

[My Desktop](#)
[Prepare & Submit Proposals](#)
[Proposal Status](#)
[Proposal Functions](#)
[Awards & Reporting](#)
[Project Reports](#)
[Submit Images/Videos](#)
[Award Functions](#)
[Manage Financials](#)
[Program Income Reporting](#)
[Grantee Cash Management Section Contacts](#)
[Administration](#)
[Lookup NSF ID](#)

Preview of Award 0823293 - Annual Project Report

[Cover](#) |
[Accomplishments](#) |
[Products](#) |
[Participants/Organizations](#) |
[Impacts](#) |
[Changes/Problems](#)

Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	0823293
Project Title:	Southern Appalachia on the Edge - Exurbanization & Climate Interaction in the Southeast
PD/PI Name:	Theodore L Gragson, Principal Investigator
Recipient Organization:	University of Georgia Research Foundation Inc
Project/Grant Period:	11/01/2008 - 10/31/2015
Reporting Period:	11/01/2013 - 10/31/2014
Submitting Official (if other than PD\PI):	Theodore L Gragson Principal Investigator
Submission Date:	11/13/2014
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?

The Coweeta LTER addresses how key ecosystem processes and the focal ecosystem services of water quantity, water quality, and biodiversity in southern Appalachia will be impacted by the transition in land uses from wildland to peri-urban, changes in climate, and the interaction between changes in land use and climate. Research activities are organized into five thematic areas and take place along gradients designed to achieve a regional understanding of the socio-ecological process entailed by our guiding question. The five thematic areas are: 1) Parcel-level to regional decision making; 2) Longitudinal variation in hillslope, riparian, and stream ecology; 3) Impacts of climate and Land Use change on biodiversity; 4) Baseline data and temporal reconstruction; and, 5) Synthesis & scaled integration.

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

Major Activities:

1. Parcel-Level to Regional Decision-Making

We continued to develop the SVAPsa to provide a 'snapshot assessment' of wadable streams of the Blue Ridge eco-region. We investigated how land use and climate change impact provisioning and cultural ecosystem services through: (1) Completion of a spatial landscape model of the yield and optimal distribution of potential bioenergy crops under current and projected future climate change on agricultural lands, and, (2) fieldwork to survey biodiversity-based cultural ecosystem services to assess spatial and temporal changes. We used data from western North Carolina to examine how the potential for water contamination from an inactive hazardous waste site is capitalized into surrounding vacant land prices. We also tested the effect of the 2010 Steep slope ordinance in Buncombe County on vacant land prices, which restricts developmental density and use on land that has a natural slope greater than 35 and an elevation greater than of 2,500 feet above sea level.

2. Longitudinal Variation in Hillslope, Riparian, and Stream Ecology

Vegetation composition and diversity was measured across hillslope-to-riparian gradients that represent urban, agriculture, and forest land uses and related to soil and soil solution nutrient flow paths. This will in turn be related to in-stream processes, and ultimately to water quality along flowpaths from small streams to rivers. We continued work on hydrological processes under representative land-use scenarios through analysis of using hydrometric data and stable isotopes of oxygen and hydrogen to evaluate vertical recharge and lateral redistribution of soil water and shallow groundwater on residential, agricultural and forested hillslopes. We completed and published two channel morphology manuscripts from the synoptic survey data and the intensively sampled watersheds data that quantify the differences in channel widths, wood frequencies, habitat distributions, and bed particle size distributions across channels varying in type of riparian vegetation. We continued to analyze patterns of hydrologic behavior, sediment concentrations, sediment yields, specific conductivities, and stream temperatures across the 12 intensively sampled watersheds that varied in both total land cover and land cover patterns to develop a conceptual and mathematical model for estimating the damping of the diurnal stream temperature signal as it is advected through the hyporheos.

3. Impacts of Climate and Land Use Change on Biodiversity

Study continued on long-term (30+ yrs) vegetation dynamics aboveground biomass and nutrient accumulation after clearcutting in Watershed 7. Field data on forest demography were collected from all sites including Coweeta (CWT--seven sites), Mars Hill (MH--two sites) and Great Smoky Mountains National Park (GSMNP--three sites) that includes tree and seedling census data, seed trap data, and environmental data. We undertook empirical research and statistical modeling of the exotic invasive plant *Microstegium vimineum* (Japanese stiltgrass) and the exotic invasive insect *Adelges tsugae*, hemlock woolly adelgid (HWA) to understand the regional and local controls on their performance on carbon cycling. We leveraged emerging precipitation datasets (e.g. PRISM and DOE DAYMET) to establish understanding of precipitation variability in the region, in particular spatio-temporal trends in precipitation intensity and frequency. We also advanced development of an Extreme Precipitation Exposure Index that characterizes geophysical and societal risk associated with precipitation related hazards. We analyzed a 23-year data set comprising standardized samples of fish in southern Appalachian streams collected by Dr. Bill McLarney. The extended spatial (186 sites sampled with consistent methods) and temporal coverage of species occurrences for a fauna comprising over 50 taxa make these data valuable for improving our understanding of how stream biota respond to environmental changes. We continued our capture-mark-recapture study of terrestrial salamander population dynamics within a hybrid zone, and our salamander removal experiment to reduce salamander abundance along an elevation gradient.

4. Baseline Data and Temporal Reconstruction

Long-term data collection projects continued including: vegetation dynamics (30+ yrs), aboveground biomass and nutrient accumulation in Watershed 7; dendrochronologic sampling for disturbance history and climate-growth interactions across southern Appalachia; weekly sampling of hillslope plots; quarterly collection of storm samples; bi-annual tree census of terrestrial gradient plots. We set-up approximately thirty local and regional microclimate stations funded through a NSF FSML grant that are now streaming data in near real-time.

5. Synthesis and Scaled Integration

We continued integrating the RHESSys ecohydrological model with a planar landsliding model for use in analysis and prediction of shallow landslides in regional watersheds. Research concentrates in the Cartoogachaye watershed, a ~400 km² catchment above Franklin, NC which experienced numerous landslides during the 2004 hurricane season. The work leverages on detailed measurement of forest root structure and cohesive strength collected over the last few years by CWT researchers. The simulations provide the probability of landslides within small catchment areas on an event level, and have the potential to develop storm-specific landslide hazard predictions. Modeling activities also integrated individual tree-scale responses with stand-level responses, and involve developing models to assimilate information at both scales and predict at the stand scale. Analysis of long term co-adjustment of forest spatial pattern of leaf area index, and catchment hydrologic behavior in response to hydroclimate change uses three decades of Landsat TM imagery, long term climate and stream discharge data for multiple CWT catchments. We find that the spatial pattern of forest leaf area index is a reliable diagnostic of catchment hydrologic behavior distributed over diverse hydroclimate conditions (elevation, slope, aspect) and over time as climate warms.

Supplemental funds were received in support of the following three activities:

Coweeta Schoolyard LTER - Funds (\$24,000) were received to purchase materials and supplies for events, restocking science Boxes, and collaboration with Muddy Sneakers environmental educators. We coordinated the Coweeta Schoolyard LTER program, where we continued our fall Migration Celebration field days for over 350 5th and 6th graders and expanded our Kids in the Creek field day to over 730 8th grade and high school students in 4 counties in western North Carolina. We also hosted a Coweeta LTER Citizen Science Lichen Bioblitz and Workshop. This event served to educate the public about lichen ecology and diversity, and compile a preliminary list of lichens for Coweeta Hydrologic Lab.

REU Request - Funds (\$16,000) were received to support two REU students to work with Drs. Pringle and Jackson on a removal experiment. Algae and leaf packs were sampled within treatments every 5 days throughout experiments; macroinvertebrates associated with leaf packs were sorted, identified and enumerated; nitrogen uptake experiments were conducted in each of the four study streams; oxygen concentrations and temperature measurements were made at 15 minute intervals over a 6 week study period; and, coarse particulate organic matter (CBOM) was collected from transects within pre-treatment reaches of the four study streams.

Release Request - Funds (\$120,000) were received representing 10% of the base funding withheld for budgetary reasons from the Coweeta LTER renewal award as initially issued. These funds were used in partial support of full-time field and laboratory technical personnel, graduate students, operational materials and supplies, and institutional indirect costs.

Specific Objectives:

Ecosystem patterns were assessed relative to the co-evolution of topographic, ecosystem and hydrologic subsystems, hydrologic downslope subsidy of ecosystems (ridge to stream), and landscape scale optimization. Hillslope hydrologic measurements were coupled with denser soil moisture sampling over our instrumented hillslopes, then space/time soil moisture patterns analyzed and their statistical association with groundwater determined with an emphasis on streamflow. Significant effort went in to remote sensing analysis of forest canopy hillslope gradients, forest canopy phenology patterns and their relation to temperature, photoperiod and water stress patterns. The objective is to understand differences in water balance among sites relative to land use and hydrologically-relevant landscape variables, and assess the implications these patterns have for current and future water resource availability in the region. We also sought to understand if precipitation patterns respond to changing land cover and how the urban land cover - hydroclimate relationship impacts flooding and land slide activity. We are building a topographically-corrected precipitation surface database at 1 km spatial resolution for Southern Appalachia with the objective of identifying the spatiotemporal distribution of extreme precipitation events for the period 1980-2011. This will be paired with a multivariate index describing exposure of populations and infrastructure to extreme precipitation.

Biodiversity-centered research focused on evaluating the effects of land-use and climate change on biodiversity, and determining the broad-scale impacts of changes in biodiversity on ecosystem function. Some of this research examined exotic invasive species such as *Microstegium vimineum* (Japanese stiltgrass) and *Adelges tsugae* (hemlock woolly adelgid). Collection of field data and statistical modeling is beginning to help us understand the regional and local controls on the spread of *M. vimineum* and the compound effects of *M. vimineum* invasion and land use on biogeochemical cycling. Work on terrestrial salamander population dynamics along an elevation gradient within the Coweeta basin focused on several major questions including: (1) how does climate and weather regulate the performance of terrestrial salamanders, (2) what is the effect of climate on population dynamics of terrestrial salamanders, (3) how do climate and

land use interact to affect dispersal and population fragmentation, (4) how does climate regulate interactions between terrestrial salamander species, and (5) what are the effects of terrestrial salamanders on forest ecosystem processes and plant diversity. The long-term goal is to incorporate evolutionary processes into population models to forecast species responses to climate change. Using the results of an ongoing salamander removal study we are looking at responses in plant distribution and abundance. A pilot study was initiated to determine whether historic hydroclimate differences in the region correlated with geographic variation in the composition and abundance of birds and salamanders. Using a PRISM model, sites were identified that differ in precipitation levels over the past 30 years, and these served for estimating the population on those sites to see if abundance correlates with hydroclimate.

In other research we examined the influence of different soil chemical parameters (as influenced by land use) on the diversity and relative abundance of bacterial and archeal ammonia oxidizers in forested watersheds. Our decomposition and macroinvertebrate studies are advancing understanding of the impact of the changing land use along the hill slope on the structure and function of the associated streams. Land use in southern Appalachia has transitioned from "exurbanization" to "suburbanization" making it particularly relevant to understand the consequences of peri-urban development and climate change. For example, how do peri-urban development and climate change influence the success and impacts of invasive species; how do they influence keystone seed-dispersing ants, which play an essential role in maintaining the floristic diversity of the forested system; and do they influence organic matter decomposition rates. By comparing the effects of land use on avian communities by quantifying the effects of land management on avian extinction and colonization. We are also able to relate differences in avian community composition and nest predation to nest predator community differences across forests, suspended developments, and residential sites, as well as species-specific responses to the structural and human components of development.

Using synoptic geomorphic surveys we are evaluating the effect of local riparian vegetation condition on a full suite of related geomorphic and physical habitat characteristics of stream reaches. We recorded local riparian conditions at 49 stream sites to evaluate the effect of local riparian vegetation condition on a full suite of related geomorphic and physical habitat characteristics of stream reaches. Due to reduced wood inputs and the resulting reduction in channel roughness, we hypothesized that stream segments with little riparian forest would feature reduced active channel widths, reduced channel width variability, reduced wood frequency, and less diverse and simpler habitat. Due to reduced filtration of overland flow from adjacent lands, we hypothesized that stream segments with little riparian forest would feature reduced median particle sizes and increased fine sediment percentages. Through an investigation of water temperatures in southern Appalachian stream reaches we assessed whether it varied systematically according to hyporheic exchange theory. The small observed differences in stream temperatures indicate that hyporheic exchange is not a dominant driver of mesoscale habitat temperatures in this basin, and temperature differences between habitat units were so small they were unlikely to have ecological significance.

