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Oral Abstracts

Interannual variability in carbon fluxes in a mature, southern Appalachian forest

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Annual carbon accumulation in forests is typically a relatively small proportion of total uptake through photosynthesis and of total losses through respiration. Photosynthesis tends to increase with forest age; as trees grow, they increase leaf area to maximize light interception and expand their root systems to maximize water and nutrient uptake. However, these features come at the expense of high respiratory costs and height-related hydraulic constraints. Thus, in mature forests, there is some uncertainty about how sensitive the balance between carbon uptake and losses are to climatic variability within and among years. We present data from an 85-year-old, mixed-species, deciduous forest, at the Coweeta Hydrologic Laboratory in the southern Appalachian mountains examining how biophysical factors affect the carbon uptake and storage. Utilizing above-canopy and understory eddy covariance systems and chamber-based respiration measurements, we compare daily, seasonal, and interannual variability in the components of the carbon budget. These results will help to inform how forest age structure will affect wood production and carbon sequestration under projected hydroclimatic variability.

Does species composition regulate seasonal variations in evapotranspiration in southern Appalachian forests?

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Forest evapotranspiration (*E*) at annual time scales is often described as a conservative process because variation among stands and among years is often low despite differences in stand structure and climate. Less is known about temporal variations in *E* within the growing season although it has been suggested that species composition helps regulate seasonal variations in transpiration (E_t), the largest single component of *E*. Here, we present E_t measurements from seven species in a diverse southern

Appalachian hardwood forest. Our objectives were to compare temporal variations in E_t of the most common woody species over a three year study period. Mean daily growing season E_t did not generally vary between the early and middle growing seasons in 2011 due to compensation among species, especially *Betula lenta* and *Liriodendron tulipifera*; however, E_t was lower in the late growing season in 2011 due to reduced E_t in *L. tulipifera*. The same patterns of E_t among species were not observed in 2012 or 2013. These results suggest that environmental factors, especially soil moisture, drive seasonal patterns of E_t but that these drivers affect species differently and the combination of species in diverse forests plays an inconsistent role in regulating seasonal variation in E_t.

Land-use driven nitrogen saturation causes regime shift in watershed nitrogen export

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Reference forest watersheds at Coweeta are highly nitrogen retentive and export is biologically controlled. However, accumulation of available nitrogen beyond what can be biologically immobilized results in nitrogen saturation and can switch the regulation of watershed nitrogen export to hydrologic control. The excess nitrogen inputs may result from atmospheric deposition, fertilization, a disturbance that increases nitrogen mineralization, or a combination of these processes. We suggest that this change in nitrogen export represents a significant regime shift. WS 7 shifted from biologically controlled export to hydrologic controlled export several years following logging. This regime shift was apparently caused by reduced tree uptake, increased mineralization of organic nitrogen, and nitrogen fixation by black locust associated microbes. A similar difference in nitrogen export regime is seen in the data from the 2010-2011 intensive study sites. Watersheds with near 100% forest land cover have much lower nitrogen export than watersheds with agricultural or suburban development, and there is also a shift in the timing of nitrogen export. In forested watersheds, maximum dissolved inorganic nitrogen concentration occurs in summer when base flow is low. In developed and agricultural watersheds, maximum concentrations occur in winter and spring when base flow is highest. We also see that this shift in timing of export occurred in WS 7. The patterns of nitrogen concentration and export from undisturbed watersheds can be explained by in-stream processes, but with any disturbance, elevated nitrogen export saturates these in-stream processes, and the nitrogen export regime becomes dominated by hydrologic transport from the terrestrial system.

Exurbanization in mountain landscapes: sedimentation is predictable from land cover, flow and specific conductivity are not

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Hydrology, sediment concentrations, and specific conductivity were intensively monitored in nine tributaries to the Upper Little Tennessee with varying land use distributions as well as in three river sites for 18 months. Variation in peak flow behavior was dominated by landscape factors other than land

use. The hydrologic effects of the differences in land use were small with respect to the precipitation and geomorphic controls on peak flow behavior. Even low levels of valley development caused significant increases in suspended sediment concentrations and large changes in stream temperature. Suspended sediment yields were a function of both water yield and land use. Data suggest that bank erosion or agriculture on the river floodplains (or both) are a dominant contributor of sediment to the big river sites, as sediment yields in the big river sites were similar to those in the most developed watersheds and did not reflect the expected dilution from the dominant forest land cover. Specific conductivity was very low in the forested sites but didn't vary predictably with land cover. Each watershed seemed to have its own specific conductivity story. Quantitative measures of relative development spatial distribution reflected our visual understanding of development patterns. The data demonstrate that how land is used is more important than how much land is used with the levels of development in this set of watersheds. They also demonstrate that the water quality story of exurbanization in a mountain landscape is not simple.

