
Principal Investigator: Gragson, Theodore L.
Organization: U of Georgia Res Fdn Inc

Submitted on: 08/02/2012
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Submitted By:
Gragson, Theodore - Principal Investigator

Title:
Southern Appalachia on the Edge - Exurbanization & Climate Interaction in the Southeast

Project Participants

Senior Personnel

Name: Gragson, Theodore
Worked for more than 160 Hours: Yes
Contribution to Project:
08/10-07/12. Coweeta LTER project director, Macon County resident survey regarding land use and stream management, examining regional natural and anthropic archives of human land use in mountainous landscapes of southern Appalachia and the north-facing Pyrenees. Partial support for activities from Coweeta LTER.

08/10-07/11. Investigating the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Partial support for activities from Coweeta LTER.

11/09-07/10. Investigating the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Partial support for activities from Coweeta LTER.

11/08-10/09: Lead Principal Investigator for the project and administrative liaison between UGA and all subawardees. Partial support for activities from Coweeta LTER.

Name: Band, Lawrence
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Integrating measurement and modeling of watersheds in the southern Appalachians, including feedbacks between ecological, hydrological, geomorphic and climate processes. Partial support for activities from Coweeta LTER.

08/10-07/11. Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

11/09-07/10. Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

11/08-10/09: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

Name: Benfield, E.
Worked for more than 160 Hours: No
Contribution to Project:
08/11-07/12. Focusing on intensive sampling program and hemlock adelgid research. Partial support for activities from Coweeta LTER.

08/10-07/11. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/09-07/10. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.
11/08-10/09: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

Name: Bolstad, Paul

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. 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. Partial support for activities from Coweeta LTER.

08/10-07/11. Measurement and modeling of forest productivity, hydrologic cycling, and environmental and anthropogenic variables affecting them. Partial support for activities from Coweeta LTER.

11/09-07/10. Measurement and modeling of forest productivity, hydrologic cycling, and environmental and anthropogenic variables affecting them. Partial support for activities from Coweeta LTER.

11/08-10/09: Measurement and modeling of forest productivity, hydrologic cycling, and environmental and anthropogenic variables affecting them. Partial support for activities from Coweeta LTER.

Name: Bradford, Mark

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Investigating link between population / community change and carbon cycling by examining the spread and performance of invasive plants, tree species movement in response to climate change, and interactions between common soil fauna and the structure and function of the forest. Partial support for activities from Coweeta LTER.

08/10-07/11. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/09-07/10. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/08-10/09: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

Name: Clark, Jim

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Conducting plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

08/10-07/11. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Dehring, Carolyn

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Investigating the impact of aquatic invasive species on land values, and individual decisions to donate land to conservation. Partial support for activities from Coweeta LTER.
08/10-07/11. Investigation of the land pricing aspects of land use regulation and open space including land conservation programs, land use regulation, and issues related to the economics of water quality and quantity. Partial support for activities from Coweeta LTER.

11/09-07/10. Investigation of the land pricing aspects of land use regulation and open space including land conservation programs, land use regulation, and issues related to the economics of water quality and quantity. Partial support for activities from Coweeta LTER.

11/08-10/09: Investigation of the land pricing aspects of land use regulation and open space including land conservation programs, land use regulation, and issues related to the economics of water quality and quantity. Partial support for activities from Coweeta LTER.

Name: Depken, Craig

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Investigation of the impact of aquatic invasive species on land values, and individual decisions to donate land to conservation. Partial support for activities from Coweeta LTER.

08/10-07/11. Investigation of the land pricing aspects of land use regulation and open space including land conservation programs, land use regulation, and issues related to the economics of water quality and quantity. Partial support for activities from Coweeta LTER.

11/09-07/10. Investigation of the land pricing aspects of land use regulation and open space including land conservation programs, land use regulation, and issues related to the economics of water quality and quantity. Partial support for activities from Coweeta LTER.

11/08-10/09: Investigation of the land pricing aspects of land use regulation and open space including land conservation programs, land use regulation, and issues related to the economics of water quality and quantity. Partial support for activities from Coweeta LTER.

Name: Ford, Chelcy

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. 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.

08/10-07/11. Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds. Partial support for activities from Coweeta LTER.

11/09-07/10. Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds.

11/08-10/09: Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds.

Name: Fraterrigo, Jennifer

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11/07/12. Evaluated the effects of land-use and climate change on biodiversity, and determine the broad-scale impacts of exotic invasive species on ecosystem function. Partial support for activities from Coweeta LTER.

08/10-07/11. Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.
11/09-07/10. Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.

11/08-10/09: Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.

Name: Hepinstall-Cymerman, Jeffery  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
08/11-07/12. 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. Partial support for activities from Coweeta LTER.  
08/10-07/11. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.  
11/09-07/10. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.  
11/08-10/09: Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.  
Name: Heynen, Nik  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
08/11-07/12. Developing the processes and methodologies through which the Coweeta Listening Project operates, coordinating community contacts and partners in Macon County. Partial support for activities from Coweeta LTER.  
08/10-07/11. Examined the relationship between Atlanta's global city status and the exurbanization of Macon County, NC, and the connection between citizen scientific engagements related to climate change within the Southern Appalachian region. Partial support for activities from Coweeta LTER.  
11/09-07/10. Examined the relationship between Atlanta's global city status and the exurbanization of Macon County, NC, and the connection between citizen scientific engagements related to climate change within the Southern Appalachian region. Partial support for activities from Coweeta LTER.  
11/08-10/09: Examined the relationship between Atlanta's global city status and the exurbanization of Macon County, NC, and the connection between citizen scientific engagements related to climate change within the Southern Appalachian region. Partial support for activities from Coweeta LTER.  
Name: Jackson, C.  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
08/11-07/12. Examining maximum daily water temperatures in riffles as function of exfiltration of hyporheic water, and storm sampling on 12 streams to develop and test rating curves to convert the continuous stage data into flow data. Partial support for activities from Coweeta LTER.  
08/10-07/11. Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.  
11/09-07/10. Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.
11/08-10/09: Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

**Name:** Knoepp, Jennifer  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. 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.

08/10-07/11. Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

11/09-07/10. Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

**Name:** Leigh, David  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Investigating human impact on landscapes through examining fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains. Partial support for activities from Coweeta LTER.

08/10-07/11. Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

11/09-07/10. Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

11/08-10/09: Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

**Name:** Maerz, John  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Monitoring salamanders at synoptic sites including mark-recapture of terrestrial salamanders at long-term plots along an elevation gradient. Partial support for activities from Coweeta LTER.

08/10-07/11. Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

11/09-07/10. Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

11/08-10/09: Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream
macroinvertebrates. Partial support for activities from Coweeta LTER.

**Name:** Mohan, Jackie  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
08/11-07/12. Investigating nitrogen cycling dynamics along both elevation and human development gradients using geophysical tools. Partial support for activities from Coweeta LTER.  
08/10-07/11. Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.  
11/09-07/10. Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.  
11/08-10/09: Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.

**Name:** Pearson, Scott  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Studying the effects of residential development and climate on breeding bird communities, potential impacts of climate change and land use history on herbaceous species of Appalachian forests, and modeling interactions between climate change, habitat fragmentation, fine-scale habitat heterogeneity, and demographic responses of terrestrial species. Partial support for activities from Coweeta LTER.  
08/10-07/11. Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.  
11/09-07/10. Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.  
11/08-10/09: Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.

**Name:** Pringle, Catherine  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Analyzing the relative effects of watershed land use and water quality on the spatial distribution of four stream focal taxa, analysis of cumulative Hazard site data sets, and customization of the Rapid Stream Visual Assessment Protocol (SVAP) for the Southern Appalachians. Partial support for activities from Coweeta LTER.  
08/10-07/11. Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.  
11/09-07/10. Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.  
11/08-10/09: Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.

**Name:** Turner, Monica  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Examining how temperature and exurban development influence the avian community and rates of nest predation, and interaction between land-use history and climate variation as it affects the establishment and growth of native herbaceous species and plant-pollinator interactions. Partial support for activities from Coweeta LTER.
08/10-07/11. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

11/09-07/10. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

11/08-10/09: Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

Name: Valett, Maurice

**Worked for more than 160 Hours:** No

**Contribution to Project:**

08/10-01/11: Participated in developing and executing synoptic and aquatic sampling of Little Tennessee Watershed. Partial support for activities from Coweeta LTER.

11/09-07/10: Participated in developing and executing synoptic and aquatic sampling of Little Tennessee Watershed. Partial support for activities from Coweeta LTER.

11/08-10/09: Participated in developing and executing synoptic and aquatic sampling of Little Tennessee Watershed. Partial support for activities from Coweeta LTER.

Name: Vose, Jim

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

08/11-02/11. Research on linking species specific parameters of water stress with plant demography. No direct support from the Coweeta LTER research funds.

08/10-07/11. Research on linking species specific parameters of water stress with plant demography. No direct support from the Coweeta LTER research funds.

11/09-07/10: Research on linking species specific parameters of water stress with plant demography. No direct support from the Coweeta LTER research funds.

11/08-10/09: Research on linking species specific parameters of water stress with plant demography. No direct support from the Coweeta LTER research funds.

Name: Webster, Jack

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

08/11-07/12. 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. Partial support for activities from Coweeta LTER.

08/10-07/11. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/09-07/10. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/08-10/09: Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Peterson, Jim

**Worked for more than 160 Hours:** No
Contribution to Project:
08/10-07/11. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

11/09-07/10. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Elliott, Kitty

Worked for more than 160 Hours: No

Contribution to Project:
08/11-07/12. Investigating disturbance history of southern Appalachian region using dendroecology and longitudinal flowpaths across land uses. Partial support for activities from Coweeta LTER.

08/10-07/11. Biotic sampling across Coweeta watershed. No direct support from the Coweeta LTER research funds.

11/09-07/10. Biotic sampling across Coweeta watershed. No direct support from the Coweeta LTER research funds.

Name: Moore, Rebecca

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Investigating the preferences and values residents place on stream-related ecosystem services through a stated choice experiment. Partial support for activities from Coweeta LTER.

08/10-07/11. Designing regional social survey. Partial support for activities from Coweeta LTER.

11/09-07/10. Designing regional social survey. Partial support for activities from Coweeta LTER.

Name: Nelson, Don

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Collaborating with Coweeta Listening Project and developing a questionnaire designed to assess the level of collaboration and interaction of the CWT PIs. Partial support for activities from Coweeta LTER.

08/10-07/11. Participated in development of the Coweeta Listening Project to facilitate communication between Coweeta LTER researchers, local residents, existing environmental organizations, and policy makers in North Carolina, and to explain research conducted by Coweeta LTER. Partial support for activities from Coweeta LTER.

Name: Barret, Jeb

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. 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. Partial support for activities from Coweeta LTER.

08/10-07/11. Investigated influence of environmental gradients on the distribution and activity of soil nitrifier communities. Partial support for activities from Coweeta LTER.

Name: Emanuel, Ryan

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Conducting biweekly sampling of shallow groundwater, soil water, surface water and precipitation to track stable isotopes (D and 18O) as tracers of flow characteristics to characterize and quantify hillslope water balances and evaluate land-use impacts on water fluxes. Partial support for activities from Coweeta LTER.

08/10-07/11. Investigated hillslope hydrological processes across a spectrum of land development in the southern Appalachians through field-based investigation. Partial support for activities from Coweeta LTER.

Name: Shepherd, J. Marshall

Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Investigating spatial and temporal trends in hydroclimate variables and possible relationships to varying degrees of urban and peri-urban forcing. Partial support for activities from Coweeta LTER.

Post-doc

Name: Warren, Robert
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

08/10-07/11. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/09-07/10. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/08-10/09: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. No direct support from the Coweeta LTER research funds.

Name: McMahon, Sean
Worked for more than 160 Hours: Yes
Contribution to Project:
11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Sourdril, Anne
Worked for more than 160 Hours: Yes
Contribution to Project:
11/08-10/09: Investigating the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Partial support for activities from Coweeta LTER.

Name: Hua, Dong
Worked for more than 160 Hours: Yes
Contribution to Project:
11/09-07/10. Measurement and modeling of forest productivity, hydrologic cycling, and environmental and anthropogenic variables affecting them. Partial support for activities from Coweeta LTER.

Name: Brantley, Steven
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Investigating scaling of component ecosystem fluxes (i.e., transpiration, soil respiration, soil evaporation, etc.) to the eddy covariance-based ecosystem flux measurements. Partial support for activities from Coweeta LTER.

08/10-07/11. Investigating scaling of component ecosystem fluxes (i.e., transpiration, soil respiration, soil evaporation, etc.) to the eddy covariance-based ecosystem flux measurements. Partial support for activities from Coweeta LTER.

Name: Novick, Kim
Worked for more than 160 Hours: No
Contribution to 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. No direct support from the Coweeta LTER research funds.

Graduate Student
Name: Duncan, Jon

**Worked for more than 160 Hours:** No

**Contribution to Project:**
08/11-07/12: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

08/10-07/11: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

11/08-10/09: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

Name: Hwang, Taehee

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
08/11-07/12: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

08/10-07/11: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

11/09-07/10: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

11/08-10/09: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Taehee Hwang is a graduate student with Lawrence E. Band.

Name: Kove, Katherine

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
08/10-07/11: Measurement and modeling of forest productivity, hydrologic cycling, and environmental and anthropogenic variables affecting them. Partial support for activities from Coweeta LTER.

11/09-07/10: Measurement and modeling of forest productivity, hydrologic cycling, and environmental and anthropogenic variables affecting them. Partial support for activities from Coweeta LTER.

11/08-10/09: Measurement and modeling of forest productivity, hydrologic cycling, and environmental and anthropogenic variables affecting them. Partial support for activities from Coweeta LTER.

Name: Keiser, Ashley

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
08/11-07/12: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

08/10-07/11: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/09-07/10: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/08-10/09: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

Name: Strickland, Michael

**Worked for more than 160 Hours:** Yes
Contribution to Project:
11/09-07/10. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/08-10/09: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

Name: Kramer, Timothy
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/08-10/09: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

Name: Tang, Zhao
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/08-10/09: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

Name: Bell, Dave
Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

08/10-07/11. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Moran, Emily
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Block, Corinne
Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.

08/10-07/11. Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.
11/09-07/10. Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.

11/08-10/09: Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.

Name: Evans, Sakura

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Investigating the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Partial support for activities from Coweeta LTER.

08/10-07/11. Investigating the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Partial support for activities from Coweeta LTER.

11/09-07/10. Investigating the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Partial support for activities from Coweeta LTER.

11/08-10/09: Investigation of land use regulation and open space including land conservation programs and land use regulation. Partial support for activities from Coweeta LTER.

Name: Gustafson, Seth

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Examined the relationship between Atlanta's global city status and the exurbanization of Macon County, NC, and the connection between citizen scientific engagements related to climate change within the Southern Appalachian region. Partial support for activities from Coweeta LTER.

08/10-07/11. Examined the relationship between Atlanta's global city status and the exurbanization of Macon County, NC, and the connection between citizen scientific engagements related to climate change within the Southern Appalachian region. Partial support for activities from Coweeta LTER.

11/09-07/10. Examined the relationship between Atlanta's global city status and the exurbanization of Macon County, NC, and the connection between citizen scientific engagements related to climate change within the Southern Appalachian region. Partial support for activities from Coweeta LTER.

11/08-10/09: Examined the relationship between Atlanta's global city status and the exurbanization of Macon County, NC, and the connection between citizen scientific engagements related to climate change within the Southern Appalachian region. Partial support for activities from Coweeta LTER.

Name: Price, Katie

Worked for more than 160 Hours: No

Contribution to Project:
11/09-07/10. Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/08-10/09: Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Long, Lynsey

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.
and patterns. Partial support for activities from Coweeta LTER.

08/10-07/11. Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/09-07/10. Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/08-10/09: Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Suther, Bradley
Worked for more than 160 Hours: Yes
Contribution to Project:
11/09-07/10. Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

11/08-10/09: Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

Name: McDonald, Jake
Worked for more than 160 Hours: Yes
Contribution to Project:
11/08-10/09: Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

Name: Rogers, James
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12: Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

11/08-10/09: Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

Name: Meadows, Jason
Worked for more than 160 Hours: Yes
Contribution to Project:
11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/08-10/09: Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

Name: Wang, Lixin
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

08/10-07/11. Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

11/09-07/10. Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

11/08-10/09: Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

Name: Milanovich, Joseph

Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

11/08-10/09: Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

Name: Cecala, Kristen

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

08/10-07/11. Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

11/09-07/10. Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

11/08-10/09: Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

Name: Frisch, John

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.

08/10-07/11. Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.

11/09-07/10. Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.
11/08-10/09: Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.

**Name:** Lumpkin, Heather

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
08/11-07/12. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

08/10-07/11. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

11/09-07/10. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

11/08-10/09: Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

**Name:** Gooch, Michelle

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
08/11-07/12. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

08/10-07/11. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

11/09-07/10. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

11/08-10/09: Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

**Name:** Kuhman, Timothy

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
11/09-07/10. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

11/08-10/09: Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

**Name:** Cheever, Beth

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
08/11-07/12. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

08/10-07/11. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/09-07/10. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.
LTER.

11/08-10/09: Participated in developing and executing synoptic and aquatic sampling of Little Tennessee Watershed. Partial support for activities from Coweeta LTER.

Name: Kratzer, Erika
Worked for more than 160 Hours: No

Contribution to Project:
08/10-07/11. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/09-07/10. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/08-10/09: Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Lin, Laurence
Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

08/10-07/11. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/09-07/10. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/08-10/09: Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Jeremiah, Nick
Worked for more than 160 Hours: No

Contribution to Project:
11/08-10/09: Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Northington, Robert
Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

08/10-07/11. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.
11/09-07/10. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/08-10/09: Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Romito, Angela  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
08/10-07/11. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

11/09-07/10. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Stine, Anne  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

08/10-07/11. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Trushel, Brittany  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
08/10-07/11. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

11/09-07/10. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Beasley, Camille  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Collected samples for occupancy modeling of bird populations. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.

08/10-07/11. Collected samples for occupancy modeling of bird populations. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.

11/09-07/10. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Fontana, Catherine  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
11/09-07/10. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

Name: McDonald, Jacob  
**Worked for more than 160 Hours:** Yes
**Contribution to Project:**

08/11-07/12. Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

08/10-07/11. Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

11/09-07/10. Research into human impact on the fluvial geomorphology and stream water quality of the southern Blue Ridge Mountains region in particular sediment transport and storage in the fluvial system and relation to aquatic ecosystems. Partial support for activities from Coweeta LTER.

**Name:** Sullivan, Jeremy

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

08/11-07/12. Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.

08/10-07/11. Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.

11/09-07/10. Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.

**Name:** Duncan, Johnathan

**Worked for more than 160 Hours:** No

**Contribution to Project:**

11/09-07/10. Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

**Name:** Kirsch, Joseph

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

08/10-07/11. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

11/09-07/10. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

**Name:** Gray, Joshua

**Worked for more than 160 Hours:** No

**Contribution to Project:**

11/09-07/10. Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

**Name:** Dycus, Justin

**Worked for more than 160 Hours:** No

**Contribution to Project:**

08/10-07/11. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

11/09-07/10. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

**Name:** Machmuller, Megan

**Worked for more than 160 Hours:** No

**Contribution to Project:**

11/09-07/10. Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.
Name: Coughlan, Michael  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
08/11-07/12. Investigating the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Partial support for activities from Coweeta LTER.  
11/09-07/10. Investigating the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Partial support for activities from Coweeta LTER.

Name: Barlow, Paige  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
08/11-07/12. Collected samples for occupancy modeling of bird populations. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.  
08/10-07/11. Collected samples for occupancy modeling of bird populations. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.  
11/09-07/10. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Baas, Peter  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
08/11-07/12. Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.  
11/09-07/10. Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.

Name: Stewart, Rebecca  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
08/11-07/12. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.  
08/10-07/11. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.  
11/09-07/10. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Ramenzoni, Victoria  
Worked for more than 160 Hours: No  
Contribution to Project:  
11/09-07/10. Investigating the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Partial support for activities from Coweeta LTER.  

Name: Freeman, Joelle  
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Population of relational databases, development of GIS datasets, and socio-economic assessments pertaining to land parcel, land sale history, and and other LTER research projects. Adds data to Coweeta IMS. Partial support for activities from Coweeta LTER.

08/10-07/11. Population of relational databases, development of GIS datasets, and socio-economic assessments pertaining to land parcel, land sale history, and and other LTER research projects. Adds data to Coweeta IMS. Partial support for activities from Coweeta LTER.

Name: McDade, Brittany
Worked for more than 160 Hours: No

Contribution to Project:
08/10-07/11. Investigated paleo-droughts related to Coweeta LTER. Partial support for activities from Coweeta LTER.

Name: Younger, Seth
Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Worked on sediment-source ascription research related to the Coweeta LTER. Partial support for activities from Coweeta LTER.

08/10-07/11. Worked on sediment-source ascription research related to the Coweeta LTER. Partial support for activities from Coweeta LTER.

Name: Killeen Jensen, Carrie
Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Surveyed streams in the Upper Little Tennessee valley in relation to the 'intensive' sites and processing sediment samples for paleoenvironmental reconstructions from alluvial stratigraphic columns. Partial support for activities from Coweeta LTER.

08/10-07/11. Surveyed streams in the Upper Little Tennessee valley in relation to the 'intensive' sites and processing sediment samples for paleoenvironmental reconstructions from alluvial stratigraphic columns. Partial support for activities from Coweeta LTER.

Name: Rice, Joshua
Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Collected synoptic samples of stream water, shallow groundwater and precipitation from Coweeta LTER hillslope sites, focusing on using stable isotopes to investigate hydrological processes among hillslope sites. Partial support for activities from Coweeta LTER.

08/10-07/11. Collected synoptic samples of stream water, shallow groundwater and precipitation from Coweeta LTER hillslope sites, focusing on using stable isotopes to investigate hydrological processes among hillslope sites. Partial support for activities from Coweeta LTER.

Name: Norman, Jeff
Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Worked on the influence of environmental gradients on the distribution and activity of soil nitrifier communities. Partial support for activities from Coweeta LTER.

08/10-07/11. Worked on the influence of environmental gradients on the distribution and activity of soil nitrifier communities. Partial support for activities from Coweeta LTER.

Name: Womack, Kip
Worked for more than 160 Hours: Yes
08/10-07/11. Research, literature review and preliminary data collection to develop projects that could potentially expand the geographic extent of socio-ecological research, within Coweeta's southern Appalachian study area. Partial support for activities from Coweeta LTER.

**Name:** Fisher, Elizabeth  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/10-07/11. Research, literature review and preliminary data collection to develop projects that could potentially expand the geographic extent of socio-ecological research, within Coweeta's southern Appalachian study area. Partial support for activities from Coweeta LTER.

**Name:** Prebyl, Tom  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Assisted with phenology project within Coweeta basin and surrounding area. Partial support for activities from Coweeta LTER.

08/10-07/11. Assisted with phenology project within Coweeta basin and surrounding area. Partial support for activities from Coweeta LTER.

**Name:** Dymond, Salli  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
08/11-07/12. Conducted field data collection, data reduction, and basic analysis in support of research related to forest plant water use and the effects of forest species change on hydrology. Partial support for activities from Coweeta LTER.

08/10-07/11. Conducted field data collection, data reduction, and basic analysis in support of research related to forest plant water use and the effects of forest species change on hydrology. Partial support for activities from Coweeta LTER.

**Name:** Kraseski, Kristin  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Developed photographic technique to measure shade levels over streams, tested model of riparian shading of stream channels. Collected shade, channel, and continuous water temperature measurements on portions of the Upper Nantahala and Upper Little Tennessee River Basins. Partial support for activities from Coweeta LTER.

08/10-07/11. Developed photographic technique to measure shade levels over streams, tested model of riparian shading of stream channels. Collected shade, channel, and continuous water temperature measurements on portions of the Upper Nantahala and Upper Little Tennessee River Basins. Partial support for activities from Coweeta LTER.

**Name:** Garst, David  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
08/10-07/11. Supported research involving land cover, land use, and hemlock mortality effects on water quality in the southern Appalachian Mountains. Partial support for activities from Coweeta LTER.

**Name:** Zhu, Kai  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
08/11-07/12. Supported research involving effects of climate change on biodiversity throughout the southeast US. Partial support for activities from Coweeta LTER.

08/10-07/11. Supported research involving effects of climate change on biodiversity throughout the southeast US. Partial support for activities from Coweeta LTER.

**Name:** Mahan, Rachel  
**Worked for more than 160 Hours:** No
Contribution to Project:
08/10-07/11. Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Allen, Karen

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Serividio, Katherine

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Ursell, Tara

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Sridhar, Bhavya

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Dickinson, Matt

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Craig, Matthew

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Strother, Chris

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Dawson, Andria

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Contribution to Project:
Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.
Undergraduate Student

Name: Watts, Brian

Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

11/08-10/09: Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

Name: Watkins, Jessica

Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-05/10. 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.

11/08-10/09: 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.

Name: Vance, Jonathan

Worked for more than 160 Hours: Yes

Contribution to Project:
08/10-07/11. 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.

08/09-07/10. 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.

11/09-07/10. 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.

11/08-10/09: 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.

Name: Love, Kenneth

Worked for more than 160 Hours: Yes

Contribution to Project:
08/10-07/11. 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.

11/09-07/10. 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.

11/08-10/09: 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.

Name: Soltof, Ben
Worked for more than 160 Hours: No
Contribution to Project:
11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Luttrell, Rachel
Worked for more than 160 Hours: No
Contribution to Project:
11/09-07/10: Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.

11/08-10/09: Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.

Name: Vulova, Stenka
Worked for more than 160 Hours: Yes
Contribution to Project:
11/08-10/09: 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.

Name: Cosgrove, Julia
Worked for more than 160 Hours: Yes
Contribution to Project:
11/08-10/09: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Hung, David
Worked for more than 160 Hours: Yes
Contribution to Project:
11/09-07/10: Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

11/08-10/09: Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

Name: Masunaga, Aki
Worked for more than 160 Hours: Yes
Contribution to Project:
08/10-07/11: Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.

11/09-07/10: Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.

11/08-10/09: Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.

Name: Moore, Bryan
Worked for more than 160 Hours: Yes
Contribution to Project:
11/09-07/10: Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.

11/08-10/09: Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.
Appalachian forests. Partial support for activities from Coweeta LTER.

Name: Kresl, Cameron
Worked for more than 160 Hours: Yes
Contribution to Project:
11/08-10/09: Biotic synoptic sampling across the Little Tennessee Watershed in relation to geomorphology and water. Partial support for activities from Coweeta LTER.

Name: Widney, Sarah
Worked for more than 160 Hours: No
Contribution to Project:
11/08-10/09: Research on linking species specific parameters of water stress with plant demography. No direct support from the Coweeta LTER research funds.

Name: Baish, Alex
Worked for more than 160 Hours: No
Contribution to Project:
11/08-10/09: Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Baker, Aurora
Worked for more than 160 Hours: No
Contribution to Project:
11/08-10/09: Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: McCoy, Brandi
Worked for more than 160 Hours: No
Contribution to Project:
11/08-10/09: Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Hart, Adam
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

08/10-07/11. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

11/09-07/10. Working on relation of nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Milch, Adam
Worked for more than 160 Hours: Yes
Contribution to Project:
11/09-07/10. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

Name: Drake, Aime
Worked for more than 160 Hours: No
Contribution to Project:
11/09-07/10. Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds.

Name: Mersmann, Calley
Worked for more than 160 Hours: No

Contribution to Project:
11/09-07/10. Understanding and predicting the impacts of the tree and invasive species movement on nutrient and carbon cycling in response to climate change. Partial support for activities from Coweeta LTER.

Name: Hanson, Graham
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. 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.

Name: Lovell, Jacob
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. 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.

Name: Little, Jamie
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.

Name: Shope, James
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Sampson, Jason
Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Database development for land economics research in French Broad. Partial support for activities from Coweeta LTER.

08/10-07/11. Database development for land economics research in French Broad. Partial support for activities from Coweeta LTER.

11/09-07/10. Database development for land economics research in French Broad. Partial support for activities from Coweeta LTER.

Name: White, Jeffrey
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Green, Katie
Worked for more than 160 Hours: No
Contribution to Project:
11/09-07/10. Performed a field experiment to test a hypothesis about how land use affects native plants, and considered the influence of other drivers on plant population persistence. Partial support for activities from Coweeta LTER.

Name: Laity, Kelly
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

Name: Liles, Kristina
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Biotic sampling across Coweeta watershed. No direct support from the Coweeta LTER research funds.

Name: Moser, Lisa
Worked for more than 160 Hours: No

Contribution to Project:
11/09-07/10. Carried out studies focused on understanding the role of land-use history and contemporary landscape patterns affect the presence and abundance of invasive plants in the forest understory. Partial support for activities from Coweeta LTER.

Name: Hickson, Morgan
Worked for more than 160 Hours: Yes

Contribution to Project:
08/10-07/11. Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

Name: Fray, Nicholas
Worked for more than 160 Hours: No

Contribution to Project:
11/09-07/10. Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

Name: Senseney, Sallie
Worked for more than 160 Hours: No

Contribution to Project:
11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Pierson, Todd
Worked for more than 160 Hours: Yes

Contribution to Project:
11/09-07/10. Examining the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota through characterizing the occupancy and relative abundance of salamander larvae and stream macroinvertebrates. Partial support for activities from Coweeta LTER.

Name: Dewolfe, Zachary
Worked for more than 160 Hours: No

Contribution to Project:
08/10-07/11. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.
11/09-07/10. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Andrus, Chris

Worked for more than 160 Hours: Yes

Contribution to Project:
08/11-07/12. Development of relational databases pertaining to land parcel, land sale history, and other LTER research projects. Provides technical support, IT maintenance and updating of the Coweeta LTER Website. Partial support for activities from Coweeta LTER.

08/10-07/11. Development of relational databases pertaining to land parcel, land sale history, and other LTER research projects. Provides technical support, IT maintenance and updating of the Coweeta LTER Website. Partial support for activities from Coweeta LTER.

Name: Davis, Barrett

Worked for more than 160 Hours: Yes

Contribution to Project:
08/10-07/11. Provides technical support, IT maintenance and updating of the Coweeta LTER Website. Partial support for activities from Coweeta LTER.

Name: Howard, Ava

Worked for more than 160 Hours: Yes

Contribution to Project:
08/10-07/11. Collected data for scaling of component ecosystem fluxes (i.e., transpiration, soil respiration, soil evaporation, etc.) to the eddy covariance-based ecosystem flux measurements. Also collected detailed measurements of sap flow calibration in the lab. Partial support for activities from Coweeta LTER.

Name: Bell, Jennifer

Worked for more than 160 Hours: Yes

Contribution to Project:
08/10-07/11. Assisted with field and lab work related to the Coweeta LTER. Partial support for activities from Coweeta LTER.

Name: Barton, David

Worked for more than 160 Hours: Yes

Contribution to Project:
08/10-07/11. Assisted with fieldwork and installation of wells for hillslope sites at Coweeta LTER. Partial support for activities from Coweeta LTER.

Name: Rossouw, Klara

Worked for more than 160 Hours: No

Contribution to Project:
08/11-07/12. Assisted with field measurements of plant growth, survival, and recruitment, sorted pollinating insect samples related to effects of climate gradients & climate change on forest herbaceous plants and their pollinators. Analyzed data pertaining to breeding bird responses to residential/exurban development. Partial support for activities from Coweeta LTER.

