Annual Report for Period: 11/2004 - 11/2005
Submitted on: 10/05/2005
Principal Investigator: Gragson, Theodore L.
Award ID: 0218001
Organization: U of Georgia Res Fdn Inc
Title:
LTER: Consequences of Land Use Change in the Southern Appalachian Mountains

Project Participants

Senior Personnel

Name: Gragson, Theodore

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: LPI of the Coweeta LTER, responsible for project management and administration as well as liaison with UGA sponsored program administration. Research on historical ecology of Native American and Euroamerican settlement in collaboration with P. Bolstad, and development of forecast framework of the effects of land use with J. Clark and others. Partial support from Coweeta LTER research funds.

Name: Vose, James

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Co-principal investigator of the Coweeta LTER and Research Leader of the USFS Coweeta Hydrologic Laboratory. Directs all research activities of cooperating USFS scientists at Coweeta and is the liaison with USFS Southern Research Station. Research on ecosystem function and water quantity/quality. Partial support from Coweeta LTER through subcontract to Coweeta Hydrologic Laboratory.

Name: Kloeppel, Brian

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Co-Principal Investigator and LTER Site Director. Supervises on-site technicians, oversees management of dormitory facilities, and coordinates use and maintenance of on-site equipment. Research on extreme climate events and allometry. Receives 10 months/year salary plus a research budget from Coweeta LTER project.

Name: Benfield, Fred

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Effort involves 1) Longterm studies of responses of organic matter processing in Coweeta streams to logging; and 2) responses of southern Appalachian region streams to disturbance (e.g., logging, agriculture, urban, and urbanization) at multiple scales in the landscape. Partial support from Coweeta LTER through a subcontract to VA Tech.

Name: Bolstad, Paul

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Working on carbon and water cycles, human land use change, and the interaction of these at a range of scales in Southern Appalachia. Includes reconstructing land use over the past 140 years estimating of early native American ecological footprints, the impact of land use on water quantity and quality, developing and evaluating surface runoff models and their sensitivity to land use, and sampling to identify the impacts of hemlock wooly adelgid on forest composition and cycling. Partial support by Coweeta LTER subcontract to the University of Minnesota.

Name: Clark, James

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Working on how forest diversity is maintained and how it will respond to future changes in climate and landuse. He is using data from long-term census plots and large experiments to parameterize models for use in prediction and assimilating complementary data sets as part of collaborations on predicting large-scale changes in landscapes. Partial support by Coweeta LTER sub-contract to Duke University.

Name: Clinton, Barton

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Collaborating USFS research scientist at Coweeta Hydrologic Laboratory collaborating with M. Hunter on wooly adelgid study. No direct support from the Coweeta LTER.

Name: Coleman, David

Worked for more than 160 Hours: No

Contribution to Project:

11/04-6/05: Coweeta activities center on advising two graduate students: Becky Ball and John Kominoski who work with M. Hunter and C. Pringle on the role of litter diversity in nutrient dynamics in soils and streams. Partial support from Coweeta LTER research funds.

Name: Elliott, Katherine

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: USFS research scientist at Coweeta Hydrologic Laboratory using dendrochronology to determine the forest disturbance history of the Coweeta Basin prior to acquisition by the U.S. Forest Service. No direct support from the Coweeta LTER research funds.

Name: Grossman, Gary

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Conducts experimental work on the effects of turbidity on fish foraging efficiency (river chub and rosyside dace) and long-term population sampling on three permanent sites in the Coweeta Creek Drainage. Partial support from Coweeta LTER research funds.

Name: Haines, Bruce

Worked for more than 160 Hours: No

Contribution to Project:

11/02-10/04: Activities center on forest responses to disturbances at Coweeta Hydrologic Labatory and training/assisting students with technology. Partially supported with a research budget from Coweeta LTER.

Name: Helfman, Gene

Worked for more than 160 Hours: No

Contribution to Project:

11/02-10/04: Activities center on the possible influences of land use practices on stream habitats and ultimately on fish species. The specific interest is in the possible impact of deforestation of watersheds on the progressive displacement of endemic, specialist southeastern species by widespread, generalist fish species. Partially supported by a research budget from Coweeta LTER.

Name: Hendrick, Ron

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Research on the role of ecto- and ericoid mycorrhizae and soil/litter chemistry in regulating nutrient pools and acquisition in Rhododendron maximum-Hardwood forests. Partial support from Coweeta LTER research funds.

Name: Hunter, Mark

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Collaborating with D. Coleman and C. Pringle on the role of biodiversity and ecosystem function (Coweeta LTER support); the effects of hemlock woolly adelgid on ecosystem structure and function (supported by USFS cooperative agreement); collaborating with R. Cooper (UGA-Forest Resources) on the effects of soil nutrients and elevation on the interactions between birds and insects on oaks (supported by NSF-Ecology funds).

Name: Knoepp, Jennifer

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: USFS research scientist at Coweeta Hydrologic Laboratory characterizing terrestrial C pools in vegetation types across the gradient in the Coweeta basin from examination of soil, forest floor and coarse woody debris. No direct support from the Coweeta LTER research funds.

Name: Leigh, David

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Project geomorphologist determining sedimentation history of streams in the study region and the measurable extent of human-impact on stream morphology, sedimentology, floods, and water quality. Partial support from Coweeta LTER research funds.

Name: Newman, David

Worked for more than 160 Hours: No

Contribution to Project:

11/04-6/05: Collaborated with D. Wear and S. Cho on evaluating the impact of social and economic factors in land use choice decisions using census data and surveys of local residents. Partial support from Coweeta LTER research funds.

Name: Pearson, Scott

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Effects of land use history on demography of understory plants in collaboration with Monica Turner; long-term studies of overstory and understory demography in forested stands in collaboration Jim Clark; breeding ecology and biogeography of the Appalachian Yellow-bellied Sapsucker; and bird inventory of Blue Ridge Parkway and Carl Sandburg Home. Partial support from Coweeta LTER research funds.

Name: Pringle, Catherine

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Collaborating with M. Hunter and D. Coleman on quantifying the relationship between species diversity and leaf litter decomposition to predict the effects of land-use change of this process; study of the effects of increased nutrients and different consumer assemblages on algae in an Appalachian stream in north Georgia; collaboration with B. Bixby on response of stream chemistry and algal primary producers to hemlock death from woolly adelgids; and, algae sampling of all the Hazard Sites. Partial support from Coweeta LTER research funds.

Name: Pulliam, Ron

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Activities focus on forest understory plant demography and distribution. Conducted measurements on herb density, distribution, demography, and monitoring physical environment (PAR, soil moisture, temperature, texture and nutrients) on 14 study grids at Coweeta and elsewhere in the study region; experimental transplants and common gardens were monitored at Coweeta and Nancytown. Partial support from Coweeta LTER research funds.

Name: Reynolds, Barbara

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Activities center on determining the effects of human-caused disturbance on soil microarthropods, decomposition, and avian communities at Coweeta Hydrologic Laboratory, Mars Hill and Nancytown in collaboration with S. Pearson and others. Partial support from Coweeta LTER research funds.

Name: Riedel, Mark

Worked for more than 160 Hours: No

Contribution to Project:

11/04-6/05: USFS research scientists at Coweeta Hydrologic Laboratory with activities focused on fine-scale hydrologic modeling based on collecting and collating information from on-site weirs. No direct support from the Coweeta LTER research funds.

Name: Swank, Wayne

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Former USFS Project leader at Coweeta Hydrologic Laboratory now retired and editing synthesis volume on research at WS7. No direct support from the Coweeta LTER research funds.

Name: Turner, Monica

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Effects of land use history on soil nutrients and productivity of forest herbs in collaboration with S. Pearson and J. Fraterrigo. Partial support from Coweeta LTER research funds.

Name: Wallace, Bruce

Worked for more than 160 Hours: No

Contribution to Project:

11/02-10/04: Conducting long-term follow up study on the effects of clear-cut logging on WS 7 at Coweeta on benthic fauna and organic matter standing crop. This is a collaboration with J. Webster and F. Benfield. Also involved with a long-term study of large wood additions to Cunningham Creek. Primary research is on whole system litter and nutrient addition to a headwater stream. This is a collaboration with J. Meyer, J. Webster and others. Nominal support for these activities from a research budget from Coweeta LTER.

Name: Wear, David

Worked for more than 160 Hours: No

Contribution to Project:

11/04-6/05: USFS project leader at Research Triangle collaborated with D. Newman and S. Cho on evaluating the impact of social and economic factors in land use choice decisions using census data and surveys of local residents. Partial support from Coweeta LTER research funds.

Name: Webster, Jack

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Functional response of streams including organic matter dynamics to disturbance including logging (WS7), agriculture and hemlock wooly adelgid. Partial support from Coweeta LTER research funds through subcontract to VA Tech.

Name: Meyer, Judy

Worked for more than 160 Hours: No

Contribution to Project:

11/02-10/04: Initiated 'Hazard Project' in 2000. Collaborates with B. Wallace and J. Webster on whole system litter addition to a headwater stream. Receives no support from Coweeta LTER.

Name: Gardner, Ned

Worked for more than 160 Hours: No

Contribution to Project:

11/02-10/04: Participated with J. Meyer in initial activities of the 'Hazard Project' in 2000. Collaborating with M. Scott, F. Benfield and others on revising a manuscript and presenting results at conferences. No direct support from Coweeta LTER.

Name: Scott, Mark

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Coordinated Stream Hazard Site sampling cycle for water chemistry, channel geomorphology, and community structure of algae, macroinvertebrates, and fishes. Partial support from Coweeta LTER research funds.

Name: Cho, Seong Hoon

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-06/05: Collaborator with D. Wear and D. Newman on evaluating the impact of social and economic factors in land use choice decisions using census data and surveys of local residents.

Name: Bradford, Mark

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Characterizing how disease agents cause mortality of dominant canopy and sub-canopy tree species, affect soil organic carbon (SOC) cycling and the related microorganisms through impacts on edaphic climate and detrital resource quality and quantity. Partial support from Coweeta LTER research funds.

Post-doc

Name: Cho, Seong.Hoon

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-06/04: Collaborator with D. Wear and D. Newman on evaluating the impact of social and economic factors in land use choice decisions using census data and surveys of local residents. Salary through June 2004 provided by Coweeta LTER, after which takes tenure track position at U of TN, Knoxville.

Name: Jong, Kwang Seuk

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-06/04: Collaborator with G. Grossman on artificial neural networks and evolutionary algorithm approaches to habitat modeling using Coweeta long-term data on freshwater fish. No direct support from Coweeta LTER.

Graduate Student

Name: McTammany, Matt

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-6/04: PhD student working with F. Benfield at VA Tech; graduated June 2004 with dissertation titled: Recovery of agricultural streams from historical agriculture.

Name: Burcher, Chris

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with F. Benfield at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid by measuring responses of macroinvertebrates and fish, litter breakdown rates, standing stocks of BOM, whole-stream metabloism, detailed strem geomorphology, and detailed land cover using GIS.

Name: Kirk, Ryan

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with P. Bolstad at U of Minnesota on increasing categorical discrimination in remotely sensed imagery.

Name: Dietze, Michael

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with J. Clark at Duke University on development of synthetic models of forest response to global change.

Name: Ibanez, Ines

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-10/04: PhD student working with J. Clark at Duke University on performance during recruitment of potential tree migrant species relative to resident species.

Name: Wolosin, Michael

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-10/05: PhD student working with J. Clark at Duke University on experimental canopy gaps.

Name: LaDeau, Shannon

Worked for more than 160 Hours: Yes

Contribution to Project:
11/02-10/04: PhD student working with J. Clark at Duke University on reproductive maturation and fecundity of forest species.

Name: Pavao-Zuckerman, Mitchell

Worked for more than 160 Hours: Yes

Contribution to Project:
11/02-10/04: PhD student working with D. Coleman at University of Georgia on soil ecology along an urbanization gradient.

Name: Butler, Sarah

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-10/05: MSc student working with K. Elliot and A. White (U of Maine) on dendrochronology and disturbance history of the Coweeta Basin.

Name: Jurgelski, William

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-10/05: Collaborates with T. Gragson on fire history and geography in southern Appalachia. No direct support from Coweeta LTER research funds.

Name: Fly, Jessie

Worked for more than 160 Hours: Yes

Contribution to Project:
7/05-10/05: PhD student working with T. Gragson at University of Georgia on land use and conservation in Southern Appalachia. No direct support from Coweeta LTER.

Name: Devine, Meredith

Worked for more than 160 Hours: Yes

Contribution to Project:
08/03-08/04: PhD student working with T. Gragson at University of Georgia on historical ecology of Cherokee settlement.

Name: Hunt, Andrew

Worked for more than 160 Hours: No

Contribution to Project:
08/03-06/04: MSc student working with T. Gragson at University of Georgia on conservation issues in Southern Appalachia.

Name: Murray, Susan

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-5/04: MA student working with T. Gragson and B. Collins at University of Georgia on project information management.

Name: Brown, Cheryl

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-5/05: MA student working with T. Gragson and B. Collins at University of Georgia on project information management.

Name: Basnet, Govinda

Worked for more than 160 Hours: Yes

Contribution to Project:
11/02-08/04: PhD student working with T. Gragson and B. Collins at University of Georgia on project data management.

Name: Vogt, Allison

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-10/04: MSc student working with G. Helfman at University of Georgia on impact of watershed deforestation on the progressive displacement of endemic, specialist southeastern species by widespread, generalist fish species.

Name: Rachel, Gary

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-8/04: PhD student working with R. Hendrick at the University of Georgia. He graduated 8/04 with a dissertation entitled: The Vertical Distribution of Arbuscular, Ericoid, and Ectomycorrhizae in a Forest soil: Correlations with Soil N and P Distribution and Root Topology.

Name: Bathala, Neeti

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-5/04: PhD student working with R. Hendrick at the University of Georgia. She is currently worknig as a postdoctoral associate at Rutgers University and finishing her dissertation based on Coweeta LTER research.

Name: Ball, Becky

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with M. Hunter at the University of Georgia on terrestrial-aquatic interactions.

Name: Frost, Chris

Worked for more than 160 Hours: No

Contribution to Project:

11/04-5/05: PhD student working with M. Hunter at the University of Georgia on leaf predation and litter decomposition. Graduated Spring 2005.

Name: Greenstone, Tom

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with M. Hunter at the University of Georgia on hemlock wooly adelgid.

Name: Price, Katie

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-6/04: MSc student working with D. Leigh at University of Georgia on stream sedimentology. Graduated 6/04 with a thesis entitled: Stream Response to human impact in the southern Blue Ridge Mountains.

Name: Dye, Susan

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-5/04: MSc student working with C. Pringle at University of Georgia on nutrient effects of different consumer assemblages on algae. Graduated Spring 2005.

Name: Kominoski, John

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with C. Pringle at University of Georgia on quantifying the relationship between species diversity and leaf litter decomposition to predict the effects of land-use change on this process.

Name: Warren, Robert

Worked for more than 160 Hours: Yes

Contribution to Project:

11/05-10/05: PhD student working with R. Pulliam at the University of Georgia on forest understory plant demography and distribution.

Name: Diez, Jeff

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: PhD student working with R. Pulliam at the University of Georgia on forest understory plant demography and distribution.

Name: Fratterrigo, Jen

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with M. Turner at University of Wisconsin Madison on effects of land use history on soil nutrients and productivity of forest herbs.

Name: Hagen, Elizabeth

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-5/04: MSc student working with J. Webster at VA Tech. Graduates May 2004 with a thesis entitle: Influence of agricultural land use on allochthonous input and leaf breakdown in southern Appalachian streams.

Name: Wojculewski, Christy

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with J. Webster at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid.

Name: Sokol, Eric

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with F. Benfield at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid by measuring responses of macroinvertebrates and fish, litter breakdown rates, standing stocks of BOM, whole-stream metabloism, detailed strem geomorphology, and detailed land cover using GIS.

Name: Jeremiah, Nick

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with F. Benfield at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid by measuring responses of macroinvertebrates and fish, litter breakdown rates, standing stocks of BOM, whole-stream metabloism, detailed strem geomorphology, and detailed land cover using GIS.

Name: Powers, Matthew

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with F. Benfield at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid by measuring responses of macroinvertebrates and fish, litter breakdown rates, standing stocks of BOM, whole-stream metabloism, detailed strem geomorphology, and detailed land cover using GIS.

Name: Morkeshi, Kate

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with J. Webster at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid.

Name: Gray, Travis

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with J. Webster at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid.

Name: Brookshire, Jack

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with J. Webster at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid.

Name: Rogers, James

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with D. Leigh at University of Georgia on stream sedimentology.

Name: Suther, Bradley

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: MSc student working with D. Leigh at University of Georgia on stream sedimentology.

Name: Luebke, Michelle

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: MSc student working with D. Leigh at University of Georgia on stream sedimentology.

Name: Malloway, Jenna

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: MSc student working with M. Hunter at the University of Georgia on hemlock wooly adelgid.

Name: Zehnder, Caralyn

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with M. Hunter at the University of Georgia on hemlock wooly adelgid.

Name: Hazelton, Peter

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with G. Grossman at U of Georgia determining the relative importance of density dependent and density independent population regulation of freshwater fish.

Name: Wurzburger, Nina

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with R. Hendrick at U of Georgia on research concerns the role of ecto- and ericoid mycorrhizae and soil/litter chemistry in regulating nutrient pools and acquisition in Rhododendron maximum-Hardwood forests.

Name: Zamor, Rich

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with G. Grossman at U of Georgia determining the relative importance of density dependent and density independent population regulation of freshwater fish.

Name: Elkins, Duncan

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with G. Grossman at U of Georgia determining the relative importance of density dependent and density independent population regulation of freshwater fish.

Name: Hersh, Michelle

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with J. Clark at Duke University on experimental canopy gaps.

Name: Welsh, Miranda

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with J. Clark at Duke University on experimental canopy gaps.

Name: Welch, Nathan

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: PhD student working with J. Clark at Duke University on experimental canopy gaps.

Name: Gananapathy, Narayanaraj

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with P. Bolstad at U of Minnesota on terrain mapping and land surface morphology.

Name: Jenks, Andy

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: PhD student working with P. Bolstad at U of Minnesota on terrain mapping.

Name: Dunbar, Kate

Worked for more than 160 Hours: Yes

Contribution to Project:

9/05-10/05: PhD student working with T. Gragson at University of Georgia on land use and conservation in Southern Appalachia. No direct support from Coweeta LTER.

