyngbya wollei) is a filamentous cyanobacteria that is rapidly spreading in NC reservoirs, as well as throughout the southeastern U.S. Lyngbya provides little to no ecosystem services and herbicide/algaecide applications are the only cost-effective management option. There is a need for management programs to control hydrilla and lyngbya while avoiding significant nontarget impacts to waterwillow populations. Monoecious hydrilla tubers collected from NCSU stock culture were sprouted and established in 14-L mesocosms before being planted in 1-L pots with established waterwillow to imitate co-existing populations. Herbicide rates and exposures were selected based on current hydrilla or lyngbya treatment regimes and were as follows: endothall ( 3 ppm; 48 hours and static with follow- up treatment), copper (1 ppm; 24 hours and static), copper (1ppm) + diquat (0.5 ppm; static), fluridone (5 ppb; static), and endothall (0.3 ppm) + peroxide (5 GPA; static). Treatments were replicated four times and the trial will be repeated in space and time. Plants were harvested 30 day after treatment and data was analyzed in R statistical software package. Results and implications for selective management for waterwillow will be discussed.

**Speaker Biography:**

## POSTER: Investigations into Water Quality and Nutrient Loading of Little Spectacle Pond, Lancaster, MA

Bregieta Arvidson SOLitude Lake Management

**Abstract:**
Little Spectacle Pond is a highly stratified, 13.35-acre waterbody located in Lancaster, Massachusetts. It flows directly into Spectacle Pond, which is an important town resource for recreation, real estate, and ecological value. Both waterbodies are anthropogenically influenced, and do not have a history of water quality impairment. However, Little Spectacle Pond experienced an algal bloom spanning through November-December of 2017. This caused concern for the potential internal and external sources of impairment for Little Spectacle Pond and prompted a season-long 2018 study of the pond assessing water chemistry, algae community assessments, bathymetry, and sediment-phosphorus. Based on the data, hypolimnetic phosphorus accumulation caused by early-onset anoxia is apparent and could be a primary contributor to the acceleration towards eutrophication of Little Spectacle Pond and ultimately Spectacle Pond. External sources of nutrient loading were further explored and documented.

**Speaker Biography:**
Brea is an Aquatic Biologist at SOLitude Lake Management, where she is involved in many of SOLitude's largest monitoring and management projects throughout New England, New York, and New Jersey. She received her BS in Marine, Estuarine, and Freshwater Biology from University of New Hampshire (2015) and has been with SOLitude for 3 years. SOLitude is an environmental firm specializing in full-service lake, pond, wetland, and fisheries management solutions.

## POSTER: The Search for Suitable Species to be Used in Environmental Risk Assessments

**Chelsea Hedderig** **Smithers**
Ashlee Kirkwood, Smithers
Christian Picard
Mike Bradley

**Abstract:**
Aquatic macrophytes are one group of organisms used in herbicide regulatory risk assessments. At Smithers, a Contract Research Organization (CRO) that conducts these ecotoxicology studies, it is crucial that all species used in these tests are reliable during both culture and exposure phase, and that the studies are repeatable. These aquatic plant tests, however, come with a unique set of challenges. Some challenges faced by aquatic plant testing include determining the best culture practices that provide plant material when needed with reasonable labor input, or finding non-hybridized species from suppliers that can send the amount needed and that are also readily available year- round. These are critical initial considerations, as organisms used in testing must be healthy and consistent in biomass at the start of any experiment. Furthermore, control plants must remain healthy and show consistent growth throughout tests for robust data evaluation, so determining appropriate experimental designs to meet each individual species needs is another important consideration. Multiple aquatic plant species were evaluated to assess the feasibility of use in standardized laboratory testing. Characteristics that were considered include: ease of culturing, optimal environmental conditions, appropriate water and soil matrices, and performance of controls in standard experimental designs. Results and discussion of these evaluations will be presented in this poster.

**Speaker Biography:**
Chelsea Hedderig is a Biologist and lab manager with Smithers in their terrestrial and aquatic plant lab in Wareham, MA. She earned her B.S. in environmental sciences at Bridgewater State University. Chelsea has been involved in agriculture and ecotoxicology since graduating in 2012. She plans to attend UMass Dartmouth in the Fall for her M.S. in general biology with a focus on pollinator sublethal affects.

## POSTER: Quantitative Assessments of Operational Selective Control of Invasive Watermilfoils in the Northern US with ProcellaCOR

**Mark Heilman, Ph.D.** **SePRO Corporation**
Erika Van Goethem, Ph.D. SePRO Corporation

**Abstract:**
ProcellaCOR (a.i. florpyrauxifen-benzyl) was approved by USEPA in early 2018 as a completely new, reduced-risk herbicide active ingredient for aquatic plant management. Previously reported mesocosm and field demonstrations have confirmed effective control of multiple invasive watermilfoils with short exposures (6 - 24 hours) to low in-water concentrations. Earlier development documented good tolerance of most native aquatic plants to ProcellaCOR. Continued operational control in 2019 generated additional quantitative data demonstrating the response of a wider range of aquatic plants under different use rates and conditions. Multiple 2019 operational case studies utilizing quantitative vegetation assessment methods will be summarized. This receive should provide Northeast managers additional evidence for selective control characteristics of ProcellaCOR to support future permitting and other management decision-making.

