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Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
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Project Title:	LTER: The Interacting Effects of Hydroclimate Variability and Human Landscape Modification in the Southern Appalachian Mountains
PD/PI Name:	Theodore L Gragson, Principal Investigator C R Jackson, Co-Principal Investigator
Recipient Organization:	University of Georgia Research Foundation Inc
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Submitting Official (if other than PD\PI):	Theodore L Gragson Principal Investigator
Submission Date:	12/21/2016
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Theodore L Gragson

Accomplishments

* What are the major goals of the project?

Southern Appalachian forests are highly productive ecosystems and globally rich in biodiversity, having been shaped by the interactions between a wet regional climate and a mountainous topography across evolutionary time scales. Now, however, forest ecosystems and human systems across the southern Appalachian Mountains are linked at multiple levels. This recognition leads to the major goal of the project, which is to understand how hydroclimate variability and the human-modified landscape separately and interactively alter southern Appalachian Mountain ecosystem processes and biotic communities, and in turn, affect the vulnerabilities of regional socio-ecological systems.

This research is developed in line with the five core research themes of LTER science, and builds on long-term studies and monitoring activities across numerous permanent plots within and beyond the Coweeta Basin. The involvement in this project of diverse scientific disciplines makes it possible to generate critical ecological understanding of the interactions that shape the nation's most diverse forested biome. Such understanding is essential for anticipating, responding to, and mitigating changes and vulnerabilities associated with stressors operating in this biome. Broader impacts for this project derive directly from activities within the Coweeta Listening Project and the Coweeta Schoolyard Program.

*** What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities:

Spatio-temporal variation in climate strongly affects southern Appalachian ecosystems. Species composition, organismal interactions, and ecosystem process rates are influenced by ridge to cove gradients in edaphic properties, and low to high elevation gradients in temperature and precipitation. While closed-canopy forest once dominated the southern Appalachian Mountains, human alterations of the climate and the landscape over the Anthropocene have been significant. Uncovering the feedbacks that link the biophysical and the human realms can serve as the foundation for developing environmental solutions at scales relevant to intervention. This environmental context and public opportunity leads to the organization of the present project into a portfolio of interrelated research and education/outreach activities.

1) Ecosystem and Organismal Sensitivity to Hydroclimate Variability and Land Use - evidence suggests that the vulnerabilities of forest understory species to shifts in hydroclimate variability and land use will depend on the interaction between individual sensitivities to the local environment and population sensitivities to the effects of habitat fragmentation and isolation. Research relying on long-term monitoring sites is examining the interacting effects of water status and flow on vegetation response and structure, microbial responses, and individual and population sensitivities among selected herb, invertebrate, salamander and bird species.

2) Riparian Land Cover Interactions with Hydroclimate - the broad impacts of climate and land use change upon aquatic resources are mediated by what happens at the interface between terrestrial and stream ecosystems. The structure and function of riparian forests in the southern Appalachian mountains have been significantly affected by continuing successional processes following the chestnut blight, the eastern hemlock die off occasioned by woolly adelgid, and the expansion of *Rhododendron maximum* (Ericaceae). These changes have led to understory microclimate and plant-litter-soil biogeochemical feedbacks that inhibit tree seedling recruitment and a sparse overstory of canopy trees. Research is examining how rhododendron manipulation at plot and reach-scales affect terrestrial and aquatic ecosystem processes.

3) Consequences of Hydroclimate Variability and Landscape Development - previous research quantified numerous local consequences to biodiversity and ecosystems from land use change and climate, as well as key uncertainties in how land use legacies affect hydrologic responses. The regional consequences of increased hydroclimate variability, however, are not well understood. Research is integrating long-term observations on soil hydrology, climate and land use with stand and hillslope interactions within the RHESSys ecohydrologic framework. By focusing on the inter-connected responses of land use, canopy structure, hydrology, and carbon and nitrogen cycling the goal is to improve understanding of the spatially-explicit responses of land use and forest change over a range of geographic and time scales.

4) Education and Outreach - these are a necessary complement to the portfolio of research activities and include The Coweeta Listening Project and the Coweeta

Scholyard Program. The former translates and communicates community-relevant results from CWT LTER research, with the goal of engaging society and collaborating with local NGOs on outreach programs to land owners on the importance of riparian corridor integrity. The Scholyard Program includes field-based environmental education and in-classroom support for middle school teachers and students, and mentoring in research for undergraduate and graduate students.

Specific Objectives:

Activity number 1 is associated with long-term studies in permanent plots. The specific activities center on determining the spatial and temporal distribution of biotic populations selected to represent trophic structure, the pattern and control of organic matter accumulation in surface soils and sediments, and the patterns of inorganic inputs and movements of nutrients through soils and waters. Measuring performance of individual species and functional types along soil moisture gradients serves to reveal the trade-offs between traits, predation and infection. Plot-level work seeks to understand aspects of the exchange of C and N between plants and soils, the long-term decline of deep soil carbon, and the relation between reduced rainfall, tree growth and nitrogen fixation. Quantification of rainfall interception along a forest chronosequence serves as the basis for estimating landscape variation and controls on surface soil moisture for scaling from plot to region.

Activity number 2 relates to a large-scale riparian rhododendron manipulation experiment examining pattern and control of primary production along with the pattern, frequency and effects of disturbance. At the reach scale, the objective is to understand how rhododendron removal alters algal accrual, decomposition, nutrient cycling, respiration and stream trophic dynamics. The effect of rhododendron cutting on stream temperature, hydrologic behavior, diurnal temperature damping in the hyporheic zone, and the rate of channel narrowing within riparian gaps and channel expansion downstream of gaps are being quantified. The effect of changes in vegetation on soil nitrogen cycling and mobility on the composition of soil microbial communities and stream ecosystems is being established through measurement of crayfish abundance, fish community composition, and changes in taxonomic and functional diversity of stream macroinvertebrate communities.

Activity number 3 centers on integrating through RHESSys species-level differences in stomatal behavior and the influence of downslope subsidies on biodiversity in order to create structured gradients in inter-annual hydroclimate and surplus water availability across watersheds. The objective is to determine the impact of biotic drivers on runoff threshold dynamics as well as the existence of a runoff signal in the inter-annual variability of biotic controls. A terrestrial ecohydrology model is being coupled with an aquatic metabolism model to evaluate and deconvolve their contributions in processing carbon and nitrogen. A methodological framework is being developed to downscale regional climate factors using NARCCAP analyses and the WRF model to assess spatio-temporal trends in extreme precipitation across the region. Efforts to measure the pattern, frequency and disturbance effects unique to the southern Appalachian domain are helping refine current regional disturbance models. The objective is to better understand the role of changes in soil hydrology in response to deforestation, cultivation, reforestation and urbanization. The objective is to refine ecohydrologic models so they capture the temporal and spatial dynamics of soil properties as mediated by human activities under the edaphic and climate conditions characteristic of mountainous landscapes.