08/10-07/11. Assisted with field measurements of plant growth, survival, and recruitment, sorted pollinating insect samples related to effects of climate gradients & climate change on forest herbaceous plants and their pollinators. Analyzed data pertaining to breeding bird responses to residential/exurban development. Partial support for activities from Coweeta LTER.

Name: Platt, Chris

Worked for more than 160 Hours: Yes

Contribution to Project:
08/10-07/11. Assisted with field measurements of plant growth, survival, and recruitment, sorted pollinating insect samples related to effects of climate gradients & climate change on forest herbaceous plants and their pollinators. Partial support for activities from Coweeta LTER.

Name: Mullen, Catherine

Worked for more than 160 Hours: No
Contribution to Project:
08/10-07/11. Collected data for occupancy modeling of bird populations. Partial support for activities from Coweeta LTER.

Name: Vose, Christian

Worked for more than 160 Hours: No

Contribution to Project:
08/10-07/11. Assisted with analysis of long-term Central Stoneroller data from Little Tennessee Watershed Association's fish Index of Biotic Integrity monitoring data. Partial support for activities from Coweeta LTER.

Name: Long, Clay

Worked for more than 160 Hours: No

Contribution to Project:
08/10-07/11. Collected leaf litter from CWT LTER terrestrial gradient plots for analysis on leaf litter biomass and N deposition associated with hailstorms. Partial support for activities from Coweeta LTER.

Name: Rich-Robertson, Ashley

Worked for more than 160 Hours: No

Contribution to Project:
08/10-07/11. Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Stratmann, Theresa

Worked for more than 160 Hours: No

Contribution to Project:
08/11-07/12. Supported research on effects of climate and land use change on terrestrial salamander population variation. Partial support for activities from Coweeta LTER.

Name: Tran, Tyler

Worked for more than 160 Hours: No

Contribution to Project:
Support of investigation of disturbance history of southern Appalachian region using dendroecology and longitudinal flowpaths across land uses.

Name: Wright, Greg

Worked for more than 160 Hours: No

Contribution to Project:
Participated in intensive sampling of hillslope sites and synthesis of work describing the effect of hemlock mortality on streams, and developing simulation models for nitrogen dynamics in streams. Partial support for activities from Coweeta LTER.

Name: Lin, Bobby

Worked for more than 160 Hours: No

Contribution to Project:
Participated in intensive sampling of hillslope sites and synthesis of work describing the effect of hemlock mortality on streams, and developing simulation models for nitrogen dynamics in streams. Partial support for activities from Coweeta LTER.

Name: Monteverde, Matt

Worked for more than 160 Hours: No

Contribution to Project:
Participated in intensive sampling of hillslope sites and synthesis of work describing the effect of hemlock mortality on streams, and developing simulation models for nitrogen dynamics in streams. Partial support for activities from Coweeta LTER.

Name: Stanley, Laura

Worked for more than 160 Hours: No

Contribution to Project:
Participated in intensive sampling of hillslope sites and synthesis of work describing the effect of hemlock mortality on streams, and developing simulation models for nitrogen dynamics in streams. Partial support for activities from Coweeta LTER.

**Name:** Farnham, Dylan

**Worked for more than 160 Hours:** No

**Contribution to Project:**
Investigating effects of residential development and climate on breeding bird communities, potential impacts of climate change and land use history on herbaceous species of Appalachian forests, and modeling interactions between climate change, habitat fragmentation, fine-scale habitat heterogeneity, and demographic responses of terrestrial species. Partial support for activities from Coweeta LTER.

**Name:** Risser, Rebecca

**Worked for more than 160 Hours:** No

**Contribution to Project:**
Supported investigating nitrogen cycling dynamics along both elevation and human development gradients using geophysical tools. Partial support for activities from Coweeta LTER.

**Name:** de la Torre Beron, Sara

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
Supported examining regional natural and anthropic archives of human land use in mountainous landscapes of southern Appalachia and the north-facing Pyrenees. Partial support for activities from Coweeta LTER.

**Name:** Bosio, Jeff

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
Supported hillslope research, collected lysimeter and well water samples, and helped measure coarse woody debris at the hemlock plots. Partial support for activities from Coweeta LTER.

**Name:** Kangas, Katie

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
Supported projects involving Microstegium vimineum and Aphaenogaster ants.

**Name:** Knoepp, Lillian

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
Supported research from terrestrial gradient plots by sorting leaf samples. Partial support for activities from Coweeta LTER.

**Name:** Pacher, Isarna

**Worked for more than 160 Hours:** No

**Contribution to Project:**
Supported the selection and installation of intensive plots to examine the impact of exurbanization on hillslope water and nutrient transport. No direct support from the Coweeta LTER research funds.

**Name:** Sims, Jordan

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
Supporting the development of the processes and methodologies through which the Coweeta Listening Project operates, coordinating community contacts and partners in Macon County. Partial support for activities from Coweeta LTER. Partial support for activities from Coweeta LTER.

**Technician, Programmer**

**Name:** Jenks, Andrew

**Worked for more than 160 Hours:** No

**Contribution to Project:**
08/10-07/11: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

11/08-10/09: Ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Partial support for activities from Coweeta LTER.

**Name:** Lish, Barbara  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

**Name:** See, Craig  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

**Name:** Bergen, Elizabeth  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

**Name:** Berger-Jones, Kaitlin  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

**Name:** Nichols, Lauren  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/08-10/09: Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

**Name:** Werrell, Peter  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

**Name:** Sobek, Christine  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12: Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds.

11/08-10/09: Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No
direct support from the Coweeta LTER research funds.

**Name:** Davis, Joseph  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.  
08/10-07/11. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.  
11/09-07/10. Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds.  
11/08-10/09: Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. Partial support for activities from Coweeta LTER.

**Name:** McCollum, Robert  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds.  
08/10-07/11. Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds.  
11/09-07/10. Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds.  
11/08-10/09: Understand and quantify how natural & human-mediated disturbances affect forest water and carbon cycling, the structural & functional controls on forest water and carbon cycling, and how water use affects tree and forest carbon fluxes. No direct support from the Coweeta LTER research funds.

**Name:** Love, Jason  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-08/12. 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. Full support for activities from Coweeta LTER.  
08/10-07/11. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.  
11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.  
11/08-10/09: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

**Name:** Chamblee, John  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**
08/11-07/12. 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.

08/10-07/11. 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.

11/09-07/10. 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.

11/08-10/09: 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.

Name: Anderson, Zach  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
11/08-10/09: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Allen, Hunter  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
11/09-07/10. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.

11/08-10/09: Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: McMillan, Joseph  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
11/08-10/09: Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Nguyen, Thuy  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
11/08-10/09: Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Brown, Cindi  
Worked for more than 160 Hours: Yes  
Contribution to Project:  
08/11-07/12. Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

08/10-07/11. Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.
11/09-07/10: Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

11/08-10/09: Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

**Name:** Muldoon, Neal  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12: Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

08/10-07/11: Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

11/09-07/10: Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

**Name:** Robertson, Shelley  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
11/08-10/09: Working to quantify channel morphology and stream temperature in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. Partial support for activities from Coweeta LTER.

**Name:** Harper, Carol  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

08/10-07/11: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/09-07/10: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/08-10/09: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

**Name:** Meador, Jason  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/10-07/11: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/09-10/10: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.
vehicles and facilities. Partial support for activities from Coweeta LTER.

11/08-10/09: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Deal, Jim
Worked for more than 160 Hours: Yes
Contribution to Project:
11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/08-10/09: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Kitzner, Jim
Worked for more than 160 Hours: Yes
Contribution to Project:
11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/08-10/09: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Poindexter, Mamie
Worked for more than 160 Hours: Yes
Contribution to Project:
08/10-07/11. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/08-10/09: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Gregory, Sheila
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.

08/10-07/11. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

11/08-10/09: Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: McLean, Katlin
Worked for more than 160 Hours: No
Contribution to Project:
08/10-07/11. Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.

11/09-07/10. Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial
support for activities from Coweeta LTER.

11/08-10/09: Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.

Name: Frankson, Paul

**Worked for more than 160 Hours:** No

**Contribution to Project:**
11/09-07/10. Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.

11/08-10/09: Research on soil nutrient biogeochemistry along the elevational gradient plots linked to vegetation dynamics. Partial support for activities from Coweeta LTER.

Name: Hutchins, Matthew

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
11/08-10/09: Studying the effects of residential development and climate on breeding bird communities and herbaceous species of Appalachian forests. Partial support for activities from Coweeta LTER.

11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Powell, Amanda

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
08/10-07/11. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Roper, Becky

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**
08/11-07/12. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Vierra, Ben

**Worked for more than 160 Hours:** No

**Contribution to Project:**
08/11-07/12. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Smith, Damian

**Worked for more than 160 Hours:** No

**Contribution to Project:**
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Chambers, David

**Worked for more than 160 Hours:** No

**Contribution to Project:**
08/11-07/12. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.
change affect forest diversity. Partial support for activities from Coweeta LTER.

11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Boisvert, Elizabeth
Worked for more than 160 Hours: No
Contribution to Project:
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Brandt, Erika
Worked for more than 160 Hours: No
Contribution to Project:
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Bower, Katie
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.
08/10-07/11. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.
11/09-07/10. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

Name: Kwit, Matt
Worked for more than 160 Hours: No
Contribution to Project:
08/11-07/12. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.
08/10-07/11. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

Name: Ivey, Michael
Worked for more than 160 Hours: No
Contribution to Project:
08/10-07/11. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.
11/09-07/10. Participated in site characterization for Phase 1 synoptic sites, developed a 2006 land cover map for the southern Appalachian study region, and documented land cover and land use change within the Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Clinton, Patsy
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Biotic sampling across Coweeta watershed. No direct support from the Coweeta LTER research funds.
08/10-07/11. Biotic sampling across Coweeta watershed. No direct support from the Coweeta LTER research funds.

11/09-07/10. Biotic sampling across Coweeta watershed. No direct support from the Coweeta LTER research funds.

**Name:** Read, Quentin  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

**Name:** Debruyne, Scott  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
11/09-07/10. Working to quantify soil properties in relation to nutrient concentrations, sediment sources, and biotic assemblages along longitudinal gradients and across watersheds differing substantially in development amounts and patterns. No direct support from the Coweeta LTER research funds.

**Name:** Armstrong, Timothy  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
11/09-07/10. Collecting data from observational studies and landscape scale experiments to analyze how disturbance and climate change affect forest diversity. Partial support for activities from Coweeta LTER.

**Name:** Cary, Richard  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Population of relational databases, development of GIS datasets and socio-economic assessments pertaining to land parcel, land sale history, and other LTER research projects. Deploying automated data streaming pilot station. Full support for activities from Coweeta LTER.

**Name:** Dutcher, Sarah  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/10-07/11. Maintenance, editing, and updating of the Coweeta LTER Website. Partial support for activities from Coweeta LTER.

**Name:** Nix, Tom  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/10-07/11. Provides photographic support for Coweeta LTER projects. Partial support for activities from Coweeta LTER.

**Name:** Nixon, Elizabeth  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Provides artistic and graphic design support for Coweeta LTER projects. Updates Coweeta LTER website. Partial support for activities from Coweeta LTER.

08/10-07/11. Provides artistic and graphic design support for Coweeta LTER projects. Updates Coweeta LTER website. Partial support for activities from Coweeta LTER.

**Name:** Laviner, Andy  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/10-07/11. Coweeta LTER site support of project activities including collecting, QC, and archiving of data, and management of vehicles and facilities. Partial support for activities from Coweeta LTER.

**Name:** Laseter, Stephanie  
**Worked for more than 160 Hours:** No
Contribution to Project:
08/11-07/12. Provides long term monitoring data from Forest Service monitoring projects. No support of activities from Coweeta LTER.

08/10-07/11. Provides long term monitoring data from Forest Service monitoring projects. No support of activities from Coweeta LTER.

Name: Neiderlehner, Bobbie
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. 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. Partial support for activities from Coweeta LTER.

08/10-07/11. 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. Partial support for activities from Coweeta LTER.

Name: Bailey, Brett
Worked for more than 160 Hours: No
Contribution to Project:
08/10-07/11. Assisted with phenology project within Coweeta basin and surrounding area. Partial support for activities from Coweeta LTER.

Name: Gateau, Nathan
Worked for more than 160 Hours: No
Contribution to Project:
08/10-07/11. Collected data for occupancy modeling of bird populations. Partial support for activities from Coweeta LTER.

Name: Hoveland, Matt
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Conducted field data collection, data reduction, and basic analysis in support of research related to forest plant water use and the effects of forest species change on hydrology. Partial support for activities from Coweeta LTER.

08/10-07/11. Conducted field data collection, data reduction, and basic analysis in support of research related to forest plant water use and the effects of forest species change on hydrology. Partial support for activities from Coweeta LTER.

Name: Sipprelle, Cara
Worked for more than 160 Hours: Yes
Contribution to Project:
08/10-07/11. Assisted in development of the Coweeta Listening Project. Interviewed local residents and environmental groups on their concerns and interests in relation to Coweeta LTER, communicated Coweeta LTER research objectives and results to these groups. Partial support for activities from Coweeta LTER.

Name: Hubinger, Christine
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Provided support of ongoing project activities such as collecting long-term monitoring data. Partial support for activities from Coweeta LTER.

08/10-07/11. Provided support of ongoing project activities such as collecting long-term monitoring data. Partial support for activities from Coweeta LTER.

Name: Peltz, Linda
Worked for more than 160 Hours: Yes
Contribution to Project:
08/10-07/11. Provided support of ongoing project activities such as collecting long-term monitoring data. Partial support for activities from Coweeta LTER.

Name: Scott, Joel
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Provided support of ongoing project activities such as collecting long-term monitoring data. Full support for activities from Coweeta LTER.

08/10-07/11. Provided support of ongoing project activities such as collecting long-term monitoring data. Partial support for activities from Coweeta LTER.

Name: Melton, Tim
Worked for more than 160 Hours: No
Contribution to Project:
08/11-07/12. Support of research involving long-term vegetation and biomass dynamic following clearcutting, disturbance history in the southern Appalachian Mountains, and how anthropogenic changes in vegetation effect watershed characteristics. Partial support for activities from Coweeta LTER.

08/10-07/11. Support of research involving long-term vegetation and biomass dynamic following clearcutting, disturbance history in the southern Appalachian Mountains, and how anthropogenic changes in vegetation effect watershed characteristics. Partial support for activities from Coweeta LTER.

Name: Adu, Crystal
Worked for more than 160 Hours: No
Contribution to Project:
08/10-07/11. Support of research involving long-term vegetation and biomass dynamic following clearcutting, disturbance history in the southern Appalachian Mountains, and how anthropogenic changes in vegetation effect watershed characteristics. Partial support for activities from Coweeta LTER.

08/10-07/11. Support of research involving long-term vegetation and biomass dynamic following clearcutting, disturbance history in the southern Appalachian Mountains, and how anthropogenic changes in vegetation effect watershed characteristics. Partial support for activities from Coweeta LTER.

Name: Williams, Letman
Worked for more than 160 Hours: No
Contribution to Project:
08/10-07/11. Support of research involving long-term vegetation and biomass dynamic following clearcutting, disturbance history in the southern Appalachian Mountains, and how anthropogenic changes in vegetation effect watershed characteristics. Partial support for activities from Coweeta LTER.

08/10-07/11. Support of research involving long-term vegetation and biomass dynamic following clearcutting, disturbance history in the southern Appalachian Mountains, and how anthropogenic changes in vegetation effect watershed characteristics. Partial support for activities from Coweeta LTER.

Name: Marchman, Samantha
Worked for more than 160 Hours: Yes
Contribution to Project:
08/11-07/12. Assisted with sampling and sample processing of long term water quality monitoring sites. Partial support for activities from Coweeta LTER.

08/10-07/11. Assisted with sampling and sample processing of long term water quality monitoring sites. Partial support for activities from Coweeta LTER.

Name: Bahn, Bob
Worked for more than 160 Hours: No
Contribution to Project:
08/11-07/12. Assisted with sampling and sample processing of long term water quality monitoring sites. Partial support for activities from Coweeta LTER.

08/10-07/11. Assisted with sampling and sample processing of long term water quality monitoring sites. Partial support for activities from Coweeta LTER.

Name: Kinney, Vanessa
Worked for more than 160 Hours: No
Contribution to Project:
Supported monitoring of salamanders at synoptic sites including mark-recapture of terrestrial salamanders at long-term plots along an elevation gradient. Partial support for activities from Coweeta LTER.

Name: Law, Elle
Worked for more than 160 Hours: Yes

Contribution to Project:
Supported investigations on effects of land use, elevation, predator communities on avian communities and nest predation rates; and the interplay of spring greenup (vegetation phenology) and elevation. Partial support for activities from Coweeta LTER.

Name: Bryant, Christopher
Worked for more than 160 Hours: Yes

Contribution to Project:
Supported investigations into integrating measurement and modeling of watersheds in the southern Appalachians, including feedbacks between ecological, hydrological, geomorphic and climate processes. Partial support for activities from Coweeta LTER.

Name: Scaife, Charles
Worked for more than 160 Hours: Yes

Contribution to Project:
Supported investigations on effects of land use, elevation, predator communities on avian communities and nest predation rates; and the interplay of spring greenup (vegetation phenology) and elevation. Partial support for activities from Coweeta LTER.

Name: Addington, Gretchen
Worked for more than 160 Hours: No

Contribution to Project:
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Becker, Lindsey
Worked for more than 160 Hours: No

Contribution to Project:
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Bettcher, Morgan
Worked for more than 160 Hours: No

Contribution to Project:
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Brendle, Mitchell
Worked for more than 160 Hours: No

Contribution to Project:
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Christopher, Dani
Worked for more than 160 Hours: No

Contribution to Project:
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Cottingham, Ben
Worked for more than 160 Hours: No

Contribution to Project:
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.
Name: Flynn, Emily  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Franke, Will  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Hodges, Alex  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Holcomb, David  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Moore, Jason  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Powers, Zaidee  
**Worked for more than 160 Hours:** No  
**Contribution to Project:**  
Supported plot-level studies arrayed along hillslopes and valley bottoms in catchments across a range of variation in combinations of climate and land use variables to examine biodiversity/ecosystem function. Partial support for activities from Coweeta LTER.

Name: Sollenberger, Daniel  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
Supported the installation of groundwater wells and lysimeters on the intensive hillslope plots and to assist in various LTER-related field research. Full support for activities from Coweeta LTER.

Name: Benson, Rob  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**  
08/11-07/12. Population of relational databases, development of GIS datasets, and socio-economic assessments pertaining to land parcel, land sale history, and other LTER research projects. Adds data to Coweeta IMS. Partial support for activities from Coweeta LTER.

Other Participant

Research Experience for Undergraduates

Name: Zyla, Abby  
**Worked for more than 160 Hours:** Yes
Contribution to Project:
11/08-10/09: Interviewed local residents of Appalachia for stories and songs about natural history, then retold them and illustrated to produce the manuscript of a children's book. Partial support for activities from Coweeta LTER.

Years of schooling completed: Other
Home Institution: Same as Research Site
Home Institution if Other: 
Home Institution Highest Degree Granted (in fields supported by NSF): Bachelor's Degree
Fiscal year(s) REU Participant supported: 2009
REU Funding: REU site award

Name: Henry, Sarah
Worked for more than 160 Hours: Yes
Contribution to Project:
Investigated Aphaenogaster ant nest relative abundance in developed versus forested sites, tested whether Aphaenogaster ants carried bait toward the forest or away from the forest edge, and Aphaenogaster and general abundance and ant richness at each site using tuna bait stations. Partial support for activities from Coweeta LTER.

Name: Sutton, Shelby
Worked for more than 160 Hours: Yes
Contribution to Project:
Investigated two species of Plethodon salamanders and their hybrid zone along an elevational gradient at Coweeta along with stream salamander occupancy in stream reaches associated with the intensive hillslope plots. Partial support for activities from Coweeta LTER.

Organizational Partners

Little Tennessee Watershed Association
Coweeta LTER researchers and staff, including P. Bolstad, J. Chamblee, T. Gragson, and J. Love, collaborate with LTWA members on a variety of outreach-related activities in the Little Tennessee Basin. These include biomonitoring and biotic inventory, water quality/quantity assessment, database development, and training.

Macon Middle School
Coweeta LTER researchers, staff and students work with members of the teaching staff at Macon Middle School (Macon County, NC) in science education. Activities include installation of meteorological equipment, co-teaching science classes, establishing citizen science projects on campus, and curriculum development.

Rabun Gap Nacoochee School
Coweeta LTER researchers, staff and students work with members of the teaching staff at Rabun Gap Nacoochee School (Rabun County, GA) in science education. Activities include installation of meteorological equipment, co-teaching science classes, establishing citizen science projects on campus, and curriculum development.

Mountain View Intermediate School
Coweeta LTER researchers, staff and students work with members of the teaching staff at Mountain View Intermediate School (Macon County, NC) in science education. Activities include installation of meteorological equipment, co-teaching science classes, establishing citizen science projects on campus, and curriculum development.

Land Trust for the Little Tennessee
Coweeta LTER researchers and staff collaborate with LTLT members on a variety of outreach-related activities in the Little Tennessee Basin. These include biomonitoring and biotic inventory, water quality/quantity assessment, database development, and training.

Other Collaborators or Contacts
COLLABORATORS or CONTACTS: 11/01/11 to 07/31/12
Comprehensive list of institutions with which Coweeta LTER senior personnel and graduate students collaborated:

>100 Private landowners
A.K. Knapp, Colorado State University
Alan Gelfand, Duke University
Allan White, University of Maine
Brian Strahm, Virginia Tech
Carrie Bishop, UGA Center for Teaching and Learning
Cary Institute of Ecosystem Science
Cherokee Creek Boys School (SC)
Christian Cummings Dustin Deadwyler, UGA Network Operations Center
Coastal Carolina University
Cullasaja Country Club
D.A. Landis, Michigan State University
Daniel Markowitz, UGA
Denis Newbold, Colorado State University
Drake Software
Eastern Band of Cherokee Indians
Ed Schwartzman, NC DNR
Friends of the Greenway
G.J.A. Hansen, University of Wisconsin
G.R. Shaver, Marine Biological Laboratory
Georgia Department of Natural Resources
Greenway Invasive Partnership (GRIP) Advisory Committee
Hayesville Middle School
Highlander Research and Education Center
Highlands Audubon Society
Highlands Biological Station
Highlands Country Club
Indiana University
Itamar Giladi, Ben-Gurion University, Israel
J.M. Melillo, Marine Biological Laboratory
Jason Manous and Michael Hill, Franklin College Office of Information Technology
Jerry Miller, Western Carolina University
Jonathan Benstead, University of Alabama
Joseph W. Jones Ecological Research Center.
Josh King, University of Central Florida
K.J. La Pierre, University of Kansas
Katie Price, EPA Office of Research and Development
Little Tennessee Land Trust
Luke Flory, University of Florida
M.D. Smith, Colorado State University
Macon County Historical Society
Macon Early College High School
Macon Middle School
NASA
North Carolina Geological Survey Landslide Mapping program
North Carolina Natural History Survey
Orianne Society
Pankaj Agarwal, Duke University
Patricia Brousseau, Virginia Tech
Rabun County Middle School
Rabun Gap-Nacoochee School
Richard Hoffman Foundation
S.E. Hobbie, University of Minnesota
S.L. Collins, University of New Mexico
Sally Horn, University of Tennessee
Soupamno Ghosh, Duke University
Southern Appalachian Raptor Research
T.J. Fahey, Cornell University
T.R. Seastedt, University of Colorado
TC Hales of the Cardiff University, Wales, UK
Ted Baggett, J.D., The Carl Vinson Institute of Government, UGA.
Thomas Molhave, Duke University
University of Alabama
University of North Carolina at Asheville
US Fish and Wildlife Service
US Forest Service ? including National Forest System, Forest Experiment Stations, and Forest Inventory and Analysis Program
USDA through AFRI program
Vlad Gulis, Coastal Carolina University
Volker Bahn, Wright State University
Wade Sheldon, GCE LTER, UGA
Western North Carolina Alliance
Wildcat Cliffs Country Club
Ted Baggett, J.D., The Carl Vinson Institute of Government, UGA.
Thomas Molhave, Duke University
University of Alabama
University of North Carolina at Asheville
US Fish and Wildlife Service
US Forest Service ? including National Forest System, Forest Experiment Stations, and Forest Inventory and Analysis Program
USDA through AFRI program
Vlad Gulis, Coastal Carolina University
Volker Bahn, Wright State University
Wade Sheldon, GCE LTER, UGA
Western North Carolina Alliance
Wildcat Cliffs Country Club
William O. McLarney and Jason Meador, Little Tennessee Watershed Association

COLLABORATORS or CONTACTS: 11/01/10 to 07/31/11
Comprehensive list of institutions with which Coweeta LTER senior personnel and graduate students collaborated:

>160 Private landowners throughout Macon County
Amy Rosemond, Odum School of Ecology, University of Georgia
Angeline Rodgers, North Carolina Natural Heritage Program
Appalachian Voices, Boone, NC
Baltimore Ecosystem Study
Bart Tedford, Cana Communications, Inc.
Carrie Bishop and Melissa Gay, UGA Center for Teaching and Learning
Cary Institute for Ecosystem Studies
Cedarville University
Christian Cummings and Dustin Deadwyler, UGA Network Operations Center
Cullasaja Country Club
Dr. A.K. Knapp, Colorado State University
Dr. Barbara Reynolds, UNC Asheville
Dr. D.A. Landis, University of Pennsylvania
Dr. Edward Gardiner, NOAA Climate Program Office
Dr. G.J.A. Hansen, University of Florida
Dr. G.R. Shaver, The Ecosystems Center
Dr. H.M. Valett, University of Montana
Dr. J.M. Melillo, The Ecosystems Center
Dr. J.M. Shepherd, Department of Geography, UGA
Dr. Katie Price, EPA post-doctoral researcher
Dr. M. Conroy, Daniel B. Warnell School of Forestry and Natural Resources, UGA
Dr. M.D. Smith, Yale University
Dr. Mark Scott, S.C. Dept. of Natural Resources
Dr. R. Cooper, Daniel B. Warnell School of Forestry and Natural Resources, UGA
Dr. Robert Hubbard, USDA Forest Service lab
Dr. S.E. Hobbie, University of Minnesota
Dr. S.L. Collins, University of New Mexico
Dr. T.C. Hales, Cardiff University in Wales, UK
Dr. T.J. Fahey, Cornell University
Dr. T.R. Seastedt, University of Colorado
Dr. William O. McLarney and Jenny Sanders, Little Tennessee Watershed Association
Drake Software
Franklin Municipal Water Supply
Friends of the Greenway
Georgia Coastal Ecosystems LTER
Grandfather Mountain Golf & Country Club
Greenway Invasive Partnership (GRIP) Advisory Committee
Hans Neuhauser, Georgia Land Conservation Center
Highlands Audubon Society
Highlands Biological Station
Highlands Country Club
Jason Manous and Michael Hill, Franklin College Office of Information Technology
K.J. La Pierre, University of Kansas
Land Trust for the Little Tennessee
Little Tennessee Watershed Association
Macon County Planning Office
Macon Early College High School
Macon Middle School
Mark Cherry, Information Technology Office of the Daniel B. Warnell School of Forestry and Natural Resources, UGA
Montana State University
Mountain Air Property Owners Association
Mountain View Intermediate School
Peter Colwell, Emeritus Professor of Finance, University of Illinois at Urbana-Champaign
Philip Clark, The Commtran Group
Rabun County Middle School
Rabun Gap-Nacoochee School
Renaissance Computing Institute (RENCI), University of North Carolina
Southern Appalachian Raptor Research
Town of Beech Mountain
UNC Institute for the Environment
University of Maine
University of Maryland Baltimore County
US Fish and Wildlife Service
US Forest Service, Nantahala Ranger District
US Forest Service, Northern Research Station
US Forest Service, Southern Research Station
US Geological Survey
Wade Sheldon, GCE LTER
Western Carolina University
Western North Carolina Alliance
Wildcat Cliffs Country Club
Wolf Laurel Homeowners Association

COLLABORATORS or CONTACTS: 11/01/09 Through 07/31/10

Comprehensive list of institutions with which Coweeta LTER senior personnel and graduate students collaborated:

Amy Rosemond, Odum School of Ecology, University of Georgia
Andrea Leslie, North Carolina DNR
Anya Hinkle, The Highlands Biological Station
Barbara Reynolds, UNC Asheville
Bill Peterman, University of Missouri
Cartoogechaye Elementary School
Cullasaja Country Club
Cullasaja Elementary School
Dan Markewitz, Warnell School, University of Georgia
Dean Anderson, LandCare, New Zealand
Drake Software
Ed Schwartzman, North Carolina DNR
Emory University
Franklin High School
Friends of the Greenway (FROGs)
Georgia Department of Natural Resources
Grandfather Mountain Golf & Country Club
Greenway Invasive Partnership (GRIP) Advisory Committee
Hans Neuhauser, Georgia Land Conservation Center
Highlander Research & Education Center
Highlands Audubon Society
Highlands Country Club
Institute for the Environment, University of North Carolina ? Chapel Hill
Jason Manous, UGA Franklin College Office of Information Technology
Jon Benstead, University of Alabama
Justin Wright, Duke University
Land Trust for the Little Tennessee
Linda Amaral Zettler, Woods Hole (MIRADA Project)
Macon Early College High School
Macon Middle School
Mark Cherry, UGA Warnell School of Forestry Information Technology Office
Mars Hill College
Martin Halek, Department of Actuarial Science, University of Wisconsin
Mountain Air Property Owners Association
North Carolina Wildlife Resources Commission
Peter Colwell, University of Illinois at Urbana-Champaign
Pisgah National Forest
R. Gil Pontius and T. Nguyen, Clark University
Rabun County Middle School
Rabun Gap-Nacoochee School
Robert Hubbard, USDA Forest Service lab
Robert Peet, University of North Carolina
Sally Horn, University of Tennessee
Southern Appalachian Raptor Research
Steve Fraley, North Carolina Wildlife Resources Commission
T.C. Hales, Cardiff University in Wales, UK
Town of Beech Mountain
US Fish and Wildlife Service
US Forest Service ? Nantahala Ranger District
US Geological Survey ? Biological Resources Division
Vlad Gulis, Coastal Carolina University
Volker Bahn, Wright State University
Wade Sheldon, Georgia Coastal Ecosystems L TER
Western Carolina University
Western NC Alliance
Wildcat Cliffs Country Club
Wildlife Management Institute
William O. McLarney & Jenny Sanders, Little Tennessee Watershed Association
Wolf Laurel Homeowners Association
Wright State University

Colaborators or Contacts: 11/01/08 Through 10/31/09

Summary of selected collaborations:

L. Band worked with TC Hales at Cardiff University and US Forest Service researcher on a project addressing altered landslide regimes and mechanisms in Southern Appalachia.
P. Bolstad worked with Bruce Cook of NASA Goddard on waveform LiDAR data collection, Emilio Chuvieco of the University of Alcala de Henares on remote sensing of canopy architecture, and Ramesh Shrestha of NCALM on discrete-return LiDAR data collection in estimation of basin-wide leaf area.

J. Chamblee worked with William McClarney of the Little Tennessee Watershed Association to develop a relational database, GIS dataset, and prototype web application providing an access portal to 19 years of biomonitoring data across the Little Tennessee Watershed. This encompasses 7,722 individual observations on 196,238 distinct fish distributed across 80 unique species and species-hybrid classes.

