Abstract Book

CATSKILL ENVIRONMENTAL RESEARCH & MONITORING CONFERENCE

October 26-28, 2022

at the Full Moon Resort in Oliverea, NY

SCAN ME

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Old-Growth Catskill Northern Hardwood Forest

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Title:	Adding the Catskills to the old-growth forest network
Corresponding Author:	Joan Maloof
Corresponding Author Affiliation:	Old-Growth Forest Network, Salisbury University
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Co-Authors:	

Presenter Bio:

Joan Maloof, Ph.D., works to educate others regarding the extent and condition of our nation's forests, and to encourage their preservation. She founded an organization with the goal of creating a network of protected forests across the US; that organization, the Old-Growth Forest Network, now has thousands of supporters and over 175 forests in 32 states (www.OldGrowthForest.net). Maloof is a professor emeritus at Salisbury University where she taught Biological Sciences and Environmental Studies. She is the author of numerous research articles and five books: *Nature's Temples; Treepedia; The Living Forest; Among the Ancients; and Teaching the Trees.*

Abstract:

The Old-Growth Forest Network (OGFN) is a national organization with the goal of identifying at least one forest in each county that is: 1. old, 2. open to the public, 3. protected from logging, 4. relatively accessible. So far Schoharie County is the only Catskills county with a forest in the Network. On the last day of the CERM conference an Ulster County forest will be dedicated into the Network. In this talk Dr. Maloof will discuss the formation of the Old-Growth Forest Network in 2012 and each of the criteria used to determine which forests should go in the Network. In addition to discussing the progress adding forests to date, Maloof will also discuss visions for the future including an old-growth forest "SWAT Team," political action, and data collection. In this talk you will learn how you can get involved in this movement, or at least learn about beautiful old forests you can visit all over the country.

Session:	Old-Growth Catskill Northern Hardwood Forest
Title:	Envisioning the natural resiliency of forests from the memories of old-growth trees
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Co-Authors:	Dario Martin Benito (INIA, Madrid, Spain), Daniel Bishop (Karen Clark & Company, Boston, MA), Tessa Mandra, (Harvard Forest, Harvard University, Petersham, MA), M. Ross Alexander, (Argonne National Laboratory, Lermont, IL), Naomi Schulberg, (Cornell University), Rachel de Sobrino (University of Minnesota), Laura Smith, (University of Tennessee, Knoxville, Knoxville, TN), David Orwig, (Harvard Forest, Harvard University, Petersham, MA)

Presenter Bio:

Neil Pederson is a forest ecologist at the Harvard Forest focusing on the dynamics and long-term development of forests, from tree to subcontinental scales, as they interact with climate and as trees interact amongst themselves. Neil also studies the natural history of trees and old-growth forests in mesic regions dominated by broadleaf species.

Abstract:

Global change is threatening the resiliency of forests and, in the worst cases, their very existence. There are times when their future ecology looks bleak. Paleoecological perspectives on the long-term development and dynamics of forests, however, allow us to understand current changes in a context far beyond the memories of humans alive today. Some balm and some comfort can be derived from the perspectives of paleoscientists. Our group specializes in studying the histories of individual trees from their growth rings, information that could be considered akin to archived memories. In some cases, we can learn of ecological events from tree rings that occurred millennia ago. In temperate mesic regions, these memories have been typically studied to interpret on the dynamics of forests going back three to four centuries. These interpretations allow us to infer when trees have died, recruited to various stages, from their time as saplings to their time in the Sun, and how they respond to the dynamic lives of their neighbors or climate over time. The response of trees to these events and to their neighbors give a sense of their resilience. We will present evidence of forest resilience in three eastern US forests over the last 300 years in response to extreme climate events, a hurricane, logging, and exotic pests and pathogens. As amazing as their resilience is, we cannot paint a blue-sky view of future forests over the next 50 years. We have recently witnessed changes in the multiple old-growth forests in the Northeastern US that were particularly shocking. And, the northeast US is likely still far from the climatic turmoil that is occurring in other parts of the world. Yet, the long-term view, especially those of the memories of trees, gives glimpses of the resiliency of trees and forests.

Session:	Old-Growth Catskill Northern Hardwood Forest
Title:	Tree-ring reconstructions, climate vulnerabilities of water resources, and connections to people in the Catskills watershed region
Corresponding Author:	Nicole Davi
Corresponding Author Affiliation:	1 William Paterson University, Wayne, NJ 2 Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY 3 Harvard Forest, Petersham, MA
Corresponding Author Email:	ndavi@ldeo.columbia.edu
Co-Authors:	William D'Andrea 2, Marianne Sullivan 1, Neil Pederson 3, Lilian Milanes 1 & Caroline Leland 1

Presenter Bio:

Nicole Davi is a an Adjunct Senior Research Scientist at the Tree-Ring Laboratory at Lamont-Doherty Earth Observatory and a professor and chair of the Department of Environmental Science at William Paterson University. Davi's research focuses on developing and interpreting high-resolution paleoclimatic records in order to further our understanding of climate change over the past 1000 years. She has authored/co-authored dozens of peer-reviewed articles on paleoclimate and has received awards from National Science Foundation and other funding agencies for her research. Davi also has several projects that focus on improving science literacy for undergraduate and K-12 students, and also for public audiences. Davi often collaborates with artists to explore new and compelling ways to communicate the excitement of scientific explorations.

Abstract:

Tree ring-based climate reconstructions for the region allow climate history to be extended to the 16th century AD, and indeed point toward a more variable climate than has been enjoyed during the past 100 years, however, the climatic history provided by tree rings is still too short to provide the full picture of natural climate variability over the region. This project will focus on developing centuries-old tree-ring records from targeted old-growth forests (in collaboration with Kudish et al. & Pederson et al., this conference) and combing these records with a new lake sediment record from Perch Lake (D'Andrea et al., this conference) to evaluate water vulnerabilities of the NYC watershed over the past 13,000 years. In addition to being important for establishing human-climate-environment temporalities for the NY Watershed, understanding the full range of natural climate variability is fundamentally important for water management and planning for the future. This project brings together a multidisciplinary team of scientists to understand the relationships between water quality and socio-economic patterns, the role intersectional experiences play in perceptions of water quality, and the vulnerabilities of water resources to the impacts of climate change in the NY Watershed. In addition to developing capacity at a minority-serving institution, the project advances undergraduate teaching and training through curricular development and hands-on research opportunities.

Session 2:

The Past and Future of Catskills Forests

October 26, 2022

Session:	The Past and Future of Catskills Forests
Title:	20 years of hemlock decline across the Catskills: Findings from a new, practitioner-friendly remote sensing model
Corresponding Author:	Andrew Reinman
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Co-Authors:	Justin Bowers

Presenter Bio:

Andrew is an assistant professor of environmental science at the CUNY Advanced Science Research Center with a teaching appointment at Hunter College. He is a forest ecologist and biogeochemist with a research program focused on understanding how different facets of environmental change impact tree growth and forest carbon cycling dynamics. His research combines field and laboratory approaches with remote sensing products and spatial analyses to quantify ecosystem response to environmental change from the plot to landscape scales.

Abstract:

Invasive forest pests and pathogens comprise a substantial threat to the health, functioning, and biodiversity of forests across the U.S., including those of the Catskill Region. Policy makers, land managers and scientists are working together to develop methods for earlier health decline detection which in turn will result in a more rapid response to infestation events. Mapping forest decline events, especially incipient infestations of pests and pathogens, can help inform policy and management actions designed to preserve forest health. As such, improving capacity for early detection of forest decline is regularly cited as a key need of forest practitioners. Eastern hemlock (Tsuga canadensis) is the most common conifer throughout the Catskills. It is a critical foundation species that creates a unique ecosystem type and provides a suite of ecological, recreational, and economic services not readily replaced by other native species. However, the exotic invasive insect hemlock woolly adelgid (HWA) is decimating hemlock stands across the region. Field surveys are the most commonly used approach to identifying new infestations, but these surveys are costly and the often remote and rugged nature of many hemlock forests can limit the feasibility and efficacy of this approach. Remote sensing technologies provide exciting opportunities for early detection of hemlock decline associated with HWA. However, the spatial scales at which hemlock decline occurs and propensity of broadleaf trees to overtop hemlocks in mixed stands present some obstacles to developing hemlock decline models using remote sensing technologies. Furthermore, the complexity of many remote sensing models and the proprietary datasets they sometimes rely on can limit utility to the practitioners on the front lines of invasive species and forest health management. Working with practitioners, we have developed a new remote sensing model for early detection of hemlock decline. This model uses freely-available airborne orthoimagery collected during the spring (i.e., before broadleaf trees leaf out) to track the health of hemlock trees at a 3-m spatial resolution and can be run by anyone with GIS expertise. We are currently running this model for the entirety of New York State and have completed runs for the Catskill Region. During my presentation, I will describe this approach, what we are learning about the current state of hemlock health across the Catskill Region and the changes that have occurred over the past 20 years.

Session:	The Past and Future of Catskills Forests
Title:	Witness trees, fire, and the Northeast tension zone
Corresponding Author:	Melissa Thomas-Van Gundy
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Co-Authors:	Greg Nowacki, Charles Cogbill

Presenter Bio:

Melissa Thomas-Van Gundy is a Research Forester at the Timber and Watershed Laboratory, Northern Research Station, US Forest Service, in Parsons, WV. Her research includes stand- and landscape-level projects focused on the restoration and sustainable management of forested ecosystems in the eastern United States. These projects include investigating the role of fire in oak forests, using witness trees to understand historical forest conditions, restoration of red spruce forests, and restoration of American chestnut.

Abstract:

Witness trees provide information fundamental for restoration ecology, often serving as baselines for forest composition and structure. Furthermore, when categorized by fire relations, witness trees can shed light on past disturbance regimes. Described here are the results of converting witness-tree points to a contiguous surface of pyrophilic percentage for four national forests in the northeast United States. Fire was found to be an important disturbance agent on the Allegheny and Finger Lakes national forests, often corresponding to large river systems and lakesides where Native American activities were concentrated. In contrast, fire was relatively unimportant on the Green Mountain and White Mountain national forests based on the witness-tree record. There, the cool, moist year-around climate coupled with lower Native American population densities greatly subdued fire, supporting their local colloquialism as “the asbestos forests”. When applying this method to town-level witness-tree data for the entire northeastern United States, a distinct east-west line dividing areas of high (south) and low (north) pyrophilic percentage was apparent. Known as the tension zone, the undulating character of this boundary, penetrating northward along major river valleys, underscores the importance of Native Americans as a disturbance agent on the presettlement landscape.

Session:	The Past and Future of Catskills Forests
Title:	Peering into the future: Currents that will shape Catskill forests over the next 50 years
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Co-Authors:	

Presenter Bio:

Charles Canham is a forest ecologist and Senior Scientist Emeritus at the Cary Institute of Ecosystem Studies. He joined the staff at the Institute in 1984, after completing his Ph.D. at Cornell. His research focuses on the ecology of forests in temperate, tropical and boreal regions. For over 30 years he has been linking field studies to the development of a spatially-explicit, individual-based model of forest dynamics (SORTIE-ND). The model encapsulates a neighborhood theory of forest dynamics, and uses novel statistical modeling for spatial processes based on likelihood estimation.

Abstract:

Scientists are often uncomfortable with the notion that understanding is fundamentally a form of belief, and take refuge in reliance on observation. But in the context of science, belief is the accumulation of conclusions based on evidence used to choose between competing ideas (hypotheses), from many different studies. After 40 years studying the dynamics of northeastern forests, I have assembled a set of beliefs about how those forests function, and how they change. Successional dynamics will continue to be the dominant current for Catskill forests, at both the stand and landscape scale, and will reflect historical legacies of the tanning industry, logging, fire suppression, and more recently over-abundant deer. Contrary to outdated assumptions that the region's forests are even-aged and can be expected to begin to decline in productivity, abundant data show that even in the face of current harvest rates and losses due to pests and pathogens, the region's forests will maintain high rates of carbon sequestration and significantly increase in carbon stocks for at least the next 60-80 years. While climate change is on everyone's minds, the demographic data and models lead to the conclusion that impacts on forest composition, structure, and productivity will lag behind the actual change in climate, likely by centuries. The notable exception is likely to be in the decline of the northern conifers of high elevations, particularly balsam fir. Seedlings are the life history stage most sensitive to climate, while the current saplings and adult trees show remarkable adaptation/acclimation to local climate. The wild card in any forecast of forest futures is our inability to predict the next forest pest or pathogen.

Session:	The Past and Future of Catskills Forests
Title:	How will the functioning of Catskill forest be affected by multiple interacting stressors?
Corresponding Author:	Gary Lovett
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Co-Authors:	Katherine Crowley

Presenter Bio:

Gary Lovett is a forest ecologist and Senior Scientist Emeritus at the Cary Institute of Ecosystem Studies. His research involves the impacts of climate change, air pollution and invasive forest pests on the functioning of forests. One of his primary research sites is the Catskills, where he has ben studying forests and watersheds for over 30 years. Gary is also active in advocating for federal policies to reduce the importation of forest pests and diseases that enter the country through international trade.