Activity number 4 draws from research on values, perceptions and worldviews resulting from the diverse ways that people inhabit, engage with and observe the southern Appalachian landscape as transformed by exurbanization. Results contribute to understanding environmental change by improving the causal theories that link physical, biotic and social forces, as well as the scale-dependent effects of

human action. Such place-based knowledge is also fundamental to the translation of ecological research findings into educational and outreach activities that impact the ways people conceptualize and respond to environmental change in southern Appalachia.

Significant Results:

Published results this year advance understanding of how hydroclimate variability and the human-modified landscape alter ecosystem processes, fluxes, and biotic communities. Publications by Webster et al., Nippgen et al., Keiser et al., Novick et al. and Caldwell et al. address nitrogen fixation, water yield, and forest disturbance history.

Webster et al. (2016) examine a regime shift in N export from a forested watershed revealed by 36 years of data from the original LTER watershed-scale forest harvest experiment. Forest disturbance caused elevated dissolved inorganic N (DIN) loss lasting for decades. This elevated N export was apparently caused by an initial pulse of organic matter input, reduced vegetation uptake, increased mineralization of soil organic N, and N fixation by bacteria associated with black locust following clearcut logging. The reference and disturbed watershed now feature different seasonal patterns of DIN, flipped concentration-discharge relationships, and a shift from biological to hydrological control of DIN export. Nippgen et al.'s (2016) analysis of long-term precipitation and streamflow data reveals substantial hydrologic memory in the CWT watersheds, indicating deep storages and long flow paths that could contribute to the long-term DIN response observed by Webster (2016).

Keiser et al. (2016) examine the effect of landscape disturbance on the linkage between rates of biogeochemical cycling and the stoichiometric demands of the organisms that cycle the elements. Keiser et al. were motivated by a lack of understanding of how carbon and nitrogen availability interact to influence nitrification rates at the landscape scale. They sampled ten watersheds with different disturbance histories in the southern Appalachian Mountains to examine the effects of disturbance on potential net nitrification rates. Results indicate that forest disturbance history determines whether nitrification and nitrogen mineralization are correlated, and the effect is apparently mediated by microbially available carbon. Historical disturbance at the landscape scale reduces soil carbon availability, which increases ammonium availability to nitrifiers at the microscale. Landscape-level soil carbon availability appears to determine the coupling of autotrophic (nitrification) and heterotrophic (nitrogen mineralization) biogeochemical processes, and hence the relationship between carbon and nitrogen cycling in soils.

Novick et al. (2016) showed that cold air drainage in CWT's mountain topography alters the spatial and temporal distribution of carbon uptake by suppressing local valley temperatures by several degrees at night and for several hours before and after sunset. The result is a 10% increase in the growing season and a 15% increase in annual net carbon uptake in valley areas. Furthermore, the timing of net carbon uptake relative to weather conditions is opposite that observed on the hillslopes.

Caldwell et al. (2016) examined 76 years of water yield, climate, and field plot vegetation measurements in six unmanaged, reference watersheds in the southern Appalachian Mountains to determine whether water yield has changed over time and attribute the causal mechanisms of change. Results suggest that changes in climate, forest structure and species composition in unmanaged forests resulting from disturbance and natural community dynamics can result in large changes in water supply. Annual water yield increased in some watersheds from 1938 to the mid-1970s by as much as 55%, but this was followed by decreases up to 22% by 2013. Forest basal area showed equivalent temporal fluctuations, as did evapotranspiration although in the opposite direction. These results indicate that

climate and vegetation disturbance can interact to substantially affect water yield.

Publications by Warren, and by Frisch et al. explore performance of individual species across time and environmental gradients. Warren (2016) questioned the long-term assumption in ecology that the distribution of species corresponds with their niche requirements and presents evidence for persistence in an unsuitable habitat for centuries. The study tests the hypothesis that a Cherokee cultivation legacy drives current regional distribution of *G. triacanthos* (honey locust) typically found in rocky uplands and xeric fields, but also inexplicably in mesic riverine corridors and floodplains. By combining field experiments and surveys Warren investigated *G. triacanthos* recruitment requirements and distribution patterns and found their distribution is best explained by historic Cherokee settlement patterns than habitat. At least in this case, human land use legacy may play a long-term role in shaping species distributions although such pre-European settlement is generally underrated as a factor influencing modern tree species distributions.

Frisch et al. (2016) modeled patch occupancy to examine factors that best predict the prevalence of four functionally important stream consumers (*Tallaperla* spp., *Cambarus* spp., *Pleurocera proxima* and *Cottus bairdi*) among 37 reaches across the Little Tennessee River basin. Occupancy was linked to parameters characterizing both the catchment and reach extent. Forest cover or its conversion to agriculture was a major determinant of occupancy for all four taxa at the catchment level, while availability of large woody debris, large cobble substrate or stream calcium concentration affected taxa occupancy at the reach level. Results thus show that stream organism abundance is determined by the taxon-dependent interplay between catchment- and reach-level factors.

Finally, articles by Allen & Moore, Graves et al., and Record et al. explicitly examine human-mediated activities and how social science can further understanding of mountainous landscape transformation. Allen & Moore (2016) demonstrate use of a nonmarket valuation technique, stated choice experiment (CE), for understanding a range of public preferences for stream-related ecosystem services in Macon County, NC. Using a split-sample design, they tested the impact of program implementation on respondent preferences and the willingness to pay for stream health improvements. While the public display consistent preferences for certain attributes of stream health, their willingness to pay varies widely. Graves et al. (2016) examined whether perennial bioenergy production limit conversion of agricultural land to development by estimating potential crop growth through AD 2100 using a process-based model. The results demonstrate that tradeoffs among bioenergy production, crop production and exurban expansion in a changing, rural mountain landscape varies spatially with climate change. Consequently, if a market develops for bioenergy crops it could potentially counter losses of agricultural land to development. Finally, Record et al. (2016) ask how the LTER Network can promote the training of social-ecological researchers so they can inform society about pressing environmental problems. They examined the importance of funding, pedagogy, research design and development, communication, networking, and the culture and attitude of senior scientists toward students pursuing social-ecological research. The singularly important factors in all cases were communication, attitude and culture. The conclusion is that the likelihood of successful graduate social-ecological research training will depend on open communication, creating a collaborative culture, and fostering an entrepreneurial attitude among students, advisers and networks.

Key outcomes or
Other achievements:

(nothing additional to add)

* What opportunities for training and professional development has the project provided?

The Coweeta LTER Schoolyard program directly engaged 2,101 students on 25 different occasions. Coweeta Schoolyard LTER coordinated and led the 5th annual Migration Celebration where in collaboration with the non-profit Southern Appalachian Raptor Research and Mainspring Conservation Trust. A total of 350 6th grade students from Mountain View Intermediate and Trimont Christian Academy participated in activities concerning migration, including tagging Monarch butterflies, banding migratory songbirds, and learning the different strategies that animals use to cope with scarce resources. A STEM component was added this year in which students created objects that soar like birds and competed to see who could create an object that soared the furthest.

