Coweeta LTER 1997 Annual Meeting Presentation Abstracts

Compiled and Edited by Brian D. Kloeppel

*Presenter

Poster Presentation

ARGO, BARRY W.* and B.L. HAINES. University of Georgia, Athens, GA 30602. Flowering Phenology of a Perennial Herb Across an Altitudinal Gradient at Coweeta LTER.

Blue Cohosh, *Caulophyllum thalictroides*, is an early-flowering perennial herb common to Eastern North America, and most abundant in the Southern Appalachians. *Caulophyllum* is conspicuous in that it exhibits rapid development of a cold-tolerant reproductive shoot, which raises the fully expanded inflorescence 2 to 5 dm. above its short-stemmed contemporaries. Well-established populations of *Caulophyllum* occur at two of five altitudinal gradient stands, instrumented in 1991 as part of the LTER project at Coweeta Hydrologic Lab. The low elevation site is at 795m.; the high elevation site is at 1374m.; a small population (25 reproductive shoots in 1996) occurs at a mid-elevation (1000 m) non-instrumented site. All study populations occur on north-facing slopes in rich, mesic soils. The objectives of this study are to characterize flowering phenology of *Caulophyllum* populations, determine potential pollinators, correlate air and soil temperature regimes with phenology, and determine the extent of conditioning/ecotypic differentiation imposed by the ecocline. The premise for these objectives is that extreme climatic fluctuations could cause phenological dysphasia in established plant-pollinator associations. Analysis of soil temperature data from 1991 through 1996 indicates that overwintering tubers at 1324m. experience 25-50 days of continuous freezing temperatures each winter, whereas those at 795m. tended to have few (4-8), if any, continuous days of frozen soil. These data suggest differences in temperature stratification requirements for the two populations. Phenological data from 1995 and 1996 show a pattern of two weeks92 delay for each phenophase from the low to high elevation, and a two week delay in the overall pattern from 1995 to 1996. Correlating heat accumulation via degree-days indicates that plants at the high elevation have a lower threshold temperature and a lower heat accumulation requirement. Sampling of insect visitors in 1996 revealed fewer and smaller taxa at the high elevation. To test for conditioning/differentiation between sites, n 3D 10 reciprocal transplants and n 3D 10 same-site control transplants were performed on 12 January 1997. Phenological data for 1997 and sub-sequent years should give indications of the adaptability of these transplants to different thermal regimes.

Oral Presentation

Arthaud, Greg*, David Wear, David Newman, and Rinku Roy Chowdhury. University of Georgia, Athens, GA 30602. Influencing Factors for Land-use Change: Macon County, North Carolina.

As part the Coweeta Long Term Ecological Research Project, we investigated land use change in Macon County, North Carolina over three time periods: 1953-1963, 1963-1981, and 1981-1994. We evaluated elevation, slope, distance to nearest road and market, and forest and agriculture productivity as possible explanatory variables for land use change. Over time, both the frequency of land use change and the factors driving land use change fluctuated. We observed large declines in agriculture

area, large increases in human influenced land uses, and moderate declines in forest area not influenced by humans.

Oral Presentation
BECKAGE, BRIAN* and JAMES S. CLARK. Duke University, Durham, NC 27708. Canopy Gaps, *Rhododendron maximum*, and Tree Recruitment in the Southern Appalachians.

Although increased tree recruitment is expected following canopy gap formation, seedling recruitment can be limited by competition with understory shrubs for resources associated with gaps. This may be particularly true when gap formation results in minimal mechanical damage to the understory, such as when drought mortality produces a standing dead tree. In the southern Appalachians, an ericaceous evergreen shrub, *Rhododendron maximum*, has expanded its areal coverage this century, likely due to altered fire regimes and the decline of *Castanea dentata*. We examined the recruitment of tree seedlings in twelve artificial canopy gaps, half of them in areas dominated by *Rhododendron*. Canopy gaps 20m in diameter were created by girdling, resulting in standing dead trees and minimal mechanical damage to the understory. Recruitment of 1st year and 1st year seedlings was monitored for four years in transects extending from adjacent undisturbed forest through the gap. Seedling densities were consistently lower beneath *Rhododendron* both inside and outside of canopy gaps. Canopy gaps did not increase recruitment beneath *Rhododendron* to levels found in adjacent areas. The potential exists for an interaction between mode of gap formation, e.g. windthrow or drought mortality, and the presence of a dominant shrub layer, which could alter forest structure over large areas.

Oral Presentation
BENFIELD, E.F.* and J.S. HARDING. Virginia Polytechnic Institute & State University, Blacksburg, VA 24061-0406. Variations in Temporal Land-use Disturbance and Functional Responses of Stream Assemblages.

GIS overlays of time-sequence land-use patterns (1948-1990) were generated for two river systems in the Southern Appalachians. Land-use and catchment development data from aerial photographs, satellite imagery and topographical maps were combined to measure the magnitude of landscape development. A range of physical characteristics, and stream benthic assemblages were then investigated at 24 sites, 12 in each river system, six in each of primarily agricultural and six forested catchments. Distinct differences were observed in the physical structure of streams with long-term agriculture compared to streams in forested catchments, similarly significant differences were observed in the functional organization of streams assemblages. All sites were dominated by collector/gather (51-87%) macroinvertebrate assemblages, however the percentage of shredders was significantly higher in forested streams (5%) than agricultural streams (0.5%). Similarly, predators were abundant in forested streams (8-15%), however their importance decreased with an increasing degree of agricultural activity (4-6%). Several catchments which had significant forest regeneration over the last 50 years still had stream benthic assemblages similar to those found in agricultural streams. Our findings suggest that forest regeneration within a catchment may alleviate some detrimental physical effects of long-term agriculture, however recovery of the fauna to its pre-disturbance structure may take decades.

Poster Presentation
Bennett, Barbara L. and E.F. Benfield. Department of Biology, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061-0406. Does Headwater Land-use Influence Downstream Invertebrate Assemblages in Agricultural Streams?

We are investigating the role of headwater land-use in structuring downstream benthic invertebrate assemblages in agricultural streams in the French Broad River drainage in western North Carolina. We sampled six agricultural streams (3 with cleared headwaters and 3 with forested headwaters) at three points along a gradient (headwaters, a midpoint, and a downstream site). At each site, we collected five Surber samples and measured a variety of physico-chemical parameters, including temperature, chlorophyll a, discharge, nutrients, and suspended solids. Preliminary results indicate that benthic invertebrates in agricultural streams with forested headwaters are evenly distributed among functional feeding groups, while in entirely agricultural streams collector-gatherers dominate (56%). Shredders compose a higher percentage at sites downstream of forested headwaters (15.3%: Pteronarcys, Tallaperla, Nemouridae, Taeniopterygidae, and Tipulidae) than at sites on entirely agricultural streams 0.6%: Nemouridae and Tipulidae). Fewer pollution-sensitive families are present in entirely agricultural streams (EPT 3D 5) than downstream of forested headwaters (EPT 3D 13). We expect that a detailed characterization of the forest/agriculture interface will contribute to our understanding of the magnitude of headwater effects on downstream physical conditions and biotic processes.

Oral Presentation
Bolstad, Paul V.*[1] and James M. Vose[2]. [1]University of Minnesota, St. Paul, MN 55102 and [2]USDA Forest Service, Coweeta Hydrologic Laboratory, Otto, NC 28763. Ecosystem Carbon Flux: Landscape to Regional Models and Estimates.

Above- and below-ground ecosystem flux measurements have been combined with spatial data compiled at range of spatial scales to develop estimates of total ecosystem and regional carbon flux. We observed large regional differences in ecosystem carbon storage and flux, both in aboveground components due to landcover, natural temperature and moisture gradients, and substrate type, and belowground in response largely to topographic position and landuse history.

Oral Presentation
Coleman, D.C.* Institute of Ecology, University of Georgia, Athens, GA 30602. An Overview of Riparian Studies at the Coweeta Hydrologic Laboratory, 1996-97.