Abstract:

Catskill forests are currently subjected to multiple environmental changes that interact to determine ecosystem functions such as productivity, carbon storage and nutrient retention. Among the most important changes are the invasion of several forests pests and diseases, climate change, and the downward trend in nitrogen deposition from air pollution. The interaction of these stressors produces a large number of possible scenarios for the future, making predictions of forest ecosystem function a difficult challenge that is best explored through simulation modeling. In this presentation, we will discuss the types of responses that could be expected from each of the stressors individually, and then use a model (Spe-CN) to generate hypotheses about how the forest ecosystem could respond when these stressors interact with one another over the coming decades.

Session 3:

Climate Change Impact on Water Supply

October 26, 2022

Session:	Climate Change Impact on Water Supply
Title:	Identifying trends in climate change indicators for the NYC Water Supply Watershed
Corresponding Author:	Jordan Gass
Corresponding Author Affiliation:	NYC Department of Environmental Protection
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Co-Authors:	Rakesh Gelda, Rajith Mukundan

Presenter Bio:

Jordan serves as the GIS specialist for the Modeling and Analysis Section in DEP's Bureau of Water Supply. He maintains geospatial and other datasets for DEP's water quality modelers and research staff. He is responsible for developing analysis and automation tools using python code. Jordan earned a Bachelor's Degree in Natural Resources from Cornell University, and a Master's in Environmental Management and Geospatial Analysis from Duke University.

Abstract:

Global climate models generally concur that the NYC water supply watersheds will experience higher temperatures and increased precipitation with more extreme storm events. To evaluate the local effects of global climate change, the Modeling and Analysis Section has developed a suite of indicators of climate change based on meteorological, hydrologic, reservoir operations and water quality data. The project aims to leverage a diverse long term datasets to describe trends of climate change in the watershed as well as related changes in the water supply system. We are developing software to automate the analysis workflows to quickly revise these trends over time as datasets are updated with new observations. The initial analyses focus on long-term datasets such as NOAA weather observations and USGS stream gages in the NYC watershed. This presentation will describe the development of the indicator analysis process and datasets being used and will present some results calculated to date. We will describe the trends found in the data and how these trends may be influencing parts of the watershed differently. We will also discuss future plans to calculate additional indicators from the water supply system.

Session:	Climate Change Impact on Water Supply
Title:	Hydroclimatology of the Catskills: 2070s and beyond
Corresponding Author:	Rakesh Gelda
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Corresponding Author Email:	RGelda@dep.nyc.gov
Co-Authors:	Rajith Mukundan, Jordan Gass, Adao Matonse, Jerry Mead

Presenter Bio:

Rakesh Gelda is a research scientist at New York City Department of Environmental Protection where he is responsible for developing and applying reservoir water quality models and studying climate change impacts. Dr. Gelda has 30 years of experience in surface water quality modeling, and has authored and co-authored more than 50 papers in peer-reviewed journals. Dr. Gelda holds Ph.D. from Michigan Technological University

Abstract:

Hydroclimatological indicators are evaluated for Ashokan watershed in the Catskill Mountains region of the New York City water supply watershed. Downscaled and secondary bias-corrected climate projections from CMIP5 (Coupled Model Intercomparison Project Version 5) from 20 GCMs (Global Climate Models) were used to compute climate indices including extreme weather indicators such as number of frost days, summer days, heat waves, and cold spells. Two greenhouse gases emission scenarios (RCP 4.5 and RCP 8.5; RCP: Representative Concentration Pathway) were considered. The same climate projections were used to drive a hydrologic model (GWLF: Generalized Watershed Loading Function) and identify potential changes in the hydrologic components of the watershed, e.g., snowfall, snowpack, and annual peak flow in Esopus Creek. Most of the indices are computed on an annual basis for 1950-2099 to allow identification of extreme weather and hydrologic conditions of multi-year recurrence interval. Results are presented in the format of time series plots of multi-model ensemble mean as well as range of indices. Compared with the current climate, future (mid-century) annual average air temperature is predicted to increase by 2.0 °C, and precipitation by 5%. Under these climate conditions, mean annual flow at Coldbrook, Esopus Creek is expected to increase by 6%, with greater increases during December-March and a reduction during April-May, lessening the overall seasonal variability. Results also show that observed values of the indices for the historical period are well within the multi-model ensemble range. Furthermore, several of the indices suggest a significant shift in the hydroclimatology of the watershed in the future.

Session:	Climate Change Impact on Water Supply
Title:	Historical climate change and impacts on Catskill region streamflow
Corresponding Author:	Douglas Burns
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Corresponding Author Email:	daburns@usgs.gov
Co-Authors:	Robin Glas

Presenter Bio:

Doug is a Research Hydrologist at the U.S. Geological Survey (USGS) in Troy, NY. He holds a Ph.D. in Water Resources Management from SUNY-ESF. His principal research focus is how human activities affect ecosystems and water quality with emphasis on climate change and air pollutant deposition effects. Currently, he manages USGS-funded sites within the National Atmospheric Deposition Program and the Next-Generation Water Observing Systems Program in the Delaware River basin. He is also Co-Chair of the ecosystems chapter of the New York State Climate Change Assessment which is currently in progress. Doug has authored more than 140 peer-reviewed publications.

Abstract:

The effects of climate change on streamflow and the hydrologic cycle in the Catskill region of New York have been the focus of several previous investigations and publications. Because of the pivotal role of the Catskills in providing water to more 9 million residents of New York City and surrounding areas, the impacts of climate change are of great interest and concern to those who manage regional water resources. Past analyses have identified warming temperatures, changes in the seasonal timing of streamflow, and increasing trends in precipitation, streamflow, and evapotranspiration in the Catskills. Future projections indicate that many of these patterns are likely to persist into the future, and that further increases in extreme precipitation and runoff events are also likely. In this presentation, we discuss an updated analysis of temporal patterns in air temperature, precipitation, and streamflow in the Catskill region during 1970 to 2021. Temporal changes in hydroclimatic variables were assessed by quantile regression and other approaches, which revealed significant trends in extreme values whereas annual average values frequently showed little change, consistent with climate change patterns that have been described across the northeastern U.S. Overall, the regional climate seems to be changing in a manner that is consistent with many modeling projections. However, there is high interannual variability, and some previously discussed patterns such as an earlier snowmelt are no longer evident in the long-term record. Periodic examinations of long-term monitoring data as described in this presentation are helpful in advancing scientific understanding of the complex manner in which the climate is changing in the Catskill region.

Session:	Climate Change Impact on Water Supply
Title:	Carbon, nutrient, and sediment export from NYC watersheds under a changing climate
Corresponding Author:	Rajith Mukundan
Corresponding Author Affiliation:	NYC Department of Environmental Protection
Corresponding Author Email:	rmukundan@dep.nyc.gov
Co-Authors:	Rakesh Gelda, Jordan Gass

Presenter Bio:

A member of the water quality modeling team at the Bureau of Water Supply in Kingston, NY. Involved in watershed scale hydrologic and water quality modeling in NYC watersheds in the context of evaluating watershed protection programs and climate change impacts. Received Ph.D. from the University of Georgia, College of Agricultural and Environmental Sciences. Has authored over 30 peer reviewed journal publications.

Abstract:

The New York City Department of Environmental protection (NYC DEP) is investigating the potential impacts of climate change on the quantity and quality of drinking water in the NYC water supply system that serves over 9 million consumers. This presentation is based on our recent work where we developed future climate scenarios for the study region, developed and tested watershed hydrology and water quality models, and investigated the impact of climate change on streamflow and stream water quality. Results on the potential impact of climate change and the resulting changes in the seasonal pattern of runoff on nutrient and sediment loading into water supply reservoirs will be presented. The loading of natural organic matter has gained more importance than before due to its role as a precursor to harmful disinfection byproducts (DBPs) and stringent regulations that increase public health protection. Ongoing work on modeling dissolved organic carbon, a precursor for DBPs in water supply streams will also be presented in the context of a changing climate.

Session 4:

Contributed Presentations

October 26, 2022

Session:	Contributed Presentations
Title:	Surficial geologic mapping in the upper Neversink River subbasin to support estimates of groundwater contributions to streams
Corresponding Author:	Daniel Doctor
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Co-Authors:	William Odom, Martin Briggs, Chris Gazoorian, Neil Terry, Robin Glas

Presenter Bio:

Dan began a career with the USGS in 2002 within the Isotope Tracers of Biogeochemical and Hydrologic Processes project of the National Research Program in Menlo Park, California. In 2006, he joined the Florence Bascom Geoscience Center in Reston, Virginia where he is a research geologist conducting geologic mapping and specialized geologic research for the Appalachian Basin project. His current interests include geologic frameworks for water resource studies, stratigraphy of the Appalachian Basin, landscape evolution within the Appalachian Valley and Ridge physiographic province, karst hydrology and geomorphology, sinkhole hazard studies, and paleoclimate records from karst regions.

Abstract:

The upper Neversink River subbasin supplies water to the Neversink Reservoir which in turn provides water supply to New York City. Surficial geologic mapping and geophysical surveys are being conducted by the U.S. Geological Survey (USGS) to support intensive monitoring studies of groundwater/surface water exchanges within the watershed as part of the USGS Next Generation Water Observing Systems program. The goal is to use new geologic information to map a variety of surficial deposits and their potential to store and release groundwater. Groundwater/surface water exchanges are investigated through continuous monitoring at gaging stations and via deployment of temperature sensors within the major stream channels as well as in headwater areas where glacial sedimentary fill provides groundwater storage. In addition, stable water isotopes and dissolved radon gas measured in streams, seeps and springs are used as indicators of groundwater fluxes to streams. In 2019, the USGS updated and/or activated stream gage sites at six locations in the headwater subbasin with continuous water temperature and electrical conductivity sensors, in addition to establishing two intensive groundwater discharge monitoring testbed sites at existing gages along the West Branch and mainstem Neversink River. These testbeds were complemented at the watershed scale by establishing 51 multi-year water and air temperature monitoring stations across a range of headwater stream sizes and elevations. Geophysical data were collected at these monitoring stations to understand the depth of sediment cover over bedrock. The local influence of groundwater on streams was derived from analysis of the stream temperature data and is being used to inform the mapping of surficial geologic units with respect to their potential for groundwater storage and flow.

Using lidar-derived elevation data, small headwater stream channels were identified as targets for future studies of focused groundwater flow from springs and seeps. Other surface features such as bedrock fractures and groundwater sapping landforms serve as a guide to identify localized zones of groundwater flow from glacial sediments. Terrain analyses of lidar-derived elevation data were conducted to extract channel bank heights along incised streams that provide an estimate of the minimum thickness of surficial materials. Hydrograph recession analyses separate the baseflow component from runoff within discharge from smaller gaged catchments, such as Biscuit Brook and Winnisook, and relate to the amount of sediment stored within the catchments. Furthermore, deep learning methods are being used to automate the mapping of shallow bedrock in the broader Catskill region. Preliminary results of this model in the Pepacton Reservoir 1:100,000 scale quadrangle illustrated that shallow bedrock, alluviated channels, and areas of glacial drift were identified by the model and the model results significantly increased the resolution of the existing mapped geology. Geophysical and drone data were also collected at the stream monitoring sites and paired with emerging analytical methods to refine the mapping of near-surface geology across the subbasin. This multiscale and multiparameter approach represents a transferable example of groundwater discharge monitoring to support the improvement of stream water quality, temperature, flow permanence, and habitat forecasts in headwater systems.

Session:	Contributed Presentations
Title:	Reconstructing long term climate changes in the Catskill Mountains with lake sediment from Andes, NY
Corresponding Author:	William D'Andrea
Corresponding Author Affiliation:	Lamont-Doherty Earth Observatory of Columbia University
Corresponding Author Email:	dandrea@ldeo.columbia.edu
Co-Authors:	Nicole Davi, Marianne Sullivan, Lilian Milanés (all from William Paterson University, Wayne, NJ)

Presenter Bio:

William D'Andrea is a sedimentologist, paleoclimatologist, and organic geochemist who uses lake sediments to quantify natural changes in climate that have occurred throughout Earth's history. He has worked extensively throughout the Arctic, as well as on Easter Island, and across the Bahamas. D'Andrea has roots in the Catskills region and enjoys as much time there as possible. He is a Lamont Associate Research Professor and the Director of the Lamont Organic Geochemistry Facility.

Abstract:

The Catskill Mountains of New York are home to ~400,000 people and contain a network of reservoirs that provide drinking water to nearly 10 million people in and around New York City. An analysis of precipitation data indicates that the Catskill region is susceptible to intermittent drought on multidecadal timescales (Frei et al., 2002). Available tree ring-based climate records from the region extend the history of drought recurrence back to the 1600s AD (Pederson et al., 2013) and highlight the fact that drought conditions have been more common and/or severe than what has been observed in recent decades. In order to anticipate the full range of future possible climate scenarios for the Catskill Mountains it is important to first document and understand the full range of climate conditions that have occurred over past centuries and millennia.Here, we present initial results from a lake sediment core from Perch Lake in Andes, NY, which we are using to develop a climate record that spans the past ~14,000 years. Lake sediments accumulate steadily through time, preserve a stratigraphic record of materials produced within their watersheds and the surrounding area, and are exceptional archives of changes in past vegetation and past climate. The sediment cores from Perch Lake contain a stratigraphic sequence of undisturbed sediments, beginning with clay that deposited as glaciers were retreating from the watershed and transitioning upward into organic-rich, well-laminated sediments. We will present the initial stratigraphy for the sedimentary sequence and the results of non-destructive x-ray fluorescence scanning, which determines sedimentary abundances of important elements used to identify units deposited under different environmental conditions. We will also discuss the biomarker (molecular fossil)-based approaches that will be applied to the sediment cores to quantify changes in temperature and precipitation in the region for the past 14,000 years. The presentation will include a summary of previous research into the paleovegetation and paleoclimate history of the Catskill Mountains since deglaciation.

