Coweeta Long Term Ecological Research Project (CWT)

The Coweeta Hydrologic Laboratory, a USDA Forest Service Research Station, was established in 1934 as a testing ground for certain theories in forest hydrology. In 1968, an extensive data base on nutrient cycling in watershed ecosystems with varied treatment history was initiated as part of the IBP Eastern Deciduous Forest Biome Project. The purpose was to evaluate the consequences of landscape management and demonstrate the compatibility of management questions to basic scientific questions concerning ecosystem behavior and regulation. Subsequent research examined the response of forest nutrient cycles to acute and chronic disturbances – a clearcut by cable logging and defoliation by the fall cankerworm *Alsophila pometaria* (Geometridae). In 1980, the Coweeta LTER was established to examine long-term forest ecosystem dynamics of defoliation, climate, rates of organic matter production and decomposition, and disturbance. In 1994 the Coweeta LTER began addressing its long-term concern with disturbance, environmental gradients, biogeochemical cycling and watershed ecosystem processes at a regional scale in an interdisciplinary fashion across 60,000 km^2 of the Southern Appalachian Mountains. In so doing, it embodied what Eugene Odum referred to as the "the Evolving Long-Term Ecological Study" able to adapt to changing ecological theory and practice, national needs, and government policies.

Site Description and Characteristics

The Coweeta Hydrologic Laboratory is located in the Nantahala Mountain Range of western North Carolina and consists of two adjacent, east-facing, bowl-shaped basins – Coweeta Basin (1,626 ha) is the primary site for watershed experimentation; Dryman Fork Basin (559 ha) is held in reserve for future studies. The Coweeta LTER study area encompasses 60 counties in the Blue Ridge province of the Southern Appalachian Mountains (SBRM) that extend from the New River divide in southern Virginia, across western North Carolina and into north Georgia. The SBRM are the result from Paleozoic uplift, thrusting and deformation of Late Proterozoic and Cambrian rocks. The region has been tectonically stable for over 100 million years except for isostatic rebound in response to long-term denudation and infrequent low-magnitude earthquakes.

The SBRM is a highly dissected ancient plateau that was never glaciated. Mountain-tops stand at 1000 to 2000 m asl while valley-bottoms are typically 600 to 700 m asl. The soil mantle of saprolite or regolith is zero to 30 m thick over the underlying bedrock, and is relatively low in fertility and naturally acidic. The drainage pattern is dendritic with most flows ultimately moving into the Mississippi River and the Gulf of Mexico. Rivers and steams are characterized by meandering channels with riffle and pool morphology. Headwater streams are steep (>2 % slope) and have cobble and boulder stream beds, that become progressively dominated by finer alluvial sediments in the downstream direction. Mainstem channels such as the French Broad River near Asheville, approach 100 m in width, and have sand and fine gravel beds.

The climate is humid subtropical (Cfa) at the lowest elevations and marine humid temperate (Cfb) at the higher elevations. Winters and summers are mild – there is little snowfall and summer days with temperatures exceeding 30 ºC are rare. Rainfall is evenly distributed throughout the year averaging 1400 mm although there is considerable spatial variability related to elevation and latitude. At the Coweeta Experiment Station precipitation generally increases about 5% per 100 m of elevation gain along an east-west axis. Mid latitude cyclones or transient low pressure systems embedded in the westerly wind flow cause widespread precipitation during the late fall, winter and early spring; convectional isolated thunderstorms are prevalent during the late spring, summer, and early fall. The inland tracks of tropical storms from the Atlantic Ocean and the Gulf of Mexico occasionally provide exceptional amounts of intense precipitation during late summer and fall that tend to trigger landslides, debris flows, and floods.

The dominant vegetation is temperate deciduous forest, although the intermixing of 'northern' and 'southern' taxa results in one of the most biodiverse regions of North America. Despite the contemporary vigor and beauty of the forest, the region harbors the ghost of land use past from forest clearing to create agricultural fields in the 13-14th centuries AD (prior to European contact) and again in the 19-20th centuries. The introduction of the Chestnut blight (*Cryphonectria parasitica*) early in the 20th century had a dramatic effect on the structural composition of the forest; timber harvesting between 1879 and 1940 accelerated slope erosion and valley sedimentation resulting in floodplain aggradation and stream channel entrenchment. Construction is an important source of present-day sediment. A completely forested watershed in SBRM generates 10-20 tonnes/km^2/yr whereas a 70 to 98% forest-covered watershed generates 21-128 tonnes/km^2/yr.

Research Focus

Coweeta LTER research has contributed to the growing understanding of how human practices can persistently influence forest and stream ecosystems at numerous scales. For example, bottom-up effects of nutrient enrichment in a detritus-based ecosystem can stimulate whole-community production and cause large changes in carbon balance and consumer productivity. This has important implications for the contemporary die-off of eastern hemlock (*Tsuga canadensis*) from the infestation by the hemlock woolly adelgid (*Adelges tsugae*). The Coweeta LTER project has achieved an understanding of the complex interactions between environmental gradients, disturbance, and land use that underpin the transformation of the "Old South" into the "New South" in ways that accommodate the growing demand that research contribute to the provision of solutions for environment and society.