We have had further follow-up studies after the August, 1995 Rhododendron removal treatment. Variables followed include: litter decomposition, N mineralization, microbial biomass, nematode biomass, soil respiration, Soil N, P, and S dynamics, and measurements of inorganic species in shallow and deep lysimeters. The study locations include: removal area, Hurricane "control area", and non-hurricane control areas. New studies, begun in April 1997 include measurement of natural regeneration and seed predation in the afore-mentioned areas as well. Some of our greatest changes in hydrology and regeneration patterns have occurred in the hurricane-impacted site, and data will be presented providing further details of these patterns by individual investigators.

Poster Presentation
D.A. Crossley, Jr., Randi Hansen, Coeli M. Hoover, and Karen L. Lamoncha. Institute

of Ecology, University of Georgia, Athens, GA 30602. Diversity of Oribatid Mites Species Along an Elevation Gradient in the Southern Appalachian Mountains.

Oribatid mite communities were characterized along our elevation gradient, using litterbag techniques and extractions from soil cores. In all, 135 species of oribatids were identified from the five gradient stands. Measures of similarity suggest that a single mite community is distributed along the gradient. The species assemblages from the two mixed oak sites were the most similar of the five. Different species were dominant in litterbags than in soil cores. In general, mites from litterbags were larger and were species which could macerate decomposing plant materials. Soil species tended to be smaller, fungal feeders. Mite assemblages from Coweeta were more species-rich than those we found at Joyce Kilmer Memorial Forest or Wine Spring Creek. However, in general, the southern Appalachians support one of the richest oribatid faunas yet documented.

Oral Presentation

DAIL, D.B.*, and J.W. FITZGERALD University of Georgia, Athens GA, 30602. Removal of Dominant Near-stream Flora, *Rhododendron* sp.: Effect on Soil C, N, S, and S-immobilization Potential.

Rosebay rhododenron (*Rhododendron maximum* L.) is expanding its range in the southern Appalachian mountains and has become the dominant near-stream flora, shading headwater stream and creating thick root mats in superficial soil horizons. We sought to determine the functional role of *R. maximum* in the soil standing stocks of C, N, and S, and the potential to immobilize precipitation-borne sulfate inputs. These stocks and processes were measured for 2 years prior and 1 year subsequent to removing a 10x30m plot of above-ground *R. maximum* biomass adjacent to a headwater stream. A similar plot 30m upstream was left uncut as a control for the removal. A-horizon percent C and N ranged from 2.0 to 4.3% and 0.09 to 0.20% respectively over the course of the study, however, no differences due to cut treament were evident. A significant increase in total S was measured in the treatment plot, but no significant changes in the sulfate adsorption or microbial immobilization processes were measured as a function of the removal. Soils in both plots adsorbed three-fold more sulfate than was immobilized in microcosm incubations; however, standing stocks of S suggested that organic forms of sulfur are more important as a long term sink in these soils.

Poster Presentation

DOWELL, KATHERINE, KATHARINE SCHOFIELD, JUDITH MEYER, AND CATHERINE PRINGLE. Institute of Ecology, University of Georgia, Athens, GA 30602-2202. Effects of Electric Exclusion of Macrobiota in Southern Appalachian Streams.

We will examine the impact of watershed land-use in southern Appalachian streams on community-level interactions among macrobiota that influence algal colonization, sediment accumulation, and invertebrate assemblages. The experiments are planned for summer 1997 in six streams in North Carolina differing in extent of forested and agricultural land cover. We will use an electric exclusion technique to manipulate the presence and absence of macrobiota, organisms ~1 cm long, including fish, crayfish and large insects. We hypothesize that the exclusion of macrobiota will release smaller invertebrates from predation, resulting in higher abundances of smaller invertebrates, lower algalbiomass and less sediment accumulation in the exclusion treatments. We plan a sediment addition experiment in one of the forested streams

to test the hypothesis that increased sediment transport such as that found in agricultural streams masks the effects of invertebrate activity on algal biomass and sediment accumulation. From a 40 d trial experiment performed in Ball Creek, Coweeta Hydrologic Laboratory, NC during winter 1997, larval dipterans (*Simuliidae* and *Chironomidae*) were significantly more abundant in exclusion treatments, and simuliid larvae were significantly larger in exclusion treatments.

Oral Presentation

Elliott, K.J. [1], B.D. Clinton*, and S.G. McNulty[2]. [1]USDA Forest Service, Coweeta Hydrologic Lab, Otto, NC 28763 and [2]USDA Forest Service, Southern Global Change Program, Cary, NC 25713. Comparative Physiology of Four Co-occurring Hardwood Species at Two Elevations in the Coweeta Basin, North Carolina, USA.

In this study we examined the relationship between resource use efficiencies and resource availability in four co-occurring tree species in the southern Appalachians. Photosynthesis and leaf conductance of red maple (*Acer rubrum* L.), chestnut oak (*Quercus prinus* L.), scarlet oak (*Q. coccinea* Muenchh.), and northern red oak (*Q. rubra* L.) at two elevations were evaluated. Use efficiencies of water and nitrogen of these four species were quantified. The availability of light, water, and nitrogen were estimated. We also considered the relationships among photosynthetic rate, leaf mass per area, and leaf nitrogen per area of these saplings. Soil water content and net nitrogen mineralization were higher while vapor pressure deficit and temperature were lower at mid-elevation than at low-elevation, suggesting that the mid-elevation site was more amenable for sapling physiology. Photosynthesis, leaf conductance, and photosynthetic nitrogen use efficiency wee generally higher at mid-elevation than at low-elevation for all oak species. Photosynthetic water use efficiency was higher at mid-elevation than at low-elevation in 1993, but was the same at both elevations in 1995. Among the oaks, *Q. coccinea* had the highest photosynthetic rate, leaf conductance, leaf nitrogen per area, and leaf mass per area. *Q. rubra* had the second highest photosynthetic rate and the highest photosynthetic nitrogen use efficiency. In 1995, net photosynthesis at light saturation was significantly related to leaf nitrogen per area and leaf mass per area.

Poster Presentation

ETTEMA, Christien H. and R. A. HANSEN. Institute of Ecology, University of Georgia, Athens GA 30602. Nematode Diversity in Litter of Varying Complexity.

More species can coexist in spatially heterogeneous than in homogenous environments. To test this hypothesis for nematodes living in leaf litter, an experiment was conducted in a temperate forest in North Carolina, USA. Natural leaf litter was excluded from a series of 1 m^2 plots and replaced with treatment litters of varying complexity. Simple litter treatments were pure birch, maple, and oak. Complex litter treatments were a mixture of these 3 litter species, and a mixture of 7 litters. Plots were sampled in Spring 1995, after receiving treatment litter in Fall 1993 and Fall 1994. Complex litters supported a higher fungal and bacterial biomass, and a higher abundance of nematodes. In particular, abundance and diversity of omnivores and predators were significantly higher in complex litters. Overall nematode diversity (richness, Fisher's A) did not vary markedly with litter complexity, but differences in species composition were evident among treatments.

Oral Presentation
Gragson, TED R. University of Georgia, Athens, GA 30602. Enclave Development and Friendly Outsiders in Southern Appalachia.

Human contribution to landscape-level disturbance in Southern Appalachia is commonly linked to observed social and economic changes in the region. A matched control group study of growth in Appalachian counties by comparison to their national counterparts indicated that between 1970 and 1991 growth was positive across the 20 US Census indicators used; the three highest areas of growth where in the following three categories: 1) dividends, interest, and rent; 2) services; and 3) finance, insurance, and real estate. Of the 13 states comprising "political" Appalachia, those undergoing the greatest amount of change were Georgia, Kentucky, North Carolina, South Carolina and Tennessee. In dollar terms, the income growth differences between Appalachian counties and their national twins translates into $8.4 billion more income for Appalachian in 1991 than in 1970.