Frei, Allan, Richard L. Armstrong, Martyn P. Clark, and Mark C. Serreze. "Catskill Mountain water resources: vulnerability, hydroclimatology, and climate-change sensitivity." Annals of the Association of American Geographers 92, no. 2 (2002): 203-224.

Pederson, Neil, Andrew R. Bell, Edward R. Cook, Upmanu Lall, Naresh Devineni, Richard Seager, Keith Eggleston, and Kevin P. Vranes. "Is an epic pluvial masking the water insecurity of the greater New York City region?." Journal of Climate 26, no. 4 (2013): 1339-1354.

Session:	Contributed Presentations
Title:	What could stream management in the Catskills look like in 50 years?
Corresponding Author:	Mark Vian
Corresponding Author Affiliation:	NYC Department of Environmental Protection
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Co-Authors:	

Presenter Bio:

Mark Vian has worked with the NYCDEP Stream Management Program since 1995. He previously worked as a Research Associate with the Hudson River National Estuarine Research Reserve, and has helped lead community-based participatory development projects in East Africa and Latin America.

Abstract:

The watercourses that comprise the freshwater stream network in the Catskills have been anthropogenically impacted to a significant degree since European settlement. Much of this impact has been the consequence of intentional stream management associated with resource extraction (logging, tanning, fishing, drinking water supply, snowmaking), transportation infrastructure development (bridges, road drainage, channel and floodplain modification), flood hazard mitigation (stormflow detention, berms) and riparian vegetation alteration (agriculture, residential landscaping). A diverse cast of stream "managers"—both official and unofficial-- continue to modify the watercourse network to meet their individual and collaborative goals. Since 1995, the NYCDEP Stream Management Program (SMP) has been working in the West of Hudson Water Supply Watershed to create a multi-objective, community-based, state-of-the-science platform for stream management, with the goal of harmonizing the interests of the many stakeholders who have an interest in the ecosystem services provided by Catskill streams and rivers.

Stream management activities take place at the intersection of a number of "ecosystems"--natural, technological, institutional—operating within a number of "climates": the literal global geophysical climate, but also the local-to-global economic and cultural climates. These "ecosystems" and "climates" will evolve over the next fifty years, both individually and interactively. For example, over the past 25 years since the SMP was established, the technology available for mapping, modeling, monitoring, analyzing and restoring Catskill watercourses has evolved dramatically. How will that technology continue to evolve over the next fifty years? What will the evolution of remote sensing technology, or AI analysis of observational data, or new river restoration techniques mean for the evolution of the institutional ecology or the local cultural climate that together shape the interaction of the many stakeholders involved in stream management? I will attempt to project current trends in each of the these "ecosystems' and "climates" through a range of alternative futures scenarios, drawing from Herrington's (2021) update of the Meadows, et al report, "The Limits to Growth" (1972).

Keynote Address

October 26, 2022

Session:	Keynote Address
Title:	A system for scanning and monitoring the future of forests
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Co-Authors:	

Presenter Bio:

Dr. Andy Hines is Associate Professor and Program Coordinator for the University of Houston's Graduate Program in Foresight and is also speaking, workshopping, and consulting through his firm Hinesight. His 30+ years of professional futurist experience includes a decade's experience working inside first the Kellogg Company and later Dow Chemical, and consulting work with Coates & Jarratt, Inc. and Social Technologies/Innovaro. His books include The Knowledge Base of Futures Studies 2020, Thinking about the Future (2nd edition), Teaching about the Future, ConsumerShift: How Changing Values Are Reshaping the Consumer Landscape, 2025: Science and Technology Reshapes US and Global Society, and his dissertation was "The Role of an Organizational Futurist in Integrating Foresight into Organizations." He is a member and was Founding Chair of the Association of Professional Futurists.

Abstract:

If a weak signal of change drops into the forest, will we hear it? We can, because the US Forest Service Northern Research State has shown us how with their Horizon Scanning and Monitoring System. A volunteer team of horizon scanners led by a few pros has been tracking changes relevant to the future of foresight for the last several years. This presentation will describe how we set it up, kept it going, and what's been learned. The really good news is that it's easy to get started and you'll soon be on your way to getting ahead of changes instead of being surprised by it.

Session 5:

Environmental Management Success Stories

October 27, 2022

Session:	Environmental Management Success Stories
Title:	Connecting wetland science, policy, and protection: Past patterns and future trends in the Catskills
Corresponding Author:	Laurie Machung
Corresponding Author Affiliation:	NYC Department of Environmental Protection
Corresponding Author Email:	LMachung@dep.nyc.gov
Co-Authors:	

Presenter Bio:

Laurie Machung is the Chief of Natural Resources in the Bureau of Water Supply of the New York City Department of Environmental Protection where she oversees Forestry, Wildlife Management, Aquatic Ecology, Wetlands, and Invasive Species Programs. Previously, she managed the Bureau's Wetlands Protection Program, and was a wetland soil scientist for the Illinois Natural History Survey. She received her Master's degree from Penn State in 1994, studying soil properties of reference and created wetlands under the mentorship of Dr. Robert P. Brooks.

Abstract:

Once bemoaned as marginal lands whose conversion was promoted, wetlands gained increased appreciation in the mid-20th century as their functions and values became understood. Policies shifted from those encouraging wetland conversion, to protection and restoration of these valuable resources. With increased awareness and inception of federal and state regulatory programs, there was a marked decrease in wetland loss. This trend has been documented both nationally, and regionally in the Catskills. A status and trends study conducted by the US Fish and Wildlife Service, estimated that the rate of vegetated wetland loss in the Catskill Watershed declined from 6.8 acres per year during the 1980s to 1990s to less than 0.1 acre per year from 1994 to 2004. Wetland protection was further enhanced in the Catskills with the onset of DEP's Watershed Protection Programs. DEP has acquired an estimated 900 acres of wetlands in the West of Hudson Watersheds since the inception of the Land Acquisition Program in 1997, raising the percentage of wetlands protected on City lands from 16.7% to 23.9%. An additional 7% of wetlands in the West of Hudson watershed are on State or other protected lands, with the remaining 69% of wetlands on private lands. With the majority of wetlands located on private lands, voluntary and regulatory protection programs are critical. DEP estimates that 60% of wetlands in the West of Hudson watershed fall beneath the current 12.4-acre regulatory threshold in the New York State Freshwater Wetlands Act, and that roughly half will remain below the 7.4-acre minimum threshold to be implemented in 2028. The reach of federal jurisdiction over wetlands has decreased based on United States Supreme Court decisions since 2001 and remains uncertain as federal agencies continue their attempts to find a definition of Waters of the United States that satisfies both the intent of the Clean Water Act and the Court's decisions. Attempts to understand the reach of wetlands and streams in the Catskills that remain outside of federal and state regulation is complicated by the accuracy of source data. To that end, DEP has explored advanced automated wetland mapping techniques that employ high resolution Light Detection and Ranging (LiDAR) data. This presentation will examine the current status and historic trends in Catskill wetlands, innovations in wetland mapping and monitoring that have been applied in the Catskills, and explore remaining data gaps. A brief summary of current and past regulatory frameworks will be discussed, as well as a look ahead to predict how anticipated regulatory and climate changes will impact Catskill wetlands.

Session:	Environmental Management Success Stories
Title:	Invasive species on the horizon: What's threatening the Catskills?
Corresponding Author:	John Thompson
Corresponding Author Affiliation:	Catskill Center for Conservation and Development
Corresponding Author Email:	jthompson@catskillcenter.org
Co-Authors:	

Presenter Bio:

John E. Thompson currently serves as Catskill Regional Invasive Species Partnership (CRISP) Director at the Catskill Center. At CRISP, John is coordinating Early Detection and Rapid Response projects; monitoring and managing invasives; collaborating with partners on invasives management initiatives; providing guidance on control of widespread invasive species; and leading education and outreach programs on invasive species, natural history and ecological management. John received his M.S. in Geology at the University of Pennsylvania and his B.S. in Environmental Conservation at the University of New Hampshire.

Abstract:

The Catskill Regional Invasive Species Partnership (CRISP), a program of the Catskill Center for Conservation and Development, has worked with partners to manage invasive species in the Catskills region since 2007. CRISP is one of eight Partnerships for Invasive Species Management in New York State and covers an area of nearly 3.3 million acres over 7 counties. The CRISP region is ecologically significant, supporting 78 state rare species and 22 state rare ecological communities. In recent years, CRISP has worked to identify populations of high impact invasive species that are in low abundance. Through early detection surveys by staff and reporting by both trained community scientists and the general public, CRISP has identified new populations of invasive species and proactively worked to survey the extent of existing populations. Where feasible, staff have worked to eradicate or contain invasive populations and prevent their spread to other areas.

Raising awareness about identifying and reporting invasives has led to a number of invasive species being reported in CRISP region for the first time. Examples of those discoveries over the past several years include jumping worm (Amynthas-Metaphire spp.) first reported in 2017, spotted lanternfly (Lycorma deliculata) in 2020, northern snakehead (Channa argus) in 2020, Quagga mussel (Dreissena bugensis) in 2020 and hardy kiwi (Actinidia arguta) in 2022. Each of these invasives could cause ecological harm in this environment. An evaluation was done of these new reports by CRISP and partners, and additional surveys were conducted to find the extent of the known populations and inspect connected areas to determine if there are other nearby populations. Management actions were determined based on the extent of each population and the effectiveness of treatment options.

A number of invasive species have spread into nearby areas and may soon be issues in the CRISP region including the Beech Leaf Disease nematode (Litylenchus crenatae mccannii), hydrilla (Hydrilla verticillata) and slender false brome (Brachypodium sylvaticum ssp. sylvaticum). Staff and community scientists are continually trained to identify and report invasives that are likely to invade the region.

CRISP and its partners are continuing to evaluate priorities for monitoring and management. There are many challenges that we face including having limited resources to monitor for invasives and manage invasives over a large area as new populations are found and new species are introduced. CRISP has worked with scientists to use novel approaches to monitor for invasive species including eDNA and remote sensing and will continue to determine vulnerable areas to invasion and vectors for invasives of concern.

Session:	Environmental Management Success Stories
Title:	Upstream/Downstream: Protection of stream networks in the Catskills
Corresponding Author:	Lee Alexander
Corresponding Author Affiliation:	Catskill Center for Conservation and Development
Corresponding Author Email:	lalexander@catskillcenter.org
Co-Authors:	

Presenter Bio:

Lee Alexander is the Director of the Streamside Acquisition Program (SAP), a public/private partnership administered by the Catskill Center for Conservation and Development and funded by New York City's Department of Environmental Protection. The SAP protects streams, wetlands, floodplains, and riparian buffers in the Catskill Mountains that drain to NYC drinking water supply reservoirs. Before joining the Catskill Center team in 2019, Lee spent close to two decades working with land trusts throughout the northeast, including The Nature Conservancy, The Trustees of Reservations, Scenic Hudson, and Columbia Land Conservancy. Lee has a degree in natural resources from Cornell University.

Abstract:

The pilot Streamside Acquisition Program, or SAP, works to protect ribbons of riparian land up and down streams in the northeastern Catskills. As one of several NYC-funded programs aimed at drinking water protection, the SAP focuses tightly on permanent protection of streams, wetlands, floodplains, and vegetated riparian areas, leaving other lands available for development. We will describe how the SAP differs from traditional land protection programs and the benefits and challenges of the SAP's approach, identifying aspects of the program that might be replicable elsewhere. We will also highlight new tools the pilot program is exploring, and how those might further improve drinking water protection and flood mitigation while complementing community needs for compatible recreation and tourism.

Session:	Environmental Management Success Stories
Title:	Evaluating suspended sediment and turbidity reduction from stream restoration projects
Corresponding Author:	Kezhen (Jenny) Wang
Corresponding Author Affiliation:	Hunter College of the City University of New York
Corresponding Author Email:	kwang@dep.nyc.gov
Co-Authors:	Dany Davis; Scott Steinschneider

Presenter Bio:

I started my research on characterizing suspended sediment transport processes during my Master's studies at UC Davis between 2016 and 2018. I continued the same research topic using more diverse modeling approaches during my PhD studies at Cornell University between 2018 and 2022.