Increases in forest evapotranspiration have decreased water yield in the southern Appalachians

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In forested watersheds, both climate change and changes in forest structure associated with stand age can affect water yield but few long-term observational records in undisturbed watersheds exist that allow an assessment of these impacts over time. In this study, we used long-term (~50 yrs) observational records of climate and water yield in reference watersheds to determine whether water yield has changed over time and to identify the causal mechanisms of change in several forested catchments in the southern Appalachian mountains of North Carolina. Double mass curves relating cumulative water yield to cumulative precipitation show changes in slope ca. 1980, suggesting that runoff ratios have decreased and evapotranspiration (ET) has increased during 1980–2010 compared to 1961–1980. Further, departures in cumulative water yield in 1981-2010 from 1960-1980 could not be explained by precipitation alone in all watersheds. Using long-term species composition, stem diameter, and stem density data from permanent plots in each reference watershed in combination with tree water use by species and diameter derived from sap flux measurements, we estimated changes in ecosystem water use that could explain the changes in water yield. Our results could have significant implications for water supply in the region and may suggest forest management strategies to mitigate climate change impacts on water resources.

Eastern deciduous forest tree growth response to hydroclimate variability

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Climate change, particularly temperature increases and precipitation shortages, is likely to become a major factor limiting tree species growth and distribution. Trees growing under the same climatic conditions may differ according to local site-related variations in soil nutrients and moisture. We evaluated the climate driven patterns of growth for dominant hardwood species in the southern Appalachians. We hypothesized that: (1) there will be growth responses to multiple hydroclimate variables; (2) there will be differences among species depending on their hydraulic architecture (i.e., functional groups; diffuse-porous *vs.* ring-porous species); and (3) these responses will depend on whether the functional groups are growing in mesic or dry topographic positions within the same climatic regime. We extracted cores from *Acer rubrum*, *Betula lenta*, *Liriodendron tulipifera, Quercus alba*, *Q. montana*, and *Q. rubra* trees across the elevation gradient in the Coweeta Basin, western North Carolina. We used standard methods to cross-date rings and measure ring width. We grouped species based on their xylem anatomy and topographic position to develop standardized tree-ring chronologies: diffuse-porous (*Acer*, *Betula*, and *Liriodendron*) and ring-porous (*Quercus*) species growing on either mesic or dry sites. We examined the relationships between these four standardized chronologies and the climatic data from 1935 to 2003 to correspond with on-site long-term climate record. Climate variables included precipitation (*P*), number of storms, dry spell length (DSL), Palmer Drought Severity [2]Index (PDSI), solar radiation, minimum (T_{MIN}) and maximum temperature (T_{MAX}), vapor pressure deficit (VPD), streamflow (*R*o), actual evapotranspiration (AET), and AET/*P* ratio. We found strong relationships between radial growth and climate variables, particularly number of small storms, DSL, solar radiation, and AET/*P*. While radial growth responded to current summer precipitation; the distribution of rainfall (i.e., number of small storms and DSL) was more strongly related to growth than the total amount of rainfall for both functional groups. We used structural equation modeling to evaluate multiple climate variables. Our results supported our hypothesis and showed that multiple variables predicted growth of our functional groups more than a single climate variable.

Climate change homogenizes landscape vegetation patterns at the catchment scale

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Forested mountain watersheds are important sources of freshwater supply and carbon sequestration, and there has been an interest how climate change and variability will impact forest ecosystem patterns and processes over short to long time scales. Forests are sensitive to hydroclimate variability and they adjust leaf area and duration in response to water and nutrient availability. Therefore, the influence of hydroclimate variability on water yield is already manifested in emergent vegetation dynamics in space and time. Landsat Thematic Mapper (TM) provides a nearly three-decade multispectral record of landscape vegetation patterns at a fine resolution (30 m) over the period of global warming. Here we characterize catchment-scale vegetation patterns with normalized difference vegetation index (NDVI) from 30-year historic Landsat TM images in six forested headwater catchments in the Coweeta Hydrologic Laboratory, North Carolina, USA. We relate vegetation dynamics with seasonal water balances and low flow patterns from observed long-term hydrologic records. We found that vegetation patterns along hydrologic flow paths have been homogenized over time, which corresponds with long-term leaf litter fall data in research plots. This suggests that the hydrologic connectivity between upslope and downslope are decreasing, mostly driven by increased vegetation water use with temperature and growing season increases. This study suggests that emergent vegetation patterns can be used as a unique diagnostic tool to infer underlying water balance and watershed-scale hydrologic behavior.