While growth is easy to recognize, the reasons for its existence are less clear. The Appalachian Regional Commission (ARC) has been the most instrumental organization in promoting growth. For the ARC, "the primary goal of the regional development program (was) to provide every person in Appalachia with the health and skills he needs to compete for opportunities wherever he chooses to live." The approach was to build highways connecting central places. This had the dual purpose of opening up areas to the opportunity for economic development and improving local access to educational, health, recreational, commercial and industrial facilities. This enclave growth model is poorly regarded from within Appalachia where many people claim the ARC has failed to benefit the Appalachian people. The critique centers on the central roles played in the region by coal mining, external ownership of resources, local politics, and environmental degradation. A key actor identified in the process of change are "friendly outsiders" who are commonly seen as misguided, naive, self-interested, or malevolent.

Oral Presentation
GROSSMAN, G.* University of Georgia, Athens, GA 30602. Long-term Population and Assemblage-level Fish Studies at Coweeta.

We examined a variety of assemblage-level characteristics in Coweeta Creek between 1984-1992. This period encompassed both a major drought (1985-1988) as well as three years with extremely high flows (1989,1990,1992). For analyses, samples were classified on the basis of season, year, and hydrologic period (drought [D], pre-drought [PR], and post-drought [PO]). Species richness (total 3D 16) was significantly higher in D than in PR or PO periods. Assemblage structure samples clustered on the basis of hydrologic period rather than season or year. Correlation analyses between species richness and microhabitat availability and diversity, and predator abundance, yielded limited results, although species richness was inversely correlated with microhabitat availability. The abundance of most benthic species did not change substantially during the drought however the abundance of most water column species increased. Variations in the abundance of potential competitors or predators did not produce strong shifts in microhabitat use by assemblage member. In conclusion, our results indicate that variability in flow had a much stronger effect on the structure, stability and use of spatial resources within this assemblage than either interspecific competition for space or predation.

Oral Presentation
Helfman, Gene*, Dale Jones, and Josh HarpeR. Institute of Ecology, University of Georgia, Athens, GA 30602. Effects of Land Use on the Fishes and Habitats of Southern Appalachian Streams.

We are examining the effects of land use practices on fish diversity and abundance in a series of 24 small vs. large streams in the French Broad and Little Tennessee River basins. We have focused on contrasting land cover designations (agricultural vs. forested watersheds) by collecting at three replicate sites of each size/land cover type in each river system. We have also tested for the effects of riparian forest fragmentation. Our analyses suggest that (1) the Little Tennessee has slightly higher fish diversity, apparently reflecting decreased diversity in small French Broad streams; (2) the French Broad has been affected more by agriculture via fine sediment inputs; (3) sediments have their greatest effect on benthic-spawning fishes; (4) trout are limited to forested systems and are correlated with reduced diversity in non-trout taxa; (5) riparian forest fragmentation depresses habitat diversity and fish density, particularly among imperiled Southern Appalachian fish families; and (6) fragmentation has a graded effect on habitat distribution and a threshold effect on fishes. From our efforts we hope to be able to predict potential shifts in aquatic habitats under different scenarios of stasis or change in land use.

Poster Presentation
Hendrick, Ronald L.[1], James M. Vose[2], David C. Coleman[1], D.A. Crossley, Jr.[1], Bruce L. Haines[1], Mark D. Hunter[1], and Brian D. Kloeppel[1]. [1]University of Georgia, Athens, GA, 30602 and [2]USDA Forest Service, Coweeta Hydrologic Laboratory, Otto, NC 28763. The Relationship Between Fine Root Dynamics, Canopy Processes and the Soil Environment.

We are measuring fine root production and longevity at the high elevation oak (427) and northern hardwoods (527) sites. These data will be combined with soil and canopy data to develop relationships between fine root demography and the soil environment, canopy development and water demand. We permanently installed five minirhizotrons (clear, plastic observation tubes) in each of three miniplots adjacent to each main LTER plot. At monthly intervals, we will videotape the roots growing along sampling frames etched onto each tube. We will measure and follow the fate of individual roots throughout the study. Additional images will be collected during and after unusual or periodic events like extended droughts, canopy expansion and senescence, herbivore outbreaks, etc. We are also measuring root activity in the observation boxes previously installed on each plot. We are augmenting the planned LTER research with additional data being collected as part of a cross-site experiment that includes both LTER and non-LTER long-term research sites in Alaska, Florida, Georgia, Michigan, and New Mexico. This additional project is designed to quantify the relative importance of plant taxon, mycorrhizal type, soil N, and climate on patterns of below ground carbon allocation and utilization.

Poster Presentation
HENEGHAN, LIAM, DAVID C. COLEMAN, XIAOMING XOU, D.A. CROSSLEY JR., and BRUCE L. HAINES. University of Georgia, Athens, GA, 30602. Site-Specific Faunal Contributions to Decomposition Dynamics: Tropical and Temperate Comparisons.

Microarthropod regulation of the microbial populations involved in leaf litter decomposition is expected to be stronger in humid tropical forests where high

moisture and temperatures and low climatic variability ensure optimal conditions for microbial growth and faunal feeding. In an experiment which contrasted decomposition of oak litter across two tropical and one temperate forest, mass loss proceeded faster in Puerto Rico and Costa Rica than in Coweeta, North Carolina, USA. Microarthropods had little effect on decomposition in the temperate forest whereas their influence was pronounced at tropical sites. Furthermore, there was a significant difference between the tropical sites in the extent of the faunal effect. Relationships between microarthropod assemblage structure and amounts faunally influenced mass loss were found both across sites and within sites. The site-specific faunal contribution to decomposition suggests that a detailed understanding of the mechanisms underpinning the role of assemblage structure in soil organic matter turnover is a pressing concern.

Oral Presentation
HILLERISLAMBERS, JANNEKE* and JAMES S. CLARK. Duke University, Durham NC 27708. Variability within Early Life History Stages of Temperate Forest Trees.

Early life history stages of forest trees can be critical determinants of diversity. Comparing distributions across these stages can illuminate the scale and magnitude of species specific recruitment limitations. We determined relationships among seedrain, seedbank, and seedling densities in four different Southern Appalachian hardwood stands. Seedrain was measured over 5 years in 20 traps within each stand type. Seedbank and seedling densities were sampled at 66 points within each stand. Seedbank strategists were those species with seeds residing in the soil for more than one year, *Liriodendron tulipifera*, *Betula* sp., *Acer rubrum*, and *Rhododendron maxima*. Non seedbank strategists were *Nyssa sylvatica, Quercus rubra*, and *Quercus* prinus. Seedbank strategists had more variable seedling densities than non seedbank strategists, reflecting stringent germination requirements. Seedbank and seedling densities were used to fit seed production, dispersal, and clumping parameters for each species present, and were compared to the seedrain. Fits for seedbank and seedling densities generated similar dispersal parameters, increased clumping, and lower correlations, possibly reflecting the scale and magnitude of germination requirements or the loss of viability. Results indicate that the progressive increase in spatial variability at each life history stage from seedrain to seedbank to seedling is species specific and could20be a key in structuring the temperate forest community.

Oral Presentation
HUNTER, MARK D.* University of Georgia, Athens, GA 30602. Causes and Consequences of Variation in Levels of Insect Herbivory at the Coweeta Hydrologic Laboratory, NC.

In three related projects, we are assessing the causes of variation in herbivory in the forest canopy, and the consequences for forest ecosystem processes. In the first project, we are assessing the effects of hurricane Opal on soil nutrient dynamics and the nutritional and defensive chemistry of trees. We plan to link nutrient availability following hurricane damage with concentrations of foliar phenolics, and subsequent defoliation levels among three damaged and three undamaged sites. Second, we are measuring inputs of herbivore-derived materials from the forest canopy to the forest floor along an elevation gradient at Coweeta. Insects introduce frass, greenfall, and modified throughfall to the forest floor. The timing of these inputs tracks leaf-flush phenology which varies with elevation. We are measuring decomposition rates,

microbial respiration, and the abundance of soil fauna in response to herbivore-derived inputs. Finally, we are assessing effects of elevation on phenolic chemistry of oaks. At three elevations on watershed seven, we are measuring natural foliar concentrations of gallotannins, proanthocyanidins, and foliar astringency to see whether gradients in phenolic concentration are reflected in gradients of herbivore activity. Long-term data from each of these projects will allow us to determine how landscape-level processes influence foliage quality for insects, and to characterize feedback loops from the canopy to the forest floor, and back to the canopy.