The Kids in the Creek program was carried out again this year, and entailed four events serving 661 students. Partners in the activities this year included Mainspring Conservation Trust, U.S. Fish and Wildlife Service, Watershed Association of the Tuckasegee River, Hiwassee River Watershed Coalition, the National Park Service and Western Carolina University. The program satisfies 8th grade science curriculum standards on the hydrosphere and water quality within the North Carolina Standard Course of Study (competency goal 3).

The Science Study Boxes once again were widely used by middle-school teachers in public schools throughout western North Carolina. The boxes were checked out a total of 11 times and served the needs of 2,197 students.

The CWT LTER hosted four REU students this year. Student recruitment involved nationally advertising the positions with a focus on students a) majoring in ecologically-related fields, b) had a desire to engage in a research experience, and c) had specific interests in aspects of the CWT LTER research. Applications were screened, short-listed applicants were interviewed by phone, and letters of recommendation from faculty and staff who had worked with the individuals were solicited.

Garrett Frandson, Central Arkansas University, worked under the supervision of Drs. Seth Wenger and Amy Rosemond, Odum School of Ecology (UGA). Research activities. Garrett developed a study to quantify the effects of temperature on detrital processing rates in headwater streams and test responses against those predicted by the metabolic theory of ecology. This study lies in activity cluster #2 focusing on riparian land cover interactions with hydroclimate. He deployed temperature loggers and leaf litter packs in streams across the Coweeta basin and monitored the effect of temperature and litter quality on leaf litter breakdown for 6 weeks. Garrett also counted shredding insects from a subset of the leaf packs to control for the effect of shredder biomass on leaf processing rates.

Sadie Roth, Florida State University, worked under the supervision of Dr. John Maerz and PhD candidate Kira McCentire in the Warnell School (UGA). Sadie was involved in monthly salamander surveys of 96 forest plots that are one of several projects in activity cluster #1 determining organismal sensitivity to hydroclimate variability. Sadie learned unmarked and capture-mark-recapture techniques for studying salamander population ecology, and developed a project to examine how behavioral differences between two competing salamander species affect the species' responses to climate change.

Natalie Harris, University of Georgia, worked under the supervision of Drs. Jeffrey Hepinstall-Cymerman, Richard Chandlers and Robert Copper in the Warnell School (UGA). Natalie was involved in songbird surveys that are one of several projects in activity cluster #1 determining organismal sensitivity to hydroclimate variability. Natalie located 75 nests that she monitored using traditional protocols and remote cameras to document nest predation events. She is presently analyzing the data to understand if nest predation increases as climate warms.

Gabriella Horn, Virginia Tech University, worked under the supervision of Dr. Jeb Barrett, Department of Biological Sciences (VTech). Gabriella's research addressed the influence of vegetation change on soils, microbial communities and biogeochemical processes as they relate to nitrogen cycling and the movement of nitrogen between terrestrial and aquatic ecosystems. It falls in activity cluster #2 concerned with riparian land cover interactions with hydroclimate. Gabriella extracted and quantified environmental DNA from soil samples, conducted chemical analyses of organic carbon, total nitrogen and inorganic nitrogen, and estimated microbial biomass using a chloroform fumigation assay. Her objective was to determine the influence of rhododendron and its removal on soil nitrifier communities and nitrogen.

All four students had opportunity to work and interact with other undergraduate students, graduate students and investigators working on the CWT LTER project, and to present their findings as a poster at the Coweeta Summer Meeting.

Other training and development opportunities included activities by CWT LTER investigators at their home institutions. For example, several incorporate portions of their research in to regularly taught courses; some led multi-day field trips to the project area in which students engage in fieldwork; others offered mini-courses on selected topics that emerge from their CWT LTER research.

*** How have the results been disseminated to communities of interest?**

In addition to published products as listed elsewhere following are summaries of selected engagements with distinct communities of interest:

Presentation on "Butterflies of the Smokies" to 38 members of the Franklin Garden Club, and on "A Closer Look at Bears" to 30 members of the Franklin Garden Club.

Fish sampling events associated with regional monitoring of biotic sensitivity to climate change on Betty Creek respectively involved 46 and 17 8th grade students from Rabun Gap-Nacoochee School; two fish diversity field trips - one on Bumgarner Branch involved 17 students from Smoky Mountain High School and one on Sweetwater Creek involved 58 students from Robbinsville High School.

The Riparian Forest Restoration Workshop brought over 50 land and resource managers to Coweeta to learn about the preliminary findings of the rhododendron removal experiment and discuss implications for future land management in the Southern Appalachian Mountains.

Water quality monitoring events on a) Crawford Branch involved 32 students from Franklin High School; b) Tennesse Creek involved 16 AP Biology students from Franklin High School; and c) Sweetwater Creek involved 58 students from Robbinsville High School.

A Shade Your Stream tree-planting event at Macon County parks connected with the Coweeta Listening Project outreach involved 60 5th grader students from Mountain View Intermediate School.

Coweeta Field Tour and Weather Presentations connected with the Coweeta Listening Project involved 47 students from Mountain View Intermediate School, 15 parents and the Superintendent of Macon County Schools.

A bird count supporting the Great Backyard Bird Count, a citizen science program from Cornell Ornithology Lab, involved 90 5th and 6th grade students from Mountain View Intermediate School and three volunteers from the Franklin Bird Club.

CWT LTER organized an Earth Day Event at Mountain View Intermediate School attended by 280 5th grade students.

*** What do you plan to do during the next reporting period to accomplish the goals?**

The next reporting period will be for a one-year no-cost-extension during which all remaining field samples obtained from the long-term permanent plots and riparian rhododendron manipulation experiment will be processed along with associated modeling and outreach/translation of the results.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
2016_02_17_Franklin_Press_GBBC.pdf	Article from The Franklin Press reporting on student participation in the "Great Backyard Bird Count" in Macon County NC organized by the CWT Schoolyard Program	Theodore Gragson	12/21/2016
2016_09_30_Franklin_Press.pdf	Article from The Franklin Press reporting on student participation in the "Migration Celebration" in Macon County NC	Theodore Gragson	12/21/2016

Filename	Description	Uploaded By	Uploaded On
	organized by the CWT Schoolyard Program		

Products

Books

Book Chapters

Leigh, D. S. (2016). Multi-millennial Record of Erosion and Fires in the Southern Blue Ridge Mountains, USA. *Natural Disturbances and Range of Variation: Type, Frequency, Severity, and Post-disturbance Structure in Central Hardwood Forests* Greenberg, C. H. and Collins, B. S.. Springer. New York. 167-202. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes

Ted L Gragson (2016). An Anthropologist Joins the LTER Network. *Long-Term Ecological Research: Changing the Nature of Scientists* Michael R. Willig and Lawrence R. Walker. Oxford University Press. New York. 167. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 9780199380213.