C. Dehring worked with the Georgia Land Conservation Program in a project using data from the relatively new Georgia Income Tax Credit Program to examine the sensitivity of conservation activity to income.

C. Ford collaborated with Nina Wurzburger at Princeton University, Ronald Hendrick at the University of Georgia, and Brain Kloeppel at Western Carolina University on a study of forest soil CO2 efflux.

A. Soudril partnered with University of North Carolina ? Asheville and Montreat College on a PhotoVoice project that was then presented and displayed at in Black Mountain and Swannanoa (Buncombe County, NC).

M. Turner worked with US Forest Service personnel at Bent Creek Experimental Forest on a detailed study of the effects of land-use history on the presence and abundance of invasive plant species in the forest understory.

J. Hepinstall collaborated with R. Pontius at Clark University on a cross-site mapping project to standardize land cover and metrics for comparison.

Comprehensive list of institutions with which Coweeta LTER senior personnel and graduate students collaborated:

1. Bent Creek Experimental Forest
2. Black Mountain Public Library
3. Cardiff University
4. Carolina Vegetation Survey
5. City of Franklin, NC
6. Clark University
7. Coastal Carolina University
8. Columbia University
9. Friends of the Greenway
10. Georgia Land Conservation Program
11. Grandfather Mountain Golf & Country Club
12. Great Smoky Mountains National Park
13. Great Smoky Mountains Institute at Tremont
14. Highlands Biological Station
15. INRA - Toulouse
16. LandCare - New Zealand
17. Land Trust for the Little Tennessee
18. Macon County Folk Heritage Association
19. Macon Middle School
20. Montreat College
21. Mountain Air Property Owners Association
22. Mt Holyoak College
23. NASA Goddard Space Flight Center
24. NC Geological Survey through the same project.
25. North Carolina Department of Natural Resources
26. Northern Arizona University
27. Oak Ridge National Laboratory
28. Pisgah National Forest
29. Princeton University
30. Rabun Gap Nachoochee School
31. Swannanoa Valley Museum
Activities and Findings

Research and Education Activities:

RESEARCH ACTIVITIES: 11/01/11 to 07/31/12

Activities this year as described below depended on funding from the Coweeta LTER award (DEB-0823293) as well as funding from NSF (other programs), National Park Service, NASA, EPA, DOE, US Forest Service, US Fish and Wildlife Service, USGS, Andrew W. Mellon Foundation, the Odum School Small Grant Program, the Cary Institute, the Soil Summer Institute, the University of Georgia Research Foundation, the CURO ?Diversity? Apprentice Program, and McIntire-Stennis formula funding to the U of Georgia Warnell School of Forest Resources and the Department of Forestry and Environmental Resources at NC State University. Activities are listed under the most relevant of the five thematic areas into which research is organized, although several activities obviously pertain to more than one thematic area given the overarching goal of achieving a regional understanding of the socio-ecological processes in southern Appalachia.

1. Parcel-Level to Regional Decision-Making

Activities on land pricing aspects of land use regulation and open space as they relate to the economic impacts of development and development policy on various aspects of the Appalachian region. The purpose of our research is to shed light on how development, especially residential, impacts ecosystem services and how the value of these services are reflected in property values.

A project is underway to investigate the individual decision to donate land to conservation in Buncombe County and Macon County, North Carolina. The objective is to determine how land donations are influenced by various public policies at the state and federal level. While public policy aims to encourage land donations to avoid disamenities of development and provide amenities to surrounding properties, to date there has been no large-scale empirical study of how changes in public policy, e.g., tax laws, influence the decision to donate land to conservation.

Research continued on the effects of land use and elevation (as a surrogate for climate change) on avian communities using modeling techniques and stakeholder involvement in Macon County, NC. The objective is to identify biologically suitable management options with stakeholder support. This year the focus has been on analyzing avian field data to model multi-species site occupancy using occupancy modeling, and implementing focus group work with stakeholders.

The Coweeta Listening Project continued to develop depth across community contacts within Macon County, writing columns for the Franklin Press and launching the project website.

We developed a stated choice experiment, refined the experiment through focus groups with Macon County, NC residents, and began administering the survey to a sample of Macon County residents. The objective is to estimate the preferences and values residents place on stream-related ecosystem services.
Work proceeded on customizing the Rapid Stream Visual Assessment Protocol (SVAP) for the Southern Appalachians, including field testing of the instrument to assess inter-user reliability and accuracy.

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

Collaboration proceeded on the ‘Uncertainty project’ led by Ruth Yanai to examine variability and uncertainty in stream water and nutrient flux measurement. Phase 2 of the project will examine uncertainty in precipitation and nutrient input measurements and calculations, and includes all LTER sites with adequate data available.

MS student Lynsey Long successfully defended her thesis quantifying the effect of geomorphic position within a channel on maximum daily water temperatures.

Research to characterize and quantify hillslope water balances and evaluate land-use impacts on water fluxes continued. This includes bi-weekly sampling of shallow groundwater, soil water, surface water and precipitation to track stable isotopes (D and 18O) as tracers of flow characteristics. Samples are currently being analyzed from two forested sites and two agricultural sites using a CRDS analyzer (Model L2120i, Picarro, Inc.).

Research was carried out to determine spatial and temporal trends in hydroclimate variables and possible relationships to varying degrees of urban and peri-urban forcing. We are examining the exposure and sensitivity components of a vulnerability framework to investigate hydroclimate-vulnerability relationships in the region. Our study area encompasses an area anchored by Atlanta, Knoxville, Asheville, and Charlotte.

Site selection and instrument installation proceeded to examine the impact of exurbanization on hillslope water and nutrient transport.

The Coweeta field team completed approximately 15 months of grab and storm sampling on 12 streams in the Upper Little Tennessee River Basin. In spring, data was processed and rating curves to convert the continuous stage data into flow data were developed. We are now analyzing the suspended sediment and specific conductivity data to look at hysteresis behavior and to develop sediment and specific conductivity rating curves for each watershed. The rating curves will be used to compare water quality behavior across the watersheds and to calculate suspended sediment loads.

Work continued with the purpose of unraveling nitrogen cycling dynamics along elevation and human development gradients, with sampling on the intensive hillslope sites to assess novel nitrogen cycling pathways (Anammox, dissimilatory nitrate reduction to ammonium (DNRA) and greenhouse gas emissions (CO2, CH4 and N2O).

A co-funded project was initiated to measure heterotrophic responses to altered ratios of N and P to examine the effect on stream processes including decomposition, metabolism and nutrient dynamics as well as the productivity fungi, macroinvertebrates, and salamanders. Following 19 months of pretreatment monitoring of 5 streams within the Coweeta basin, we initiated the nutrient alteration via a continuous drip.

3. Impacts of Climate and Land Use Change on Biodiversity

A second field season was completed looking at the interplay of spring greenup (vegetation phenology) and elevation in the Coweeta and surrounding basins. This research combines field measurements (photographs, vegetation scoring, and light, temperature, and relative humidity sensors) to satellite-based (MODIS) vegetation measurements.

Studied the interaction between land-use history and climate variation as it affects the establishment and growth of native herbaceous species as well as plant-pollinator interactions.

Analysis was carried out of the relative effects of watershed land use and water quality on the spatial distribution of four stream focal taxa in the Little Tennessee River basin: Tallaperla spp. (stonefly), Cambarus spp. (crayfish), Pleurocera proxima (snail), and Cottus bairdi (mottled sculpin). We used occupancy models to simultaneously estimate detection probability and occupancy rate to determine which environmental parameters best predicted the observed spatial distribution of each focal taxon.

Over the past year the analysis of empirical data on biodiversity/ecosystem function from long-term plots has continued. Particular emphasis has been placed on modeling, which has resulted in a number of papers linking biodiversity responses to climate variables from individual to subcontinental scales.

Participated in a survey of rare bog turtle populations in North Georgia, that used known locations of bog turtles in western North Carolina to develop a habitat model for predicting their location in adjacent areas.
To predict the influence of tree species movement on nutrient and carbon cycling in response to climate change, we continued and extended experimental field and laboratory experiment established using sites, soils and litters within the basin and extending outside of the basin to higher elevation (Blue Ridge Parkway). This question forms the basis for Ashley Keiser’s doctoral research and is funded through a five-year doctoral stipend (and tuition) from Yale, as well as monies from a UGA cooperative agreement. Further, for Year 3 Ashley has been awarded an EPA STAR Fellowship to advance this research.

We completed the displacement studies to look at how the creation of forest gaps associated with roads or powerlines affected movement rates of stream salamanders.

We continued our second full year of mark-recapture of terrestrial salamanders in 6 long-term plots along an elevation gradient. The objectives are to determine the effect of climate on population dynamics of terrestrial salamanders, and the effects of terrestrial salamander abundance on forest ecosystem processes and plant diversity.

We continued with a large, observational study established across a pronounced climate gradient, with 12 paired invasion sites at each of three locations (in around the basin, the Chatahoochee, the Georgia Piedmont; giving 72 experimental plots) and measured ecosystem and community consequences of the presence of Microstegium vimineum, in addition to metrics that will help us delineate the species’ niche. Data collection in the last year focused on the implications of grass invasion for soil nitrogen dynamics and on understanding the spread of the grass; with the idea being to generate empirical data and knowledge to seed landscape-scale models of grass spread and impact.

We examined how temperature and exurban development influence the avian community and rates of nest predation using artificial nests with clay and quail eggs and video cameras.

We have substantially increased our research into ants and termites in the forest floor. These eusocial insects are thought to be two of the most abundant animals in the forest but there is surprisingly little data on their abundance, biomass and ecosystem impacts. Both use wood as a resource (food, nesting) and in the last year we have inventoried to develop spatial estimates of their numbers and biomass, as well as initiated a series of projects to investigate how interactions (ants eat termites, and termites eat the wood the ants nest in) influence wood decomposition (and hence nutrient cycling rates) and other aspects of woodland ecology that are shaped by these fauna (e.g. herb dispersal rates and hence persistence).

Work to investigate control over nitrogen cycling in hillslope soils in a variety of watersheds through an examination of the distribution of soil nitrifying microbes and their role in mobilization of nitrogen in Coweeta watersheds.

4. Baseline Data and Temporal Reconstruction
A photographic reference set was assembled that includes 50 Blue Ridge streams. It contains 16 cross-sectional photos and 16 canopy photos at each of the 50 sites for both winter and summer conditions. This provides a scientific photographic benchmark for stream conditions in the Upper Little Tennessee River valley for 2011/2012 that will be housed on the Coweeta server for research purposes.

We automated production of GIS data across multiple watersheds as well as the development of a new website aimed and translating scientific results to the public and fostering dialog with residents living the CWT LTER study area.

We succeeded with NSF supplement funds to install one streaming sensor site for PAR data and additional sensors and sites are expected to be established before the September ASM.

We wrote and disseminated a series of plans within the CWT LTER to change data collection protocols and to address data backlogs, as well as further collaboration with the GCE LTER to adapt their technology. This year, we specifically focused on plans to adapt the GCE Data Toolbox for use in a planned upgrade to transform our current long-term monitoring system into a streaming sensor network.

5. Synthesis and Scaled Integration
A synthesis project examining the long-term stream chemistry data on US Forest Service Experimental Forests, several of which are LTER sites, HBR, HJA is underway with the first publication from these efforts was just submitted to Frontiers.

Work proceeded on coupling ecosystem, hydrologic and geomorphic processes in the Coweeta basin and in the surrounding Little Tennessee drainage. Modeling was focused on the interface of catchment hydrology with the spatial distribution of canopy properties along topographic flowpaths, and interactions with landslide dynamics through the development of transient responses in pore pressures and in root cohesive strength. The work is being extended to include the influence of engineered drainage paths including roads and culverts.
Work proceeded with quantifying the primary factors and relationships governing forest mass and water cycles in the study region, including human as well as natural agents, particularly for the development of spatially-explicit estimates and models. The transfer of point-specific models to spatial estimates is a multistep process with many parts, and there is a growing realization that point model complexity often outruns supporting data.

Supplement-funded Activities
Funds were received to purchase of supplies in support of Schoolyard activities during AY2011-12 including hosting the Migration Celebration, re-supply and provisioning of existing Coweeta Science Boxes, and the assembly of new Coweeta Science Boxes.

Funds representing base funding withheld for budgetary reasons from the Coweeta LTER renewal were received in support of operational activities.

Funds were received to partially fund the salary plus benefits of hiring an Assistant IM and the expenses for two participants to the SensorNIS workshop in Durham, NH.

Funds were received to support two REU students and one RET teacher during summer 2012.

Four light measurement/data transmission kits were purchased to stream phenology records from the highest and lowest elevations in the Coweeta Basin, process and store the data stream on the Coweeta LTER server.

RESEARCH ACTIVITIES: 11/01/10 to 07/31/11
Activities this year as described below depended on funding from the Coweeta LTER award (DEB-0823293) as well as funding from NSF (other programs), National Park Service, NASA, EPA, DOE, US Forest Service, US Fish and Wildlife Service, USGS, Andrew W. Mellon Foundation, the University of Georgia Research Foundation, the CURO ?Diversity? Apprentice Program as well as support from McIntire-Stennis formula funding to the U of Georgia Warnell School of Forest Resources.

Watershed level ecohydrology activities included: hillslope hydrology; the coupling of spatial patterns and processes of water, carbon and nutrient cycling at the hillslope and watershed scale; the long term development and adjustment of the forest canopy to microclimate, hydrologic regime and geomorphology; detailed spatial and temporal patterns of canopy phenology; multi-scale remote sensing of forest canopy properties; and the coupling of landslide dynamics to forest canopy, terrain and hydrologic systems.

We advanced measurement of forest physiology by coupling intensive plot measurements on sap flux and forest structure with discrete-return LiDAR. Activities included individual tree water use data and hourly or higher frequencies in stands spanning the coastal plain to mountain gradient. These data collections were supplemented by micrometeorological data, stem conductance, soils, and stand characterization measurements. Data were analyzed, and relationships between variables measureable at landscape scale and tree through stand-level transpiration developed. In addition, three test watersheds in a piedmont to coastal plain gradient were identified, and data collected on landcover, hydrology, and species composition developed. We also collected basin-wide, high-resolution, discrete-return LiDAR, approximately 10 returns per square meter, for the Coweeta Basin, and are in the process of analyzing these data.

Coweeta IM undertook construction of new servers, the configuration of new laboratory computers, completed an overhaul of infrastructure for the University of Georgia?s computer network at the Coweeta Hydrologic Laboratory Campus that included installation of an enterprise wireless network.

New measurements were carried out on warm sites in the Piedmont (Duke Forest) to address complex interactions between climate variables and competition. Long-term data already exist at the Duke forest, which provides comparative temperature and moisture gradients with Mars Hill and Coweeta. Due to their importance for biodiversity in the Southeast, new gap sites were established in the Great Smoky Mtn National Park in order to extend the gradients to higher elevation and old-growth sites.

Using seedling and tree data sets updated with new cohorts, demographic response models that include all climate variables and interactions with competition were developed. We can now rank species in terms of their sensitivity to each climate variable, to determine which species are vulnerable to combinations of warming and drying and how that compares with vulnerability to competition. We have identified the interactions of these variables, showing that many of those interactions tend to amplify one another.

Activities are underway to investigate the individual decisions to donate land to conservation. This question is important because public policy aims to encourage property to be placed in conservation so to avoid disamenities of development and to provide other amenities to surrounding properties. However, to date there has been no study into the characteristics of the individuals who donate their land to conservation and how
changes in public policy, e.g., tax laws, influence the decision to donate land to conservation. This study aims to be a unique contribution in the area of land conservation and to help guide public policy in this area.

Instrumentation of catchments was begun that will contribute to characterize and quantify the hillslope water balance and evaluate land-use impacts on water fluxes. Methods include monitoring of shallow groundwater on hillslopes and tracking of stable isotopes (D and 18O) in precipitation, hillslope and stream water. Isotope sampling began in June 2011 and will continue monthly.

We began simulating landscape dynamics by altering rates of habitat creation and destruction on a landscape comprised of habitat of varying quality to explore how heterogeneity in the quality and spatial configuration of suitable habitat affects population persistence. In a second study, we will explore how climate change might affect population persistence in a dynamic landscape. We will simulate stochastic and directional changes by modifying demographic parameters (i.e., survival, and reproductive output) and run scenarios on spatially heterogeneous landscapes subject to habitat creation and destruction. We anticipate that these studies will yield new insights about the potential interacting effects of habitat modification and climate change for population dynamics.

We completed the 2006 land cover map and documentation, and modified previously developed land cover for 1986, 1991, and 1996 to match the processing that was done to the 2001 and 2006 land cover maps. These data are now available to LTER researchers and others through our Coweeta website.

We developed a high resolution land use and land cover (LULC) database for the nine Intensive watersheds being used by the larger CWT group using color 2007 digital orthophotographs (DOQQ’s; 1:14,400 scale). LULC classes were digitized and matched with (or hierarchically nested within) the standard 2001-2 National Land Cover Database (NLCD) classification scheme. Field work using GPS units was carried out to developing training sites for photointerpretation and to then test the final classification, as well as to collect ground-truth points to further evaluate the accuracy of the 2006 land cover map.

Statistical analysis were carried out on the relationship between local riparian condition and channel morphology from stream survey data taken in 2009 on 49 stream reaches located throughout the Upper Little Tennessee River. The data clearly demonstrate that riparian forest conversion has resulted in narrower and simpler channels lacking in woody debris. A manuscript summarizing this analysis is in preparation.

We carried out testing and running sensitivity analysis on an improved model of riparian shading on stream channels. The model incorporates canopy overhang from the streambank and calculates the fraction of the channel surface shaded from incident light. We have also developed and tested a photographic technique for measuring instantaneous shade levels over a reach. We have prepared a manuscript for submission to Journal of Hydrology.

We took shade, channel, and continuous water temperature measurements on stream segments in the Upper Nantahala and Upper Little Tennessee River Basins. This data will be used to test a stream temperature model that will estimate the relative effects of riparian conversion and climate change on stream temperatures in the Southern Appalachians.

Sampling and sample processing were conducted on the 12 intensive water quality monitoring sites.

Bi-weekly soil water lysimeter collections, quarterly leaf litter collections, quarterly bulk throughfall collections, and monthly microclimate downloads at the CWT LTER terrestrial gradient sites were carried out.

Monthly Hach Hydrolab downloads/calibrations (DO, temp, conductivity, turbidity), weekly stream grabs, periodici storm sampling from ISCO automated storm sampler, bi-monthly stream gauge downloads from 12 watersheds intensively monitored.

Weekly phenology measurements (fall and spring) and monthly downloads of microclimate data (soil moisture, PAR, soil temp, air temp) at long-term soil moisture/phenology stations.

Bi-weekly growing season soil moisture (using CS Hydrosense) measurements and monthly microclimate station downloads at the CWT LTER gap plots, a 10 year CWT LTER project linked to forest dynamics/epidemiology research.

We continued monitoring salamanders at a subset of synoptic sites to assess interannual variation in estimates. We continued to conduct research on mechanisms to explain reduced salamander abundance in watersheds undergoing residential development. We used displacement studies to look at how the creation of forest gaps associated with roads or powerlines affected movement rates of stream salamanders.

We conducted mark-recapture surveys every 2-4 weeks beginning in September 2010 and continued through July 2011. Mark-recapture was coupled with measures of salamander dehyrdation rates under different conditions, and the effects of cliamte and weather on salamander
Foraging success and diet. Preliminary results indicate that terrestrial salamander abundance increases with elevation, which we interpret as a measure of cooler temperatures. We also found that salamanders are major predators on ants, which disperse 80% of the understory plant species that occur in southern Appalachia.

From August 2010 - July 2011, seasonal fish and habitat samples were made at 46 reaches in 29 wadeable streams. The sample streams were chosen to represent the range of stream sizes, geology, and dominant land uses in the basin. Hierarchical, multi-species, multi-state occupancy models to evaluate the relative support of hypotheses regarding influence of local and landscape level features on stream fish community structure.

Occupancy sampling was used to collect four focal stream taxa at our 9 intensive synoptic sites that exhibit different types land use (urban, low density residential, agricultural and forested) and degrees of hillslope land development. Samples are currently being analyzed.

We sampled algae at the 9 intensive synoptic sampling sites during both July 2010 and July 2011. We now have chlorophyll a and AFDM data for 100 m reaches upstream of the data sondes installed at each site. Epilithon samples from July 2010 have been analyzed for C:N:P stoichiometry in the Ecology Analytical Laboratory (this data is now available). C:N:P stoichiometry of epilithon collected in July 2011 is currently being analyzed.

The 2010-11 sampling of the Coweeta Hazard sites took place. This project is based on a proactive sampling strategy designed and implemented in 2000 by the Coweeta LTER Program to document changes in streams whose catchment land uses were predicted to change over the next two decades due to increased building density. Every five years (beginning in 2000), algae, macroinvertebrates, fishes, suspended solids, dissolved solids, and bed composition are sampled/measured at two reference? sites and six hazard? sites.

We began the customization of the Rapid Stream Visual Assessment Protocol (SVAP) for the Southern Appalachians.

Analyses were completed using powerful new multilevel models designed to understand species distributions and community assemblages. Typically, separate analytical approaches (e.g., logistic regression and ordination) are used to model the distribution of individual species and to relate community composition to environmental variation. Multilevel models (MLMs) offer a promising strategy for integrating species and community-level analyses. We demonstrate the use of MLMs for explaining the distributions of 14 species of forest herbs native to the southern Appalachians and compare these results to those of Nonmetric Multidimensional Scaling and logistic regression.

To assess the influence of climate and land-use history on performance and population dynamics of forest herbs, 20 sites were selected using a 2 x 2 design reflecting climate suitability (suitable or not) and stand age (old or young). Climate suitability was determined using data described above for five species (Arisaema triphyllum, Caulophyllum thalictroides, Disporum lanuginosum, Sanguinaria canadensis, and Trillium grandiflorum). At each site, 20 x 20 m performance plots were established that contained populations of at least three of these species. Premanent quadrats (1 x 2 m) were established around populations of these species, and individual plants were mapped to the nearest centimeter. Measurements related to biomass and life-history stage (i.e., stem height, leaf area, number of flowers and/or fruits) were taken for each individual until a sample size of at least 20 individuals per species was reached in every plot. The same environmental covariates described above for the distribution modeling were also recorded for each of these plots. Additionally, a Thermocron iButton data-logger was placed in the air and in the soil (buried to a depth of 10 cm) in each performance plot to record air/soil temperature at 4-hour intervals throughout the year. The same plants are being re-measured during summer 2010 and summer 2011 to monitor individual plant performance (indicated by change in biomass) and population dynamics (indicated by death and establishment rates).

To assess the influence of climate and land-use history on establishment of forest herbs experimentally, a 20 x 20 m germination plot was established adjacent to or in close proximity to each of the performance plots. An additional two data-loggers were placed in each of the germination plots. Seeds were collected from wild plants of six species (Disporum lanuginosum, Maianthemum racemosum, Melampyrum lineare, Trillium erectum, Trillium grandiflorum, and Streptopus amplexifolius) and planted along three transects in each plot. Species were randomly ordered within three 2 x 2 m subplots along each transect, for a total of nine subplots per plot. Seed densities varied from 10 to 20 seeds per 0.5 m2. Data on percent germination and performance of seedlings are being collected during summers of 2010 and 2011. Analyses will be conducted this coming year.

A field study was initiated summer 2010 to characterize the community of insect pollinators in plots that vary in elevation and land-use history. The importance of insect pollinators for maintaining plant diversity in forests is well known. However, there is evidence for a decline in pollinators throughout the world, along with a concurrent decline in the plant species that are reliant on pollination services. This decline may be related to habitat alteration, climate change, or possibly some combination of the two. During summer 2010, measurements of the pollinator community were made in forests of different ages (young vs. old) and elevation (low vs. high) using bee bowls (4-oz plastic bowls spray painted different colors and filled with water and unscented dishwashing detergent). The field methods and taxonomic identification were fine-tuned and the study was repeated in spring 2011 during the flowering period of the spring ephemerals. Sample identification and analyses
are underway.

The Schoolyard LTER program reached 1085 students on 12 separate occasions; Science Study Boxes reached an addition 1676 students and were checked out a total of 14 times. See attached summary for more information about Schoolyard LTER program, and the detailed description of activities in the Outreach Activities entries.

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RESEARCH ACTIVITIES: 11/01/09 to 07/31/10

Activities this year depended on funding from the Coweeta LTER award (DEB-0823293) as well as funding from NSF (other programs), National Park Service, NASA, EPA, DOE, US Forest Service, US Fish and Wildlife Service, USGS, Andrew W. Mellon Foundation, the University of Georgia Research Foundation, the CURO ?Diversity? Apprentice Program as well as support from McIntire-Stennis formula funding to the U of Georgia Warnell School of Forest Resources. Activities this year included:

A 2006 land cover map for the Southern Appalachians study area was developed using the methodologies used to develop the 2001 NLCD dataset for the same region. The previously developed land covers for 1986, 1991, and 1996 were modified to match the processing that was done to the 2001 and 2006 land cover maps. These data are now available to LTER researchers and others through our Coweeta website. A nest-predation study originally conducted in 2009 was repeated this year at four (two high elevation and two low elevation) sites. At each site, nine plots were established with 10 artificial nests for a total of 36 plots and 360 artificial nests. Artificial nests were checked at three-day intervals over 18 days in June to record depredation of the two Button Quail eggs placed in each artificial nest at the beginning of the experiment. Initial analyses revealed that nest predation rates were greater at low elevation sites. A clay egg is being placed in each artificial nest with the goal of recovering the clay egg and identifying potential predators by their bite marks. Motion-triggered infrared cameras are being used to photograph and identify nest predators. In addition, track plates are being deployed at the nest predation sites, and the tracks that are recorded can be used to identify the species that may depredate the nests.

An unexpected application of ongoing research quantifying sap flow work in eastern hemlock trees has been its relevance to systemic insecticide efficacy. Chemical control has been effective in controlling hemlock woolly adelgid infestation in eastern hemlock trees; however, the effectiveness of soil and stem applications has varied based on injection method, timing of application, and other tree-specific characteristics. Because uptake and transport of systemic insecticides occurs via mass flow in the transpiration stream, we hypothesized that treatment efficacy may be linked to the volume and velocity of xylem water movement, and thus the concentration of the insecticide in the xylem sap. We carried out a field study addressing this question and found that dosages based on a xylem transport model not only significantly improved tree health more than the trees receiving the current recommended dosage, but also caused greater reductions in the live HWA population. The implications of this work are that by improving treatment dosages we can reduce treatment cost, non-targeted effects, allow land managers to treat a greater number of small size-class trees, and increase the efficacy of insecticide treatments on large size-class trees. This work was published as a USDA Forest Service General Technical Report.

Analysis of 24 native forest herbs species sampled at 50 random points in the summer of 2009 across a climate gradient generated using Mahalanobis Distance. A 20 x 20m plot was created at each random point. Within each plot, three transects were established at 0, 10 and 20 m, and percent cover of 24 focal species was recorded in six 1 x 1-m quadrats evenly spaced along each transect. Other variables measured in each plot included percent cover for herbs and shrubs, litter depth, tree species composition, basal area, and density (using point-quarter counts), aspect, slope, and terrain shape. Additionally, five soil cores (15-dm depth) were obtained from each plot. Data will be used to model climate suitability for each species and to predict potential range shifts under climate change scenarios. Initial analyses of the distribution data using stepwise AIC selection for multiple logistic regression models showed that several topographic and environmental variables were important for explaining the presence or absence of the focal herb species. The most important topographic predictor across species was elevation, which was significant in the best models for six species. C. thalictroides, D. lanuginosum, L. superbum, T. grandiflorum, and U. grandiflora were found more frequently at higher elevations, whereas C. maculatum was found more frequently at lower elevations. In linear regression models that explained species abundance for the plots in which they were present, elevation was again the most important topographic predictor. Species that were found in higher abundance at high elevations included A. triphyllum, C. thalictroides, M. racemosa, and P. biflorum. Biotic and soil variables were more important for predicting species abundances than presence. Analyses of this data set will be completed during the coming year and a manuscript will be submitted.

Analysis was carried out of sampled collected in summer 2009 at a 33-site subset of the synoptic sampling sites on four focal stream taxa: 1. the stonefly, Tallaperla maria; 2. the crayfish, Cambarus bartonii; 3. the snail, Elimia proxima; and 4. the sculpin, Cottus bairdi. These taxa were selected based on their key functional roles in stream food webs and stream ecosystem processes. We predict that some of these taxa will respond differently to land use changes and water quality on large spatial scales. We are using fine-scale niche occupancy models to collect count and presence/absence data, infer detection probabilities, and derive density and occupancy patterns of these focal organisms. In addition, we are using stream order, geomorphology, stream chemistry, sediment, and other watershed data in a multivariate analysis to examine those factors that best explain the distribution data of the focal organisms. Tallaperla shows particular promise as an indicator of human disturbance.
of stream systems, as increasing agricultural land use dramatically reduced the probability of Tallaperla occurrence in watersheds throughout the Little Tennessee River basin.

Analysis was conducted of algae collected at 9 intensive synoptic sampling sites during July 2010. We now have chlorophyll a and AFDM data for 100 m reaches upstream of the data sondes installed at each site. C:N:P stoichiometry of epilithon is currently being analyzed. As part of an interdisciplinary team investigating longitudinal flowpaths across land uses, anthropogenic changes are being evaluated as to their effect on vegetation gradients in watershed characteristics and biogeochemical processes. Several measurements are planned (2011-2013) including vegetation composition, diversity and plant nutrient pools across hillslope-to-riparian gradients that represent urban, agriculture, and forest land uses. These measurements will then be related to soil and soil solution nutrient flow paths, which will in turn be related to in-stream processes, and ultimately to water quality along flowpaths from small streams to rivers.

Coweeta Information Management had the goal to upgrade the Information Management Infrastructure in order to implement best practices for hardware maintenance, network security, server architecture, and web applications. This has involved the construction of new servers, the configuration of new laboratory computers, as well as the purchase, configuration and installation of new network security appliances.

Customization of the Rapid Stream Visual Assessment Protocol (SVAP) began during summer 2010 and is ongoing through the fall. Data-Development projects this year included a project-wide Synoptic Sampling Program regional GIS data.

During summer 2010, a field study was initiated to characterize the community of insect pollinators in plots that vary in elevation and land-use history. The importance of insect pollinators for maintaining plant diversity in forests is well known. However, there is evidence for a decline in pollinators throughout the world, along with a concurrent decline in the plant species that are reliant on pollination services. This decline may be related to habitat alteration, climate change, or possibly some combination of the two. During summer 2009, measurements of the pollinator community are being made in forests of different ages (young vs. old) and elevation (low vs. high) using bee bowls (4-oz plastic bowls spray painted different colors and filled with water and unscented dishwashing detergent). The field methods and taxonomic identification will be fine-tuned and the study will be implemented in spring 2011 during the flowering period of the spring ephemerals.

Field data collection on carbon and water cycling and land use change in the southern Appalachians was carried out. The emphasis was on the hydrologic cycle, particularly scaling leaf- and tree-level plant response models to watersheds and regions with the goal of estimating changes in catchment water yield due to changes in species composition. E.g., due to introduced pests or disease, or due to changes in climate, or a combination of these factors.

