CURRENT SITE PROJECTS

?OWEETA

ong-Term Soil Chemistry Changes

ssessing potential long-term forest productivity requires lentification of the processes regulating chemical changes forest soils. We re-sampled the litter layer and upper two ineral soil horizons in two aggrading southern Appala- ian watersheds 20 years after an earlier sampling. Soils om a mixed-hardwood watershed exhibited a small but gnificant decrease in soil pH. Extractable base cation ntent declined substantially in both mineral horizons. For ample, calcium levels in the upper soil horizon fell 66% om 1970 to 1990. The decline was greatest for magne- um, which dropped more than 80%. A white pine antation was planted in 1956, after clear-felling hard- oods and recutting sprouts for 15 years, without the moval of any cut materials. Soil pH and base cation ncentrations declined only in the upper soil horizon from 970 to 1990. Soil pH declined from 5.9 to 5.0 and lcium levels by 46%. Cation content did not change gnificantly in the second soil horizon. We were able to nstruct nutrient budgets using the soil and litter data plus isting data on bedrock and soil weathering rates, forest owth, atmospheric inputs and stream outputs. The creases in soil base cations and soil pH are attributed to questration of nutrients in biomass and leaching to reams. ◆ *Jennifer D. Knoepp & Wayne T. Swank*

'EDAR CREEK

tmospheric N Deposition from Agriculture

rhaps one of the best documented but least discussed mponents of global change, especially for the general blic, is the recent increase in atmospheric nitrogen (N) position in from modern agriculture. In a series of 13- ar-old experiments, Cedar Creek LTER is studying the nsequences of long-term N additions on the dynamics of asslands and oak savannahs. Our results show a pattern terrestrial eutrophication analogous to the well-described enomenon of aquatic eutrophication. As the availability the limiting nutrient increases, productivity increases, e dominant species change, often to non-native or xious species, and the overall species diversity of the stem drops dramatically. Thus, N deposition is a gnificant threat to remnants of North America's most dangered ecosystem type, the tallgrass prairie. Just ten ars of N addition at rates comparable to those found day in the Ohio valley are leading to the displacement of tive prairie communities by non-native grasses. Because ost rare species and most of North America's biodiversity ists in relatively nutrient poor, unproductive habitats, nging from peatlands and bogs to open "balds" of the palachian Mountains to sand plains and barrens of the astal plain, the threat of N deposition to biodiversity is t limited to the tallgrass prairie.

Nitrogen Deposition and the Carbon Budget

Cedar Creek experiments document the consequence of long-term N loading on the overall carbon and N dynamics of these grassland ecosystems. Because N limits the productivity of most temperate terrestrial ecosystems, it has been hypothesized that increased N deposition to a significant portion of the Northern Hemisphere would lead to significant increases in productivity, and thus to the amount of C stored in ecosystems. Is N deposition part of the answer to the missing C question debated by the global biogeochemists? Our work indicates that the answer depends on which plant species are present. In a grassland dominated by common non-prairie old field species, the addition of 2.0 to 3.4 g N m^{-2} yr^{-1} for 12 years, rates comparable to the highest annual N deposition rates observed in North America, resulted in less than a 2 percent increase in total C relative to the control plots. In contrast, grasslands dominated by native prairie vegetation have had total C increases ranging from 11 percent to 33 percent. However, these native species eventually are squeezed from the ecosystem by high rates of N deposition, thus suggesting that N deposition will not lead to significant C storage.

Biodiversity & Ecosystem Stability

One of the ecological tenets justifying conservation of biodiversity is that diversity begets stability. Impacts of biodiversity on population dynamics and ecosystem functioning have long been debated, however, with numerous theoretical explorations, but few field studies. Our long-term study of grasslands shows that primary productivity in more diverse plant communities was more resistent to, and recovered more fully from, a major drought. The curvilinear relationship we observed suggests that each additional species lost from our grasslands had a progressively greater impact on drought resistance. Our results support the diversity-stability hypothesis, but not the alternative hypothesis that most species are functionally redundant. This study implies that the preservation of biodiversity is essential for the maintenance of stable productivity in ecosystems. ◆ *David Wedin & David Tilman*