Wooten, Richard, M. and Witt, Anne, C. and Miniati, Chelcy, F. and Hales, Tristram, C. and Aldred, Jennifer, L. (2016). Frequency and Magnitude of Selected Historical Landslide Events in the Southern Appalachian Highlands of North Carolina and Virginia: Relationships to Rainfall, Geological and Ecohydrological Controls, and Effects. *Natural Disturbances and Historic Range of Variation: Type, Frequency, Severity, and Post-disturbance Structure in Central Hardwood Forests USA and Historic Range of Variation* Collins, Beverly S. and Greenberg, Cathryn H.. Springer International Publishing. Switzerland. 203-262. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: Doi 10.1007/978-3-319-21527-3_9.

Inventions

Journals or Juried Conference Papers

Allen, Karen, E. and Moore, Rebecca (2016). Moving beyond the exchange value in the nonmarket valuation of ecosystem services. *Ecosystem Services*. 18 78-86. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1016/j.ecoser.2016.02.002

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Berdanier, Aaron B. and Miniati, Chelcy F. and Clark, James S. (2016). Predictive models for radial sap flux variation in coniferous, diffuse-porous and ring-porous temperate trees. *Tree Physiology*. 36 (8), 932-941. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1093/treephys/tpw027

Berdanier, Aaron, B. and Clark, James, S. (2016). Multi-year drought-induced morbidity preceding tree death in southeastern US forests. *Ecological Applications*. 26 (1), 17-23. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1890/15-0274.1

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Bruce, Richard, C. (2016). Application of the Gompertz Function in Studies of Growth in Dusky Salamanders (Plethodontidae: Desmognathus). *Copeia*. 104 (1), 94-100. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1643/ce-14-204

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Chandler, Richard and Hepinstall-Cymerman, Jeffery (2016). Estimating the spatial scales of landscape effects on abundance. *Landscape Ecology*. 31 1383-1394. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1007/s10980-016-0380-z

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Coughlan, Michael, R. and Gragson, Ted, L. (2016). An Event History Analysis of Parcel Extensification and Household Abandonment in Pays Basque, French Pyrenees, 1830–1958 AD. *Human Ecology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s10745-016-9808-y

Elliott, Katherine J. and Vose, James M. (2016). Effects of riparian zone buffer widths on vegetation diversity in southern Appalachian headwater catchments. *Forest Ecology and Management*. 376 9-23. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1016/j.foreco.2016.05.046

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Grossman, Gary, D. and Sundin, Gary and Ratajczak, Robert, E. (2016). Long-term persistence, density dependence and effects of climate change on roside dace (Cyprinidae). *Freshwater Biology*. 61 832-847. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1111/fwb.12741

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Keiser, Ashley D. and Knoepp, Jennifer D. and Bradford, Mark A. (2016). Disturbance Decouples Biogeochemical Cycles Across Forests of the Southeastern US. *Ecosystems*. 19 (1), 50-61. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1007/s10021-015-9917-2

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- McEntire, Kira, D. (2016). Arboreal Ecology of Plethodontidae: A Review. *Copeia*. 104 (1), 124-131. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: <http://dx.doi.org/10.1643/OT-14-214>
- Nippgen, Fabian and McGlynn, Brian, L. and Emanuel, Ryan, E. and Vose, James, V. (2016). Watershed memory at the Coweeta Hydrologic Laboratory: The effect of past precipitation and storage on hydrologic response. *Water Resources Research*. 52 (3), 1673-1695. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/2015wr018196
- Norman, Jeff, S. and Barrett, John, E. (2016). Substrate availability drives spatial patterns in richness of ammonia-oxidizing bacteria and archaea in temperate forest soils. *Soil Biology & Biochemistry*. 94 169-172. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.soilbio.2015.11.015
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- Record, Sydne and Ferguson, Paige, F.B. and Benvensite, Elise and Graves, Rose, A. and Pfeiffer, Vera, W. and Romolini, Michele and Yorke, Christie, E. and Beardmore, Ben (2016). Graduate students navigating social-ecological research: insights from the Long-Term Ecological Research Network. *Ecology and Society*. 21 (1), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: <http://dx.doi.org/10.5751/ES-08111-210107>
- Rice, Joshua, S. and Emanuel, Ryan, E. and Vose, James, S. (2016). The influence of watershed characteristics on spatial patterns of trends in annual scale streamflow variability in the continental U.S. *Journal of Hydrology*. 540 850-860. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: <http://dx.doi.org/10.1016/j.jhydrol.2016.07.006>
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- Vose, James M. and Elliott, Katherine J. (2016). OAK, FIRE, AND GLOBAL CHANGE IN THE EASTERN USA: WHAT MIGHT THE FUTURE HOLD?. *Fire Ecology*. 12 (2), 160–179. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.4996/fireecology.1202160
- Vose, James, V. and Miniati, Chelcy, F. and Luce, Charles, H. and Asbjornsen, Heidi and Caldwell, Peter, V. and Campbell, John, L. and Grant, Gordon, E. and Isaak, Daniel, J. and Loheide II, Steven, P. and Sun, Ge (2016). Ecohydrological implications of drought for forests in the United States. *Forest Ecology and Management*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: <http://dx.doi.org/10.1016/j.foreco.2016.03.025>
- Warren, Robert, J. (2016). Ghosts of Cultivation Past - Native American Dispersal Legacy Persists in Tree Distribution. *PLoS One*. 11 (3), e0150707. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1371/journal.pone.0150707
- Webster, Jackson R. and Knoepp, Jennifer D. and Swank, Wayne T. and Miniati, Chelcy F. (2016). Evidence for a Regime Shift in Nitrogen Export from a Forested Watershed. *Ecosystems*. 19 (5), 881-895. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: doi:10.1007/s10021-016-9974-1

Licenses

Other Conference Presentations / Papers

Love, Jason (2016). *2016 Coweeta LTER Winter All-PI Meeting*. 2016 Coweeta LTER Winter All-PI Meeting. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Caldwell, Peter and Miniati, Chelcy Ford and Brantley, Steven and Elliott, Katherine and Laseter, Stephanie and Swank, Wayne (2016). *LONG TERM RECORDS PROVIDE INSIGHTS ON THE RELATIVE INFLUENCE OF CLIMATE AND FOREST COMMUNITY STRUCTURE ON WATER YIELD IN THE SOUTHERN APPALACHIANS*. Fifth Interagency Conference on Research in the Watersheds. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Graves, Rosa, A., Pearson, Scott, M., and Turner, Monica, G. (2016). *Landscape dynamics of floral resources: implications for cultural ecosystem service supply in the Southern Appalachians*. US-IALE 2016 Annual Meeting. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Elliott, Katherine and Miniati, Chelcy F. and Knoepp, Jennifer and Crump, Michael A. and Jackson, C. Rhett (2016). *RESTORATION OF SOUTHERN APPALACHIAN RIPARIAN FORESTS AFFECTED BY EASTERN HEMLOCK MORTALITY*. Fifth Interagency Conference on Research in the Watersheds. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Elliott, Katherine and Vose, James M. (2016). *RIPARIAN AREA HARVESTING IMPACTS ON VEGETATION COMPOSITION AND DIVERSITY*. Fifth Interagency Conference on Research in the Watersheds. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Knoepp, Jennifer and Elliott, Katherine J. and Jackson, William A. and Vose, James M. and Miniati, Chelcy Ford and Zarnoch, Stanley J (2016). *SOIL AND STREAM CHEMISTRY RELATIONSHIPS IN HIGH ELEVATION WATERS*. Proceedings of the Fifth Interagency Conference on Research in the Watersheds. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Other Products