Assessing exposure of infrastructure and populations to extreme precipitation in the Southeastern United States

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Significant increases in precipitation extremes have been observed during recent decades in the Southeastern United States (SEUS) and these extreme rainfall events are expected to continue under a warmer atmosphere (National Climate Assessment, 2014). Considering their societal impacts (e.g., services disruption, property damage, and loss of life), adaptation strategies to this climatic reality should incorporate the classification/representation of exposure and vulnerability of infrastructure and populations to extreme precipitation. Ideally, these representations should support decision making by encapsulating multiple complex relationships. Here, we report on our development of an extreme precipitation exposure index (EPEI), which incorporates those relationships as well as the spatial representation of physiography, infrastructure and human populations. Index development used Daymet daily precipitation for the period 1980-2012 to identify the spatial distribution of frequencies of precipitation extremes (days with precipitation > 25 mm) in the SEUS. Impervious surfaces and degrees of exposure to rainfall were represented by a reclassification of the 2011 National Land Cover Dataset (USGS). A digital elevation model at 30-meter postings (USGS) was used to derive slope for the area of study. Environmental variables were used as input to a rule-based classifier to identify critical areas regarding water accumulation, erosion and potential mass movement. Map algebra, including proximity analysis, was used to identify spatial relationships between critical areas, infrastructure and populations. Results included continuous surfaces of EPEI indicating the distribution of degrees of exposure of infrastructure and populations to extreme precipitation over the SEUS. The results also pave the way for continued works on aspect of hydroclimate variability and vulnerability in the Coweeta LTER Renewal.

A tiered approach to monitoring Timber Rattlesnake populations in the Southern Appalachians

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The Orianne Society is an organization based at the University of Georgia focused on herpetological research, education, and conservation. Orianne has been working with Timber Rattlesnakes in the Appalachians for 4 years. Timber Rattlesnakes are a wide ranging species that occur in a variety of forest types and whose range overlaps with some of the highest human densities in the North America. Due to the overlap with human populations, they have declined throughout their range. We have implemented a hierarchical approach to monitoring their populations in the Southern Appalachians including 1) identifying the distribution of potential rattlesnake habitat using remotely sensed imagery and identify a series of monitoring landscapes, 2) using visual surveys and cameras to implement an occupancy based approach to monitor trends in snake distribution and to estimate reproductive output, and 3) selecting a small number of sentinel sites to examine specific questions in applied ecology. I will present preliminary results from our monitoring in the Nantahala Mountains of Georgia and North Carolina. Using this approach we are able to monitor trends in timber rattlesnake populations while minimizing our impact on the animal's behavior and survival. This is an approach that could be implemented across the range of the Timber Rattlesnake.

Grass invasion of hardwood forests differentially affects soil organic carbon storage across an urban-rural gradient

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Plant invasions can alter the quality and quantity of detrital and root-derived inputs, influencing the activities of microbial decomposers. Meta-analyses indicate that these changes may decrease, increase, or have neutral effects on soil carbon storage, yet the broad-scale processes that lead to this variation remain relatively unexplored. Here, we examine (1) how invasion by the exotic grass *Microstegium vimineum* affects carbon cycling across an urban-rural gradient and (2) evaluate the importance of nitrogen availability for explaining these patterns. Effects of *M. vimineum* invasion differed across the gradient. Invasion-associated declines in total soil organic carbon were 3.5 times greater in the forested and 2.5 times greater in the rural matrix than in the urban matrix. Rates of leaf litter decomposition were also lower in invaded areas in the forested matrix than in the urban matrix. 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, unchanged particulate organic matter, and higher mineral-associated organic matter carbon. These findings suggest that, although this invader may accelerate carbon-cycling in forest soils, its effects on soil carbon storage largely depend on nitrogen availability, which can be altered by land-use context.