Oral Presentation

KLOEPPEL, BRIAN D.*[1], DREW C. FELDKIRCHNER[2], PAUL V. BOLSTAD[3], and JAMES M. VOSE[4]. [1]University of Georgia, Athens, GA 30602, [2]University of Wisconsin - Madison, Madison, WI 53706, [3]University of Minnesota, St. Paul, MN 55108, and [4]USDA Forest Service, Coweeta Hydrologic Laboratory, Otto, NC 28763 USA. Tree Stem Temperature and Respiration Dynamics in Southern Appalachian Forests.

As part of a larger regional study on the effects of land-use change on ecosystem carbon dynamics, the analysis of tree stem temperature and respiration flux is crucial to our understanding of the carbon dynamics of Southern Appalachian forests. Two years of bi-monthly respiration measurements across species at a three-site chronosequence as well as a comparison of cove, midslope, and ridge forested study sites has enabled us to quantify the major attributes of woody plant respiration. Stem temperature, sapwood volume, and wood nitrogen concentration have been modeled to species and stem diameter. These measurements function as the scaling factors which enable us to move from the chamber to the tree scale. Work planned for the 1997 field season includes the development of tree allometric equations which will enable us to scale measurements to the plot and stand level. There are numerous allometric equations available from the forestry literature which predict main stem wood volume and biomass, but few if any available for the ecologically dynamic tree components such as sapwood volume, leaf biomass, or new twig biomass. These equations are also critical to the calculation of site productivity which should yield a number of publications based on follow-up and other cooperative studies in the Coweeta LTER Program.

Oral Presentation

Knoepp, Jennifer D.* and Wayne T. Swank. USDA Forest Service, Coweeta Hydrologic Laboratory, Otto, NC 28763. Rates of Nitrogen Mineralization Across an Elevation and Vegetation Gradient.

Southern Appalachian hardwood forest soils are characterized as being dominated by NH_4^+-N with low nitrification rates. We measured N transformation rates for six years to examine temporal variation across the vegetation and elevation gradient that exists within the Coweeta basin. Mineralization and nitrification rates were measured using 28 day *in situ* closed core incubations. Incubations were conducted at various intervals for six years ranging from monthly during the growing season to four annual incubations based on vegetation phenology. Vegetation types include xeric oak-pine; cove hardwoods; low elevation mixed oak, high elevation mixed oak, and northern hardwoods. Elevations range from 780 to 1350 m. Strong seasonal trends in mineralization and nitrification were observed. Highest rates occur in spring and summer with negligible activity in winter. Transformation rates also vary with vegetation type. Mineralization rates are lowest in the oak-pine and mixed oak sites averaging less than 1.5 mg N^{-1} kg $soil^{-1}$ 28 $days^{-1}$. Rates in the cove hardwood site

are significantly greater than all other low elevation sites with an annual average of 4.7 mg N^{-1} kg $soil^{-1}$ 28 $days^{-1}$. The northern hardwood site rates were greatest with an annual average N mineralization rate of 19 mg N^{-1} kg $soil^{-1}$ 28 $days^{-1}$. Nitrification rates are typically low with rates of 0.5 mg N^{-1} kg $soil^{-1}$ 28 $days^{-1}$, or less. The exception is the northern hardwood site where nitrification averages 9.5 mg N^{-1} kg $soil^{-1}$ 28 $days^{-1}$. These data show that most forest types in the southern Appalachians have an NH_4 based nitrogen economy. However, in the northern hardwood forest type, NO_3 plays an important role in the nitrogen cycle.

Oral Presentation

Joshua Laerm*[1], Michael A. Menzel[2], D.J. Wolf[2], and N.G. Hicks[2]. [1]Museum of Natural History, University of Georgia, Athens, GA 30602, and [2]D.B. Warnell School of Forest Resources, University of Georgia, Athens, GA 30602. Role of Riparian Zones in Structuring Small Mammal Communities in the Southern Appalachians

We examined the role of riparian zones in structuring small mammal communities at Coweeta Hydrological Laboratory in western North Carolina. We compared capture statistics of 21 dependent variables including abundance, richness, diversity, and evenness of small mammals in trapping grids established in riparian zones (the treatments) and adjacent non-riparian controls. Sites included a riparian gradient (seeps, first, second, and third order streams) ranging from 715 to 1525 m elevation and a vegetational (and moisture) gradient from xeric oak hickory, to mesic oak hickory, cove hardwood and northern hardwood cover types. We recorded 16,464 pitfall and 4,707 live trap nights during which we recovered twelve mammal species including *Sorex cinereus*, *Sorex fumeus*, *Sorex hoyi*, *Sorex palustris*, *Sorex hoyi*, *Blarina brevicauda*, *Peromyscus leucopus*, *Peromyscus maniculatus*, *Ochrotomys nuttalli*, *Microtus pinetorum*, *Clethrionomys gapperi*, and *Napaeozapus insignis*. We found no significant differences between riparian zones and upland controls as a group or for individual riparian zones. No differences were found between stream order and/or vegetational cover type and our dependent variables in the riparian or control plots. Significant correlations with elevation were observed for *P. leucopus*, *P. maniculatus*, *C. gapperi*, *N. insignis*, total live captures, and pitfall richness. We conclude that riparian zones have limited to no influence on the structure of small mammal communities, species richness, or species abundance in the southern Appalachian forests.

Poster Presentation

LEI, TOM T.*, SHAWN W. SEMONES, and ERIK T. NILSEN. Virginia Tech, Blacksburg, VA 24061-0406. Is the Deep Shade Alone Sufficient to Eliminate Tree Seedlings Under *Rhododendron maximum* Thickets?

Growth and survival of tree seedlings in forest understory depend heavily on the light reaching the forest floor through the canopy. Further reduction of light exists under thickets of *Rhododendron maximum*, a prevalent evergreen shrub in southern Appalachian forests. This additional light interception may contribute to the absence of tree seedlings. We made a detailed assessment of the light environment using canopy photographs and quantum sensors across seasons and between sites with and without *R. maximum* (+Rm and -Rm, respectively). Canopy photo analysis of 90 locations revealed a reduction of 20-25% in monthly direct radiation under +Rm compared with -Rm. Similarly, +Rm received 12-29% less diffuse light than -Rm during the growing season. More strikingly, quantum sensors showed mean mid-day (1000-1400h EST) PFD values in +Rm sites below 10 mmol m^{-2} s^{-1} on both clear and

overcast days, and only 0-20 minutes when PFD was greater than 10 >mmol m^{-2} s^{-1}. In contrast, -Rm sites received 18-25 mmol m^{-2} s^{-1} mean PFD on clear days, and 100-220 minutes of light greater than 10 mmol m^{-2} s^{-1} in all weather conditions. These results suggest that conditions below light compensation point predominate in +Rm sites and are sufficient to halt seedling regeneration. However, there are "gaps" within +Rm where inhibition of seedling survival imply contribution by other factors.

Poster Presentation
Martin, Lara A., Barbara Greyson, Jennifer L. Tank, Jon S. Harding, and E.F. Benfield. Department of Biology, Virginia Tech, Blacksburg, VA 24061. The Effects of Substrate Type on Shredder Growth in Pine and Hardwood Watersheds.