Finally, we sought to understand how interdisciplinary groups such as the CWT LTER function to produce scientific knowledge and how that knowledge is communicated and contributed to the larger community. Through Translational Dialogues we brought the scientific and public communities into dialogue to co-produce knowledge. Through other Coweeta Listening Project activities we are making the CWT LTER more visible in the community, and by listening to the community in a co-production of knowledge process, we are able to translate scientific knowledge into forms that are readily understandable by local groups. It also makes it possible to serve as a trusted source of information regarding polemical issues such as climate change and regulating steep slope development.

Significant Results:

We have produced several large synthetic analyses of the census tree plot data and FIA data. Clark et al 2013 (JABES) report how to synthesize responses of a large number of species and types of responses, including growth, survival, and fecundity, to determine which species are most vulnerable to climate change. Clark et al. 2014 (GCB) applies these methods to rank species in terms of their vulnerabilities. One of the surprising results was that most of the interactions between climate variables and competition are positive and amplify one another. For example, the largest responses to drought for most species occur in wet sites, not dry sites. Clark et al. 2014 (EA) solves the problem of how to jointly model both species distribution and abundance. Species distribution models have been unable to estimate effects of climate on abundance for several reasons, including the aggregation in climate data, the fact that responses of each species to climate also depend on how all other species respond. Large-scale analyses of FIA data show almost no significant relationships between abundance and growth unless FIA data are aggregated to such a coarse spatial scale that only broad spatial trends are apparent. A number of studies predict no effect of climate change on the basis of species distribution. Others focus primarily on functional groups rather than species. Many analyses of FIA data show little or no sensitivity to environmental variables that we know have big effects. Realizing the need for prediction based on inference at the same scale we are now developing dynamic joint distribution models that use both FIA and our demographic plots, which integrate the individual level and the population level data.

We found evidence supporting hierarchical niche relations theory and the Eltonian noise hypothesis (Fraterrigo et al. 2014), such that macroclimate structures local biotic interactions, while local abiotic relations are regionally conserved. Biotic interactions suppress *M. vimineum* in drier climates but have little effect in wetter climates. The effects of invasion on soil carbon storage differ with regional land use; and its effects on soil carbon storage largely depend on nitrogen availability and invader biomass, which can be altered by landscape-level patterns of land use. Compared to the urban matrix, invasion-associated declines in total soil organic carbon in the forested and agricultural landscapes were 3.5 and 2.5 times greater, respectively. Nitrogen availability and *M. vimineum* biomass interacted to explain these patterns: when both nitrogen availability and *M. vimineum* biomass were high, invaded soils exhibited higher total organic carbon, unchanged particulate organic matter carbon, and higher mineral-associated organic matter carbon compared to adjacent uninvaded soils (Warren et al. 2014).

Our analysis revealed that 25 mm/day is an appropriate threshold for characterizing extreme precipitation in the Southeast (Shepherd et al. 2013). We find that less than 1% of the Southeast U.S. experiences rates greater than 25 mm/day over the period 1980-2013, but these events are typically associated with catastrophic consequences. As expected, the heaviest rainfall events are clustered in the southern Appalachian region, but there is significant inter-mountain heterogeneity in the distribution of heaviest rain events. Results reveal that January-March is likely to have the greatest percentage of extreme precipitation days followed by October-December. In terms of trends, there is a detectable positive trend in extreme precipitation days across the regions from 1980-2013, but it is not statistically significant. Amidst the high spatial variability in precipitation across the southern Appalachians, the effects of urbanization, exurbanization, and rural

agriculture upon stormflows are swamped by differences in precipitation amongst basins (Jackson et al. 2014). Nevertheless, land cover has high predictive power for differences among sediment concentrations, sediment yields, and specific conductivities across basins. In this landscape, sediment concentrations and water chemistry are reflective of land cover, but stormflow behavior is not.

Heat transfer rates between water and bed sediments of different temperatures are very rapid relative to flow velocities through the hyporheos, and thus the temperature time series of water advected from the stream through the hyporheos is rapidly damped. Thus, streams with large fractions of hyporheic exchange should feature temperature time series with lower diurnal variability and damping of both the temperature peaks and troughs (Long and Jackson 2014; Booth et al. 2014). Our research furthermore clearly shows that riparian conditions of streams influence channel form and aquatic habitat, and that the human-element of riparian vegetation management is a crucial factor (Leigh et al. 2013; Jensen et al. 2014; Jackson et al. 2014). Leigh's paleoenvironmental data are showing that moderate climate modulations occurred during the past few thousand years that were significant enough to be reflected in the sedimentary record (Leigh and Rogers 2013). Also, his research finds that Native American agricultural and land management practices had little to no detectable influence on stream geomorphic systems, but that the Euroamerican settlement caused drastic changes in stream geomorphology.

The Coweeta LTER IM office built a package manager application to manage our PASTA Migration efforts, which will continue to be used to manage incoming data. 138 data sets have now been loaded into PASTA, 51 additional data sets are staged for entry, and another 48 data sets are expected from researchers. Work also centered around the FSML sensor network project (NSF Grant # 1226983) resulting in the upgrade or addition of 45 remote, streaming stations to the Coweeta LTER sensor network. We deployed or upgraded 31 microclimate and regional weather stations during the funding period, and made purchases and preparations to deploy an additional 14 stations after the funding period. We replaced, upgraded, or upgraded and moved equipment for 18 stations, including all stations within the Coweeta Basin, as well as stations in the French Broad River valleys. We also deployed 13 new stations, expanding our ability to track regional climate variation in Southern Appalachia.

Forest spatial patterns of leaf area index at the hillslope to catchment level show a persistent change in response to warming hydroclimate that is strongly correlated to downslope lateral flow and subsidy of ecosystems, freshwater flow regimes and low flow dynamics (Hwang et al. 2014). Climate change is resulting in a divergence of forest phenology between low to high elevation sites in the southern Appalachians, in which low elevation sites are showing increased incidence of drought induced early leaf senescence and fall, while upper elevation sites are not. Long term trends in Canadian-American humid mountain transect indicates two divergent trends, with reductions in stream NO₃ concentration and loads in northern sites, and increase in southern sites, both potentially linked to climate change.

Key outcomes or Other achievements:

The Coweeta LTER Schoolyard program directly engaged 1,903 students on 13 different occasions. Coweeta Schoolyard LTER coordinated and led the fifth annual Migration Celebration where we collaborated with the non-profit Southern Appalachian Raptor Research and Land Trust for the Little Tennessee (LTLT) to lead over 350 5th and 6th grade students from Mountain View Intermediate in activities concerning migration, including tagging Monarch butterflies, banding migratory songbirds, and learning the different strategies that animals use to cope with scarce resources. For the second year in a row, we coordinated a 4-day Kids in the Creek field trip in April for approximately 340 8th graders from Macon Middle School, Nantahala School, Highlands School, and Trimont Christian School. The event was spearheaded by the Coweeta LTER Schoolyard program, but also involved aquatic biologists from the Land Trust for the Little Tennessee, U.S. Fish and Wildlife Service, North Carolina Division of Water Quality, North Carolina Wildlife Resources Commission, and North Carolina Natural Heritage Program. The program met 8th grade science curriculum standards, focusing on the hydrosphere and water quality as part of the North Carolina Standard Course of Study (competency goal 3). The program included follow-up classroom work.

We expanded the Kids in the Creek event to 3 additional counties: Clay, Jackson, and Swain. In May we held a Kids in the Creek event for 110 students from Hayesville Middle School, collaborating with the Hiwassee River Watershed Coalition (WATR) and LTLT to host the event. In September we collaborated with LTLT and Watershed Association for the Tuckasegee River to host a Kids in the Creek event for 127 9th to 12th grade students from Smoky Mountain High School. In October we collaborated with the National Park Service, LTLT, WATR, the USDA Coweeta Hydrologic Laboratory, and Swain County Soil and Water Conservation District to host a Kids in the Creek event for 160 Swain Middle School 8th graders.

The Science Study Boxes continued to be utilized by local teachers and were checked out a total of 13 times during the 2013/2014 academic year, serving 2,057 students. The Coweeta LTER Citizen Science Lichen Bioblitz and Workshop filled up quickly with 30 participants, including several professional botanists from the USFS, NC Natural Heritage Program, and Virginia Tech. Approximately 80 specimens were identified and it is expected that we will have between 200 and 300 species at Coweeta.

Two articles were published related to the integration of Coweeta research into an interdisciplinary pedagogical model, engagement in production of Coweeta Listening Project Writing Collective articles for the Franklin Press (Vercoe et al. 2014; Welch-Devine et al. 2014).

We are leading an LTER intercomparison project including CWT, other LTER sites and USFS and Canadian experimental watersheds along a transect from Turkey Lakes in central Ontario through Coweeta. Analysis of long term trends in nitrogen concentrations and loads is underway to compare snow dominated to rain dominated catchments over multi-decadal time periods.

International collaborative research is revealing interesting parallels between human-influenced landscape histories of the Pyrenees Mountains and those of the Southern Blue Ridge Mountains. A major finding is that agropastoral land use activities that have occurred in the Pyrenees are sustainable, while somewhat different land use trajectories in the Blue Ridge Mountains are not sustainable (Leigh et al. 2014; Coughlan 2013a, 2013b). This research on baseline and temporal reconstructions has revealed the stratigraphic imprint of human activities on the landscape that extend back thousands of years in support of the proposed Anthropocene epoch.

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

Coweeta Co-PIs provided numerous opportunities for training and professional development to high school, undergraduate, and graduate students from their home institutions and elsewhere as well as staff both from the project as well as other LTER projects. In addition, several co-PIs incorporate portions of their research in to regularly taught courses, lead multi-day field trips to the project area in which students engage in field work, or offered mini-courses on selected topics that emerge from their Coweeta LTER research.

Noteworthy activities this year included:

Katherine Elliott (USFS) mentored two undergraduate and two graduate students from University of Texas at San Antonio, and one undergraduate student from University of North Carolina.

James Clark (Duke U) involved postdocs, graduate students and undergraduate students in the analysis of long-term CWT data with FIA and other LTER sites (Harvard Forest, Hubbard Brook, Luquillo) gaining training in field and lab methods and data management.

Jennifer Fraterrigo (U of Illinois) offered opportunities for the training of three graduate students, and six female and one male undergraduate students including one student from an underrepresented group. Students were trained in various techniques including sample processing, data entry, and data analysis.

Jack Webster (VTech) took a group of 10 undergraduates on a field trip to Coweeta where they talked about the history of research and looked at many of the ongoing projects.

David Leigh (U of Georgia) presents many of the findings from his research in his General Geomorphology Class (GEOG 3010), Fluvial Geomorphology Class (GEOG 4020), and Geomorphology Seminar (GEOG 8020). Also, several graduate and undergraduate students have participated in all aspects of the research and have gained excellent first-hand experience in field, laboratory, and academic settings.

John Chamblee (U of Georgia) provided training for three technicians in the best practices of environmental monitoring sensor deployment and near-real time data collection.

Chelcy Miniati (USFS) provided post-doctoral associate Dr. Chris Oishi with additional experience in the design, maintenance, and analysis of eddy covariance data through his participation in the 2014 FLUXCOURSE, July 2014, Nederland CO. A second post-doc, Dr. Steven Brantley and a technician attended a LiCOR training course in Lincoln NE during this year to learn how to operate, maintain and analyze data from the LiCOR 6400 portable infrared gas analyzer with a leaf fluorometer. The skill sets they gained included the ability to take measurements of short-term leaf stress and metabolism, measurements that are being used to address whether silvicultural treatments on declining eastern hemlock populations are being effective.

Catherine Pringle (U of Georgia) involved 12 graduate students in the Integrated Conservation (ICON) PhD program in Coweeta environmental outreach activities through an ICON core course taught by Pringle and Heynen. Students communicated conservation applications of Coweeta LTER research to the general public through a series of ~ 10 articles that they published in the Franklin Press (North Carolina) in Spring 2014.

Lawrence Band (U of North Carolina Chapel Hill) provided advanced training in geospatial and modeling technologies to graduate and undergraduate students through classes and short courses. Short course in spatially distributed ecohydrological modeling was provided to participants in universities, government agencies (USFS) and private industry (Tetra Tech).

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

In addition to publications and thesis as listed elsewhere, following is a selected summary of activities by co-PIs and students at national/international professional meetings or engaging with distinct communities of interest:

Elliott presented information to public groups and universities visiting Coweeta Hydrologic Laboratory including: Finland visitors and Dr. Robert Coulson from Texas A&M, 8 May 2014.

Clark served as a Plenary Speaker for the Graybill Conference (the Environmental Section of the American Statistical Association), the Sun-Yat Sen Lecture in Ghuanzhou, the Plenary Lecture at the annual meeting of the International Society of Biogeography, and Plenary Speaker for the Next Generation Climate Data Products workshop at NCAR.

Turner had regular contact with at least 10 volunteer landowners in which activities included bird identification, data exploration, and interpretative hikes in support of understanding the spatial and temporal patterns of biodiversity.

