Project Participants

Senior Personnel

Name: Gragson, Theodore
Worked for more than 160 Hours: Yes
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.

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:
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:
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:
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:
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:
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:
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:
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, Cheley

Worked for more than 160 Hours: Yes

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.

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:
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:
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:**  
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:**  
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:**  
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:** Leigh, David  
**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:** Maerz, John  
**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: Mohan, Jackie
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: Pearson, Scott
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: Pringle, Catherine
Worked for more than 160 Hours: Yes
Contribution to Project:
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: Turner, Monica
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: Valett, Maurice
Worked for more than 160 Hours: No
Contribution to Project:
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:
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:
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:  
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:  
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: No  
Contribution to Project:  
11/09-07/10. Designing regional social survey. Partial support for activities from Coweeta LTER.

Post-doc  
Name: Warren, Robert  
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. 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.

Graduate Student  
Name: Duncan, Jon  
Worked for more than 160 Hours: No  
Contribution to Project:
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, Tahee  
**Worked for more than 160 Hours:** Yes  
**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.

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

**Name:** Keiser, Ashley  
**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:** 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:**
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, Corrine

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

**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: Evans, Sakura

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

**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.

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:** No

**Contribution to Project:**
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: 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: No

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: 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:
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.
macroinvertebrates. Partial support for activities from Coweeta LTER.

Name: Cecala, Kristen

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: McLean, Katlin

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: Frisch, John

Worked for more than 160 Hours: Yes

Contribution to Project:
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:
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:
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: No  
Contribution to Project:  
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: 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:  
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:  
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: No  
Contribution to Project:  
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:  
11/09-07/10. Biotic sampling of fish species across Little Tennessee watershed. Partial support for activities from Coweeta LTER.

Name: Trushel, Brittany  
Worked for more than 160 Hours: No
**Contribution to Project:**
11/09-07/10. Biotic sampling of fish species across 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:**
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:** No

**Contribution to Project:**
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:**
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:**
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:** 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: Barlow, Paige
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.

Name: Baas, Peter

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: Stewart, Rebecca

Worked for more than 160 Hours: Yes
Contribution to Project:
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.

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:
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:
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: Davis, Joseph

Worked for more than 160 Hours: Yes

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.

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: Luttrel, Rachel

Worked for more than 160 Hours: No

Contribution to Project:
11/09-07/10. Performed a field experiment to test a hypothesis about a 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 a 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: Long, Lynsey

Worked for more than 160 Hours: Yes

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: 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:
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.

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:** No

**Contribution to Project:**

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: Beasley, Camille

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

**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.

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:**  
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:**  
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.

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

Technician, Programmer

Name: Jenks, Andrew  
Worked for more than 160 Hours: No  

Contribution to Project:
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.
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:**
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: McCollum, Robert  
**Worked for more than 160 Hours:** Yes  
**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.

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:**
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:**
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

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.

Name: McMillan, Joseph

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

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

Contribution to Project:
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

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: Robertson, Shelley

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:**  
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:**  
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:**  
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:**  
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: 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.

**Name:** Powell, Amanda  
**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:** Stein, Anne  
**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:** Roper, Becky  
**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:** 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:**  
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:  
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:  
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:  
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:  
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.

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

**Organizational Partners**

**Yale University**
Coweeta LTER researcher Mark Bradford is based at Yale School of Forestry & Environmental Studies. Students working with him, including B. Watts, Z. Tang, A. Keiser, and M. Strickland, received support from Yale that includes doctoral stipends, tuition and student grants.

**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.

**Other Collaborators or Contacts**

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
Annual Report: 0823293

Summary of selected collaborations:

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
32. Swannanoa Valley Public Library
33. The Little Tennessee River Watershed Association
34. The National Center for Airborne Laser Mapping
35. Town of Beech Mountain
36. University of Alabama
37. University of Alcala de Henares
38. University of Illinois
39. University of North Carolina - Asheville
40. University of Pau
41. University of Toulouse
42. University of Wisconsin
43. US Environmental Protection Agency
Activities and Findings

Research and Education Activities:
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 take 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 (LULC) database for the nine Intensive watersheds being used by the larger CWT group. He has used color 2007 digital orthophotographs (DOQQs; 1:14,400 scale) to digitize LULC classes matching (or hierarchically nested within) the standard 2001-2 National Land Cover Database (NLCD) classification scheme. He has visited the field twice to use GPS units to first train his eye for photointerpretation and then to test his final classification. In addition, he will compare his classification to the 2006 land cover classification derived from Landsat Thematic Mapper imagery described above. Furthermore, we will use his ground-truth points to further evaluate the accuracy of the 2006 land cover map.