Exurbanization impacts on myrmecochorous woodland plants, ants and their dispersal interactions

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Exurbanization is the fastest growing, and most extensive, form of anthropogenic development in U.S. natural areas. Exurban development extends urban impacts beyond the suburbs, and it often is characterized by low-density developments in woodland areas with housing used for long-distance commuting or second home. Because exurban developments often retain their original ecosystem structure – such as a forest canopy rather than open lawn – their ecological impacts may be underestimated. Other human disturbances of forest generally reduce abundance of woodland herbs – a key part of floristic diversity – particularly those which are poor colonizers, such as plants with seeds dispersed by ants. However, exurban impacts on ant-dispersed woodland herbs (myrmecochores) and the ants that disperse their seeds are unknown. The keystone seed dispersers in eastern deciduous forests are ants from the genus *Aphaenogaster*. These ants are exceedingly abundant in woodlands, but they generally avoid forest edge. We asked how exurbanization changes *Aphaenogaster* foraging abundance, nest colonization and nutrient status; myrmecochore abundance and diversity; and seed dispersal patterning between ants and myrmecochores. Preliminary results indicate that the ants visited seed bait stations more often in moist habitat, but not after rain, and with further distance from forest edges. The ants also generally dispersed seeds away from forest edges. The ants did not differ in abundance between exurban and forested patches, but exurban ants were significantly healthier than forest ants.

Multi-scale effects of exurban development on birds at protected and unprotected sites: An application of an occupancy model accounting for false positive and false negative detections

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Exurban development, the construction of low-density residential homes in a rural landscape, is the fastest growing type of land use in the United States and is prominent in the southern Appalachian region. A potential consequence of exurban development is the loss and fragmentation of native habitat. We developed a Bayesian model that accounts for false positive and false negative detections to make inferences about how the occupancy of six forest-dwelling, Neotropical migrant birds is related to multi-scale attributes of exurban development. Many ecological models estimate the probability of false negative detections. However, false positive detections are also known to occur in ecological data, and if this type of imperfect detection is not accounted for in models, estimates will be biased. We built on previous attempts to account for false positive and false negative detections in occupancy models, while addressing some of the criticisms of past models. Through simulations, we evaluated our model parameterization using simulated data and then modeled the relationship between avian occupancy and

land use at National Forest, land trust, and unprotected sites in Macon County, North Carolina. Our model parameterization generated accurate and precise posterior distributions. Results from modeling the effects of exurban development indicated that landscape- and local-scale covariates influenced posterior occupancy probabilities more than site-scale covariates and that landscape composition and elevation had a greater effect on posterior occupancy probabilities than configuration. The Black-throated Blue Warbler and Wood Thrush had the lowest posterior occupancy probabilities of the six focal species. National Forest sites had high occupancy, but land trust sites exhibited patterns similar to unprotected sites. Our findings can provide guidance to land use planners and land trusts as they decide how to respond to exurban development. Also, our study demonstrates the application of an improved occupancy model that can generate more accurate inference by accounting for both types of imperfect detection while describing heterogeneity.

Poster Abstracts

Hydrologic variability in the Southern Blue Ridge Mountains

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The purpose of this research was to determine how climate, geomorphology and land cover influence the hydrology of wadable streams in the Southern Blue Ridge Mountains during the peak flood months of December through March. Fifteen USGS-gaged watersheds ranging in size from 70 to 765 km^2 were analyzed to determine how stormflow fluctuated, spatially and temporally, during the period of 1986-2006. The watersheds used in this study had no large impoundments, had at least 25 years of near-continuous measures of discharge, and were chosen to represent the traditional land use (forested uplands and pastured valley bottoms with various levels of development) that characterizes the region. Due to the paucity of long-term climate stations in the study area, monthly precipitation data modeled by the PRISM climate group were used. Alluvial and colluvial soils were modeled using digital elevation models, due to inconsistent soil surveys across state boundaries. The TIGER streets network was used to augment the CWT historical land cover datasets (Hepinstall-Cymermann, 2011) to better represent the area covered by impervious surfaces in each watershed. The results of this project indicate that while climate is the most important variable controlling hydrologic variability, land cover and its spatial orientation has a significant impact on the hydrology of the region. Additionally, this project found that the relationship between hydrology and basin characteristics differs during periods of wetness and drought; indicating a need for an adaptable water management plan if the region continues to experience extreme variations in hydroclimatology.