Abstract:

Elevated turbidity levels from suspended-sediment (SS) flux during and following flood events can degrade water supply quality and aquatic ecosystem integrity. Streams draining glacially conditioned mountainous terrain, such as those in the Catskill Mountains of New York, are particularly susceptible to chronic and acute high levels of turbidity from SS sourced from erosional contact with glacial related sediment. Implementing stream restoration projects at the SS-sourced headwater basins can be effective to reduce turbidity in water supplies. However, it is often difficult to assess the effectiveness of these restoration projects due to changing hydrologic conditions (Q),which are anticipated under a changing climate. After Hurricane Irene in August 2011, New York City (NYC) and the federal government supported the constructions of 8 stream sediment and turbidity reduction projects (STRPs) in the Stony Clove Creek catchment, an 83 sq km watershed in the Ashokan Reservoir basin and part of the NYC water supply system. In 2016, the USGS started a 10-year SS source monitoring research project with NYC using 29 monitoring stations in the Ashokan basin. Reduced SS concentrations (SSC) in the watershed have been observed. However, flood hydrology since 2012 has been abnormally low, potentially obscuring restoration impacts. This study builds on the ongoing NYC-USGS research initiative to advance a framework to identify restoration project effectiveness in the presence of hydrologic trends. We use Dynamic Linear Models (DLMs) to statistically characterize daily variations in the SSC-Q rating curve prior to and following STRP installation, in order to isolate the timing of SS yield changes independent of flow. We compare the observed rating curve dynamics against those in nearby catchments with limited or no STRP installation, and rating curve dynamics that are simulated by a process-based River Erosion Model (REM) calibrated to the Stony Clove Creek catchment and parameterized without influences from STRPs. The comparative analysis provides a way to estimate the amount of SSC reduction attributable to restoration projects and hydrologic trends, respectively. The proposed framework can expedite the assessment of projects in order to generate more rapid feedback that can guide management practices.

Session 6:

Catskill Recreation: Trends/Projections

October 27, 2022

Session:	Catskill Recreation: Trends/Projections
Title:	Outdoor recreation trends in New York State
Corresponding Author:	Laura DiBetta
Corresponding Author Affiliation:	NYS Department of Environmental Conservation
Corresponding Author Email:	laura.dibetta@dec.ny.gov
Co-Authors:	

Presenter Bio:

Laura DiBetta is Director of Outdoor Recreation at the NYS Department of Environmental Conservation, overseeing the agency's Adventure NY initiative launched in 2017. Prior to joining DEC, Laura spent nearly 20 years working for state and national nonprofit organizations on environmental issues, program development, and communications. Laura holds a bachelor's degree in public affairs, Magna cum laude, from the University of Albany, where she was Phi Beta Kappa, and a graduate certificate in urban policy, also from Albany.

Abstract:

In this introductory session, we will hear about outdoor recreation trends in New York State along with some of the broader societal changes and shifts likely to have an impact on outdoor recreation in New York and the Catskills region in particular in the coming years.

Session:	Catskill Recreation: Trends/Projections
Title:	The Catskill Advisory Group Report
Corresponding Author:	McCrea Burnham
Corresponding Author Affiliation:	NYS Department of Environmental Conservation
Corresponding Author Email:	mccrea.burnham@dec.ny.gov
Co-Authors:	Members of the CAG

Presenter Bio:

A 26 year Department employee who spent the last 20 years focused on improving the Departments stewardship of lands it manages. Appointed the Catskill Coordinator in December 2021.

Abstract:

In October 2020, DEC announced the formation of the Catskill Strategic Planning Advisory Group (CAG). The advisory group will collaboratively provide advice to DEC on how to balance critical issues associated with increased public use in the Catskill Park in order to protect the area's natural resources for future generations.

The Advisory Group is charged to make recommendations for strategies, actions, and tactics. New York State identified six goals for managing public use in the Catskill Park region:

1. Ensure public safety within the communities, along roadways, at trailheads, and in interior areas;
2. Address impacts and public safety in areas experiencing significant and unsustainable public use;
3. Protect natural resources and recreation infrastructure;
4. Provide a quality recreation experience for visitors and users of all backgrounds;
5. Support local economic vitality; and
6. Ensure that science/fact-driven decisions are made with the use of best available data.

The Advisory Group is comprised of stakeholders with expertise in local government, recreation, natural resource protection, business, tourism, and other priority areas.

The Final report is broken down into 5 major categories.

1. Whole Park Management;
2. Natural Resources;
3. Marketing, Communication, and Education;
4. Traffic and Parking;
5. Benefits to Catskill Park Communities;
6. Diversity, Equity, Inclusion, and Justice

Session:	Catskill Recreation: Trends/Projections
Title:	Cycling to the Future
Corresponding Author:	Kevin Smith and Andy Mossey
Corresponding Author Affiliation:	Woodstock Land Conservancy
Corresponding Author Email:	kevin@woodstocklandconservancy.org and andy@woodstocklandconservancy.org
Co-Authors:	

Presenter Bio:

Kevin Smith, Board Chair:
Kevin is an avid road and trail cyclist (a member of both Team Overlook and Fats in the Cats Mountain Biking Club). Additionally, he is the Board Chair for Woodstock Land Conservancy, and has served as co-chair of the Friends of the Catskill Mountain Rail Trail Committee since its inception in 2013. He is currently Chair of the Ulster County Trails Advisory Committee (since 2020), served on the Ulster County Transportation Council Technical Advisory Committee for the 2040 & 2045 Ulster County Long Range Transportation Plan updates (2015 & 2020). He also serves as a liaison to the Town of Woodstock Complete Streets Committee. Kevin believes the human and non-human communities, alongside the natural resources of the Hudson Valley and the Catskill Mountains, are our greatest asset for the future.

Andy Mossey, Executive Director:
Skiing, cycling, backpacking, climbing, and wandering in the woods are the activities that brought Andy outside. Once there, he unlocked a deep passion for speaking up for public lands without a voice. Since the beginning of his career, Andy has worked with non-profit organizations and land management agencies to ensure that public access to lands across the United States is protected, and sensitive ecosystems are preserved. Andy comes to Woodstock Land Conservancy after working for the Catskill Center and before that, the Leave No Trace Center for Outdoor Ethics. Andy holds a B.S. in Expeditionary Studies from SUNY Plattsburgh. When Andy is not in Woodstock, he can be found exploring a new section of trail or remote corner of the world.

Abstract:

The most efficient and arguably healthiest form of travel has evolved over the last 50 years. Today, the bicycle and those who ride them, offer a hint for what's to come over the next 50 years. Self identified cyclists, pedal pushers, recreationists, couriers and commuters alike utilize this climate smart form of travel and recreation.
As the climate changes and the world adapts to it, bicycles and the effective infrastructure for their use, offer an exhaust free, healthy solution - hyper efficient travel for a fraction of the price that a car costs to operate. Trail connectivity for recreation and commuting are the key for unlocking the bicycles true potential in the Catskills and beyond. The advancements in community connection via trail and bicycle evolution offer tantalizing hints for what may come in the next 50 years. Join us as we explore how cycling will change recreation and daily travel for the masses.

Session:	Catskill Recreation: Trends/Projections
Title:	Trends in outdoor recreation on New York City Watershed lands
Corresponding Author:	Tom Davidock
Corresponding Author Affiliation:	NYC Department of Environmental Protection
Corresponding Author Email:	tdavidock@dep.nyc.gov
Co-Authors:	tdavidock@dep.nyc.gov

Presenter Bio:

Tom Davidock is the Recreation Program Supervisor for NYC DEP's City Land Stewardship Program, which provides oversight and permitting of activities and uses of City-owned lands. For the past six years, Tom has been overseeing the DEP recreation program, which manages more than 340,000 acres of land and water for the public to use for low-impact recreational activities such as hunting, fishing, boating, and hiking. Tom has his Master's degree from Antioch University Seattle in Environment and Community and has 20 years of professional experience in watershed management.

Abstract:

New York City Department of Environmental Protection (DEP) manages the largest unfiltered water supply in the country, delivering 1 billion gallons of clean water each day to more than 9.5 million New Yorkers. To protect its resources, DEP manages a robust land protection initiative and has opened more than 140,000 acres of its protected land and water for low-impact recreation. While the public's enthusiasm for recreation within the City's watersheds grows, DEP is tasked with finding the balance between recreation and source water protection. Over the past 20 years, the DEP recreation program has matured to include reservoir and stream fishing, hunting, recreational boating, hiking, and other low-impact forms of recreation. In 2019, DEP opened 11.5 miles of its Ashokan shoreline to a world-class rail trail, attracting nearly half a million visitors since then. DEP also manages an access permit program of 110,000 users, issues boat tags for over 13,000 fishing boats stored on reservoir shorelines, and facilitates a growing recreational boating program for select Catskill reservoirs. In recent years, DEP has seen an increase in recreation, both in terms of the number of visitors as well as requests for the use of watershed lands for recreational activities. This presentation will look at some of these trends and identify strategies DEP is taking to ensure that recreation and drinking water protection remain compatible. Central to this task is a strategic collaboration with regional stakeholders coupled with careful planning. As a key public landowner in the greater Catskill Region, DEP is committed to supporting efforts to enhance recreational opportunities for visitors to the region.

Session 7:

Social Trends, Ecosystem Response, and the Evolution of Environmental Management

October 27, 2022

Session:	Social trends, ecosystem response, and the evolution of environmental management
Title:	Economic impact from outdoor recreational activities in the Catskills
Corresponding Author:	Brian Zweig
Corresponding Author Affiliation:	Business Opportunities Management Consulting
Corresponding Author Email:	bzweig@businessop.com
Co-Authors:	

Presenter Bio:

Brian Zweig is Principal of Business Opportunities Management Consulting, which helps organizations in developing business plans, identifying sources of funding, and conducting economic impact estimates. In addition, Brian serves as a trustee of Hudson Valley Community College, and he has previously served on the Rensselaer County legislature and as the President of a local land trust. Brian holds an MBA from the Amos Tuck School at Dartmouth College and a B.S. in Ag Economics from Cornell University.

Abstract:

The presentation will be based on the "Economic Valuation Study for Public Lands in the Central Catskills," a study originally completed in 2012 and updated in December 2019. Prior to this study, there had never been an analysis conducted to determine the number of annual outdoor recreational visitors to the Catskills. Using these visitor estimates and economic impact models, estimates of the impact of recreation activities on the economy of the Catskills region were generated, including the value-added impact on the local economy and the number of jobs supported.

Economic impact estimates and job creation numbers are often used to justify investments in the private sector, including government support for projects. Such justifications are less common when it comes to natural resources and the investments that may be needed to protect or allow for appropriate use of natural resources for recreational purposes. Quantifying and analyzing public usage of the outdoor recreational assets of the Catskills allows for these resources to be valued. Quantifying the value of these resources provides the information needed to consider public investment in such resources and also can serve to increase the appreciation for how these resources help sustain both the environment and the local economy.

In keeping with this year's conference theme of 'What could the Catskills look like in 50 years?' determining the number of visitors that use the Catskills for outdoor recreation and quantifying the economic impact of these visitors provides vital information for making decisions about the future of the region. Tracking visitor usage provides information needed to predict the amount of future investments needed to support visitors that are expected to be using these recreational resources. Similarly, quantifying the economic benefits generated by these activities can be used to justify the cost of these investments. Quantifying and valuing activities pertaining to outdoor recreation provides objective information so that leaders and stakeholders will be able to make good decisions about how best to protect both the natural resources and the economy of the Catskills region.

Session:	Social trends, ecosystem response, and the evolution of environmental management
Title:	Demographic trends in the Catskills
Corresponding Author:	Jan Vink
Corresponding Author Affiliation:	Cornell University Program on Applied Demographics
Corresponding Author Email:	jkv3@cornell.edu
Co-Authors:	Leslie Reynolds

Presenter Bio:

Jan Vink is an extension associate at the Cornell Program on Applied Demographics, part of the Cornell Population Center. Jan represents New York State in cooperatives with the U.S. Census Bureau and currently chairs the Federal State Cooperative on Population Estimates. The Program focuses on population estimates and projections and how it relates to change and public policy.

Abstract:

In this presentation we will present a snapshot of the current population in and around the Catskill park, a background into recent changes and a glance into a possible future. We will address demographic change, but also related social and economic shifts.

We will draw upon data from the Decennial Census, a variety of population and economic surveys and on population projections created by the Cornell Program on Applied Demographics.

Session:	Social trends, ecosystem response, and the evolution of environmental management
Title:	Scenic Hudson's solar mapping tool: A land-use planning approach to unite economics and environment
Corresponding Author:	Alex Wolf
Corresponding Author Affiliation:	Scenic Hudson
Corresponding Author Email:	awolf@scenichudson.org
Co-Authors:	Audrey Friedrichsen

Presenter Bio:

Alex Wolf, Conservation Scientist at Scenic Hudson, conducts research and analyses pertaining to Hudson Valley natural resources, with a focus on climate change adaptation, mitigation, and resilience, as well as the ecology and conservation of local flora and fauna. Prior to joining Scenic Hudson, he was a researcher at several institutions including the Cary Institute for Ecosystem Studies and the Missouri Department of Conservation. Alex has co-authored more than 12 scientific publications. He earned a Bachelor of Science in Ecology, Evolution, and Behavioral Biology and a Master of Science in Wildlife Ecology.