**Speaker Biography:**
As Senior Aquatic Technology Leader for SePRO, Dr. Heilman leads the company's research and development efforts to bring forward new technologies for managing water resources. He also directly assists many public and private natural resource managers in the US and some international colleagues with challenging projects managing aquatic invasive species with an emphasis on aquatic plants. Dr. Heilman received his Ph.D. in Aquatic Ecology from the University of Notre Dame in 1998 where he was a NASA Global Change Research Fellow for his work examining changes in methane cycling associated with submersed aquatic plants. He received the NEAPMS Aquatic Plant Science Award in 2011 and the APMS Outstanding Research and Technical Contributor Award in 2013. He is Immediate Past President of NEAPMS and President Elect of the national APMS.

## POSTER: Development of Hydrilla Biological Control in the US with Focus on the Monoecious Biotype

**Nathan Harms** **U.S. Army Corps of Engineers**
Matthew Purcell,
Dean Williams
Jialiang Zhang
Sun-Hee Hong
Graham McCulloch

**Abstract:**
Biological control of hydrilla (Hydrilla verticillata (L.f.) Royle) in the US has been ongoing since the 1980's but control has been inconsistent. Although both monoecious and dioecious biotypes of Hydrilla verticillata occur in the US, information on genetic identity was not available during initial surveys. Therefore, the original suite of agents was not specifically sourced from hydrilla populations genetically-matched to those in the US. Worldwide surveys for biological control agents of hydrilla have been conducted since the 1970's, and recent surveys, between 1996 and 2013, focused on China, Southeast Asia and Australia. To inform foreign exploration for agents of US monoecious hydrilla, China and South Korea were widely sampled during 2013-2016, leading to identification of at least six sites with plants that were haplotype matches to US monoecious plants. Since 2016, regular surveys of native range monoecious hydrilla has been ongoing. To aid identification of common herbivore species (i.e. chironomids, Hydrellia spp.), DNA barcoding was conducted on plant samples collected during 2013-2016. A number of associations between hydrilla haplotypes and potential agents were made, including an unidentified Hydrellia sp. that was collected only from the US monoecious haplotype in South Korea. That Hydrellia sp. is currently undergoing preliminary host-range testing in quarantine, the results of which will be presented here. Additionally, an unidentified defoliating moth species was collected from the US monoecious biotype in China and will be evaluated in the future. Further surveys are recommended in China and South Korea where hydrilla haplotypes exist that match those found in the United States. Lastly, there was a recent report of a new hydrilla introduction in the CT River, USA which represents a unique haplotype in the US. Genetic testing is underway on plants from that population to determine whether native range surveys have already been conducted at sites in South Korea and China with matching haplotypes and whether potential agents have already been identified.

**Speaker Biography:** Nathan Harms is a Research Biologist at the US Army Engineer Research and Development Center, Vicksburg, MS. His research primarily focuses on biological control of aquatic invasive plant species and impacts of invasive species on invaded ecosystems. Since 2005, he has been involved with various aspects of biological control development and implementation, from overseas exploration for new agents to rearing, release and monitoring of control agents. He has worked on management of submersed (hydrilla, Eurasian watermilfoil), emergent (alligatorweed, flowering rush) and floating (giant salvinia, water hyacinth, water lettuce, water pennywort) invasive plants. Currently, his focus is on the importance of genetic variation for management of introduced plants as well as climatic limitations on biological control.

## POSTER: Boat Stewardship at the Manasquan Reservoir, NJ

Kyle Clonan New Jersey Water Supply Authority and Montclair State University

**Abstract:**
The Manasquan Reservoir is a source of drinking water for local municipalities. The Reservoir is also a natural setting for recreational activities and outdoor pursuits and is the most frequented site in the Monmouth County Park System with over one million annual visitors. The New Jersey Water Supply Authority, a state-owned utility, operates and maintains the water supply functions of the Reservoir while the Monmouth County Park System manages the recreational elements. In a partnership between the Authority and the County Park System, a Boat Stewards Program was conducted at the Manasquan Reservoir Boat Launch on weekends and holidays throughout the summer of 2019 designed to reduce the spread of aquatic invasive plant species. The program was modeled after successful Boat Steward Programs in New York and other northeastern states. To stop the spread of aquatic invasive plants like hydrilla, Stewards inspected 1,979 boats for "hitchhiking" invasive species fragments, intercepting 243 boats from entering the reservoir with plant fragments and 442 vessels leaving the Manasquan Reservoir with fragments. Stewards also educated patrons on aquatic invasive species and surveyed boat owners on boat cleaning habits, typical boat usage, and level of familiarity with invasive species.