Conversion of forested catchments from deciduous hardwoods to monocultures of pine is occurring in various parts of the world. The effects of such changes in vegetation on stream insects is poorly understood. We investigated the growth of two leaf shredding aquatic insects, *Tallaperla* (Peltoperlidae) and *Tipula* (Tipulidae), when fed hardwood versus pine substrates. Two 1-month laboratory feeding experiments were conducted in which the insects were offered pine wood, pine needles, oak wood, or oak leaves as food. Substrates were colonized for 30 days in streams at Coweeta Hydrological Laboratory, NC. For each treatment, 1 shredder and 1 type of substrate were placed in each of 10 temperature controlled, aerated chambers. At the beginning and end of the experiment several microbial analyses were conducted on the substrates (ergosterol, cellobiohydrolase activity, and microbial respiration), and shredders and substrates were weighed. Microbial biomass and activity was significantly higher on oak than pine substrates. *Tallaperla* growth did not differ significantly among substrate types, however *Tipula* growth was 500% higher on both oak leaves and pine needles than on wood. In our study, vegetation species had little effect on the growth of two common shredders, but leaf material was a better food source for *Tipula* than wood.

Poster Presentation
McTammany, M.E., J.S. Harding, and E.F. Benfield. Department of Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0406. Biodiversity and Differential Urbanization in Southern Appalachian Stream Ecosystems.

Human land-use practices, including urbanization, have significant impacts on stream benthic invertebrate assemblages. The Little Tennessee and French Broad River watersheds in western North Carolina are areas of increasing urban development. The pressure on streams can be seen as a disturbance continuum from mild development (i.e. building vacation homes along stream corridors) to severe urbanization (i.e. industrial and commercial development). We investigated the effect of varying degrees of urbanization on benthic invertebrate diversity, abundance, and community composition in four streams from three levels of urbanization along this disturbance continuum. Quantitative benthic samples were taken along with a variety of water chemistry and geomorphological variables. Preliminary results indicate lower invertebrate diversity with greater watershed urbanization. Heavily urbanized streams also had fewer "pollution sensitive" taxa (4 EPT families) than streams in less developed watersheds (11 EPT families). Heavily urbanized streams were dominated by larger proportions of "pollution tolerant" organisms (45% Chironomidae) than streams in moderately (25% Chironomidae) or less developed watersheds (8% Chironomidae). Results from this study may be useful in developing

new strategies to mitigate the negative effects of urbanization on stream ecosystems.

Oral Presentation

Menzel, Michael A.*[1], Joshua Laerm[2], William M. Ford[3], and Diane Krishon[4]. [1]Warnell School of Forest Resources, University of Georgia, Athens, GA 30602, [2]Museum of Natural History, University of Georgia, Athens, GA30602, [3]Westvaco Corporation, Box 577, Rupert, WV 25984, and [4]Division of Forestry, West Virginia University, P.O. Box 6125, Morgantown, WV 26506. Forest to Food Plot: Habitat Gradient Analysis Among Small Mammals in the Southern Appalachians.

We superimposed a 120 station trap grid on 5 x 5 meter intervals in 5 wildlife food plots and adjacent forests in the Nantahala National Forest, North Carolina. Each grid was sub-divided into five, 24 trap station blocks, each 10 meters in width, consisting of food plot interior, food plot-forest edge, near forest, mid-forest, and deep forest, with each trapping station consisting of 1 pitfall trap and 1 sherman-live trap. Over a 12,000 trapnight period we collected 831 specimens including: 191 masked shrews, 58 smoky shrews, 95 red-backed voles, 29 pine voles, 92 white-footed mice, and 366 deer mice. The relative abundance of masked shrews and red-backed voles, and diversity and evenness measures were significantly higher along edge blocks than food plot or forest blocks. Conversely, the relative abundance of deer mice was highest in deep forest blocks. Measures of coarse woody debris, an important habitat component for many small mammal species, within each block showed a strong gradient from large loadings of coarse woody debris in deep forest blocks, declining to negligible levels within food plots. Our results show that habitat generalists such as masked shrews respond favorably to micro-habitat heterogeneity produced along an edge.

Oral Presentation

MEYER, JUDY L.* Institute of Ecology, University of Georgia, Athens GA 30602. Experimental Manipulations in Southern Appalachian Streams to Explore Mechanisms of Human Influence.

Alteration of the riparian zone and nutrient enrichment are two ways in which human actions have modified Southern Appalachian streams. To better understand the mechanisms responsible for these modifications, we used experiments to assess the effect of elimination of riparian litter inputs, the elimination of riparian shading on periphyton, an experimental addition of 15N to quantify nitrogen cycling in Coweeta streams, and experimental exclusion of macroinvertebrates to assess the interactions of sediment, algae and invertebrates. I will present highlights from the first 3 experiments, and Cathy Pringle will discuss the 4th (see also posters by Dowell et al. and Sutherland et al.). Exclusion of leaf litter from the first 200 m of a headwater stream led to a reduction in standing stock of benthic organic matter, a shift in the resource base of the food web, less secondary production of benthic invertebrates (Wallace et al. in press), and increased periphyton biomass. The periphyton increase was probably a result of decreased nutrient competition with heterotrophic microbes (to be tested in experiments planned for this summer) and less shading by leaf litter on the stream bottom. Periphyton increased when rhododendron were experimentally eliminated from the riparian zone. In response to litter exclusion, dissolved organic carbon concentrations and export were lower during autumn and winter as a result of reductions in leachable organic matter in the stream bed, which appears to contribute a third of annual DOC exports. In another experiment, results

from experimental additions of 15 NH_4 to a headwater stream (Hugh White Creek) were compared with model preditions to assess our understanding of N cycling in Southern Appalachian streams. The model was a poor predictor unless the detrital N pool was divided into labile (microbial) and refractory compartments (see also poster by Sanzone et al.). A second $15NH_4$ addition was done this fall as part of a separately funded intersite study testing predictions about how N cycling in streams changes with geomorphology, extent of nutrient limitation, and trophic status.

Oral Presentation
Mitchell, Katherine, *[1] Paul V. Bolstad[1], and James M. Vose[2]. [1]University of Minnesota, St. Paul, MN 55102 and [2]USDA Forest Service, Coweeta Hydrologic Lab, Otto, NC, 28763. Leaf Respiration: Variation Among Species and Along an Environmental Gradient in the Southern Appalachians.

Leaf respiration was measured on 428 leaves from 18 deciduous tree species on a 1200 m elevation gradient in the Southern Appalachians. We found significant differences in respiration rates per unit area, mass, and mass nitrogen when comparisons were made among species and among leaf light environment within species. Canopy nitrogen increased with elevation, resulting in higher respiration rates per unit mass for higher elevation tissue at a fixed temperature. However, acclimation was partial in that ambient respiration rates were lower at higher elevations once site temperature was considered.

Oral Presentation
NEWMAN, DAVID H.* BARBARA A. HARRISON, and GREG ARTHAUD. Warrnell School of Forest Resources, University of Georgia, Athens, GA 30602-2152. The Georgia Public and its Forests: Attitudes and Knowledge Regarding Forest Use.

Substantial concerns have been raised over the past few decades regarding the management of Georgia92s forests. Increasing urbanization and the rising voting power of urban voters have made the likelihood of restrictive forest management legislation a possibility. In response to these concerns, a random general public phone survey of Georgia residents was performed in April of 1996. A total of 844 residents were asked a variety of questions regarding forest issues and knowledge. Results from the survey showed surprising support for the majority of forestry activities (clearcutting, prescribed burning, and others) on private and commercial forest lands. However, the public maintains substantial concerns regarding these same activities on public lands. Even though the public appeared satisfied with the state of Georgia's forests, strong support remains for continued regulation of forestry activities. A final finding was that a substantial amount of education is needed to improve the publics understanding and knowledge of forest conditions.

Oral Presentation
NILSEN, ERIK T.* and ROBERTO CORDERO. Virginia Tech, Blacksburg, VA 24061-0406. Regulation of Water Flow and Conductance in *Rhododendron* species in Two LTER Sites: The Importance of Drought and Freeze-Thaw Cycles on Hydraulic Conductance.