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

Allen, Karen, E.. *Conservation Planning in a Global Era: The Role of Market-based Mechanisms in Promoting Sustainable Development in Costa Rica*. (2016). University of Georgia. Acknowledgement of Federal Support = Yes

Jacob M. McDonald. *Regional- and Local-Scale Drivers of Stormflow and Channel Morphology in the Southern Blue Ridge Mountains*. (2016). University of Georgia. Acknowledgement of Federal Support = Yes

Coats, William A.. *The Effects of Gaps in Riparian Forest Cover on Abiotic Stream Conditions in the southern Appalachians*. (2016). University of Georgia. Acknowledgement of Federal Support = Yes

Websites

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Gragson, Theodore	PD/PI	1
Jackson, Rhett	Co PD/PI	2

Name	Most Senior Project Role	Nearest Person Month Worked
Band, Lawrence	Co-Investigator	1
Barrett, John	Co-Investigator	1
Benfield, E.	Co-Investigator	1
Bolstad, Paul	Co-Investigator	1
Bradford, Mark	Co-Investigator	0
Burke, Brian	Co-Investigator	1
Clark, James	Co-Investigator	1
Elliott, Katherine	Co-Investigator	1
Emanuel, Ryan	Co-Investigator	1
Fraterrigo, Jennifer	Co-Investigator	1
Hepinstall-Cymerman, Jeff	Co-Investigator	1
Heynen, Nik	Co-Investigator	1
Holloway, Steven	Co-Investigator	1
Hwang, Taehee	Co-Investigator	1
Knoepp, Jennifer	Co-Investigator	1
Leigh, David	Co-Investigator	1
Maerz, John	Co-Investigator	1
Miniat, Chelcy	Co-Investigator	1
Novick, Kim	Co-Investigator	1
Pearson, Scott	Co-Investigator	1
Pringle, Catherine	Co-Investigator	1
Rice, Jennifer	Co-Investigator	1
Shepherd, J.	Co-Investigator	1

Name	Most Senior Project Role	Nearest Person Month Worked
Strahm, Brian	Co-Investigator	1
Turner, Monica	Co-Investigator	1
Warren II, Robert	Co-Investigator	1
Welch-Devine, Meredith	Co-Investigator	1
Wenger, Seth	Co-Investigator	1
Wurzbarger, Nina	Co-Investigator	1
Duncan, Jon	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Hawthorne, Sandra	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Lin, Laurence	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Oishi, A.	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Sokol, Eric	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Benstead, Jon	Other Professional	0
Brooks, Joshua	Other Professional	0
Brown, Cindi	Other Professional	3
Caldwell, Peter	Other Professional	1
Chandler, Richard	Other Professional	0
Clapp, Roger	Other Professional	0
Clinton, Patsy	Other Professional	1
Conroy, Michael	Other Professional	0
Cooper, Robert	Other Professional	0
Desmond, Dennis	Other Professional	0

Name	Most Senior Project Role	Nearest Person Month Worked
Flowers, Kathy	Other Professional	1
Fowler, Randy	Other Professional	1
Francis, Judy	Other Professional	0
Fuller, Scarlett	Other Professional	0
Gifford, Matt	Other Professional	0
Hales, TC	Other Professional	0
Herndon, Brian	Other Professional	12
Hopey, Mark	Other Professional	0
Johnson, Virgil	Other Professional	12
Kinney, Vanessa	Other Professional	1
Kozak, Ken	Other Professional	0
Long, Dwight	Other Professional	0
Love, Jennifer	Other Professional	0
Love, Jason	Other Professional	12
McLarney, Bill	Other Professional	0
McNab, H.	Other Professional	0
Meador, Jason	Other Professional	0
Meador, Kristen	Other Professional	0
Miles, Brian	Other Professional	2
Monar, Kelder	Other Professional	0
Moore, Callie	Other Professional	0
Painter, Rusty	Other Professional	0
Peebles, Gary	Other Professional	0

Name	Most Senior Project Role	Nearest Person Month Worked
Perez Diaz, Gabriela	Other Professional	1
Phillips, Brian	Other Professional	0
Plemmons, Heather	Other Professional	0
Posey, Sara	Other Professional	0
Rosemond, Amy	Other Professional	0
Smathers, Stephanie	Other Professional	0
Swank, Wayne	Other Professional	1
West, Shannon	Other Professional	0
Bower, Katherine	Technician	12
Gregory, Sheila	Technician	12
Harper, Carol	Technician	12
Hecoeks, Sarah	Technician	1
Hunt, James	Technician	1
Johnson, Sara	Technician	1
Marshall, Charles	Technician	3
Melear, Nathan	Technician	1
Scott, Joel	Technician	9
See, Craig	Technician	5
Siminitz, Jordan	Technician	6
Sobek, Chris	Technician	3
Welch, Brandon	Technician	12
Zietlow, David	Technician	6
Abernathy, Heather	Graduate Student (research assistant)	1

Name	Most Senior Project Role	Nearest Person Month Worked
Bransford, Daniel	Graduate Student (research assistant)	3
Candeias, Matthew	Graduate Student (research assistant)	3
Chitwood, Ryan	Graduate Student (research assistant)	1
Coats, Alan	Graduate Student (research assistant)	2
Dudley, Maura	Graduate Student (research assistant)	5
Dymond, Salli	Graduate Student (research assistant)	1
Eliason, Kevin	Graduate Student (research assistant)	1
Graves, Rose	Graduate Student (research assistant)	5
Howard, Jillian	Graduate Student (research assistant)	1
Lovette, John	Graduate Student (research assistant)	4
McDonald, Jacob	Graduate Student (research assistant)	1
McEntire, Kira	Graduate Student (research assistant)	1
Merker, Samuel	Graduate Student (research assistant)	1
Miles, Micah	Graduate Student (research assistant)	1
Minucci, Jeffrey	Graduate Student (research assistant)	1
Olejniczak, Michael	Graduate Student (research assistant)	1
Pinzone, Phil	Graduate Student (research assistant)	1
Ream, Kelsey	Graduate Student (research assistant)	3
Scaife, Charles	Graduate Student (research assistant)	6
Singh, Nitin	Graduate Student (research assistant)	1
Solomon, Kelsey	Graduate Student (research assistant)	2
Sorrells, Robert	Graduate Student (research assistant)	1
Sullivan, Jeremy	Graduate Student (research assistant)	1