Field sampling and modeling activities focused on forest responses to climate change. Long term plots were sampled for tree growth, maturation, fecundity, survival, and dispersal.

Field work was carried out at the 12 intensive sites, including installing and calibrating ISCO samplers and Hydrosondes. In addition, planning and organizing the hazard site collections was carried out.

From August 2009 - July 2010, seasonal fish and habitat samples were taken at 46 reaches in 29 wadeable streams. The sample streams were chosen to represent the range of stream sizes, geology, and dominant land uses in the basin. Hierarchical, multi-species, multi-state occupancy models to evaluate the relative support of hypotheses regarding influence of local and landscape level features on stream fish community structure.

In order to predict the influence of tree species movement, in response to climate change, on nutrient and carbon cycling, we continued and extended experimental field and laboratory experiment established using sites, soils and litters within the basin and extending outside of the basin to higher elevation (Blue Ridge Parkway). This question forms the basis for Ashley Keiser’s doctoral research and is funded through a five-year doctoral stipend (and tuition) from Yale, as well as monies from a UGA cooperative agreement. For Year 3 Ashley has been awarded an EPA STAR Fellowship to advance this research.

In understanding and predicting the impacts of the invasive grass Microstegium vimineum on ecosystem and community processes under the context of exurbanization and climate change, we continued a large, observational study across a pronounced climate gradient, with 12 paired invasion sites at each of three locations (in around the basin, the Chatahoochee, the Georgia Piedmont. This gives 72 experimental plots) and measured ecosystem and community consequences of the grasses presence, in addition to metrics that will help us delineate the species niche. In addition, we used survey approaches to investigate the species presence or absence based on proximate variables (e.g. soil moisture and light) and proxy variables (e.g. distance to waterway or slope). The survey work sets the stage for further investigation of the species fitness (e.g. seed abundance and quality) as a function of habitat and to inform experimental hypotheses relating to its likely spread and impact per climate change and exurbanization.

K.C. Love, an undergraduate student in the CWT IM Laboratory worked Summer 2010 developing a high resolution land use and land cover
Large-scale catchment experiments at Coweeta have quantified the effect of how various treatments on forest vegetation affect water yield. A critical unknown in these experiments was whether the resulting vegetation in the treatment catchment and the vegetation in the nontreated catchment responded similarly to climate or not. We used intervention (statistical) models to quantify the apparent increase in long-term air temperature at Coweeta (manuscripts in review at Global Change Biology and International Journal of Environmental Studies). Using the long-term hydrology data on treated watersheds, I co-developed and applied statistical models that identified that many of the management treatments resulted in stand structure and species composition that interacted with climate differently than the unmanaged reference stand, and modeled responses under two IPCC climate change scenarios using global circulation model (GCM) climate data for the Coweeta Basin. These interactions provide strong evidence that forest management may exacerbate or mitigate future climatic conditions (results presented in numerous presentations below).

Major improvements were made in cyber-infrastructure with a special emphasis on the upgrade of aging hardware. We have built a new centralized file server for the IM office, a new web server, based in Linux, open source, and best practices for web server management. We have also built an automated, off-site disk-to-disk backup system in which data loss could only occur if four drives fail simultaneously at two separate locations.

Modeling of tree demographic responses to climate change entailed development of new models for seedling dynamics and soil moisture. We have been focusing on interactive effects of different climate variables and determined which variables limit each of the demographic rates of each species.

Monitoring of stream temperatures throughout the study area was carried out to assess the effects of temperature logger position within the channel on temperatures, to quantify local variability in stream temperatures, and evaluate the differences in stream temperatures between basins with differing spatial distributions of forest conversion. Completed channel width, woody debris, and habitat distribution surveys on over 40 streams distributed throughout the study area (all but the largest of the synoptic streams).

Ongoing collaboration with Dr. T.C. Hales (Cardiff University, Wales UK) investigates the interactions between species composition, topographic and soil characteristics, and landslide potential. Earlier work published in Journal of Geophysical Research- Earth Surface showed that species and topographic position affect root tensile strength and thus landslide potential; however the specific controls of soil moisture, soil hydraulic conductivity and root xylem anatomy and conductivity were unexplored. A greenhouse experiment coupled with an intensive field experiment in the Coweeta Basin and Plynlimon Experimental Forest (Wales, UK) is underway in which the effects of these variables on root tensile strength will be quantified.

Paige Barlow is conducting dissertation research that looks at the effects of land use and elevation (as a surrogate for climate change) on avian communities. She is interested in using modeling techniques and stakeholder involvement to assess the effects of land use on avian and salamander occupancy, principally in Macon County, NC to identify biologically suitable management options with stakeholder support.

Quantifying patterns of salamander occupancy and abundance across the upper Little Tennessee River watershed as part of the ?synoptic? research program core to LTER project, we are relating land use to in stream processes and patterns of biodiversity across the greater Coweeta region. In 2010, we resampled 8 synoptic study streams to determine how consistent abundance and occupancy estimates are from year to year. This will provide a measure of interannual variation or estimate error. We will continue to monitor those 8 sites annually, and we resample all 37 synoptic sites every 5-6 years. These will contribute new, long-term core data sets to the Coweeta LTER.

Recent studies have shown that planted pine stands exhibit higher evapotranspiration (ET) and are more sensitive to climatic conditions compared to hardwood stands. Whether this is due to management and stand effects, biological effects, or their interaction is poorly understood. We led a study that estimated growing season canopy- and leaf-level transpiration in five major overstory species over three years. Results from the study showed that ET in the planted pine stand exceeded hardwood ET by 2-fold during all three years, and that transpiration among species contributed substantially to the stand ET difference, suggesting that physiological differences were equally as important as structural factors to the overall difference in ET. This work is published in the journal Ecohydrology. This species-level understanding of variation in canopy transpiration and conductance, and their interactions with climatic driving variables, has important implications for predicting watershed-level responses to stand management, species invasion and loss, and climate variability. Follow-up studies have been initiated to incorporate this species-level understanding in process models.
Research discerning the relationship between forest soil CO2 efflux and transpiration is in preliminary stages. By combining the ongoing measurements of forest transpiration in a species-rich system (described above), with measurements of soil CO2 efflux and modeling techniques, we will be able to elucidate patterns of soil autotrophic respiration.

Research was carried out on ecohydrological modeling of catchment water and carbon cycling, forest growth and analysis of canopy, soil moisture and discharge data. Additional research carried out partially with previous Forest Service funds, investigated patterns of root strength between different species and topographic positions, and impacts on slope stability. Major findings included the systematic variation of root strength with greater tensile strength on slopes and ridges, and lower strength in hollows, much lower strength of Rhododendron Maximum compared to overstory species, and the tendency of forest canopy LAI to form patterns along topographic flowpaths that appears to optimize transpiration and net primary productivity at the hillslope or catchment scale.

The second year of data collection took place on the interaction between contemporary landscape patterns and climate variation as it influences the avian community and rates of nest predation. The purpose of this study is to determine if the effects of exurban development on (a) bird species abundance and (b) nest predation will be exacerbated by the warmer climate projected for the Southern Appalachian region. Point counts for the avian abundance study were conducted in seven study sites (four high elevation and three low elevation) with 15 points at each site for a total of 105 points. Each point was visited three times during mornings in May and June for a 10-min point count. Partial Mantel tests were used to identify correlations between bird communities (relative abundance transformed into a plot-wise distance matrix using Bray-Curtis distance) and three Euclidian distance matrices based on three different environmental gradients. Matrices for environmental gradients were derived from (1) elevation as the indicator of climate variability between sample location, (2) number of buildings per hectare within 200 meters of each sample location as a relevant indicator of exurban development variability, and (3) the latitude and longitude of the center of each sample location in UTM as a relevant indicator of geographic distance. Results showed that the avian community responded to all three variables, elevation had the highest correlation, suggesting that climate variability is important for Southern Appalachian bird communities. Analyses performed on individual species found that exurban development and climate were significant predictors for over 50% of bird species detected in at least 10% of study plots. The rate of response of some species to exurban development is only affected by elevation at high bird abundance, indicating limited interaction between these two drivers.

To assess the influence of climate and land-use history on establishment of forest herbs experimentally, a 20 x 20 m germination plot was established adjacent to or in close proximity to each of the performance plots. An additional two data-loggers were placed in each of the germination plots. Seeds were collected from wild plants of six species (Disporum lanuginosum, Maianthemum racemosa, Melampyrum lineareae, Trillium erectum, Trillium grandiflorum, and Streptopus amplexifolius) and planted along three transects in each plot. Species were randomly ordered within three 2 x 2 m subplots along each transect, for a total of nine subplots per plot. Seed densities varied from 10 to 20 seeds per 0.5 m². Data on percent germination and performance of seedlings is being collected during summer 2010, and seeds will be planted out again during 2010 to measure germination success during another year.

To assess the influence of climate and land-use history on population dynamics of forest herbs, 20 sites were selected using a 2 x 2 design reflecting climate suitability (suitable or not) and stand age (old or young). Climate suitability was determined using data described above for five species (Arisaema triphyllum, Caulophyllum thalictroides, Disporum lanuginosum, Sanguinaria canadensis, and Trillium grandiflorum). At each site, 20 x 20 m performance plots were established that contained populations of at least three of these species. Permanent quadrats (1 x 2 m) were established around populations of these species, and individual plants were mapped to the nearest centimeter. Measurements related to biomass and life-history stage (i.e., stem height, leaf area, number of flowers and/or fruits) were taken for each individual until a sample size of at least 20 individuals per species was reached in every plot. The same environmental covariates described above for the distribution modeling were also recorded for each of these plots. Additionally, a Thermocron iButton data-logger was placed in the air and in the soil (buried to a depth of 10 cm) in each performance plot to record air/soil temperature at 4-hour intervals throughout the year. The same plants are being re-measured during summer 2010 to monitor individual plant performance (indicated by change in biomass) and population dynamics (indicated by death and establishment rates).

To determine the impacts of exotic invasive species on ecosystem function, we are studying the impacts of exotic plants and insects on nutrient cycling. We are focusing on the species Microstegium vimineum, a shade-adapted C-4 grass that is rapidly expanding its distribution in eastern deciduous forests. We performed a 15N-tracer study to determine the fate of different N forms in invaded and non-invaded forest understories. We found that M. vimineum substantially alters N dynamics by sequestering N in its aboveground biomass and effectively reducing its availability to other plant species.

To estimate the role of salamanders in nutrient dynamics of headwater streams we estimated larval salamander abundances, biomass, nutrient storage and excretion rates in five headwater streams within the Coweeta basin. The results of that research show that larval salamanders are relatively large biotic standing stock of nitrogen and phosphorus, with one species (D. quadramaculatus) holding more P than estimates of total macroinvertebrate standing stocks for similar Coweeta streams. Estimates of nitrogen and phosphorous excretion suggest that plethodontids may contribute very little through recycling to stream nitrogen demand, and only a modest amount to stream phosphorus demand. These results
suggest that larval salamanders are important biotic stocks of limiting nutrients in headwater systems, and that the loss of these species would alter nutrient dynamics in those systems. Future work will focus on estimating the full contribution of salamanders to stream nutrient dynamics including estimating subsidies in the form of egg deposition, nutrient uptake in the form of larval production, and fluxes in the form of metamorph emergence from streams.

Undertook negotiations with the GSMNP to establish new long-term plots at mid to high elevation sites (including spruce fir) this autumn.

We engaged in innovative and substantive social science research focusing on the economic impacts of development and development policy on various aspects of the Appalachian region. The purpose of our research is to shed light on how development, especially residential, impacts ecosystem services and how the value of these services are reflected in property values.

We published an analysis of the North Carolina watershed protection policy that limits the ability for land owners to subdivide their property for residential development. The intention of the policy was to limit the negative externalities created by dense residential development, especially on down-stream residents and water users. Using data from Buncombe County (Asheville) we identified the impact of this policy on the value of undeveloped but encumbered land, showing that the economic impact was both statistically and economically significant. This paper was published in Regional Science and Urban Economics, which is one of the leading journals in the field of regional science. A condensed version of this paper was also published in the publication Regulation, which is a policy-oriented magazine with an audience of policy makers, advisors, and practitioners.

We seek to understand the mechanisms that lead to low abundances of salamanders in forested reaches where land conversion has occurred farther down in the watershed. One hypothesis is that loss of forest cover downstream acts as a behavioral barrier to up stream dispersal, limiting recolonization of first order streams. To test this idea, we used translocation experiments through summer 2010 to measure return rates of salamanders across forest gaps of varying sizes.

We’ve collected and organized the climate (NOAA sources), water yield (USGS), forest structure (USFS), and landform (USGS) data, and combined these with specific measurements and models of plant water use created at the Coweeta Hydrologic Lab and in the southern Appalachians. With this data, a series of experiments were run within the model comparing 1) estimated to observed water yields in the historic records, 2) modeled yields with current conditions and after removing a subset species, 3) water yields with predicted future climates, and 4) water yields with combinations of 3 and 4. We have not yet presented these results at national meetings.

Work with the Little Tennessee Watershed led to development of a relational database model to store 20 years of biomonitoring data of fish species diversity and water quality in the Upper Little Tennessee Watershed. It includes a database applications in mySQL and Microsoft Access.


Ball, B.A., Hunter, M.D., Kominoski, J.S., Pringle, C.M., Bradford, M.A. Differential responses of litter and microbial carbon dynamics with simulated tree species loss in a coupled terrestrial and aquatic system.

Bradford, M.A., Strickland, M.S., Devore, J.L., Maerz, J.C. Substantial allocation of recent-photosynthate carbon from a grass invader to the belowground foodweb.

Ford, C.R., Laseter, S.H., Swank, W.T. and Vose, J.M., Can forest management be used to sustain ecosystem services in the face of climate change? Global Change Biology. (in review).


Kominoski, J.S., Pringle, C.M., Ball, B.A., Bradford, M.A., Coleman, D.C., Hunter, M.D., Mattsson, B.J. Litter chemistry and decomposer biota differentially explain litter diversity effects on terrestrial and aquatic decomposition.


Strickland, M.S., Devore, J.L., Maerz, J.C., Bradford, M.A. Loss of faster-cycling soil carbon pools following grass invasion across multiple forest sites.

Warren, R.J, Bradford, M.A. The shape of things to come: woodland herb niche contraction begins during recruitment in mesic forest microhabitat.

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RESEARCH ACTIVITIES: 11/01/08 to 10/31/09

Activities this year depended on funding from the Coweeta LTER award (DEB-0823293 and DEB-0218001) as well as funding from NSF (other programs), National Park Service, NASA, EPA, DOE, US Forest Service, US Fish and Wildlife Service, Andrew W. Mellon Foundation, the University of Georgia Research Foundation, the CURO ?Diversity? Apprentice Program as well as support from McIntire-Stennis formula funding to the U of Georgia Warnell School of Forest Resources. Activities this year included:

A field seeding experiment with non-native Oriental bittersweet (Celastrus orbiculatus) was implemented to elucidate the specific factors related to land-use history that might be facilitating invasion.

A project was initiated in the French Broad on the interaction between land-use history and climate variation as it affects establishment and growth of native herbaceous species. To investigate the influence of climate and land-use history on species? current distribution, 50 random points were sampled across a climate gradient that was generated using Mahalanobis Distance models for 24 native forest herb species. These models were created using existing data from the Carolina Vegetation Survey. A 20 x 20m plot was created at each random point. Within each plot, three transects were established at 0, 10 and 20 m, and percent cover of 24 focal species was recorded in six 1- x 1-m quadrats evenly spaced along each transect. Other variables measured in each plot included percent cover for herbs and shrubs, litter depth, tree species composition, basal area, and density (using point-quarter counts), aspect, slope, and terrain shape. Additionally, five soil cores (15-dm depth) were obtained from each plot. Data will be used to model climate suitability for each species and to predict potential range shifts under climate change scenarios.

A set of studies were completed this year focused on understanding the role of land-use history and contemporary landscape patterns as they affect the presence and abundance of invasive plants in the forest understory. Tom Albright (previous PhD student affiliated with CWT) submitted a manuscript on the distribution of Celastrus orbiculatus, and that paper is now in press (Albright et al., in press). Dean Anderson (previous postdoc) submitted a manuscript on the distribution of Microstegium vimineum with a focus on relatively undisturbed forest plots.

A study was carried out on channel morphology and stream temperature across 57 locations in 12 watersheds within the Little Tennessee Basin as part of a larger effort to quantify differences in amount and pattern of development along longitudinal gradients.

A study was carried out on the consequences of exurbanization on local societies and on landscape in Buncombe County, NC. Fieldwork was carried out in four communities in Buncombe County consisting of interviews with local residents, a PhotoVoice project centered on perceptions of the land-use changes through photographs that informants were asked to take, and participatory GIS.

A study was initiated determine if the effects of exurban development on (a) bird species abundance and (b) nest predation will be exacerbated by the warmer climate projected for the Southern Appalachian region. Point counts and an artificial nest experiment were conducted during summer 2009 at locations of varying exurban development density and climate, using elevation as a surrogate for climate. Both the avian abundance and nest predation study employed a 2 x 3 experimental design in which treatments were stratified by elevation (high and low) and exurban development density (none, low, and high). Point counts for the avian abundance study were conducted in seven study sites (four high elevation and three low elevation) with 15 points at each site for a total of 105 points. Each point was visited three times during mornings in May and June for a 10-min point count. These points were revisited in July to characterize the surrounding area and forest structure. An artificial nest experiment was conducted at four (two high elevation and two low elevation) of the sites used for point counts. At each site, nine plots were established with 10 artificial nests for a total of 36 plots and 360 artificial nests. Artificial nests were checked at three-day intervals over 18 days in June to record depredation of the two Button Quail eggs placed in each artificial nest at the beginning of the experiment. Analyses of data from both of these studies are in progress.

Activities directed at linking species-specific parameters of water stress with plant demography were carried out. The goal is to improve plant demography models by linking soil moisture stress and mortality.

Built three GIS datasets in support of the development and publication of land parcel and land sale history in relation to environmental protection regulations to real estate market capitalization in Buncombe County, NC. These consisted of an annualized 8-year land ownership parcel history database, a 13-year comprehensive land sale database, and a reference environmental and socio-economic database. These were used multiple GIS sampling episodes and relational-database driven data censoring to develop datasets for input into hedonic price models.
Conducted ecohydrologic analysis and simulation of distributed carbon, water and nitrogen cycling, forest growth, spatial patterns of canopy LAI and root depth and strength. Two publications have resulted from this work: The first investigates the development of soil shear strength augmentation by root reinforcement, and variations with species and topographic positions, the second on the long term adjustment of the forest canopy spatial pattern to distributed hydrologic processes. Research in both cases included detailed field research on root distribution and properties, field and lab measurement of root properties, and spatial analysis and simulation of ecohydrological processes and patterns.

Conducted fluvial geomorphology and stream water quality analysis in the Little Tennessee Basin to determine relative human impact. Focus is on both long-term and short-term timescales that encompass prehistoric to modern changes as well as recent changes within the last several decades related to housing growth and development in the region. The research is concerned with sediment transport and storage in the fluvial system and how it relates to aquatic ecosystems.

Conducting a large, observational study across a pronounced climate gradient, with 12 paired invasion sites at each of three locations (in around the basin, the Chatahoochee, the Georgia Piedmont; giving 72 experimental plots) and measured ecosystem and community consequences of the grasses presence in addition to metrics that will help us delineate the species' niche. Survey approaches were used to investigate the species presence or absence based on proximate variables (e.g. soil moisture and light) and proxy variables (e.g. distance to waterway or slope). The survey work sets the stage for further investigation of the species fitness (e.g. seed abundance and quality) as a function of habitat and to inform experimental hypotheses relating to its likely spread and impact per climate change and exurbanization.

Conducted a large, observational study across a pronounced climate gradient, with 12 paired invasion sites at each of three locations (in around the basin, the Chatahoochee, the Georgia Piedmont; giving 72 experimental plots) and measured ecosystem and community consequences of the grasses presence in addition to metrics that will help us delineate the species' niche. Survey approaches were used to investigate the species presence or absence based on proximate variables (e.g. soil moisture and light) and proxy variables (e.g. distance to waterway or slope). The survey work sets the stage for further investigation of the species fitness (e.g. seed abundance and quality) as a function of habitat and to inform experimental hypotheses relating to its likely spread and impact per climate change and exurbanization.

Data collected from observational studies and landscape scale experiments was analyzed to discern how disturbance and climate change affect forest diversity. Results are being assimilated using models to understand how forests will respond to future climate change. The goals include predictions of species at risk of extinction, those likely to increase in dominance, and others likely to immigrate with climate change.

Developed relational database in support of thematic analysis of 442 spatially-contextualized ethnographic interviews concerning land use and land use change among short-term and long-term residents in the Swannanoa Valley, Buncombe County, NC. Including generating maps for follow-up interviews concerning photograph locations.

Development 2006 land cover map for the regional study area that supports different projects and CWT participants. The map is based on satellite data compiled and pre-processed, ancillary geospatial data layers (e.g., elevation and derived layers), training and testing sites classified from digital aerial imagery (DOQQs), and preliminary classifications completed. Final products should be available for use fall 2009.

Document the avian communities surrounding synoptic study sites in the Little Tennessee Basin. Each of 38 sites were sampled 2 or 3 times during the 2009 breeding season (May 15th ? July 5th). All birds seen or heard were recorded.

Development relational database with linked GIS dataset along with a prototype web application for display and download of retrospective fish-species diversity data across the Little Tennessee Watershed.

Initial stages of a project were completed that builds on historic research at Coweeta demonstrating the effects nutrient enrichment on nutrient dynamics and heterotroph communities in streams. This research, drawing on funding from other sources as well, will be a multi-year study of stream responses to different ratios of nitrogen and phosphorus enrichment.

Investigated the impact of conservation easements on immediately proximate and distant properties in the Asheville, NC area. Those properties that are immediately adjacent to a conservation easement likely receive some benefits as development is limited whereas those properties that are in the so-called ?viewshed? or which have visual access to the easement, even if they are miles away, may also receive an amenity effect of a conservation easement, something that has heretofore not been investigated. First part of the empirical work focused on proximate properties is finished, the second part, focusing on the viewshed, is ongoing.

Investigated the impact of land-use restrictions in watersheds on property values of the encumbered properties and those properties that are impacted (generally in a positive manner) from the land-use restrictions. Paper was published in Regional Science and Urban Economics, which is a high-quality peer-reviewed journal.

Lead editors of Coweeta WS7 synthesis volume completed manuscript for submission to Oxford Press.
Patterns of salamander species loss under projected climate change scenarios was modeled using current and future climatic ranges for all species currently located within the southern Appalachian mountains. To address the potential consequences of species losses, current abundance and nutrient stocks retained within salamander communities within the Coweeta basin were measured. In situ communities were also constructed to representing current and future projected assemblages of salamanders to determine whether their will be a net change in larval salamander biomass and associated nutrient retention within headwater ecosystems.

Preliminary steps were taken on investigating the relation between Atlanta as a global city and the exurbanization of Macon County, NC. This includes establishing connection between citizen scientific engagements to climate change within the Southern Appalachian region.

Project documented recent land use and land cover change within the Little Tennessee watershed in collaboration with G. Pontius from Clark University. The work involved compiling land cover, land use, and ancillary geospatial data for the watershed, documented changes, and developing a model to explain the observed changes.

Project was initiated with Gaby Katul (Duke University) and John Walker (US-EPA) to establish an eddy flux tower at Coweeta using a combination of funds from the USFS, the US-EPA, with support from Coweeta LTER.

Relational database in support of the Synoptic Sampling Program in Macon County, NC, was built. This consisted of developing a relational database framework for geomorphological and photographic data, and delineating watersheds based on synoptic sampling and GIS-based resampling of regional datasets to the spatial extent of derived watersheds. Also compilation of data documentation and metadata as well as developing occupancy index to establish a gradient of human activity among watersheds that are all heavily forested, and in semi-rural areas located far from the nearest town settlement.

Research was initiated to discern the relationship between forest soil CO2 efflux and transpiration is in preliminary stages. By combining the ongoing measurements of forest transpiration in a species-rich system (described above), with measurements of soil CO2 efflux and modeling techniques, we will be able to elucidate patterns of soil autotrophic respiration.

Roadside surveys were conducted throughout a four-county region to determine the distribution of a suite of non-native forest invaders, and the factors explaining their distributions were examined at local and regional scales using linear and generalized linear models.

Sap flux methodology and scaling techniques were used to quantify the transpirational flux of eastern hemlock and co-occurring deciduous species to assess the probable effect of replacing hemlock by co-occurring deciduous species. Eastern hemlock is at risk of potential extirpation throughout its range due to attack by the invasive, exotic insect hemlock woolly adelgid (HWA).

Several manuscripts were prepared for an edited book on comparing land use change between Southern Appalachia and the North-facing Pyr?n?es (France) mountains.

Synoptic Stream Sampling project was initiated this year to examine the effects of historic and projected future land use patterns on stream morphology, hydrology, water quality and biota. Fifty seven streams across 12 watersheds representing different land use categories were selected. Stream morphology was measured along with water chemistry during two sampling periods. In addition, occupancy and relative abundance of salamander larvae, stream macroinvertebrates and fish species were characterized in relation to land use metrics and stream character.

Tim Kuhman completed his dissertation (Kuhman 2009), which focused on non-native invasive plants that are well adapted for spread in forested landscapes and pose a threat to forest communities in the southern Appalachians.

To assess the influence of climate and land-use history on establishment of forest herbs experimentally, an additional 20 x 20 m germination plot was established adjacent to or in close proximity to each of the performance plots. An additional two data-loggers were placed in each of the germination plots. Seeds were collected from wild plants of six species (Disporum lanuginosum, Maianthemum racemosum, Melampyrum lineare, Trillium erectum, Trillium grandiflorum, and Streptopus amplexifolius) and planted along three transects in each plot. Species were randomly ordered within three 2 x 2 m subplots along each transect, for a total of nine subplots per plot. Seed densities varied from 10 to 20 seeds per 0.5 m2. Data on percent germination and performance of seedlings will be collected during summer 2010.

To assess the influence of climate and land-use history on performance and population dynamics of forest herbs, 20 sites were selected using a 2 x 2 design reflecting climate suitability (suitable or not) and stand age (old or young). Climate suitability was determined using data described above for five species (Arisaema triphyllum, Caulophyllum thalictroides, Disporum lanuginosum, Sanguinaria canadensis, and Trillium grandiflorum). At each site, 20 x 20 m performance plots were established that contained populations of at least three of these species. Premanent quadrats (1 x 2 m) were established around populations of these species, and individual plants were mapped to the nearest
centimeter. Measurements related to biomass and life-history stage (i.e., stem height, leaf area, number of flowers and/or fruits) were taken for each individual until a sample size of at least 20 individuals per species was reached in every plot. The same environmental covariates described above for the distribution modeling were also recorded for each of these plots. Additionally, a Thermocron iButton data-logger was placed in the air and in the soil (buried to a depth of 10 cm) in each performance plot to record air/soil temperature at 4-hour intervals throughout the year. The same plants will be re-measured during summer 2010 to monitor individual plant performance (indicated by change in biomass) and population dynamics (indicated by death and establishment rates).

We collected and organized climatic data records, including soil and air temperature, soil moisture, precipitation, solar insolation, and river flow, both from the Coweeta network (4 to 12 stations, depending on variables), and regional networks (11 to 62 stations, depending on variables), over a 30-year record. Then developed models to estimate spatial fields of important environmental driving variables, including air temperature, precipitation, insolation, vapor pressure deficit, soil depth, moisture, and temperature, overstory leaf area, and species composition. Finally optimized spatial field models, and estimated plant watershed in hierarchical models, testing sensitivity to parameter variation using Monte-Carlo/Markov Chain simulations. The objective is to determine how does forest structure, particularly leaf area, species composition, and canopy display of leaves, affect aggregate plant water use and carbon cycling across space and time, and second, how does human disturbance history and current disturbance regimes alter these cycles.

We developed a spatially explicit simulation model to investigate how stochasticity in survival and reproduction influence population dynamics on landscapes that differ in habitat configuration. Results indicated that habitat configuration has a dominant effect on population size, accounting for up to 80% of the variation in population size. Stochasticity in survival and reproduction were much less influential, but tended to exacerbate the negative effects of habitat configuration by increasing the number of local extinctions in isolated habitat patches. In a separate study.

We examined the response of six forest herb taxa to N fertilization in forests with and without an agricultural history to examine the hypothesis that plants in post-agricultural stands are N limited.

We have a combined, experimental field and laboratory experiment established using sites, soils and litters within the Coweeta basin and extending outside of the basin to higher elevation (Blue Ridge Parkway) in a study to predict the influence of tree species movement, in response to climate change, on nutrient and carbon cycling.

We initiated an investigation of the effects of hemlock loss, due to infestation by the hemlock woolly adelgid, on nutrient dynamics along an N deposition gradient in the Coweeta basin. Our primary objective is to understand how the spread of exotics (plant or insect) will alter the availability and cycling of nutrients in Southern Appalachian forests.

PUBLICATIONS NOT REPORTED ELSEWHERE (in press, in revision & in review): 11/1/08 to 10/31/09


Dye, S.E., C.M. Pringle and J.L. Meyer. Weak trophic cascades In a complex foodweb with omnivory. Freshwater Biology.

Ford C.R., Reynolds B.C., Vose J.M. Xylem transport models optimize effectiveness of systemic insecticide applications for controlling
hemlock woolly adelgid. Forest Science.


Leigh, D.S. Morphology and channel evolution of small streams in the southern Blue Ridge Mountains of western North Carolina. Southeastern Geographer.


Warren, R.J, Bradford, M.A. Climate change: ecologists think global, climate acts local.


Findings: (See PDF version submitted by PI at the end of the report)

RESEARCH FINDINGS ? 11/01/11 to 07/31/12
Findings are listed under the most relevant of the five thematic areas into which research is organized, although several findings obviously pertain to more than one thematic area given the overarching goal for the research to achieve a regional understanding of the socio-ecological processes in southern Appalachia. Other publications listed in this report may contain additional findings not mentioned here.
1. Parcel Level to Regional Decision-Making

Our studies have shown that land-use decisions influence proximate and distant properties alike. These findings have implications for efficient and effective public policy concerning land-use decisions (Chamblee et al. 2011).

Our findings have shown the importance of distinguishing between land cover and land use as predictors of different water quality parameters in the rapidly exurbanizing landscape surrounding Coweeta. It is critical that managers consider both of these drivers at a basin-wide level in making management decisions to protect water resources. To insure high water quality, management must extend to areas distant from streams -- in addition to traditional riparian zone management and point source effluent regulation in near-stream areas. High nitrate concentrations are of particular concern, and our research has provided evidence that development in steep mountainous areas, far from streams, can be a major contributor to elevated stream nitrate levels (Webster et al. 2012).

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

A field experiment was completed in the Coweeta Basin measured soil moisture, root tensile strength, and root hydraulic conductivity in two species in two landscape positions (fully factorial). The study showed that root tensile strength differs by 40% between species, and that wet roots are significantly weaker than drier roots (lower tensile strength). The results of this work have also recently been incorporated into landslide models (Band et al. 2012).