Abstract:

New York State and the Hudson Valley have seen an explosion of solar development in recent years. Developing renewable energy capacity is critical to combatting climate change and reaching New York's climate goals. Scenic Hudson is dedicated to helping the Hudson Valley become a model for a regional response to climate change that includes responsibly siting renewable energy development to minimize impacts to other resources. As one of the tools in our 'How To Solar Now' Toolkit, we developed the Solar Mapping Tool with input from a variety of stakeholders. The Solar Mapping Tool uses web-based digital mapping technology to bring together industry, government, and local community members for an accessible, collaborative land-use planning approach to solar planning. Our model of land-use planning, grounded in stakeholder input, focuses on envisioning a future where valuable resources are protected and low impact solutions are identified for "win-win" outcomes. This approach can be broadly applied to land-use planning to find solutions for the environmental challenges we currently face.

Session:	Social trends, ecosystem response, and the evolution of environmental management
Title:	VISION 2050: Fulfilling the promise of the Adirondack Park
Corresponding Author:	Julia Goren and Jackie Bowen
Corresponding Author Affiliation:	Adirondack Mountain Club and Adirondack Council
Corresponding Author Email:	Julia@adk.org and jbowen@adirondackcouncil.org
Co-Authors:	

Presenter Bio:

Julia Goren was Director of the Adirondack Council's VISION 2050 project. She is currently Deputy Executive Director for the Adirondack Mountain Club.

Jackie Bowen is the Council's Conservation Director.

Abstract:

The Adirondack Park is a national treasure-- a legacy we inherited more than 100 years ago—among that we must collectively protect for current and future generations. Today, the Park is in a race against visible and invisible threats to its natural and human communities. Current management structures do not support the long-range planning necessary to fulfill its promise.

The Adirondack Council, with input from experts and other stakeholders, offers VISION 2050 to achieve a future with intact natural systems, vibrant and diverse human communities, and cutting-edge management. This proposal for a long-range strategy for the next 30 years of the Adirondack Park offers a path forward.

This publication organizes discussion into three principle sections: preserving natural communities; fostering vibrant human communities; managing the park.

The following major recommendations are among the dozens of proposals described in the report, which can be read at https://www.adirondackcouncil.org/page/vision-2050-332.html .

To preserve its natural communities, the Adirondack Park must elevate the importance of ecological integrity and wild character in its management.

Such management must be based on regular monitoring, research, and the public dissemination of information. A reimagined and adequately funded Adirondack Park Agency should coordinate and oversee a robust research and monitoring infrastructure. Funding for research would come from an independent mechanism.

Prioritizing ecological integrity and wild character sets the stage for rewilding (recovery of species and ecosystems). Many species rely on being able to move across the landscape for their survival. As climate change worsens, the ecological health of the Park will rely on species being able to shift their ranges. They all will depend on connectivity among regions inside and outside the Park.

The Adirondack Park must build a broad and diverse constituency for nature and the Adirondacks.

Human communities within the Adirondack Park must have the resources to thrive economically and demographically and fit the character of the place. This relies upon fostering a sense of identity, so that those currently in the Park maintain their connection to their home through places of importance and local history. Pride in place helps youth envision themselves as part of a community's future.

Communities must also prioritize welcoming diversity. Adirondack communities of the future should resemble those of the rest of the state. This includes embracing the work of the Adirondack Diversity Initiative.

Communities must have aid from the state and others to plan and build infrastructure to support individuals, local businesses, and communities. Infrastructure needs are varied by community, but include roads, wastewater treatment, communications, and housing.

Management creates a structure that can accomplish these goals. One important change is for the Adirondack Park to manage itself as a singular entity rather than a collection of disparate units.

The Adirondack Council offers this VISION 2050 to pay a path to fulfill the promise of the Adirondack Park.

Session 8:

Contributed Presentations

October 27, 2022

Session:	Contributed Presentations
Title:	i-Tree HydroPlus enables forest cover scenario analysis to plan for cleaner waters & fewer heatwaves
Corresponding Author:	Theodore (Ted) Endreny
Corresponding Author Affiliation:	SUNY College of Environmental Science and Forestry
Corresponding Author Email:	te@esf.edu
Co-Authors:	

Presenter Bio:

Theodore (Ted) Endreny is a professor in the Department of Environmental Resources Engineering at the State University of New York College of Environmental Science and Forestry (SUNY ESF). His scholarship involves developing i-Tree software to guide strategic land cover changes that deliver needed ecosystem services. He teaches courses in engineering hydrology and hydraulics, river form and process, and applications of i-Tree tools. He earned a BS at Cornell University, served as a Peace Corps Volunteer, worked at the Environmental Law Institute, earned a MS at North Carolina State University, and earned a PhD at Princeton University.

Abstract:

Mindful of Congressman Blackburn's advice that "the best time to conserve the habitat necessary for our wildlife would have been 50 or 100 years ago", the Catskill Environmental Research & Monitoring group is asking our community, What could the Catskills look like in 50 years?. This talk first explains the utility of i-Tree tools for envisioning future land cover scenarios and their impact on the quality of our air and water resources, and then offers guidance on working with model inputs and outputs. The i-Tree tools are developed to represent structure-function processes, vetted through a peer-reviewed process, with the goal of assisting individuals and communities plan and obtain ecosystem services and benefits based on the science of trees. The i-Tree Hydro model simulates the water and pollutant balance for watersheds or smaller parcels, considering leaf phenology, canopy interception, infiltration and macropore flow, as well as removal of pollutants via green infrastructure such as bioretention cells, swales, porous pavement, and green roofs. The i-Tree Cool River model supports healthy rivers by simulating water temperature as a function of riparian shade, upstream inflows, lateral inflows including from warm reservoirs or stormwater discharges, groundwater inflows including from green infrastructure recharge, hyporheic flux (e.g., mixing of surface and subsurface water), and the radiation from sky and land surfaces. The i-Tree Buffer model simulates the daily to annual load of phosphorus and nitrogen runoff to receiving waters as a function of land cover and runoff, as well as the spatial distribution of nonpoint source pollution hot spots, to assist with total maximum daily load regulations. The i-Tree Cool Air model simulates how forests mitigate the urban heat island and impact of heatwaves, representing how radiation is partitioned between latent and sensible heat (e.g., trees transpire water and use radiation that would otherwise warm the air), as well as differences in land cover heat transfer properties and anthropogenic sources of heat. Tree cover and associated ecosystems improve biological diversity, climate change adaptation and mitigation, and pollutant removal. Risks to human well-being and biodiversity are increased by climate change, which brings unprecedented interactions of heat waves, infectious disease, and pollution to a population that is growing with respect to head count, inequities, and vulnerability. The i-Tree tools are available to help those responding to these challenges with nature-based solutions.

Session:	Contributed Presentations
Title:	Seeing climate adaptation through an equity lens: Lessons learned from community adaptation to flood risk in Ulster County, NY
Corresponding Author:	Sarah Walker
Corresponding Author Affiliation:	University of Colorado Boulder
Corresponding Author Email:	sarah.walker-1@colorado.edu
Co-Authors:	Karen Bailey, Elizabeth Smith

Presenter Bio:

Sarah E. Walker is a social scientist who uses human well-being frameworks to investigate human–environment interactions. Most of her work focuses on climate change adaptation, social identities, and equity. She received her master's and Ph.D. from Colorado State University and is currently a postdoctoral researcher at University of Colorado Boulder and NatureNet Fellow with The Nature Conservancy.

Abstract:

In this presentation we will describe the conceptual interactions between climate change adaptation and equity by analyzing flooding adaptation strategies in the Catskills region of New York State. We will articulate the importance of an equity lens to support a more nuanced understanding of adaptation and inform adaptation strategy design that prioritizes equity as an outcome, rather than an externality. Our discussion will include equity frameworks that can be used by practitioners and examples and of what adaptation 'looks' like when applying an equity lens specific to rural communities vulnerable to flooding impacts. We'll argue the importance of such a lens for creating effective and just climate adaptation.

Session:	Contributed Presentations
Title:	How team science bridges the research-implementation gap in the Catskills region
Corresponding Author:	Ava Goodale
Corresponding Author Affiliation:	Cary Institute of Ecosystem Studies
Corresponding Author Email:	goodalea@caryinstitute.org
Co-Authors:	

Presenter Bio:

Ava Goodale facilitates the Catskill Science Collaborative, where she supports coordination and communication of research initiatives in the Catskills Region of southeastern New York. She uses a team science approach to champion interdisciplinary, multi-institutional research endeavors that strengthen partnerships between multiple stakeholders. Ava is also involved in education research in the areas of place-based learning, global citizenship, and stewardship education. Prior to joining the Cary Institute, Ava was a teacher and leader in science education for over 10 years. She ran international professional development programs, student travel expeditions, and national curriculum design initiatives. She has a B.S. in Natural Resources from Cornell University and a M.A.T in Biological Science from Miami University.

Abstract:

What could the Catskills Region of New York State look like in 50 years with a team science approach to environmental research and conservation? All too often, conservation is limited by scientists and practitioners operating in isolated tracks, resulting in a mismatch between research topics and implementation needs. This mismatch can limit evidence-based strategies and create a research-implementation gap (Dubois et al., 2019; Salafsky et al., 2019). Team science, which champions collaborative, interdisciplinary, multi-institutional research approaches (Read et al., 2019), can strengthen and create partnerships between land-use managers, academia, scientists, and community members. The Catskill Science Collaborative, launched in 2018, seeks to fill these gaps in coordination, communication, and collaboration by providing a locus of exchange across agencies and institutions, data sharing platforms, and public engagement forums. This presentation will use interview data and case studies to assess how the Catskill Science Collaborative's team science approach to their fellowship program has helped bridge the research-implementation gap. This analysis will inform transferable recommendations to amplify conservation successes in the Catskills Region now and into the next 50 years.

Dubois, N. S., Gomez, A., Carlson, S., & Russell, D. (2019). Bridging the research-implementation gap requires engagement from practitioners. Conservation Science and Practice, 2(1). https://doi.org/10.1111/csp2.134

Read, E. K., O'Rourke, M., Hong, G. S., Hanson, P. C., Winslow, L. A., Crowley, S., Brewer, C. A., & Weathers, K. C. (2016). Building the team for team science. Ecosphere, 7(3). https://doi.org/10.1002/ecs2.1291

Salafsky, N., Boshoven, J., Burivalova, Z., Dubois, N. S., Gomez, A., Johnson, A., Lee, A., Margoluis, R., Morrison, J., Muir, M., Pratt, S. C., Pullin, A. S., Salzer, D., Stewart, A., Sutherland, W. J., & Wordley, C. F. (2019). Defining and using evidence in conservation practice. Conservation Science and Practice, 1(5). https://doi.org/10.1111/csp2.27

Session:	Contributed Presentations
Title:	Water memories: A Catskills heteroglossia
Corresponding Author:	Karen Rauter
Corresponding Author Affiliation:	Resident, Town of Halcott
Corresponding Author Email:	karen.rauter@gmail.com
Co-Authors:	

Presenter Bio:

Karen Rauter is a conservation worker who managed watershed protection programs in partnership with NYC water supply managers for about 25 years. Through the initiation of many innovative watershed projects, she proved a vast love for Catskills communities and a deep knowledge of stakeholder concerns in agriculture, forestry and riverside communities, and the resources available to them to advance good ideas on their land. As an experienced writer, presenter, and spokesperson, she practices relentless public engagement with a side of education/outreach, in service to rural people and their home places. She shares the 60-acre Pleasant View Farm in Halcott Center with spouse Jim, son Julian and his seven cousins, the next generation of land stewards. A new project presented today ties these themes to some unknown histories of the Catskills called water memories. Ms. Rauter studied English and Women's Studies at Hamilton College.

Abstract:

Three dominant water histories describe the Catskills as a region of resource extraction. This presentation seeks to review these distinct water histories and how each one memorializes its infrastructure in the region. "Sites of memory" inform these stories and are mostly "monoglossic," a messaged version created and recreated by the tellers and their institutions over the past centuries. 19th century settlers and tenants struggled with large patent holders, a scenario that gave way to family agriculture and tourism in the 20th/21st century. As downstate interests developed drinking water infrastructure for New York City overlapping this period, upstate communities worked through social, political and economic conflict over the building of the reservoir system. How have the voices in these histories fared in the past 25 years since the FAD? What are the larger cultural trend lines in these histories? Are they becoming more, or less, harmonized? Have the watershed programs contributed to synthesis, division or something else? And what are the water histories of traditionally underrepresented voices in the region: Indigenous Peoples, women, and workers? What might water infrastructure memorialization look like as told in a Catskills "heteroglossia?" What can we learn from a more inclusive approach to our water history and can this approach offer constructive ideas to inform and recommend action for the next 50 years: what future scenarios will sculpt the memorial of the next century? Methodology: Primary sources; archival and ethnographic sources.