Fraterrigo participated in outreach activities through the University of Illinois Undergraduate Researchers Initiative for STEM Women, in which three female undergraduates interested in STEM fields were mentored. She also participated in the UI Women in Science Club to engage and support young women interested in science.

Love led or co-led 12 different university and adult outreach events, reaching over 121 participants:

- 1) Tour for University of Georgia Mountain Geography class
- 2) Tour for Dr. Forest Isbell, Assistant Professor, Plant Biology, University of Georgia
- 3) Tour for University of Georgia Integrative Conservation class of 12 PhD students from four different disciplines
- 4) Tour for University of Nebraska at Lincoln scientists and graduate students
- 5) Tour of University of North Carolina at Asheville Forest Ecosystems of the Southern Appalachians class
- 6) Tour for Alabama A&F class
- 7) Tour and birding hike for the Franklin Bird Club at Gibson Bottoms, a Land Trust for the Little Tennessee property and one of the LTER hillslope study sites
- 8) Tour for the Franklin Bird Club at Coweeta that highlighted some of the long-term bird studies
- 9) Tour for an international group of scientists taking part in the 10th International Symposium on Earthworm Ecology
- 10) Tour for Stephen F. Austin State University forestry/wildlife class
- 11) Presented Butterflies of the Smokies to the Otto Garden Club and highlighted the Migration Celebration that hosts Macon County 6th graders
- 12) Coordinated the Citizen Science Lichen Bioblitz and Workshop

Chamblee contributed materials to a Wiki on Environmental Sensor Networks developed as part of the ESIP Federation's EnviroSensing Cluster. He also developed and made available via the Coweeta LTER Reports page, a best practices document that outlines the general procedures we follow in deploying a station. Every deployed station has a customized web site providing daily updates of all data that are downloadable as either chart images or tables that can be easily imported into a spreadsheet.

Heynen conducted Translational Dialogues (Focus groups), wrote a regular column in the Franklin Press, and established a Facebook presence to also use social media.

Emanuel used Coweeta LTER research results in outreach presentations to undergraduate members of the American Indian Science and Engineering Society and to high school students visiting NCSU during recruitment events targeting American Indians from the Lumbee Tribe and Eastern Band of Cherokee Tribe, both of North Carolina.

Band delivered invited talks at over 20 universities on his ecohydrologic research in the Coweeta LTER.

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

Water isotope samples from residential hillslopes are being analyzed, and the results will be incorporated into the ongoing isotopic study. Hydrometric and isotopic data, results and analyses are being combined with results from other project teams in a synthesis study that seeks a holistic understanding of how ecological and hydrological processes interact on hillslopes and how these processes and their interactions affect water quantity and quality, including stream ecological conditions, within the region.

Long-term biotic monitoring and experimental plots within the Coweeta basin, Great Smoky Mtns Nat. Park, Duke Forest and Mars Hill will be resampled. These are the basis for examining the evolution and interaction of space/time patterns of the forest canopy relative to watershed geomorphology, hydrologic cycling and transport. Sampling included tree growth and development and seed production. In addition, baseline samples will be collected of soil and forest floor chemistry for the expanded gradient plots in the Great Smokey Mountain National Park.

Long-term monitoring on salamanders will continue at a subset of synoptic and intensive hillslope sites to assess interannual variation in estimates and terrestrial salamander population dynamics along an elevation gradient within the Coweeta basin. This terrestrial work focuses on how climate and weather regulate the performance of terrestrial salamanders, the effect of climate on population dynamics, how climate and land use interact to affect dispersal and population fragmentation, how climate regulates interactions between terrestrial salamander species, and the effects of terrestrial salamanders on forest ecosystem processes and plant diversity. We will also begin to monitor responses of understory herb communities to removal of salamanders and associated increases in ant populations, and will repeat and expand the hydroclimate variability research to additional sites.

Within the Coweeta Basin, long-term data collection will continue on vegetation dynamics, aboveground biomass and nutrient accumulation in Watershed 7. Hillslope plots will be resampled for below ground nutrient cycling measurements along with forest floor and soil chemistry and soil solution and groundwater chemistry. We will conduct the routine 5 year sample collections of the LTER gradient plots. In the larger region, dendrochronologic sampling will continue directed at relating disturbance history and climate-growth interactions.

Sampling of experimental units (wood posts) for decay, microbial, and faunal communities will continue, a regional-scale study into controls on forest structure and function. There will also be continued sampling in to how habitat structure influences invasive plant species spread.

For the Coweeta LTER Schoolyard program, we will continue the Migration Celebration in the fall and the Kids in the Creek in the spring. We will also continue to update and replenish supplies and activities in our Science Study Boxes.

Products

Books

Swank, Wayne T. and Jackson R. Webster (2014). *Long-term response of a forest watershed ecosystem: clearcutting in the southern Appalachians*. Oxford University Press. New York. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7

Book Chapters

Adams, Mary Beth and James N. Kochendenfer (2014). Recovery of central Appalachian Forested Watersheds. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian*. 194-212. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Boring, Lindsay, Katherine R. Elliot, and Wayne T. Swank, Wayne (2014). Successional forest dynamics. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian*. Swank, Wayne T. and Webster, Jackson R.. Oxford University Press. 11-35. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Heneghan, Liam and Alissa Salmore (2014). Wood decomposition following clearcutting at Coweeta Hydrologic Laboratory. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachia*. Swank, Wayne T. and Webster, Jackson R.. Oxford University Press. 134-145. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Hornbeck, James W., Amey S. Bailey, Christopher Eager and John L. Campbell (2014). Comparisons with results from the Hubbard Brook Experimental Forest in the Northern Appalachians. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian*. Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 213-228. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Knoepp, Jennifer D., Wayne T. Swank and Bruce L. Haines, Bruce (2014). Long- and short- term changes in nutrient availability following commercial sawlog harvest via cable logging. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian*. Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 57-84. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Mattson, Kim, G. and Wayne T. Swank (2014). Wood decomposition following clearcutting at Coweeta Hydrologic Laboratory. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian*. Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 118-132. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Meyer, Judy L., Jackson R. Webster, Jennifer D. Knoepp and E. F. Benfield (2014). Dynamics of dissolved organic carbon in a stream during a quarter century of forest succession. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian*. Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 102-117. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Qualls, Robert, Bruce Haines and Wayne T. Swank, Wayne (2014). Soluble organic nutrient fluxes. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachians*. Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 85-101. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Reynolds, Barbara, Timothy Schowalter, and D. A. Crossley Jr. (2014). Watershed clearcutting and canopy arthropods. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian*. Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 146-155. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Ryan, Michael G., Jame M. Vose, Paul J. Hanson, Louis R. Iverson, Chelcy F. Miniati, Charles H. Luce, Lawrence E. Band, Steven L. Klein, Don McKenzie David N. Wear (2014). Forest Processes. *Climate Change and United States Forests* 57. Peterson, David L., James M. Vose and Toral Patel-Weynand. Advances in Global Change Research. 25-54. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 0.1007/978-94-007-7515-2_3.

Swank, Wayne T. and Jackson R. Webster (2014). Programmatic background, site description, and experimental treatment. *Long-term response of a forest watershed ecosystem: clearcutting in the southern Appalachians*. Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 1-10. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7..

Swank, Wayne T., Jennifer D. Knoepp, James M. Vose, Stephanie N. Laseter Jackson R. Webster (2014). Response and recovery of water yield and timing, stream sediment, abiotic parameters, and stream chemistry following logging. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian* Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 36-56. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Swank, Wayne, T. and Jackson R. Webster (2014). Programmatic background, site description, experimental approach and treatment, and natural disturbances. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian* Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 1-10. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Wallace, J. Bruce and Damon T. Ely (2014). Stream macroinvertebrate response to clearcut logging. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian*. 177-193. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Webster, Jackson R., E. F. Benfield, Stephen W. Golladay and Matthew E. McTammany (2014). Recovery of particulate organic matter dynamics in a stream draining a logged watershed. A pressing situation. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian* Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 156-176. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Webster, Jackson R., Wayne T. Swank, James M. Vose, Jennifer D. Knoepp and Katherine J. Elliott (2014). Bridging the gap between ecosystem theory and forest watershed management. A synthesis of 30+ years of research on WS 7. *Long-term response of a forest watershed ecosystem. Clearcutting in the southern Appalachian*. Swank, Wayne T. and Jackson R. Webster. Oxford University Press. 229-247. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0-19-537015-7.

Conference Papers and Presentations

Graves, R.A., S.M. Pearson, and M.G. Turner. (2014). *Bioenergy in a changing climate: future productivity potential in the Southern Appalachians*.. 13th Annual International Climate Change Summer School. . Status = OTHER; Acknowledgement of Federal Support = Yes

Graves, R.A., S.M. Pearson, and M.G. Turner (2014). *Bioenergy production in a changing landscape: Farmlands in the Southern Appalachians*.. Ecological Society of America. Sacramento, CA.. Status = OTHER; Acknowledgement of Federal Support = Yes

Knoepp, J.D., W.A. Jackson, K.J. Elliott and S. Zarnoch (2014). *Cation depletion in high elevation watersheds in the southern Appalachians*. Workshop, "Critical Loads, Forest Sustainability, and Soil Productivity". Coweeta Hydrologic Laboratory, Otto, NC. Status = OTHER; Acknowledgement of Federal Support = Yes

Jones, J.A., I.F. Creed, A. Spargo, J.M. Buttle, M.B. Adams, F.D. Beall, E. Booth, J.L. Campbell, D.W. Clow, K. Elder, C.R. Ford, N.B. Grimm, P. Ramlal, S. Amartya, S.D. Sebestyen, D. Spittlehouse, S.M. Sterling, M.W. Williams, R.D. Winkler and H. Yao (2013). *Changing forest water yields in response to climate warming: Results from long-term experimental watershed sites across North America*.. American Geophysical Union Annual Meeting. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Maerz, J.C., K. Servidio, K. McEntire, J. Howard, R. Mahan, and V. Kinney Terrell (2014). *Climate and Plethodon ecology at the Coweeta LTER*. Joint Meeting of Ichthyologists and Herpetologists. Chattanooga, Tennessee. Status = OTHER; Acknowledgement of Federal Support = Yes

Wurzburger, N. and C.F. Miniati (2013). *Drought enhances symbiotic di-nitrogen fixation and competitive ability of a temperate forest tree*.. Soil Science Society of America annual meeting. Tampa, FL. Status = OTHER; Acknowledgement of Federal Support = Yes

Katherine J. Elliott, Chelcy Ford Miniati, Neil Pederson, Stephanie H. Laseter (2014). *Eastern deciduous forest tree growth response to hydroclimate variability*. 2014 Coweeta LTER Summer Symposium. Otto, NC. Status = OTHER; Acknowledgement of Federal Support = Yes

Boeck, A.K., J.K. Bush, K.J. Elliott, J. Hashenburger (2014). *Effect of changes in hydrochory, due to climate change, on the shallow seed bank and future vegetative community*.. North American Congress for Conservation Biology. , Missoula, MT. Status = OTHER; Acknowledgement of Federal Support = Yes

Novick, K.A., C.F. Miniati, S.T. Brantley, J.T. Walker and J.M. Vose (2013). *Flux measurements in a new site challenged by topography, landscape heterogeneity, and adverse environmental conditions*.. U.S. North American Carbon Program Annual Meeting. Albuquerque, NM. Status = OTHER; Acknowledgement of Federal Support = Yes

Hwang, T., L.E. Band, C.F. Miniati and C. Song (2013). *Frequent summer droughts homogenize landscape vegetation patterns at the catchment scale*.. American Geophysical Union Annual Conference. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley, S.T., C.R. Ford, S.H. Laseter, K.J. Elliott, J.D. Knoepp and J.M. Vose (2013). *Hemlock loss affects nitrate fluxes and stormflow in southern Appalachian headwater streams*.. Conference on Invasion Biology, Ecology and Management. Lexington, KY. Status = OTHER; Acknowledgement of Federal Support = Yes

Miniati, C.F., S.T. Brantley, K.J. Elliott, S.H. Laseter and J.M. Vose (2014). *Hydrologic changes after HWA-Induced Mortality*.. North Carolina Society of American Foresters Annual Meeting. Asheville, NC. Status = OTHER; Acknowledgement of Federal Support = Yes

Caldwell, P.V., C.F. Miniati, S.T. Brantley, K.J. Elliott and S.H. Laseter (2014). *Increases in forest evapotranspiration have decreased water yield in the southern Appalachians*.. American Society of Agricultural and Biological Engineers International Symposium on Evapotranspiration. Raleigh, NC. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley, S.T., K.A. Novick, A.C. Oishi, J.M. Vose and C.F. Miniati (2014). *Intra-annual variations in forest transpiration in a species- rich southern Appalachian forest*.. American Society of Agricultural and Biological Engineers International Symposium on Evapotranspiration. Raleigh, NC. Status = OTHER; Acknowledgement of Federal Support = Yes