Name	Most Senior Project Role	Nearest Person Month Worked
Tomasek, Brad	Graduate Student (research assistant)	3
Bien-Aime, Kerndja	Undergraduate Student	1
Brockman, Lauren	Undergraduate Student	1
Bunch, Benjamin	Undergraduate Student	0
Gooden, Molly	Undergraduate Student	0
Keurajian, Aubree	Undergraduate Student	4
Kidd, Anjelika	Undergraduate Student	0
Kirk, Shannon	Undergraduate Student	1
Lancaster, Grace	Undergraduate Student	0
Lee, Katie	Undergraduate Student	1
Pressley, Patrick	Undergraduate Student	1
Reategui, Daniel	Undergraduate Student	3
Smith, Kaitlyn	Undergraduate Student	1
Spratt, Savannah	Undergraduate Student	0
Stewart, Andrea	Undergraduate Student	1
Thorton, Danielle	Undergraduate Student	3
Harris, Natalie	Research Experience for Undergraduates (REU) Participant	0
Horn, Gabriella	Research Experience for Undergraduates (REU) Participant	0
Roth, Sadie	Research Experience for Undergraduates (REU) Participant	0

Full details of individuals who have worked on the project:

Theodore L Gragson

Email: tgragson@uga.edu

Most Senior Project Role: PD/PI

Nearest Person Month Worked: 1

Contribution to the Project: CWT LTER lead principal investigator responsible for fiscal affairs, subawards, institutional coordination and overall research direction in consultation with Science Advisory

Funding Support: UGA and other sources

International Collaboration: Yes, France

International Travel: No

Rhett Jackson

Email: rjackson@warnell.uga.edu

Most Senior Project Role: Co PD/PI

Nearest Person Month Worked: 2

Contribution to the Project: Helped continue the riparian rhododendron manipulation study. Installed water level sensors and temperature loggers in these streams. Completed a pilot study of the effects of riparian gaps on channel morphology and stream temperature. Continued analyzing data from synoptic and intensive watershed studies.

Funding Support: Warnell school, NSF, McEntire Stennis, various

International Collaboration: No

International Travel: No

Lawrence E. Band

Email: lband@email.unc.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Integrating measurement and modeling of watersheds in the southern Appalachians, including feedbacks between ecological, hydrological, geomorphic and climate processes

Funding Support: UNC

International Collaboration: Yes, United Kingdom

International Travel: No

John E. Barrett

Email: jebarre@vt.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Measurement of the role of soil microbes in mobilization of nitrogen in watersheds within the Coweeta basin and Rhododendron removal plots

Funding Support: Virginia Tech University

International Collaboration: No

International Travel: No

E. Fred Benfield

Email: benfield@vt.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Characterization of aquatic macrobiota and their response to riparian manipulation in Rhododendron removal plots

Funding Support: Other

International Collaboration: No

International Travel: No

Paul Bolstad

Email: pbolstad@umn.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Organized spatial sampling for expanded soil moisture network across Coweeta Basin, and implemented and analyzed data

Funding Support: Coweeta LTER, Minnesota Agricultural Experiment Station

International Collaboration: No

International Travel: No

Mark Bradford

Email: mark.bradford@yale.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 0

Contribution to the Project: Callaborator was co-author on research paper

Funding Support: this project

International Collaboration: No

International Travel: No

Brian Burke

Email: burkebj@appstate.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Coweeta Listing Project activities including data collection and analysis for self-study, production of newspaper columns on themes of communicating LTER science

Funding Support: Appalachian State University

International Collaboration: Yes, France

International Travel: No

James S. Clark

Email: jimclark@duke.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Forest census and demographics in long-term permanent tree plots, population ecology, modeling

Funding Support: DEB, LTER, DOE, ONR

International Collaboration: No

International Travel: No

Katherine Elliott

Email: kelliott@fs.fed.us

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: vegetation dynamics to ecosystem, processes, climate change, land use and other organisms

Funding Support: USFS

International Collaboration: No

International Travel: No

Ryan E. Emanuel

Email: ryan_emanuel@ncsu.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Stable isotope analysis of geomorphic water samples to determine residence time and interacting effect of water status and flow

Funding Support: UNC

International Collaboration: No

International Travel: No

Jennifer M. Fraterrigo

Email: jmf@illinois.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Measurement of biodiversity and ecosystem processes in long-term permanent plots to determine sensitivity to hydroclimate variability and land use

Funding Support: Other

International Collaboration: No

International Travel: No

Jeff Hepinstall-Cymerman

Email: jhepinstall@warnell.uga.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Effects of land use, elevation, predator communities on avian communities and nest predation rates, and the interplay of spring greenup (vegetation phenology) and elevation

Funding Support: UGA

International Collaboration: No

International Travel: No

Nik Heynen

Email: nheyne@uga.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Social organization, environmental activism, and climate change perceptions of citizens in SW North Carolina

Funding Support: none

International Collaboration: No

International Travel: No

Steven Holloway

Email: holloway@uga.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Evaluation of long-term, regional land use and human demographic expansion in Southern Appalachia

Funding Support: UGA

International Collaboration: No

International Travel: No

Taehee Hwang

Email: taehee@indiana.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength

Funding Support: NSF CWT LTER, NSF CyberSEES

International Collaboration: No

International Travel: No

Jennifer D. Knoepp

Email: jknoepp@fs.fed.us

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Research examining riparian restoration, including effects of rhododendron removal on soil nutrient availability and nutrient cycling processes

Funding Support: USFS

International Collaboration: No

International Travel: No

David S. Leigh

Email: dleigh@uga.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Geomorphic legacy effects of land use and landscape development across Southern Appalachia

Funding Support: UGA

International Collaboration: Yes, France

International Travel: No

John Maerz

Email: jcmaerz@uga.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Research lead on all Plethodon capture-mark-recapture sampling and removal experiments in the basin and in the rhododendron removal project

Funding Support: UGA

International Collaboration: No

International Travel: No

Chelcy Ford Miniati

Email: cfminiat@fs.fed.us

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: USFS project leader coordinating activities of USFS researchers and participating in research on long-term effects of hemlock mortality and rhododendron removal

Funding Support: USFS

International Collaboration: No

International Travel: No

Kim Novick

Email: knovick@indiana.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Measurement of carbon and nutrient fluxes, and water cycling as it relates to ecosystem sensitivity to hydroclimate variability

Funding Support: Indiana University

International Collaboration: No

International Travel: No

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Appalachian State University	Academic Institution	Boone, NC
Cardiff University	Academic Institution	United Kingdom
Indiana University	Academic Institution	Bloomington, IN
Ladyss/CNRS	Academic Institution	France
Land Trust for the Little Tennessee	Other Nonprofits	Franklin, NC
Lyndon B. Johnson Job Corps	Other Nonprofits	Franklin, NC
Macon Middle School	State or Local Government	Franklin, NC
Mars Hill University	Academic Institution	Mars Hill, NC
Mountain View Intermediate School	School or School Systems	Franklin, NC
NC Division of Natural Resources	State or Local Government	Raleigh, NC
NC Division of Water Resources	State or Local Government	Raleigh, NC
NC Wildlife Resources Commission	State or Local Government	Raleigh, NC
Colorado State University	Academic Institution	Fort Collins, CO
Nantahala School	School or School Systems	Topon, NC
North Georgia College and University	Academic Institution	Gainesville, GA
Northeast Georgia - GA Youth Science and Technology Centers	Other Nonprofits	Ellaville, GA
Rabun Gap-Nacoochee School	School or School Systems	Raburn Gap, GA
SUNY Buffalo State	Academic Institution	Buffalo, NY
SW NC Resource Conservation and Development Council	Other Nonprofits	Waynesville, NC
Southern Appalachian Raptor Research	Other Nonprofits	Mars Hill, NC
Swain Middle School	School or School Systems	Swain County, NC
Trimont Christian School	School or School Systems	Franklin, NC