Reading List/Sources:

The Political Ecology of Water Memory: contending narratives of past hydraulic infrastructure in Barcelona
Purdy, Jedediah. After Nature: A Politics for the Anthropocene
Steuding, Bob. Last of the Handmade Dams
Soll, David. Whose Environment is It? New York State Archives Winter 2014
Bessire, Lucas. Running Out: In Search of Water in the High Plains
Hoover, Elizabeth. The River is in Us: Fighting Toxics in a Mohawk Community
Wessels, Tom. Reading the Forested Landscape
Sanderson and Boyer. Manahatta
Brody, Hugh. The Other Side of Eden: Hunters, Farmers and the Shaping of the World
Cronon, William. Changes in the Land: Indians, Colonists and the Ecology of New England
Shorto, Russell. The Island at the Center of the World
Galusha, Diane. Liquid Assets
Anand, Nikhil. Hydraulic City
Basso, Keith H. Wisdom Sits in Places: Landscape and Language Among the Wester Apache
Caton, Steven C. Yemen Chronicle: An Anthropology of War and Mediation Hill and Wang, 2005
https://digitalcommons.northgeorgia.edu/cgi/viewcontent.cgi?article=1159&context=issr
Kudish, Michael. Catskills: A Forest History
Rauter, Julian. City and Country: Dialect Acquisition in the Catskill Mountains of New York State Sacha, Mark DEP Archivist: Annual Reports of the BWS
Time and the Valleys Museum
Gilboa Museum

Dinner Speaker

October 27, 2022

Session:	Dinner Speaker
Title:	Why ice storms aren't cool: The latest research on forest response to these catastrophic events
Corresponding Author:	Dr. Lindsey Rustad
Corresponding Author Affiliation:	USDA Forest Service
Corresponding Author Email:	Lindsey.Rustad@usda.gov
Co-Authors:	

Presenter Bio:

Dr. Lindsey Rustad is Co-Director of the USDA Northeast Climate Hub, providing expertise on the impacts of global change on northeastern forests. She is also a Research Ecologist for the USDA Forest Service Center for Research on Ecosystem Change in Durham, NH and a Team Leader for the Hubbard Brook Experimental Forest in NH. Her areas of expertise include biogeochemistry, global change impacts, and advanced environmental sensor systems. Her current interests include implementation of cybertechnology in forests across the northeastern United States and integration of Arts and Science at long term ecological field stations.

Abstract:

ICE STORMS are a common disturbance in north temperate and boreal forests worldwide. In the United States, they account for roughly 60% of winter storm losses; have caused more than $16.3 billion in insured property losses (between 1949 and 2000); are a major cause for road, school and business closing; and result in accidents and loss of life. Current models suggest that the frequency and severity of ice storms may increase in the coming decades in response to changes in climate. These glazing events (defined as 0.25 in. of ice accretion or more) are often perceived as rare occurrences, even though the return interval is as short as 2-5 years in the most ice storm prone northeastern U.S. Despite their influential role in shaping forest ecosystems and economic costs to rural communities, knowledge of ice storms and their impacts remains relatively limited, largely because these storms remain hard to predict and scientists don't know when or where they will next occur.

To address this information gap, we created the first ever controlled ice storm experiments. During the winters of 2016 and 2017, water was pumped out of Hubbard Brook and sprayed over the forest canopy during subfreezing conditions to simulate a glaze ice events. The icing treatments included targets of 0, 0.25, 0.50 and 0.75 inches of radial ice accretion sprayed in winter 2016 (to evaluate the impacts of different intensities of ice storms), and 0.50 inches sprayed again in winter 2017 (to evaluate impacts of consecutive ice storms). Measured ice accretion on wooden dowels suspended in the canopy showed that a gradient of ice accretion was achieved. The treatments resulted in significant increases in canopy openness, inputs of fine and coarse woody debris, and alterations in soil microclimate. Surprisingly, impacts on soil microbial processes during the first two years following icing were minimal. Results are providing the scientific community, land managers and the concerned public greater insight on the impacts of these powerful, frightening, and curiously aesthetic extreme winter weather events on ecosystem dynamics in northern hardwood forests.

Poster Session

October 26-27, 2022

Session:	Poster Session
Title:	Integrating Survey 123 Point Assessments into Informal Trail Monitoring
Corresponding Author:	Garrett Clark Boland
Corresponding Author Affiliation:	SUNY College of Environmental Science and Forestry
Corresponding Author Email:	gcboland@syr.edu
Co-Authors:	

Abstract:

Informal trail networks (IT's) have blossomed in the past decade throughout Catskill Forest Preserve due to the increased interest in outdoor recreation and the prevalence of social media and fitness tracking apps being used to discover new places. In 2019, the DEC assessed over 39 miles of ITs on Catskill high peaks using heat maps from Strava, a fitness tracking app, and IT monitoring protocol developed by the National Park Service. In 2022 we will continue the assessment of ITs and include point assessment surveys using Survey123 to better determine the level of degradation caused by informal trails and the accuracy of Strava heat maps in showing usage levels.

The main research objective for the summer of 2022 is to continue the monitoring effort to evaluate the patterns of use that occurred during the pandemic. Ground truthing and point assessment surveys will determine whether using STRAVA and other novel data sources are accurate at showing the impact of IT's. Point assessment surveys in Survey123 will determine the impact of informal trails and provide data for future corrections.

The 2022 field work will use STRAVA to investigate areas where new IT's have become established that were not included in the 2019 monitoring effort. The field work will be concentrated in, but not limited to, the following areas: the Big Indian Wilderness, Slide Mountain Wilderness, Hunter-West Kill Wilderness and Kaaterskill Wild Forest. Field work will involve evaluation of the largest and most established IT'S. Sections of IT will be categorized in the point assessment surveys as sustainable or unsustainable based on observed grades, alignments, and drainage characteristics.

The main outcome and deliverable from the summer will be a written report detailing the research conducted in the 2022 season containing data on visitor use impacts on trail-less high peaks in the Catskills, the location and intensity of IT trail systems, and recommendations for future management initiatives. The desired product of this research and report will be detailed informal trail monitoring methods and data collection using Survey123 that can be used yearly for continued monitoring and replicated easily outside the Catskills. The poster for the CERM conference will include the findings of the report, a review of the process of developing the survey methods, and information on data gathered with point assessment surveys on the sustainability of informal trails and the accuracy of Strava heat maps in showing intensity of use.

Data collection will take place between May and August of 2022. Deliverables will consist of a written report detailing the baseline data collected that will be used to identify indicators and protocols that can be incorporated into a long-term monitoring program, as well as a poster containing research and data collected over the summer. Due to the large increase in visitation to the Catskills, it is expected that this research will inform decisions on creating a formal trail system on trailless high peaks that have experienced significant degradation.

Session:	Poster Session
Title:	Evaluation of Road Stream Crossings in The Catskills
Corresponding Author:	Adam Bonemery
Corresponding Author Affiliation:	Department of Environmental Conservation
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Co-Authors:	

Abstract:

The Department of Environmental Conservation and its Hudson River Estuary Program have a simple goal of protecting the river and its estuary. This includes all tributaries, streams, wildlife, infrastructure, and land within the valley. Finding culverts that act as barriers to water and species connectivity are a priority of the Hudson River Estuary Program. With the proposed increase in discharge and frequency of severe storms brought by climate change and the hundreds of undersized culverts throughout the region; the streams, wildlife, and infrastructure throughout the Catskills could potentially be altered within the next 50 years. This change could be felt environmentally as well as economically and socially. The purpose of this study will be to examine what might become a financial and logistical strain on the Catskills stemming from old and undersized "road stream crossings". Furthermore, it will help present the importance of designing infrastructure with climate change in mind.

This study will be focused on the barrier road stream crossings in the Catskills and how many of these should be prioritized for repairs or removal. It will include averages of financial data from local engineering firms to get a basic understanding on the costs of these prioritized projects. The social aspect of this study will focus on road closures and the proposed longevity of them. Environmentally, the classification of the streams, habitat, and important species will be studied, as well as the negative impact barrier road stream crossings have on stream morphology and infrastructure.

Barrier road stream crossing can alter stream velocity, constriction, erosion, scour, water chemistry, species passage, and cause structure/road damage. Most of these issues are generated by undersized structures that need replacement. The Hudson River Estuary Program aids in finding these undersized or problematic barriers and prioritizing them with NAACC and water classification data. While working with engineering firms we help design the best new road stream crossings to provide natural stream bed, erosion armoring, species passage, and stream connectivity all while being mindful of road closures and finances.

Lastly, climate change and its potential impact on stream discharge, storm events, and water levels will be covered in relation to culverts that are not currently a barrier. Appropriately sized culverts today could become prioritized for removal in the future. This will put an interesting lens on infrastructure planning and engineering for the near future.

Hopefully this study will present the potential issue that undersized crossings are to the infrastructure and the environment in the Catskills, while simultaneously displaying the way climate change can exacerbate said issues.

Session:	Poster Session
Title:	Headwater Flow Permanence and Water Temperature Patterns in the Upper Neversink River, Catskill Mountains, NY
Corresponding Author:	Donald B. Bonville
Corresponding Author Affiliation:	U.S. Geological Survey
Corresponding Author Email:	dbonville@usgs.gov
Co-Authors:	

Abstract:

The permanence of flow from headwater streams is an essential part of a watershed's ability to maintain cold-water habitat. Connectivity between headwater streams and downstream areas are particularly critical during summer recession periods, when baseflow contributions can vary spatially throughout the watershed and headwater streams can play a disproportionately large role in maintaining cold-water habitat. We monitored water temperature and water level to assess the flow permanence of first order streams throughout the upper Neversink River, a tributary to the Delaware River in the Catskill Mountains of New York State. Thirty-five monitoring locations were divided between the east and west branches of the upper Neversink River to assess a wide range of watershed factors that could affect flow permanence in the watershed. The monitoring locations were selected based on fine scale changes in landscape and geology identified through US Geological Survey mapping in the Neversink watershed as part of the Next Generation Water Observing System. Data are being collected across three seasons (spring-fall) for two years (2021 & 2022) with the intent of encompassing the period of drying and subsequent re-wetting of streams in the watershed. Water temperature is collected at 15-minute intervals and water levels are captured daily using digital imagery and staff plates.

During 2021, results were heavily influenced by anomalously high rainfall throughout the late summer. As a result, flow persisted at all 35 locations for the entire monitoring period. Nonetheless, depth to bedrock appeared to be an important factor influencing water level in the streams. Climatic conditions have been markedly drier during 2022, yet flow has remained present in most streams. Precipitation was most likely the dominant influence on the persistence of streamflow during 2021. In 2022, a year characterized by more typical rainfall and streamflow in the region, other factors such as upslope contributing area and the presence of groundwater seeps may be the most critical factors affecting flow permanence.

Session:	Poster Session
Title:	Estimating Nutrient Loads from Two Streambank Erosion Sites on the West Branch Delaware River, Delaware County, New York
Corresponding Author:	Michael C. Coryat
Corresponding Author Affiliation:	Delaware County Soil and Water Conservation District
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Co-Authors:	M. Graydon Dutcher and Laurence Day

Abstract:

In 1994, the New York State Department of Environmental Conservation identified the Cannonsville Reservoir and its source water, the West Branch Delaware River (WBDR), as priority water bodies in need of Total Maximum Daily Load (TMDL) development for total phosphorus (TP). The phosphorus reduction efforts that followed were largely successful. The Cannonsville Reservoir was removed from the phosphorus restricted list in 2002 and the WBDR was removed from the NYS 303(d) impaired list in 2004. However, 2019 records of elevated median annual TP concentration of the WBDR along with a return of the Cannonsville Reservoir to near-eutrophic levels indicate that TP loading issues may not be resolved. DCSWCD sought to estimate the volume of sediment and mass of TP and total nitrogen (TN) loaded from two locations, 2.3 kilometers apart, on the WBDR where streambank erosion was thought to be severe. It is hypothesized that these locations of severe streambank erosion contributed substantially to the overall nutrient load of the Cannonsville Reservoir between 2009 and 2019. In order to estimate sediment load volumes and nutrient load masses due to streambank erosion at the study sites, three approaches were combined: the first was an analysis of eroded land volume; second, soil nutrient concentrations and physical properties at the affected locations were measured; and third, these data were combined to estimate nutrient load masses introduced to the river. In a 10-year period it was estimated that 33,000 metric tons of soil, 49 metric tons of TN, and 9.3 metric tons of TP were loaded into the WBDR from the two study sites. The average TP loading rate of 930 kg/yr from these sites amounts to 2.1% of the non-point source TP load, and 1.7% of the total TP TMDL for the Cannonsville Reservoir as of the year 2000. Excessive streambank erosion at the sites has continued since 2019 with both high and relatively low flows responsible for the erosion. Analyses of past and recent trends in stream flow and weather may inform how excessive erosion and down-valley meander migration may persist into the future. The outlined process to estimate sediment and nutrient loads has been streamlined in order to identify areas of instability and prioritize them for more in-depth assessment. This process to estimate sediment and nutrient loads due to streambank erosion is currently being implemented in additional watersheds within Delaware County, NY.

Session:	Poster Session
Title:	Zebra Mussel Invasion
Corresponding Author:	Liza Cruz
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Co-Authors:	

Abstract:

In 2022, I was hired as a summer intern for the New York City Department of Environmental Protection (DEP) in Kingston, New York as part of my studies at the State University of New York (SUNY) at Ulster County. The focus of my internship was to assess a new infestation of zebra mussels in the Amawalk, Muscoot, and New Croton Reservoirs. In addition to field research, I compiled and graphed water chemistry data (calcium, pH, and alkalinity) for all reservoirs both east and west of the Hudson River that was vital to understanding whether zebra mussels would thrive in these reservoirs. For nearly 40 years zebra mussels (Dreissena polymorpha) have been progressing through and proliferating in the United States waterways, including parts of the watershed that feed the New York City (NYC) water supply. NYC water supply provides approximately 1.2 billion gallons of water to nearly one-half the population of New York State every day, including eight million residents of the NYC and one million residents upstate. DEP kept zebra mussels out of their water supply for over 30 years despite them being abundant in the nearby Hudson River. Lake Mahopac is a private lake located within the NYC watershed was identified early on as a high probability source of zebra mussels to Amawalk Reservoir. Lake Mahopac flows into the Amawalk Reservoir through a natural stream, the Muscoot River. In 2021 Hurricane Ida transported veligers as well as rafting adults from Lake Mahopac into the Amawalk Reservoir which flows to the Muscoot and then New Croton Reservoirs.