**Speaker Biography:**
Kyle is an Assistant Watershed Protection Specialist with the New Jersey Water Supply Authority—Watershed Protection Division. Kyle is involved with projects regarding the Authority's invasive species management program, water monitoring programs, environmental planning, and outreach efforts. He earned his B.S. in Environmental Science at Fordham University and his currently pursuing his master's at Montclair State University. Kyle has previously worked with the Monmouth County Park System, the Delaware DNREC, and the Monmouth County Division of Planning.

## POSTER: The Adirondack Park Aquatic Nuisance Species Spread Prevention Program

**Eric Paul** **Adirondack Watershed Institute-Paul Smith's College**
Dan Kelting
Zoe Smith

**Abstract:**
Adirondack waters currently have a low number of aquatic invasive species (AIS) but are at high risk of invasion due to increased recreational pressure and spread from nearby invested waterbodies. The AIS spread prevention program managed by the Paul Smith's College Adirondack Watershed Institute is on the front lines in protecting these water resources, and provides boat inspections, decontaminations, and education. The origin of this program is a story of a grass roots effort. It started with the recognition of local lake associations and governments recognizing the fragility of their own waterbodies and investing resources into spread prevention methods. Twelve organizations participated in an effort to develop the Adirondack Park Aquatic Nuisance Species Management Plan which was adopted by the Adirondack Park Agency and was endorsed by local governments. The program expanded with federal funding until New York State took a leadership role in funding, coordinating, and standardizing a statewide program that has led to consistent messaging and consolidation of data. The spread prevention program in New York State is presented with many inherent challenges in the present day from geography, to staffing, and economic factors. However, there is plenty of room for opportunity due to the bottom up progression of the program's origins which has resulted in engagement and buy in from local stakeholders. The data collected since the origin of the program has played a role in advising its current state.

**Speaker Biography:** Eric Paul has been working in the aquatic invasive species field since 2010 with the Paul Smith's College Adirondack Watershed Institute. He started on the front lines as a Watershed Steward while pursuing his second B.S. in Natural Resources Management. Eric progressed from his original role as a watershed steward to Regional Supervisor, then to Program Manager. In 2019 he assumed the role of Director of the Stewardship Program. In this position he coordinates with partner agencies and organizations to execute the Adirondack Watershed Institute's role in the Aquatic Invasive Species Spread Prevention Program across the Adirondack Park which employs over 120 seasonal staff members.

## POSTER: ARMOR: A New Tool for Managing the Spread of Invasive Aquatic Species

**Jeremy Farrell, Ph.D.** **Rensselaer Polytechnic Institute Department of Biological Sciences and Darrin Fresh Water Institute**
Marc E. Frischer, Skidaway Institute of Oceanography - University of Georgia
Lawrence W. Eichler, Rensselaer Polytechnic Institute - Darrin Fresh Water Institute
Joe Stanek, Lake George Park Commission
Sandra A. Nierzwicki-Bauer, Rensselaer Polytechnic Institute Department of Biological Sciences and Darrin Fresh Water Institute

**Abstract:**
Although only a small fraction of introduced species establish self-sustaining populations and cause harm, invasive species are recognized as an important driver of global environmental change. Freshwater ecosystems are especially vulnerable to species invasion and its effects. Much of the ongoing spread of Aquatic Invasive Species (AIS) can be attributed to the overland movement of small privately-owned boats. Thus, an effective approach for reducing the risk of new introductions has been the implementation of boat inspection and washing stations to intercept and remove AIS from trailered boats before they enter new water bodies. Employing survey data from boat wash stations, we developed a machine learning model to predict the presence of AIS on arriving boats. Initial tests of the model have proven successful, correctly identifying 96.5% of invasive species transported by trailered boats to Lake George, New York. We have expanded our work to incorporate data from the New York State Watercraft Inspection Steward Application and have achieved similar results from statewide data. Identification of high-risk watercraft at their points of entry will improve the efficiency and efficacy of detecting and mitigating new invasive species introductions.

**Speaker Biography:** Dr. Jeremy Farrell has a research focus that utilizes data analytics approaches to address questions in Limnology and Freshwater Biology. He has worked on large collaborative projects with government (NYSDEC, EPA, NYSM, VTDEC), business (IBM), nonprofit (LGA, Fund for Lake George) and academic scientists (UGA, Skidmore, Cornell). One limnology topic that his research addresses is the global issue of invasive species and their impact on aquatic ecosystems. Additionally, he is involved with projects that examine cultural eutrophication, acid deposition and salinization and the impacts these perturbations have on freshwater ecosystems. One of his goals is to involve students in research and provide them with the basics of interdisciplinary science to explore environmental issues.