Will severe droughts exceed the tolerance threshold of symbiotic dinitrogen fixation and impair ecosystem resilience?

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In the eastern United States, global climate models predict reductions in summer precipitation resulting in more severe drought events. One key way in which drought may alter ecosystem dynamics is through its influence on the nitrogen (N) cycle. N limits primary production in terrestrial ecosystems of the temperate zone, making a consideration of symbiotic N_2-fixation (SNF), the main natural source of new N, crucial for these ecosystems. N_2-fixing plants are abundant during early stages of succession, acting to replace N lost during disturbance events. Therefore, SNF is a recovery mechanism that supplies new N to ecosystems, facilitating resilience in the context of disturbance. To examine how drought affects this process, we are diverting 0%, 20% and 40% of growing season precipitation from 18 $9m^2$ plots in a regenerating forest. Tree census data from the first summer of treatment revealed that growth of *Robinia pseudoacacia*, the system's dominant N_2-fixing species, was more affected by drought than its competitors. This upcoming summer I will measure N_2-fixation rate of *R. pseudoacacia* through acetylene reduction assay and foliar $\delta^{15}N$ isotopic analysis. These data will allow me to assess whether drought can constrain the symbiotic N_2-fixation and thus potentially impair ecosystem resilience.

Examining how historic microclimates relate to current avian and plethodontid assemblages

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Recent evidence suggests that the southern Appalachian Mountains region is experiencing both increasing frequency of extreme precipitation and a reduced frequency of more moderate precipitation. Moreover, heterogeneity in precipitation among subwatersheds has resulted in neighboring watersheds experiencing large differences in precipitation levels over the past 30 years. This extreme spatial variability creates an opportunity to examine how differences in precipitation relate to the abundances of regional flora or fauna. Salamander and breeding bird abundance were measured on areas of intact forest in Macon County, North Carolina, USA that have varied in precipitation over the past 30 years. I hypothesized that long term changes in moisture regimes would causes terrestrial vertebrates to persist in an area were their species specific environmental requirements were being met. Specifically I hypothesized that Plethodontidae would be in greater abundance in the historically wet sites and focal passerines of this study have variable life history traits and therefore vegetation that promotes their respective habitat would be main factor determining their abundance; furthermore, vegetation is proximally associated with precipitation, therefore some measurable difference among sites may exist. All dry sites in this study have higher estimated avian densities, Black-throated Blue Warblers were found exclusively on dry sites and Black-throated Green Warblers were found almost exclusively on wet sites. Plethodontidae were only found on dry sites in this study. These results suggest that a correlation exist between microclimate and avifauna and Plethodontidae surveyed in this study.

Avian communities in suspended development: mechanistic effects of changing habitat structure versus human habitation

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The mechanisms behind impacts of urbanization on avian communities are not well understood. Opportunely, suspended developments – residential projects that were abandoned before completion – may help elucidate these mechanisms. Having had structural changes to the original forest landscape but no human habitation, they allow the separation of these two major components of development. We studied avian community composition in undisturbed forests, suspended developments, and established subdivisions, allowing us to disentangle which changes to the community are caused by habitat alteration and which by human activities. We found significantly higher species richness and abundance in suspended developments and subdivisions, likely due to habitat heterogeneity. Species occupancy and abundance modeling for 26 species indicated that distribution patterns for eight species could be attributed to structural habitat mechanisms, eight to human-associated mechanisms, and five to a combination of both. Twenty-one species were influenced by finer-scale habitat variables. These findings will inform planning efforts in areas expected to experience future conversion of forest to residential development.

Impacts of land use on leaf breakdown and macroinvertebrate assemblages in southern Appalachian streams

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Alterations in the structural and functional integrity of stream ecosystems have long been associated with anthropogenic disturbance of riparian landscapes. Land-use regimes such as agriculture and urbanization have been shown to cause bank erosion and sedimentation, changes in rates of organic matter processing, and reduced faunal biodiversity. The effects of exurbanization on stream integrity, however, are not as well understood. This phenomenon is relatively new and best defined as the movement of people from urban centers to rural areas. Southern Appalachian streams are embedded in a mosaic of forested, exurban, and agricultural lands, making them ideal study locations. We aimed to assess the structural and functional integrity of streams draining each of the three land-use categories using macroinvertebrate community metrics and leaf breakdown rates, respectively. We predicted that leaf breakdown rates would increase as land-use progressed from forested, to exurban, to agriculture. We also predicted that macroinvertebrate diversity andvother metrics would decrease along the land-use gradient. Leaf breakdown rates differed significantly among land-use categories. Macroinvertebrate diversity, while showing a decreasing trend, did not differ significantly among categories.