Kraskeski, K.A., D.B. Booth, and C.R. Jackson (2014). *Local and watershed-scale determinants of summertime urban stream temperatures*. 3rd Symposium on Urbanization and Stream Ecology. Portland, OR.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Silva, G.E., T. Cofer, K.J. Elliott, C.F. Miniati (2014). *Microclimate in southern Appalachian forests with and without *Rhododendron maximum**.. College of Sciences Research Conference, Collaborative Basic and Translational Research in the Sciences. University of Texas at San Antonio. Status = OTHER; Acknowledgement of Federal Support = Yes

Rice, J.L., N. Heynen, S. Gustafson, B. Burke, T. Gragson, D. Nelson, S. Evans and M. Welch- Devine (2013). *Public Engagement Through Sustained Coproduction of Ecological Knowledge: Lessons from the Coweeta Listening Project*.. Southeastern Division of the Association of American Geographers (SEDAAG) Meeting. Roanoke, VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Elliott, K.J., C.F. Miniati, N. Pederson, N. and S.H. Laseter (2013). *Southern Appalachian forest growth responds most strongly to precipitation variability*.. Ecological Society of America Annual Meeting. Minneapolis, MN. Status = OTHER; Acknowledgement of Federal Support = Yes

Oishi, A.C., K.A. Novick, S.T. Brantley, S.H. Laseter, P.V. Bolstad, J.M. Vose and C.F. Miniati (2014). *Subcanopy Evapotranspiration within a Southern Appalachian Forest Chronosequence*.. American Society of Agricultural and Biological Engineers International Symposium on Evapotranspiration. Raleigh, NC. Status = OTHER;

Acknowledgement of Federal Support = Yes

Rice, J.L., B. Burke and N. Heynen (2014). *The Democratization of Climate Change Knowledge: Heterodox Ethico-Political Theory in Southern Appalachia*. Association of American Geographers Annual Meeting. Tampa, FL. Status = OTHER; Acknowledgement of Federal Support = Yes

Llarena, F., K.J. Elliott, J.K. Bush (2014). *The genetic variation and clonal diversity within a Rhododendron maximum hill-slope population*. College of Sciences Research Conference, Collaborative Basic and Translational Research in the Sciences. University of Texas at San Antonio. Status = OTHER; Acknowledgement of Federal Support = Yes

Cofer, T., K.J. Elliott, J.K. Bush, C.F. Miniati (2014). *The soil seed bank and its restoration potential in deciduous forests with and without Rhododendron maximum*. College of Sciences Research Conference, Collaborative Basic and Translational Research in the Sciences. University of Texas at San Antonio. Status = OTHER; Acknowledgement of Federal Support = Yes

Inventions

Journals

Adams, M.B., Jennifer D. Knoepp and Jackson R. Webster (2014). Inorganic nitrogen retention by watersheds at Fernow Experimental Forest and Coweeta Hydrologic Laboratory. *Soil Science Society of America Journal*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.2136/sssaj2013.11.0463nafsc

Booth, Derek B., Kristin A. Kraseki and C. Rhett Jackson (2014). Local-scale and watershed-scale determinants of summertime urban stream temperatures. *Hydrological Processes*. 28 (4), 2427-2438. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/hyp.9810

Booth, Derek B., Kristin Kraseski and C. Rhett Jackson (2014). Local and watershed-scale determinants of summertime urban stream temperatures. *Hydrological Processes*. 28 2427-2438. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/hyp.9810

Bradford, Mark A., Robert J. Warren II, Petr Baldrian, Thomas W. Crowther, Daniel S. Maynard, Emily E. Oldfield, William R. Wieder, Stephen A. Wood and Joshua R. King (2014). Climate fails to predict wood decomposition at regional scales. *Nature Climate Change*. 1-6. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/nclimate2251

Brantley, Steven T., Chelcy F. Miniati, Katherine J. Elliott, Stephanie H. Laseter and James M. Vose (2014). Changes to southern Appalachian water yield and stormflow after loss of a foundation species. *Ecohydrology*. 7 (5), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/eco.1521

Burke, Brian J. and Nik Heynen (2014). Transforming Participatory Science into Socio-Ecological Praxis: Valuing Marginalized Environmental Knowledges in the Face of the Neoliberalization of Nature and Science. *Environment and Society*. 5 7-27. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3167/ares.2014.050102

Butler, Sarah M., Alan S. White, Katherine J. Elliott and Robert S. Seymour (2014). Disturbance history and stand dynamics in secondary and old-growth forests of the Southern Appalachian Mountains, USA. *The Journal of the Torrey Botanical Society*. 141 (3), 189-204. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3159/TORREY-D-13-00056.1

Campbell, Petya K. Entcheva, Elizabeth M. Middleton, Kurt J. Thome, Raymond F. Kokaly, Karl Fred Huemmrich, David Lagomasino, Kimberly A. Novick and Nathaniel A. Brunsell (2013). Hyperion reflectance time series at calibration and validation sites: stability and sensitivity to seasonal dynamics. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*. 6 (2), 276-290. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1109/jstars.2013.2246139

Cecala, Kristen K., Winsor H. Lowe and John C. Maerz (2014). Riparian disturbance restricts in-stream movement of salamanders. *Freshwater Biology*. 59 2354-2364. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/fwb.12439

Clark, James S. Gelfand, Alan E. Woodall, Christopher W. Zhu, Kai (2014). More than the sum of the parts: forest climate response from joint species distribution models. *Ecological Applications*. 25 (4), 990-999. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: http://dx.doi.org/10.1890/13-1015.1

Clark, James S., David M. Bell, Matthew Kwit and Kai Zhu (2014). Competition-interaction landscapes for the joint response of forests to climate change. *Global Change Biology*. 20 (6), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12425

Clark, James S., David M. Bell, Matthew Kwit, Amanda Powell and Kai Zhu (2013). Dynamic Inverse Prediction and Sensitivity Analysis With High-Dimensional Responses: Application to Climate-Change Vulnerability of Biodiversity. *Journal of Agricultural, Biological, and Environmental Statistics*. 18 (3), 376-404. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s13253-013-0139-9

Cohen, Emily, B., Scott M. Pearson and Frank R. Moore (2014). Effects of landscape composition and configuration on migrating songbirds: inference from an individual-based model. *Ecological Applications*. 24 (1), 169-180. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1890/12-1867.1

Coughlan, Michael R. (2013). Errakina: Pastoral Fire Use and Landscape Memory in the Basque Region of the French Western Pyrenees. *Journal of Ethnobiology*. 33 (1), 86-104. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: etbi-33-01-05.3d

Coughlan, Michael R. (2013). Farmers, flames, and forests: Historical ecology of pastoral fire use and landscape change in the French Western Pyrenees, 1830–2011. *Forest Ecology and Management*. 1-12. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: http://dx.doi.org/10.1016/j.foreco.2013.10.021

Coughlan, Michael R. (2013). Unauthorized Firesetting as Socioecological Disturbance: A Spatiotemporal Analysis of Incendiary Wildfires in Georgia, USA, 1987-2010. *Fire Ecology*. 9 (3), 45-63. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.4996/fireecology.0903045

Creed, Irena F., Adam T. Spargo, Julia A. Jones, Jim M. Buttle, Mary B. Adams, Fred D. Beall, John L. Booth, John L. Campbell, Dave Clow, Kelly Elder, Mark B. Green, Nancy B. Grimm, Chelcy F. Miniati, Patricia Ramlal, Amartya Saha, Stephen Sebestyen, Dave Spittlehouse, Sahnnon Sterling, Mark W. Williams, Riate Winkler and Huaxia Yao (2014). Changing forest water yields in response to climate warming: results from long-term experimental watershed sites across North America. *Global Change Biology*. 20 3191-3208. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12615

Diez, Jeffrey M., Itamar Giladi, Robert Warren and Ronald H. Pulliam (2014). Probabilistic and Spatially Variable Niches Inferred from Demography. *Journal of Ecology*. 1-11. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/1365-2745.12215

Dodds, W. K., J. R. Webster, C. L. Crenshaw, A. M. Helton, J. M. O'Brien, E. Marti, Anne E. Hershey, Jennifer L. Tank, A. J. Burgin, N. B. Grimm, S. K. Hamilton, D. J. Sobata, G. C. Poole, J. J. Beaulieu, L. T. Johnson, L. R. Ashkenas, Robert O. Hall, S. L. Johnson, Wilfred M. Wollheim and William B. Bowden (2014). The Lotic Intersite Nitrogen Experiments: an example of successful ecological research collaboration. *Freshwater Science*. 33 (700-710), . Status = PUBLISHED; Acknowledgment of Federal Support =

Yes ; Peer Reviewed = Yes ; DOI: <http://dx.doi.org/10.1086/676938>

Dodds, W. K., S. M. Collins, S. K. Hamilton, Jennifer L. Tank, S. L. Johnson, J. R. Webster, Matt R. Whiles, M. R. Rantala, W. H. McDowell, S. D. Peterson, T. Riis, C. L. Crenshaw, C. L. Thomas, Beth M. Cheever, A. S. Flecker, N. A. Griffiths, T. Crowl, Emma J. Rosi-Marshall, R. El-Sabaawi, R. and E. Marti (2014). You are not always what we think you eat: selective assimilation across multiple whole-stream isotopic tracer studies. *Ecology*. 95 2757-2767. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1890/13-2276.1

Dohyoung, Kim, Ram Oren, Christopher A. Oishi, Cheng, Hsieh, Nathan Phillips, Kimberly A. Novick and Paul C. Stoy (2014). Sensitivity of stand transpiration to wind velocity in a mixed broadleaved deciduous forest. *Agricultural and Forest Meteorology*. 187 62-71. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.agrformet.2013.11.013

Elliott, K.J., J.M. Vose, and D. Rankin (2014). Herbaceous-layer species composition and richness of mesophytic cove forests in the southern Appalachians: Synthesis and Knowledge Gaps. *Journal of the Torrey Botanical Society*. 141 (1), 39-71. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3159/TORREY-D-13-00054.1

Fraterrigo, Jennifer M., Stephanie Wagner and Robert J. Warren II (2014). Local-scale biotic interactions embedded in macroscale climate drivers suggest Eltonian noise hypothesis distribution patterns for an invasive grass. *Ecology Letters*. 17 1447-1454. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/ele.12352

Gustafson, S., N. Heynen, T. Gragson, J. Rice, J.M. Shepherd, and C. Strother. (2013). Megapolitan Political Ecology and Urban Metabolism in Southern Appalachia. *Professional Geographer*. 66 1-12. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1080/00330124.2014.905158

Hartman, Melannie D., Jill S. Baron, Holly A. Ewing, A. Holly and Kathleen C. Weathers (2014). Combined global change effects on ecosystem processes in nine U.S. topographically complex areas. *Biogeochemistry*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s10533-014-9950-9.

Hwang, Taehee, Lawrence E. Band, Chelcy Ford Miniatt, Conghee Song, Paul V. Conghe, James M. Vose and Jason P. Love (2014). Divergent phenological response to hydroclimate variability in forested mountain watersheds. *Global Change Biology*. 20 2580-2595. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12556

Jackson, C. Rhett, David S. Leigh and John F. Chamblee (2014). Herbaceous versus forested riparian vegetation: narrow and simple versus wide, woody and diverse stream habitat. *River Research and Applications*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/rra.2783

Jackson, C. Rhett, Menberu Bitew and Enhao Du (2014). When interflow also percolates: Downslope travel distances and hillslope process zones. *Hydrological Processes*. 28 3195-3200. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/hyp.10158

Jackson, M. M., Monica G. Turner and Scott M. Pearson (2014). Logging legacies affect insect pollinator communities in southern Appalachian forests. *Southeastern Naturalist*. 13 (2), 317-336. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1656/058.013.0213

Jensen, Carrie K., David S. Leigh and C. Rhett Jackson (2014). Scales and arrangements of large wood in first- through fifth-order streams of the Blue Ridge Mountains. *Physical Geography*. 35 (6), 532-560. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1080/02723646.2014.958798

Johnson, Laura T., Jennifer L. Tank, Robert O. Hall, Patrick J. Mulholland, Stephen K. Hamilton, H. Maurine Valett, Jackson R. Webster, Melody J. Bernot, William H. McDowell, Bruce J. Peterson and Suzanne M. Thomas (2013). Quantifying the production of dissolved organic nitrogen in headwater streams using 15N tracer additions. *Limnology and Oceanography*. 58 (4), 1271-1285. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.4319/lo.2013.58.4.1271

King, Joshua R., Robert J. Warren and Mark A. Bradford (2013). Social Insects Dominate Eastern US Temperate Hardwood Forest Macroinvertebrate Communities in Warmer Regions. *PLOS ONE*. 8 (10), 1-11. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0075843