Name	Type of Partner Organization	Location
UNC Chapel Hill	Academic Institution	Chapel Hill, NC
Conservation Trust of North Carolina	Other Nonprofits	Raleigh, NC
UNC Charlotte	Academic Institution	Charlotte, NC
USFS Southern Research Station	State or Local Government	Knoxville, TN
USFWS	State or Local Government	Knoxville, TN
University of Illinois	Academic Institution	Chicago, IL
University of Illinois, Urbana-Champaign	Academic Institution	Champaign, IL
University of Minnesota	Academic Institution	Minneapolis, MN
University of Wisconsin	Academic Institution	Madison, WI
Université Paris Ouest	Academic Institution	France
Université de Toulouse	Academic Institution	France
Virginia Polytechnic Institute and State Univ.	Academic Institution	Blacksburg, VA
Duke University	Academic Institution	Durham, NC
Watershed Association of the Tuckasegee River	Other Nonprofits	Bryson City, NC
West Virginia University	Academic Institution	Morgantown, WV
Yale University	Academic Institution	New Haven, CT
Georgia Tech	Academic Institution	Atlanta, GA
Great Smoky Mountains National Park	State or Local Government	Gatlinburg, TN
Hayesville Middle School	School or School Systems	Hayesville, NC
Highlands School	School or School Systems	Highlands, NC
Hiwassee River Watershed Coalition	Other Nonprofits	Murphy, NC

Full details of organizations that have been involved as partners:
Appalachian State University
Organization Type: Academic Institution

Organization Location: Boone, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:

Cardiff University

Organization Type: Academic Institution

Organization Location: United Kingdom

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:

Colorado State University

Organization Type: Academic Institution

Organization Location: Fort Collins, CO

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:

Conservation Trust of North Carolina

Organization Type: Other Nonprofits

Organization Location: Raleigh, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:

Duke University

Organization Type: Academic Institution

Organization Location: Durham, NC

Partner's Contribution to the Project:

Financial support

Collaborative Research

More Detail on Partner and Contribution:

Georgia Tech

Organization Type: Academic Institution

Organization Location: Atlanta, GA

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:**Great Smoky Mountains National Park**

Organization Type: State or Local Government

Organization Location: Gatlinburg, TN

Partner's Contribution to the Project:

Facilities

Collaborative Research

More Detail on Partner and Contribution:**Hayesville Middle School**

Organization Type: School or School Systems

Organization Location: Haysville, NC

Partner's Contribution to the Project:

Financial support

Collaborative Research

More Detail on Partner and Contribution:**Highlands School**

Organization Type: School or School Systems

Organization Location: Highlands, NC

Partner's Contribution to the Project:

Facilities

Collaborative Research

More Detail on Partner and Contribution:**Hiwassee River Watershed Coalition**

Organization Type: Other Nonprofits

Organization Location: Murphy, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:**Indiana University**

Organization Type: Academic Institution

Organization Location: Bloomington, IN

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:**Ladyss/CNRS**

Organization Type: Academic Institution

Organization Location: France

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:**Land Trust for the Little Tennessee**

Organization Type: Other Nonprofits

Organization Location: Franklin, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:**Lyndon B. Johnson Job Corps**

Organization Type: Other Nonprofits

Organization Location: Franklin, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:**Macon Middle School**

Organization Type: State or Local Government

Organization Location: Franklin, NC

Partner's Contribution to the Project:

Facilities

Collaborative Research

More Detail on Partner and Contribution:**Mars Hill University**

Organization Type: Academic Institution

Organization Location: Mars Hill, NC

Partner's Contribution to the Project:

Facilities
Collaborative Research

More Detail on Partner and Contribution:

Mountain View Intermediate School

Organization Type: School or School Systems
Organization Location: Franklin, NC

Partner's Contribution to the Project:

Facilities
Collaborative Research

More Detail on Partner and Contribution:

NC Division of Natural Resources

Organization Type: State or Local Government
Organization Location: Raleigh, NC

Partner's Contribution to the Project:

Facilities
Collaborative Research

More Detail on Partner and Contribution:

NC Division of Water Resources

Organization Type: State or Local Government
Organization Location: Raleigh, NC

Partner's Contribution to the Project:

Facilities
Collaborative Research

More Detail on Partner and Contribution:

NC Wildlife Resources Commission

Organization Type: State or Local Government
Organization Location: Raleigh, NC

Partner's Contribution to the Project:

Facilities
Collaborative Research

More Detail on Partner and Contribution:

Nantahala School

Organization Type: School or School Systems

Organization Location: Topon, NC

Partner's Contribution to the Project:

Facilities

Collaborative Research

More Detail on Partner and Contribution:

North Georgia College and University

Organization Type: Academic Institution

Organization Location: Gainesville, GA

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:

Northeast Georgia - GA Youth Science and Technology Centers

Organization Type: Other Nonprofits

Organization Location: Ellaville, GA

Partner's Contribution to the Project:

Facilities

Collaborative Research

More Detail on Partner and Contribution:

Rabun Gap-Nacoochee School

Organization Type: School or School Systems

Organization Location: Rabun Gap, GA

Partner's Contribution to the Project:

Facilities

Collaborative Research

More Detail on Partner and Contribution:

SUNY Buffalo State

Organization Type: Academic Institution

Organization Location: Buffalo, NY

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:

SW NC Resource Conservation and Development Council

Organization Type: Other Nonprofits
Organization Location: Waynesville, NC

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Southern Appalachian Raptor Research

Organization Type: Other Nonprofits
Organization Location: Mars Hill, NC

Partner's Contribution to the Project:
Facilities
Collaborative Research

More Detail on Partner and Contribution:

Swain Middle School

Organization Type: School or School Systems
Organization Location: Swain County, NC

Partner's Contribution to the Project:
Facilities
Collaborative Research

More Detail on Partner and Contribution:

Trimont Christian School

Organization Type: School or School Systems
Organization Location: Franklin, NC

Partner's Contribution to the Project:
Facilities
Collaborative Research

More Detail on Partner and Contribution:

UNC Chapel Hill

Organization Type: Academic Institution
Organization Location: Chapel Hill, NC

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

UNC Charlotte**Organization Type:** Academic Institution**Organization Location:** Charlotte, NC**Partner's Contribution to the Project:**