The hydraulic architecture and physiological responses of stomata to climate will be measured for *Rhododendron maximum* and *R. Catawbiensis* in Coweeta LTER in NC, *R. macrophyllum* in H.J. Andrews LTER in OR, and *R. minus* at Highlands Research Station in NC. The objective of the research is to determine the relative susceptibility

of the water transport system to cavitation induced by both drought and freeze-thaw cycles. It is predicted that *R. macrophyllum* will be tolerant of drought but sensitive to freeze-thaw, *R. maximum* will be sensitive to drought and tolerant of freeze-thaw, *R. catawbiensis* will be tolerant of both, and *R. minus* will be relatively sensitive to both. Initial measurements indicate that there is no difference in average diameter of xylem elements in all species which suggests all species have a relatively high tolerance of freeze-thaw. Initial data indicate that stomatal closure occurs at a lower water potential in *R. macrophyllum* than in *R. maximum*. The overall project and expected results will be discussed in light of the preliminary evidence.

Poster Presentation

PEARSON, S.M.[1], K.R. COX[1], and M.G. TURNER[2]. [1]Biology Department, Mars Hill College, Mars Hill NC 28754 and [2]Department of Zoology, University of Wisconsin - Madison, Madison WI 53706. Evaluating Landscape Pattern for Species with Different Life Histories.

Landscape-level changes alter the abundance and spatial pattern of habitat for native species. A field study of cove-forest communities demonstrated that small forest fragments had reduced density and diversity of some herb species. The mechanisms responsible for the effects of fragmentation on these species include disruption of population dynamics due to the reduction and fragmentation of habitat. A simulation model was used to compare the effects of different patterns of habitat fragmentation on species with different life-history strategies. The model simulates the population dynamics of ten species that vary in three life-history parameters: survival, fecundity, and dispersal. All species had the same intrinsic rate of increase, but they achieved it in different ways. The model was run on ten maps of forest habitat taken from a land-cover map of the Southern Blue Ridge. The simulation results demonstrated that species with high survivorship probabilities were best able to tolerate high degrees of habitat fragmentation. Increased fecundity also promoted population persistence, but less so than increased survivorship. Annual life histories were susceptible to extinction in fragmented landscapes. The persistence of species on fragmented landscape was correlated with the statistical distribution of patch sizes.

Poster Presentation

Petty, J. Todd and Gary D. Grossman. School of Forest Resources, University of Georgia, Athens, GA 30602. Prey Patchiness, Competitive Interactions, and the Space Use Dynamics of a Predatory Benthic Stream Fish.

We examined the effects of invertebrate patch dynamics and competitive interactions among conspecifics on the movements and space use behaviors of mottled sculpin, *Cottus baird*, in a southern Appalachian stream. Using mark-recapture techniques, we characterized the small scale movements and patch use dynamics of juvenile and adult sculpin in the study system. In addition, we related movements and shifts in patch use by sculpin to small scale changes in prey abundance. Individuals exhibited patterns of area restricted space use and often maintained residency within discrete patches ($<1m^2$) for long periods of time (3 - 12 months). However, there were consistent age/size related differences in the movements and space use behaviors of sculpin for the duration of the study. For example, although juveniles utilized discrete areas in a manner similar to adults, juveniles abandoned patches at nearly twice the rate of adults (0.35 - 0.18). In addition, when shifts in patch use occurred there was a tendency for adults to move from patches of low prey abundance to

patches of high abundance. However, such a pattern was not observed for juveniles. These results suggest that the dynamics of space use by sculpin are controlled simultaneously by the spatio-temporal dynamics of their patchily distributed prey and size related competitive interactions among conspecifics.

Oral Presentation

PRINGLE, CATHERINE M.*, JUDY MEYER, KATHERINE DOWELL, and KATHARINE SCHOFIELD. Institute of Ecology, University of Georgia, Athens GA. Intersite Comparisons of Macroconsumer Effects on Sedimentation and Benthic Community Structure in Riverine Ecosystems: Southern Appalachia, Puerto Rico and Costa Rica.

In contrast to most temperate stream systems, relatively undisturbed tropical streams are often characterized by an abundance of omnivorous fish and/or shrimp macroconsumers which have a relatively large body size (relative to the resources that they consume) and insects with very small body sizes. Experimental results from neotropical streams in Puerto Rico (Luquillo LTER) and Costa Rica (OTS La Selva) indicate that fishes and shrimps significantly reduce sediments, algae and insects in benthic environments. Strong direct trophic effects of fish and shrimp macroconsumers on multiple trophic levels also override indirect trophic effects such as resource competition and trophic cascades. Studies have also indicated that fishes and shrimps in tropical streams influence the response of benthic communities to disturbances (high discharge events), leading to the prediction that, in their absence, natural discharge fluctuations in the stream will cause increased export and turbidity and dramatic shifts in the availability and quality of algal food resources for both suspension and bottom feeders.

We are exploring the interaction among stream macrobiota (large predatory insects, fish, crayfish, salamander larvae), sediments, algae, and herbivorous insects in Southern Appalachian streams. In these systems, we hypothesize that fishes and large predatory insects will play key roles in controlling the benthic community and that their exclusion will result in a trophic cascade (in contrast to neotropical streams). We also hypothesize that interactions between stream macrobiota, sediments, and algae will be influenced by changes in land-use (through changes in light regimes and sediment delivery to the channel). We predict that macrobiota will have a significant effect on sediment removal in relatively undisturbed forested streams. However, in disturbed agricultural streams, we expect that biotic effects will be masked as a consequence of high rates of sedimentation.

Intersite comparisons of stream foodweb dynamics and effects of macrobiotic assemblages on sedimentation will allow us to begin to address critical questions such as: (1) To what extent are stream biota important in stabilizing stream benthic communities and their resistence to disturbance; (2) Are macroconsumers more important in structuring streams in tropical versus temperate streams; and (3) What are the legacies of extirpated macroconsumers (e.g., fishes, crayfish, mussels) in highly disturbed streams?

Oral Presentation

ROSI, EMMA J.* and J.BRUCE WALLACE. University of Georgia, Athens, GA 30602 USA. The Trophic Basis of Production Along a River Continuum: Temporal and Spatial Variability in the Flow of Energy in Macroinvertebrate Communities.

We estimated the trophic basis of production (TBP) along a resource gradient to determine the dominant carbon resources exploited by aquatic macroinvertebrates. Gut contents of eleven taxa, which comprise from 50-68% of the total macroinvertebrate secondary production, were analyzed at four sites along the Little Tennessee River (5-7th order) during four seasons in 1996. Suspended organic matter quantity (AFDM/L) and composition was also measured. The community TBP shifted from20detritus (leaves) to diatoms and algae to amorphous detritus along the continuum. Seasonal shifts were most pronounced in the midorder sites. The heterogeneity in resource consumption estimated in this study suggests that the flow of energy to consumers in aquatic systems may be directly influenced by carbon resource dynamics.

Poster Presentation

Sanzone, Diane M.[1], Jennifer L. Tank[2], P.J. Mulholland[3], J.L. Meyer[1], J.R. Webster[2], B.J. Peterson[4]. [1] Institute of Ecology, University of Georgia, Athens, GA 30602, [2] Department of Biology, Virginia Tech, Blacksburg, VA 24061, [3] Oak Ridge National Lab, Oak Ridge, TN 37831, [4] Marine Biological Lab, Woods Hole, MA 02543. A Comparison of Cellular Microbial Nitrogen on Three Commonly Found Stream Substrates.

The chloroform fumigation-extraction method is widely used to determine microbial nitrogen in terrestrial soils. We use this method to determine microbial nitrogen on stream substrates by comparing total nitrogen in K_2SO_4 extracts from CHC_{13}-fumigated (cells lysed) and nonfumigated substrates. Total N in the K_2SO_4 extracts is determined by persulfate oxidation followed by analysis for NO_3. This method allows complete recovery of total N present in K_2SO_4 extracts and so is useful in detecting low levels of nitrogen. We adopted this method to determine cellular microbial N on three commonly found substrates in Upper Ball Creek, a 2nd-order stream at Coweeta Hydrologic Lab, NC in autumn 1996. Upper Ball Creek typically has background levels of NH_4-N ranging from 2-4 mg/L and of NO_3-N ranging from 1-8 mg/L. We sampled wood biofilm, leaves, and FBOM from 4 stations along a 200 meter reach. Results indicate that microbial nitrogen in streams can be isolated using this fumigation-extraction procedure and that FBOM has the greatest amount of cellular microbial N of the three substrates.