Recent studies have shown that planted pine stands exhibit higher evapotranspiration (ET) and are more sensitive to climatic conditions compared to hardwood stands. Whether this is due to management and stand effects, biological effects, or their interaction is poorly understood so a study was carried out to estimate growing season canopy- and leaf-level transpiration in five major overstory species over three years. Results from the study showed that ET in the planted pine stand exceeded hardwood ET by 2-fold during all three years, and that transpiration among species contributed substantially to the stand ET difference, suggesting that physiological differences were equally as important as structural factors to the overall difference in ET (Ford et al. 2011, Ecohydrology).

In recently completed research it was hypothesized that the tail-outs of riffles would feature lower water temperatures due to exfiltration of hyporheic water and that the tail-outs of pools would feature higher water temperatures as these are areas of infiltration into the hyporheic zone. Data, however, indicated the effect of channel position on stream temperature in the Upper Little Tennessee River was minimal (Long 2012).

3. Impacts of Climate and Land Use Change on Biodiversity

Research efforts on the effects of land-use change on the structure (biodiversity of invertebrates and fish) and function (ecosystem level processes) of aquatic ecosystems in the Blue Ridge Physiographic Province has demonstrated that stream communities and processes recover more slowly from disturbance to the landscape than do associated terrestrial habitats. This is most likely due to legacy effects of sedimentation resulting from timbering, agriculture, and development (Sokol et al. 2011).

Analysis on regional evapotranspiration (ET), primarily in forested catchments, and across a range of measured and simulated temperatures and species mixes shows that ET responses to warmer climates depend primarily on the relative day/night temperature increases. In contrast to previous estimates, plant water use is unlikely to increase as temperatures increase, if night temperatures increase faster than daytime temperatures, as have been observed over the past few decades. If temperatures increase uniformly, analysis points to large increases in ET, and from approximately 5 to 10% less runoff in streams and rivers. Changes in species composition, to more xeric or more mesic species, will have approximately equivalent impacts as uniform changes in temperature (Hwang et al. 2011).

The spread and performance of invasive plants (using the exotic grass Microstegium vimineum as a case-study) have been tied to the resulting consequences for foodwebs and carbon cycling (Fraterrigo et al. 2011; Strickland et al. 2011; Warren et al. 2011).

Work has predicted the influence of tree species movement, in response to climate change, on nutrient and carbon cycling (Bradford et al. 2012).

Research has been carried out to understand interactions between common soil fauna (ants, termites) and the structure and function of the forest (e.g. understory herb distributions, wood decomposition rates) (Warren et al. 2012; Warren and Bradford 2012; Warren et al. 2011).

Our studies have shown that interactions between climate and local competition range from large to undetectable across the dominant tree species of Southern Appalachia (Clark et al, Trans Roy Soc, Global Change Biol, PlosOne, Ecology), that tree species are not migrating fast enough to track climate change (Zhu et al. Global Change Biol), and that hydrology will become more variable with climate change (Wu et al. 2011 and 2012).

We showed how dispersal and fecundity contribute to fitness and hybridization of oaks (Moran and Clark 2012, and Moran et al 2012).
Research on eastern hemlock has shown that as light levels increase, soil moisture increases, and growth by co-occurring trees and shrubs increase by up to 3x that expected in plots where hemlock is either experiencing mortality mediated by the hemlock woolly adelgid or was girdled to simulate infestation (Ford et al. 2012, Oikos).

Measuring ET in hemlock plots and projecting when annual and seasonal ET would return to pre infestation levels has shown that annual ET will return to pre-infestation levels by 2020, but winter and autumn ET will be permanently reduced due to the lack of an evergreen canopy once hemlock is extirpated (Ford et al. 2011).

A study was performed in which N-13 tracer was used to determine the fate of different N forms in invaded and non-invaded forest understories and found that M. vimineum substantially alters N dynamics by sequestering N in its aboveground biomass and effectively reducing its availability to other plant species (Fraterrigo et al. 2011).

A recently completed dissertation examines the relationships between individual decision making in salamanders and population connectivity in dendritic systems in southern Appalachia. Behavioral mechanisms were determined, which account for observed occupancy patterns in a basin-wide survey of salamanders. One mechanism of particular interest is the removal or thinning of riparian vegetation associated with anthropogenic activities. As riparian vegetation becomes more open and animals that have evolved in low-light environments (i.e. Eastern Hemlock and Rhododendron forests), open can encourage them to make decisions that are no longer adaptive. Gaps in forest cover such as roads or power-line transects may create movement barriers fragmenting stream populations (Cecala 2012).

Our current work with bird communities indicates that as exurban development expands in the Southern Appalachians, forest interior species and Neotropical migrants are likely to decline, and edge species are not likely to benefit. This suggests an overall negative net impact on the bird community (Lumpkin 2011).

Research at Coweeta has shown that many interior-forest, Neotropical migrants occur at high elevations, and our results indicate that these species may face increased nest predation if climate warms in the Southern Appalachians (Lumpkin et al. 2012).

Our work on the effects of hemlock mortality on streams suggests that the major effect may come for the rapid growth and expansion of rhododendron in riparian areas along small streams (Webster et al. 2012).

4. Baseline Data and Temporal Reconstruction

Prehistoric streams of the Blue Ridge mountains exhibited meandering channel morphology, counter to recent contentions in the literature that multichannel or anabranching streams were the norm for the eastern United States. In addition, Holocene climate change in the Southern Blue Ridge Mountains did not feature a component of middle Holocene warming and drying, like parts of the Midwestern United States (McDonald and Leigh 2011; Wang and Leigh 2012; Bain et al. 2012).

CWT IM used equipment supplement funds to execute a data streaming pilot project within the Coweeta Hydrologic Laboratory boundary. The project consists of deployment of a field station that collects soil and air temperature, soil moisture, and photosynthetically active radiation measurements and then transmits the data every 24 hours through a cellular modem to an offsite computer. The data are then checked for QA/QC, appended to the existing data from the site, and values from the last 7 days are displayed in graph form on our website. This fully automated process increases the quality of data by quickly performing QA/QC, exposing equipment failures and reducing station downtime, decreasing time spent retrieving data from the station, and making data available much more quickly compared to manually performing these tasks.

5. Synthesis and Scaled Integration

Technical advances include new modeling tools to infer aggregate population responses to climate variation (Ghosh et al 2012, JABES), to allow for analysis of climate in large containing many zeros as occur in abundance data (Ghosh et al 2012, Biometrics), and the interactions at the individual scale that control regional abundance (Clark et al 2012, Trans Roy Soc, Global Change Biol, PlosOne, Ecology).

New algorithms have been developed exploit temporal coherence in population simulation studies (Agarwal et al. 2011).

Forest ecosystem surface and subsurface canopy conditions are closely coupled to hydrologic and geomorphic behavior of catchments to the extent that remote sensing of canopy conditions can be used to infer hydrologic behavior (runoff regime, hydrologic connectivity), regionalize parameters in distributed ecohydrologic models, and predictions of relative geomorphic stability of hillslopes (Band et al. 2012).

A review of emerging needs in ecohydrology (Vose et al. 2011) was published along with a synthesis of ET across a range of biomes showing that the ratio of AET to P was proportional to the ratio of PET to P over which energy was limiting rather than water (Sun et al. 2011).
Large-scale catchment experiments at Coweeta have quantified the effect of how various treatments on forest vegetation affect water yield. Intervention (statistical) models were used to quantify the apparent increase in long-term air temperature at Coweeta (Laseter et al. in press; Ford et al. 2011, Ecol App).

Results of spatially explicit simulation of population dynamics on landscapes indicate that habitat configuration accounts for up to 80% of the variation in population size. Stochasticity in survival and reproduction were much less influential, but tended to exacerbate the negative effects of habitat configuration by increasing the number of local extinctions in isolated habitat patches (Pearson and Fraterrigo 2011). This study suggests that greater environmental variability, as might arise due to climate change, is likely to compound population losses due to habitat fragmentation and variation in habitat quality.

An improved model of riparian shading on stream channels (SHADE2) was recently published. The model was used to run sensitivity analysis of riparian vegetation height, vegetation overhand, channel width, channel azimuth, and latitude (Li et al. 2012). The model incorporates canopy overhang from the streambank and calculates the fraction of the channel surface shaded from incident light. The paper also presents a new photographic technique for measuring instantaneous shade levels over a reach (Li et al. 2012).

Supplement-Funded Findings
On September 26, 27, 28 and October 4 we hosted the second ‘Migration Celebration.’ This event was attended by the entire 6th grade class at Mountain View Intermediate School (approximately 328 students) in addition to 25, 5th grade students, as well as 18 adolescent boys from Cherokee Creek Boys School in SC. The event was once again held at Tessentee Bottomland Preserve and featured Monarch tagging, bird banding (led by the non-profit Southern Appalachian Raptor Research), Migration Headache game, and other activities relating to migration. This event is carried out in collaboration with our partners Southern Appalachian Raptor Research and the Land Trust for the Little Tennessee, and in coordination with the NCS Extension program to the Eastern Band of Cherokee Indians and Revitalization of Traditional Cherokee Artisan Resources.

We also continued ongoing activities at Mountain View Intermediate and Macon Middle schools in partnership with the Little Tennessee Land Trust, Little Tennessee Watershed Association, and the Macon County Soil and Water Conservation District. Coweeta LTER staff and/or scientists directly engaged with some 1018 students on 9 different occasions from August 2011 ? March 2012.

We restocked science boxes for use by middle school teachers, and built new boxes to be used in the Pioneer RESA (Regional Education Service Agency) based in Cleveland, GA. This agency provides resources and support for 14 K-thru-12 school districts across 12 counties in north Georgia that include the headwaters of the Little Tennessee River Basin. Science study boxes were checked-out a total of 10 times during the school year and were used by approximately 1951 students.

Base funding released was used in support of personnel (field and laboratory technicians and graduate students), materials and supplies associated with regional sampling activities, and UGA indirect cost expenses.

An Assistant Information Manager was hired with the primary responsibility to work with data sets, develop preliminary documentation for the data ingestion process, and assist field and other technicians in the use of GCE’s Matlab Toolbox for initial data post-processing.

The Assistant Information Manager and a Coweeta field technician participated in the LTER-wide SensorNIS activities attending two workshops (one local and one remote).

Two undergraduate students participated as REU students in Coweeta LTER research during summer 2012. They were involved in 1) measuring coarse woody debris at our nine intensive hillslope plots corresponding to three different land use scenarios: forested, traditional valley development, and new mountaintop development. And 2) stream salamander surveys across the Little Tennessee River basin helping with the development of a methodology to rapidly survey salamanders, aquatic snails, crayfish and Tallaperla stoneflies using leaf litterbags.

Three RET teachers were funded to work together at the Coweeta Hydrologic Laboratory during summer 2012 from Macon Middle School and Mountain View Intermediate School. They directly engaged with LTER scientists and graduate students in research within the Little Tennessee River basin and documented their research experiences in the form of podcasts and newspaper articles.

Equipment was purchase to radio-transmit light monitor data from the highest and lowest elevations in the Coweeta Basin. The first field station has been successfully deployed, and the balance will be in place by the end of the summer field season. The station collects soil and air temperature, soil moisture, and photosynthetically active radiation measurements and then transmits the data every 24 hours through a cellular modem to an offsite computer. The data are then checked for QA/QC, appended to the existing data from the site, and values from the last 7 days are displayed in graph form on our website. This fully automated process increases the quality of data by quickly performing QA/QC,
exposing equipment failures and reducing station downtime, decreasing time spent retrieving data from the station, and making data available much more quickly compared to manually performing these tasks.

COMMUNICATIONS NOT REPORTED ELSEWHERE: 11/01/11 to 07/31/12


Leigh, D. S. 2012. 'Pre- Versus Post-Settlement Alluvial Sedimentation Rates in the Upper Little Tennessee River Valley, Blue Ridge Mountains'. Southeastern Division of the Geological Society o in Asheville, NC


Webster, J.R., and D. Newbold. Biological controls on nutrient dynamics in streams (and possible global change effects). Global change effects on aquatic ecosystems: Insights into controls on ecoystem functions and implications to their protection, conservation and restoration. A symposium inspired by the work of Patrick J. Mulholland, Oak Ridge, Tennessee, 4-5 November 2011.


Coweeta Listening Project (Writing Collective) (2011) Science, Public Policy, and Community: Acid Rain and air quality in the Appalachians.
Forest canopies in Coweeta tend to develop a phenologic pattern of leaf-on and leaf-senescence that covaries with topographic position in complex terrain, and interannual hydroclimate. MODIS determination of phenologic patterns shows that while leaf-on is monotonically later with higher elevation, and north facing slopes, leaf-off period is at a maximum at mid-elevations in Coweeta, decreasing with increased elevation due to temperature limitations, and decreasing at lower elevations with water stress (Hwang et al, 2011, Landscape Ecology).

MODIS and Thematic mapper imagery can be successfully used to downscale MODIS phenologic patterns of fractional absorbed photosynthetically active radiation (FPAR) to Thematic mapper resolution (30m). Comparisons of two approaches with and without topographic illumination correction shows that correction is only significant near the winter solstice. This suggests that the simple downscaling is adequate to combine frequent temporal signals of canopy FPAR from MODIS with high spatial resolution information from Thematic Mapper (Hwang et al 2011, Remote Sensing of Environment).

Coupled models of distributed ecohydrologic processes and landslide stability can be used to predict zones of active landslide activity. Using information generated from previous publications on root cohesive strength patterns, with short and long term ecohydrologic dynamics, locations of slope instability could be predicted without calibration with observed landslide scars (Band et al, 2011, Geomorphology).

The gradient of vegetation NDVI with topographic flowpath position, represented by the topographic wetness index, can be used to explain variance in key hydrologic behaviour of catchments in Coweeta, and key hydraulic model parameters of the RHESSys model. This indicates that a remotely sensed property of the canopy can provide effective regionalization of hydrologic behavior and model parameters (Hwang et al, submitted, Water Resources Research).

Our findings have shown the importance of distinguishing between land cover and land use as predictors of different water quality parameters in the rapidly "exurbanizing" landscape surrounding Coweeta. High nitrate concentrations are of particular concern, and our research has provided evidence that development in steep mountainous areas, far from streams, can be a major contributor to elevated stream nitrate levels (Kirk et al. 2011).

Plant water use depends substantially on species and plausible changes in species composition may have a 10-15% impact on water use. Warming climates may increase water use, but the magnitude of the effect depends on the relative daytime vs. nighttime warming, with higher daytime temperatures leading to up to 24% increases in mean plant water use, night-time weighted temperature increases may lead to no net increase or even slight decreases in water use. Leaf area and species composition are the largest sources of uncertainty in modeling, and methods to improve sampling should be developed (Narayanaraj et al. 2010).

We have demonstrated that the use of conservation easements alters land markets in a way that those engaged in conservation activities may not
anticipate and that such alterations need to be taken into account when planning land acquisitions for conservation purchases. We also demonstrated that easements may at some level encourage development and hinder conservation goals. Finally, we demonstrated the viewsheds from a given property have a measurable effect on land prices. We have also learned that technology transfer between LTER sites is a cost-effective way to generate systems upgrades and these processes are mutually, if somewhat unevenly distributed for the technology donors and recipients (Chamblee et al. 2011, Land Economics).

We developed a spatially explicit simulation model to investigate how stochasticity in survival and reproduction influence population dynamics on landscapes that differ in habitat configuration (Fraterrico et al. 2009). Results indicated that habitat configuration has a dominant effect on population size, accounting for up to 80% of the variation in population size. Stochasticity in survival and reproduction were much less influential, but tended to exacerbate the negative effects of habitat configuration by increasing the number of local extinctions in isolated habitat patches. In a separate study, we considered the additional influence of spatial variation in habitat quality on plant populations, finding again a dominant effect of habitat configuration. Together, these studies suggest that greater environmental variability, as might arise due to climate change, is likely to compound population losses due to habitat fragmentation and variation in habitat quality (Pearson and Fraterrico 2011).

Our biotic inventory results have allowed us to rank species in terms of their vulnerability to summer drought and potential gain from longer growing seasons, in the context of local competition for light and moisture. We have demonstrated that responses to environmental variation promote coexistence by concentrating competition within the species. The differences among species at the level of individual responses are the basis for vulnerability to future climate change (Clark et al. 2011, 2010; Evans et al. 2011; Luo et al. 2011, 2010; Agarwal et al. 2011; Wu et al. 2010; Moran and Clark 2010; Villedent et al. 2010).

An unexpected application of ongoing work quantifying sap flow work in eastern hemlock trees has been its relevance to systemic insecticide efficacy. Chemical control has been effective in controlling hemlock woolly adelgid infestation in eastern hemlock trees; however, the effectiveness of soil and stem applications has varied based on injection method, timing of application, and other tree-specific characteristics. Because uptake and transport of systemic insecticides occurs via mass flow in the transpiration stream, we hypothesized that treatment efficacy may be linked to the volume and velocity of xylem water movement, and thus the concentration of the insecticide in the xylem sap. We carried out a field study addressing this question and found that dosages based on a xylem transport model not only significantly improved tree health more than the trees receiving the current recommended dosage, but also caused greater reductions in the live HWA population. The implications of this work are that by improving treatment dosages we can reduce treatment cost, non-targeted effects, allow land managers to treat a greater number of small size-class trees, and increase the efficacy of insecticide treatments on large size-class trees (Ford et al. 2010; Clinton et al. 2011).

Structural and species controls on canopy transpiration in hardwood and planted pine stands. Recent studies have shown that planted pine stands exhibit higher evapotranspiration (ET) and are more sensitive to climatic conditions compared to hardwood stands. Whether this is due to management and stand effects, biological effects, or their interaction is poorly understood. I led a study that estimated growing season canopy- and leaf-level transpiration in five major overstory species over three years. Results from the study showed that ET in the planted pine stand exceeded hardwood ET by 2-fold during all three years, and that transpiration among species contributed substantially to the stand ET difference, suggesting that physiological differences were equally as important as structural factors to the overall difference in ET (Sun et al. 2011; Ford et al. 2011; Vose et al. 2011).

Climate change, increased climatic variability, and land-use change are three interacting forces that are likely to have a major impact on water resources in the coming decades. Large-scale catchment experiments at Coweeta have quantified the effect of how various treatments on forest vegetation affect water yield. A critical unknown in these experiments was whether the resulting vegetation in the treatment catchment and the vegetation in the nontreated catchment responded similarly to climate or not. I used intervention (statistical) models to quantify the apparent increase in long-term air temperature at Coweeta (Ford et al. in press).

Riparian forest conversion has reduced active channel widths, reduced wood frequency, simplified habitat, and reduced median particle sizes in streams of the Southern Appalachians. Also, the ratio of drainage area to local channel slope better explains the variation in active channel width than drainage area alone, and this when evaluated against this width predictor, the effect of riparian conversion on channel width is nearly invariant (see figure below). Riparian conversion has also substantially increased stream temperatures. The data suggest that even modest increases in the extent and width of forested riparian buffers would substantially improve stream habitat conditions for native aquatic species (Price et al. 2011).

We have found that a riverine bog along the Nantahala River was initiated about 14,000 years ago and has persisted ever since. Stratigraphic sections indicate climatic variability during that time, but finer scale resolution must wait until colleagues at the University of Tennessee complete their analysis of pollen cores. Three stratigraphic sections of fluvial overbank sediment that span the past 1500 years provided significant evidence of large floods that occurred around the beginning and end of the Medieval Warm Period. Data from previous and ongoing studies show that human impact have caused more than 50 percent narrowing of small stream channels in the upper Little Tennessee River.
Microstegium vimineum is a shade-adapted C-4 grass that is rapidly expanding its distribution in eastern deciduous forests. Early in the current cycle, we performed a 15N-tracer study to determine the fate of different N forms in invaded and non-invaded forest understories and found that M. vimineum substantially alters N dynamics by sequestering N in its aboveground biomass and effectively reducing its availability to other plant species. Together, these studies suggest that greater environmental variability, as might arise due to climate change, is likely to compound population losses due to habitat fragmentation and variation in habitat quality (Fraterrigo et al. 2011; Warren et al. 2011).

Our findings have shown the importance of distinguishing between land cover and land use as predictors of different water quality parameters (unpublished).

In addition, we can use our findings to make landscape-scale predictions regarding the presence and absence of focal organisms outside of our study area—based on land use data within the southern Appalachians [available from Geographic Information System (GIS) data] (Frisch et al. 2011).

A primary conclusion from our studies to date is that historic land use has a profound and lasting legacy on both plant communities and ecosystem processes in forests of the Southern Appalachians. Our current work with bird communities indicates that, as exurban development expands in the Southern Appalachians, forest interior species and Neotropical migrants are likely to decline, and edge species are not likely to benefit, suggesting an overall negative net impact on the bird community. Further, many interior-forest, Neotropical migrants occur at high elevations, and our results indicate that these species may face increased nest predation if climate warms in the Southern Appalachians (Lumpkin 2011).

We found that demographic variability, such as due to enhanced climatic variation, could exacerbate the negative effect of habitat fragmentation. Habitat abundance, spatial pattern, and quality had the greatest effect on population persistence of theoretical species similar to forest perennial herbs; however, demographic variability increased the sensitivity to habitat loss and fragmentation. Variability in survival rates was more important than in reproduction. Increases in dispersal did not ameliorate the negative effects (Kuhman et al. 2011, 2010).

Findings from biotic sampling of the synoptic sampling sites during summer 2010 indicate that Tallaperla stoneflies are key indicators of land use. In fully forested stream reaches, Tallaperla were abundant, with 30-100+ individuals detected. In contrast, in sites impacted by residential or agricultural development Tallaperla were absent or rare, with 0-2 individuals detected. Each of our four focal taxa exhibited different distribution patterns. As percent agriculture within a watershed increased, snails were present more frequently and Tallaperla were found less frequently. Crayfish were present more frequently when more rhododendron was present at a sampling location. Finally, sculpin were present more frequently in watersheds that had larger drainage areas; watersheds with larger drainage areas tended to be valley streams with fewer barriers to fish movement than steeper-sloped headwater streams (Frisch et al. unpublished)

The occupancy sampling protocol has several advantages. The methodology allowed us to assess a large number of streams during a short period of time and enabled evaluation of watersheds feeding into the Little Tennessee River at a landscape scale. By sampling a reach over three consecutive days, we were able to assess the probability of detecting our focal taxa when they were present, and correct our occupancy estimations appropriately. Finally, the sampling approach has the potential application of predicting threshold levels of human land use within a watershed that result in extirpation of Tallaperla, an indicator that the stream environment has been negatively impacted by human activities. In addition, we can use our findings to make landscape-scale predictions regarding the presence and absence of focal organisms outside of our study area—based on land use data within the southern Appalachians [available from Geographic Information System (GIS) data] (Frisch et al. unpublished).

Our findings have shown the importance of distinguishing between land cover and land use as predictors of different water quality parameters in the rapidly exurbanizing landscape surrounding Coweeta. It is critical that managers consider both of these drivers at a basin-wide level in making management decisions to protect water resources. To insure high water quality, management must extend to areas distant from streams--in addition to traditional riparian zone management and point source effluent regulation in near-stream areas. High nitrate concentrations are
of particular concern, and our research has provided evidence that development in steep mountainous areas, far from streams, can be a major contributor to elevated stream nitrate levels (Webster et al. in press)

COMMUNICATIONS NOT REPORTED ELSEWHERE: 11/01/10 to 07/31/11

CONFERENCE PAPERS / CONFERENCE PROCEEDINGS


NEWSPAPER ARTICLES


NEWSLETTER ARTICLES


REPORTS

are to anticipate how plant communities, ecosystems, and landscapes will respond to environmental and land use changes in the next century. Understanding of long-term vegetation dynamics and forest succession across environmental gradients is critical if natural resource managers (Vose 2010). This research is based on long-term permanent plots at Coweeta; Elliott is leading the remeasurement of these plots in 2009-2012. An

Elliott has used multivariate approaches to understand vegetation response following known disturbances (Elliott and Swank 2008, Elliott and Vose 2010). This research is based on long-term permanent plots at Coweeta; Elliott is leading the remeasurement of these plots in 2009-2012. An understanding of long-term vegetation dynamics and forest succession across environmental gradients is critical if natural resource managers are to anticipate how plant communities, ecosystems, and landscapes will respond to environmental and land use changes in the next century.

To evaluate the effects of land-use and climate change on biodiversity, we developed a spatially explicit simulation model to investigate how stochasticity in survival and reproduction influence population dynamics on landscapes that differ in habitat configuration (Fraterrigo et al. 2009). Results indicated that habitat configuration has a dominant effect on population size, accounting for up to 80% of the variation in population size. Stochasticity in survival and reproduction were much less influential, but tended to exacerbate the negative effects of habitat configuration by increasing the number of local extinctions in isolated habitat patches. In a separate study, we considered the additional influence of spatial variation in habitat quality on plant populations, finding again a dominant effect of habitat configuration (Pearson and Fraterrigo in press). Together, these studies suggest that greater environmental variability, as might arise due to climate change, is likely to compound population losses due to habitat fragmentation and variation in habitat quality.

We have documented in two separate studies that policies affecting land use can create material economic benefit or harm to those who are impacted by the policy. In the case of watershed protection, the benefits of the protection are offset by the costs imposed on the landowners who find themselves unable to subdivide their land, even if that is what they want to do. This is a classic public choice problem, that is, there are some who benefit and some who are harmed by a legal mandate. Economists consider such policies to be more efficient if those who are harmed are compensated by those who benefit. In the case of Buncombe County it seems that those landowners impacted by the watershed protection policies were not compensated, yet this might have been caused by a lack of information about the impact of the policy on landowners (Chamblee et al. 2009; Dehring & Depken 2010).

The systematic variation of root strength with greater tensile strength on slopes and ridges, and lower strength in hollows, much lower strength of Rhododendrom Maximum compared to overstory species. The tendency of forest canopy LAI to form patterns along topographic flowpaths that appears to optimize transpiration and net primary productivity at the hillslope or catchment scale (Hales et al. 2009; Hwang et al. 2009).

Elliott has used multivariate approaches to understand vegetation response following known disturbances (Elliott and Swank 2008, Elliott and Vose 2010). This research is based on long-term permanent plots at Coweeta; Elliott is leading the remeasurement of these plots in 2009-2012. An understanding of long-term vegetation dynamics and forest succession across environmental gradients is critical if natural resource managers are to anticipate how plant communities, ecosystems, and landscapes will respond to environmental and land use changes in the next century.
Our ongoing research illustrates the importance of considering soil alteration, not just impervious surfaces, when considering the effects of forest conversion on watershed hydrology. Our work has also shown that S. Appalachian basins with higher percentages of forest and lower percentages of pasture/grass cover have higher low flows, presumably because the reduced soil storage in the converted lands outweighs the reduced transpiration from these lands. The geomorphic surveys on the synoptic streams have shown that thin forested riparian buffers are associated with significantly narrower channels, less aquatic habitat area, and greatly reduced large wood inventories. These surveys are also providing insight into small scale variability in channel width. My recent Bioscience paper with Cathy Pringle uses a variety of case studies to demonstrate that partial restoration of aquatic habitats is not always beneficial and such efforts must be considered in a matrix of pollutants, endangered species, and other system modifications (Price et al. 2010; Jackson & Pringle 2010).

Moderate levels of human impact on the landscape, specifically conversion of forest to pastures and lawns, result in significant reduction in the width of small streams (<20 km2) and associated aquatic habitat in the Blue Ridge province (Leigh, 2010). Appalachian assemblages of fishes and macroinvertebrates can be well predicted (R2 = 0.5-0.8) with multivariate regression models of either land cover, geomorphic, or water quality variables, and the best models involve combinations of these variables (Walters, Roy, Leigh, 2009).

Post-settlement (since circa 1870) sedimentation rates in alluvial valleys of the Blue Ridge province have been about an order of magnitude greater than pre-settlement rates, owing to erosional land use practices such as timber harvest, farming, and exurbanization (Leigh, 2010).

We are beginning to understand how salamander species distributions may shift in response to climate change through species distribution modeling and forecasting. We modeled the current climatic distributions of 44 plethodontid salamander species that currently occur within the Appalachian Highlands region, and then used a range of 4 climate change scenarios for the region to project near (10 year) and longer-term (40-70 year) shifts in species climatic distributions. The results of that study project the loss of many currently dominant species from high-elevation forests in the Coweeta region, with the retention of more cosmopolitan species. We find that salamanders are important in the nutrient dynamics of headwater and first order streams, and that salamanders decline in abundance as a result of loss of forest cover associated with agriculture or mountainside development, and we project near-term declines in salamander abundance as a result of climate change. As a result, we project shifts in headwater and first order stream nutrient dynamics (Milanovich et al. in press).

Findings from biotic sampling of the synoptic sampling sites during summer 2009 indicate that Tallaperla stoneflies are key indicators of land use. In fully forested stream reaches, Tallaperla were abundant, with 30-100+ individuals detected. In contrast, in sites impacted by residential or agricultural development Tallaperla were absent or rare, with 0-2 individuals detected. Each of our four focal taxa exhibited different distribution patterns. As percent agriculture within a watershed increased, snails were present more frequently and Tallaperla were found less frequently. Crayfish were present more frequently when more rhododendron was present at a sampling location. Finally, sculpin were present more frequently in watersheds that had larger drainage areas; watersheds with larger drainage areas tended to be valley streams with fewer barriers to fish movement than steeper-sloped headwater streams.

The occupancy sampling protocol has several advantages. The methodology allowed us to assess a large number of streams during a short period of time and enabled evaluation of watersheds feeding into the Little Tennessee River at a landscape scale. By sampling a reach over three consecutive days, we were able to assess the probability of detecting our focal taxa when they were present, and correct our occupancy estimations appropriately. Finally, the sampling approach has the potential application of predicting threshold levels of human land use within a watershed that result in extirpation of Tallaperla, an indicator that the stream environment has been negatively impacted by human activities. In addition, we can use our findings to make landscape-scale predictions regarding the presence and absence of focal organisms outside of our study area based on land use data within the southern Appalachians.

Data Products & Websites Developed
a. Land cover map for Southern Appalachians for 2006 at a 30m cell resolution
b. Field measurements of avian communities (site occupancy and detection probabilities) at 152 sites
c. Vegetation characterization of ~60 avian field sites
d. GPS coordinates and NLCD land cover class for ~200 point locations in Macon County
e. LULC polygons for nine Intensive Watersheds and 120 2010 avian field sites derived from 2007 DOQQs.

Presentations
Coweeta LTER senior personnel and their students delivered oral presentations of their research at the following venues:


Cecala, K. and J. C. Maerz. Patterns of occupancy and abundance of larval salamanders across land use gradients within the upper Little Tennessee Watershed. 2010 Coweeta LTER Annual Summer Meeting, Otto, NC.

Ford, C.R., Laseter, S.H., Swank, W., and Vose, J.M., Climate change and variability interact with land-use to impact water quantity. p. 19 (Published abstract). Contributed oral presentation at the 2009 2nd International Conference on Forests and Water in a Changing Environment in Raleigh, NC.

Ford, C.R., Laseter, S.H., Swank, W., and Vose, J.M., Climate change and variability interact with land-use to impact water quantity. Contributed oral presentation at the 2009 Coweeta Hydrologic Laboratory 75th Anniversary Science Symposium in Dillard, GA.


Maerz, J. C., Invasive species, land use and climate change: salamander ecology in a rapidly changing world?, 2010 Department of Biological Sciences, University of Maryland, College Park, MD.

Maerz, J. C., Invasive species, land use and climate change: salamander ecology in a rapidly changing world?, 2010 Distinguished Alumni Lecture, Department of Biological Sciences, State University of New York, Binghamton, NY.