Kirsch, Joseph E. and James T. Peterson (2014). A Multi-scaled Approach to Evaluating the Fish Assemblage Structure within Southern Appalachian Streams. *Transactions of the American Fisheries Society*. 143 (5), 1358-1371. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1080/00028487.2014.935478

Leigh, David, S. and James C. Rogers (2013). Modeling stream-bank erosion in the Southern Blue Ridge Mountains. *Physical Geography*. 34 (4-5), 354-372. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1080/02723646.2013.846745

Lin, Laurence and Jackson R. Webster (2014). Detritus decomposition and nutrient dynamics in a forested headwater stream. *Ecological Modeling*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.ecolmodel.2013.12.013

Long, S.L. and C.R. Jackson. (2014). Variation of stream temperature among mesoscale habitats within stream reaches: southern Appalachians.. *Hydrological Processes*. 28 3041-3052. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/hyp.9818

McDonnell, T.C., T.J. Sullivan, B.J. Cosby, W.A. Jackson and K.J. Elliott (2013). Effects of climate, land management, and sulfur deposition on soil base cation supply in National Forests of the southern Appalachian mountains. *Water Air Soil Pollution*. 224 (1733), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s11270-013-1733-8

Milanovich, Joseph R. and John C. Maerz (2013). Realistic Fasting Does Not Affect Stable Isotope Levels of a Metabolically Efficient Salamander. *Journal of Herpetology*. 47 (4), 544-548. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1670/12-223

Mitchell, R.J., Y. Liu, J.J. O'Brien, K.J. Elliott, G. Starr, C. Ford Miniatt, and J.K. Hiers (2014). Future climate and fire interactions in the southeastern region of the United States. *Forest Ecology and Management*. 327 316-326. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.foreco.2013.12.003

Norman, J.S. and J. E. Barrett (2013). Substrate and nutrient limitation of ammonia-oxidizing bacteria and archaea in temperate forest soil. *Soil Biology & Biochemistry*. 69 141-146. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.soilbio.2013.11.003

Norman, J.S. and J. E. Barrett (2014). Substrate and nutrient limitation of ammonia-oxidizing bacteria and archaea in temperate forest soil. *Soil Biology & Biochemistry*. 69 141-146. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 0.1016/j.soilbio.2013.11.003

Northington, R.M., J.R. Webster, E. F. Benfield, B. M. Cheever and B.R. and B.R. Niederlehner. (2013). Ecosystem function in headwater streams during active infestation by hemlock woolly adelgid. *PLoS ONE*. 8 (4), 61171. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 0.1371/journal.pone.0061171

Novick, K.A., J. Walker, W.S. Chan, A. Schmidt, C. Sobek and J.M. Vose (2013). Eddy covariance measurements with a new fast-response, enclosed-path analyzer: Spectral characteristics and cross-system comparisons. *Agricultural and Forest Meteorology*. 181 17-32. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.agrformet.2013.06.020

Novick, Kimberly A., Steven T. Brantley, Chelcy Ford Miniati, J. Walker and J. M. Vose (2014). Inferring the contribution of advection to total ecosystem scalar fluxes over a tall forest in complex terrain. *Agricultural and Forest Meteorology*. 185 1-13. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.agrformet.2013.10.010

Oishi, A. Christopher, Sari Palmroth, Kurt H. Johnsen, Heather R. McCarthy and Ram Oren (2014). Sustained effects of atmospheric [CO₂] and nitrogen availability on forest soil CO₂ efflux. *Global Change Biology*. 20 1146-1160. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12414

Rice, Joshua, S. and Ryan E. Emanuel (2014). Landscape position and spatial patterns in the distribution of land use within the southern Appalachian Mountains. *Physical Geography*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1080/02723646.2014.909218

Rocca, Monique E., Chelcy Ford Miniati and Robert J. Mitchell (2014). Introduction to the regional assessments: Climate change, wildfire, and forest ecosystem services in the USA. *Forest Ecology and Management*. 327 265-268. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.foreco.2014.06.007

Shepherd, J. Marshall, Theresa Andersen, Christopher Strother, Wayne A. Horst, L. Bounoua, and C. Mitra (2013). Urban climate archipelagos: a new framework for urban impacts on climate. *earthzine*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Vercoe, R., M. Welch-Devine, N. Heynen, R.D. Hardy, J. Demoss, S. Bonney, K. Allen, J.P. Brosius, D. Charles, B. Crawford, S. Heisel, R. de Jesús-Crespo, N. Nibbelink, L. Parker, C. Pringle, A. Shaw, L. Van Sant. (2014). Acknowledging Trade-offs and Understanding Complexity: Exurbanization issues in Macon County, North Carolina.. *Ecology and Society*. 19 (1), 23. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; OTHER: <http://www.ecologyandsociety.org/vol19/iss1/art23>

Warren, Robert J., II, Itamar Giladi and Mark A. Bradford (2014). Competition as a Mechanism Structuring Mutualisms. *Journal of Ecology*. 102 486-495. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/1365-2745.12203

Welch-Devine, M. R. D. Hardy, J. P. Brosius and Nik Heynen (2014). A Pedagogical Model for Integrative Training in Conservation and Sustainability. *Ecology and Society*. 19 (2), 10. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.5751/ES-06197-190210

Wu, Wei, James S. Clark and James M. Vose (2014). Response of hydrology to climate change in the southern Appalachian Mountains using Bayesian inference. *Hydrological Processes*. 28 1616-1626. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/hyp.9677

Wurzburger, Nina and Chelcy Ford Miniati (2014). Drought enhances symbiotic dinitrogen fixation and competitive ability of a temperate forest tree. *Oecologia*. 174 1117-1126. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s00442-013-2851-0

Yanai, Ruth D., Naoko Tokuchi, John L. Campbell, Mark B. Green, Eiji Matsuzaki, Stephanie N. Laseter, Cindi L. Brown, Amey S. Bailey, Pilar Lyons, Carroe R. Levine, Donald C. Buso, Gene E. Likens, Jennifer D. Knoepp and Keitaro Fukushima (2014). Sources of uncertainty in estimating stream solute export from headwater catchments at three sites. *Hydrological Processes*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/hyp.10265

Zhu, Kai, Christopher W. Woodall, Souprano Ghosh, Alan E. Gelfand and James S. Clark (2014). Dual impacts of climate change: forest migration and turnover through life history. *Global Change Biology*. 20 251-264. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gcb.12382

Licenses

Other Products

Other Publications

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B4. April 18, (2014). *A healthy stream is a functioning stream*. How do you know if a stream isn't healthy? Do you take its temperature? Check to see if it's in pain? Or do you simply notice that something isn't right? Unusual stream flows can indicate a stream is unhealthy. If a stream is not flowing normally, that usually indicates it is unhealthy. Maybe the water is gushing faster than usual. Perhaps where there were once schools of fish there are now none. Changes like this would most likely be evident to anyone who spent a lot of time with the stream. But what if the stream change took place over decades instead of days?. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B4. April 4, (2014). *Beauty is in the eye of the... fish?*. We've all heard the saying, "Beauty is in the eye of the beholder." The truth behind this well-known phrase is obvious when you visit some of the many streams of the southern Appalachian Mountains, because each person's idea of beauty determines the state of their land and streams. Do streams that appear "pretty" or "clean" to us also function as "healthy" streams? The answer to that question is a matter of perspective. To gain some perspective, let us consider a "beautiful" stream from the eyes of a fish.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B4. February 21 (2014). *Collaboration: LTLT and UGA students form partnership*. A new partnership is expected to strengthen the existing relationship between the Land Trust for the Little Tennessee (LTLT) and the University of Georgia (UGA). Eleven PhD students from UGA's Integrative Conservation (ICON) Program have committed their academic spring semester to help LTLT and ICON partner, extending the existing relationships between the Coweeta Long Term Ecological Research (LTER) Project and local community members. The new collaboration, initiated by Jason Meader and Bill McLarney of LTLT and Drs. Cathy Pringle and Nik Heynen of ICON/LTER, was established with the hope that the partnership will be sustainable and extend beyond this original semester-long timeframe.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. "Daniel Reategui and the Coweeta Listening Project Writing Collective." The Franklin Press. Column on "Science, Public Policy, Community." Page B4. November 8, (2013). *Daniel Reategui and Citizen Science*. Over the years, science has changed from the experiments of curious tinkerers in their home-based labs and in isolated field sites to include the full-time work of large teams in million-dollar facilities and extensive field station activities. This transition to Big Science has brought impressive innovations, but it also makes science more distant from people's everyday lives and experiences, sometimes even ignoring important local knowledge. But a new wave of scientists is trying to rebuild that connection by involving residents in conducting scientific research. In this column, Daniel Reategui explains how.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B4. January 24, (2014). *How America is preparing for a changing climate*. A new study by researchers from the health, environmental, business and university sectors has concluded that America is doing "more than before" when it comes to climate preparedness, "but less than needed." Given that some degree of climate change is inevitable, even if we halt all new green-house gas emissions today, they conclude that we need to do more to ensure that America's health, economy, and environment will be safe in a changed future.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B4. January 10, (2014). *Invasion: Japanese Stilt-grass*. Here in

southern Appalachia, we have an interesting invasive plant invader that Coweeta LTER Scientists have been studying. Japanese Stilt- grass — also known as Nepalese Browntop or porcelain packing grass — (*Microrstegium vimineum*) is a shade-tolerant annual grass in our forests that we think deserves more attention given some of the changes it is causing within local ecosystems. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B4. February 7, (2014). *The economics of conservation*. The majority of lands in western North Carolina are under private ownership. In Macon County, for example, private owners control 64 percent (180,000 acres) of the land. Land owners can play an important role in ensuring the benefits of nature, such as maintaining water quality, connecting natural areas, and providing wildlife habitat. In North Carolina there are options available that help keep private land intact as conserved natural areas or as working farms and forests through tools that include conservation easements and by enrolling land to be taxed at its "present use value.". Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B8. November 22, (2013). *Transformative Science at the LTER*. One of the main reasons the Coweeta Listening Project (CLP) began writing our regular column was that it was made clear to us that community members did not have a good sense of what the Coweeta Long-Term Ecological Research Project has accomplished since it started in 1980. In this column, we want to take the opportunity to mention, in a straightforward way, the sorts of "transformative" science that has been accomplished over the decades within your community.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B4. December 6, (2013). *Urbanization effects on local birds*. While the economic recession of 2008 resulted in a significant slowdown in new housing developments in southwestern North Carolina, it presented a unique research opportunity for LTER researchers Camille Beasley and Dr. Jeff Hepinstall-Cymerman of the University of Georgia to study birds and urbanization in the region.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B4. March 7 (2014). *Visual Assessment Protocol defined*. We hope you had a chance to read our last column, and if you did, you'll know that Ph.D. students from the University of Georgia's Integrative Conservation (ICON) program are working with the Land Trust for the Little Tennessee (LTLT) and the Coweeta Long Term Ecological Research (LTER) Project this spring to develop a plan for implementing a new southern Appalachian Stream Visual Assessment Protocol (saSVAP) specific to this region, adapted by Jeremy Sullivan, a Ph.D. candidate at UGA. But what is a Stream Visual Assessment Protocol, and why is it important for the region?. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coweeta Listening Project. The Franklin Press. Column on "Science, Public Policy, Community." Page B4. March 21 (2014). *What is a stream, anyway?*. If you have been following our recent columns, you already know about a new partnership between students from the University of Georgia's Integrative Conservation (ICON) program, the Land Trust for the Little Tennessee (LTLT), and the Coweeta Long Term Ecological Research (LTER) Project this spring.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Patents

Technologies or Techniques

Thesis/Dissertations

Barlow, Paige, F.. *Ecological, economic, and social dynamics associated with exurban development in southern appalachia*. (2014). University of Georgia. Acknowledgement of Federal Support = Yes

Norman, Jeffrey S.. *Environmental Controls on the Diversity, Growth, and Activity of Ammonia-Oxidizing Microorganisms in Temperate Forest Soils*. (2013). Virginia Polytechnic Institute and State University. Acknowledgement of Federal Support = Yes

Evans, Sakura, R.. *Exurbanizing water: stream management decision-making among newcomer and generational landowners in southern Appalachia*. (2013). University of Georgia. Acknowledgement of Federal Support = Yes

Lin, Laurence. *Influences of mountainside residential development to nutrient dynamics in a stream network*. (2013). Virginia Polytechnic Institute and State University. Acknowledgement of Federal Support = Yes

Rice, Joshua Sayre. *Land Use and Runoff Generation in the Southern Appalachian Mountains*. (2013). North Carolina State University. Acknowledgement of Federal Support = Yes

Ripken, Malena. *Quantifying links between natural forcing and human impacts on two southern Appalachian headwater catchments, Coweeta Hydrologic Laboratory (western North Carolina, USA)*. (2013). Universitat Bremen. Acknowledgement of Federal Support = Yes