Poster Presentation

SEMONES, SHAWN W.* and E.T. NILSEN. Virginia Tech, Blacksburg, VA 24061-0406. The Effect of *Rhododendron maximum* L. on the Photosynthetic Capacity of Canopy Tree Seedlings Growing in Eastern Deciduous Forests.

Research is currently being conducted to determine the possible mechanisms of inhibition by *Rhododendron maximum* thickets on the establishment and survival of forest tree seedlings in the Appalachian Mountains. One of the more pronounced impacts thickets of have on the above ground environment is a drastic reduction in the availability of light. Mean midday PAR under thickets of *R. maximum* was 2 mmol m^{-2} sec^{-1} compared to 20 mmol m^{-2} sec^{-1} in the forest without *R. maximum* thickets. Light response curves generated using first year *Quercus rubra* L. seedlings. indicate seedlings growing under thickets of *R. maximum* have light compensation points between 7 to 9 m mol m^{-2} sec^{-1}, while seedlings growing in forest without *R. maximum* exhibited light compensation points between 12 to 14 m mol m^{-2} sec^{-1}. Midday photosynthetic rates were higher for seedlings growing in the forest understory without thickets of *R. maximum* 1.5 to 2.6 mmol m^{-2} sec^{-1}. Midday

photosynthetic rates for *Q. rubra* seedlings growing under thickets of *R. maximum* were less than 1 SIZE3D3>mmol m^{-2} sec^{-1}. These data implicate the importance of sun flecks and efficient utilization of transient light for seedling carbon gain and survival when growing within thickets of *R. maximum.*

Poster Presentation
SUTHERLAND, ANDREW, JUDY L. MEYER, and NED GARDINER. Institute of Ecology, University of Georgia, Athens, GA 30602. Effects of Landuse Change on Sediment Transport and Fish Recruitment.

Sediment bedload was measured in six streams in the Little Tennessee basin during Dec 1996 through Mar 1997. Three streams drain watersheds with landuse dominated by agriculture and three drain forested watersheds. Although many samplers filled completely between sampling dates and hence provided only minimum estimates of bedload transport, trends were apparent. Variation between landuse types was greater (2-3 fold) than variation within a site, with agricultural sites having highest bedload transport. Bedload collection will continue this summer. Streams (9 - 12 sites) draining similar-sized watersheds with different fractions of agricultural vs. forested land cover in the Little Tennessee basin will be examined for patterns in physical and biological parameters that can be related to land use. Sediment composition, movement, and stability will be assessed by habitat surveys and by measuring turbidity, bedload transport, infiltration of fine sediments, and changes in channel profile. These changes will be related to the fish community by examining differences in recruitment and growth of young fishes.

Oral Presentation
Swank, Wayne T. et al. USDA Forest Service, Coweeta Hydrologic Laboratory, Otto, NC 28763. Potpourri.

I will share information on synthesis efforts the past year that have included a review of Coweeta history and perspectivs on long-term ecological research (with Meyer and Crossley), long-term nitrogen dynamics of Coweeta watersheds (with Vose), and a revised nitrogen cycling model (with Vose). I will also discuss synthesis and research plans for the coming year.

Poster Presentation
TAYLOR, SHARON F.*[1], BRIAN BECKAGE[2], BRIAN D. KLOEPPEL[1], and DAVID C. COLEMAN[1]. [1]University of Georgia, Athens, GA 30602, and [2]Duke University, Durham, NC 27706. Riparian Zone Seedling Establishment, Growth, Dynamics, and the Influence of *Rhododendron maximum*.

The effect of *Rhododendron maximum*, a dominate species in the riparian zones of the Southern Appalachians, on carbon, water, and nutrients en route to the streams is an ongoing study in the LTER research program at Coweeta Hydrologic Laboratory. To study seedling establishment, growth, and dynamics in riparian zones one m^2 quadrats have been established. There are four sites which include one treatment site, where the rhododendron has been removed from the riparian zone, one hurricane site, where there is extensive disturbance from Hurricane Opal, and two control sites, one upslope from the treatment site and one upstream from the hurricane site. Each of these four sites have ten randomly located natural regeneration one m^2 quadrats as well as four randomly located replicates of three adjacent one m^2 quadrats. In each of the three adjacent quadrats, the litter was

removed from the lower half to determine the effect of litter on the germination and growth of seedlings. Two of the adjacent quadrats have been broadcast seeded with *Acer rubrum*, *Liriodendron tulipifera*, and *Quercus rubra.* In one of the two quadrats that have been broadcast seeded, a predator exclusion mesh screen, 1m x 0.5 m with 0.64 cm (0.25 inch) openings, has been installed in the quadrat to determine the effect of small mammal predation on regeneration. Quadrats were installed on 24 April 1997, and an initial vegetation survey was conducted in May 1997. All seedlings were permanently tagged at this time and quadrat physical characteristics such as slope, aspect, and distance from stream were recorded. Broadcast seeding was done on 21 May 1997. Each year a census will be conducted in spring and fall on each quadrat and seedling species, density, age, and annual height growth will be recorded. This project will help to document the effect of *Rhododendron maximum* on regeneration in the riparian areas as well as the effect of hurricane disturbance on regeneration.

Oral Presentation

Thomas, T.* and J.W. Fitzgerald. Department of Microbiology, University of Georgia, Athens GA, 30602. Sulfur Processing and *in situ* Concentrations of S in Riparian Zone Samples Collected from Watershed 55.

Sediment and A-horizon soils were assayed for organic S formation and for sulfate adsorption potential. Twenty-nine to 58% of added sulfate was adsorbed in the soils. Sediment samples adsorbed 13-23% of the added sulfate. Sediment samples exhibited less adsorption and formation potentials than those for soil. Samples were also analyzed for intrinsic sulfur concentrations. The majority of the total sulfur present in these soils was as ester sulfate (76%) while carbon bonded sulfur was a much smaller percentage, representing 24% of the total sulfur. No seasonal or st ream distance dependent trends were seen in intrinsic sulfur or in formation/absorption potentials.

Poster Presentation

THOMPSON, ANDREW R., J. TODD PETTY, and GARY D. GROSSMAN. Warnell School of Forest Resources. University of Georgia, Athens, GA 30602. The Influence of Physical and Biological Characteristics on Habitat Use by the Longnose Dace, Rhynichthys cataractae.

We examined the influence of prey availability and physical habitat characteristics on habitat use and foraging intensity by a benthic fish in a fourth order Appalachian stream. We compared macroinvertebrate abundances and physical characteristiscs between locations where fishes foraged and randomly selected locations. Longnose dace were under represented in areas containing high amounts of silt, sand, and debris. Fish foraged on cobbles and boulders with significantly greater numbers and biomass of macroinvertebrates than were found on randomly selected stones. Our results suggest that longnose dace are able to assess physical and biological properties of their environment and forage in locations which may increase their rate of food intake. Examining prey distributions as well as physical characteristics may help elucidate causal factors driving benthic fish distribution patterns.

Oral Presentation

TURNER, M.G.*[1], S.M. PEARSON[2], and A.B. SMITH[2]. [1]University of Wisconsin - Madison, Madison, WI 53706 and [2]Mars Hill College, Mars Hill, NC 28754. The Effects of Disturbances and Abiotic Gradients on Herbaceous Plant Diversity in Mesic Forests.

The effects of disturbance, terrain shape, and soil chemistry on the diversity and abundance of cove forest herbs were studied in mesic forests. Herb communities were sampled using 250-400 m transects. These transects were placed in (a) highly disturbed, small patches of forest; (b) highly disturbed, large patches; and (c) relatively undisturbed, large patches. Herb diversity/abundance, terrain shape, and soil chemistry was sampled at a 10-m resolution. Species richness was greatest in the least disturbed sites in large patches. Disturbance negatively affected the coverage of old-growth indicator species, lilies, and mesophytic species. Differences in patch size, given the same level of disturbance, did not significantly affect the coverage of old-growth indicators and mesophytic species. Weedy species were most abundant in small patches. Disturbance had no significant effect on these weedy species in large patches. The abiotic factors having the greatest influence on coverage of cove and mesophytic species were: soil humic matter and soil pH. Terrain shape, soil cations, P, and Ca were correlated with soil humic matter and pH.