For the fieldwork we collected plankton samples for veliger analysis and conducted a survey for adult mussels in the New Croton Reservoir. Veliger samples were collected by passing a known volume of water through a plankton net with a pump. The sample was then analyzed using a settling technique and cross polarized microscopy for presence and concentration. For the office work I updated data from an earlier study that assessed risk of invasion based on the three analytes mentioned above. Field results revealed low density of settled adults and low concentrations of veligers in New Croton Reservoir, which is expected since this is a new occurrence. Impacts to infrastructure and water quality are expected if the population increases. Zebra mussels reproduce quickly and are continuing to invade many waterways in the country. Efforts to prevent further spread in the Croton system focus on education and outreach, scientific monitoring, and proper decontamination techniques.

Session:	Poster Session
Title:	Risk Perceptions and Trailhead Registration at the Catskill Nature Preserve
Corresponding Author:	Joy Damon
Corresponding Author Affiliation:	SUNY College of Environmental Science and Forestry, Cary Institute
Corresponding Author Email:	jcdamon@syr.edu
Co-Authors:	Diane Kuehn

Abstract:

Trailhead registers provide the DEC with valuable data regarding the use of trails within parks. In 2019, a study was conducted in the Catskills Nature Preserve which found evidence that registers within the park are not providing an accurate count of how many people are using the trails. This study also found a positive correlation between an individual's view of the risk to their personal safety and their willingness to sign in at a trailhead. Using a mix of surveying and observations, this study plans to confirm the findings from the 2019 study as well as test the view of risk, and find ways in which sign-in rates can be improved.

Session:	Poster Session
Title:	An Evaluation of Stakeholder Engagement in the Rondout Neversink Watershed
Corresponding Author:	Alison Dervensky
Corresponding Author Affiliation:	Cary Institute Catskill Science Collaborative Research Fellow 2021-2022 and a Binghamton University Sustainable Communities Masters Graduate 2022.
Corresponding Author Email:	adereve2@binghamton.edu
Co-Authors:	George Homsy

Abstract:

This project titled "An Evaluation of Stakeholder Engagement in the Rondout and Neversink Watersheds," is sponsored by the Cary Institute of Ecosystem Studies, NYC Department of Environmental Protection, and the Rondout Neversink Stream Program (RNSP). This project includes a literature review of the current practices and challenges of environmental communication, which demonstrates that a key component of successful environmental communication is public participation. Also, demographics such as age, geographic location, race, education level, political affiliation, and occupation can impact the success of various environmental communication methods. An analysis of demographic changes over a 10-year period in the Rondout and Neversink basins to see if shifting demographics might call for changes in communication approaches finds that there has been little to no change in the Rondout Neversink Watershed's population in the last ten years. A survey of landowners in the Rondout and Neversink basins was conducted to investigate the best ways for the Rondout Neversink Stream Program to reach out to residents and increase stakeholder engagement in the stream management planning process, and to share other important stream management information with the community. The survey results show that the best way to communicate with residents in the Rondout and Neversink basins is through paper and email. Finally, nine interviews with outreach coordinators, program directors, and community engagement specialists from stream, river, or natural resource management programs were conducted to collect information on the current practices for environmental communication across the U.S. The majority of interviewees stated that more resources are needed to expand efforts and to increase technology adaptation methods to cope with post-pandemic communication needs.

Session:	Poster Session
Title:	Using First and Old Growth Forest data to locate Old Growth Indicator Lichen Species
Corresponding Author:	John Franklin
Corresponding Author Affiliation:	Working with Catskill Old Growth Forest Group
Corresponding Author Email:	johnfranklin2001@aol.com
Co-Authors:	

Abstract:

Using First and Old Growth Forest data to locate Old Growth Indicator Lichen Species. For decades since Selva and Rose developed the Old Growth Indicator Lichen Lists, these lists have been used in numerous locations around the world to determine forest age, richness, and diversity. Old Growth Indicator Lichens are specific species that are endemic in the most pristine and ancient forests and not often found in any other locations. Working with the Old Growth Forest Group in the Catskill Forest Preserve, I found we had a unique opportunity. Instead of using Lichens on the Old Growth Indicator List to accurately locate Old or First Growth Forests, I did the reverse. I used pre-determined Old and First Growth Forest locations to locate Old Growth Indicator Lichens! With over 50 years of research in the Catskill Forest, Dr. Michael Kudish has carefully mapped out areas of the forest that have never been burned, cut, or otherwise negatively impacted by human actions. His meticulous forest mapping includes entry points separating areas that have been impacted with those more remote areas that were spared negative impacts of barking, logging, charcoal production, and mineral mining operations. Recently, The Old Growth Forest group of Dr. Kudish, Steve Parisio, and Dr. Morton S. Adams have expanded on that work adding new entry points and additional acreage of First Growth Forests to the map. Using this data in reverse, they revisited known Old or First Growth Forest areas to verify entry points and possible locate additional areas of First Growth Forest. Over the last 4 years, I made 33 individual hikes into the Catskill Forest Preserve, totaling more than 200 miles of forest trail. Rather than randomly walking through the woods, each of these hikes went to a specific remote location in the Catskill Forest Preserve where Dr. Kudish had previously determined that area to be free of obvious human disturbance and thereby designated as First Growth or Old Growth. On each of these 33 hikes, Steve Parisio located and measured and recorded trees over 30". We examined the moss and lichen epiphytes found on every tree we noticed. I photographed, examined, and per NYS DEC permit, collected some lichen samples to send Dr. James Lendemer at the New York Botanical Gardens for Lab identification and permanent retention in the NYBG Steere Herbarium. The previous work by Dr. Kudish was insightful because in every single location of pre-determined old or first growth forest that we examined, we found lichens on the Selva Old Growth Lichen Indicator List. Findings range from a low of (2) old growth species at Obese Cherry Valley and a high of (8) old growth species on Slide Mountain. Also interesting was the fact that we seldom found any of these Old Growth Indicator Lichens outside of the pre-established First Growth entry points. In the process, I found two new Old Growth species, Hypogymnia tubulosa and corticolous Ramalina intermedia, that previously had not been found in the Catskill Forests.

Session:	Poster Session
Title:	Rapid Habitat Assessment of Vernal Pools for Amphibian Conservation
Corresponding Author:	Avalon Johnson
Corresponding Author Affiliation:	Marist College
Corresponding Author Email:	avalon.johnson1@marist.edu
Co-Authors:	Zion Klos

Abstract:

Intermittent aquatic ecosystems that emerge in the spring and early summer before drying in the late summer and fall, also known as vernal pools, are prime breeding areas for many species of amphibians. In New York's Hudson Valley, there are many conservation sites that contain vernal pools. Specifically, the Black Rock Forest and the Arnika, Lloyd, and Dominican Camp conservation sites, owned by Scenic Hudson, contain vernal pools with a variety of different surrounding ecologic and physiographic features. While many different factors may contribute to the overall health of a pool, only some of these variables have been found to correlate to the success of amphibian breeding in the pool. Previous studies in pools (n = 9) at the Arnika Site in the summer of 2021 indicate nitrogen and chloride concentrations, pool depth, as well as the average and the range of substrate temperatures may have significant effects on the amount of amphibian egg masses observed within a pool, but a larger dataset was collected to further clarify these preliminary findings. This research analyzed more pools than previously possible by focused observation of identified key variables. Through a rapid assessment of 21+ pools over the summer of 2022, an initial dataset of 30 pools from the Hudson Valley region allows for stronger correlations to be made between ecological variables and the amount of egg masses found. By gaining a better understanding of which variables are the strongest, even faster vernal pool assessments can be completed easily across the Northeast. These contributing variables are important to know because with a changing climate, there is a risk of lowering the general biodiversity of the area, especially through the loss of already threatened amphibian species (e.g. Ambystoma Salamander) that are dependent on these pool habitats. Through this expanded dataset, conservation priority can be placed on higher risk vernal pools and the species surrounding them so that high biodiversity in the region continues.

Session:	Poster Session
Title:	Exploring the Potential Water Quality Impacts of Spotted Lanternfly On the NYC Water Supply System
Corresponding Author:	JJ Kathe
Corresponding Author Affiliation:	Dept. of Geography & Planning SUNY Albany Graduate School
Corresponding Author Email:	jkathe@albany.edu
Co-Authors:	

Abstract:

The 19 reservoirs and 3 controlled lakes which make up the New York City Water Supply system largely rely on natural filtration to maintain water quality, which is determined by the ecological health of the Croton, Catskill, and Delaware watersheds. In addition to erosion, contamination, and climate change, invasive species presence is a significant ecological stressor within these watersheds. The Spotted Lanternfly (SLF), an invasive forest and agricultural pest which has devastated the Northeast since its 2014 introduction to Pennsylvania, is swiftly spreading into New York State and towards these critical conservation areas. This comprehensive study aims to identify, quantify, and predict correlations between SLF, land cover, and water quality, to explore how and where watershed health may be compromised, and assess the risks posed to public water supply by SLF-induced landscape changes. Highlighting the relationships between these elements will illuminate the urgency for land managers to combine public water supply protection, invasive species suppression, and natural area conservation efforts for the benefit of all stakeholders.

Session:	Poster Session
Title:	Assessing Community Vitality in the Catskill-Delaware Watersheds
Corresponding Author:	Anusha Lamsai
Corresponding Author Affiliation:	SUNY College of Environmental Science and Forestry
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Co-Authors:	

Abstract:

Assessing Community Vitality in the Catskill-Delaware Watersheds The historic New York City (NYC) Watershed Memorandum of Agreement (MOA), signed 25 years ago, sought to safeguard water quality, and strengthen community vitality in the upstream watersheds. Water quality has been actively regulated and evaluated over the last 25 years, yet attention to the well-being of watershed communities has been minimal. This research aims to evaluate the impacts of the Watershed Protection and Partnership Program (WPPP) on community vitality of watershed communities. Are these communities thriving, striving, or just surviving? This study attempts to answer if the WPPP established by MOA achieved both of its goals to maintain and enhance (i) the quality of the NYC drinking water supply system, and (ii) the economic vitality and social character of the watershed communities. We aim to test the hypothesis that the watershed residents are not convinced that WPPP has put enough effort into or even considered building healthy social characters and maintaining economic vitality across the Catskill-Delaware watershed communities. To determine if watershed communities are thriving, striving, or just surviving, we will reach out to key stakeholders (via face-to-face interviews, focus groups and traditional surveys), including the signatories of the MOA, various government and non-government organizations within the Watershed, Watershed residents and the New York City Department of Environmental Protection. After 25 years, NYC continues to benefit from plentiful, high-quality water from the Catskill-Delaware watersheds. Our results will shed light on whether these watershed communities are also benefiting from this relationship with NYC. Keywords: Community vitality, Memorandum of Agreement, watershed, watershed communities, Watershed Protection Program, water quality.

Session:	Poster Session
Title:	Mapping surficial materials and estimating minimum depth-to-bedrock in the Neversink River watershed using deep learning and high-resolution lidar
Corresponding Author:	William Odom
Corresponding Author Affiliation:	U.S. Geological Survey
Corresponding Author Email:	wodom@usgs.gov
Co-Authors:	Daniel Doctor

Abstract:

The quality and volume of water supplied to the Neversink Reservoir are strongly influenced by bedrock and surficial materials of the upper Neversink River watershed. Detailed characterization of the area's surficial geology remains a central focus of ongoing mapping efforts. These efforts have been bolstered by the production of high-resolution (1-3 m) lidar-derived digital elevation models (DEMs) in the upper Delaware River Basin (DRB), which provide a powerful tool for characterizing bedrock exposures and unconsolidated surficial materials. This investigation used a combination of deep learning classification techniques and geomorphic measurements made on DEMs, in addition to geophysical and geologic fieldwork, to map and estimate the thicknesses of surficial sediments in the Neversink area.

Recent developments in deep learning-based mapping techniques have greatly improved our ability to rapidly identify and characterize surficial materials from lidar-derived DEMs. Using published New York and Pennsylvania geologic quadrangles to the south and west of the Neversink River watershed, we trained a ResNet-18 convolutional neural network on a 3-m resolution, 3-band raster to identify exposed bedrock and alluvium-filled valleys. Training lasted 395 minutes, yielding a final pixel classification accuracy of 79%. The model classified exposed bedrock and alluvium-filled valleys in the Neversink River watershed in three minutes. We then utilized the USGS DEM Geomorphology Toolbox to measure bank heights as proxies for minimum sediment thickness in the vicinity of streams, while the edges of classified bedrock exposures were denoted as points of zero thickness. After eliminating spurious points along roads/rails and streams on mapped bedrock, we generated a minimum thickness raster by interpolating the combination of sediment thickness values from bank height estimates and bedrock edges using an inverse distance weighting approach (fixed interpolation distance = 250 m, output resolution = 30 m).