Hart, Adam M.. *Seasonal Variation in Whole Stream Metabolism across Varying Land Use Types*. (2013). Virginia Polytechnic Institute and State University. Acknowledgement of Federal Support = Yes

Younger, Seth Edward. *Sediment source ascription of forest roads in the Upper Little Tennessee River Basin*. (2013). University of Georgia. Acknowledgement of Federal Support = Yes

Gustafson, James Seth. *Urban Political Ecology and Exurban Environmental Knowledge in Poast-2008 Southern Appalachia*. (2014). University of Georgia. Acknowledgement of Federal Support = Yes

Websites

Participants/Organizations

Research Experience for Undergraduates (REU) funding

Form of REU funding support: REU supplement

How many REU applications were received during this reporting period? 2

How many REU applicants were selected and agreed to participate during this reporting period? 2

REU Comments:

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Gragson, Theodore	PD/PI	4
Band, Lawrence	Co-Investigator	1

Name	Most Senior Project Role	Nearest Person Month Worked
Barrett, John	Co-Investigator	1
Benfield, Fred	Co-Investigator	3
Bolstad, Paul	Co-Investigator	1
Clark, James	Co-Investigator	2
Dehring, Carolyn	Co-Investigator	1
Depken, Craig	Co-Investigator	1
Elliott, Katherine	Co-Investigator	1
Emanuel, Ryan	Co-Investigator	1
Ford Miniati, Chelcy	Co-Investigator	3
Fraterrigo, Jennifer	Co-Investigator	1
Freeman, Mary	Co-Investigator	1
Hepinstall-Cymerman, Jeff	Co-Investigator	1
Heynen, Nik	Co-Investigator	1
Jackson, Rhett	Co-Investigator	2
Knoepp, Jennifer	Co-Investigator	2
Leigh, David	Co-Investigator	1
Maerz, John	Co-Investigator	1
Mohan, Jackie	Co-Investigator	1
Pearson, Scott	Co-Investigator	1
Pringle, Catherine	Co-Investigator	2
Rice, Jennifer	Co-Investigator	1
Shepherd, Marshall	Co-Investigator	5
Swank, Wayne	Co-Investigator	1
Turner, Monica	Co-Investigator	1
Webster, Jackson	Co-Investigator	3
Welch-Devine, Meredith	Co-Investigator	1
Wurzburger, Nina	Co-Investigator	1
Brooks, Joshua	K-12 Teacher	0
Bernades, Sergio	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Brantley, Steven	Postdoctoral (scholar, fellow or other postdoctoral position)	3
Burke, Brian	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Hwang, Taehee	Postdoctoral (scholar, fellow or other postdoctoral position)	6
Kim, Yuri	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Oishi, Christopher	Postdoctoral (scholar, fellow or other postdoctoral position)	1

Name	Most Senior Project Role	Nearest Person Month Worked
Bahn, Robert	Other Professional	2
Brown, Cindi	Other Professional	9
Caldwell, Peter	Other Professional	3
Chamblee, John	Other Professional	12
Clinton, Patsy	Other Professional	1
Fowler, Randy	Other Professional	1
Kinney Terrell, Vanessa	Other Professional	1
Laseter, Stephanie	Other Professional	6
Love, Jason	Other Professional	12
Niederlehner, Bobbie	Other Professional	6
Smith, Sarah	Other Professional	3
Benson, Robert	Technician	1
Bower, Katherine	Technician	12
Cary, Richard	Technician	8
Gregory, Sheila	Technician	12
Harper, Carol	Technician	12
Herndon, Brian	Technician	8
Hopey, Mark	Technician	0
Hubinger, Christine	Technician	6
Marshall, Charles	Technician	6
McCollum, Robert	Technician	1
Muldoon, Neal	Technician	3
Scott, Joel	Technician	12
Sobek, Chris	Technician	3
Vulova, Stenka	Technician	6
Welch, Brandon	Technician	12
Allen, Karen	Graduate Student (research assistant)	6
Baas, Peter	Graduate Student (research assistant)	9
Barlow, Paige	Graduate Student (research assistant)	4
Bell, Dave	Graduate Student (research assistant)	0
Cameron, Christopher	Graduate Student (research assistant)	1
Coats, Alan	Graduate Student (research assistant)	1
Coughlan, Michael	Graduate Student (research assistant)	6
Dudley, Maura	Graduate Student (research assistant)	5

Name	Most Senior Project Role	Nearest Person Month Worked
Duncan, Jon	Graduate Student (research assistant)	3
Dymond, Salli	Graduate Student (research assistant)	6
Evans, Sakura	Graduate Student (research assistant)	6
Fisher, Elizabeth	Graduate Student (research assistant)	9
Gosak, Ben	Graduate Student (research assistant)	6
Graves, Rose	Graduate Student (research assistant)	5
Gustafson, Seth	Graduate Student (research assistant)	9
Jensen, Carrie	Graduate Student (research assistant)	2
Joshua, Rice	Graduate Student (research assistant)	1
Kraseski, Kristin	Graduate Student (research assistant)	5
Kwit, Matt	Graduate Student (research assistant)	0
Lin, Laurence	Graduate Student (research assistant)	6
McDonald, Jacob	Graduate Student (research assistant)	9
Miles, Brian	Graduate Student (research assistant)	6
Muller, Kristen	Graduate Student (research assistant)	6
Nicholson, Joseph	Graduate Student (research assistant)	3
Pringle, Ross	Graduate Student (research assistant)	9
Scaife, Charles	Graduate Student (research assistant)	4
Sorrells, Robert	Graduate Student (research assistant)	1
Stine, Anne	Graduate Student (research assistant)	0
Sullivan, Jeremy	Graduate Student (research assistant)	5
Tomasek, Brad	Graduate Student (research assistant)	3
Younger, Seth	Graduate Student (research assistant)	1
Zhu, Kai	Graduate Student (research assistant)	0
Becker, Cassidy	Undergraduate Student	1
Bell, Eleanor	Undergraduate Student	3
Bhuiyan, Ridwan	Undergraduate Student	2
Bilcik, Emily	Undergraduate Student	1
Chitwood, Ryan	Undergraduate Student	1
Falkner, Amber	Undergraduate Student	1
Fulmeral, Alexander	Undergraduate Student	1
Gooden, Molly	Undergraduate Student	0
Hunt, James	Undergraduate Student	1
Kidd, Anjelika	Undergraduate Student	0

Name	Most Senior Project Role	Nearest Person Month Worked
Lancaster, Grace	Undergraduate Student	0
Lynn, Rebecca	Undergraduate Student	1
Rowe, Pamela	Undergraduate Student	1
Soker, David	Undergraduate Student	1
Allen, Mary Beth	Other	0
Bellflower, Suzanne	Other	0
Bitew, Menberu	Other	0
Booth, Derek	Other	0
Chandler, Richard	Other	0
Clapp, Roger	Other	0
Cohen, Emily	Other	0
Conroy, Michael	Other	0
Cooper, Robert	Other	0
Desmond, Dennis	Other	0
Du, Enhao	Other	0
Flowers, Kathy	Other	3
Fraley, Stephen	Other	0
Francis, Judy	Other	0
Fuller, Scarlett	Other	0
Hales, TC	Other	0
Hopey, Mark	Other	0
Leslie, Andrea	Other	0
Long, Dwight	Other	0
Love, Jennifer	Other	0
McLarney, Bill	Other	0
Meador, Jason	Other	0
Meador, Kristen	Other	0
Monar, Kelder	Other	0
Moore, Callie	Other	0
Newbold, Denis	Other	0
Peeples, Gary	Other	0
Phillips, Brian	Other	0
Plemmons, Heather	Other	0
Reategui, Daniel	Other	8

Name	Most Senior Project Role	Nearest Person Month Worked
Sharma, Ajay	Other	0
Smathers, Stephanie	Other	0
Sprague, Lynn	Other	0
West, Shannon	Other	0
Williams, Ed	Other	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: 4

Contribution to the Project: Lead Principal Investigator serving as point of contact for NSF-DEB and UGA-Sponsored Programs, and responsible for scientific and fiscal oversight on the project.

Funding Support: Partial support from NSF

International Collaboration: Yes, France

International Travel: Yes, France - 0 years, 0 months, 20 days

Lawrence 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: None, other than this award.

International Collaboration: No

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: Investigating controls over nitrogen cycling in hillslope soils in a variety of watersheds by examining controls over the distribution of soil nitrifying microbes and their role in mobilization of nitrogen in Coweeta watersheds.

Funding Support: None, other than this award.

International Collaboration: No

International Travel: No

Fred E. Benfield

Email: benfield@vt.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 3

Contribution to the Project: Organic matter decomposition in streams, Historic and contemporary land use effects on stream structure and function

Funding Support: None, other than this award

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: Focusing on projects related to forest ecosystems process, chiefly mass and water cycles, and land cover and land use change, chiefly land use change measurement and modeling through time.

Funding Support: None, other than this award

International Collaboration: No

International Travel: No

James S. Clark

Email: jimclark@duke.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 2

Contribution to the Project: Consequences of climate, CO2, and disturbance on dynamics of forests.

Funding Support: DEB, LTER, DOE, ONR

International Collaboration: No

International Travel: No

Carolyn Dehring

Email: cdehring@terry.uga.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Working on research papers pertaining to steep slope regulations and land pricing, and also to flood and landslide risk

Funding Support: None, other than this award.

International Collaboration: No

International Travel: No

Craig Depken

Email: cdepken@uncc.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Social science research focusing on applied economics and applied econometrics.

Funding Support: None, other than this award

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: Forest Service

International Collaboration: No

International Travel: No

Ryan Emanuel

Email: ryan_emanuel@ncsu.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: quantify differences in shallow subsurface hydrological processes among land use types at seasonal and yearly time scales

Funding Support: None, other than this award.

International Collaboration: No

International Travel: No

Chelcy Ford Miniati

Email: cfminiati@fs.fed.us

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 3

Contribution to the Project: Evaluating, explaining, and predicting how water, soil, forest, and aquatic resources respond to ecosystem management practices, natural disturbances, and the atmospheric environment; and to identify practices that restore, protect, and enhance watershed health.

Funding Support: USDA Forest Service

International Collaboration: No

International Travel: No

Jennifer Fraterrigo**Email:** jmf@illinois.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1**Contribution to the Project:** Biodiversity and ecosystem processes**Funding Support:** None, other than this award.**International Collaboration:** No**International Travel:** No

Mary C. Freeman**Email:** mcfreeman@usgs.gov**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1**Contribution to the Project:** temporal trends in stream fish abundances**Funding Support:** None, other than this award**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:** Investigating the effects of land use, elevation, predator communities on avian communities and nest predation rates; and the interplay of spring greenup (vegetation phenology) and elevation. Developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within Southern Appalachians.**Funding Support:** None, other than this award**International Collaboration:** No**International Travel:** No

Nik Heynen**Email:** nheynen@uga.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1**Contribution to the Project:** Coweeta Listening Project**Funding Support:** None, other than this award.**International Collaboration:** No**International Travel:** No

Rhett Jackson**Email:** rjackson@warnell.uga.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 2**Contribution to the Project:** Investigating effects of land use activities on hydrology, water quality, and aquatic habitat. Stream temperature modeling. Collaborating with ecologists to investigate abiotic controls on aquatic ecosystems.**Funding Support:** Warnell school, NSF, McEntire Stennis, various**International Collaboration:** No**International Travel:** No

Jennifer Knoepp**Email:** jknoepp@fs.fed.us**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 2**Contribution to the Project:** Focused on selection and installation of intensive plots to examine the impact of exurbanization on hillslope water and nutrient transport. Partial support for activities from Coweeta LTER.**Funding Support:** USDA Forest Service**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:** PI (geomorphologist)**Funding Support:** None, other than this award.**International Collaboration:** No**International Travel:** No

John Maerz**Email:** jcmaerz@uga.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1**Contribution to the Project:** Monitoring salamanders at synoptic sites including mark-recapture of terrestrial salamanders at long-term plots along an elevation gradient.**Funding Support:** None, other than this award.**International Collaboration:** No**International Travel:** No

Jackie Mohan**Email:** jmohan@uga.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1**Contribution to the Project:** Global Change Ecology/ Forest Dynamics**Funding Support:** None, other than this award.**International Collaboration:** No**International Travel:** No

Scott Pearson**Email:** spearson@mhu.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1**Contribution to the Project:** landscape, population, conservation ecology**Funding Support:** None, other than this award**International Collaboration:** No**International Travel:** No

Catherine Pringle**Email:** cpringle@uga.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 2**Contribution to the Project:** Planning and coordination (with graduate student) of algal sampling and experiments that were conducted in four focal streams prior to rhododendron removal treatment and manuscript preparation (with graduate student) for CWT Hazard Site Project.**Funding Support:** None, other than this award**International Collaboration:** No**International Travel:** No

Jennifer L. Rice**Email:** jlrice@uga.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1**Contribution to the Project:** Examine the role of various forms of knowledge in understanding and responding to socio-environmental change in southern Appalachia**Funding Support:** None, other than this award.**International Collaboration:** No**International Travel:** No

Marshall Shepherd**Email:** marshgeo@uga.edu**Most Senior Project Role:** Co-Investigator

Nearest Person Month Worked: 5

Contribution to the Project: Project and scientific leadership and analysis

Funding Support: None, other than this award.