Collaborative Research

More Detail on Partner and Contribution:**USFS Southern Research Station****Organization Type:** State or Local Government**Organization Location:** Knoxville, TN**Partner's Contribution to the Project:**

Facilities

Collaborative Research

More Detail on Partner and Contribution:**USFWS****Organization Type:** State or Local Government**Organization Location:** Knoxville, TN**Partner's Contribution to the Project:**

Facilities

Collaborative Research

More Detail on Partner and Contribution:**University of Illinois****Organization Type:** Academic Institution**Organization Location:** Chicago, IL**Partner's Contribution to the Project:**

Collaborative Research

More Detail on Partner and Contribution:**University of Illinois, Urbana-Champaign****Organization Type:** Academic Institution**Organization Location:** Champaign, IL**Partner's Contribution to the Project:**

Collaborative Research

More Detail on Partner and Contribution:

University of Minnesota

Organization Type: Academic Institution
Organization Location: Minneapolis, MN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

University of Wisconsin

Organization Type: Academic Institution
Organization Location: Madison, WI

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Université Paris Ouest

Organization Type: Academic Institution
Organization Location: France

Partner's Contribution to the Project:
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: Collaborative, multi-sited research examining how people use observations of biodiversity change to make sense of environmental changes, climate change, and possibilities for adaptation.

Université de Toulouse

Organization Type: Academic Institution
Organization Location: France

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Comparative historical ecology of mountain landscapes.

Virginia Polytechnic Institute and State Univ.

Organization Type: Academic Institution
Organization Location: Blacksburg, VA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Watershed Association of the Tuckasegee River

Organization Type: Other Nonprofits

Organization Location: Bryson City, NC

Partner's Contribution to the Project:

Facilities

Collaborative Research

More Detail on Partner and Contribution:

West Virginia University

Organization Type: Academic Institution

Organization Location: Morgantown, WV

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:

Yale University

Organization Type: Academic Institution

Organization Location: New Haven, CT

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:

What other collaborators or contacts have been involved?

Nothing to report

Impacts

What is the impact on the development of the principal discipline(s) of the project?

CWT scientists published 31 peer-reviewed articles, three book chapters, two dissertations, one masters thesis, and five other one-time publications in 2016. Papers were published this past year in journals including Ecology, Ecological Applications, Ecosphere, Global Change Biology, Water Resources Research, and Forest Ecology and Management. The topics addressed with direct relevance to the goals of this project within the principal discipline include multi-year drought-induced morbidity preceding tree death in Southeastern forests; reproductive trade-offs with canopy exposure across tree species in temperate forests; declining water yield from forested mountain watersheds in response to climate change; and landscape patterns of bioenergy in a changing climate.

What is the impact on other disciplines?

CWT LTER involves diverse scientific disciplines in keeping with the research objective for the project. Some of the contributions from these disciplines are methodological such as the design of regional sampling protocols and the integrative RHESSys modeling fundamental to activity clusters #1, #2 and #3 described elsewhere. Papers were published this past year in journals beyond the principal discipline including Ecosystem Services, Forest Science, Human

Ecology, Environmental Management, Soil Biology and Biochemistry, Ecology and Society, and Hydrology. The topics addressed with direct relevance to this project include watershed characteristics on spatial patterns in streamflow variability; patterns in richness of ammonia-oxidizing bacteria and archaea; a space-time permutation analysis of wildland arson; and moving beyond exchange value in the nonmarket valuation of ecosystem services.

What is the impact on the development of human resources?

Individuals involved with the research last year included 29 investigators, along with 19 undergraduate students of which 4 were REU participants, 26 graduate students, 5 post-doctoral investigators, and 41 other professionals including collaborating scientists and Middle/High School teachers. These individuals all benefitted from long-term exposure with the project. In addition, a grand total of 5,309 middle school and high school students from public and private schools across the project area benefitted from participation in one or more day-long events linked to education and outreach activities sponsored and supported by the CWT LTER.

What is the impact on physical resources that form infrastructure?

The CWT LTER has installed a regional network of environmental sensors within the Little Tennessee and the French Broad watersheds that collect soil moisture and temperature measurements. Some stations are on USFS property including Coweeta Hydrologic Laboratory and Bent Creek Experimental Forest, while others are on university properties including Mars Hill and University of Georgia. Soil moisture stations measure and record at 5-minute intervals, creating datasets with 12 times greater resolution than previously established stations. Daily, data from all established stations are retrieved, processed and made publicly available online through the Coweeta LTER streaming data portal.

What is the impact on institutional resources that form infrastructure?

The CWT LTER maintains several field vehicles and equipment including aquatic samplers and survey-grade GPS units at the Coweeta Hydrologic Laboratory for use by researchers, students and technicians during fieldwork in the region. The Coweeta dormitory can accommodate up to 20 people and is jointly operated by the U.S. Forest Service and the University of Georgia. Its primary purpose is to provide comfortable accommodations for researchers, graduate students and summer students who in addition to sleeping quarters have access to two fully furnished kitchens and additional amenities including Internet connection as well as washers and dryers. The USFS Analytical Laboratory supports studies of watershed-scale ecosystem responses to natural and human disturbances of southeastern forests and processes most samples related to CWT LTER research.

What is the impact on information resources that form infrastructure?

The CWT LTER sensor network provides public access via a website to near-real-time data from stations across the region. This distributed field network serves as a regional resource for measurements of soil moisture, as well as the basis for analysis of regional to continental patterns and controls on climate. Collaborations with landowners from this project have led to use of this data for unforeseen purposes including real-time weather information for emergency management, improving conservation and cost savings by a local water management authority, and informing farmers about the best time to plant crops. The increased data availability connects long-term datasets and study plots, serves as an example of successful environmental network measurements, and contributes to the mandate that federally funded research results be available in a format that is both useful and minimally constrained.

What is the impact on technology transfer?

The 'Shade Your Stream' educational campaign seeks to educate landowners about the importance of riparian vegetation. It encourages land owners to adopt practices that promote riparian vegetation in order to improve stream water quality as well as in-stream and riparian habitat. Funding from other sources supports landowner workshops, billboards, and a website that together service the Little Tennessee, the Hiwassee, and the Tuckasegee watersheds. This program draws directly from CWT LTER research demonstrating that vegetated buffers keep streams cool, stabilize stream banks, increase habitat heterogeneity, decrease sedimentation, and provide biotic inputs to the stream that provide food and habitat for stream organisms.

What is the impact on society beyond science and technology?

The CWT website is used to disseminate publications, reports, research data, photographs and other products of research. CWT scientists regularly give seminars and public presentations, and use CWT LTER data in their classes and the CWT Basin as a class laboratory. They also contribute articles to newsletters and newspapers such as the Franklin Press. The Coweeta Schoolyard program brings several thousand middle school and high school students and their teachers from north Georgia, western North Carolina and eastern Tennessee together for several science learning events each year. These events involve representatives from the US Fish and Wildlife, NC Division of Water Quality, NC Wildlife Resources Commission and several local NGOs.

Changes/Problems

Changes in approach and reason for change

Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

Nothing to report.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.