Name: Shaffer, Jen

Worked for more than 160 Hours: Yes

Contribution to Project:

9/05-10/05: PhD student working with T. Gragson at University of Georgia on land use and conservation in Southern Appalachia. No direct support from Coweeta LTER.

Name: DeRocher, Julien

Worked for more than 160 Hours: Yes

Contribution to Project:

1/05-10/05: MA student working with T. Gragson and B. Collins at University of Georgia on project information management.

Name: Fievet, Charles

Worked for more than 160 Hours: Yes

Contribution to Project:

5/05-10/05: MA student working with T. Gragson and B. Collins at University of Georgia on project information management. Partial support from Coweeta LTER research funds.

Name: Eustis, Scott

Worked for more than 160 Hours: Yes

Contribution to Project:

11/05-10/05: PhD student working with R. Pulliam at the University of Georgia on forest understory plant demography and distribution.

Undergraduate Student

Name: Galland, Grant

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-10/04: Undergraduate student working with G. Helfman at University of Georgia on sediment particle size and its correlations with fish assemblage dynamics.

Name: Brennan, Amanda

Worked for more than 160 Hours: Yes

Contribution to Project:

11/02-10/04: Undergraduate student working with K. Reynolds at UNC Asheville on soil microarthropod studies at gap sites at Coweeta.

Name: Scarborough, Phaedra

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Undergraduate student working with K. Reynolds at UNC Asheville on a litter bag decomposition study in gap plots in relation to soil microarthropod communities.

Name: Korcel, Katrina

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Undergraduate student working with J. Webster at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid.

Name: Minter, Zach

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Undergraduate student working with J. Webster at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid.

Name: Schreib, Rich

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Undergraduate student working with J. Webster at VA Tech on stream functional response to disturbance from logging, agriculture and hemlock wooly adelgid.

Name: Kaminski, Cynthia

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Undergraduate student working with K. Reynolds at UNC Asheville on a litter bag decomposition study in gap plots in relation to soil microarthropod communities.

Name: Nichols, Sara

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Undergraduate student working with S. Pearson at Mars Hill College on the effects of land use history on demography of understory plants and long-term studies of overstory and understory demography in forested stands.

Name: Flores, Diana

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Undergraduate student working with S. Pearson at Mars Hill College on the effects of land use history on demography of understory plants and long-term studies of overstory and understory demography in forested stands.

Name: Bailey, Jared

Worked for more than 160 Hours: No

Contribution to Project:
11/04-10/05: Undergraduate student working with S. Pearson at Mars Hill College on the effects of land use history on demography of understory plants and long-term studies of overstory and understory demography in forested stands.

Name: Evans, Brian
Worked for more than 160 Hours: No
Contribution to Project:
11/04-10/05: Undergraduate student working with S. Pearson at Mars Hill College on the effects of land use history on demography of understory plants and long-term studies of overstory and understory demography in forested stands.

Name: Gerber, Adam
Worked for more than 160 Hours: Yes
Contribution to Project:
11/04-10/05: Undergraduate student working with P. Bolstad at U of Minnesota on terrain mapping.

Name: Srivistava, Jaya
Worked for more than 160 Hours: Yes
Contribution to Project:
11/04-10/05: Undergraduate student working with M. Bradford at U of Georgia on disease agents that cause mortality of dominant canopy and sub-canopy tree species.

Name: Rosamilia, Nichole
Worked for more than 160 Hours: No
Contribution to Project:
9/05-10/05: Undergraduate student working with T. Gragson and B. Collins at University of Georgia on project information management.

Technician, Programmer

Name: Collins, Barrie
Worked for more than 160 Hours: Yes
Contribution to Project:
11/04-10/05: Coweeta information manager. Full time salary and benefits provided by Coweeta LTER.

Name: Steiner, Susan
Worked for more than 160 Hours: Yes
Contribution to Project:
11/04-8/05: Field technician and Coweeta Schoolyard LTER coordinator. Full salary and benefits provided by Coweeta LTER.

Name: Deal, James
Worked for more than 160 Hours: Yes
Contribution to Project:
11/04-10/05: Coweeta Analytical Lab Manager. Full salary and benefits provided by Coweeta LTER.

Name: Harper, Carol
Worked for more than 160 Hours: Yes
Contribution to Project:
11/04-10/05: Coweeta Analytical Laboratory technician. Full salary and benefits provided by Coweeta LTER.

Name: Mazzarelli, Lisa
Worked for more than 160 Hours: Yes
Contribution to Project:
11/02-04/04: MS-level technician from January 2003 through May 2004. Partially supported by Coweeta LTER through end of April 2004 at which point she takes position at Highlands Biological Station.

Name: Enos, Linda
Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-1/05: Coweeta LTER project record keeper and LPI assistant. Ninety-five percent of salary and benefits provided by UGA, balance by Coweeta LTER.

Name: Ratajczak, Robert

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-10/05: Full-time research professional working with G. Grossman at University of Georgia. Salary and benefits from UGA.

Name: Baughens, Renee

Worked for more than 160 Hours: Yes

Contribution to Project:
4/05-10/05: Coweeta LTER project administrative associated and LPI assistant. Hundred percent of salary and benefits provided by UGA.

Name: Fitzgerald, Shannon

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-10/05: Research technician working with G. Grossman at University of Georgia on density dependent and density independent population regulation of freshwater fish. Partial support from Coweeta LTER research funds.

Name: Peck, Chris

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-10/05: Research technician working with G. Grossman at University of Georgia on density dependent and density independent population regulation of freshwater fish. Partial support from Coweeta LTER research funds.

Name: Greene, Jason

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-10/05: Research technician working with G. Grossman at University of Georgia on density dependent and density independent population regulation of freshwater fish. Partial support from Coweeta LTER research funds.

Name: Ogden, Lee

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-10/05: Research technician working with R. Hendrick at University of Georgia on the role of ecto- and ericoid mycorrhizae and soil/litter chemistry in regulating nutrient pools and acquisition in Rhododendron maximum-Hardwood forests. Partial support from Coweeta LTER research funds.

Name: Porterfield, Dale

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-10/05: Research technician working with R. Hendrick at University of Georgia on the role of ecto- and ericoid mycorrhizae and soil/litter chemistry in regulating nutrient pools and acquisition in Rhododendron maximum-Hardwood forests. Partial support from Coweeta LTER research funds.

Name: Kitzner, James

Worked for more than 160 Hours: No

Contribution to Project:
11/04-10/05: Field technician working with B. Kloeppel. Partial support from Coweeta LTER research funds.

Name: Seehorn, Joshua

Worked for more than 160 Hours: Yes

Contribution to Project:
11/04-9/05: Field technician working with S. Steiner. Partial support from Coweeta LTER research funds.

Name: Parrish, Michael

Worked for more than 160 Hours: Yes

Contribution to Project:

11/04-10/05: Field technician working with M. Hunter on the effects of hemlock woolly adelgid on ecosystem structure and function. Partial support from Coweeta LTER research funds.

Name: Lamoncha, Karen

Worked for more than 160 Hours: Yes

Contribution to Project:

3/05-10/05: Senior technician working with D. Coleman on DNA probing using 18 S rRna for fungal gut contents of beetles and Oribatid mites. Partial support from Coweeta LTER research funds.

Name: Fowler, Randy

Worked for more than 160 Hours: Yes

Contribution to Project:

5/05-10/05: USFS Technology Transfer specialist at Coweeta Hydrologic Laboratory responsible for communication and outreach. No direct support from the Coweeta LTER research funds.

Other Participant

Name: Bixby, Becky

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Collaborates with C. Pringle Bixby on response of stream chemistry and algal primary producers to hemlock death from infestations of hemlock woolly adelgids. Partial support from Coweeta LTER research funds.

Name: Cooper, Robert

Worked for more than 160 Hours: No

Contribution to Project:

11/04-10/05: Collaborates with M. Hunter on the effects of soil nutrients and elevation on the interactions between birds and insects on oaks

Research Experience for Undergraduates

Name: Pinner, Davis

Worked for more than 160 Hours: Yes

Contribution to Project:

5/03-8/03: REU student working with K. Elliot at Coweeta Hydrologic Laboratory on dendroecological reconstruction of the disturbance history of Coweeta Basin.

Years of schooling completed: Junior

Home Institution: Other than Research Site

Home Institution if Other: Furman University

Home Institution Highest Degree Granted(in fields supported by NSF): Master's Degree

Fiscal year(s) REU Participant supported: 2003

REU Funding: REU supplement

Name: Keyes, Hunter

Worked for more than 160 Hours: Yes

Contribution to Project:

5/03-8/03: REU student working with M. Hunter at the University of Georgia on ecosystem effects of the hemlock wooly adelgid in the southern Appalachian region.

Years of schooling completed: Junior

Home Institution: Same as Research Site

Home Institution if Other:

Home Institution Highest Degree Granted(in fields supported by NSF): Doctoral Degree

Fiscal year(s) REU Participant supported: 2003

REU Funding: REU supplement

Name: Marcus, Kenneth

Worked for more than 160 Hours: Yes

Contribution to Project:

5/03-8/03: REU student working with J. Knoeppe at Coweeta Hydrologic Laboratory on nutrient content and bulk density determination of coarse woody debris in the Coweeta Basin.

Years of schooling completed: Junior

Home Institution: Other than Research Site

Home Institution if Other: UNC Asheville

Home Institution Highest Degree Granted(in fields supported by NSF): Bachelor's Degree

Fiscal year(s) REU Participant supported: 2003

REU Funding: REU supplement

Name: Adams, Robin

Worked for more than 160 Hours: Yes

Contribution to Project:

5/04-8/04: REU student working with S. Pearson at Mars Hill College sampling salamander communities at a set of sites that vary with respect to forest patch size and density of residential development.

Years of schooling completed: Junior

Home Institution: Other than Research Site

Home Institution if Other: Mars Hill College

Home Institution Highest Degree Granted(in fields supported by NSF): Bachelor's Degree

Fiscal year(s) REU Participant supported: 2003

REU Funding: REU supplement

Name: Moore, Erin

Worked for more than 160 Hours: Yes

Contribution to Project:

5/04-8/04: REU student worked Mark Riedel on sediment transport at Coweeta Hydrologic Laboratory.

Years of schooling completed: Freshman

Home Institution: Other than Research Site

Home Institution if Other: UNC Asheville

Home Institution Highest Degree Granted(in fields supported by NSF): Bachelor's Degree

Fiscal year(s) REU Participant supported: 2004

REU Funding: REU supplement

Organizational Partners

Virginia Polytechnic Institute and State University

Provides laboratory and office facilities for J. Webster and students associated with his Coweeta LTER research. Provides partial salary and benefits for J. Webster, although a significant portion of his total EFT is dedicated to Coweeta LTER research and support activities. Provides institutional accounting and management services on sub-contract award.

Duke University

Provides laboratory and office facilities for J. Clark and graduate students associated with his work at Coweeta. Provides partial salary and benefits to J. Clark, although a significant portion of his total EFT is dedicated to research or support activities on the Coweeta LTER. Provides institutional accounting and management services on sub-contract award.

UNIVERSITY OF MINNESOTA

Provides laboratory and office facilities for P. Bolstad and graduate students associated with his work on the Coweeta LTER. Provides partial salary and benefits for P. Bolstad, although a significant portion of his total EFT is dedicated to Coweeta LTER research and support activities. Provides institutional accounting and management services on sub-contract award.

Mars Hill College

Provides laboratory and office facilities for S. Pearson and undergraduate students in support of his Coweeta LTER research. Provides partial salary and benefits for S. Pearson, although a significant portion of his total EFT is dedicated to Coweeta LTER research or support activities. Provides institutional accounting and management services on sub-contract award.

University of North Carolina at Asheville

Provides laboratory and office facilities in support of K. Reynolds and undergraduate students in support of her Coweeta LTER research. Provides partial salary and benefits for K. Reynolds, although a significant portion of her total EFT is dedicated to Coweeta LTER research and support activities. Provides institutional accounting and management services on sub-contract award.

University of Wisconsin-Madison

Provides laboratory and office facilities for Monica Turner and her students on Coweeta LTER research.

USDA Forest Service

Long-term cooperative agreement with USDA Forest Service, Southern Research Station, Coweeta Hydrologic Laboratory. Cooperation involves shared facilities (analytical labotory, researcher dormitory, conference center); personnel exchanges (technical staff supported by Coweeta LTER providing analytical services to Forest Service activities). Direct funding to Coweeta LTER activities is provided through numerous and varied cooperative agreements; purchasing and procurement of analytical supplies; salaries and benefits for all collaborating USFS research scientists and varied facilities support staff; direct maintenance expenses on all facilities and infrastructure including roads and weirs.

University of Georgia

Provides office and laboratory facilities for all UGA-affiliated researchers, students and staff. Covers 100% of salary and benefits for administrative associate (Renee Baughens). Provides partial salaries and benefits for several UGA researchers, and tuition waivers for all UGA graduate students supported on Coweeta LTER project. Provides personnel exchanges so that Coweeta Site Manager (B. Kloeppel), analytical lab staff (J. Deal and C. Harper), and field technician (S. Steiner) employed by UGA are stationed at Coweeta Hydrologic Laboratory.

Universite de Pau

Provides laboratory and office space for all collaborating researchers and their students, and visiting Coweeta researchers. Provides in-kind support in the form of lodging, consumption, and transportation expenses for visiting researchers. Provides transportation costs from Europe to US for collaborating French researchers.

American Museum Natural History

Provides salary and benefits for N. Gardner and the flexibility for participation in the project.

South Carolina Department of Natural Resources

Provides salary and benefits for M. Scott and the flexibility to collaborate on the project.

Other Collaborators or Contacts

01/04-10/05: Katherine Elliot: Collaborating with Dr. Al White, College of Forest Resources, Dept of Ecosystem Science, University of Maine, on dendrochronology study at Coweeta to characterize stand dynamics and disturbance history of the Basin.

11/02-10/05: Ted Gragson: collaboration with Dolores de Bortoli and other researchers of the Site Atelier AnthroposystÞmes et HydrosystÞmes PyrÚnÚens Atlantiques of the Zone Atelier Adour Garonne based at the University of Pau, France. The activities are independently financed by NSF and CNRS. There has been a regular exchange of researchers between the two sites, participation in scheduled meetings both in Europe and the United states, and publication of one collaborative article. Objective is to promote and enhance understanding of long-term phenomena

across regional, national and oceanic boundaries through social and ecological sciences approaches.

11/03-10/05: Jim Clark: modeling to understand forest responses to global change has expanded to include Howard Shultz, Computer Science, University of Massachussetts.

11/04-10/05: Barton Clinton: collaboration with researchers at the U of Missouri and Clemson U on study of riparian structure and function of 1st order catchments and the assignment of buffer widths to mitigate timber harvest activities.

11/04-10/5: David Coleman: collaboration with Drs. Gonzales, Lodge and Silver at Luquillo LTER on synthesis of organic matter decomposition.

11/04-10/5: David Coleman: collaboration with Barny Whitman, Dac Crossley and Karen Lamoncha (all at U of Georgia) on DNA probing using 18 S rRNA for fungal gut contents of beetles and Oribatid mites. This work is an outgrowth of earlier detrital food web research by Crossley and Coleman and students on earlier Coweeta funding.

11/04-10/05: Gary Grossman: collaboration with Sheryl Coombs, Parmly Hearing Institute at Loyola University of Chicago, on a study examining the prey orienting and rheotactic behaviors of mottled sculpin from populations in a fluvial system (Coweeta Creek) and a lacustrine population (Lake Michigan).

11/04-10/05: Brian Kloeppel: partnering with faculty at Western Carolina University, Southwestern Community College, Rabun Gap Nacoochee College Preparatory School, and Macon Middle School on Schoolyard LTER activities.

11/04-10/05: Ron Pulliam: collaboration with Nick Waser, U of California-Riverside on a manuscript that analyzes Coweeta results.

11/02-10/05: Jack Webster: collaboration on The Lotic Intersite Nitrogen eXperiment (NSF) study of nitrogen cycling in streams involving simulation modeling, field tracer (15N) additions, and intersite comparison. Collaborators are based at U of Tennessee, Oak Ridge National Laboratory, Arizona State U, Institute of Ecosystems Studies, Kansas State U, Marine Biological Laboratory, Michigan State U, U of Notre Dame, Oregon State U, U of Georgia, U of New Hampshire, U of New Mexico, U of Wyoming, and Eco-Metrics, Inc. They include: Pat Mulholland, Jennifer Tank, Robert Hall, Steve Hamilton, Bruce Peterson, Geoff Poole, Stuart Findlay, Water Dodds, Maury Valett, Nancy Grimm, Cliff Dahm, Stan Gregory, Sherri Johnson, and Bill McDowell.

11/02-10/05: Ted Gragson: Agrarian Landscapes in Transition (NSF) is an interdisciplinary project tracing the effects of the introduction, spread, and abandonment of agriculture at six U.S. LTER sites, with cross comparisons in Mexico and France. Principal contact is Charles Redman of Arizona State University. Additional collaborators include David Foster at Harvard University; Myron Gutmann at the University of Michigan; Craig Harris at Michigan State; Gerad Middendorf at Kansas State University; and Peter Kareiva at The Nature Conservancy. Full information on this research collaboration is available at http://ces.asu.edu/agtrans/.

11/02-10/05: Scott Pearson: continued collaboration with John Gerwin (NC Museum of Natural History), Alan Smith (Mars Hill College) and Curtis Smalling (National Audubon Society) on inventory of bird species found on Blue Ridge Parkway and Carl Sandburg National Historic Site (funding from National Park Service), and the taxonomy, geographic distribution, and habitat requirements of the Appalachian yellow-bellied sapsucker (funding from US Fish & Wildlife Service).

11/02-10/05: Ron Pulliam: collaboration with Robert Harris, Cornell U, on the experimental transplants at Coweeta.

11/02-10/04: Jim Vose: A collaboration with Dr. Larry Band, University of North Carolina-Chapel Hill and the Baltimore Ecosystem LTER, is directed at a cross-site comparison of streamflow and water quality. The research will use large scale models to examine contemporary and future impacts of land use change (i.e., development) on water resources. It will also examine scaling issues to determine how fine-scale disturbances (i.e., subwatershed level development or forest harvesting) integrate to influence large scale hydrologic responses.