The deep learning model classified 103 km2 of bedrock and 9 km2 of alluvium. The remaining 72 km2 consist of undifferentiated glacial materials. Following interpolation and masking, the minimum depth-to-bedrock raster had a mean value of 3.2 ± 2.7 m (1σ), with a maximum depth of ~16.9 m. Estimated thicknesses were greatest along stream banks and decreased toward bedrock exposures. Comparison of our minimum depth-to-bedrock estimates with horizontal-to-vertical spectral ratio (HVSR) passive seismic measurements showed that our approach usually underestimated sediment thicknesses, but occasionally overestimated sediment thicknesses when seismic measurements were collected on bedrock exposures. These discrepancies likely reflect small-scale variabilities in thickness that are not resolved at the DEM resolution, and/or buried bedrock relief that cannot be accurately modeled with inverse distance weighted interpolation.

Presently, we are working to improve our bank height estimates using the recently developed Floodplain and Channel Evaluation Tool (FACET), which accounts for valleys of variable width. Ongoing improvements in the deep learning technique have also enabled mapping of additional material classes, including glacial deposits and colluvium, that will provide new context for improved depth-to-bedrock estimates. Work in the upper DRB outside of the Neversink River watershed has shown these approaches to be readily scalable, opening the door to rapid generation of detailed surficial geology and thickness maps.

Session:	Poster Session
Title:	First Growth and Old Growth Forest in the Catskills
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Abstract:

"First growth" refers to a forest which has never been logged, cleared, or otherwise disturbed by human activities. It is recognized by the species composition and the age-structure, plus a knowledge of forest history: where the mills were, the tanneries, the acid wood factories, the farms, the quarries, the human-caused fires.

"Old growth" is harder to define. In the Catskills, we have identified old growth based on field observations including (i) mixed-aged stands including more than a few living trees exhibiting a size and/or growth form indicative of advanced age; (ii) dead standing and fallen trees of similar size and form; (iii) pit and mound microtopography; and (iv) a suite of epiphytic lichens and bryophytes which are strongly associated with old growth forest.

Based on more than 50 years of research and field work by one of us, the extent of first growth forest in the Catskills is now estimated at 73,217 acres or 114.4 square miles. This represents approximately 7 to 14% of the Catskills, depending on how broadly the region is defined.

The mean elevation at which first growth begins is about 2,850 feet. The field data consists of "entry points" which are located along a traverse from younger forest into first growth. The entry points are used, together with property boundaries and topographic features in some cases, to delineate the first growth forest. At present there are 562 entry points delineating 54 separate stands. A GIS polygon layer has been created and is being updated as new field data is collected.

Representative old growth stands have been located by looking within areas of first growth for site characteristics optimum for development of long-lived, late successional tree species such as sugar maple, yellow birch, and hemlock. Much overlap exists between first growth and old growth and there is much variability within each. There are examples of first growth which is not old growth and vice versa.

Direct evidence of old growth trees in the form of tree ring counts from increment cores is currently scarce in the Catskills. The authors are cooperating with researchers who seek to collect such data in old growth stands as part of broader investigations into climate change.

With the exception of 562 acres (less than 1% of the total acreage), mapped Catskill first growth forest is on protected State Forest Preserve land. The forests are not, however, entirely free of anthropogenic changes. For example, American beech which was co-dominant with sugar maple, yellow birch, and hemlock in much of original forest canopy has, over the past 50 years, been impacted by beech bark disease and now persists mainly in the understory as small diameter stump sprouts. More recently, the forest has been impacted by hemlock woolly adelgid and emerald ash borer which are further changing species composition as they spread throughout the region. Because of these threats, the health and survival of Catskill old growth forest is uncertain and requires continued monitoring.

Session:	Poster Session
Title:	Assessing spatial and temporal variability in dissolved organic matter in the Neversink reservoir and watershed
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Abstract:

Dissolved organic matter (DOC) is commonly defined as the portion of the organic matter pool smaller than 0.45 µm that makes up over 90% of the total organic matter pool in most lakes and reservoirs (Thurman 1985; Wetzel 1992, 2001; Hedges 1992). The Neversink reservoir, which is part of the drinking water supply for New York City, has high concentrations of DOC. This can cause many problems in drinking water and associated treatment processes including reacting with chlorine during water treatment and forming harmful disinfection byproducts (DBPs; EPA, 1998; Matilainen et al., 2010; Crittenden et al., 2012). DBPs, such as trihalomethanes (THMs) and haloacetic acids (HAAs), pose important health risks (Hong et al. 2008). Many DBPs are potentially carcinogenic, mutagenic, and may be associated with negative reproductive/developmental effects (Richardson et al. 2007). Managing (DOC) is thus an important component of overall drinking water treatment (Singer 1994; Barrett et al. 2000; Garvey and Tobiason 2003; Crittenden et al. 2012). DOC quality is often distinguished by source: a higher molecular weight, more aromatic, terrestrial (allochthonous) fraction versus a lower molecular weight, less aromatic, microbial (autochthonous) fraction. These fractions differentially regulate many water quality characteristics. For example, microbially-derived DOC is less light absorbing, highly bioavailable, easily respired, and can shape bacterial community composition (Amon and Benner, 1996; Jankowski et al., 2014; Amaral et al., 2016). Evidence indicates that microbially-derived DOM also reacts less with chlorine, producing fewer disinfection byproducts (Nguyen et al., 2005; Beggs et al., 2009). The Neversink reservoir contains many hotspots and unknown sources of DOC which complicate management practices. Here, we characterize the spatial and temporal variability in the concentration and sources of DOC in the Neversink Reservoir and watershed, as a critical step toward generating improved proxies for DBP precursors in this drinking water supply.

Session:	Poster Session
Title:	Results of integrated sediment transport studies in the Esopus Creek watershed, 2017-2021
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Abstract:

The USGS began monitoring suspended sediment at one location in the upper Esopus Creek watershed in 1997. In cooperation with the New York City Department of Environmental Protection and the Ashokan Watershed Stream Management Program, monitoring expanded to 32 sediment flux or turbidity monitoring stations throughout the basin by 2017. Bedload transport and sediment fingerprinting are also monitored at a subset of locations. The general goals of this work are to: 1) characterize the variability of suspended-sediment concentrations (SSC) and turbidity among subbasins and several stream reaches within the Stony Clove Creek watershed, 2) evaluate the effectiveness of sediment and turbidity reduction projects (STRPs) at multiple spatial, temporal, and hydrologic scales, 3) quantify bedload transport at 2 locations, and 4) identify geologic and land cover sources of suspended sediment and apportion sediment loads to those sources using sediment fingerprinting techniques.

Results from 2017-2021 suggest that Stony Clove Creek and Woodland Creek continue to be the primary subbasin contributors of suspended sediment to the Esopus Creek. SSC per unit streamflow has decreased in the monitored subbasins after STRPs have been implemented, with the greatest reductions in Stony Clove Creek where multiple STRPs have been constructed since 2012. A small reduction in Esopus Creek SSC per unit streamflow just upstream of the Ashokan Reservoir was measured, but it remains unclear if this reduction can be attributed directly to the STRPs. Active and passive tracers provided estimates of incipient motion and transport distance of bed material, and traditional bedload measurement results suggest bedload transport per unit streamflow may increase by an order of magnitude after a large flood. A source sediment library was developed for sediment fingerprinting and preliminary results indicate source contributions shift between near stream forest, alluvium, glacial till, and glacial lacustrine sources through the hydrograph. The current work will continue through 2027.

Session:	Poster Session
Title:	Characterization of Stream Turbidity in the Catskills, New York, USA: Insights into Environmental Controls
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Abstract:

The Catskills region is an important supplier of water to the residents of New York City (NYC), as the Catskill/Delaware Watersheds contribute to more than 90% of NYC's daily water needs. Considering that the NYC water supply system (NYCWSS) is one of the largest unfiltered surface water supplies in the world, it is imperative to ensure that high quality water is delivered to NYC for safe consumption. Stream turbidity is one parameter often examined in water quality investigations, which is a measure of the cloudiness of water due to the light scattering from fine suspended sediments in the water column. However, maintaining high quality water in the NYCWSS is nuanced due to the multiple sources and nature of turbidity in this region. The nature of the sources of turbidity in the Catskills are largely caused by the steep topography of the region, which allows for highly erodible sediments to generate turbidity. Therefore, understanding the turbidity conditions in the Catskills is necessary not only to guide present-day watershed management decisions, but also to provide key insights with respect to the sustainability of the NYCWSS. Previous studies have examined turbidity conditions in the Catskills, but, from our knowledge, this information has not been synthesized for the entire region. Thus, in this study, we synthesize over a decade's worth of existing turbidity data in the Catskills to better understand the drivers of turbidity in this study area. We characterized turbidity in the Catskills by examining the spatial and temporal trends in turbidity across monitoring sites, and then related these results to the existing streamflow data. Preliminary results indicate that there is a statistical difference in mean turbidity across streams; these results suggest that there are various mechanisms controlling turbidity in the Catskills, including differences in topography and land use across sites. Additionally, performing seasonality analysis indicates that turbidity peaks in January, March, and April across sites; these peaks are likely driven by earlier spring snowmelt events. The preliminary findings from this study provide insights into the variability of turbidity in the Catskills, which may be useful to better inform policy and engineering solutions for protecting the sustainability of the NYCWSS. Future work will involve further examination of the streamflow-turbidity relationship, as well as the implementation of a predictive model to identify the environmental controls most strongly related to the generation of turbidity in the Catskills.

Session:	Poster Session
Title:	Investigating suspended sediment load hysteresis patterns as tools for evaluating geomorphic response to hydrologic disturbance in the Stony Clove watershed
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Abstract:

Stream turbidity originating from suspended sediment sources in the Catskill Mountain fluvial system has been an ongoing concern for the New York City Department of Environmental Protection (DEP) in its effort to provide the highest quality unfiltered drinking water to their customers. Stony Clove Creek has historically been a chronic source of turbidity to Esopus Creek and the receiving Ashokan Reservoir. As part of a collaborative research partnership between the DEP and US Geological Survey (USGS) to quantify relative tributary turbidity sources in the Esopus Creek basin, the USGS maintains six automated high-frequency monitoring stations for streamflow (Q) and turbidity (Tn) in the Stony Clove watershed. Suspended sediment concentration (SSC) is also frequently measured by the USGS at these stations, across a range of Q conditions, providing data for developing a SSC-Tn regression relationship to estimate high frequency SSC used to compute suspended sediment load. High magnitude-low frequency runoff events are an assumed driving force in episodic changes of Catskill stream turbidity production through increased erosional connectivity with suspended sediment sources, temporarily altering SSC-Q hysteresis and suspended sediment (SS) load. The December 24-25, 2020 flood, a 10-25 year recurrence runoff event in the Stony Clove watershed provides an excellent opportunity to assess the impact of hydrologic disturbance events on Tn-Q and SSC-Q dynamics to test whether changes in hysteresis can be linked to observed erosional connectivity responses mapped in 2021. This investigation uses the high frequency monitoring data to evaluate the potential for hysteresis analysis to aid in turbidity source condition interpretation and turbidity reduction management optimization at the sub-basin to catchment basin scale.

Session:	Poster Session
Title:	Roles of cover cropping on dissolved phosphorus runoff through integrated laboratory and field studies
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Abstract:

About 90% of the New York City water supply is taken from the Catskill/Delaware watersheds, and the Cannonsville Reservoir watershed has the highest proportion of agricultural land among them. Historically, excess phosphorus (P) loading from both point and non-point sources in the watershed led to high total P concentrations and eutrophic conditions in the reservoir. Various efforts have been made to reduce P loading from the point and non-point sources, and winter cover cropping is one widely adopted practice to mitigate soil erosion and nutrient runoff from agricultural soils. Although this practice generally is effective in reducing soil erosion and particulate P runoff, its effectiveness in reducing total P export is inconsistent, as elevated dissolved P loss relative to bare soil was frequently observed. The impacts of cover crops on P loss from soils are the results of complicated interaction between cover crop, soil, and climate. First, cover crops are an external P source to soils and can release soluble P during their aging and decomposition in soils. The rate and extent of P release vary between plants and are affected by climate, such as freeze-thaw and/or wet–dry processes. Second, P mobilization from agricultural land is affected by factors such as soil properties, hydrological conditions, and landscapes. Particularly, soil adsorption capacity and water-soil interaction primarily control the retention of soluble P release from cover crops/crop residue. To evaluate the potential contribution of cover cropping to P export from agricultural lands in the Cannonsville Reservoir watershed, it is important to determine P release from common cover crops used in the watershed and ability of the agricultural soils in retaining the released P, under environmental conditions that are specific to the watershed (e.g., climate, time and rate of application). In this work, we adapt laboratory study to obtain quantitative data on P release and mobilization behaviors and identify watershed-specific factors that regulate the behaviors. The results will help evaluate the impacts of winter cover cropping to dissolved P loading (rate and timing) and watershed-scale modeling of nutrient management.