International Collaboration: No

International Travel: No

Wayne T. Swank

Email: wswank@uga.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Forest hydrology and ecology

Funding Support: US Forest Service

International Collaboration: No

International Travel: No

Monica Turner

Email: turnermg@wisc.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Extending out long-term studies of climate and land use on plant and bird communities to biodiversity-based ecosystem services.

Funding Support: None, other than this award.

International Collaboration: No

International Travel: No

Jackson R. Webster

Email: jwebster@vt.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 3

Contribution to the Project: Working on intensive sampling of hillslope sites, synthesis of work describing the effect of hemlock mortality on streams, and developing simulation models for nitrogen dynamics in streams.

Funding Support: None, other than this award.

International Collaboration: No

International Travel: No

Meredith Welch-Devine

Email: mwdevine@uga.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: Participation in Coweeta Listing Project activities, including but not limited to: data collection and analysis for self-study, production of newspaper columns, submission of multiple journal articles on themes of communicating LTER science.

Funding Support: None, other than this award

International Collaboration: No

International Travel: No

Nina Wurzburger

Email: ninawurz@uga.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

Contribution to the Project: biogeochemical processes of terrestrial ecosystems

Funding Support: None, other than this award

International Collaboration: No

International Travel: No

Joshua Brooks

Email: jbrooks@swainmail.org

Most Senior Project Role: K-12 Teacher

Nearest Person Month Worked: 0

Contribution to the Project: Collaborator is a teacher associated with Coweeta LTER Schoolyard program.

Funding Support: None, other than this award

International Collaboration: No

International Travel: No

Sergio Bernades

Email: sbernard@uga.edu

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 1

Contribution to the Project: Data processing and analysis. Software development. Article preparation.

Funding Support: None, other than this award

International Collaboration: No

International Travel: No

Steven Brantley

Email: sbrantley@umn.edu

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 3

Contribution to the Project: Investigating scaling of component ecosystem fluxes (i.e., transpiration, soil respiration, soil evaporation, etc.) to the eddy covariance-based ecosystem flux measurements.

Funding Support: Federal grant external to DEB-0823293.

International Collaboration: No

International Travel: No

Brian Burke

Email: bjburke@uga.edu

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 0

Contribution to the Project: Coweeta Listening Project

Funding Support: None, other than this award.

International Collaboration: No

International Travel: No

Taehee Hwang

Email: h7666@email.unc.edu

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 6

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

Yuri Kim

Email: yuri513@email.unc.edu

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 1

Contribution to the Project: Developed watershed models for the Little Tennessee Watershed

Funding Support: NSF CWT LTER NC DENR

International Collaboration: No

International Travel: No

Christopher A. Oishi

Email: acoishi@fs.fed.us

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 1

Contribution to the Project: Ecophysiology and Micrometeorology

Funding Support: US Forest Service

International Collaboration: No

International Travel: No

Robert Bahn

Email: bahnr@uga.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 2

Contribution to the Project: Provided data collection and analysis support.

Funding Support: Combination of state and federal funds external to LTER.

International Collaboration: No

International Travel: No

Cindi L. Brown

Email: clbrown@fs.fed.us

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 9

Contribution to the Project: Chemistry lab manager.

Funding Support: USDA Forest Service

International Collaboration: No

International Travel: No

Peter V. Caldwell

Email: pcaldwell02@fs.fed.us

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 3

Contribution to the Project: Hydrologist

Funding Support: US Forest Service

International Collaboration: No

International Travel: No

John F Chamblee

Email: chamblee@uga.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 12

Contribution to the Project: Development of relational databases, GIS datasets, and socio-economic assessments pertaining to land parcel, land sale history, and environmental protection, and maintenance and updating of the Coweeta LTER Website. Partial support for activities from Coweeta LTER.

Funding Support: Core staff. Funded by DEB-0823293. ARRA-funded Service Agreement for Software Development with the LTER Network Office at the University of New Mexico.

International Collaboration: No

International Travel: No

Patsy Clinton

Email: pclinton@fs.fed.us

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Administrative

Funding Support: Forest Service

International Collaboration: No

International Travel: No

Randy Fowler

Email: rlfowler@fs.fed.us

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Biological Scientist

Funding Support: US Forest Service

International Collaboration: No
International Travel: No

Vanessa Kinney Terrell
Email: vkinney@uga.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Monitoring salamanders at synoptic sites including mark-recapture of terrestrial salamanders at long-term plots along an elevation gradient.

Funding Support: None, other than this award.

International Collaboration: No
International Travel: No

Stephanie Laseter
Email: slaseter@fs.fed.us
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 6

Contribution to the Project: Hydrologist

Funding Support: US Forest Service

International Collaboration: No
International Travel: No

Jason Love
Email: jplove@uga.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: Site Manager, oversaw LTER Schoolyard program planning and educational programs, supports project activities including collecting, QC, and archiving of data, and management of vehicles and facilities.

Funding Support: Core staff. Funded by DEB-0823293.

International Collaboration: No
International Travel: No

Bobbie Niederlehner
Email: bnieder@vt.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 6

Contribution to the Project: Sample processing, chemical analyses, data synthesis and statistical analysis of long-term data related to hemlock mortality. Maintains of equipment in our analytical laboratory, trains graduate and undergraduate in lab techniques and data quality assurance.

Funding Support: None, other than this award

International Collaboration: No
International Travel: No

Sarah Smith
Email: sarahsmith@fs.fed.us
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: Administrative

Funding Support: US Forest Service

International Collaboration: No
International Travel: No

Robert W Benson
Email: rwbenson@uga.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Increasing data availability by preparing GIS data for inclusion in PASTA

Funding Support: None, other than this award.

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Cardiff University	Academic Institution	United Kingdom
Duke University	Academic Institution	Durham NC
North Carolina State University	Academic Institution	Raleigh NC
Northeast Georgia - Georgia Youth Science and Technology Cen	School or School Systems	Cleveland, GA
Rabun Gap-Nacoochee School	School or School Systems	Rabun Gap, GA
Smithsonian Institution	State or Local Government	Washington, D.C.
Southern Appalachian Raptor Research	Other Nonprofits	Mars Hill, NC
Southwestern NC Resource Conservation and Development Council	Other Nonprofits	Waynesville, NC
Stroud Water Research Center	Other Nonprofits	Avondale, PA
Swain Middle School	School or School Systems	Swain County, NC
Trimont Christian Academy	School or School Systems	Franklin, NC
US Fish and Wildlife Service	State or Local Government	Asheville, NC
Hiwassee River Watershed Coalition	Other Nonprofits	Murphy, NC
USFS Coweeta Hydrologic Laboratory	State or Local Government	Otto NC
Univ. of Cal. at Santa Barbara	Academic Institution	Santa Barbara, CA.
University of Illinois	Academic Institution	Champaign IL
University of Minnesota	Academic Institution	Minneapolis MN
University of North Carolina	Academic Institution	Chapel Hill NC
University of Wisconsin	Academic Institution	Madison WI
Virginia Polytechnic Institute & State University	Academic Institution	Blacksburg VA
Watershed Association of the Tuckasegee River	Other Nonprofits	Bryson City, NC
Yale University	Academic Institution	New Haven CT
Land Trust for the Little Tennessee	Other Nonprofits	Franklin NC
Lawrence Berkeley National Laboratory	State or Local Government	Berkeley, California
Macon County Schools	School or School Systems	Macon County, NC
Mars Hill College	Academic Institution	Mars Hill NC
NC Division of Water Resources	State or Local Government	Asheville, NC
NC Natural Heritage Program	State or Local Government	North Carolina
NC Wildlife Resources Commission	State or Local Government	North Carolina

Full details of organizations that have been involved as partners:**Cardiff University****Organization Type:** Academic Institution**Organization Location:** United Kingdom**Partner's Contribution to the Project:**

Collaborative Research

More Detail on Partner and Contribution: Collaboration on measurement of root cohesion and structure, analysis of spatial distribution of root properties, simulation of

landslide distributions

Duke University

Organization Type: Academic Institution

Organization Location: Durham NC

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: Faculty are co-PIs on the LTER project, are active in project research and supervising graduate students.

Hiwassee River Watershed Coalition

Organization Type: Other Nonprofits

Organization Location: Murphy, NC

Partner's Contribution to the Project:

Facilities

Personnel Exchanges

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

Land Trust for the Little Tennessee

Organization Type: Other Nonprofits

Organization Location: Franklin NC

Partner's Contribution to the Project:

Facilities

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: This local NGO is the principal local partner in the project area helping to coordinate community engagement events and providing venues for some events.

Lawrence Berkeley National Laboratory

Organization Type: State or Local Government

Organization Location: Berkeley, California

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: Modeling, data interpretation, spatial analysis

Macon County Schools

Organization Type: School or School Systems

Organization Location: Macon County, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: Collaborator is a teacher associated with Coweeta LTER Schoolyard program.

Mars Hill College

Organization Type: Academic Institution

Organization Location: Mars Hill NC

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: Faculty are co-PIs on the LTER project, are active in project research and supervising graduate students.

NC Division of Water Resources

Organization Type: State or Local Government

Organization Location: Asheville, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

NC Natural Heritage Program

Organization Type: State or Local Government

Organization Location: North Carolina

Partner's Contribution to the Project:

Facilities

Personnel Exchanges

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

NC Wildlife Resources Commission

Organization Type: State or Local Government

Organization Location: North Carolina

Partner's Contribution to the Project:

Facilities

Personnel Exchanges

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

North Carolina State University

Organization Type: Academic Institution

Organization Location: Raleigh NC

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: Faculty are co-PIs on the LTER project, are active in project research and supervising graduate students.

Northeast Georgia - Georgia Youth Science and Technology Cen

Organization Type: School or School Systems

Organization Location: Cleveland, GA

Partner's Contribution to the Project:

Facilities

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

Rabun Gap-Nacoochee School

Organization Type: School or School Systems

Organization Location: Rabun Gap, GA

Partner's Contribution to the Project:

Facilities

Personnel Exchanges

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

Smithsonian Institution

Organization Type: State or Local Government

Organization Location: Washington, D.C.

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: Collaborated on study of effects of landscape change on migratory birds

Southern Appalachian Raptor Research

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

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

Southwestern NC Resource Conservation and Development Council

Organization Type: Other Nonprofits
Organization Location: Waynesville, NC

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution: Collaborator and overseer of the Section 319 Non Point Source Pollution Control Grant which helps fund part of the Macon County Kids in the Creek program.

Stroud Water Research Center

Organization Type: Other Nonprofits
Organization Location: Avondale, PA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Collaborator from Stroud Water Research Center, investigating the flow of nutrients (primarily nitrogen, phosphorus and carbon) to streams and rivers and how those nutrients are processed, transformed and transported by the stream and river ecosystem.

Swain Middle School

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

Partner's Contribution to the Project:
Personnel Exchanges

More Detail on Partner and Contribution: Collaborator is a teacher associated with Coweeta LTER Schoolyard program.

Trimont Christian Academy

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

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

US Fish and Wildlife Service

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

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

USFS Coweeta Hydrologic Laboratory

Organization Type: State or Local Government
Organization Location: Otto NC

Partner's Contribution to the Project:
Financial support
In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: USFS Coweeta Hydrologic Laboratory is the principal partner in CWT LTER providing a base of field operations, analytical laboratory facilities, and residential and conference facilities.

Univ. of Cal. at Santa Barbara

Organization Type: Academic Institution
Organization Location: Santa Barbara, CA.

Partner's Contribution to the Project:

In-Kind Support
Collaborative Research

More Detail on Partner and Contribution: Data, Interpretation

University of Illinois

Organization Type: Academic Institution
Organization Location: Champaign IL

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: Faculty are co-PIs on the LTER project, are active in project research and supervising graduate students.

University of Minnesota

Organization Type: Academic Institution
Organization Location: Minneapolis MN

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: Faculty are co-PIs on the LTER project, are active in project research and supervising graduate students.

University of North Carolina

Organization Type: Academic Institution
Organization Location: Chapel Hill NC

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: Faculty are co-PIs on the LTER project, are active in project research and supervising graduate students.

University of Wisconsin

Organization Type: Academic Institution
Organization Location: Madison WI

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: Faculty are co-PIs on the LTER project, are active in project research and supervising graduate students.