Maerz, J. C., Invasive species, land use and climate change: salamander ecology in a rapidly changing world?, 2009 Conservation Ecology Lecture Series, Odum School of Ecology, University of Georgia, Athens, GA.

Milanovich, J. R. 2009. Projected loss of a salamander diversity hotspot as a consequence of global climate change. 7th Southern Forestry and Natural Resource Management GIS Conference. Athens, GA.


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FINDINGS: 11/01/08 to10/31/09

Ecohydrological equilibrium, or optimality, has been posed as an adjustment of canopy density?to local soil and climate conditions at the patch level, which maximizes productivity. We have demonstrated that this equilibrium concept operates at the level of hydrologic flowpaths where ecosystem patches are connected by the downslope transport of water and nutrients, and by extension to the catchment. This suggests that entire patterns of forest canopy density? (quantified here as leaf area index), are adjusted to maximize ecosystem productivity at the landscape level, and is not limited to individual patches (Hwang et al. in press).

Research was completed on the adaptive capacity of non-native invasive plants to spread in forested landscapes and pose a threat to forest communities in the southern Appalachians (Kuhman 2009). Both contemporary and historic land use can affect invasion by non-native plants. Factors related to land use, the biotic community and the abiotic template were investigated at local to regional scales in western North Carolina to determine their roles in shaping the distributions of forest invaders. The influence of agricultural land-use history and roads was evaluated in a forested watershed where cultivated areas had been abandoned a century earlier. A field seeding experiment with non-native Oriental bittersweet (Celastrus orbiculatus) was implemented to elucidate the specific factors related to land-use history that might be facilitating invasion. Finally, roadside surveys were conducted throughout a four-county region to determine the distribution of a suite of non-native forest invaders, and the factors explaining their distributions were examined at local and regional scales using linear and generalized linear models. Land-use history was an important determinant of invasion, particular at local scales. Areas with agricultural land-use histories often had overstory communities with high tulip poplar (Liriodendron tulipifera) dominance. Such areas had more invasive plants than comparable sites.
that were never cultivated and typically dominated by oaks (Quercus spp). Field experiment results indicated that higher invisibility in tulip poplar stands could be attributed to thinner leaf litter layers and moister soil conditions. Results from the broader-scale survey showed that the factors explaining distributions of forest invaders throughout the region varied among species and between scales of analysis. At the regional scale, many species were more common closer to the city center (Asheville, NC), at lower elevations, and in watersheds with less forest cover. At the local scale, species responded more strongly to land use and land cover; many were more common in areas with greater forest regrowth and less total forest cover. Overall, results emphasize the important role of land-use history and provide insights regarding the interactions between historic land use and the contemporary landscape that influence non-native plant invasion in the forest-dominated southern Appalachians. Three manuscripts are forthcoming from this work.

Forests with a history of agriculture can have reduced nitrogen (N) availability. Response of six forest herb taxa to N fertilization was examined in forests with and without an agricultural history to assess the hypothesis that plants in post-agricultural stands are N limited (Fraterizzo et al. 2009). Significant interaction was found between land-use history and N treatment for several species, such that N fertilization increased aboveground biomass or leaf area more in the post-agriculture site than in the reference site. Surprisingly, N fertilization depressed aboveground biomass or leaf area for several species in the reference site. These results suggest that some plants growing in post-agricultural stands may be N limited, whereas undisturbed stands in this region appear to be approaching N saturation. Thus, environmental conditions, and particularly N availability, may be an obstacle to the restoration of forest herb communities. We also considered the joint effects of contemporary land use and climate variation on plant persistence.

A spatially explicit simulation model was developed to investigate how stochasticity in survival and reproduction influence population dynamics on landscapes that differ in habitat configuration (Fraterizzo et al. 2009). Results indicated that habitat configuration has a dominant effect on population size, accounting for up to 80% of the variation in population size. Stochasticity in survival and reproduction were much less influential, but tended to exacerbate the negative effects of habitat configuration by increasing the number of local extinctions in isolated habitat patches. In a related study currently in press (Pearson and Fraterizzo, in press), the influence of spatial variation in habitat quality on plant populations was considered, finding a dominant effect of habitat configuration. Together, these studies suggest that greater environmental variability, as might arise due to climate change, is likely to compound population losses due to habitat fragmentation and variation in habitat quality. Additional results are included in a review article on disturbance-driven changes in ecological variability (Fraterizzo and Rusak 2008). Work recently published (Hales et al. 2009) provides the results of an investigation into the relationship between species composition, topographic and soil characteristics, and landslide potential. This work showed that species and topographic position affect root tensile strength and thus landslide potential. Furthermore, data showed that across all species, root tensile strength was positively correlated with root cellulose content, and that within a species, root cellulose content per unit root diameter was greater in species occupying more convex topographic positions compared to more concave ones.

A study was published (Nuckolls et al. 2009) on hemlock decline induced by either girdling or HWA infestation and quantified the concurrent changes to the carbon cycle in a mixed stand of hemlock and hardwoods. The results of this research suggest that hemlock is declining more rapidly from HWA infestation in the southeast than in the northeast, and that hemlock decline from HWA has a rapid effect on the carbon cycle.

Among several recent published results are the findings that species show large differences in terms of their sensitivities to mean climate differences (i.e., spatial variation), which are typically used to model biodiversity response to climate change, and variation within a location, over time. The latter is what species will actually experience and may explain the results of invasion studies that the successful species were not necessarily those most likely to invade with future climate change (Ib??ez et al. 2008, 2009).

A Coweeta LTER project investigated the impact of land-use restrictions in watersheds influences property values of the encumbered properties and those properties that are impacted (generally in a positive manner) from the land-use restrictions. Results indicated that encumbered properties were reduced in value, as reflected in market transactions, whereas those properties that enjoyed ecosystem benefits from the watershed protection policy increased in value. These findings were the basis for suggestions that policy makers might consider compensatory measures in future watershed policies (Chamblee et al. 2009).

A study by Ardon et al. (2009) used standardized analytical techniques to measure chemistry and breakdown rate of leaves from common riparian tree species. Comparisons of the effects of leaf litter chemistry on leaf breakdown rates in tropical versus temperate streams are hindered by the lack of comparability of analytical methods used to measure leaf chemistry between studies and across sites. We conducted this study at two sites where there is a relatively large amount of information on litter chemistry and breakdown rates in streams: a tropical site (La Selva Biological Station, Costa Rica) and a temperate site (Coweeta Hydrologic Laboratory, N.C., USA). We selected eight common riparian tree species from La Selva and seven common riparian species from Coweeta that spanned the range of leaf litter chemistry naturally entering streams at each site. We predicted that concentrations of secondary compounds would be higher in the tropical species than in the temperate species and that concentrations of condensed tannins would decrease breakdown rates in both sites. Contrary to our predictions, mean
concentration of condensed tannins was significantly greater (2.6 fold, p < 0.001) for Coweeta than for La Selva species. Concentrations of condensed tannins were negatively correlated with breakdown rate among Coweeta species (r = -0.77), but not among La Selva species. Concentrations of structural compounds were strongly correlated with breakdown rate at both sites (Coweeta species: lignin r = -0.94, cellulose r = -0.76; La Selva species: cellulose r = -0.78, carbon r = -0.76). Findings challenge previous generalizations regarding tropical-temperate differences in how leaf litter secondary compounds determine breakdown in streams, by suggesting that the initial chemistry among these eight riparian species from La Selva and seven riparian species from Coweeta is not as different as previously thought. The results underline the importance of using standardized analytical techniques to measure leaf chemistry when making cross-site comparisons.

The publication by Gardiner et al. (2009) describes a proactive sampling strategy designed and implemented in 2000 by the Coweeta LTER Program to document changes in streams in which catchment land uses were predicted to change over the next two decades due to increased building density. Diatoms, macroinvertebrates, fishes, suspended solids, dissolved solids, and bed composition were measured at two reference sites and six hazard sites, where a socioeconomic model suggested new building construction would influence stream ecosystems in the future. The six hazard sites were located in catchments with forested and agricultural land use histories. Diatoms were species-poor at reference sites but did not show clear patterns among the hazard sites. Cluster analysis, Wishart’s distance function, non-metric multidimensional scaling, indicator species analysis, and t-tests show that macroinvertebrate assemblages, fish assemblages, in situ physical measures, and catchment land use and land cover were different between streams whose catchments were mostly forested, relative to those with agricultural land use histories. Based on previous sampling and similar statistical analyses, we predict more rapidly deteriorating biotic integrity at the agricultural sites where more intense building activities occur. Comparing current fish collections with a previously collected data set, catchment classes were identified and mapped (K-means clustering) throughout an 8600 km2 region in western North Carolina’s Blue Ridge physiographic province. Combining field sampling, ordination, and simple statistical procedures, we identify catchments that were likely to be similar to the hazard sites at the inception of the study. A major contribution of this manuscript is that it predicts how two different trajectories of land use change will support streams with diverging biota and physical conditions over the next two decades and it provides a foundation for further hazard site monitoring by the Coweeta LTER Project.

Findings described in Kominoski et al. (2009) address the relationship between species diversity and leaf litter breakdown based on examining effects of leaf litter quality and species mixing on microbial community diversity and litter processing in a forested headwater stream. Single- and mixed-species litter from dominant tree species (Liriodendron tulipifera, Acer rubrum, Quercus prinus, Rhododendron maximum) were incubated in a southern Appalachian headwater stream at Coweeta. Litter carbon-to-nitrogen ratios (C:N), mass loss, microbial respiration, and microbial community diversity were analyzed on individual litter species after incubation. Initial C:N varied widely among individual litter species, and these differences persisted throughout the 50-day incubation period. Litter C:N of the recalcitrant species R. maximum remained higher than that of all other litter species, and C:N of R. maximum and L. tulipifera increased when both species were present together in a mixture. Although mass loss of individual species was generally unaffected by mixing, microbial respiration was greater on A. rubrum and Q. prinus litter incubated with R. maximum compared to either species alone. Enhanced resource heterogeneity, which was experimentally achieved by litter mixing low- and higher-quality litter species, resulted in apparent shifts in microbial community diversity on individual litter species. Responses of bacterial and fungal community diversity to litter mixing varied among individual litter species. Findings suggest that changes in tree species composition in riparian forests and subsequent changes in litter resource heterogeneity could alter stream microbial community diversity and function. As bacteria and fungi are important decomposers of plant litter in aquatic ecosystems, resource-dependent changes in microbial communities could alter detrital processing dynamics in streams.

In a paper in press by Kominoski and Pringle, results are presented from testing the effects of leaf litter species diversity (i.e. litter mixing) on litter mass remaining and macroinvertebrate communities (taxon diversity, abundance and biomass) during breakdown in a detritus-based headwater stream at Coweeta. A full-factorial analyses was used of single- and mixed-species litter from dominant riparian tree species with distinct leaf chemistries [red maple (Acer rubrum), tulip poplar (Liriodendron tulipifera), chestnut oak (Quercus prinus) and rhododendron (Rhododendron maximum)] to test for additivity (single-species litter presence / absence effects) and non-additivity (emergent effects of litter species interactions). Findings were significant for non-additive effects of litter mixing on litter mass remaining that was explained by species composition, but not richness, and litter-mixing effects were variable throughout breakdown. Litter mixing had non-additive effects on macroinvertebrate community structure. The number of species in litter mixtures (two to four), but not litter species composition, was a significant predictor of the dominance of particular macroinvertebrates (i.e. indicator taxa) within mixed-species packs. In addition, the presence / absence of high- (L. tulipifera) and low-quality (R. maximum) litter had additive effects on macroinvertebrate taxon richness, abundance and biomass. The presence of L. tulipifera litter had both positive (synergistic) and negative (antagonistic) effects on invertebrate taxon richness, that varied during breakdown but were not related to litter chemistry. In contrast, the presence / absence of L. tulipifera had a negative relationship with total macroinvertebrate biomass (due to low leaf mass remaining when L. tulipifera was present and higher condensed and hydrolysable tannins associated with leaf packs lacking L. tulipifera). Macroinvertebrate abundance was consistently lower when R. maximum was present, which was partially explained by litter chemistry [e.g. high concentrations of lignin, condensed tannins, hydrolysable tannins and total phenolics and high carbon to nutrient (N and P) ratios].

In a synthesis paper now in press (Kominoski et al. in press) examine effects of resource and consumer diversity on stream organic matter
processing to identify general patterns and potential mechanisms of non-additivity across spatial and temporal heterogeneity. They also review multi-trophic consumer response patterns to resource diversity to assess how consumer diversity responses compare to independent resource and consumer effects on organic matter processing in streams. Consistent emergent patterns include: (1) Top-down (i.e. consumer) diversity effects are common among vertebrate, invertebrate and microbial trophic levels and are generally explained by species evenness; (2) bottom-up (i.e. resource) diversity effects are mediated by species evenness and vary both spatially and temporally and (3) consumer responses to resource diversity that best explain resource diversity effects are predominantly seen at the microbial level. Resource and consumer diversity effects are driven by dominance of functionally distinct taxa. However, response of consumers to resource diversity only partially explain resource diversity effects, suggesting functional differences between how naturally colonizing and manipulated consumer assemblages use organic matter resources. The challenges facing general ecology and the advancement of Biodiversity-Ecosystem Function (BEF) Theory include an improved understanding of how environmental heterogeneity and temporal and spatial variation influence BEF patterns.

An article published in Ecological Indicators (Walters et al. 2009) reiterates that fine sediment is detrimental to aquatic biota. This and other information derived from the 2009 Synoptic Sampling in the Little Tennessee Basin clearly show that human impact has caused more than 50 percent narrowing of small stream channels in the upper Little Tennessee River basin. Narrowing of small stream channels equates to loss of aquatic habitat, so it has great ecological significance.

Presentations
Coweeta LTER senior personnel and their students delivered oral presentations of their research at the following venues:

2009 Southeastern Ecology and Evolution Annual Meeting in Gainesville, FL
The University of Alcala de Henares, Spain
Complutense University, Madrid, Spain
The University of Zaragoza, Spain
2009 Ecological Society of America Annual Meeting, Albuquerque, NM
2009 North American Bethological Society Annual Meeting, Grand Rapids, MI
Georgia Water Resources Conference, April 27-29, University of Georgia
American Geophysical Union Conference, San Francisco, CA
2009 All Scientists LTER Meeting, Estes Park

Media Coverage
Two recently published articles by Coweeta LTER researchers generated significant media coverage:


Story published 3/11/09: ClimateWire (online news source with subscription), Washington, DC: ?Changing the carbon cycle of eastern U.S. forests, one hemlock at a time?


Story aired 3/4/09: WJCW-AM, Johnson City, TN: Chelcy Ford appeared on live morning show 'Thinking Out Loud' at 7:45 am. This is a commercial radio station.


Story published on 2/27/09: Hickory Daily Record newspaper, NC, (By Bruce Henderson, McClatchy Tribune Wire Service): ?Insect may kill off most Eastern hemlocks?
http://www2.hickoryrecord.com/content/2009/feb/27/insect-may-kill-most-eastern-hemlocks/lifestyles/

Story published on 2/27/09: Statesville Record & Landmark newspaper, NC, (By Bruce Henderson, McClatchy Tribune Wire Service): ?Insect may kill off most Eastern hemlocks?
http://www2.statesville.com/content/2009/feb/27/insect-may-kill-most-eastern-hemlocks/lifestyles/


Story published on 2/27/09: Greenwire (online news source with subscription), Washington, DC: ?Eastern insect killing trees at high rate ? study? (Story available with subscription)

Story published on 2/27/09: RedOrbit.com (online news source): ?Hemlock Trees Dying Rapidly?


Story on 2/26/09: WATE-TV, ABC affiliate, Knoxville, TN ?Study: most Hemlock trees in S. Appalachia could die within decade?

Story on 2/26/09: WUNC Public Radio in Raleigh, NC carried the story in afternoon newscasts

Story on 2/26/09: WLRH Public Radio in Huntsville, AL carried the story in newscasts

Science Daily (online news source) ?Hemlock Trees Dying Rapidly, Affecting Forest Carbon Cycle?

ScienceMode (online news source) ?Study finds hemlock trees dying rapidly, affecting forest carbon cycle?

Physorg.com (online news source) ?Study finds hemlock trees dying rapidly, affecting forest carbon cycle?

ScienceBlog.com (online news source) ?Study finds hemlock trees dying rapidly, affecting forest carbon cycle?

Genetic Engineering News, (online and print publication) ?Study finds hemlock trees dying rapidly, affecting forest carbon cycle?


Georgia Forestry Commission - Aug. 31, 2009 (has a link to the article on their website under 'Forestry News' http://www.gfc.state.ga.us/

EurekAlert - Aug. 31, 2009 'Rhododendron expansion may increase the chance of landslides on Southern Appalachian slopes'

PhysOrg Mobile - Aug. 31, 2009 'Rhododendron expansion may increase the chance of landslides on Southern Appalachian slopes'
http://pda.physorg.com/rhododendron-species-southern_news170946074.html

Bright Surf - Aug. 31, 2009 'Rhododendron expansion may increase the chance of landslides on Southern Appalachian slopes'
RedOrbit - Aug. 31, 2009 'Rhododendron expansion could increase the chance of landslides on Southern Appalachian slopes'

First Science - Aug. 31, 2009 'Rhododendron expansion may increase the chance of landslides on Southern Appalachian slopes'

Asheville Citizen Times - Sept. 1, 2009 'Study: More Rhododendrons may increase chances of landslides in Appalachians'

Training and Development:

TRAINING & DEVELOPMENT: 11/01/11 to 07/31/12
Undergraduate students participating in the Institute for the Environment at UNC Chapel Hill during fall semester at the Highlands Biological Station participate in Coweeta LTER research through internships and research projects in the Little Tennessee watershed.

A short course was offered last year in our ecohydrologic modeling systems attended by some 15 graduate students, research scientists and post-docs from UNC and other universities.

Examples from Coweeta LTER research are used in Ecology and Freshwater Ecology at Virginia Tech University, as well as in guest lectures in engineering and forestry undergraduate classes that emphasize changes in the southern Appalachian landscape since the 1850’s and the legacy effects of those changes on stream ecosystems.

Last year, four undergraduate students received hands-on experience and one-on-one training in computer programming, relational database development, GIS data development, scripted data development routines, XML programming, web authorship and good data management practices. Most of these projects involved the development of research materials used by Coweeta PIs, allowing the students the opportunity to connect specific data development activities with research-based conclusions.

The long-term plots have been used for field trips, and the resulting data analyzed in courses on Biodiversity Science and Applications and Models for Ecological Data at Duke University. These courses are attended by undergrads, grad students, and postdocs.

Land parcel results have been incorporated in a graduate econometrics class at University of North Carolina to introduce students to new methodologies incorporating GIS data and in the form of out-of-class projects focusing on replication. Replication projects help students gain first-hand experience with difficult data.

Data from gradient hydrology project were used as examples in a watershed hydrology course at NCSU (graduate and undergraduate sections).

Graduate and undergraduate students and student-technicians at UGA have improved their abilities to conduct ecological field research using birds or amphibians as taxa to study the potential effects of land use and elevation on ecological function. They have also learned to use GPS and geospatial data and techniques to pre-select field sites.

The Coweeta Listening Project served as the basis for a required graduate seminar at UGA in the Integrative Conservation PhD program jointly sponsored by Anthropology, Geography, Ecology and Forestry.

Data and findings from the Coweeta LTER stream work have been used extensively in undergraduate and graduate hydrology classes at the University of Georgia.

Coweeta LTER fluvial geomorphology data and results are used in a General Geomorphology Class (GEOG 3010), a Fluvial Geomorphology Class (GEOG 4020), and a Geomorphology Seminar (GEOG 8020) at UGA.

Schoolyard were expanded and now reach 1016 students at 6 different K-12 schools. Science study boxes reached 1951 students showing that these resources continue to be used in science classes in Macon County. Duplicate science study boxes were created for used in the North Georgia Pioneer RESA that serves 14 school systems in a 12 county area.

A group of about 18 undergraduates from Virginia Tech University were taken on a field trip to Coweeta where they are introduced to the rich history of research and look at many of the ongoing projects.
TRAINING & DEVELOPMENT: 11/01/10 to 07/31/11

Information generated as part of the Coweeta LTER project has been used in college classes and high school presentations, and has been the focus of post-doctoral training. Information was used as part of a NASA funded climate change outreach grant for NC high school teachers this past June, and has been used as coursework for classes in watershed simulation and watershed GIS.

The Coweeta LTER Information Management Office is a key locus of undergraduate mentoring. In the last year, four undergraduate students received hands-on experience and one-on-one training in computer programming, relational database development, GIS data development, scripted data development routines, XML programming, web authorship and good data management practices. Most of these projects involved the development of research materials used by Coweeta PIs, allowing the students the opportunity to connect specific data development activities with research-based conclusions. One undergraduate student, KC Love, completed a directed project to develop an intensive land cover classification for the watersheds involved in Coweeta's broader Synoptic Sampling Program.

Undergraduate and graduate students in the Biodiversity course at Duke University work in the Coweeta plots each year and learn about factors affecting forest diversity. Data sets are analyzed as part of the course.

Coweeta research was used in the Business School to educate those unfamiliar with the working of land markets on the consequences, sometimes unintended, of conservation actions.

Coweeta research is used in graduate-level courses in econometrics in the form of out-of-class projects focusing on replicating the results. The unique characteristics of the data help the students to enjoy first-hand experience of working with difficult data to answer an important question.

Undergraduate CWT summer interns have been advised from Furman University, Florida A&M, University of North Carolina, Western Carolina University, Tuskegee University, and Clemson University. The research projects of these students were developed through participation in the Long-Term-Ecological Research Program.

Supervision of 3 graduate students and 5 technicians in the context of ongoing CWT LTER improved their abilities to conduct ecological field research using birds as a taxa to study the potential effects of land use and elevation on ecological function. In addition, they have learned to use GPS and geospatial data and techniques to pre-select field sites. One technician has been accepted into graduate school at the University of Massachusetts for fall 2011.

Many graduate and undergraduate students have participated in the Coweeta geomorphic stream surveys. Some of these students have primary responsibility for other aspects of the LTER research program, but they have participated in the stream surveys to learn more about streams, geomorphic processes, and aquatic habitat. Data and findings from the Coweeta LTER stream work has been used extensively in undergraduate and graduate hydrology classes at the University of Georgia.

CWT Geomorphology research has contributed to the skills and experience of undergraduate students and graduate students in terms of research activities and results being closely linked with his teaching activities. Findings from this research has been used in General Geomorphology (GEOG 3010), Fluvial Geomorphology (GEOG 4020), and a Geomorphology Seminar (GEOG 8020).

Graduate and undergraduate students participating in all aspects of the geomorphic research have gained excellent first-hand experience in field, laboratory, and academic settings. The public's understanding of science and technology.

+++++++++++++++++++++++++++++++ TRAINING & DEVELOPMENT: 11/01/09 to 07/31/10 ++++++++++++++++++++++++++++++++ Coweeta LTER research material on landslides and catchment hydrology have been directly incorporated into an undergraduate/graduate class in watershed GIS.

Undergraduate student capstone projects in the Highlands Biological Station ? UNC Chapel Hill Institute for the Environment Field Site - were on fish diversity patterns in the Little Tennessee River network in collaboration with the Little Tennessee Watershed Association and the Coweeta LTER.

Activities include the development of an ecology textbook chapter, based on interactive learning using computer software, as part of a larger effort by joint private industry and NSF funding to develop undergraduate, educational materials. The chapter utilizes the location and research
conducted at the Coweeta LTER to illustrate concepts and present data and real world examples of decomposition in terrestrial and freshwater ecosystems.

The Coweeta LTER Information Management Office is a key locus of undergraduate mentoring. Last year, four undergraduate students received hands-on experience and one-on-one training in computer programming, relational database development, GIS data development, scripted data development routines, XML programming, web authorship and good data management practices. Most of these projects involved the development of research materials used by Coweeta PIs, allowing the students the opportunity to connect specific data development activities with research-based conclusions. One undergraduate IM student, Jessica Watkins, attended the LTER ASM, presented a poster and interacted with a wide variety of scholars. CWT IM also provided short term mentoring and data development assistance to five graduate students conducting fieldwork within the Coweeta study area.

Coweeta LTER research based at Duke University supported high school students (Ivan Bukovnik, Noah Lavine), undergraduates and recent graduates (Nathan Buchanan, Melissa Burt, Alyssa Cooper, Natalia Dorfman, Amy Hamilton, Amber Loucks, Clint Oakley, Luke Pangle, Danielle Racke, Quentin Read, Sarah Rorick, Greta Schmoyer, Jason Styons, Emily White, Miranda Welsh, Jaimie West), Masters students (Allen McBride, John Williamson, Nathan Welch), PhD students in Ecology, Nicholas School, and Biology departments (Dave Bell, Michelle Hersh, Emily Moran, Carl Salk), and postdocs (Sean McMahon, Wei Wu). Mentoring of participants in the projects additionally Muskie fellows from Ukraine (Maryana Draga) and Azerbaijan (Saida Ismayilova). Sabbatical fellows participating in the research included Benoit Courbaud (France), Zehao Shen (China), and Chengjin Chu (China).

Coweeta LTER research was used as training materials in Forest Stand Dynamics Southeast: A Graduate-Level Forest Management Short Course, through the NC State Dept Forestry & Environ Scientific Extension and Outreach.

We led demonstrations as part of public and professional outreach programs, including NC School of Math and Science, the Forester's Guild of America, the 49th Annual Conference of the Society for Economic Botany (12 participants), the Southeast regional meeting of the Forest Guild (27 participants), the Duke Forest Annual Research Tour (13, general public), the Research Symposium Tour (44, general public), and the Nicholas Board of Visitors and Environmental Explorers (15 participants).

Clark is developing a web-based course on hierarchical modeling that stems from decadal research at Coweeta on succession, which incorporates the examples from this application (http:\courses.duke.edu, search for: Nicholas School, (2009 Spring) MODELS FOR ENV DATA (01L)). The website will include documentation, computer code, data sets, and podcasts of the lectures.

Results from Chamblee et al. 2009 have been incorporated to a graduate econometrics class in the form of out-of-class projects focusing on replicating the results. The unique characteristics of the data help the students to enjoy first-hand experience of working with difficult data to answer an important question.

Elliott has led over 30 site tours in the last five years (2006-2010). These tours include discussion and lecture of her personal research projects as well as results from research of other investigators on the LTER project. Tours typically require 4-6 hrs to conduct and include written results (handout format with tables, figures, and short narrative) for participants. Groups include universities, local colleges, other governmental agencies, and international visitors interested in the ecological research at Coweeta.

Ford conducted eight tours of public, university and private groups through the research program in the Coweeta Basin in 2009. These tours inherently include many aspects of LTER research in addition to Forest Service research.

Several students have gained experience in conducting ecological field research using birds as a taxa to study the potential effects of land use and elevation on ecological function. In addition, they have learned to use GPS and geospatial data and techniques to pre-select field sites.

Many graduate and undergraduate students have participated in the Coweeta geomorphic stream surveys. Some of these students have primary responsibility for other aspects of the LTER research program, but they have participated in the stream surveys to learn more about streams, geomorphic processes, and aquatic habitat.

Leigh's activities in the Coweeta LTER have contributed to the skills and experience of undergraduate students and graduate students through his teaching: he 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).

Data and findings from the Coweeta LTER stream work has been used extensively in undergraduate and graduate hydrology classes at the University of Georgia:

1. Provided an authentic research experience for summer research interns James Shope and Jeffrey White and UNC's Institute for the
Environment student Sallie Senseney

2. Assist in the collection, QC, and archiving of a number of different data sets for a number of Coweeta LTER projects, LTER PIs, and Coweeta scientists to facilitate LTER research

3. Expanded Coweeta LTER Schoolyard activities, reaching over 500 students at 7 different K-12 schools; put together 6 Science Study Boxes so teachers can check out science equipment that is typically not available in their schools; work on planning an outdoor classroom on property between Macon Middle School and the new Mountain View Intermediate School

4. Worked with seniors from Warnell School of Forestry and Natural Resources to engage them in developing a management plan for Rabun Gap-Nacoochee School as part of their senior project

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TRAINING & DEVELOPMENT: 11/01/08 to 10/31/09

Graduate students involved with Coweeta LTER research worked both as Research Assistants as well as Teaching Assistants in classes in hydrology, GIS, modeling, geography, and ecology often using material from the Coweeta project.

A distributed graduate seminar titled “From Yardstick to Gyroscope” centering on socioecological methods for long-term research was co-taught January-May, 2009, by Ted Gragson (CWT), Laura Ogden (FCE), Morgan Grove (BES), and Chris Boone (CAP). Guest presentations explicitly identified the social and behavioral science theory behind focal questions driving site-level research along with how data are collected and analyzed. During this class, 25 graduate students distributed across the LTER Network worked with four site LPIs (FCE, BNZ, BES and CWT) and nine additional site researchers.

Undergraduate students in the UNC Institute for the Environment program based at the Highlands Biological Station collaborated with Coweeta personnel and local watershed NGOs on aquatic ecology of the Little Tennessee River.

Coweeta LTER researchers served as advisors to Post-doctoral investigators, as well as PhD and MS students at Yale University, University of Minnesota, University of Wisconsin, University of Illinois, University of North Carolina, Duke University, and University of Georgia. Five students graduated with a PhD and four with an MS.

A Coweeta LTER researcher (M. Bradford) is lead author for an ecology textbook chapter based on interactive learning using computer software. This is part of a larger effort by joint private industry and NSF funding to develop undergraduate, educational materials. The chapter utilizes the location and research conducted at the Coweeta LTER to illustrate concepts and present data and real world examples of decomposition in terrestrial and freshwater ecosystems.

Career development training and instruction in basic research were provided for three highschool students through the University of Georgia’s Young Dawgs career development program.

Between August 1, 2008 and June 25, 2009, the Coweeta LTER web site served 68,000 unique hosts and transferred 395 GB of data. Downloads of publications and data directories alone account for 72% of all bandwidth. An additional 10% of all traffic was accounted for by access of files and directories that provide key Information Management services including metadata provision, regional GIS data support, interpretation for the public of our research proposals and products, Schoolyard support, and collaborative research products.

Students enrolled in courses taught by Coweeta LTER researchers at Yale University, University of Minnesota, University of Wisconsin, University of Illinois, University of North Carolina, Duke University, and University of Georgia read papers written by Coweeta LTER researchers. These courses included graduate and undergraduate students in real estate, econometrics, and allied social sciences as well as geography, hydrology, biology, and ecology.

Graduate and undergraduate students were included in the execution of winter and summer synoptic sampling of 57 locations across the Little Tennessee Basin, as well as the conceptual basis for the assessment. The students participating in this research are being trained in climate change influences on streams, computational approaches to N uptake in streams, ?pulse? and ?steady-state? assessment of nutrient uptake in streams, determining N and P availability in streams and the role that consumers (i.e., aquatic macroinvertebrates) may play in nutrient cycling, and application of the Redfield Ratio to microbial assemblages in streams and stoichiometric control of N and P uptake.

Summer student interns working at the Coweeta Hydrologic Laboratory with the Coweeta LTER Site Manager and USFS researchers have
been provided authentic research experiences and the opportunity to co-author a long-term stream salamander paper; assist with the collection, QC, and archiving of a number of different data sets; work with the Schoolyard coordinator to train middle school students at Rabun Gap-Nacoochee School (RGNS) in field methods and establishment of citizen science projects at both RGNS and Macon Middle School; worked with graduate students and researchers in locating field sites and coordinating research activities; and participated in the Summer Coweeta LTER meeting.