11/02-10/04: J. B. Wallace: 1999-Present, appointed by conservation groups to work with U.S. E.P.A., Fish & Wildlife Service, U.S. Army Corps of Engr., and Office of Surface Mining to review an Environmental Impact Statement for the practice of Mountaintop Removal and Valley Filling (MTR/VF) as currently being practiced in the central Appalachian region following a Settlement between the WVA Highlands Conservancy, Lawyers for Public Justice, and Federal Agencies in the southern district Federal Court, Charleston, WVA. Drafting court affidavits for use by Trial Lawyers for Public Justice, Washington, DC about the potential adverse impacts of Valley Fills for Mountaintop Mining of coal in central Appalachians on stream communities.

11/02-10/04: Brian Kloeppel: Collaborations with Dr. Jacek Oleksyn, Poland Academy of Sciences at the Institute of Dendrology in Kornik,

Poland and Dr. Adolf Korczyk, of the Poland Academy of Sciences at the Forest Research Institute in the Białowieża National Park in Białowieża, Poland to conduct international LTER studies in Poland (NSF). The studies use the natural 13C isotope signals in wood to determine the impact of historic (>300 years to present) changing CO2 regimes on water use efficiency. A related study compares the foliar natural 13C ratio of 12 populations of Norway spruce (Picea abies) along its native elevational gradient in the Tatra Mountains as well as in a 12-year-old common garden site from the same seed source to determine if water-use efficiency depends more on genetic or microsite factors.

11/02-10/04: David Coleman: A collaboration with Dr. Barny Whitman, to develop an International workshop on the molecular basis of soil biodiversity with Dr. Chih-Yu Chiu and Prof. T.M. Shao of the Academia Sinica, and Dr. Hen-Biau King, Taiwan Institute of Forestry Research. The conference will be held in Taipei on April 18-24, 2004, and will involve persons from six+ LTER sites as well as several foreign countries.

11/02-10/04: Gary Grossman: collaborating with Dr. Pedro Rincon, National Museum of Natural History, Madrid Spain, on fish foraging efficiency.

11/03-10/04: Kitti Reynolds: collaborating with Dr. Stephanie Madson, Warnell School of Forest Resources, UGA, on the soil microarthropod project in experimental gap plots at Coweeta Hydrologic Laboratory.

01/04-10/04: Ted Gragson: collaborating with Emilio Moran and others from Indiana University at Bloomington on NSF-Science and Technology Center proposal (selected for a site review in September 2004) for an 'Integrative Science Center for Environmental Solutions and Education.' The proposed Center will integrate and synthesize research produced by a diverse group of social, natural and physical scientists into a consistent, quantitative understanding of human-environment dynamics in eastern North America and the Amazon Basin of South America. The objective is to provide innovative ways to disseminate understanding of these ecosystems among K-12, undergraduate and graduate students, industry, environmental NGOs, and civil society to facilitate the formulation of environmental solutions to the most pressing problems defined by these stakeholders.

Activities and Findings

Research and Education Activities:

The research objective of the 2002-2008 Coweeta LTER is to advance scientific understanding of the spatial, temporal, and decision-making components of land use and land-use change in the southern Appalachian Mountains over the last 200 years, and forecast patterns into the future 30 years. Our guiding hypothesis is that the frequency, intensity, and extent of land use represents human decision-making in response to socioeconomic and biogeophysical conditions with consequences that cascade through ecosystems.

11/04-10/05

Activities this year depended in their entirety on the current Coweeta LTER award (DEB-0218001) or leveraged Coweeta LTER funding or installations to obtain funding from NSF, National Park Service, NASA, US Natural Resource Conservation Service, EPA, DOE, US Forest Service, or McIntire-Stennis formula funding to the U of Georgia Warnell School of Forest Resources. Activities this year include:

1. Measured litter breakdown rates, standing stocks of benthic organic matter (BOM) and litter input in 3 streams draining a clear-cut (WS7) and three streams draining a long-term reference site (WS14).

2. Measured responses of macroinvertebrate and fish, litter breakdown rates, standing stocks of BOM, whole-stream metabloism, detailed stream geomorphology, and detailed land cover using GIS and path analysis to link land cover change with specific responses of biota in three streams.

3. Established three climate stations at two forest plots on Mars Hill College campus.

4. Reconstructed land use over the past 140 years using aereal photography and historical cartography.

5. Modeled early native American ecological footprints using historical cartography, historical census records and resource abundance measures.

6. Completed testing reactive distances and capture success of the rosyside dace at multiple turbidity levels and two temperatures.

7. Assessed the impact of land use on water quantity and quality through an evaluation of surface runoff models and their sensitivity to land use.

8. Quantified differences in community composition in understory forest stands with different land use histories to test hypotheses about mechanisms that explain land use effects including anthropogenic alterations to soil chemistry on understory species.

9. Inventoried understory and overstory populations at long-term forest plots on Mars Hill College campus.

10. Conducted bird inventory of Blue Ridge Parkway and Carl Sandburg Home to test hypotheses related to trends in species abundance related to elevation, land cover, and latitude.

11. Designed and developed laboratory methods to characterize soil organic carbon dynamics and related microbial activity. These include (a) Long-term soil incubations to characterize size of the active, slow and passive SOC pools as routinely defined in soil organic carbon models such as Century and Rothamsted; (b) a modified methodology for estimation of microbial biomass C & N that overcomes the two key limitations of the currently most-recognized & routine methodology: CFE (chloroform-fumigation & extraction).

12. Using long-term census plot and large experimental gap data parameterized models to predict future changes in landuse and climate.

13. Installed arrays of light sensors, TDR (soil water), and soil and air temperature sensors on 12 permanent hemlock plots to collect data using automated technologies.

14. Carried out measurements on 1st order catchments of stream water chemistry and TSS, soil CO2 evolution, litter decomposition, soil microarthropods, litter and wood inputs, soil temperature and moisture, coarse woody debris amounts and associated C and N pools, use of riparian areas by bats and salamanders, soil chemistry, soil solution chemistry including DOC, woody and herbaceous vegetation.

15. Conducted a 183d study of leaf litter species diversity on decay rate (k), chemical diversity, microbial biomass, and macroinvertebrate community composition in the stream-riparian interface.

16. Experimentally examined nutrient effects in situ using clay saucers enriched with nitrogen- and phosphorus-releasing fertilizer pellets, and simultaneously examined the top-down control of algal growth by excluding macroconsumers (fish and crayfish) using an electric exclusion technique, and excluding snails manually, in a 2 x 3 factorial design over a 40 day period.

17. Sampled nutrient chemistry and algae at selected stream sites to evaluate the response of stream chemistry and algal primary producers to hemlock death.

18. Second-round sampling of all Hazard Sites (previously sampled in 2000) with measurements made on water chemistry, channel geomorphology, and community structure of algae, macroinvertebrates, and fishes.

19. DNA probing using 18 S rRNA of fungal gut contents on beetles and Oribatid mites.

20. Analyzed the effect of drought on the severity of white pine mortality due to southern pine beetle and the overall effect on watershed hydrologic dynamics.

21. Collected water samples, soil samples, and stream morphology/sedimentology measurements on stream 'end-members' of human impact; analyzed data to characterize sedimentation history of streams.

22. Ring widths of tree cores (n~800) measured to the nearest 0.01 mm with a Velmex system and J2X software, then visually cross-dated using marker years that was then checked with COFECHA. Disturbance chronologies and intensity for each stand were prepared based on age distribution can canopy structure.

23. Measurements made of herb density, distribution, and demography along with physical environment (i.e., PAR, soil moisture, temperature, texture and nutrients) on 14 study grids at Coweeta and elsewhere in the study region

24. Experimental transplants and common gardens monitored at Coweeta and Nancytown, and two new subplots established at Nancytown.

25. Analyzed long term data to determine the relative importance of density dependent and density independent population regulation,

including the use of artificial neural networks and evolutionary algorithm approaches to habitat modeling.

26. Experiment established to look at the effect of increased turbidity on the reactive distance, capture success and behavioral interactions of the rosyside dace (a native species) and the yellowfin shiner (an introduced species in the Little Tennessee drainage).

27. Used PCR and sequencing to identify different mycorrhizae occurring on roots of three host species characteristic of high elevation, hardwood forests in the Coweeta basin.

28. Used scanned images of root fragments to determine topological parameters including altitude, magnitude, and total exterior path-length in order to compare the topology of roots colonized by different mycorrhizae.

29. Collected coarse woody debris samples from across the vegetation gradient in the Coweeta basin to scale up to weight and area.

30. Compared hydrologic dynamics of evergreen and deciduous watersheds at Coweeta Hydrologic Laboratory.

31. Measurements of primary production, litter inputs, leaf and wood decomposition, and nitrogen and phosphorus dynamics made to determine functional response of streams to disturbance.

32. Measured long-term productivity of vegetation gradients in southern Appalachian ecosystems.

33. Measured impacts of native and exotic insects on forest and aquatic ecosystem function.

34. Installed a field tracer study using 15N labeled P-T complexes to quantify movement of 15N into soil pools and root biomass.

35. Video images of root production and mortality were collected on forest herb species for species with extensive prior above ground demography and growth data.

36. Manipulated leaf litter diversity and measured rates of decomposition, nutrient dynamics, faunal community composition and microbial activity.

37. Measured nutrient availability in soil solution and rates of nitrogen mineralization to predict how losses of hemlock in the southern Appalachians might affect nutrient dynamics at watershed scales.

38. Measured soil, forest floor and coarse woody debris across vegetation gradient in the Coweeta basin to characterize terrestrial C pools in vegetation types.

39. Manipulated the presence and absence of birds to assess whether plant productivity, plant quality, or predation pressure has the greatest impact upon oak herbivores.

40. Held Coweeta LTER mid-term review at Coweeta Hydrologic Laboratory, June 28-29, 2005.

One or more presentations were given at each of the following meetings:
1. Geological Society of America Annual Meeting, Salt lake City, UT Oct 16-19, 2005.
2. North American Benthological Society 53rd Annual Meeting, New Orleans, La May 22-27, 2005.
3. Ecological Society of America 90th Annual Meeting, Montreal, Canada, August 1-5, 2005.
4. American Society of Ichthyologist and Herpetologists, Tampa, Fl, July 6-11, 2005.
5. Annual Meeting of the Soil Ecology Society, Argonne National Laboratory, Illinois, May 22-25, 2005.
6. Southeastern Ecology and Evolution Conference, Athens, GA, March 11-13, 2005.
7. International Canopy Symposium in Leipzig, Germany, July 10-17, 2005.
8. American Society of Limnology and Oceanography meeting, Salt Lake City, Utah, February 20-25, 2005.
9. Blue Ridge Undergraduate Research Conference in Bristol, VA
10. East Tennessee Research Conference, Johnson City, TN
11. U of North Carolina Asheville Sigma Xi meeting, Asheville, NC.

Invited seminars were given at the following institutions:
1. National Academy of Sciences (Plenary Speaker), Irvine, CA.
2. Colloquium at the University of Michigan.

3. Colloquium at the University of Maryland.
4. Colloquium at Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
5. Harvard Forest, Petersham, Massachusetts

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11/03-10/04
Numerous experimental, observational, monitoring and study set-up activities were carried out this year. These activiteis depended in their entirety on the current Coweeta LTER award (DEB-0218001), followed-up on activities initiated with funding from the previous Coweeta LTER award (DEB-9632854), or leveraged the current funding and existing Coweeta LTER installations to obtain additional funding from: NSF (ECL, DEB, INT, GEO and SBE), National Park Service, NASA, US Fish & Wildlife Service, DOE, US Forest Service (various), EPA, McIntire-Stennis formula funding to the University of Georgia D.B. Warnell School of Forest Resources, the Wetlands Society, and the University of Georgia Center for Biodiversity and Ecosystem Processes. Activities this year include:

1. Measured litter input, litter breakdown rates, and standing stocks of benthic organic matter (BOM) in 3 streams draining a clear-cut (WS7) and three streams draining a long-term reference site (WS14). The objective is to understand the legacy effects of disturbing southern Appalachian forest stands on associated streams.

2. Measured responses of macroinvertebrate and fish, litter breakdown rates, standing stocks of BOM, whole-stream metabloism, detailed strem geomorphology, and detailed land cover using GIS. The purpose is to compare streams draining agricultural areas with forested streams, agricultural vs urban streams, rapidly urbanizing streams vs slowly urbanizing streams, and old growth vs logged streams.

3. Quantified land use trajectories in the southern Appalachian Mountains over the past 300 years. Previous research shows that human-induced land use change is one of two primary factors influencing aquatic and terrestrial structure and function in the region. Identifying causal relationships prior to the Coweeta LTER research was hindered because specific land use is unknown for most of the region prior to the 1970s or for the region at large prior to the 1950s.

4. Determined impacts of landuse change on sediment generation and transport in Appalachian landscapes. The type and distribution of land uses during the 19th and 20th centuries would suggest dramatic shifts in the generation and transport of sediment across the region, but previous research has been largely inferential as to the magnitude of the effect.

5. Described and quantified forest carbon cycling in southern Appalachian forests. While general relationships between environmental variables, age, forest structure, and carbon pools and fluxes are well understood for most species and community types these relationships are not quantified so it is not possible to effectively model stand-to-landscape level carbon cycles.

6. Six stands were selected at Coweeta and two at Joyce Kilmer Memorial Forest along a moisture gradient within the oak (-chestnut) forest type. Prism sampling (2 or 3 BAF, metric) was done at ten points spaced along transects in each stand to characterize composition and structure; species, diameter at breast height (1.37 m), height, and crown class were recorded for each tree greater than 10 cm DBH along with stand slope, aspect and elevation. All trees tallied were cored (~800), and prepared for analysis using Velmex system the computer cross-dating program COFECHA.

7. Experimentally determined the effect of turbidity on river chub foraging efficiency using tanks and initiated similar experiments on rosyside dace. Continued long-term population sampling at three permanent sites in the Coweeta Creek Drainage.

8. Measured across a matched set of streams the relation between particle size in streams, distribution of fish species and habitat using common metrics of habitat: the EPA categories based on water surface appearance, and the Froude number that incorporates water column/bottom interactions. Objective is to determine the possible impact of watershed deforestation on the progressive displacement of endemic, specialist southeastern species by widespread, generalist fish species.

9. Measured below ground productivity, quantifying mycorrhizal community composition and structure, and quantifying root system architecture. Objective is to understand role of ecto- and ericoid mycorrhizae and soil/litter chemistry in regulating nutrient pools and acquisition in Rhododendron maximum-Hardwood forests.

10. Measured the impact different mycorrhizal types have on root system architecture of host species using PCR and sequencing. Scanned images of each root fragment were used to determine topological parameters including altitude, magnitude, and total exterior path-length to serve as the basis for comparing the topology of roots colonized by different mycorrhizae.

11. Litter diversity was manipulated in soils and streams, and decomposition and nutrient dynamics were catalogued. The objective is to determine whether tree species diversity matter to ecosystem function in riparian and stream systems. Experiments are less than a year old and there are no results to report at this early stage.

12. Determined the location and size of all Cherokee towns for selected dates between 1685 and 1775 using historical cartography and colonial census records. Information was then digitized, cross-validated and georeferenced to correlate it with various physical and cultural factors. The objective is to determine Colonial Cherokee time- and space-specific disturbance as a function of resource use and political economic relations.

13. Using a diversity of North Carolina State records and Federal records, an 80-year sequence (~1920-2000) consisting of approximately 15,000 fire events on state and federal lands was compiled. This record is now being analyzed to develop a comprehensive temporal (day-of-the-week, month, year, decade, period) and spatial (area, county, management unit) description of fire for the region.

14. Began instrumenting 20 permanent plots and 12 experimental plots for a long-term study of how adelgid-induced hemlock mortality influences nitrogen dynamics, mycorrhizal diversity, and salamander diversity. The objective is to determine the effect of hemlock woolly adelgid on ecosystem structure and function at Coweeta.

15. An experiment is being set up to begin March 2005 in which birds will be excluded from oak branches at various elevations at Coweeta to see how insect populations respond. Objective is to determine the effect of soil nutrients and elevation on the interactions between birds and insects on oaks, with the expectation of tieing predator-prey interactions to soil quality along an elevation gradient.

16. Re-measurement conducted of five 80x 80 m Gradient Plots established 1991 in the Coweeta Basin. Determinations included sampling all 3 organic layer horizons (Oi, Oe, and Oa layers); samples were weighed following oven-drying then ground for chemical analysis. Forest floor mass and coarse woody debris (greater than 1 m in length and greater than 7 cm in diameter) volume, length and diameter were also re-measured then each piece was tagged and put in one of 5 decay classes. Objective is to determine long-term changes in forest floor and soil processes in southern Appalachian forests under the hypothesis that as forests age in the Coweeta basin, coarse woody debris will become a larger component of the forest floor and a more important factor in the regulation of nutrient cycling.

17. Collected water samples, soil samples and completed morphology and sedimentology measurements on matched streams representing 'end-members' of human impact. Objective is to determine sedimentation history of streams in the study region and the measurable extent of human-impact on stream morphology, sedimentology, floods, and water quality.

18. Established herb and tree demography plots along an elevational gradient from North Georgia to Western North Carolina in the French Broad and Little Tennessee watersheds.

19. Monitored breeding bird responses to artificial gaps created in Coweeta watersheds; carried out inventory of bird species on the Blue Ridge Parkway and Carl Sandburg National Historic Site; and, carried out research on the taxonomy, geographic distribution, and habitat requirements of the Appalachian yellow-bellied sapsucker. The objective is to determine effects of land use history, abiotic gradients, and landscape change on plant & animal communities of the Southern Blue Ridge Mountains.

20. Carried out a 183d study at the Coweeta Hydrologic Laboratory to assess the effect of leaf litter species diversity on decay rate (k), chemical diversity, microbial biomass, and macroinvertebrate community composition in the stream-riparian interface. Objective is to examine the land-water interface as one ecosystem; comparable methods are being used to detect patterns in decomposition between terrestrial and aquatic ecosystems.

21. Experimentally examined nutrient effects of different consumer assemblages on algae in situ (an Appalachian stream in north Georgia) by using clay saucers enriched with nitrogen- and phosphorus-releasing fertilizer pellets. Top-down control of algal growth was measured by a) excluding macroconsumers (fish and crayfish) using an electric exclusion technique, and b) excluding snails manually, in a 2 x 3 factorial design over a 40 day period. The effect of nutrient loading on the biotic integrity of streams is of great concern, given increased anthropogenic inputs common in agricultural and urban environments. However, few studies have addressed the potential of top-down forces to regulate the increase in primary production that often results.