Fluctuations in springtime precipitation and commensurate stream flows influence the abundance of an algivorous fish commonly found in the Southern Appalachians

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Environmental conditions can affect species living in streams in a multitude of ways. In particular, precipitation amounts and commensurate stream discharge associated with rainfall events can both directly and indirectly affect aquatic organisms. Long-term ecological data collection offers a means to detect these types of community dynamics over years and decades. These data may also support predictive models for future ecosystem fluctuations resulting from a changing climate. We are using fish counts collected by one of us, (Bill) and other staff and volunteers working with LTLT at 7 fixed sites in the Little Tennessee River basin over 19 years to test an hypothesized effect of springtime stream flow on stoneroller (*Campostoma anomalum*) population dynamics. Stonerollers are algivores and are hypothesized to achieve greater population growth following drier (lower flow) springtime conditions, possibly as a result of reduced scour and enhanced algal accrual. We are using PRISM precipitation data (interpolated for watersheds above each fish-collection site), and USGS gage data, to represent these springtime flow conditions. Preliminary results using linear mixed models indicate a negative relationship between springtime precipitation and stoneroller abundance in the following year, as hypothesized. The LTLT long-term fish monitoring database is an invaluable resource for scientists wishing to test hypotheses regarding the effects of changes in precipitation, temperature, climate and land use on aquatic biota.

Bioenergy production in a changing landscape: farmlands in the Southern Appalachians

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Exurban development has increased in rural landscapes throughout the US, often at the expense of agricultural lands. Demand for renewable energy, such as bioenergy, provides new potential pathways for land-use/land-cover change and may provide an incentive for farmland conservation. However, the potential for bioenergy production will be affected by changing climate, and development pressure is competing with agricultural land uses. Most bioenergy productivity assessments have focused on global and national scales; few assess scales relevant to regional or local planning. We used a mechanistic plant growth model to simulate bioenergy crop productivity for switchgrass, giant miscanthus, and hybrid poplar and project spatial patterns of bioenergy production across an agricultural landscape in the southern Appalachian Mountains. Bioenergy crop productivity varied substantially among crops across the landscape (range: 0 to 28 Mg/ha/yr). Crops differed in the strength of the relationship between productivity and climate and soil variables. Total landscape productivity of bioenergy on agricultural land within the study area ranged from 1.3 million to 1.6 million Mg/yr, with the highest landscape productivity projected under a mixed-crop landscape. Of note for regional planning, 55% of land with the highest projected bioenergy yield is considered at high-risk of development (>80% probability of conversion). Shifting patterns of productivity in response to climate may alter future patterns of competition between ecosystem service provision and other land uses.

Assessing the effect of rhododendron removal from riparian zones on ecosystem function in headwater streams of the southern Appalachians

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Widespread alteration of the community composition of stream riparian zones is occurring in response to habitat degradation, disease, and the introduction of non-native species. Over the last century, riparian communities in the southern Appalachians have experienced substantial change from the loss of two keystone tree species, *Castanea dentata* and *Tsuga canadensis*, due to human-spread pathogens, and subsequent dominance by a native understory shrub, *Rhododendron maximum* L. Dominance by rhododendron dominates riparian communities and inhibits the recruitment of hardwood upper story species, potentially altering stream carbon dynamics due to a reduction in primary production from increased understory shade, and an increase in recalcitrant leaf litter inputs, which are less palatable to aquatic invertebrates. Rhododendron removal is a potential management strategy that is being considered by land management agencies to promote the recruitment of upper story hardwood species. Our research project is a collaboration between the University of Georgia and the USDA Forest Service through the Coweeta Long Term Ecological Research Project (LTER) that aims to assess the short- and long-term impact of rhododendron removal by quantifying carbon resources through measurements of stream algal primary production and leaf litter standing stocks in the stream. We will assess how changes in basal resources affect stream ecosystem functions, such as whole-stream metabolism, nutrient uptake, and trophic dynamics. We will test hypotheses regarding changes in top-down control of stream macroconsumers on algal growth and decomposition by experimentally manipulating the presences and absence of fishes and crayfishes before and after the rhododendron removal.