Outreach Activities:

OUTREACH ACTIVITIES: 11/01/11 to 07/31/12
Public lectures have been given on water resources, climate change and ecosystems that draw on research results from Coweeta. Investigators have also participated in North Carolina state committees on nutrient sensitive waters and water resources (NC Nutrient Sensitive Waters Scientific Advisory Board) drawing on research results and experience working in the southern Appalachians.

Results on invasive species from Coweeta LTER research was incorporated to a climate change science course taught by Dr. Robert Warren through Highlands Biological Station.

The Coweeta Listening Project website was released. It serves as the portal to a research-driven initiative to translate science results to the community that exists in the CWT LTER study area and foster dialog that leads to the formulation of new science questions based on community needs and concerns.

There has been close interaction by multiple investigators with over 100 property owners in Macon County both privately and in public fora. This has been information sessions on specific projects including nest predation, ecohydrology, fluvial geomorphology, and land use and management.

A field trip at Coweeta was conducted for 28 international, mostly indigenous participants to the Indigenous Revival and Sacred Sites Conservation conference (7 April 2012).

A tour was led of 13 Alabama A & M minority forestry students (15 May 2012) that visited WS 7 and talked about the collaborative approach to research between Coweeta and Coweeta LTER.

A tour was led of 18 teachers enrolled in ?Teaching Climate Change Science in Middle & High School? (12 June 2012) in which climate change science taking place at Coweeta was discussed.

A special tour was given for Dr. Dave Cleaves, Climate Change Advisor for the Chief of the USFS (20 June 2012).

An overview was given at the Franklin Rotary Club (30 November 2011) to 50 members and guests that covered the Coweeta LTER outreach and education activities.

A presentation was given at Asbury Methodist Church, Otto, NC (20 February 2012) black bear ecology and conservation.

Methods developed for sampling salamanders as part of the synotpic project have been incorporated into the Coweeta Schoolyard activities and are being adopted by a local land trust.

Dr. Maerz spoke to an audience of 65 at the Atlanta Botanical Garden?s Science Caf on Appalachian salamanders and global change.

The Coweeta Listening Project collective published a regular column in the most widely read local newspaper, The Franklin Press, under the tag-line ?Science, Public Policy, Community?. The column introduces the public to the LTER?s scientific research and explains how the research can inform local decision-making.

A team-developed poster was produced for the LTER Schoolyard Program entitled People and the Land in Southern Appalachia: A thousand year land use legacy. The poster illustrates the major epochs of land use change in southern Appalachia to help middle school students visualize how those changes are manifested on the present day landscape. The poster is available from the Coweeta LTER Resources page:
http://coweeta.uga.edu/dbpublic/resource_details.asp?id=695

Coweeta LTER Schoolyard Program Activities ? 11/01/11 to 07/31/12
August 3rd ? Coweeta LTER partnered with Coweeta Hydrologic Lab to host a group of students from the Eastern Band of Cherokee Indians (EBCI). Twenty-four 3rd-6th graders learned a bit about stream ecology by catching salamanders and crayfish and went on a tree identification hike.
September 20th - Personnel led Butterfly survey and Monarch tagging for 30 students in the MVI Science Club.

October 21st - Personnel led a ?Naturalist Ramble? hike in cooperation for the Land Trust for the Little Tennessee. The hike including birding, butterflying, plant id, and discussions about Coweeta LTER research at the site and elsewhere in the county. There were 10 participants on this 2 hour hike.

On October 26-27th Coweeta LTER Schoolyard participated in Conservation Field Day at Tessentee Bottomland Preserve. Multiple state and local agencies expose students at this event to the field of natural resources. Coweeta LTER Schoolyard had a booth attended by the entire 7th grade at Macon Middle School. This involved setting up an ISCO water sample and doing activities related to the importance and relative scarcity of potable fresh water. Approximately 300 students were served over the period of about 20 minutes for each group.

November - Personnel helped MVI teacher set up weather experiments for 26, 5th grade students. Students compared temperature, rainfall, soil temperature, and windspeed between a forested and non-forested site at the school. Students created short 5 minute presentations about their findings and shared their results with their peers and other teachers.

November 30th - Personnel gave 15 minute presentation about the Schoolyard LTER program to the Franklin Rotary. There were approximately 50 attendees, including the Macon County Schools Superintendent and principals from local schools.

December 12th - Twenty-one 7th graders from Hayesville Middle School came to Coweeta Hydrologic Laboratory and spent 6 hours learning how to calculate stream discharge, learned about Climate Station 1 and air quality issues, and took part in a citizen science stream salamander survey.

December 13th - Liz Nixon, a scientific illustrator who works with Coweeta LTER, gave a presentation about scientific illustration to 30 students in the MVI science club. She then had the students draw natural objects and gave them pointers on how to draw.

December 16th - Personnel set up an educational booth about Coweeta Schoolyard LTER program and Coweeta LTER research at the Rabun Gap-Nacoochee Middle School Science Fair. Approximately 100 students came by the booth over the course of 3 hours.

February 20th - Personnel led citizen science project ?Great Backyard Bird County? for 30 students at MVI science club for 1.5 hours. We spotted 14 species, including an American Kestrel and 2 Wilson?s Snipe!

March 24th - Personnel helped judge the Rabun Gap-Nachoochee High School Science Fair for 4 hours interviewing approximately 50 students.

April 14th - Personnel led ?Naturalist Ramble? hike on the Greenway on behalf of the Western NC Alliance. 8 participants.

May 10th - Personnel led 26 MVI students in fish shocking on Porters Creek with Bill McLarney and LTLT staff.

An outdoor pavilion was completed at Mountain View Intermediate School to be used in the Coweeta Schoolyard Program. Funds derived from Coweeta LTER Schoolyard Program ($6,000 in supplies), Macon County Board of Commissioners ($5,000 in labor), Macon County Board of Education ($5,000 materials and labor), Mountain View Intermediate PTO ($1,000 materials and labor), North Carolina Foundation for Soil and Water ($2,500 grant for materials), Ritter Associates Architecture ($1,000 donation in engineer certified drawings), Ben West with Smoky Mountain Surveying ($500 donation in survey work), Macon County Lowe?s ($300 donation of cedar shakes and bushes), Tony Oberley Construction ($2,400 in labor), Volunteers ($2,400 in labor).

OUTREACH ACTIVITIES: 11/01/10 to 07/31/11

Twelve tours were led at Coweeta, ranging from college students to middle school students and reaching 133 people. Talks were conducted at the Franklin Bird Club (14 participants) summarizing Coweeta LTER research focused on birds, and another at the Otto Garden Club (29 participants) on black bear research and conservation. A bird hike (13 participants) on behalf of the Land Trust for the Little Tennesse at one of their properties included a discussion of Coweeta LTER research ties in with local conservation efforts.

A presentation by CWT investigator at The Western NC Public Lands Council on acid deposition and the threats it poses to natural areas based on the latest data and research from Great Smoky Mountains National Park and Coweeta Hydrologic Lab. This presentation summarized the importance of Coweeta and the Coweeta LTER. In attendance were representatives at 5 of western NC counties, including a representative
from Representative Heath Shuler’s office and high ranking officials from Great Smoky Mountains National Park, NC State Parks, and western NC National Forests.

Article about the Coweeta LTER in ugaResearch magazine was produced and had a distribution of 20,000.

Several CWT investigators assisted with the filming of a documentary by Freshwater Illustrated at Coweeta. The documentary is comparing ‘Future Scenarios’ of water issues in the Pacific NW (Andrews LTER), upper Midwest (North Temperate Lakes LTER), New England (Harvard Forest LTER), and Southeast (Coweeta LTER).

Coweeta Schoolyard LTER Summary?AY10-11 (see file attached to Research and Education Activities for details on encounters)

The Coweeta Schoolyard LTER program continued to serve students in Macon and Rabun counties in the 2010/2011. From August 2011 to July 2011, we directly engaged with over 1000 students on 12 separate occasions (Table 1). In addition, we worked with interns in UNC’s Institute for the Environment program in the fall. I mentored two students who performed an inventory of herpetofauna in 3 natural areas in western North Carolina and northeastern Georgia. I also co-mentored a student who worked on completing a phenology curriculum for local schools and environmental centers.

The Science Study Boxes continued to be utilized by local teachers and were checked out a total of 14 times during the school year, serving over 1600 students (Table 2). In addition, we were able to add a dissecting microscope ? digital microscopy unit that is available for teachers to check out. In October 2010, Coweeta Schoolyard LTER partnered with Southern Appalachian Raptor Research (SARR) and the Land Trust for the Little Tennessee (LTLT) to host a “Migration Celebration? field trip for the entire 6th grade at Mountain View Intermediate School (MVI). The event took place at LTLT?’s 90 acre Tessentee Bottomland Preserve just a few miles down the road from Coweeta. Approximately 310 students learned first-hand about bird banding and bird migration, inventoried butterflies with aerial nets and learned about the ecology and migration of the Monarch butterfly, and took part in activities discussing how different animals adapt to the cold of winter.

In March we had our first contact with students from Hayesville Middle School. Approximately 23 8th grade students took part in taking stream discharge measurements on Ball Creek using only meter sticks, a stop watch, and an orange. They then learned about a weir, toured the Analytical Lab, and learned about the climate station and air quality issues. To top it all off, the students took part in a citizen science stream salamander research project, surveying 30 leaf litter bags for salamanders, Tallaperla stoneflies, crayfish, and aquatic snails following the same protocols as Coweeta LTER scientists and graduate students.

Teachers at both MVI and Rabun Gap-Nacoochee School (RGNS) continued to take part in citizen science projects on their own school grounds that were installed and supported by the Coweeta Schoolyard LTER program. At MVI, these activities include insect surveys (including Monarch tagging), seed dispersal adaptations (which utilized the dissecting microscope), weather station/weather observation studies (which included the entire 5th grade at MVI ? over 300 students), evergreen/deciduous tree studies, and the beginning of a local native plant garden which will also be used to teach phenology.

At RGNS, students continue to check salamander cover boards and reptile tins as part of an amphibian and reptile survey. Coweeta LTER also had a role in several science fair projects at the school. A student used a weather station supplied by Coweeta LTER Schoolyard to compare temperature and cloud formations as part of his science fair project. Another student used previous LTER stream chemistry data from Jack Webster to assist her with a study on stream health on an impaired creek that runs through the school’s property. The winners of the ?Environmental Science? section of the science fair measured variables impacting Hellbender (Cryptobranchus alleganiensis) presence/absence in streams and actually found a live Hellbender thanks to help from Coweeta LTER and UNC’s Institute for the Environment interns. In February, Coweeta LTER was able to connect non-LTER graduate students from the University of Alabama performing research on Wood Frogs (Rana sylvatica) to high school students at RGNS. The researchers visited a biology class and explained their project and later that evening students joined the researchers in searching for Wood Frogs at a local wetland, learning first hand about field research.

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OUTREACH ACTIVITIES: 11/01/09 to 07/31/10

Findings on the sensitivity landslide potential in the Southern Appalachians with development and expansion of Rhododendron Maximum were published in JGR Earth Surface. Results were presented at the SAMAB conference that includes members of the public, reported in a set of media outlets including wire services - Asheville and Knoxville newspapers - and internet media.

Coweeta’s new website (still under development) is designed to explicitly link research projects, personnel, data and publications in a way that allows the public and policy makers to see how broad conclusions written for non-technical audience are linked to scientific publications and data.
The Chamblee et al. 2009 paper on watershed protection policy informs policy makers about land-use policies that might be very popular yet impose costs on individuals. If efficiency is a goal, such individuals should be compensated for any economic damages caused by the policy.

The Coweeta video was shown to the following groups, who were then led on a field tour of watershed 7 and hemlock plots:

a) 15 technicians and managers from the Great Smoky Mountains National Park (10 March 2010)

b) 12 students and two professors from Haywood Community College (16 March 2010)

c) 25 students and 3 teachers from Macon Early College High School (19 March 2010)

d) 17 students and one professor from University of Georgia Mountain Geography Class (27 March 2010)

e) 20 landscape ecologists attending the International Association for Landscape Ecology meetings in Athens, GA (9 April 2010)

f) 12 students and professor from University of Georgia Ecosystems Ecology Class (10 April 2010)

g) 10 undergraduate students and two professors from Alabama A&M Forestry Class (3 June 2010)

h) 28 students and professor from Haywood Community College (22 July 2010)

Schoolyard Program (see attached PDF with tables & photos)

The program served students in Macon and Rabun counties in the 2009/2010. From August 2009 to April 2010, we directly engaged with 581 students on 18 separate occasions (Table 1). We also worked with an intern in UNC’s Institute for the Environment program to complete our Science Study Boxes, which were available for teachers to check out during AY 2009/2010. The boxes are filled with equipment and activities on a variety of subjects, including Stream Ecology, Geology, Light and Sound, Soil, Heat Energy, and Biodiversity. Boxes were checked out a total of 20 times during the school year, serving over 1080 students (Table 2). In the fall of 2009, former Coweeta LTER Schoolyard Coordinator Jennifer Love and local high school teacher Adrian Holt traveled to Greensboro, NC for the North Carolina Science Teachers Association (NCSTA) annual conference. They presented 1) the Little Tennessee Watershed curriculum that Adrian Holt developed in collaboration with Coweeta LTER and LTWA and 2) using citizen science in the schoolyard (with collaboration from Great Smoky Mountains Institute at Tremont School Program Coordinator Jen Martin). Jason and Jennifer Love presented the Science Study Boxes to participants at the Northeast Georgia Education Conference and discovered that the study boxes definitely fill a niche, as there are no other types of resources/equipment available for science teachers in NE Georgia.

In May we partnered with the Land Trust for the Little Tennessee (LTLT) and the non-profit Southern Appalachian Raptor Research (SARR) to establish a bird banding station at Tessentee Bottomland Preserve. The banding station is part of the nation-wide citizen science program called Monitoring Avian Productivity and Survivorship (MAPS). The program is a great way to introduce both students and adults to birds and bird biology; there were seven banding sessions this summer; because of the success of the program, we plan to band in the fall as well to gather data on fall migrants. This time of year would also lend itself better to school groups. For more information about the results of Tessentee MAPS, check out http://www.bigbaldbanding.org/id4.html.

Established a stream salamander monitoring program at Rabun Gap Nacoochee School (Middle and Highschool). Leaf litter bags are used to survey stream salamanders, with information collected at regular intervals and recorded in a database for long-term analysis of trends. The program is modeled on the long-term Stream Salamander Monitoring in Great Smoky Mountains National Park?. This citizen science stream salamander monitoring program was initiated in 1999 at Great Smoky Mountains Institute at Tremont, TN.

Installed manual weather station at Macon Middle School in Franklin, NC, where students will check the weather every morning (temperature, max/min temp, barometer, wind direction, wind speed, rainfall). Based on their data, they can use The Wheel of Weather? to predict the forecast, which will then be included in morning announcements.

Published Upper Little Tennessee Watershed Water and Habitat Quality Educational Curriculum? by Adrian Holt in cooperation with Coweeta LTER and the Little Tennessee Watershed Association for distribution with Coweeta Stream Study Box and use by local science teachers and
organizations.

Finalized Coweeta Stream Study Box this includes equipment for measuring flow, temperature, dissolved oxygen, pH, turbidity, etc. with an associated curriculum and cards to help teachers tie the activities to the NC-mandated science curriculum. The box includes a series of digital and hard-copy maps produced by Coweeta LTER Information management for use in the ?How Healthy is Your Stream? activity. The maps consist of 6, 42 in x 42 in maps of different subsections of the Upper Little Tennessee Watershed, laminated for re-use.

Coweeta Stream Study Box used by: Macon Middle School (300 students), the Macon County 4-H (25 students), the Macon County Gear Up Program (24 students), Macon County Homeschool Group (15 students), and Little Tennessee Watershed Association ? Cherokee Reservation Stream Program (25 students).

Organized and led three-day Citizen Science training trip at Great Smoky Mountains Institute at Tremont (46 students and 8 teachers). Courses centered on ?Salamander Monitoring and the Scientific Method?, ?Stream Ecology? and ?Stream Physics?. Students were exposed/introduced to national projects called Firefly Watch, Frog Watch, The Community collaborative Rain, Hail and Snow Network (CoCORaHS), and the USGS Phenology Project.

Coordinator co-taught stream ecology at Macon Middle School to approximately 300 students. One class used Stream Assessment Protocol included in the Coweeta Stream Study Box along with the Curriculum to assess the stream health through observation. Another group looked at dissolved oxygen and pH and a third group looked at turbidity and temperature.

Coordinator co-taught 300 students at Macon Middle School to use seine nets, buckets, waders, bug boxes, macro-invertebrate keys and hand nets to conduct a macroinvertebrate inventory of stream on school property to determine stream health.

Science Club established at Macon Middle School - 20 students participate every Thursday from 3:00 ? 4:30 for one semester. A new group of 20 students then participate for the second semester.

ORGANIZED EVENTS:

2. Franklin Trail Days Event (4 April 2009, Franklin, NC) ? booth at event at which about 25 citizens stopped by to pick up literature or talk about the Schoolyard program.
3. Macon County Folk Heritage Festival (18 July 2009, Franklin, NC) ? set up booth at festival; approximately 200 participants stopped by the booth to talk and/or pick up literature.
4. Presented curriculum and stream study box at Great Smoky Mountains Institute at Tremont for the Smoky Mountain Science Teacher Institute; 26 teachers attended.
5. Coweeta Open House (25 July 2009, Coweeta Hydrologic Lab, NC) ? Approximately 300 citizens toured Coweeta, including learning about the LTER program at Coweeta.
6. Rabun Gap-Nacoochee School (2 June 2009, Coweeta Hydrologic Lab) ? gave field and lab tour of Coweeta to 10 RGNS teachers/administrators (2 hour tour).
7. Coweeta Hydrologic Laboratory (18 March 2009) ? 2 hr presentation and field tour to 6 student from Iowa State University.
8. Presented ?Learning to Appreciate, Identify and Understand Lichens? program for the brown bag lunch program at Coweeta Hydrologic Lab; 25 adults attended.

MEDIA COVERAGE:

April 1 ? Franklin Press article ?Help with Stream Studies?
May 13th - Franklin Press article ?Middle School Kids Go Outdoors, Learn Science the Hands-on Way?
May 13th - Macon County News article ?Education Program Grooms Budding Scientists?

Journal Publications


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### Web/Internet Site

**URL(s):**
- http://coweeta.uga.edu/ecology/research.html
- http://coweeta.uga.edu/ecology/chem_lab.html
- http://coweeta.uga.edu/ltwa
- http://coweeta.uga.edu/
- http://listening.coweeta.uga.edu

**Description:**
URL 1: represents a reorganization of the research section of the Coweeta LTER website - includes documentation for the 2008-2014 "Southern Appalachia on the Edge" project, an links to projects from previous funding cycles.

URL 2: an overview of the Coweeta Analytical Lab with links to procedures for processing samples

URL 3: website for the distributed graduate seminar "From Yardstick to Gyroscope"

URL4: Website highlighting our partnership with the Little Tennessee Watershed Association and the Core data set of Biomonitoring data they have provided to us.

URL5: Coweeta LTER Knowledgebase. A repository of technical information on Information Management and Long Term Field Monitoring Activities.

URL6: A completely overhauled Coweeta LTER website.
URL7: The website for the Coweeta Listening Project.

### Other Specific Products

#### Contributions

**Contributions within Discipline:**

Contribution have been made to development of advanced spatial analysis and modeling methods to address the dynamics of developed and undeveloped watersheds, and interfaces between direct, indirect activities of people and institutions, with environmental processes.

Contributions have been made to the base of knowledge, theory, research and pedagogical methods in the field of geomorphology.

Contributions have been made to the methodology and theory of economic valuation.

Contributions have been made in hydrology to determining local hyporheic effects on stream temperature, improving the ability interpret
temperature monitoring data in Southern Appalachia.

Intensively monitored watersheds have demonstrate the relation between forest preservation and water quality providing practical guidelines for natural resource management.

Contributions to spatial data collection, terrain analysis, processing, accuracy analysis, and testing have been incorporated into a textbook ?GIS Fundamentals? that has been adopted by 350+ universities and colleges.

Contributions to fundamental ecological understanding on community and ecosystem consequences of invasion due to niche infilling with a particular focus on how it affects the flow of carbon in foodwebs and soil carbon dynamics.

Contributions to niche theory by providing empirical evidence that facilitation, in particular animal-mediated dispersal, should be considered an essential niche axis.

Contributions to biogeochemistry by demonstrating that resource history shapes contemporary function and that this history persists in new environments, making it essential to explicitly consider microbes in ecosystem models that project carbon and nutrient cycling.

Contributions from the Coweeta Listening Project include insights into the politics and practices of ecological knowledge production, circulation and use that inform geography, anthropology and Science and Technology Studies.

Contributions Within Discipline 11/10 to 07/11
Research activities have contributed to knowledge and methods in coupled evolution of ecohydrologic, hydrologic and geomorphic systems in mountain environments.

Research in LiDAR data analysis for ecosystem structure and function has resulted in the development of methods for data processing, LiDAR-spectral data fusion, and relation to vertical structure and understory dynamics that are new to this field.

Research has contributed materially to the methodology used to estimate the impacts of land-use decisions on property values.

Use of the permanent plot network coupled with dendrochronology techniques is contributing to our understanding of past disturbance legacies and environmental gradients in shaping current vegetation patterns in the southern Appalachians.

We are filling a gap in knowledge in the variability of stable isotopes (D and 18O) in natural waters of the southern Appalachian region.

Research demonstrates the importance of considering soil alteration, not just impervious surfaces, when examining the effects of forest conversion on watershed hydrology. Our work has also shown that S. Appalachian basins with higher percentages of forest and lower percentages of pasture/grass cover have higher low flows, presumably because the reduced soil storage in the converted lands outweighs the reduced transpiration from these lands.

Our research has shown that riparian forest conversion has reduced active channel widths, reduced wood frequency, simplified habitat, and reduced median particle sizes in streams of the Southern Appalachians. In addition, we have established that the ratio of drainage area to local channel slope better explains the variation in active channel width than drainage area alone, and that when evaluated against this width predictor, the effect of riparian conversion on channel width is nearly invariant. Riparian conversion has also substantially increased stream temperatures. The data suggest that even modest increases in the extent and width of forested riparian buffers would substantially improve stream habitat conditions for native aquatic species.

The CLP ? Coweeta Listening Project ? research contributes to the expanding knowledge and theory around engaged and citizen science. On the research side, it is increasing our understanding about the co-production of knowledge, how the democratization of science may improve decision outcomes, science communication, and the value of engagement for the communities and the scientists involved.

GIS and remote sensing methods were developed to study canopy phenology in mountainous environment, allowing the quantification of impacts of phenology on catchment hydrology and canopy carbon budgets and growth patterns.
Our hydrologic research illustrates the importance of factoring in soil alteration, not just impervious surfaces, when considering the effects of forest conversion on watershed hydrology. We have shown that S. Appalachian basins with higher percentages of forest and lower percentages of pasture/grass cover have higher low flows, presumably because the reduced soil storage in the converted lands outweighs the reduced transpiration from these lands.

Geomorphic research in the Coweeta LTER has contributed to the base of knowledge, theory, research and pedagogical methods in the field of fluvial geomorphology.

Coweeta LTER research has materially advanced knowledge in Geosciences (hydrology), Biology (Ecosystems), and Social and Behavioral Science (Geography).

Our hydrologic research has improved the methods for estimating plant impacts on water yield. Best methods to date are regression-based, and don’t include factors that represent plant species composition and density. Our models address this shortcoming.

We have identified uncertainties about forest structure, particularly leaf area, as the largest single contributor to variation in estimates.

Our Coweeta LTER research into invasion biology addresses the need identified by various bodies including the NRC, to provide a framework for species invasion that relies on fundamental ecological understanding.

We are contributing to niche theory providing a counter-argument to the idea that facilitation extends the niche; showing that it might extend space? per se but not niche space.

Land economics research contributes to the economics and real estate fields in illustrating the effects of environmental protection on land prices. In particular it addresses the private vs. social cost argument of these types of protective measures, contributing evidence in the debate regarding the effects of building codes on safety and property risk.

In biogeochemistry, we have shown that microbial communities adapt to new resource conditions, which influences the rate of biogeochemical processes, but this adaptation is dependent on their history. This means we can expect microbial communities to directly influence decomposition and nutrient cycling following ecosystem perturbation in manners dependent on the ecosystem history.

The IM laboratory developed several automated methods for integrating landscape data across multiple watersheds and is using those data to analyze the relationship between water quality and land use. By integrating GIS into econometric studies, we also showed the importance of ecological and land use heterogeneity in shaping economic behavior.

Our Coweeta LTER is pioneering the application of multi-scale patch and reach occupancy models as a means to assess the presence and abundance of species across a large geographic area. This is a novel application of the relatively recent surge in use of occupancy models. Historical approaches of quantifying salamander abundances were either inadequate or so logistically challenging that they limited large-scale studies over broad geographic area. We believe that our approach will serve as a model for large spatial and temporal scale studies of vertebrate distributions that will provide for scalable inferences from more fine-scaled research.

Our research on salamander species distribution modeling and climate change forecasting is an excellent example of using ensemble approaches to creating a range of scenarios for how species distributions may shift in both near and longer-terms. In particular, we have generated testable hypotheses about processes that currently limit species distributions and how those processes may be affected by shifts in climate.

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11/08 to 10/09
We have developed methods within geography and hydrology to characterize the joint distributions of canopy LAI, root depth from a combination of high resolution remote sensing, field sampling and spatial statistical analysis as conditioned by topographic position. The methods may be extended to significantly improve the parameterization of landslide hazard models commonly used in geomorphic and engineering analysis of slope stability.

Results were published that address the dynamics of N cycling in streams, which help understand streams as ecosystems along with their response to increased availability of reactive N.

Dialogue was increased between French and American social scientists as to the interactions between society and environment. While this is a
subject well-advanced in North America, it is largely unexamined by French social scientists.

Advanced the methodology for occupancy sampling of invertebrate taxa at landscape scales in aquatic ecology.

Recent publications address the ecologically fundamental issues of metabolic theory and spatial subsidies as controls over ecosystem metabolism. In addition, we have addressed the fundamental issue of steady-state dynamics in headwater stream and its implications for using streams as signatures for ?terrestrial? processes. This issue is generic to many of the claims being made both by aquatic and terrestrial ecologists in regards to the locations and character of N retention on the landscape.

Published research findings have contributed to the scientific understanding of the importance of terrestrial resource diversity to stream consumer structure and ecosystem functioning.

Cross-site comparisons between Coweeta and La Selva made important scientific contributions of our understanding of tropical-temperate differences in how leaf litter secondary compounds determine breakdown in streams.

Published results contributed to a better general understanding of the base of knowledge, theory, research and pedagogical methods in the field of fluvial geomorphology.

Our research has contributed methodological techniques and new empirical findings in the area of land economics.

Our research contributes to the economics and real estate fields in illustrating the effects of environmental protection on land prices. In particular, the private vs. social cost argument of these types of protective measures. This contributes evidence in the debate regarding the effects of building codes on safety and property risk.

We have contributed to improved understanding of the controls of plant water use on a watershed to regional scale (relying on heat pulse and dissipation probe measurements). This is a missing piece in hydrology, as much effort has been dedicated by plant physiologists to understanding water relations and use at the cellular through leaf to branch and lately, plant scales, while hydrologic science has focused on physical aspects of spatial hydrology.

Our research addresses the need identified by various bodies including the NRC, to provide a framework for species invasion that relies on fundamental ecological understanding.

We have contributed results furthering the basic understanding of forest and biodiversity response to climate change.

**Contributions to Other Disciplines:**


Work in values and valuation integrates economics and social science.

Work in ecohydrology is contributing to the development of advanced cyberinformatics integrating disparate data sources and data models within formal workflows.

Work in tree demography by JS Clark is highly interdisciplinary and engages collaborators in Computer Science and Statistics.

Work in aquatic ecology has contributed new tools for visualization of land cover data as related to watershed structure, enabling the quantitative characterization of exurban development in a way that allows linking hill slope development to changes in the geomorphic process and stream chemistry.

Work at intensive sites has improved understanding of aquatic ecosystems in terms of interactions between the geomorphic and biotic systems, along with the basis for biogeochemical modeling.

Work in climatology is filling in knowledge gaps on the relationships between urbanization and climate in complex terrain, specifically Appalachia. It is specifically extending hypotheses and findings into a new geographic regime to demonstrate that orography is a first order forcing function on warm season rainfall, yet emerging urbanization/exurbanization may be significant as well.

Contributions to Other Disciplines 11/10 to 07/11
Our research contributes to the land economics and real estate fields in illustrating the effects of environmental protection on land prices. The 2011 paper published in Land Economics is the first study to examine price effects of conservation land in real time using an event study methodology. It is also the first to distinguish between conservations in deed and in easement.

Collaboration between geomorphologists, natural resource economists and human geographers have led to developing research strategies for understanding how and why rural residents make decisions about stream and riparian zone management.

The development of a 2006 land cover and land use map of the Southern Appalachians and the 2007 LULC high-resolution map of the nine Intensive watersheds will have broad applicability to a variety of fields and will be essential to regionalizing (scaling-up) local studies through modeling.

The development of the LTWA Biomonitoring Database provides researchers with a usable and standard format for accessing 20 years of data on fish species diversity and overall stream health for 368 sites across the Upper Little Tennessee River basin. By making this database with the North Carolina Natural Heritage Program, Coweeta and the LTWA were able to help the NC NHP expand the geographic scope of the Little Tennessee Natural Heritage area.

Our work on the roles of salamanders in stream nutrient dynamics contributes to a depauperate literature on the function of biota, particularly vertebrates, in ecosystems. We used a stoichiometric approach that provides comparative results to similar studies of fish and macroinvertebrates in tropical freshwater streams. Our results will inform recent theoretical predictions about the roles of biota, particularly long-lived predators, on nutrient fluxes in streams. Our research can be specifically used to test recent hypotheses about consumer effects on the velocity with which materials flow downstream.

Research has documented the importance of soil management to the hydrology of rural and urban stream systems by demonstrating 1) that soils underlying lawns and pastures frequently produce Hortonian overland flow and contribute significantly to peak flow increases when forest lands are converted, and 2) that the loss of soil storage and infiltration in converted forest soils exceeds the effect of reduced transpiration from such conversion with the net result of reduced baseflows.

We are advancing the use of climate envelop modeling to predict future climatic distributions of species to overcome the current criticism that these approaches fail to account for other processes such as biological interactions, and over weight the role of climate in organismal distributions. We have examined both distributions that assume strict and relaxed climatic control on species ranges. And, bracket the predictions around a suite of climate change models and expected CO2 levels. This allows collectively examining a range of pessimistic and optimistic scenarios for changes in species distributions within a region.

We have extended patch level optimality theory to full, three dimensional landscapes which represents a significant advance in the study of coupled geomorphic / climate / ecosystem processes as well as tight coupling of water, carbon and nutrient cycling. By working in a data-rich environment (Coweeta LTER), we are able to develop complex, linked models of long term canopy development within catchments, and test the models with detailed spatial and temporal data. The use of ecosystem information in addition to more standard hydrology information in the development of ecohydrologic models provides much better constraints and identifiability of complex model structure.