22. Measurements carried out on herb density, distribution, and demography; in addition, physical environment parameters (PAR, soil moisture, temperature, texture and nutrients) were monitored on 14 study grids at Coweeta and elsewhere in the study region. Experimental transplants and common gardens were monitored at Coweeta and Nancytown, and additional subplots were established at Nancytown and Mars Hill to accommodate an expanded research protocol. The objective is to focus on understory plant demography and distribution for the purpose of forecasting change in forest understory herbs in relation to climate and land use change.

23. Measured soil microarthropod numbers and community structure seasonally at Coweeta, Mars Hill and Pisgah National Forest, NC, and Nancytown, GA. Objective is to compare minimally disturbed sites with sites which were recently logged or post-agricultural in order to determine the effects of disturbance on soil arthropods contributing to litter decomposition.

24. Initiated a litter bag decomposition study in the experimental gap plots at Coweeta in order to compare litter and soil microarthropod communities as to their effect on decomposition rates to results from the recently-established plots at Nancytown and Mars Hill.

25. Conducted long-term follow up study on the effects of clear-cut logging on WS 7 at Coweeta on benthic fauna and organic matter standing crop, as well as long-term study of large wood additions to Cunningham Creek.

26. Continued whole system manipulations of litter and nutrient additions to headwater streams. In one experiment on the 7th-order Little Tennessee River, varying amounts of Podostemum ceratophyllum (Michx) were added and its influence on macroinvertebrate abundance, biomass, community composition, and functional feeding group structure determined. Previous research indicates that Podostemum is associated with extremely high secondary production of benthic macroinvertebrates in open-canopy rapids. In a second experiment, a headwater stream was enriched with dextrose, and a quick assimilation of the labile carbon source into all functional groups of stream animals was observed.

27. Econometric spatial modeling was carried out of housing and land choice as a function of household characteristics, community characteristics and site-specific attributes. Hedonic values in urban and rural communities across Southern Appalachia were developed using 1990 US Census block data from the region. This model of demand bridges the broad and fine scales of economic analysis of land use by examining community choices (broad units) in conjunction with site-specific housing demand (fine-scale units).

28. Forecasting group (e.g., J. Clark, B. Kloeppel, P. Bolstad, J. Vose, M. Hunter, D. Coleman, T. Gragson, D. Leigh, S. Pearson, R. Pulliam, D. Wear, M. Turner) met on three separate occasions and developed a conceptual framework for modeling carbon and water balance using a hierarchical Bayesian approach.

One or more presentations were given at each of the following meetings:
1. 52nd Annual Meeting of the North American Benthological Society, Vancouver, BC. June, 2004.
2. 18th Annual Meeting of the Society for Conservation Biology, New York. July 2004.
3. Annual Meeting of the Ecological Society of America, Portland, OR. August 2004.
4. 84th Annual Meeting of the American Society of Ichthyologists and Herpetologists, Norman, OK. May 2004.
5. Annual Meeting of the Geological Society of America, Seattle, WA. November 2003.
6. Annual Meeting of the Association of American Geographers, Philadelphia. March 2004.
7. Joint Annual Meeting of the International Geographical Conference and the International Geomorphological Union, Glasgow, Scotland. August 2004.
8. 2nd International Wildland Fire Ecology and Fire Management Congress, Orlando, FL. November 2003.
9. Annual Meeting of the Social Science History Association. Baltimore, MA. November 2003.
10. Biennial Conference on the Ecology and Evolutionary Ethology of Fishes. Saudßrkr¾kur, Iceland. August 2004.

Invited seminars were given at the following institutions:
1. Department of Biology, University Karlstad, Karlstad Sweden
2. Department of Biology, Virginia Commonwealth University
3. Department of Biology, Clemson University
4. Marine Sciences, University of South Carolina

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11/02-10/03
The major research activity in Year 1 was the organization of the research activities and initial compilation of information relative to the characterization of the socio-natural template (Initiative 1). Organizational aspects of this activity were carried out at our two regular meetings of the Coweeta LTER: the All-PI Winter 2003 Meeting (7-8 January), and the Summer 2003 Science Meeting (June 24-25). Full reports and presentations are available at: http://cwt33.ecology.uga.edu/science_meeting/archives.html. Following are highlights from these meetings.

The All-PI Winter meeting was organizational in nature since funding had just been received by the University of Georgia, and research accounts had not yet been established. The main outcome was the consensus on developing study plans for individual research themes as outlined in the proposal. The Summer Science Meeting convened all investigators and their students to report on the progress-to-date of their

research activities or advances in planning their research. Six students prepared posters for the 1st Coweeta Student Poster competition with a prize to the winner in support of their research. This year's winner was Chris Frost with a poster entitled 'Frass from Canopy Herbivores Increases Soil Nitrogen, Carbon, and Nitrogen Export from Quercus rubra Mini-ecosystems.' We also had two invited presentations by researchers working in the region and/or on topics relevant to the Coweeta LTER program. J. Hilten presented on the 'All Taxa Biotic Inventory' at the Great Smoky Mountains National Park while B. Clinton and P. Gulusky described their rhododendron ecophysiology research.

There have been several interrelated research activities over the past year focused on improving the temporal sampling of our land use data: 1) increasing the spatial and categorical detail and accuracy of current and recent historical land use information; and 2) extending the time period of land use back to the late 17th century. The results from these activities will serve as the basis for testing a number of hypotheses on techniques (e.g., categorical detail/accuracy tradeoffs in multi-scale data, quantification of classification accuracy for high-resolution spatial data, mapping sub-canopy features on high-resolution data). It will also be used to establish the location and pattern of disturbance (a disaggregation of disturbance through time with the change from a primarily agricultural to a diversified service economy with related changes in riparian vegetation). Finally, anthropogenic disturbance trajectories will be derived that reveal, for example, the divergence in disturbance regimes on public vs. private lands.

During summer 2003, the Coweeta LTER program sponsored three REU students. Davis C. Pinner worked with Dr. Katherine J. Elliott (Coweeta Hydrologic Laboratory) on dendroecological reconstruction of the disturbance history of Coweeta Basin. Hunter M. Keyes worked with Dr. Mark Hunter (University of Georgia) on the ecosystem effects of the hemlock wooly adelgid in the southern Appalachian region. Finally, Kenneth D. Marcus worked with Dr. Jennifer Knoepp (Coweeta Hydrologic Laboratory) on the nutrient content and bulk density determination of coarse woody debris in the Coweeta Basin.

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

11/04-10/05

Key findings from the various activities described above are bulleted below. Selected results that are particularly interesting or noteworthy are on the attached PDF file with related figures and citations.

1. We have documented stream degradation resulting from forest management practices, agricultural practices and urban development by our short and long-term studies of macroinvertebrate and fish biodiversity, disturbance of stream habitat due to sedimentation and flashy flows, and disturbance to stream processes like decompositon, metabolism, and primary production.

2. Direct evidence and modeled results indicate that suitable agricultural land, village land, hard mast, and fuelwood were not limiting to Native American settlement, however, white-tailed deer where given their levels of utilization.

3. Streams of order 1 and 2 are poorly represented in spatial data in the southern Appalachians, and existing terrain extraction methods suffer from a number of problems. We are developing new methods to substantially improve stream representation.

4. We have determined the extent to which different tree species are limited by recruitment, growth, and mortality and the impact of environmental variation on these demographic rates.

5. Based on results from one sampled stand, 2.2% of oaks on average showed major releases per decade (100% increase in average ring width for one 10-year period relative to the average for the preceding 10 years); another 4.5% of the oaks showed moderate releases per decade (60%-99% growth increase); and, 11.1% showed minor releases per decade (25%-59% growth increase). These preliminary results show major releases occurring as far back as the 1700s although they were not evenly distributed throughout the decades. Forty percent of the oaks experienced moderate or major releases in the 1920s and 1930s coinciding with a time of known logging and the spread of the chestnut blight.

6. Stream fishes' reactive distances and capture success are negatively impacted by increasing turbidity levels. However, the degree of this impact depends on the particular species and is also influenced by water temperature. We did not see any difference in responses due to size differences in the species.

7. Turbidity had a negative affect on the foraging success of rosyside dace by reducing reactive distance and capture success. It appears that rosyside dace forage better at a given turbidity in spring/autumn temperature conditions as they had longer reactive distances and higher capture success. However there is an interaction effect between turbidity and temperature on reactive distance and it suggests that reactive distance is more drastically reduced by slight increases in turbidity at spring/autumn temperatures than at summer temperatures. There was no interaction effect between turbidity and temperature on capture success although both were individually significant. There was no effect of size on reactive distance or capture success with increasing turbidity.

8. Human impact is well expressed in terms of water quality parameters (nutrients, other chemical constituents, suspended sediment, temperature, etc.), but that degradation of water quality has not reached levels similar to those of more populated areas like the Piedmont physiographic province. While readily apparent, the levels of water quality degradation are not at levels generally accepted as 'polluted' or 'impaired'.

9. Stream morphology and sedimentology are less well expressed as they relate to human impact. Historical sedimentation rates are rapid, approximately an order of magnitude greater than prehistoric time, but stream morphology does not bear a distinct signature related to human impact. Current levels of human impact (last 40 years) appear to be similar to early periods of human impact (circa 1850-1960) in terms of historical sedimentation rates on river and stream floodplains.

10. Analysis of river chub data at one temperature level indicates that prey capture success at the lower turbidity levels (0, 5, and 10 NTU's) were significantly higher from prey capture successes at the increased turbidity levels (15, 20, and 25 NTU's). In regards to reactive distance, chubs had significantly lower average reactive distances at 0, 15, and 20 NTUs, respectively.

11. Conversion of forest cover in the region to agricultural and urban land uses is associated with changes to stream water chemistry, channel geomorphology, and shifts in biological community structure.

12. Endemic fishes with specialized ecological attributes are replaced by more generalized widespread fishes, with implications for species conservation.

13. Since ERM roots are concentrated in the O horizons, it is suggestive that ERM fungi are responsible for greater PPO activity in these horizons. From a reciprocal litter enzyme study, leaf litter type was not responsible for PPO activities, but location under R maximum was associated with greater PPO activity ($p=0.05$). These data suggest that ERM fungi are driving greater PPO activity under R maximum and mediating the acquisition of this complexed organic N to its host.

14. We have shown that riparian areas and streams respond differently to changes in litter diversity. The identity of litter appears to be of prime importance in the stream, whereas it matters less in the terrestrial environment.

15. We have made major progress this year on modeling the distributional responses of forest herbs to variation in light and moisture, and the plant-fungal interactions for one species, Goodyera pubescens. Moisture has an especially strong inflence on the distribution, abundance and demograpy of most species. Light levels have less influence on distribution but, in some species, sexual reproduction is promoted by increased light availability as occurs in treefall gaps.

16. Coweeta soils show no major changes in nitrogen dynamics during hemlock dieback, although we expect that to change over time.

17. Findings indicate that snails have a regulatory effect on algal biomass, preventing increased algal standing crop accrual when nutrients were added. Macroconsumers had less of a direct effect on algal biomass, suggesting that algivorous and omnivorous species are not significant grazers, compared to snails.

18. Our research on soil microarthropods and decomposition has shown that prior to the gap formation there were significant seasonal effects on soil microarthropod communities. Since the gap was formed, there has been a decrease in soil microarthropod numbers in plots directly affected by the gap opening compared to control sites and the plots before gap formation occurred.

19. The effects of land use history vary with respect to the life history and habitat requirements of different forest-dwelling taxa. For plants and animals, dispersal ability and habitat specialization have strong influences on the ability to colonize new habitats. Species with limited dispersal ability are often absent in isolated, small patches of forest after anthropogenic disturbance while generalist, well-dispersed species are little affected by land use history and habitat fragmentation. Recovery from past land use depends on the type and intensity of the disturbance.

20. The breeding populations of the Appalachian Yellow-bellied Sapsucker are confined to western NC with small breeding groups in the high mountains of eastern TN, and southwestern VA. Breeding populations are found at elevations of 900 - 1500 m, most frequently around 1200 m in high elevation coves and moderately exposed slope positions. Forest stands preferred for breeding must include trees >35 cm dbh. These stands typically include a large component of red oak (Quercus rubra), maple (Acer spp), and black locust (Robinia pseudoacaia).

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11/03-10/04

Human land use alterations are the largest single disturbance factor in southern Appalachia, and the type and extent of disturbance has varied in three distinct periods. Although difficult to quantify directly, pre-Euroamerican (pre 1720) impacts were small, indirect, and largest in their affects through harvest of the dominant herbivores. Quality and reach of information about the second period (1720-1920) is substantial making it possible to quantity the widespread clearing and agriculture, with attendant changes in aquatic and terrestrial environments. The third period, from 1920 to present, is characterized by agricultural abandonment, urban development and migration to perhipheral and a few interior economic centers, and the gentrification and influx of retirees.

Our research on colonial period Cherokee has enabled us to generate the first spatially- and temporally-specific evaluation of Cherokee disturbance during the period of initial contact. From Colonial eye-witness accounts (traveler-explorers, military expeditions, etc.), regional archaeological and geophysical evidence, and ethnohistoric information and analogy, per-unit (person, household and town) distinct footprints have been determined for: settlement; agriculture; tree nut harvest; firewood; and deer hunting. This information is critical for understanding human disturbance in the Southeast. This research covers the initial sustained contact between the Cherokee and European populations; the establishment of the Cherokee political and economic alliance with the British; the emergence of a Cherokee native state; and, the final collapse of the traditional Cherokee system.

Our research during the 19th century indicates the period from 1880 to 1911 as one of comprehensive political reform. Among other effects, this political reform thoroughly transforms the southern Appalachian fire regime simultaneous to the extensive regional penetration of railroads and the dramatic rise in commercial forestry. Important questions we are addressing about this period include: Who causes fires? Why are fires started? What is the frequency of fires? What is the acreage burned by fires? With the most comprehensive and continuous record of fire for western North Carolina now in place, we are able to determine patterns of cause, magnitude and recurrence in fire events.

In our research on contemporary human populations of southern Appalachia we have demonstrated that it is unrealistic to predict land use based strictly on physical, locational, or topographic evaluation of land potential. Our research reveals how demographic and community 'landscapes' are the context for making land use decisions. The marginal effects of household characteristics and community attributes in community choices indicate that more conservative, less crowded, safer, and more stable communities attract more households regardless of the type of community. More educated communities attract more households in the urban-moderate communities and cleaner air quality attracts more households in the rural communities. There is thus a distinct heterogeneity across the region in land choice: socioeconomic factors are critical to urban communities while environmental motives are critical to rural communities in making housing decisions.

The effects of land use across time vary with respect to the life history and habitat requirements of different forest-dwelling taxa. For this reason, much of our research effort on non-human populations has focused on type and intensity of disturbance. For plants and animals, dispersal ability and habitat specialization have strong influences on the ability to colonize new habitats. Species with limited dispersal ability are often absent in isolated, small patches of forest after anthropogenic disturbance while generalist, well-dispersed species are little affected by land use history and habitat fragmentation. We have furthermore shown that for some herbs, soil moisture has a stonger influence on distribution and abundance than other factoirs like light and soil nutrients. Light levels have little influence on distribution but in some species, sexual reproduction is promoted by increased light availability as occurs in treefall gaps. Studies of genetic variability of some of the species have shown high levels of heterozygosity and common garden experiments indicate a high degree of local adaptation. Recent work indicates that plant fungal interactions may play an important role in patterns of distribution and abundance.

Our research on below ground processes have allowed us to determine the differential distribution throughout the soil horizon of ecto-, ericoid and arbuscular mucorrhizal fungi (the three types dominant at Coweeta). ERM fungi occurred predominately in O horizons and AM fungi occurred mainly in B horizons. The majority of ECM fungi were located within the B horizon but were found in the O and B as well. ERM fungi were correlated with high concentrations of inorganic N and organic N and P. AM fungi were negatively correlated with inorganic and organic N, while ECM occurred throughout the N and P fraction distribution. We hypothesize that this fungal distribution relates to the capacity of each fungal type to use various soil substrates as nutrient sources. There is no noticeable effect of ECM groups on root topology.

Human land use has resulted in substantial increases in sediment generation and transport in the southern Appalachian mountains. Models show sediment generation that is two to four orders of magnitude higher in altered vs. undisturbed systems. These rates are sustained over both the agricultural and urbanization periods, with inputs from unpaved roads replacing row-crop agriculture as the primary source of sediment. These alterations have had significant impacts on both upland and aquatic ecosystem structure and function. Aquatic communities depend largely on substrate characteristics, which in turn depends on the sedimentation history of the basin above the stream reach. In general, historical sedimentation rates are rapid and approximately an order of magnitude greater than prehistoric rates. However, stream morphology does not bear a distinct signature of human impact so that current levels of human impact (last 40 years) appear to be similar to early periods of human impact (circa 1850-1960) in terms of historical sedimentation rates on river and stream floodplains.

Southern Appalachian aquatic ecosystems respond predictably to watershed disturbance based on landscape context, historical conditions, temporal trajectory, and spatial extent of disturbance. Diversity of fishes is influenced by landscape change through alteration of aquatic

habitats, manifested as a decline of endemic highland taxa and their replacement by more widespread, 'weedy' species. This pattern is congruent with a general process of biotic homogenization that renders formerly distinct regional biotas more similar to each other, ultimately resulting in loss of continental and global biological diversity. We have furthermore demonstrated that stream metrics that focus on water surface appearance are not as sensitive to changes in fish habitat as those that incorporate water column/bottom interactions. This result makes sense because fishes interact with the entire water column, not just the surface. It is anticipated that these results will improve the way stream habitats are evaluated, not just for fishes but for all species that live in flowing water and are affected by anthropogenic impacts

Human impact on Appalachian streams is of a moderate magnitude and expressed most significantly in terms of water quality parameters (nutrients, other chemical constituents, suspended sediment, temperature, etc.). However, the degradation of water quality has not reached levels similar to those of more populated areas like the Piedmont physiographic province. As such, while readily apparent, the level of water quality degradation do not yet reach those of 'polluted' or 'impaired.'