Virginia Polytechnic Institute & State University

Organization Type: Academic Institution
Organization Location: Blacksburg VA

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: Faculty are co-PIs on the LTER project, are active in project research and supervising graduate students.

Watershed Association of the Tuckasegee River

Organization Type: Other Nonprofits
Organization Location: Bryson City, NC

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution: Collaborator assisted with outreach and education associated with Coweeta LTER Schoolyard program.

Yale University

Organization Type: Academic Institution
Organization Location: New Haven CT

Partner's Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: Faculty are co-PIs on the LTER project, are active in project research and supervising graduate students.

Have other collaborators or contacts been involved? No

Impacts

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

The impact of David Leigh's research on the principal discipline of ecology is providing longer temporal perspectives than are typically available. In addition, his research illustrates the importance of the geomorphic template as the foundation for aquatic habitat. His research is providing key insights into the sensitivity and dynamic nature of the geomorphic template, and a better understanding of long-term human-imprints on the landscape and the newly proposed Anthropocene epoch. More broadly, this research contributes to a better understanding of the prehistoric human influence on changes in the fluvial system, and specifically sedimentation rates. This is an important area of geomorphology.

We are working across disciplines and seeing important bridging of natural and social scientific assumptions about Long-Term SocioEcological Science. Theoretical and empirical advancements through the CLP efforts are pushing understanding on how to better integrate socioecological questions, data collection and analysis. We are also pushing new ways of understanding public engagement with science through the methodologies used through the CLP.

Our work helps to place the ecological and biogeochemical results of this project in a hydrological context. Specifically, the work by Ryan Emanuel shows the importance of both local hydrological conditions (e.g. infiltration and soil water recharge) and watershed-scale processes (e.g. lateral redistribution of shallow groundwater) for vegetation and soil related processes in each land use. Combined with the work by Larry Band, it is possible to assess the impacts in hydrology, geomorphology and geography through development of new theory, technology, methods for analysis and prediction of water resources outcomes of ecohydrological and climate change.

The research by Turner on wildflower resources and bird community diversity introduces a novel approach for empirically estimating provision of biodiversity-based cultural ecosystem services and incorporating temporal dynamics into landscape patterns of ecosystem services.

The research by Fraterrigo on local and regional controls on invader performance contribute to theory concerning ecological niche models and prediction of species distributions. These findings related to land use and invasion interactions, and will contribute to biogeochemical theory, specifically regional controls on plant-soil feedbacks, which are currently poorly understood.

By developing documentation and protocols for the rapid and systematic deployment of new field sensor stations, we have enhanced the ability of researchers to respond to dynamic conditions and major changes that could have an impact on ecological systems. This rapid-response ability may be relevant to studies of resilience and resistance both in the short- and long-term. In addition, the ability to collect near real-time data across basin-level elevational, hydrologic, and climatic gradients is providing an empirical foundation for addressing theoretically significant regional scale ecological questions. In addition, we have increased the potential for cross-site comparisons by adopting a widely shared tool to address data processing and post-processing challenges that are common across the LTER network.

By disentangling the mechanistic effects of soil pH and NH₄⁺ availability on naturally-occurring populations of ammonia oxidizing bacteria and archaea, Barrett found that soil pH and NH₄⁺ availability had largely independent effects on the activity and diversity of each group. He further developed an qPCR-based in situ growth assays based on traditional buried-bag incubations for assessing group-level contributions to soil biogeochemistry that it is hoped will be employed by other researchers. Furthermore, this study provided the first molecular biology-based characterizations of ammonia oxidizer community structure at Coweeta LTER, a site with a long history of transformative research on nitrogen cycling.

Our work is impacting the hydrologic sciences by merging traditional hydrometric approaches for assessing soil and shallow groundwater status and fluxes with isotopic approaches for assessing water sources and residence times.

Our work on salamanders has bridged the ecosystem and organismal foci of Coweeta, and specifically addressed the roles of salamanders in nutrient storage and demand within headwater streams. We have also addressed how salamanders may impact other biodiversity through the manipulation of salamander abundance.

Band developed clear evidence of how forest canopy spatial patterns are adjusting to climate change, and how these changes are directly linked to freshwater availability. He developed remote sensing based technologies to measure forest patterns that can be used to estimate the spatial distribution of freshwater flows from forest catchments. He also demonstrated temporal shifts in forest phenology that diverge over elevational gradients in response to climate change, following interannual and long term shifts in water

balance.

What is the impact on other disciplines?

As part of the Organization committee for the Statistical Ecology Program at NSF, Statistical and Applied Mathematical Sciences Institute (SAMSI), James Clark brought together grads, postdocs, and faculty in ecology, statistics, and mathematics for a year-long program.

Jason Love created a 'Stream Velocity and Discharge' lesson that is now available online. Following are some quotes from the 6th grade students and a grandparent that shed light on how programs like our 'Migration Celebration' are impacting students: A) Thank you for inviting us to come on the field trip and be scientists. Most people would not let us touch animals and bugs, but you did! You even let us run in the woods and catch butterflies! B) I am excited to see if my butterfly makes it to Mexico. I had fun catching butterflies and learning and seeing a bunch of stuff I have never seen before. C) Thank you for letting our school come and learn about butterflies, birds, and insects. I love learning about nature. D) My grandson Mark came home so excited, he said it was one of the best days he ever had! Thank you for sparking an interest for science in these young minds!

Datasets and analyses from our Coweeta LTER work were used in undergraduate and graduate courses taught by Ryan Emanuel at NCSU. Courses included Watershed Hydrology (undergraduate and graduate sections), and Wetland Assessment, Delineation and Regulation (undergraduate and graduate sections).

We involved 12 graduate students in the new PhD Program in Integrated Conservation (ICON) at the University of Georgia in Coweeta environmental outreach activities through an ICON core course taught by Pls Cathy Pringle and Nik Heynen. Students communicated conservation applications of Coweeta LTER research to the general public through a series of 10 articles published in the Franklin Press (North Carolina) in Spring 2014. Their involvement in the ICON program has further allowed us to explore and refine a pedagogical model that emphasizes a particular approach to interdisciplinary work, experiential learning, and development of strategic communication skills.

What is the impact on the development of human resources?

By working closing with a meteorologist, Coweeta LTER scientists and technicians were able to design and coordinate installation of two small experiments in the Coweeta region. These projects will provide additional long-term data, quantify the variability in precipitation along a gradient, and explore small urbanization effects on the hydroclimate of the region.

The documentation accompanying automated software-based station management provides continuity across changes in personnel and updating documentation provides the opportunity to review protocols in light of changing scientific practice.

A cohort of undergraduate and graduate students at NCSU being trained in laboratory analysis of stable isotopes of water using cavity ring-down laser spectroscopy.

Marshall Shepherd and his post-doctoral researcher Sergio Bernardes are respectively African American and Latino, and provide much-needed diversity to the Coweeta LTER. Both of these groups are severely-underrepresented in ecological and climate sciences, and Dr. Shepherd discussed these issues in an article in the national magazine outlet, Ebony.com: <http://www. Ebony.com/news-views/blacks-dont-care-about-climate-change-fact-or-fiction>

Software-driven approaches to field sensor station management enhance protocol-based management by allowing a central management unit to check data from field stations against one another for consistency. The standardization required for automated streaming thereby provides opportunities for field personnel to increase their technical capacity.

What is the impact on physical resources that form infrastructure?

30 new weather and microclimate stations were installed across the project area that are now streaming data in near real time and are available to researchers and the public. By upgrading our sensor network and using a systems approach to provide consistently formatted and constantly maintained streaming sensor stations, we have essentially created a 'wall-plug' that any CWT LTER investigator can use in their research.

The Coweeta Listening Project activities have helped simultaneously develop the Integrative Conservation (ICON) PhD program at the University of Georgia through connecting the pedagogic mission of the ICON Program with the research base of the Coweeta LTER and Coweeta Listening Project.

EcoHydrologic workflows were published on GitHub to automate model development: <https://github.com/selimnairb/EcohydroLib/>

What is the impact on institutional resources that form infrastructure?

Our deployment of a near-real time sensor network for the Coweeta LTER enabled us to partner with the GCE LTER in hosting a workshop on the GCE Data Toolbox for 14 LTER Information Managers. This workshop contributed to an increased user base for the GCE Data Toolbox, both within and beyond the LTER community. It also resulted in online documentation that allows anyone with a MATLAB license to download the GCE Data Toolbox and begin using it to process environmental data.

Marshall Shepherd participated in early planning discussions for the recent NASA sponsored field program IPHEX, which supported the Global Precipitation Measurement Mission ground validation efforts. IPHEX took place in southern Appalachia and has produced datasets that will be used in Coweeta LTER research.

What is the impact on information resources that form infrastructure?

The near real-time delivery of sensor data through a public website is a direct contribution to making federally funded research results available in a format that is both useful and minimally constrained. Collaborations with landowners from this project have resulted in the data being used by the public for unforeseen purposes, including the updating of weather information with highly localized data by an emergency management agency, the use of the data in guiding irrigation decisions toward greater water conservation and cost savings, and the local near-term confirmation of more spatially and temporally extensive trends to inform farmers deciding when to plant crops.

What is the impact on technology transfer?

James Clark is serving on the organizing committee for a NIMBIOS workshop on data analysis for the ESA SEEDS program. As co-director of the National Assessment of Drought Impacts on Forests, part of the National Climate Assessment process funded by the USFS, Clark is working with academic and agency scientists to identify the changes occurring now and the impacts that might occur in the future.

The Extreme Precipitation Exposure Index that we are developing can be a useful tool for planning, response, and resilience in the face of increasing precipitation hazards like flooding, landslides, and erosion. Coupled with human systems and methodologies, we see the potential for real action that benefits residents of the region.

The work of Marshall Shepherd is a key link between the NASA Precipitation Program (Dr. Shepherd is on the science team) and the Coweeta LTER. Their work is providing a climatological perspective on spatio-temporal trends in precipitation, and is the only work unit in the project composed of actual meteorologists and climatologists. The methods used and datasets introduced (e.g., PRISM and DAYMET) have benefited the project overall, and other investigators are now exploring these datasets in their work.

Our research shows that in the absence of the Coweeta Listening Project columns in the Franklin Press, Macon County residents only view newspaper articles that treat the environment primarily as a recreational amenity or as a danger. The columns we produce give residents a place-based understanding of ecological science and better understanding of the linkages between human actions and environmental change, and thus an improved base of knowledge for decision making.

Coweeta LTER work on riparian shade has helped motivate the Little Tennessee Land Trust to implement a "Shade Your Stream" advertising campaign across the Upper Little Tennessee River basin through billboards and a website. The goal of the "Shade Your Stream" is to educate landowners about the importance of maintaining vegetated riparian buffers to improve water quality and stream habitat.

Our results show that in the context of the southern Appalachians and similar areas, the position of development and land use change within a hydrologically dynamic landscape can be as important to regional ecological or hydrological processes as the overall amount of development or land use change.

The salamander research at Coweeta has been used to engage local citizens through the Coweeta Listening Project, while the methods we use for measuring stream salamander responses to riparian land use have been adopted for school curricula and a local NGO monitoring streams with the assistance of students and citizen scientists for the purpose of advancing stream restoration.

What is the impact on society beyond science and technology?

Coweeta LTER research has shown that vegetated buffers keep streams cool, stabilize stream banks, increase habitat heterogeneity, decrease sedimentation, and improve stream health. The "Shade Your Stream" effort is an example of how Coweeta LTER research is being used by non-profits to try and educate landowners about the importance of maintaining vegetated riparian buffers to improve stream water quality as well as in-stream and riparian habitat. Jason Love, CWT LTER Site Manager, was one of several partners who wrote a successful 3-year, \$214,000 Section 319 Non-Point Pollution Grant Proposal now administered in by the Southwestern North Carolina Resource Conservation and Development Council that supports the Shade Your Stream campaign in the upper Little Tennessee Watershed. This includes landowner workshops, billboards, and a website (<http://shadeyourstream.org/>). He also contributed to a proposal submitted by the Hiwassee River Watershed Coalition funded by the Duke Riparian Habitat Enhancement Fund for \$20,000 that is being used to expand the Shade Your Stream effort to the Hiwassee River Watershed and the Tuckasee River Watershed.

NC Cooperative Extension Agency of Macon County hosted the Youth Conservation Field Day on May 7 attended by approximately 346 7th graders from Macon Middle School and Trimont Christian Academy. Students rotated through stations tiered towards land and water conservation, and engaged in a role-playing game to simulate thermal tolerances of different fish species to learn how vegetation provides cooler water for thermal sensitive species in the area. Partners included: LTLT, Coweeta LTER, Coweeta Hydrologic Laboratory, US Forest Service, NC Forest Service, NC Wildlife Resources Commission, National Parks Service, and Macon County Soil & Water Conservation District.

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.