Our research activities have contributed to some improved understanding of aquatic ecosystems in terms of interactions between the geomorphic and biotic systems.

**Contributions to Human Resource Development:**

Contributions to human development 11/01/2011 - 7/31/2012

Advanced training in field measurement, modeling and spatial analysis have provided graduate students, undergraduate students and technicians classes in hydrology and watershed GIS.

Three undergraduate employees went on to graduate school (2) and full-time employment with National Park Service (1) based on their experience with GIS gained while employed in the CWT IM Office.

Four summer interns with Coweeta LTER had authentic research experiences in the field and interaction with project PIs.
Coweeta LTER field technicians attended a one week “Data Acquisition from Remote Locations” training workshop at UNM Sevilleta Field Station in June 2012.

All Coweeta LTER technicians attended National Safety Council CPR/First Aid Training Certification on January 12th.

Coweeta LTER technicians Joe Davis, Joel Scott, Daniel Sollenberger, and Katie Bower contributed to teaching ecology/science to middle school students in the Coweeta Schooyard Program.

Coweeta LTER technicians Katie Bower and Joe Davis attended a Hach training seminar in Atlanta on 23 August 2011 to efficiently calibrate Hach Hydrolab data sondes.

Contributions to Human Resource Development 11/10 to 07/11
Two undergraduate employees in the CWT IM office graduated and went on in one case to graduate school and in the other to employment in a full-time, GIS-based conservation position.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
11/09 to 07/10

Our work has contributed directly to the training of graduate students, specifically the production of Ph.D. level researchers, and creating research experiences for undergraduates.

In addition:

a. We provided authentic research experiences for 2 summer research interns
b. Research Technician (Jason Meador) was able to attend LTER All-Scientist meeting in Estes Park in September
c. All UGA Coweeta LTER Technicians attended the Coweeta 75th Anniversary Symposium held in November
d. Research Technician Jason Meador and Katie Bower had the opportunity to teach ecology/science to middle school students
e. Working with Jennifer Love and intern Sallie Senseney we develop six ?Science Study Boxes? to provide local school teachers the materials they need to engage students in science
f. All UGA Coweeta LTER technicians and summer students attended the Coweeta LTER Summer Science Symposium held on June 29
g. All UGA LTER technicians attended the USFS All Cultures Day in Cherokee, NC to learn more about Native Americans and Cherokee culture
h. Coweeta USFS employee Neal Muldoon had the opportunity to help teach students as part of the Coweeta LTER Schoolyard program

Three out of the five undergraduate employees in the CWT IM office graduated, and all three went on to full-time, well paying jobs in computer programming, GIS-based forest management, or conservation education. This is clear evidence that the CWT IM Office serves as a stepping-stone for students interested in technical, conservation, and research oriented fields.

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11/08 to 10/09

Material from the Coweeta LTER research rapidly finds its ways into undergraduate and graduate courses taught by project researchers at University of Minnesota, University of North Carolina, University of Wisconsin, University of Illinois, University of Georgia, Duke University, and Mars Hill College. Students coming through these classes are trained in new developments in digital spatial analysis, numerical
models, watershed theory, ecosystem theory, occupancy modeling, use of GIS approaches in econometrics, etc. A number of students have successfully moved into graduate programs or professional careers making significant use of these skills.

Coweeta LTER research and outreach has served as a springboard to additional research in ecology, biology, social science as well as greater exposure among local residents in western North Carolina increasing their familiarity with the research program.

Coweeta LTER investigators worked with, supported, and involved in project research activities a total of 30 graduate students, 34 undergraduate students and 2 highschool students this year. They participated in many aspects including sampling in the field, data compilation and analysis, and presentation in professional meetings. These activities contributed materially to their professional development.

Full-time research technicians in addition to providing investigator support, were provided with opportunities to help analyze long-term salamander data and to be co-author of manuscript; and, teach ecology/science to middle school students involved with the Coweeta Schoolyard Program.

Contributions to Resources for Research and Education:

Contributions to research and education ? 11/01/2011 ? 7/31/2012
We are developing formalized workflows to access and process spatial data on land cover, terrain, soils, ecosystems to compute fundamental behavior of water, carbon and nutrient cycling from research at Coweeta.

Public outreach and service through state commissions, and reviews of major federal environmental restoration programs have benefitted from experience and methodologies developed with partial funding through the Coweeta LTER.

Contributions to Resources for Research and Education 11/10 to 07/11
We are building a large database of avian community field records to support modeling avian occupancy in response to land use, elevation, and development status across Macon County.

The development of a 2006 land cover map and modification of 1986, 1991, 1996, 2001 land cover maps of the Southern Appalachians and the 2007 LULC high-resolution map of the nine Intensive watersheds will have broad applicability to a variety of fields and will be essential to regionalizing (scaling-up) local studies through modeling.

One CWT investigator is the sole designer and teacher of ecology courses at a small liberal arts university within the project area. His involvement in LTER research keeps him up-to-date in this field and enhances his ability to deliver a quality educational experience to undergraduates in the field.

LTER research generated research and internship opportunities for undergraduate students and enhanced the skills learned by students in college at all participating institutions.

In using a technology transfer model for upgrading the CWT IM Infrastructure, we provided a model for cross-site technology transfer and development in the context of science based technology centers. We showed that, for a collaboration be successful, technologies in question should be suitable for the purposes to which they were being put and that the principals should strive to achieve mutual benefit whenever possible.

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11/09 to 07/10

CWT IM?s commitment to upgrading and securing networks, computer hardware, and web sites will provide Coweeta LTER scientists and their partners with a firm information infrastructure on which to build their research. Such efforts are an essential periodic activity at any long-term research site. The associated teleconferencing center provides CWT researchers with the means to collaborate more intensively and over greater distances with lower overall transaction costs.

Electromagnetic induction (EMI) techniques were used non-destructively to determine soil conductivity/soil moisture and near-infrared spectrometry to quantify %N and %C over large spatial scales (6400 m2). These techniques are contributing to soil biogeochemical knowledge and mapping.

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11/08 to 10/09
Our work in LTER network is providing useful examples and demonstrations of the necessity of working in interdisciplinary, place-based projects to facilitate interdisciplinary science. A Coweeta researcher (L. Band) is incoming Board Chair for the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI), and he is drawing on Coweeta projects and experience to help plan the consortium’s activities promoting interdisciplinary hydrologic science.

Coweeta LTER has put significant effort into providing greater access to CyberInfrastructure, relational database design principles and tools, and GIS analytical frameworks to partner organizations, including the Rabun Gap Nacoochee School, the Highlands Biological Station, and the Little Tennessee Watershed Association.

Development of a 2006 land cover and land use map for the Southern Appalachians along with the compilation of satellite imagery, digital orthophotographs, and ancillary geospatial data will be available through the CWT digital archive. This represents the most current classification publicly available for the region. (NLCD is dated 2001.)

**Contributions Beyond Science and Engineering:**

**Contributions Beyond Science and Engineering 11/11 to 07/12**
Coweeta LTER Site Manager J Love serves as Chair of the Western North Carolina Public Lands Council, which advises the governor’s office (North Carolina) on matters pertaining to sustainable development and conservation of western North Carolina’s natural resources.

Coweeta LTER Site Manager J Love serves on the Mountain Resources Commission, a state appointed advisory body created to take care of our natural resources to enhance and sustain quality of life and ensure the long-term health of our region and our people.

PI Shepherd is a member of the NOAA Science Advisory Board and President-Elect of the American Meteorological Society, which allows him to expand the scope and influence of Coweeta LTER science, products, and influence in a positive manner.

**Contributions Beyond Science and Engineering 11/10 to 07/11**
CWT Investigators participated in steering committee to educate the public about invasive species and in managing and restoring native plant communities along the Little Tennessee River Greenway

CWT Investigator was appointed to the Western NC Public Lands Council to advise the governor’s office on matters pertaining to sustainable development and conservation of western North Carolina’s natural resources.

The CLP is working toward both understanding the distribution of knowledge as well as democratizing produced forms of knowledge.

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**11/09 to 07/10**

The Coweeta Site Manager (J. Love) is a member of the steering committee to educate the public about invasive species and in managing and restoring native plant communities along the Little Tennessee River Greenway. He is also an appointee to the NC Parks, Parkway, and Forests Development Council to advise the governor’s office on matters pertaining to sustainable development and conservation of western North Carolina’s natural resources.

The public’s understanding of science and technology has been enhanced by Coweeta LTER research results being conveyed to nonprofit organizations including the Little Tennessee Watershed organization and the Little Tennessee Land Trust.

Coweeta LTER Econometric research is contributing to the development and refinement of appropriate methodologies to analyze the impacts of public policy on real estate markets.

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**11/08 to 10/09**

The Coweeta Site Manager (J. Love) is a member of the steering committee to educate the public about invasive species and in managing and restoring native plant communities along the Little Tennessee River Greenway. In addition, he was recently appointed to the NC Parks, Parkway, and Forests Development Council to advise the governor’s office on matters pertaining to sustainable development and conservation of western North Carolina’s natural resources.

The public’s understanding of science and technology has been enhanced by Coweeta LTER research results being conveyed to nonprofit...
watershed conservation organizations, such as the Little Tennessee Watershed organization.

Key project results help inform the public of the costs of land use restrictions designed to protect water supplies and guides policy on protection of these water sources. In addition, they reveal the policy consequences related to the unintended consequences of regulations designed to protect buildings in high hazard areas. These raise important questions about the best scale of governance with regard to mitigation.

**Conference Proceedings**

**Special Requirements**

**Special reporting requirements:** None  
**Change in Objectives or Scope:** None  
**Animal, Human Subjects, Biohazards:** None

**Categories for which nothing is reported:**

Any Product  
Any Conference
We conducted a 3-year, full-factorial, mixed-litter decomposition study of four dominant tree species in a temperate forest and measured nitrogen and phosphorus dynamics to explore whether nutrient dynamics in mixtures were additive or non-additive. Our data illustrate that the identity of species in mixtures is key to their role in non-additive interactions, with repercussions for mineral nutrient availability and storage. These results suggest that predictions of ecosystem-level nutrient dynamics using litter monoculture data likely do not accurately represent actual dynamics because the effects of litter species interactions are not incorporated.
Plant populations migrating in response to climate change will have to colonize established communities. To determine the capacity of migrating species to colonize established communities we conducted extensive long-term transplant experiments where potential tree migrant species, i.e. species within 'migration range,' were planted side by side with resident ones. Results suggest that potential immigrant species had similar growth rates in the new environment than those from resident species ensuring their ability to establish in the area. However, contrary to our expectations, the soil moisture requirements for the immigrant group were similar to those of the resident species. These results could have major implications for vegetation changes under the predicted drier climate for the region. If it is the case that neither resident species nor potential migrants are able to maintain stable populations, the region may experience a decline in local biodiversity.

The recent infestation of southern Appalachian eastern hemlock stands by hemlock woolly adelgid (HWA) is expected to have dramatic and lasting effects on forest structure and function. We studied the short-term changes to the carbon cycle in a mixed stand of hemlock and hardwoods, where hemlock was declining due to either girdling or HWA infestation. The reduction in Esoil and the concurrent declines in BAI and standing very fine root biomass suggest rapid declines in hemlock productivity from HWA infestation. The accelerated inputs of detritus resulting from hemlock mortality are likely to influence carbon and nutrient fluxes, and dictate future patterns of species regeneration in these forest ecosystems.

Figure 1. Hypothesized changes in the carbon cycle during the study period in girdled (GDL) plots (A-B), and in hemlock plots infected with hemlock woolly adelgid (HWA) (A-C). DAI denotes basal area increment. Lines of boxes and arrows among panels indicate magnitude of hypothesized changes.

Figure 5. Observed mean soil CO₂ efflux ($E_{soil}$) from soil O horizon from the girdled (GDL) and HWA treatments (A), predicted responses ($E_{pred}$) in (B), and the deviation from predicted value (C). Bars denote standard error. Different letters in (A) and (C) denote significant differences among years. Girdling occurred in July 2004. HWA infestation was observed in December 2004.

Research on natural enemies demonstrates the potential for exotic plants to be integrated into foodwebs through the activities of native herbivores. We sampled invertebrates in a tree-canopy gap and under canopy area, and used the unique carbon isotope value of *M. vimineum* to estimate the quantitative importance of the invader as a food resource relative to native. Seven of the eight invertebrate species derived on average 35% of their biomass carbon from *M. vimineum*, and some individuals representing both ‘chewing’ and ‘sucking’ feeding guilds derived their biomass carbon exclusively from *M. vimineum*.

![Image](image_url)

**Fig. 1** A long-horned grasshopper (*Orchelimum* sp.) on the foliage of *M. vimineum*. Note the evidence of invertebrate leaf-chewing on the leaf-blade immediately to the right of the orthopteran.

Forests growing on former agricultural land often have reduced frequencies of many native forest herbs compared with forests that were never cleared for agriculture. We examined the response of six forest herb taxa (*Arisaema triphyllum*, *Cimicifuga racemosa*, *Disporum lanuginosum*, *Osmorhiza* spp., *Polygonatum* spp., and *Prenanthes altissima*) to nitrogen (N) fertilization in forests with and without an agricultural history to investigate how N availability affects plant performance. Results suggest that some plants growing in post-agricultural stands may be N limited, whereas undisturbed stands in this region appear to be approaching N saturation. Thus, environmental conditions, and particularly N availability, may be an obstacle to the restoration of forest herb communities.

![Graphs showing response of understory herbaceous plants to nitrogen fertilization](image)

Fig 2. Mean relative change (± SE) in leaf area of the four taxa investigated in this study that responded to N fertilization. Different lowercase letters above bars indicate significant differences between treatment groups within each site based on Turkey's test.
Urbanization compromises the biotic integrity and health of streams, and indicators of integrity loss are needed to improve assessment programs and identify mechanisms of urban effects. We investigated linkages between landscapes and assemblages in 31 wadeable Piedmont streams in the Etowah River basin in northern Georgia (USA). Macroinvertebrate descriptors were better predicted by land cover whereas fish descriptors were better predicted by geomorphology. Full models explained 63–81% of the variation among descriptors, indicating strong relationships between landscape properties and biotic assemblages across our sites. Reduced and simple models were weaker, explaining 48–79% and 42–79%, respectively, of the variance among descriptors. Considering the difference in predictive power among these model sets, we recommend a tiered approach to variable selection and model development depending upon management goals. GIS variables are simple and inexpensive to collect, and a GIS-based modeling approach would be appropriate for goals such as site screening (e.g., identification of reference streams). As management goals become more complex (e.g., long-term monitoring programs), additional, easily collected field variables (e.g., embeddedness) should be included. Finally, labor-intensive variables (e.g., nutrients and fines in sediments) could be added to meet complex management goals such as restoration of impaired streams or mechanistic studies of land use effects on stream ecosystems.

<table>
<thead>
<tr>
<th>Tier</th>
<th>Datasets required</th>
<th>Management goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Land cover, Morphometry, Species distributions*</td>
<td>Identify areas where biotic integrity is severely compromised, Identify intact or minimally impaired systems (i.e., “reference” sites), Identify at-risk populations of sensitive, protected or endemic species, Guide development plans for local or regional planning commissions</td>
</tr>
<tr>
<td>2</td>
<td>Land cover, Morphometry, Easily collected geomorphology and water quality variables (e.g., bed texture and turbidity), Biotic community data</td>
<td>Monitoring, Identification of incipient levels of decline for specific regions or watersheds, Assessment of temporal changes in stream habitat, water quality, or biotic assemblages</td>
</tr>
<tr>
<td>3</td>
<td>Land cover, Morphometry, Full geographic survey, Full water quality survey including field measures and laboratory analyses, Hydrology*</td>
<td>Regional assessment or condition studies, Restoration of impaired streams, Evaluation of best management practice (BMP) implementation programs, Mechanistic or experimental studies of land use effects on stream ecosystems, Development of habitat conservation plans</td>
</tr>
</tbody>
</table>

* Spatial data not used in this study, but often readily available through state agencies.

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Table 4: Application of a tiered approach for assessing stream responses to land use change based on management goals. As management goals become more complex or specific (Tiers 1–3), variables that are more intensive, laborious, and relatively expensive to collect may be required for modeling efforts.
We developed a stoichiometrically explicit computer model to examine how heterotrophic uptake of nutrients and microbial mineralization occurring during the decay of leaves in streams may be important in modifying nutrient concentrations. The simulations showed that microbial uptake can substantially decrease stream nutrient concentrations during the initial phases of decomposition, while mineralization may produce increases in concentrations during later stages of decomposition. The simulations also showed that initial nutrient content of the leaves can affect the stream nutrient concentration dynamics and determine whether nitrogen or phosphorus is the limiting nutrient. Finally, the simulations suggest a net retention (uptake > mineralization) of nutrients in headwater streams, which is balanced by export of particulate organic nutrients to downstream reaches. Published studies support the conclusion that uptake can substantially change stream nutrient concentrations. On the other hand, there is little published evidence that mineralization also affects nutrient concentrations. Also, there is little information on direct microbial utilization of nutrients contained in the decaying leaves themselves.

Figure 1. Model of nutrient and carbon dynamics in a stream dominated by allochthonous organic sources. Water and seston compartments are in transport in the water column. Detritus, made up of decaying leaves (BOM) and associated microbes, is stationary on the stream bottom. Solid and dashed arrows represent flows of inorganic phosphorus and nitrogen. Other arrows represent flows of organic materials including organic carbon, nitrogen, and phosphorus. Within these arrows and within the compartments, gray shading represents carbon, black is phosphorus, and dotted areas are nitrogen, though these fractions are not represented in realistic stoichiometric ratios.

We describe a striking new species of the lungless salamander family Plethodontidae from the Appalachian foothills of northern Georgia, USA. This miniature species, c. 25–26mm (adult standard length), is so distinctive genetically and morphologically that we erect a new genus, the first new genus of amphibian described from the US in nearly 50 years. A plethodontid phylogeny derived from mitochondrial and nuclear DNA sequences places it in the tribe Spelerpini as the sister taxon to Eurycea. Genetic divergence between the new species and Eurycea for the nuclear gene Rag-1 (4.7%) is among the higher levels observed between long-established spelerpine genera (2.6–5.3%). This new form appears to be rare and is of immediate conservation concern.

Shallow landslides are a significant hazard in steep, soil-mantled landscapes. During intense rainfall events, the distribution of shallow landslides is controlled by variations in landscape gradient, the frictional and cohesive properties of soil and roots, and the subsurface hydrologic response. We investigated whether geomorphically controlled variations in ecology affect the spatial distribution of root cohesion by measuring the distribution and tensile strength of roots from soil pits dug downslope of 15 native trees in the southern Appalachian Mountains, North Carolina, United States. Root tensile strengths from different hardwood tree species were similar and consistently higher than the only native shrub species measured (Rhododendron maximum). Roots were stronger in trees found on noses (areas of divergent topography) relative to those in hollows (unchanneled, convergent topography) coincident with the variability in cellulose content. Quantification of this feedback between physiologic controls on root growth and slope hydrology has allowed us to create a curvature-based model of root cohesion that is a significant improvement on current models that assume a spatially averaged value.

The adjustment of local vegetation conditions to limiting soil water by either maximizing productivity or minimizing water stress has been an area of central interest in ecohydrology since Eagleson’s classic study. This work has typically been limited to consider one-dimensional exchange and cycling within patches. We extend this theory to the hillslope and catchment scale, with in situ and downslope feedbacks between water, carbon and nutrient cycling within a fully transient, distributed model. Lateral hydrologic connectivity of a small catchment is calibrated with streamflow data and further tested with measured soil moisture patterns. Then, the spatial gradient of vegetation density within a small catchment estimated with fine-resolution satellite imagery and field measurements is evaluated with simulated vegetation growth patterns from different root depth and allocation strategies as a function of hillslope position. Optimal carbon uptake ranges show effective compromises between multiple resources (water, light, and nutrients), modulated by vegetation allocation dynamics along hillslope gradient.

![Figure 12. Three-dimensional plots for long-term annual net primary productivity (NPP) and aboveground NPP (ANPP) under (a) constant and (b) alternative allocation strategies with varying \( RD_{av} \) and \( RD_{avg} \) parameters. Contours at the x-y plane represent ANPP values. Note that allocation ratios of ANPP to NPP are constant under constant allocation strategy, while they decrease in proportion to rooting depth under alternative allocation strategy. Long-term patterns of vegetation density (LAI) follow ANPP as a constant portion of cumulative ANPP is allocated into foliar biomass.](image)

There is little understanding about the role eastern US forested headwater riparian areas play in protecting aquatic habitats and water quality from impacts of side slope forest harvest. To better understand this important riparian area function, we selected three sites from management units with a 2-age regeneration silvicultural prescription located on the Nantahala National Forest, North Carolina, USA. Each site was harvested and a riparian buffer was left uncut along the stream. Transects were established perpendicular to a 200 m stream reach, from streamside to 50 m upslope for intensive study. Forest cutting increased extractable NO$_3$ at both 0–10 cm and 10–30 cm soil depths compared to pre-treatment concentrations. Soil solution NO$_3$ concentrations increased only in harvested areas, on all sites; increases were greater in sites with narrow riparian buffers. Stream water NO$_3$ concentration increased significantly following site harvest only on the 0 m buffer site. Dissolved organic C and N did not respond to harvesting in either soil solution or stream samples. Our results suggest that riparian buffers are effective in removing NO$_3$ from soil solution prior to its entering the stream.

![Graph showing stream water NO$_3$ concentrations response to forest harvest for each of the three riparian zone buffer widths](image)

*Fig. 3. Stream NO$_3$−N concentrations response to forest harvest for each of the three riparian zone buffer widths. Stream samples are collected weekly below the harvested area and reference. Values shown are treated minus reference for weekly concentrations, collections begin in January 2005. An arrow indicates beginning of post-harvest sample collection for each site.*

The ubiquitous transition of plant communities across slope aspects is a well described, but rarely tested, ecological dynamic. To investigate the mechanisms and demographic stages driving the observed distribution patterns of two woodland herbs in the southeastern USA, seeds and adults were transplanted across north- and south-facing slopes, and moisture and light were experimentally manipulated. Stage- and species-specific abiotic responses resulted in similar landscape-level patterning for Hexastylis arifolia and Hepatica nobilis, but the underlying abiotic drivers were unique. Adult rather than seed survival best explained the natural distributions across slope aspects, and Hexastylis arifolia was limited by higher temperature, whereas Hepatica nobilis was limited by lower soil moisture. The stage- and species-specific responses indicated that the use of slope aspect to explain plant distributions not only obfuscates explanatory mechanisms, but probably undermines the portability of results.

A full understanding of hydrologic response to human impact requires assessment of land-use impacts on key soil physical properties such as saturated hydraulic conductivity, bulk density, and moisture retention. Such properties have been shown to affect watershed hydrology by influencing pathways and transmission rates of precipitation to stream networks. Our objective was to characterize soil physical properties under three land-use classes (forest, pasture, and managed lawn) in the southern Blue Ridge Mountains of southwestern North Carolina. Saprolitic and alluvial soils were emphasized, and sites were selected that showed consistent land-use history over a period of at least 30 years. Forest soils demonstrated markedly lower bulk densities and higher infiltration rates, and water holding capacities, than lawn and pasture soils. The magnitudes of differences between forest and nonforest infiltration rates suggest that widespread conversion of forest to other land uses in this region will be accompanied by decreased infiltration and increased overland flow, potentially significantly altering water budgets and leading to reduced baseflows and impaired water quality.

![Graph showing comparison of soil saturated hydraulic conductivities with precipitation intensities occurring in western North Carolina. The solid lines represent the recurrence intervals (RI) of storm events of given precipitation intensity and duration in Franklin, NC (re-created from Bonnin et al., 2004). The dashed lines represent the mean saturated hydraulic conductivity (Ksat) of soils underlying each land use (n = 30 sites per land use, mean = geometric). As Ksat represents the lower bound of the soil infiltration rate, the figure demonstrates the far greater likelihood of Hortonian overland flow in lawn and pasture soils, especially associated with sustained storm events, during which overland flow is of greatest concern to watershed hydrologic processes.](image-url)
Table 1. Coweeta LTER staff directly engaged with students on 14 different occasions.

<table>
<thead>
<tr>
<th>Month</th>
<th>Activity</th>
<th># Stu</th>
<th>Grade</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>Stream ecology</td>
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<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
<td>MMS</td>
</tr>
<tr>
<td>September</td>
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<td>7</td>
<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
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<tr>
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<td>Franklin High</td>
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<tr>
<td>October</td>
<td>Invasive Exotics</td>
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<td>12</td>
<td>11&lt;sup&gt;th&lt;/sup&gt; &amp; 12&lt;sup&gt;th&lt;/sup&gt;</td>
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<tr>
<td>November</td>
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<td>7&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>July</td>
<td>Bird Banding</td>
<td>31</td>
<td>4&lt;sup&gt;th&lt;/sup&gt; - 7&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Summer Adventures Camp</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>581</strong></td>
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</tbody>
</table>
Table 2. Science study boxes were checked-out a total of 20 times during the school year and were used by approximately 1080 students. Boxes were typically checked out for three weeks each time.

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
<th># Stu</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream Box</td>
<td>8th</td>
<td>80</td>
<td>MMS</td>
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<tr>
<td>Stream Box</td>
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<td>15</td>
<td>Macon Early College</td>
</tr>
<tr>
<td>Soil Box</td>
<td>11th-12th</td>
<td>19</td>
<td>RGNS</td>
</tr>
<tr>
<td>Biodiversity Box</td>
<td>6th</td>
<td>20</td>
<td>MMS</td>
</tr>
<tr>
<td>Heat Energy Box</td>
<td>6th</td>
<td>79</td>
<td>MMS</td>
</tr>
<tr>
<td>Light and Sound Box</td>
<td>6th</td>
<td>79</td>
<td>MMS</td>
</tr>
<tr>
<td>Heat Energy Box</td>
<td>6th</td>
<td>78</td>
<td>MMS</td>
</tr>
<tr>
<td>Light and Sound Box</td>
<td>6th</td>
<td>78</td>
<td>MMS</td>
</tr>
<tr>
<td>Geology Box</td>
<td>6th</td>
<td>79</td>
<td>MMS</td>
</tr>
<tr>
<td>Stream Box</td>
<td>9th</td>
<td>18</td>
<td>Macon Early College</td>
</tr>
<tr>
<td>Soil Box</td>
<td>6th</td>
<td>79</td>
<td>MMS</td>
</tr>
<tr>
<td>Stream Box</td>
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<td>80</td>
<td>MMS</td>
</tr>
<tr>
<td>Stream Box</td>
<td>Various</td>
<td>12</td>
<td>Home school</td>
</tr>
<tr>
<td>Heat Energy Box</td>
<td>6th</td>
<td>79</td>
<td>MMS</td>
</tr>
<tr>
<td>Geology Box</td>
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<td>79</td>
<td>MMS</td>
</tr>
<tr>
<td>Biodiversity Box</td>
<td>6th</td>
<td>20</td>
<td>MMS</td>
</tr>
<tr>
<td>Soil Box</td>
<td>6th</td>
<td>79</td>
<td>MMS</td>
</tr>
<tr>
<td>Stream Box</td>
<td>6th</td>
<td>15</td>
<td>MMS</td>
</tr>
<tr>
<td>Light and Sound Box</td>
<td>6th</td>
<td>79</td>
<td>MMS</td>
</tr>
<tr>
<td>Stream Box</td>
<td>7th-8th</td>
<td>15</td>
<td>MMS</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>1082</td>
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</table>
In October, sixth grade students in Macon Middle School’s Science Club participate in Monarch Watch, a citizen science program where participants catch and tag Monarch butterflies. This project was successful in getting students actively engaged in catching butterflies, learning about butterfly biology, and collecting real and relevant data on Monarch migration.
Jason preps Rabun Middle School students about stream ecology before the students venture into the creek to search for salamanders.
Cowee LTER is partnering with the Little Tennessee Watershed Association and Land Trust for the Little Tennessee to develop an outdoor classroom and stream restoration project for Porters Creek, a small tributary of the Cullasaja River that lies between Macon Middle School and Mountain View Intermediate School. The stream is in a perfect location for outdoor studies, but is deeply incised in some places and contains several sections where the streambank is collapsing.
Coweeta LTER is partnering with Southern Appalachian Raptor Research and the Land Trust for the Little Tennessee to set up a Monitoring Avian Productivity and Survivorship (MAPS) bird banding station at nearby Tessentee Bottomland Preserve. The program has proved successful in teaching students about bird ecology. In the above picture, students gaze excitedly at the release of a female Northern Cardinal (below).
Table 1. Coweeta LTER staff and/or scientists directly engaged with students on 12 different occasions from August 2010 – May 2011.

<table>
<thead>
<tr>
<th>Month</th>
<th>Activity</th>
<th># Students</th>
<th>Grade Level</th>
<th>School</th>
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<tbody>
<tr>
<td>September</td>
<td>Monarch tagging</td>
<td>30</td>
<td>6th</td>
<td>MVI</td>
</tr>
<tr>
<td>October</td>
<td>Migration Celebration</td>
<td>310</td>
<td>6th</td>
<td>MVI</td>
</tr>
<tr>
<td>November</td>
<td>Coweeta Tour</td>
<td>15</td>
<td>11th</td>
<td>Franklin High – AP Chemistry</td>
</tr>
<tr>
<td>January</td>
<td>Coweeta Tour</td>
<td>15</td>
<td>10th, 11th, 12th</td>
<td>RGNS</td>
</tr>
<tr>
<td>January</td>
<td>Coweeta Tour</td>
<td>14</td>
<td>10th, 11th, 12th</td>
<td>RGNS</td>
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<tr>
<td>February</td>
<td>Wood Frog Study</td>
<td>15</td>
<td>11th</td>
<td>RGNS</td>
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<td>March</td>
<td>Coweeta Field Trip</td>
<td>23</td>
<td>8th</td>
<td>Hayesville Middle School – Honors Science Class</td>
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<tr>
<td>March</td>
<td>Black Bear Presentation</td>
<td>18</td>
<td>7th</td>
<td>Rabun Middle School</td>
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<tr>
<td>March</td>
<td>Science Fair</td>
<td>60</td>
<td>11th</td>
<td>RGNS</td>
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<tr>
<td>April</td>
<td>Career Day</td>
<td>550</td>
<td>7th &amp; 8th</td>
<td>MMS</td>
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<tr>
<td>May</td>
<td>Stream Salamanders</td>
<td>15</td>
<td>7th &amp; 8th</td>
<td>Rabun Middle School</td>
</tr>
<tr>
<td>May</td>
<td>Stream Salamanders</td>
<td>20</td>
<td>5th &amp; 6th</td>
<td>MVI</td>
</tr>
<tr>
<td>TOTAL</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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Table 2. Science study boxes were checked-out a total of 14 times during the school year and were used by approximately 1676 students. Boxes were typically checked out for three weeks each time.

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
<th>Number of Students</th>
<th>School</th>
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</thead>
<tbody>
<tr>
<td>Biodiversity</td>
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<td>25</td>
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<tr>
<td>Stream Box</td>
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<td>25</td>
<td>MVI</td>
</tr>
<tr>
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<tr>
<td>TOTAL</td>
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