We have demonstrated that decomposition of organic material is a fundamental ecological process that influences nutrient cycling and energy flow in southern Appalachian ecosystems. In forested streams, allochthonous organic matter is a primary food resource; the structure and dynamics of these ecosystems are directly linked to the availability and quality of leaf litter inputs. Leaves with decreased lignin, lower tannin and phenolics, and higher C:N exhibit faster rates of decay and are more bioaccessible to consumers. Since different leaves have different decay rates, the temporal and spatial bioavailability of different leaf species as food sources to aquatic micro- and macroconsumers is variable. Changes in land-use often cause reductions in species diversity of native plants and result in the addition of exotic species.

Our findings indicate that snails have a regulatory effect on algal biomass, preventing increased algal standing crop accrual when nutrients were added. Macroconsumers have a less direct effect on algal biomass, suggesting that algivorous and omnivorous species are not significant grazers, compared to snails, in this stream. However, our data suggest that insectivorous and omnivorous species did regulate invertebrate grazer biomass, indirectly leading to more algal biomass than we predicted for plots with both snails and macroconsumers present. Although insect grazer densities were not significantly different between treatments, dominant species were Baetid mayflies (Baetidae: Ephemeroptera), which are highly motile.
Overall, our results suggest that feeding behaviors of dominant fish species and crayfish, as well as invertebrate grazers, could be a significant factor in the regulation of increased algal biomass due to nutrient loading. Impending multivariate analysis of both biotic and abiotic parameters will help to elucidate observed patterns in algal biomass and invertebrate densities. Algal taxa identification (currently in progress) will also illustrate nutrient and grazer effects on algal community composition. These results are also critical to interpreting the algal data obtained within the Hazard Site Project since it provides information on algal indicator taxa in different nutrient regimes.

11/02-10/03
A unifying theme of both present and historic Coweeta LTER research is the quantification of ecological responses to natural and anthropogenic disturbance on levels ranging from the organism to the ecosystem. To build on our core research effort, we are undertaking a number of activities directed at cross-site and synthetic research. These activities are directly tied to our future efforts of constructing and validating explicit forecast scenarios on the response-trajectories of terrestrial and aquatic systems to natural and anthropogenic disturbance.

Training and Development:
11/04-10/05
Following are the most significant training and development activities for the past year.

Undergraduate students working with P. Bolstad learned about three-dimensional reconstruction of historical photographs, large database management methods, field measurements of water chemistry and sediment, the operation of electronic field data logging equipment, and a number of other tasks specific to the research project but not or lightly covered in any academic setting.

An undergraduate ecology major was trained by M. Bradford in soil organic carbon dynamics as related to microbial activity.

Long-term tree census plots and large-scale experimental gap plots were used as demonstation for the Community Ecology course taught to grads and undergrads at Duke University.

Experimental procedures for measuring the effect of increased turbidity on the reactive distance of fluvial fishes were used in a graduate seminar on conservation biology of aquatic systems.

Tagged CWD (coarse woody debris) was used in Schoolyard LTER program for 6th graders visiting the Coweeta gradient plots

Sedimentology activities have been used to train graduate students in methods and provide undergraduates with direct experience of field

procedures.

Undergraduate students from Mars Hill College, which does not have a graduate program, worked side-by-side with graduate students from the University of Wisconsin in the field over the course of the PhD-research by J. Fraterrigo.

Coweeta research results were used in teaching Introductory Biology at the University of Wisconsin-Madison.

Four PhDs and two MSc degrees were awarded during this award year to students directly involved in Coweeta LTER research.

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11/03-10/04
Training and development activities are as diverse as the Coweeta investigators and the research they are engaged in. Activities during this year ranged from having students directly involved in research to formal educational situations making use of Coweeta facilities and/or the results of research. Following are the most significant training and development activities for the past year.

1. Three graduate students and six undergraduate students worked directly with P. Bolstad at the University of Minnesota on Coweeta research. These students participated in experimental design, field data collection, development, and processing, data reduction, quality control, analysis, and publication.

2. P. Bolstad's research on spatial categorization and metrical determination of land use in the Coweeta LTER is the source for his 'GIS Fundamentals: A first text on Geographic Information Systems' book used widely around the country in college courses. It is also used in his annual teaching of GIS to 100-150 undergraduate students at the University of Minnesota.

3. Experimental gap sites at Coweeta are used by J. Clark in a community ecology class he teaches at Duke University.

4. The experimental gap modeling studies of J. Clark and his students were the foundation for an NSF-funded summer school that trained 24 graduate students and postdocs in modern statistical computation for ecological forecasting. This workshop was held at Duke University, June 2004.

5. Based on D. Coleman's years of research at Coweeta, he contributed to the development of the research skills of 20 students in Taiwan and 40 students in China. His second edition of 'Fundamentals of Soil Ecology' (2004 Coleman, Crossley and Hendrix) is used widely at both high school and undergraduate college levels.

6. In the context of K. Elliot's dendrochology research on disturbance history of the Coweeta Basin, she has trained two REU students, two graduate students and one technitian in dendrochronology and vegetation sampling methods.

7. Four graduate students participated in T. Gragson's research on historical ecology of 17th and 18th century Cherokee disturbance receiving training in research design, methods and techniques of data collection and analysis. This research is also the basis of an advanced graduate seminar in historical ecology at the University of Georgia with an enrollement of eight PhD students.

8. G. Grossman trained three PhD and four MSc students in the course of his experimental foraging studies on river chub. He also taught classes in Fish Ecology and Quantitative Approaches to Conservation Biology at UGA, and presented a weeks-worth of invited lectures for undergrads, graduate students and faculty at the University Karlstad (Karlstad Sweden), Texas A & M University, and Virginia Commonwealth University.

9. G. Helfman is writing a book entitled 'Fish Conservation: The Degradation and Restoration of Biodiversity' for Island Press based on his research and that of his students in the Coweeta LTER.

10. R. Hendrick trained three PhD students in methods for determining below ground productivity, quantifying mycorrhizal community composition and structure, and quantifying root system architecture.

11. M. Hunter employes four graduate students and four undergraduate students in his various projects at Coweeta.

12. J. Knoepp worked with undergraduate student interns from Furman College in sampling the forest floor, and LTER schoolyard groups sampling litterfall and tree respiration.

13. Several graduate students have participated in all aspects of D. Leigh's research at Coweeta and gained excellent first-hand experience in geomorphology and stream sedimentology.

14. S. Pearson developed teaching materials for ecology courses at Mars Hill based on Coweeta LTER data and research results. He involved undergraduate students from Mars Hill (this is an undergraduate-only college) in setting up herb and tree demography plots, and in the process provided them the opportunity to work side-by-side with graduate students from the University of Wisconsin and Duke University.

15. R. Pulliam has two graduate students and two undergraduates actively participating within him on his research at Coweeta and Nancytown.

16. Under K. Reynolds tutelage, two undergraduates learned techniques in experimental design, sampling methods for studying soil microarthropods and soil abiotic factors, identification of soil microarthropods, data recording, use of spreadsheets and SAS for data analysis, and improved their skills in writing scientific reports.

17. Nine undergraduate students participated in J. Webster Coweeta research learning research skills and how to work effectively a group.

18. Brian Kloeppel trained one graduate student and two undergraduate students in the undergraduate curriculum at the University of North Carolina at Chapel Hill. The research focused on ecosystem impacts (both plant and water impacts) as a result of native (southern pine beetle) and exotic (hemlock woolly adelgid) insect outbreaks.

19. Coweeta led Schoolyard LTER activities for the sixth year in 2003-2004 including events for sixth grade, high school, and community college students. Eighteen sixth grade students at Macon Middle School (Franklin, NC) participated in 8 events held on Saturdays throughout the school year. Twenty-five high school sophomores from Rabun Gap - Nacoochee School (Rabun Gap, GA) measured tree growth on three long-term terrestrial gradient plots in Coweeta's watershed 18. Twenty-nine chemistry students from Southwestern Community College (Cullowhee, NC) measured tree stem CO2 efflux on three long-term carbon-flux plots in Coweeta's watershed 2.
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11/02-10/03
In the Coweeta Schoolyard LTER initiative we are partnering with five instructors and approximately 65 students. The schools involved are: Sixth grade science classes at Macon County Middle School in Franklin, NC; High School environmental science students at Rabun Gap Nacoochee School in Rabun Gap, GA; and, Freshmen College level biology and chemistry classes at Southwestern Community College in Sylva, NC. Field work is conducted on school property study areas, the Coweeta Hydrologic Laboratory, and surrounding southern Appalachian study sites such as Joyce Kilmer Old Growth Memorial Forest. Data summary and discussions take place at Coweeta and the home institution of participating teachers and students. Data archives can be found at http://coweeta.ecology.uga.edu/webdocs/1/schoolyardlter.htm.

Outreach Activities:

11/04-10/05
Researchers assisted the NCCAT (North Carolina Center for the Advancement of Teaching) through Western Carolina University to develop a workshop curriculum for science teachers.
Coweeta research lectured and displayed results at Barrow Elementary School, Effingham County Elementary Schools, the Mary Kahrs Warnell Forest Education Center, and the Clarke County Girl Scout Summer Camp 2005.

A total of 72 education and outreach tours were provided to national and international science tours, and university and college on-site field trips.

Seven researchers, four teachers, and 49 students (18 sixth grade, eight high school, and 23 community college) participated in the Schoolyard LTER program. Middle-school students participated in studies of forest litter collection and sorting across a gradient of forest types; weather patterns and climate recording; tree growth and tree stem respiration; stream health, macroinvertebrate health and fish shocking; and, global positioning system use and measurements. High-school students spent a week in the Joyce Kilmer Memorial Forest (old growth) collecting stream water samples and re-measuring long-term vegetation plots. College freshman studied the chemical and biological dimensions of carbon flux in forest trees.

Public understanding of science and technology has been enhanced by research results being conveyed to nonprofit watershed conservation organizations such as the Little Tennessee Watershed organization.

Researchers have given lectures on their Coweeta research to local civic organizations; led educational hikes for public programs; and,

interacted with K-5 teachers on incorporating environmental science into their classroom activities.

Researchers advised the science educators at the Appalachian Highlands Science Learning Center (Great Smoky Mountains National Park) on techniques to study soil arthropods.

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11/03-10/04
Outreach activities this year were collectively responsible for increasing the public's understanding of science and technology as well increasing the relevance of ecological science to the legislative process of environmental protection.

Coweeta Hydrologic Laboratory scientists and staff provided guided field and laboratory tours for 58 groups and a total of 1060 individuals including primary through college education classes, visiting scientists, and forest and watershed managers were provided educational and guided scientific tours. For a complete summary of these visiting groups, please see the link below(http://coweeta.ecology.uga.edu/webdocs/1/tours.html). Depending on the need of each group, tour topics included ecosystem function, vegetation management, stream biology, water quality and yield, road construction and maintenance, etc.

In Schoolyard LTER activities we partnered with five instructors and 72 students. The schools involved are: Sixth grade science classes at Macon County Middle School in Franklin, NC; High School sophomore environmental science students at Rabun Gap Nacoochee School in Rabun Gap, GA; and freshmen and sophomore college biology and chemistry classes at Southwestern Community College in Cullowhee, NC.

P. Bolstad interacted with local governments and NGOs to provide land use data to inform the public. For example, he provided past, present, and predicted future landcover data to the Upper Little Tennesee Watershed Association for use in public forums and publications to inform the local population on the state of their river resoures, and the opportunities and need for protection. He also shared data with planners working for Buncombe County to assist with land use and zoning plan development.

D. Leigh provided results of his research to several nonprofit watershed conservation organizations including the Little Tennessee Watershed organization.

S. Pearson delivered lectures to local civic organizations, led educational hikes for public programs, and assisted K-5 teachers incorporate environmental science into classroom activities.

M. Scott was invited to speak to the Lake Keowee Anglers Association.

B. Wallace was appointed in 1999 by conservation groups to work with U.S. E.P.A., Fish & Wildlife Service, U.S. Army Corps of Engr., and Office of Surface Mining to review an Environmental Impact Statement for the practice of Mountaintop Removal and Valley Filling (MTR/VF) as currently being practiced in the central Appalachian region. This led to his work this year with Trial Lawyers for Public Justice, Washington, DC for which organization he as written several court affidavits about the potential adverse impacts of Valley Fills for Mountaintop Mining of coal in central Appalachians on stream communities. He made the following presentations on the subject:

Disappearing Streams and Forests of the Central Appalachians: The Saga of Mountaintop Mining û Joan M. Stroud Memorial Lecture, a Public Lecture Series. Stroud Research Center, West Chester Co. PA, 13 November 2003.

Disappearing Streams and Forests of the Central Appalachians: The Saga of Mountaintop Mining û Ecology, Evolutionary Biology, and Behavior Seminar Program - Michigan State University, East Lansing, MI 19 November, 2003.

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11/02-10/03
Brian Kloeppel coordinated 58 groups and a total of 825 individuals including primary through college education classes, visiting scientists, and forest and watershed managers were provided educational and guided scientific tours (http://coweeta.ecology.uga.edu/webdocs/1/tours.html). These tours were led by a variety of scientists and staff at Coweeta Hydrologic Laboratory who specialize in the various topics presented. Depending on the need of each group, tours covered ecosystem function, vegetation management, stream biology, water quality and yield, and road construction and maintenance. In 2003 we also hosted several international science visitors: A group of six Japanese led by Dr. Hideaki Shibata, Associate Professor at Hokkaido University; a group of six French led by Ms. Dolores de Bortoli, Researcher at the Universite de Pau; Dr. Martin Sharman, Head of the Biodiversity Sector of the European

Commission, Brussels; and Dr. Adolf Korczyk, Natural Forests Department Head of the Forest Research Institute of the Poland Academy of Sciences in the Białowieża National Park in Białowieża, Poland.

Bruce Haines conducted a field tour of the Coweeta Basin for the 88th Annual Meeting of the Ecological Society of American, held in Savannah (GA), August 2003. In asking the visitors, 'Are there any lessons, approaches, methods, or findings from the Coweeta Project that could help you better manage water, nutrients, vegetation, wild life and people back in your homeland?' Dr. Haines sought to encourage tour participants to become interested in landscape ecology.

Ted Gragson with the assistance of graduate students Meredith Devine and William Jurgelski, prepared a permanent museum exhibit entitled 'Chuttahsotee's Long Rifle and the Sand Town Cherokee.' The exhibit incorporates Coweeta LTER results on early white settlement in southern Appalachia and a unique pre-Civil War rifle manufactured in western North Carolina to tell a story of Indian-White land relations significant to local history.

Susan Murry is a Graduate Research Assistantship working in the Coweeta Information Management Laboratory, and with Barrie Collins (Coweeta Information Manager) she rendered a Native Garden plan for the Memory Lane Park, a small urban park in Franklin, NC adjacent to the Macon County History Museum. The rendered plan highlights native plants of Western North Carolina based on work at Coweeta and the region to create a place of repose as well as an educational exhibit that extends the museum's displays outdoors.

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Web/Internet Site

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http://coweeta.ecology.uga.edu

Description:

The Coweeta LTER program subscribes to the philosophy that the future of scientific research is tied to the free and efficient exchange of research and ideas in the scientific community. We have accordingly invested heavily in supporting emerging worldwide standards for research and GIS data and metadata, and the Coweeta LTER website was completely overhauled during Year 1 to reflect this approach. All information holdings were inventoried to determine that relevant parts (i.e., data, metadata, GPS, coverages, etc.) were complete; the missing information was either collected or key-coded. EML-compliant metadata was then developed for our tabular data legacy to provide machine-readable information for data harvesters. We simultaneously developed Coweeta Data Set Summaries to provide human-friendly metadata. The Coweeta Data Summaries incorporate the information contained in the EML-compliant metadata, but also provide access to geographic coordinates as well as data.

The single most important accomplishment of the overhaul of the Coweeta LTER website was the move to Open Source Software to develop a relational database management system. This provides complete access to the entire Coweeta data legacy in a recursive fashion from anywhere in our website. The architecture is based on MySQL and PHP. MySQL is a powerful, flexible and efficient database management system, while PHP is a CGI program with a built-in scripting language that dynamically accesses MySQL and outputs to an HTML browser. In contrast to a Google search that is static and only as good as the meta-tagging on individual web-pages, the Coweeta GLOBAL Data Search gives access to all holdings of any kind anywhere in the archives from anywhere on the site. First access to this search engine is available in the ?Data & Research? section of the Coweeta LTER homepage.

Other Specific Products

Product Type:

Data or databases

Product Description:

The foremost reason for developing the Coweeta MySQL-PHP relational data management system was to give us complete control over our data legacy. The tabular data legacy now consists of nearly 200 data sets fully described and accessible according to the NSF LTER Type I and Type II criteria as implemented at Coweeta. Following are the most significant online resources available from the "Data & Research" section of the Coweeta LTER homepage:

>>Publications - 1219 citations dating from 1928, 1104 PDF publications available online.

>>Thesis/Dissertations - 225 theses and dissertations online, dating from 1937.

>>Researcher's Biographical Sketches - formatted biographies of all 27 PIs.

>>Sample Archives - 93 collections featuring 17,000+ archived samples.

>>Species Lists I, GMNH Mammal/Amphibian Collection - 20,000+ vouchered specimens for southern Appalachia from 1905 onward held at the Georgia Museum of Natural History.

>>Species Lists II - Observed and collected species at Coweeta Hydrologic Laboratory.

>>Digital Elevation Model (DEM) Catalog - raster contour maps for the southern Appalachian study region.

>>Digital Raster Graphic (DRG) Catalog - DRGs for the southern Appalachian study region.

>>Digital Orthophoto Quadrangle (DOQ) Catalog - DOQs for the greater Coweeta area.

>>Demographics - US Census block-level data for the southern Appalachian study region.

>>Monthly Climate Data (NOAA/NCDC) - Geo- and temporally-referenced records for 123 stations in the southern Appalachian study region. (Daily climate data will soon also be available.)

Sharing Information:

The relational data structure allows us to assemble, manage and dynamically deliver via the Coweeta website many types of information including species lists, biographical sketches, and a comprehensive bibliography of publications, theses, and dissertations that we are in the process of converting to downloadable PDFs.

Product Type:

Audio or video products

Product Description:

This video cassette program focuses on one important stage in the flow pattern of a river or stream: the bankfull stage. This video demonstrates how to consistently identify bankfull stage for a variety of stream types located in five physiographic provinces of the eastern United States. The program focuses primarily on streams located in forested areas and provides a systematic, reproducible procedure for determining and verifying that bankfull stage has been properly identified.