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 stream studies 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 found that *M. vimineum* substantially alters N dynamics by sequestering N in its aboveground biomass and effectively reducing its deciduous forests. We performed a 15N-tracer study to determine the fate of different N forms in invaded and non-invaded forest understories.

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 North America. 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 is being collected during summer 2010, and seeds will be planted out again during 2010 to measure germination success during another year.

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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.

Laseter, S.H., Ford, C.R., Vose, J.M. and Swift, L., Long-Term Climate Trends at the Coweeta Hydrologic Laboratory, Otto, North Carolina,
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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.

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.

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.

Document the avian communities surrounding synoptic study sites in the Littlee 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.

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 larvas, 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 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 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


for demography of plant populations. in T. O'Hagan and M. West (eds) Handbook of Bayesian Analysis, Oxford University Press.


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


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.

Invasion by the Microstegium vimineum can be explained in the context of known ecological theory, as opposed to having to impose new rules? because it is an invasive species, which should facilitate more accurate prediction of impacts and management of the grass. Specifically, we’ve shown that roads and waterways (i.e. Edge habitat), previously thought to just be dispersal corridors, are also the most favorable habitat for the species. This suggests that successful management of this ?understory invader? might best target edge habitat because the understory populations are maintained by these edge habitat populations; (2) The impacts of Microstegium vimineum on soil carbon stocks are dependent, across regional gradient, on soil clay content. This might enable improved prediction of where invasion will negatively affect forest fertility and carbon storage; (3) In contrast to current opinion, Microstegium vimineum is an important food source for aboveground, plant herbivore foodwebs, with multiple taxa incorporating a substantial fraction of its carbon into their tissues. This changes the way we think about how this invader affects recipient ecosystems ? showing that changes in native foodwebs might be directly caused because this plant is a food resouce; (4) In the regional framework, cool season temperature and precipitation patterns (since 1934) are explained statistically by the North Atlantic Oscillation and not global, annual changes in climate. No pronounced warming or drought pattern is perceived. In contrast, warm season temperature is just starting to show an increase that parallels, from a relative if not absolute perspective, the trend of global climate warming. The NAO best explained salamander abundance patterns; (5) Facilitative interactions between seed dispersers and understory herbs extend the spatial but not niche distribution of understory herbs, challenging the new theoretical expectation that facilitation expands the niche. Specifically this is because the mutualists (in this case ants and herbaceous plants) might have niches that do not perfectly overlap. (6) History remains an important agent structuring the function of microbial communities suggesting that land-use change will influence nutrient dynamics and decomposition because soil microbial communities are not functionally redundant in the shorter- or longer-term (Warren et al. in press-A; Warren et al. in press-B; Bradford et al. 2010-A; Bradford et al. 2010-B; Strickland et al. 2010).

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 land-owners 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 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:


Band, L.E., T. Hwang, T. Randolph 2010. Climate, geomorphic and species controls on transient canopy development and soil water, carbon
and nutrient cycling following disturbance. Association of American Geographers Annual Meeting, Washington, D.C. April, 2010


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.


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 invasibility 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 (Fraterrrigo 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 (Fraterrrigo 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 Fraterrrigo, 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 (Fraterrrigo 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 high-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: Greenwire (online news source with subscription), Washington, DC: "Eastern insect killing trees at high rate? study?" (Story available with subscription)


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


Georgia Forestry Commission - Aug. 31, 2009 (has a link to the article on their website under 'Forestry News' http://www.gfc.state.ga.us/


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' http://www.brightsurf.com/news/headlines/48206/Rhododendron_expansion_may_increase_the_chance_of_landslides_on_Southern_Appalachian_s


Training and Development:
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: 11/01/09 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.bighaldbanding.org/id4.html.

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

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:

1. Macon County Beekeeper's Association (5 March 2009, Franklin, NC) - presentation on bear biology, black bear conservation and management, and preventing bear-human conflicts; 40 people attended.
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  

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"

Other Specific Products

Contributions within Discipline:
11/09 to 07/10

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 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:
11/09 to 07/10

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.

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11/08 to 10/09

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:**
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:**
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 publically available for the region. (NLCD is dated 2001.)

Contributions Beyond Science and Engineering:
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
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**TOTAL** 581
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.

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**TOTAL** 1082
Schoolyard Photos

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.
Coweeta 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).