Partnerships for youth Environmental Education in three western North Carolina counties

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As a result of the partnership between the Land Trust for the Little Tennessee (LTLT) and the Coweeta Schoolyard LTER Program, we have directly engaged with over 1,500 students from North Carolina on 7 separate events in the past year. Outreach has involved students ranging from K-12th grade enrolled in 9 different schools within the Hiwassee, Little Tennessee, Nantahala, and Tuckasegee River watersheds. LTLT's plan is to continue to grow the Environmental Education/Citizen Science program in the Tuckasegee watershed, as appropriate. However, it is important to note that, even at our current level of engagement, this would not be possible without strong partnerships with Coweeta LTER and other agencies.

Spatial patterns of precipitation in complex terrain: optimizing sampling efficiency and estimating interpolation uncertainty

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Gridded, national-scale precipitation products provide estimates of precipitation for a wide variety of research, planning, and decision-making activities. These estimates are not perfect, and associated uncertainties can significantly affect the outcomes of analyses using these grids as input. Uncertainties stem from relatively coarse grid resolutions, sparse station data, and interpolation methodology, among others. However, these errors involved are difficult to quantify, because high-resolution ground truth data are typically lacking. A high-quality, high-density rain gauge network maintained at the Coweeta Hydrologic Laboratory Watershed in North Carolina, USA, provides an opportunity to better understand the actual spatial patterns of precipitation in a mountainous region, and help quantify the sources and magnitudes of uncertainties in national-scale precipitation datasets.

In this study, eight years of precipitation data from sixty-nine gages were analyzed to determine the spatial distribution of seasonal (winter vs. summer) precipitation within the Coweeta Hydrologic Laboratory Watershed. Inverse distance weighting interpolation was used to visualize the data. Detrended kriging was used to investigate the relationship between precipitation and elevation. Elevation was derived from a digital elevation model (DEM), expressed at a range of spatial scales using a low-pass filter. Interpolation uncertainty at each DEM scale was estimated through jackknife cross-validation. Stations were also omitted (one by one) from the analysis to assess their contribution to the error in the interpolated surface. Results indicated that: i) elevation explains a majority of the spatial patterns of precipitation, ii) the dominant of scale of the precipitation-elevation relationship varies with season, and iii) a station's contribution to the overall spatial pattern is highly dependent on its location within the watershed. The next phase of this analysis will use these results to evaluate the uncertainty in national precipitation grids generated by the PRISM Climate Group at Oregon State University, which are rendered at relatively coarse spatial resolution, and use just a fraction of the station data available to this analysis.

Coweeta LTER Summer Symposium and Meeting Agenda
June 30-July 1, 2014

Monday June 30

8:00 Light breakfast

8:30 Welcome (Love/Miniat)
8:35 Update on Renewal & LTER Network (Gragson)
8:45 Summary of Coweeta Hydrologic Laboratory research (Miniat)
9:00 Interannual variability in carbon fluxes in a mature, southern Appalachian forest (Oishi)
9:25 Does species composition regulate seasonal variations in evapotranspiration in southern Appalachian forests? (Brantley)
9:50 Land-use driven nitrogen saturation causes regime shift in watershed nitrogen export (Webster)

10:15 Break (15 minutes)

10:30 Exurbanization in mountain landscapes: sedimentation is predictable from land cover; flow and specific conductivity are not (Jackson)
10:55 Increases in forest evapotranspiration have decreased water yield in the southern Appalachians (Caldwell)
11:20 Eastern deciduous forest tree growth response to hydroclimate variability (Elliott)
11:45 Climate change homogenizes landscape vegetation patterns at the catchment scale (Band)

12:10 Lunch (1 hour 20 minutes)

1:30 Assessing exposure of infrastructure and populations to extreme precipitation in the Southeastern United States (Shepherd)
2:00 A tiered approach to monitoring Timber Rattlesnake populations in the Southern Appalachians (Jenkins)
2:25 Safety Meeting (Miniat & Love)

2:50 Break (40 minutes)