Sharing Information:

This video (published in 2003) is distributed by the USDA Forest Service, Rocky Mountain Research Station. [VHS Closed Caption, 46-min.] It is a public-accessible product and is available via government and university libraries.

Contributions

Contributions within Discipline:

The Coweeta LTER project has researchers representing a wide range of disciplinary fields including aquatic ecology, terrestrial ecology, ecosystem ecology, behavioral ecology, forestry, geomorphology, hydrology, economics and anthropology. Fundamantal contributions this year to various disciplines include:

11/04-10/05
We have improved our ability to predict small stream locations in the region, and in general in humid temperate forests.

We have provided scarce base measurements of changes in forest carbon pools and fluxes with forest land use change. Forest succession/development hypotheses suggest that CWD becomes an important C pool as forests age and approach 'old growth.' These data allow us to examine that hypothesis.

Knowledge gained on the foraging behavior of fluvial fish will assist nature resource managers in making decisions and predictions on the impacts of sedimentation on aquatic ecosystems, as well as prioritize the effects due to differences in species responses and environment changes.

Our research with Rhododendron maximum has demonstrated that its suppressive effects on the forest understory may be related to its ability to shift soil nitrogen pools to a form relatively unavailable to its competitors, but readily available to itself.

Our work on hemlock woolly adelgid has contributed to theory linking ecosystem structure with ecosystem function, and the links between population processes and ecosystem processes. We have also contributed to fundamental theory in food web processes and trophic structure.

Our research on the distribution of tree species, the impact of native and exotic insects and watershed hydrology provides important insights on ecosystem services and values in a human-dominated ecosystem.

Our use of cutting-edge technology, specifically Cs-137 dating of sediments, is the basis for determining sedimentation rates and changes in stream morphology that will provide information for one of the least-studied regions in the US, the Blue Ridge Mountains.

Some of our research contributes directly to niche theory and the application of niche theory to understanding how species respond to climate variability.

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11/03-10/04
Some of the fundamental contributions from our research this year to these various fields include:

Building on niche theory and applying niche theory to understand how species respond to climate variability.

Increasing knowledge on the effects of forest disturbances on decomposer organisms in the soil and litter, and the decomposition process itself.

Increasing knowledge about the effects of forest gaps on avian communities.

Establishing the links between community choice and land use decisions to broaden the scope of economic and social science investigation of land use change.

Advancing the understanding of mycorrhizal fungal community composition and structure, and fine root architecture in forest soils.

Determining the relation between forest change over time as it relates to changes in the cycling processes of nutrient and carbon pools.

Applying a novel technology û Cs-137 dating of sediments û to determine sedimentation rates and changes in stream morphology at a regional scale.

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11/02-10/03
While the principal discipline of the Coweeta LTER research is ecosystem ecology, the 27 investigators span a wide gamut of contributory subdisciplines. Publications this year contributed to our understanding of many key ecological concerns: trophic trade-offs; aboveground biomass and nutrient accumulation; an optimal foraging model for drift-feeding stream minnows; salamander diversity and abundance; density-dependent mortality and the latitudinal gradient in species diversity; leaf litter breakdown and invertebrate assemblages; retention of soluble organic nutrients in a forested ecosystem; seasonal respiration of foliage, fine roots, and woody tissues in relation to growth, tissue N, and photosynthesis; and hillslope nutrient dynamics following vegetation disturbance.

Contributions to Other Disciplines:
Coweeta LTER research makes contributions beyond the disciplinary fields of individual researchers. For example:

11/04-10/05
Our research quantifying the resource gathering footprint of early Native Americans in the Blue Ridge draws from and contributes to several social and natural science disciplines including history, ethnohistory, anthropology, landscape ecology, and biology.

Our sedimentology research contributes to geosciences, environmental biology, and other crosscutting programs since it pertains to the interrelationships of different components of water and soil systems as well as various aspects of aquatic environmental systems.

The involvement in Coweeta LTER research by one investigator qualified him to serve as Program Coordinator of the Regional Studies Program at his undergraduate-only institution during the previous 5 years, and lead faculty member last year. This program is an interdisciplinary endeavor that includes studies in the humanities, social sciences, and natural sciences.

Some of our research links plant ecology to climate studies and soil science.

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11/03-10/04
Our current research linked plant ecology to climate studies and soil science.

Our research on forecasting land use change is providing a mechanism for translating human drivers to ecological implications of landscape change.

Our mycorrhizal research tested and refined current methods developed for non-soil fungi to determine their suitability for soil-borne fungi. In the process, this research highlighted the paucity of information on soil fungi in large databases like Genbank.

Our disciplinary studies contribute to the interrelationships between different components of water and soil systems, and the greater understanding of aquatic environmental systems in general.

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11/02-10/03
Our contributions are not limited to ecosystem ecology, but penetrate other science disciplines as well. David Leigh is applying geomorphological techniques to the 'Hazards Project' that will document the response trajectory of streams to changing land use patterns in southern Appalachia over the next 30 years. In the process he is comparing two widely used yet divergent physical stream survey parameters û USGS and USEPA û to develop a standardized methodology for use in the Appalachian Highlands. Seong Cho along with David Wear and David Newman are conducting an economic analysis of the site-specific factors of land development in the French Broad and Little Tennessee River Basins. In the process, they are advancing the nascent field of spatial econometrics.

Contributions to Human Resource Development:

The Coweeta LTER makes numerous contributions to human resource development that reflect the reach and scope of the research and the diversity of researchers and collaborators. The contributions span settings from K-12 through advanced graduate, at multiple institutions on three continents in both direct encounters and special publications.

11/04-10/05
This research provided participation opportunities for graduate and undergraduate students in field work and data analysis at the University of Georgia, University of Wisconsin-Madison, University of Minnesota, Virginia Tech, Mars Hill College, University of North Carolina-Asheville, Duke University, and Furman College.

Research has provided several graduate students with the opportunity to attend an present their results at national and international science meetings.

Our tours and outreach to K-12 students and visiting scientists and students helps expand the skills and opportunities of our LTER staff and students in communicating to diverse audiences on complex topics.

The interdisciplinary and regional nature of the Coweeta LTER research prepares undergraduate and graduate students for diverse fields that apply earth, natural and social sciences to resource and land management at local, state, and federal levels of organization.

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11/03-10/04
Opportunities to participate in research and be mentored in experimental design; field data collection, reduction and processing; quality control; analysis; and publication were realized for 72 K-12 students, two REU students, over 100 undergraduates, and 82 graduate students. These opportunities took place at the University of Minnesota, the University of Georgia, the Coweeta Hydrologic Laboratory, Mars Hill College, the University of North Carolina Asheville, Virginia Tech, the Taiwan Forestry Research Institute and Academia Sinica (China).

Classroom offerings included courses in using and problem-solving with GIS in natural resource systems, community ecology, soil ecology, fish ecology, conservation biology, Bayesian modeling, introductory ecology and historical ecology. The total number of students in these various courses reached approximately 200 undergraduates and 50 graduates a the University of Minnesota, Duke University, Mars Hill College, the University of Georgia, Texas A&M, Virginia Commonwealth and University of Karlstad (Sweden). In addition, Coweeta LTER researchers have produced two significant textbooks that are widely used around the country in high school and undergraduate college courses: 'GIS Fundamentals: A first text on Geographic Information Systems' (approximately 5,000 units sold this year) and 'Fundamentals of Soil Ecology' (2nd edition released August, 2004). A third textbook, 'Fish Conservation: The Degradation and Restoration of Biodiversity,' is currently nearing completion.

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11/02-10/03
Although already noted in other categories, the Coweeta LTER program provides numerous opportunities for the development of human resources. We have three post-doctoral fellows working on research projects in the southern Appalachian study region. There are 31 graduate

students, both M.S. and Ph.D. level, assisting with, participating in, or conducting their own research in the Coweeta LTER program. Finally, with NSF supplemental funds to the Coweeta LTER program we sponsored three REU students in summer 2003. Following are three additional contributions to the development of human resources.

James Clark will run a 2004 summer school with NSF funding on statisical computation, which is a direct outgrowth of his Coweeta LTER research on trophic dynamics, density-dependent growth and mortality of Appalachian tree species. Students will work in groups guided by the course instructors; they will select data sets for analysis, develop models, write and execute code, produce predictive distributions, and write case studies for publication as a volume. Topics to be covered in the course include: principles of Bayesian inference; graphical modeling for complex processes; hierarchical modeling; data, process, and parameter models; the Gibbs sampling framework; robustness and sensitivity to stage-wise specification; and model adequacy/validation/model selection.

Brian Kloeppel & Susan Steiner direct the Coweeta Schoolyard LTER program that provides exposure to science and technology for students and teachers from grade school through college. As part of this effort, they direct and organize on and off-site data collection and discussion in association with ongoing Coweeta LTER studies. These efforts contribute to the needs of students at all levels, as well as the needs of visiting scientists of all kinds, ecosystem managers, and the public at large.

Phaedra Scarborough, a student researcher working with Dr. Kitti Reynolds, learned basic microarthropod taxonomy in sorting microarthropods from Coweeta soil samples. She also participates in the decision-making of setting up new off-site research plots associated with experiments on climate and site controls of forest form and function (a component of Coweeta LTER Research Initiative 2).

Contributions to Resources for Research and Education:

Coweeta LTER research and education makes far-reaching contributions beyond the easily measured number of students taught or book units sold. Our research compares and evaluates standard yet divergent methods and has far-reaching implications.

11/04-10/05

Our research is defining new methods and ways to analyze river and stream systems. For example, our use of the Cesium-137 dating technique for recent river sediments has involved a significant upgrade of the Geomorphology Laboratory facilities at the University of Georgia. Three graduate students are directly involved with this research and use both their research data and experiences in the undergraduate instructional laboratories they are responsible for.

Equipment including microscopes used in LTER research at undergraduate-only colleges is improving ecology and soils classes through the laboratory exercises that rely on the improved identification possible with this equipment.

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11/03-10/04

Comparisons included the characterization of aquatic habitats using an EPA protocol based on water surface appearance to Froude numbers incorporating water column/bottom interactions; it also included methods to determine flow and flood regimes such as EPA vs. USGS that rely on different observables and observation intervals. Each standard is used extensively through a diverse array of public and private organizations at local, state and national levels.

Coweeta LTER researchers served this year on the editorial boards of numerous international scientific journals including Animal Biodiversity and Conservation; Freshwater Biology; and Ecology Freshwater Fish; Soil Biology & Biochemistry; European Journal of Soil Biology; Pedobiologia; Advances in Agroecology; Applied Soil Ecology; Science of Soils; and Global Change Biology.

One easily measurable contribution is the use of the Coweeta LTER website. This year, we completed our repository of over 200 datasets, 1,219 journal publications (1104 available online in PDF format)and 225 theses and dissertations. Stored in a dynamic and searchable database, quantitative and textual information can be globally searched and retrieved in a variety of formats. As of May 2004, the Coweeta website served 39,315 distinct users, an average of 463 pages a day, and transferred a daily average of 84 megabytes of information. Sixty two percent of all files downloaded were .php or .pdf indicating extensive downloading of the Coweeta knowledge base. (.php files include data, archives, species lists and researcher's biographical sketches; .pdf files are publications.)

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11/02-10/03

One of the most significant contributions in the first year of the Coweeta LTER research cycle is the development of a true relational archive for our data legacy. Not only is this a critical component to the success of our activities in the years to come, but it is a significant contribution

to the infrastructure for research and education. Not to be overlooked, however, are the complete renovation of the Analytical Laboratory and the Residence, and the construction of the Conference Center at the Coweeta Hydrologic Laboratory. This achievement was made possible by funds and inter-institutional collaborations by the USFS, the NSF, and the University of Georgia. The facilities meet the day-to-day research, communication, and residential needs of Coweeta investigators and students, as well as many other research collaborators. In some of the most practical ways imaginable, these three facilities make the Coweeta LTER program possible.

Contributions Beyond Science and Engineering:

11/04-10/05

Little change is forecast in the total area of Southeastern forests between 1995 and 2040, since forest losses to urban uses will be offset by conversion of agricultural land to forest. The anticipated decrease in forest cover and increase in urban sprawl east of the Blue Ridge have important socioeconomic and biophysical implications for Southern Appalachia that are already appearing. These include decreases in water availability and quality, native habitats, biological diversity and recreational opportunities. As residential density decreases, vehicle miles traveled increase leading to increases in carbon monoxide, particulate matter, nitrogen oxides and hydrocarbons that deteriorate air quality. More houses at lower densities increase the pressure on existing sewer systems while the increase in stormwater runoff and sewage seepage impact flow regimes. Our results are providing local governments with important information that can help them overcome the challenged of dealing with such complex issues because of their relatively modest tax revenues to refurbish existing service networks or expand new ones.

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11/03-10/04

Coweeta LTER researchers made numerous contributions this year that go beyond science and engineering. However, one of the most significant is the work by B. Wallace with the Trial Lawyers for Public Justice, Washington, DC. Through his public speaking engagements and his drafting of court affidavits on Mountaintop Mining, B. Wallace is demonstrating how science can be used to inform regulatory policy for the protection of headwater streams across Southern Appalachia.

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11/02-10/03

Understanding the causes and consequences of land-use change is a critical research challenge at both national and global scales. Our current research addresses ecological and socioeconomic aspects of land-use change while continuing our studies of environmental gradients and natural disturbance regimes. This will produce a comprehensive understanding of ecological dynamics in the southern Appalachian Mountains and make possible the development of reliable forecasts of its future ecological state. Such forecasts offer the opportunity to formulate policies and management objectives with increased chances of success.

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Unobligated funds: less than 20 percent of current funds

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Coweeta LTER Year 1 (Nov 2002-Oct 2003) Annual Report
NSF Award DEB-0218001
Consequences of Land Use Change in the Southern Appalachian Mountains
Submitted October 25, 2003

Introduction

This report covers Year 1 (November 2002-October 2003) activities on the Coweeta LTER program in the following four categories: Participants, Activities & Findings, Products, and Contributions. The Coweeta LTER Program has evolved since 1980 from a site-based to a site- and region-based project examining the effects of disturbance and environmental gradients on biogeochemical cycling, and the underlying watershed ecosystem processes that regulate and respond to those cycles. The objective for the proposed 2002-2008 research is to advance scientific understanding of the spatial, temporal, and decision-making components of land use and land-use change in the southern Appalachian Mountains over the last 200 years, and forecast patterns 30 years into the future. To accomplish this task, we will address the ecological and socioeconomic aspects of land-use change while continuing long-term studies of environmental gradients and natural disturbance regimes.

1. Participants: Who has been involved?

Participants in the Coweeta LTER program include a large number of individuals from numerous State and Federal institutions. By virtue of the expertise of the individuals involved and the nature of the research itself, numerous collaborators and contacts have also been established.

What people have worked on the project and what other organizations are involved as partners?
A total of 27 investigators from eight institutions worked on the Coweeta LTER program as listed on the following table.

Participant	Institution	Role
Fred Benfield	Virginia Tech	Investigator
Paul Bolstad	U Minnesota	Investigator
James Clark	Duke U	Investigator
Barrie Clinton	USDA-USFS	Investigator
David Coleman	U Georgia	Investigator
Katherine Elliott	USDA-USFS	Investigator
Ted Gragson	U Georgia	Principal Investigator
Gary Grossman	U Georgia	Investigator
Bruce Haines	U Georgia	Investigator
Gene Helfman	U Georgia	Investigator
Ron Hendrick	U Georgia	Investigator
Mark Hunter	U Georgia	Investigator
Brian Kloeppel	U Georgia	CoPrincipal Investigator
Jennifer Knoepp	USDA-USFS	Investigator
David Leigh	U Georgia	Investigator
David Newman	U Georgia	Investigator
Scott Pearson	Mars Hill	Investigator

Catherine Pringle	U Georgia	Investigator
Ron Pulliam	U Georgia	Investigator
Barbara Reynolds	UNC Asheville	Investigator
Mark Riedel	USDA-USFS	Investigator
Wayne Swank	USDA-USFS	Investigator
Monica Turner	U Wisconsin	Investigator
James Vose	USDA-USFS	CoPrincipal Investigator
Bruce Wallace	U Georgia	Investigator
David Wear	USDA-USFS	Investigator
Jack Webster	Virginia Tech	Investigator

Working directly with these investigators are 31 graduate students, both M.S. and Ph.D., and three post-doctoral fellows. One of the post-doctoral fellows and approximately half of the graduate students are supported by Coweeta LTER funds; for the students, this means they also receive tuition grants-in-aid from their home institution. The balance of graduate students while engaged in Coweeta LTER activities, are supported by other funds. There are four full-time technicians affiliated with the Coweeta LTER program; three are based at the Coweeta Hydrologic Laboratory in Otto and one at the University of Georgia campus in Athens. Finally, we sponsored three REU students during summer 2003, and worked with 20 undergraduate students involved as summer or fall interns, or hourly lab and field assistants during the school year.

Have you had other collaborators or contacts? Either by leveraging the Coweeta LTER project resources – data, personnel, infrastructure – participants on the Coweeta LTER have established several important collaborations. These include:

Jack Webster: The Lotic Intersite Nitrogen eXperiment (NSF) is a collaborative study of nitrogen cycling in streams involving simulation modeling, field tracer (^{15}N) additions, and intersite comparison. The principal contact is Pat Mulholland of Oak Ridge National Laboratory. Additional collaborators include Prof. Alan Hildrew, Queen Mary and Westfield College, London; Prof. Horton Hobbs, Whittenburg College, Ohio; and Linda Ashkenas and Dan Soboda, of Oregon State University. Full information on this research collaboration is available at http://sparc.ecology.uga.edu/webdocs/linx/.

Ted Gragson: Agrarian Landscapes in Transition (NSF) is an interdisciplinary project tracing the effects of the introduction, spread, and abandonment of agriculture at six U.S. LTER sites, with cross comparisons in Mexico and France. Principal contact is Charles Redman of Arizona State University. Additional collaborators include David Foster at Harvard University; Myron Gutmann at the University of Michigan; Craig Harris at Michigan State; Gerad Middendorf at Kansas State University; and Peter Kareiva at The Nature Conservancy. Full information on this research collaboration is available at http://ces.asu.edu/agtrans/.