Oral Presentation

VOSE, JAMES M.*[1], PAUL V. BOLSTAD[2], JOHN BUTNOR[2], J. ROBERT WEBSTER[2], and WALTER H. BURCH[2]. [1]USDA Forest Service, Coweeta Hydrologic Laboratory, Otto, NC 28763 and [2]University of Minnesota, St. Paul, MN 55108. Variation in Soil CO_2 Evolution Among Land Use Types in the Southern Appalachians.

Soil CO_2 evolution is a key component of ecosystem carbon (C) cycling because soils contain a large proportion of ecosystem C. We measured soil CO_2 evolution in four land use types: old growth forest, mid-successional forest, early-successional forest, and pasture. Our objectives were to determine overall ecosystem C budgets and to determine factors regulating spatial and temporal variation in soil CO_2 evolution. There were large differences in soil CO_2 evolution among land use types. Pasture had the greatest average annual rate (9.04 m mol m^{-2} s^{-1}), followed by mid-successional forest (5.58 mm ol m^{-2} s^{-1}) old-growth forest (4.59 mmol m^{-2} s^{-1}), and early-successional forest (4.46 mmol m^{-2} $s^{-}1$). The ratio of soil CO_2 evolution to total ecosystem C pools was lowest for old growth and highest for pasture. Within land use types, variables regulating temporal variation in soil CO_2 evolution varied considerably. For example, in old growth, litter C and nitrogen (N), coarse root N, and fine root C were important variables. In pasture, soil C and N were important variables. Across land use types, litter N and fine root mass were important variables.

Oral Presentation

WALKER, J.F.* and O. K. MILLER. Biology Department, Virginia Tech, Blacksburg, VA 24061. Mycorrhizal Competition Related to Inhibition of Canopy Tree Seedlings by *Rhododendron maximum* L.

Failure of canopy tree seedling regeneration in dense thickets of *Rhododendron maximum* L. (*R. max*) in the Southern Appalachians is a recognized problem. To assess competitive interactions, blocks were established in forests with and without *R. max* present. Litter and organic layer substrates were reciprocally transferred between plots in these blocks and the plots were planted with canopy tree seedlings. In the first year's sample, *Tsuga canadensis* L. (Carrière) seedlings were 44% less mycorrhizal in blocks with *R. max*. *Quercus rubra* L. seedlings were 17% less mycorrhizal in *R. max* blocks. Similar trends which were statistically significant ($p<.05$) were observed from unmanipulated control plots for *T. canadensis*. The *Cenococcum geophilum* Fr. mycorrhizal morphotype was more abundant in (mean

13.6%) than out of *R. max* thickets (mean 2.3%) on *T. canadensis* seedlings ($p<.05$). The following statistically significant ($p<.05$) treatment effects were observed for the percent of mycorrhizal roots colonized by *C. geophilum*: 1) Forest organic layer substrate (mean 36.5%) versus *R. max* organic layer substrate (mean 20.7%), and 2) Forest litter substrate (mean 19.3%) versus *R. max* litter substrate (mean 37.8%). Growth parameters related to the health of the seedlings are being examined for correlation with percent mycorrhization. This study has important implications for canopy tree seedling establishment in the Southern Appalachians because thickets of *R. max* are currently spreading in highly productive areas.

Oral Presentation

WEAR, DAVID N. and Paul V. Bolstad. USDA Forest Service, Economics of Forest Protection and Management, Research Triangle Park, North Carolina 27709.
Forecasting Human Occupancy and Land Uses in the Southern Appalachians.

Human activities have been and continue to be the dominant force shaping landscape structure throughout the world. This study investigated factors determining where and how development proceeded in the Southern Appalachians from the 195092s to the 199092s. Empirical relationships were then used to construct a forecasting model for land uses in the region. Satellite imagery and aerial photos were interpretted for land use and building locations in the 195092s and 199092s. These data were then overlaid with other spatially referenced data in a GIS and data for randomly selected plots were used to estimate land use change models. We adopted a two stage approach. First, human occupancy--defined by building density in the vicinity of a plot97was modeled as a function of lagged building density and several other explanatory variables. Predicted human occupancy was then used as an explanatory variable in the second stage, where the probabilities of land cover classes were estimated. A Poisson regression approach was used in the first stage to address the use of count data for the dependent variable and the censoring of the data. Probabilities of land cover classes were estimated using a logit model. Models as well as most coefficients proved significant. An evaluation of verification data sets indicates that these models have strong forecasting power as well. Accordingly, these models should prove useful in generating scenarios for subsequent evaluation of ecological effects.

Oral Presentation

Wright, Christina J.* and D.C. Coleman. University of Georgia, Athens, GA 30602.
Changes in Microbial C and N, Nematode Community Structure, and Litter Decomposition Rates Following *Rhododendron* Removal and Hurricane Damage at the Coweeta LTER.

In order to determine the role of *Rhododendron maximum* within a riparian watershed, all rhododendron were harvested in August 1995. In addition, in October 1995, hurricane Opal decimated the paired control plot, downing the majority of the vegetation. Beginning in 1994, soil samples and litterbags were collected seasonally along three transects located 1, 5, and 15 meters from the stream. Comparisons by seasonal sampling date show minimal treatment effects from the rhododendron removal or hurricane damage upon microbial C and N levels. Furthermore, for the first year post-treatment, there were no significant effects upon nematode abundance or community structure from either treatment. Decomposition rates of *Quercus prinus* and rhododendron litter were significantly slower after one year, post-treatment. Minimal treatment effects are likely due to a combination of factors,

including: the presence of a thick layer of organic matter upon the soil surface and the high inherent variability in soils data.

Oral Presentation

WYCKOFF, PETER H.* and JAMES S. CLARK. Duke University, Durham, NC 27708.
Improved Mortality Functions Alter the Predictions of a Gap-Type Forest Model.

Gap-type forest models use growth rate to determine the likelihood of mortality for each simulated tree. In these models, individuals growing slower than a threshold growth rate are at risk of stress related mortality, while those growing faster are not at risk. Owing to a lack of empirical data, this threshold growth rate has been assumed to be the same for all species. In the southern Appalachians, we used increment cores to parameterize functions describing probability of mortality as a function of growth rate for several co-occurring species. We then modified a gap-type forest model, LINKAGES, to incorporate these relationships. The model modified by field data gives substantially altered predictions of successional development in southern Appalachians. In the modified model, *Acer rubrum* is predicted to increase in dominance much earlier in succession than in the unmodified model, a prediction consistent with observations of Appalachian secondary forest development. Also, the introduction of the differences in low growth tolerance implied by our data leads to large changes in the predicted performance of two related species, *Quercus prinus* and *Quercus rubra*. To improve gap-type forest models, our results illustrate the need to replace the functional relationships based on assumption with relationships based on data.

Oral Presentation

J. ALAN YEAKLEY. Environmental Science & Resources, Portland State University, Portland, OR 97207-0751. An Update on Nutrient and Water Flux Studies in the Riparian Zone Experiments at the Coweeta Hydrologic Laboratory.

Following the vegetation removal and hurricane impact during August to October 1995, preliminary results using random intervention analysis show significant disturbances in mean nutrient concentrations in both sites. Elevation in nitrate concentrations, however, is much more dramatic in the site receiving hurricane impact. Near stream soil moisture content also shows a significant difference in the slope that received hurricane impact in comparison with the other slope, and appears to be elevated in comparison to years prior to impact. The TAPES-C/IHDM4 hydrology model is being used to determine soil moisture content, monthly water fluxes, and nutrient loads to streams from these slopes before and after impacts. Calibration and simulation results from the model will be discussed.