3:30 Poster Session in Main Conference Room

- Hydrologic variability in the Southern Blue Ridge Mountains (McDonald & Leigh)
- Will severe droughts exceed the tolerance threshold of symbiotic dinitrogen fixation and impair ecosystem resilience? (Minucci, Miniat & Wurzburger)
- Examining how historic microclimates relate to current avian and plethodontid assemblages (Abernathy, Hepinstall-Cymerman & Maerz)
- Avian communities in suspended development: mechanistic effects of changing habitat structure versus human habitation (Beasley, Hepinstall-Cymerman & Moore)
- Impacts of land use on leaf breakdown and macroinvertebrate assemblages in southern Appalachian streams (Muller & Benfield)

- Fluctuations in springtime precipitation and commensurate stream flows influence the abundance of an algivorous fish commonly found in the Southern Appalachians (Pringle, McLarney & Freeman)
- Bioenergy production in a changing landscape: farmlands in the Southern Appalachians (Graves, Pearson & Turner)
- Assessing the effect of rhododendron removal from riparian zones on ecosystem function in headwater streams of the southern Appalachians (Dudley & Pringle)
- Partnerships for youth Environmental Education in three western North Carolina counties (Meador & Love)
- Spatial patterns of precipitation in complex terrain: optimizing sampling efficiency and estimating interpolation uncertainty (Roberti et al.)

5:00 Social and poster session at Coweeta Dorm (Science Advisory Committee Meets in Conference Room)

6:00 Dinner at Coweeta Dorm

Tuesday July 1

8:00 Light breakfast

8:30 Morning announcements
8:35 Grass invasion of hardwood forests differentially affects soil organic carbon storage across an urban-rural gradient (Fraterrigo)
9:00 Exurbanization impacts on myrmecochorous woodland plants, ants and their dispersal interactions (Warren)
9:25 Multi-scale effects of exurban development on birds at protected and unprotected sites: An application of an occupancy model accounting for false positive and false negative detections (Hepinstall-Cymerman)
9:50 Coweeta LTER streaming data network and catalogue (Chamblee)

10:00 Break-out Sessions
10:00-12:00
a) Terrestrial Gradient (J. Knoepp)
b) Synoptic (R. Jackson)
c) Graduate Students (R. Pringle)

12:00 Lunch
1:00-3:00
a) Hillslope (J. Webster)
b) Rhododendron Removal (K. Elliott)

3:00 Meeting Adjourns

Don't know anything about renewal – supposed to know something mid-July
Scott Ollinger stepping down from NEON – consuming $25 million/year for next 5 years
LTER getting new Network Office – Information Management component of LTER will be in new office

Miniat – USFS

- David Zietlow is new junior scientist
- 3 main priorities
    - Restoration
    - Climate Change
    - Fire

- 3 main priorities for Coweeta

ADD

Recently completed projects:

1) Hydrologic effects of hemlock loss and HWA treatment
2) National Climate Assessment: Fire and Climate Change
3) The ecosystem service of water supply: quantifying the role of National Forests in the Southeast
4) Drought effects of early successional forests
5) Consequences of stand age and structure on forest water yield
6) Restoration of base cation depleted high-elevation watersheds\
7) NEE flux towers: eddy covariance
8) Effects of reduced precipitation on C, H2O and N cycling in early successional forests
9) Growth-climate relationships of southern Appalachian trees: dendroclimatology of six species spanning 85+ years
10) Eucalpytus: total water use and source partitioning in woody bioenergy crops determined by coupled mass flux and stable isotope signatures
11) Restoring riparian forests in the wake of hemlock mortality
12) Silvicultural treatment to increase efficacy of biological control on hemlock
13) Collaboration investigating spatial and temporal trends in precipitation within the Coweeta basin

Coweeta SAC
Attendees: Chelcy Miniat, John Maerz, Jack Webster, Cathy Pringle, Rhett Jackson, Ted Gragson, John Chamblee (Ex-Officio); Jason Love (Ex-Officio)
Unable to attend: Wurzburger, Band, Heynen, Dehring

- Webster is stepping down from the SAC; no point in filling the position until we know more about the renewal
- Saran sent an email saying that with all the things happening with NSF that they couldn't possibly let LTER folks know until mid-July; NSF usually closes August 1
- Assuming we are funded, funding wouldn't be coming in until November 1; need to have at least one SAC meeting to make sure we are still on the right track, probably somewhere between October 1 & November 1
- We should have some metadata at the onset to act as a planning guide for research;

- LNO is splitting into two units; all Information Management is being merged with other IM sectors of NSF
- We send data to LNO but we don’t necessarily receive direct support from LNO
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