Jim Vose: A collaboration with Dr. Larry Band, University of North Carolina-Chapel Hill and the Baltimore Ecosystem LTER, is directed at a cross-site comparison of streamflow and water quality. The research will use large scale models to examine contemporary and future impacts of land use change (i.e., development) on water resources. It will also examine scaling issues to

determine how fine-scale disturbances (i.e., subwatershed level development or forest harvesting) integrate to influence large scale hydrologic responses.

Brian Kloeppel: Collaborations with Dr. Jacek Oleksyn, Poland Academy of Sciences at the Institute of Dendrology in Kornik, Poland and Dr. Adolf Korczyk, of the Poland Academy of Sciences at the Forest Research Institute in the Białowieża National Park in Białowieża, Poland to conduct international LTER studies in Poland (NSF). The studies use the natural ^{13}C isotope signals in wood to determine the impact of historic (>300 years to present) changing CO_2 regimes on water use efficiency. A related study compares the foliar natural ^{13}C ratio of 12 populations of Norway spruce (*Picea abies*) along its native elevational gradient in the Tatra Mountains as well as in a 12-year-old common garden site from the same seed source to determine if water-use efficiency depends more on genetic or microsite factors.

David Coleman: A collaboration with Dr. Barny Whitman, to develop an International workshop on the molecular basis of soil biodiversity with Dr. Chih-Yu Chiu, Academia Sinica, and Dr. Hen-Biau King, Taiwan Institute of Forestry Research. The conference will be held in Taipei on April 18-24, 2004, and will involve persons from six+ LTER sites as well as several foreign countries.

2. Activities and Findings: What have you done & what have you learned?

The guiding hypothesis for the Coweeta LTER is that the frequency, intensity, and extent of land use represents human decision-making in response to socioeconomic and biogeophysical conditions with consequences that cascade through ecosystems. The research activities are organized into three initiatives: (1) characterization of the socio-natural template, (2) ecosystem responses to the socio-natural template, and (3) forecasting ecosystem responses to changes in the socio-natural template. As the first year of a significantly reorganized project, most effort has been on activities to enable the research so that findings are still limited.

What were your major research and education activities? The major research activity in Year 1 was the organization of the research activities and initial compilation of information relative to the characterization of the socio-natural template (Initiative 1). Organizational aspects of this activity were carried out at our two regular meetings of the Coweeta LTER: the All-PI Winter 2003 Meeting (7-8 January), and the Summer 2003 Science Meeting (June 24-25). Full reports and presentations are available at: http://cwt33.ecology.uga.edu/science_meeting/archives.html. Following are highlights from these meetings.

The All-PI Winter meeting was organizational in nature since funding had just been received by the University of Georgia, and research accounts had not yet been established. The main outcome was the consensus on developing study plans for individual research themes as outlined in the proposal. The Summer Science Meeting convened all investigators and their students to report on the progress-to-date of their research activities or advances in planning their research. Six students prepared posters for the 1st Coweeta Student Poster competition with a prize to the winner in support of their research. This year's winner was Chris Frost with a poster entitled "Frass from Canopy Herbivores Increases Soil Nitrogen, Carbon, and Nitrogen Export from *Quercus rubra* Mini-ecosystems." We also had two invited presentations by researchers working in the region and/or on topics relevant to the Coweeta LTER program. J. Hilten

presented on the "All Taxa Biotic Inventory" at the Great Smoky Mountains National Park while B. Clinton and P. Gulusky described their rhododendron ecophysiology research.

There have been several interrelated research activities over the past year focused on improving the temporal sampling of our land use data: 1) increasing the spatial and categorical detail and accuracy of current and recent historical land use information; and 2) extending the time period of land use back to the late 17th century. The results from these activities will serve as the basis for testing a number of hypotheses on techniques (e.g., categorical detail/accuracy tradeoffs in multi-scale data, quantification of classification accuracy for high-resolution spatial data, mapping sub-canopy features on high-resolution data). It will also be used to establish the location and pattern of disturbance (a disaggregation of disturbance through time with the change from a primarily agricultural to a diversified service economy with related changes in riparian vegetation). Finally, anthropogenic disturbance trajectories will be derived that reveal, for example, the divergence in disturbance regimes on public vs. private lands.

During summer 2003, the Coweeta LTER program sponsored three REU students. **Davis C. Pinner** worked with Dr. Katherine J. Elliott (Coweeta Hydrologic Laboratory) on dendroecological reconstruction of the disturbance history of Coweeta Basin. **Hunter M. Keyes** worked with Dr. Mark Hunter (University of Georgia) on the ecosystem effects of the hemlock wooly adelgid in the southern Appalachian region. Finally, **Kenneth D. Marcus** worked with Dr. Jennifer Knoepp (Coweeta Hydrologic Laboratory) on the nutrient content and bulk density determination of coarse woody debris in the Coweeta Basin.

What are your major findings from these activities? A unifying theme of both present and historic Coweeta LTER research is the quantification of ecological responses to natural and anthropogenic disturbance on levels ranging from the organism to the ecosystem. To build on our core research effort, we are undertaking a number of activities directed at cross-site and synthetic research. These activities are directly tied to our future efforts of constructing and validating explicit forecast scenarios on the response-trajectories of terrestrial and aquatic systems to natural and anthropogenic disturbance. Synthesis and cross-site comparison projects supported with supplemental NSF funds include:

- *Mark Hunter* who is conducing long-term monitoring of hemlock stands for woolly adelgid infestation.
- *Katherine Elliott* who is directing dendroecological research in the southern Appalachian mountains.
- *David Leigh* who is benchmarking "Hazard Sites" in the Little Tennessee and French Broad drainages.
- *Brian Kloeppel* who is bringing archived data sets on-line as part of our effort to convert all our holdings to a relational data structure compliant with EML.
- *Ted Gragson* who is comparing long-term land use trajectories between southern Appalachia and the southern Pyrenees.

What opportunities for training and development has the project helped provide? In the Coweeta Schoolyard LTER initiative we are partnering with five instructors and approximately 65 students. The schools involved are: Sixth grade science classes at Macon County Middle School in Franklin, NC; High School environmental science students at Rabun Gap Nacoochee

School in Rabun Gap, GA; and, Freshmen College level biology and chemistry classes at Southwestern Community College in Sylva, NC. Field work is conducted on school property study areas, the Coweeta Hydrologic Laboratory, and surrounding southern Appalachian study sites such as Joyce Kilmer Old Growth Memorial Forest. Data summary and discussions take place at Coweeta and the home institution of participating teachers and students. Data archives can be found at http://coweeta.ecology.uga.edu/webdocs/1/schoolyardlter.htm.

What outreach activities have you undertaken? Coweeta LTER scientists and staff conduct numerous tours for varied groups both on and off-site. Outreach activities this year were also carried out with The Macon County Historical Museum (Franklin, NC). Details of these activities follow.

Brian Kloeppel: In 2002, 58 groups and a total of 825 individuals including primary through college education classes, visiting scientists, and forest and watershed managers were provided educational and guided scientific tours (http://coweeta.ecology.uga.edu/webdocs/1/tours.html). These tours were led by a variety of scientists and staff at Coweeta Hydrologic Laboratory who specialize in the various topics presented. Depending on the need of each group, tours covered ecosystem function, vegetation management, stream biology, water quality and yield, and road construction and maintenance. In 2003 we also hosted several international science visitors: A group of six Japanese led by Dr. Hideaki Shibata, Associate Professor at Hokkaido University; a group of six French led by Ms. Dolores de Bortoli, Researcher at the Universite de Pau; Dr. Martin Sharman, Head of the Biodiversity Sector of the European Commission, Brussels; and Dr. Adolf Korczyk, Natural Forests Department Head of the Forest Research Institute of the Poland Academy of Sciences in the Białowieża National Park in Białowieża, Poland.

Bruce Haines: Conducted a field tour of the Coweeta Basin for the 88th Annual Meeting of the Ecological Society of American, held in Savannah (GA), August 2003. In asking the visitors, "Are there any lessons, approaches, methods, or findings from the Coweeta Project that could help you better manage water, nutrients, vegetation, wild life and people back in your homeland?" Dr. Haines sought to encourage tour participants to become interested in landscape ecology.

Ted Gragson: With the assistance of graduate students Meredith Devine and William Jurgelski, prepared a permanent museum exhibit entitled "Chuttahsotee's Long Rifle and the Sand Town Cherokee." The exhibit incorporates Coweeta LTER results on early white settlement in southern Appalachia and a unique pre-Civil War rifle manufactured in western North Carolina to tell a story of Indian-White land relations significant to local history.

Susan Murry: Susan is a Graduate Research Assistantship working in the Coweeta Information Management Laboratory, and with Barrie Collins (Coweeta Information Manager) she rendered a Native Garden plan for the Memory Lane Park, a small urban park in Franklin, NC adjacent to the Macon County History Museum. The rendered plan highlights native plants of Western North Carolina based on work at Coweeta and the region to create a place of repose as well as an educational exhibit that extends the museum's displays outdoors.

3. Products: What has the project produced?

As in the past, the greatest single achievement of individuals involved with the Coweeta LTER program is the significant number of publications. This year we have also developed significant web-accessible databases.

What have you published as a result of this work? Over the past year, Coweeta investigators and their students have published 31 journal articles and/or book chapters, two M.S. theses and two Ph.D. dissertations. Following are some of the most salient publications; a complete listing is available at http://cwt33.ecology.uga.edu/coweeta_publications.php.

Clark, James S.; Mohan, Jacqueline; Dietze, Michael; Ibanez, Inez. Coexistence: How to identify trophic trade-offs. *Ecology* 84(1): 17-31.

Coleman, David C.; Hunter Mark D.; Hutton, John; Pomeroy, Steven; Swift, Lloyd, Jr. 2002. Soil respiration from four aggrading forested watersheds measured over a quarter century. *Forest Ecology and Management* 157: 247-253.

Elliott, Katherine, J.; Boring, Lindsay, R.; Swank, Wayne, T. 2002. Aboveground biomass and nutrient accumulation 20 years after clear-cutting a southern Appalachian watershed. *Canadian Journal of Forest Research* 32: 667-683.

Grossman, G.D.; Rincon, P.A.; Farr, M.D.; Ratajczak, R.E. Jr. 2002. A new optimal foraging model predicts habitat use by drift-feeding stream minnows. *Ecology of Freshwater Fish* 11: 2-10.

Hicks, Norman, G.; Pearson, Scott M. 2003. Salamander diversity and abundance in forests with alternative land use histories in the Southern Blue Ridge Mountains. *Forest Ecology and Management* 177: 117-130.

HilleRisLambers, Janneke; Clark, James S.; Beckage, Brian. 2002. Density-dependent mortality and the latitudinal gradient in species diversity. *Nature* 417: 732-735.

Hutchens, John, J., Jr.; Wallace, J. Bruce. 2002. Ecosystem Linkages between Southern Appalachian Headwater Streams and Their Banks: Leaf Litter Breakdown and Invertebrate Assemblages. *Ecosystems* 5: 80-91.

Kloeppel, Brian D., Clinton, Barton D.; Vose, James M.; Cooper, Aaron R. 2003. Drought impacts on tree growth and mortality of southern Appalachian forests. In *Climate Variability and Ecosystem response at Long-Term Ecological Research Sites*, David Greenland, Douglas G. Goodin, and Raymond C. Smith, Eds. Pp. 43-55. Oxford: Oxford University Press.

Qualls, R.G.; Haines, B.L.; Swank, W.T.; Tyler, S.W. 2002. Retention of soluble organic nutrients by a forested ecosystem. *Biogeochemistry* 61: 135-171.

Turner, Monica G., Collins, Scott L.; Lugo, Ariel E., Magnuson, John J., Rupp, T. Scott, Swanson, Frederick. 2003. Disturbance dynamics and ecological response: The contribution of long-term ecological research. *BioScience* 53(1): 46-56.

Vose, James M.; Ryan, Michael G. 2002. Seasonal respiration of foliage, fine roots, and woody tissues in relation to growth, tissue N, and photosynthesis. *Global Change Biology* 8: 182-193.

Wyckoff, Peter H.; Clark, James S. 2002. The relationship between growth and mortality for seven co-occurring tree species in the southern Appalachian Mountains. *Journal of Ecology* 90: 604-615.

Yeakley, J. Alan; Coleman, David C.; Haines, Bruce L.; Kloeppel, Brian, D.; Meyer, Judy L.; Swank, Wayne T.; Argo, Barry W.; Deal, James M.; Taylor, Sharon F. 2003. Hillslope nutrient dynamics following upland riparian vegetation disturbance. *Ecosystems* 6(2): 154-167.

What Web site(s) or other Internet site(s) reflect this project? The Coweeta LTER program subscribes to the philosophy that the future of scientific research is tied to the free and efficient exchange of research and ideas in the scientific community. We have accordingly invested heavily in supporting emerging worldwide standards for research and GIS data and metadata, and the Coweeta LTER website (http://coweeta.ecology.uga.edu) was completely overhauled during Year 1 to reflect this approach. All information holdings were inventoried to determine that relevant parts (i.e., data, metadata, GPS, coverages, etc.) were complete; the missing information was either collected or key-coded. EML-compliant metadata was then developed for our tabular data legacy to provide machine-readable information for data harvesters. We simultaneously developed Coweeta Data Set Summaries to provide human-friendly metadata. The Coweeta Data Summaries incorporate the information contained in the EML-compliant metadata, but also provide access to geographic coordinates as well as data. An example can be found at http://cwt33.ecology.uga.edu/summaries/summary1005. For our GIS data legacy we adhere to the Federal Geographic Data Committee (FGDC) Geospatial Standards format (http://cwt33.ecology.uga.edu/fgdc_overview.html).

The single most important accomplishment of the overhaul of the Coweeta LTER website was the move to Open Source Software to develop a relational database management system. This provides complete access to the entire Coweeta data legacy in a recursive fashion from anywhere in our website. The architecture is based on MySQL and PHP. MySQL is a powerful, flexible and efficient database management system, while PHP is a CGI program with a built-in scripting language that dynamically accesses MySQL and outputs to an HTML browser. In contrast to a Google search that is static and only as good as the meta-tagging on individual web-pages, the Coweeta GLOBAL Data Search gives access to all holdings of any kind anywhere in the archives from anywhere on the site. First access to this search engine is available in the "Data & Research" section of the Coweeta LTER homepage, http://coweeta.ecology.uga.edu/webdocs/1/index.htm.

What other specific products have you developed? The foremost reason for developing the Coweeta MySQL-PHP relational data management system was to give us complete control over our data legacy. The tabular data legacy now consists of nearly 200 data sets fully described and accessible according to the NSF LTER Type I and Type II criteria as implemented at Coweeta (http://coweeta.ecology.uga.edu/webdocs/3/static/datapolicies.html). However, the relational data structure also allowed us to assemble, manage and deliver many other types of information including species lists, biographical sketches, and a comprehensive bibliography of publications, thesis and dissertations that we are in the process of converting to downloadable PDFs. Following are the most significant online resources available from the "Data & Research" section of the Coweeta LTER homepage:

- Publications - 1214 citations dating from 1928, 62 publications available online.
- Thesis/Dissertations - 195 theses and dissertations online, dating from 1937.
- Researcher's Biographical Sketches - formatted biographies of all 27 PIs.

- Sample Archives - 93 collections featuring 17,000+ archived samples.
- Species Lists I, GMNH Mammal/Amphibian Collection - 20,000+ vouchered specimens for southern Appalachia from 1905 onward held at the Georgia Museum of Natural History.
- Species Lists II - Observed and collected species at Coweeta Hydrologic Laboratory.
- Digital Elevation Model (DEM) Catalog - raster contour maps for the southern Appalachian study region.
- Digital Raster Graphic (DRG) Catalog - DRGs for the southern Appalachian study region.
- Digital Orthophoto Quadrangle (DOQ) Catalog - DOQs for the greater Coweeta area.
- Demographics – US Census block-level data for the southern Appalachian study region.
- Monthly Climate Data (NOAA/NCDC) – Geo- and temporally-referenced records for 123 stations in the southern Appalachian study region. (Daily climate data will soon also be available.)

4. Contributions: How has the project contributed?

The 1996-2002 Coweeta research effort revealed surprisingly strong effects of land-use history on the current state of terrestrial and aquatic ecosystems in the southern Appalachian Mountains. Natural disturbances and human land use interact with steep environmental gradients to produce complex spatial patterns and temporal dynamics at the individual, population, community, ecosystem, and landscape levels. This research positioned us for significant advances in the scientific understanding of the spatial, temporal, and decision-making components of land use and land-use change in the southern Appalachian Mountains during 2002-2008. Particular contributions not already mentioned above are noted next.

To the development of the principal discipline(s) of the project? While the principal discipline of the Coweeta LTER research is ecosystem ecology, the 27 investigators span a wide gamut of contributory subdisciplines. Publications this year contributed to our understanding of many key ecological concerns: trophic trade-offs; aboveground biomass and nutrient accumulation; an optimal foraging model for drift-feeding stream minnows; salamander diversity and abundance; density-dependent mortality and the latitudinal gradient in species diversity; leaf litter breakdown and invertebrate assemblages; retention of soluble organic nutrients in a forested ecosystem; seasonal respiration of foliage, fine roots, and woody tissues in relation to growth, tissue N, and photosynthesis; and hillslope nutrient dynamics following vegetation disturbance.

To other disciplines of science or engineering? Our contributions are not limited to ecosystem ecology, but penetrate other science disciplines as well. David Leigh is applying geomorphological techniques to the "Hazards Project" that will document the response trajectory of streams to changing land use patterns in southern Appalachia over the next 30 years. In the process he is comparing two widely used yet divergent physical stream survey parameters – USGS and USEPA – to develop a standardized methodology for use in the Appalachian Highlands. Seong Cho along with David Wear and David Newman are conducting an economic analysis of the site-specific factors of land development in the French Broad and Little Tennessee River Basins. In the process, they are advancing the nascent field of spatial econometrics.

To the development of human resources? Although already noted in other categories, the Coweeta LTER program provides numerous opportunities for the development of human resources. We have three post-doctoral fellows working on research projects in the southern Appalachian study region. There are 31 graduate students, both M.S. and Ph.D. level, assisting with, participating in, or conducting their own research in the Coweeta LTER program. Finally, with NSF supplemental funds to the Coweeta LTER program we sponsored three REU students in summer 2003. Following are three additional contributions to the development of human resources.

James Clark will run a 2004 summer school with NSF funding on statisical computation, which is a direct outgrowth of his Coweeta LTER research on trophic dynamics, density-dependent growth and mortality of Appalachian tree species. Students will work in groups guided by the course instructors; they will select data sets for analysis, develop models, write and execute code, produce predictive distributions, and write case studies for publication as a volume. Topics to be covered in the course include: principles of Bayesian inference; graphical modeling for complex processes; hierarchical modeling; data, process, and parameter models; the Gibbs sampling framework; robustness and sensitivity to stage-wise specification; and model adequacy/validation/model selection.

Brian Kloeppel & Susan Steiner direct the Coweeta Schoolyard LTER program that provides exposure to science and technology for students and teachers from grade school through college. As part of this effort, they direct and organize on and off-site data collection and discussion in association with ongoing Coweeta LTER studies. These efforts contribute to the needs of students at all levels, as well as the needs of visiting scientists of all kinds, ecosystem managers, and the public at large.

Phaedra Scarborough, a student researcher working with Dr. Kitti Reynolds, learned basic microarthropod taxonomy in sorting microarthropods from Coweeta soil samples. She also participates in the decision-making of setting up new off-site research plots associated with experiments on climate and site controls of forest form and function (a component of Coweeta LTER Research Initiative 2).

To physical, institutional, and information resources that form the infrastructure for research and education? One of the most significant contributions in the first year of the Coweeta LTER research cycle is the development of a true relational archive for our data legacy. Not only is this a critical component to the success of our activities in the years to come, but it is a significant contribution to the infrastructure for research and education. Not to be overlooked, however, are the complete renovation of the Analytical Laboratory and the Residence, and the construction of the Conference Center at the Coweeta Hydrologic Laboratory. This achievement was made possible by funds and inter-institutional collaborations by the USFS, the NSF, and the University of Georgia. The facilities meet the day-to-day research, communication, and residential needs of Coweeta investigators and students, as well as many other research collaborators. In some of the most practical ways imaginable, these three facilities make the Coweeta LTER program possible.

To the public welfare beyond science and engineering? Understanding the causes and consequences of land-use change is a critical research challenge at both national and global

scales. Our current research addresses ecological and socioeconomic aspects of land-use change while continuing our studies of environmental gradients and natural disturbance regimes. This will produce a comprehensive understanding of ecological dynamics in the southern Appalachian Mountains and make possible the development of reliable forecasts of its future ecological state. Such forecasts offer the opportunity to formulate policies and management objectives with increased chances of success.

On Human Settlement and Agricultural Production in the Blue Ridge: Through the middle of the 18th century, the Indian population concentrated at fewer sites and forest cover expanded on abandoned agricultural lands (Gragson and Bolstad 2005). Euroamerican settlers began arriving in large numbers in the late 1700s; they re-cleared land for agriculture in the river valleys, as the Indians before them had, and grazed livestock in the adjacent forests. Between 1850 and 1900, the number of farms increased 275% as the average farm area decreased by 66%; between 1900 and 1950, the number of farms increased by 14% as the average farm area decreased by 36% (Gragson and Bolstad 2006).

The New South emerging after 1960 marks a transition in the kinds of human activities affecting Southern Appalachia although the consequences of past land-use practices during the preceding 100 years are still very evident in the structure and function of contemporary ecosystems. Settlement through the 1960s was concentrated almost exclusively in lowlands, on large flats or near the confluence of rivers; since that time, individual dwellings are dispersed in loose clusters across the landscape, particularly on steep slopes and upland ridges (Cho and Newman 2004).

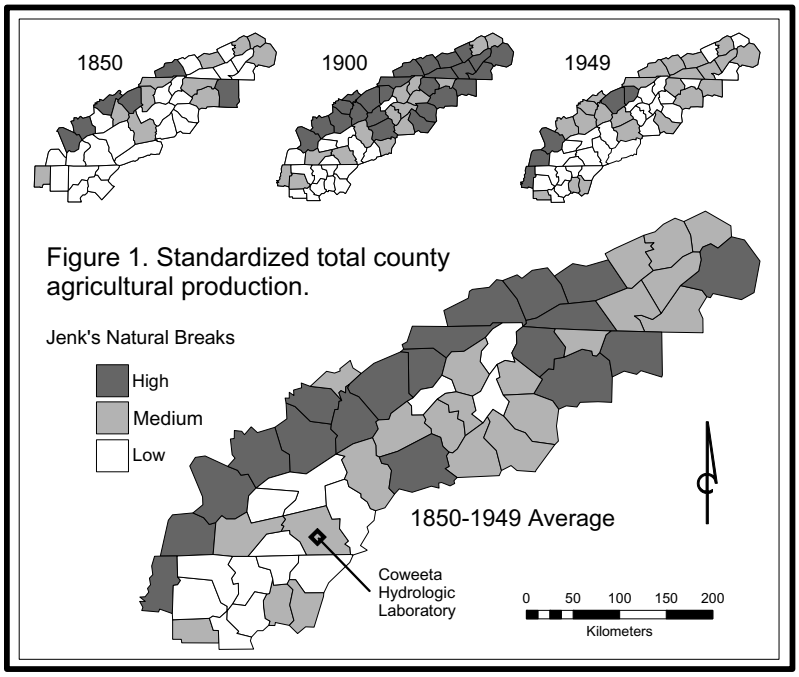


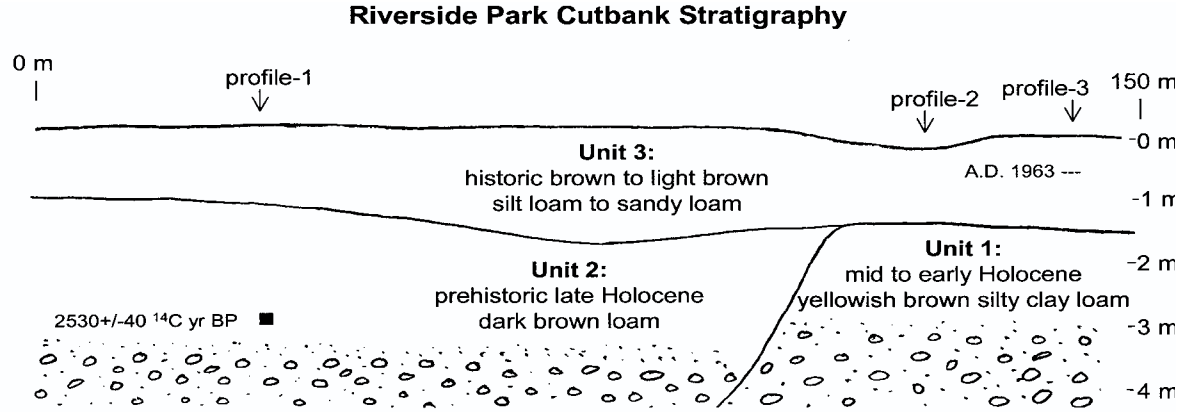
Figure 1. Standardized total county agricultural production.

Gragson, Ted L. and Paul Bolstad. 2006. Land Use Legacies and the Future of Southern Appalachia. Society and Natural Resources 19 (in press).

Gragson, T.L., and P.V. Bolstad, 2005. A regional analysis of Cherokee town placement and population ca. 1721. Social Science History (submitted).

Cho, Seong-Hoon and David H. Newman. 2005. Spatial analysis of rural land development. Forest Policy and Economics 7:732-744.

On the Sedimentary History of the Little Tennessee River and Environs: The cutbank exposure at Riverside Park provides a stratigraphic reconstruction of past sedimentation rates and flood frequency (Figure 1). A radiocarbon date of 2530 +/- 40 ^{14}C yr BP (UGA# 9054) from the base of the overbank facies in the prehistoric late Holocene stratum indicates that long-term average prehistoric overbank sedimentation rates were approximately 0.05 cm/yr. In contrast, the thickness of the historical stratum indicates that long-term average historical sedimentation rates were more than an order of magnitude greater than the prehistoric rates (0.5 to 1.3 cm/yr), assuming a date of 1870 for the onset of widespread erosive land use.



Preliminary results provide clear data about large differences in prehistoric versus historic sedimentation rates, which are probably related to greater erosive land use and sediment yield since circa 1870 (Leigh and Webb 20005. Furthermore, our data suggest that the post-1963 suburbanization/gentrification phase of land use in the Little Tennessee basin is producing comparable (or perhaps higher) levels of sedimentation compared to earlier modes of timber harvest and agricultural land uses. Flood frequency patterns are apparent from the sedimentary record, but sedimentary information about flood magnitude is problematic.

Leigh, D.S. and Webb, P.W. 2005. Holocene erosion and sedimentation at Raven Fork, Blue Ridge Mountains, USA. Geomorphology (in press).

On Land-Use History and Soil Biophysical Properties: Our current studies are investigating the effects of land-use history on variation in soils, nitrogen mineralization rates, and soil microbial communities. Mean sizes of the nitrogen, potassium and phosphorus pools differed with past land use, and potential net nitrogen mineralization in reference forests was nearly double that in former pastures. Most interestingly, however, were differences in the spatial heterogeneity of soil resources with past land use. In general, soil nutrients varied over fine spatial scales in reference forests, but this variability had been homogenized in former pastures (Fraterrigo et al. 2005).

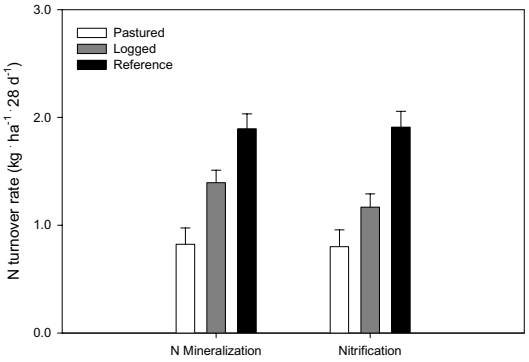


Figure 1. Mean rates of potential nitrogen mineralization and nitrification from soils sampled in 2002. Error bars represent ± 1 SE.

The changes in spatial heterogeneity of soil nutrients influenced the spatial distribution of herbaceous species (Fraterrigo et al. in review *a*). Geostatistical analyses showed that spatial variation in soil nutrients was important in structuring the spatial patterns of herbs in reference forests but not in forests with historic land use. Biomass allocation in herbs also varied with past land use, with adult plants allocating more biomass to leaves in formerly pastured stands and more to stems in reference stands (Fraterrigo et al. in review *b*); herbaceous cover was greater in reference stands, and these plants may experience more competition for light.

We have also found that soil microbial community composition varied with past land use. Communities in former pastures had a higher relative abundance of Gram negative bacteria and a lower abundance of fungi compared with previously logged and reference stands (Fraterrigo et al. in review *c*). Our results show that patterns of historic land use can influence soil nutrients, microbial communities and herbaceous plants for at least 75 years in this landscape. Historic landscape patterns have introduced an important source of spatial heterogeneity both within and among forests in the Southern Appalachians.

Fraterrigo, J. M., M. G. Turner, S. M. Pearson, and P. Dixon. 2005. Effects of past land use on spatial heterogeneity of soil nutrients in Southern Appalachian forests. Ecological Monographs 75:215-230.

Fraterrigo, J. M., M. G. Turner and S. M. Pearson. Interactions between past land use, life-historiy traits and understory spatial heterogeneity. Landscape Ecology (In review a).

Fraterrigo, J. M., M. G. Turner and S. M. Pearson. Understory plant allocation and growth vary with historical land use. Journal of Ecology (In review b).

Fraterrigo, J. M., T. C. Balser and M. G. Turner. Long-term impacts of land use on microbial communities in forest soils. Ecology Letters (In review c).

On the Distribution of Ericoid Mycorrhizal Fungi: PPO enzymes release organic N from polyphenol complexes. PPO activity was significantly greater under *R maximum* in the O horizons, but not the A horizon (Fig. 1). Since ERM roots are concentrated in the O horizons, it is suggestive that ERM fungi are responsible for greater PPO activity in these horizons. From a reciprocal litter enzyme study, leaf litter type was not responsible for PPO activities, but location under *R maximum* was associated with greater PPO activity (p=0.05). These data suggest that ERM fungi are driving greater PPO activity under *R maximum* and mediating the acquisition of this complexed organic N to its host (Rachel and Hendrick 2005).

Since *R maximum* contributes to greater litter inputs and litter tannins have a greater capacity to complex organic N, polyphenol-organic N complexes are likely to predominate *R maximum* soils. We have evidence that *R maximum* can access this pool of organic N via extra-cellular PPO enzymes. In addition, fine root length under *R maximum* is two and a half times greater than under hardwood stands (p=<0.0001). Together, these data suggest that *R maximum* roots have a physiological and morphological advantage over ECM overstory trees to intercept and degrade immobile polyphenol-organic N complexes. Future work focuses directly on movement of polyphenol-complexed organic N into mycorrhizal and/or plant biomass.

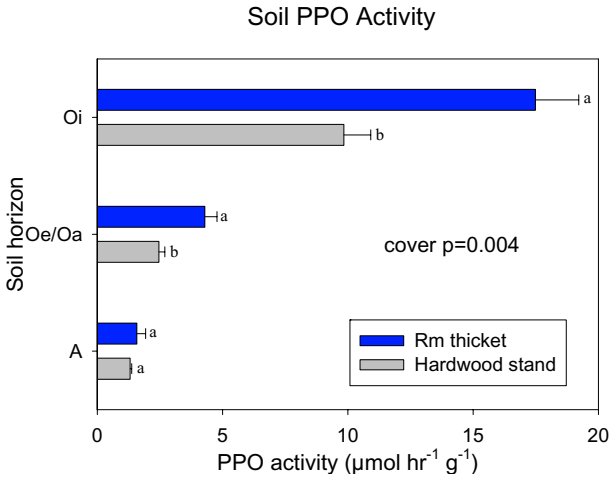
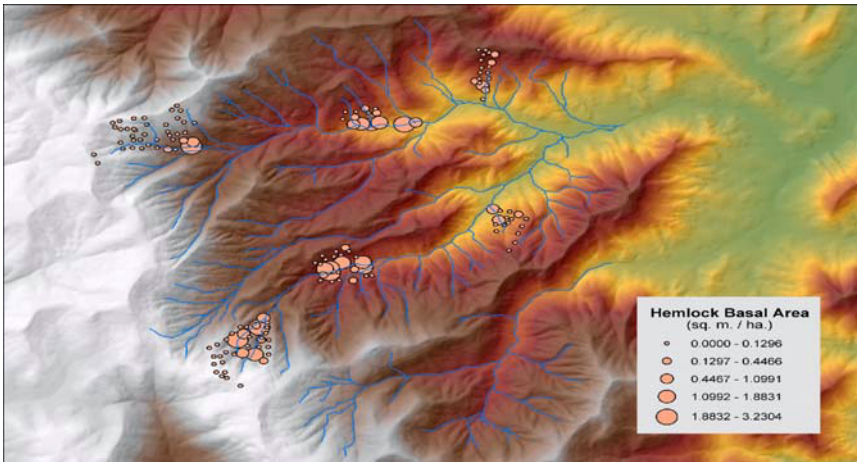
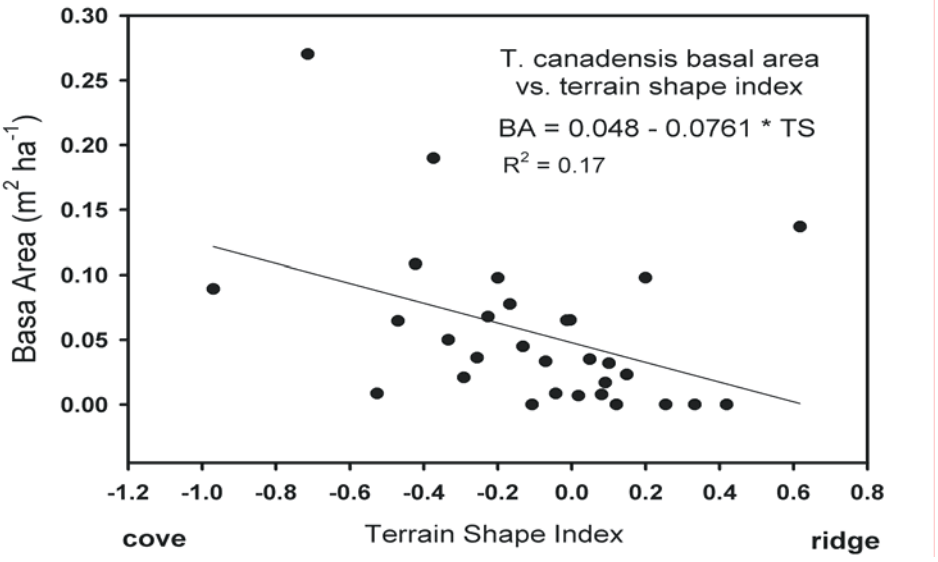


Figure 2. Soil extra-cellular PPO activity in soil horizons under *R maximum* thickets and hardwood stands.

Rachel, G. and R.L. Hendrick. 2005. Vertical distribution of ericoid, ecto- and arbuscular fungi in relation to soil N and P. Mycorrhiza (submitted).

On Predicting the Impacts of Hemlock Woolly Adelgid: The specific distribution of hemlock within the southern Appalachians is not well known (Brown 2004; Knoepp et al. 2005). They are generally most prevalent along streams and on mesic north facing slopes; however, we do not have a predictive understanding of hemlock distribution, number and size within patches, patch area, or distance between patches. These data are key to understanding the importance of hemlock across the landscape and to develop control and restoration strategies. Specific objectives for mapping hemlock distribution are: (1) develop and evaluate methods for mapping hemlock distribution using photographic, and medium and high resolution satellite images, and (2) develop and evaluate terrain-based predictive models of hemlock distribution.





Brown, Josh 2004 Impacts of hemlock woolly adelgid on Canadian and Carolina hemlock forests. Land use change and implications for biodiversity on the Highlands plateau. A report by the Carolina Environmental Program. Highlands, NC. Highlands Biological Station, 19-36.

Knoepp, J.D., K.J. Elliott, J.M. Vose, B.D. Clinton, and B.D. Kloeppel. 2005. Hemlock woolly adelgid research at Coweeta Hydrologic Laboratory. Symposium Proceedings, B. Onken and R. Reardon, compilers. Third Symposium on Hemlock Woolly Adelgid in the Eastern United States. Asheville, NC. p. 308.