PALMER STATION

Winter Sea Ice Ecology

In the Palmer Station (PAL) LTER's conceptual model of the marine pelagic ecosystem west of the Antarctic Peninsula, sea ice plays a central role in both biological/physical interactions and in trophic interactions. To test some of these concepts, researchers from all components of the project, from seabirds to light and physics, participated

see next page, top

CURRENT SITE PROJECTS

in a cruise in the late austral winter (August/September 1993) to investigate winter ecology and sea ice/water column interactions. Data from the Antarctic winter is very scarce due to both logistical difficulties and the short day (4 hours of daylight). The cruise covered a large region 400 km alongshore and 200 km offshore south of Anvers Island where Palmer Station (64°45' S 64°05' W) is located. During the month-long cruise, we had the opportunity to sample and compare processes in areas that had been covered by ice for different amounts of time. Thus, the spatial extent of our sampling region also represented duration of ice cover. Within the PAL LTER area the spatial extent, and duration in any specific geographical location, of annual sea ice is variable.

The sea-ice model shows some evidence of a persistent six- to eight-year cycle, where consecutive high ice years (1979-82, 1986-87 and 1991-92) alternate with low ice years (1983-85, 1988-90, and 1993-94). The southern part of this region was already ice-covered in June 1993, but sea ice had only appeared in the northern region in the two weeks prior to the late winter cruise. This same large geographical region is sampled repetitively every summer (January) for interannual comparisons of water column dynamics, grazer abundance and distribution and predator activity. A comparison of summer and winter results on distribution, abundance and rates allows us to evaluate the role of sea ice in the annual energy flow in this ecosystem.

In order to compare the under-ice surface and water column habitats, SCUBA divers conducted under-ice surveys of small grazers, using specially designed suction samplers to sample the under-ice surface for plant pigments, gases, carbon and microbial activity, and swam transects while continuously measuring UV (ultraviolet radiation) and PAR (photosynthetically active radiation). The water column was sampled for the same parameters with a bio-optical profiling sytem (BOPS), water bottles, nets and bioacoustics.

In summer, activity of primary producers and grazers is below the surface, with peak abundance of primary producers and grazers often 10 to 50 m deep in the water column. Almost uniformly, in winter the level of activity or concentration of a parameter shifts close to the surface and is closely linked to the under-ice habitat. One major grazer, larval krill (*Euphausia superba*), moves from daytime depths of 200 to 250 m to close association with the sea ice. Grazing pressure shifts from filtering phytoplankton in the water column to scraping algae off the underside of the ice. In the winter phytoplankton concentrations in the water column are low, due to the lack of light and water column stability. Both viruses and bacteria were also in higher abundance within the ice and, in fact, were higher than some summer values. These high activities support the PAL LTER's concept of ice as an important aspect of the functioning of this polar ecosystem, and pave the way for future work on the ice habitat. ◆ *Robin Ross, PAL*

VIRGINIA COAST RESERVE

Effects of Flooding on Vegetation

Barrier island vegetation is extremely resilient to the effects of flooding with sea water from coastal storms. Based on the salinity data in greenhouse experiments, the plants (Myrica) shut down when exposed to saline waters and thus provide protection from osmotic desiccation. Soil porewater salinity quickly drops after overwash events and normal Myrica function resumes. (In press, *Journal of Coastal Research.*) ◆ *Don Young, VCR*

Review & Synthesis of Climate Controls by Vegetation

In a review and synthesis of climate controls by vegetation, new analyses are presented on the role of biogenic hydrocarbons as greenhouse gases in the control of nighttime minimum temperatures. The role of plant evapotranspiration in suppressing daytime maximum temperatures and biosphere contributions to atmospheric cloud condensation and ice nuclei are also presented. (In review, *Ecological Applications.*) ◆ *Bruce P. Hayden, VCR*

Northampton County GIS Partnership

The Virginia Coast Reserve LTER site research program has entered into an arrangement with Northampton County, Virginia to assist the county in the development of a GIS information system. Data collections from the VCR LTER will be incorporated into the county GIS mapping system. This partnership will not only speed the development of the Northampton County GIS but will also permit the timely transfer of scientific information for local decisionmakers. As part of this partnership, VCR LTER staff will help bring the county go on-line. ◆ *Bruce Hayden & John Porter, VCR*

Contribution of Bacterial Secondary Production to Overall Carbon Flow Through Food Webs

In comparison with Chesapeake Bay, bacterial abundance and biomass in VCR lagoons are low, though bacterial growth rates are greater. Higher bacterial growth rates in the presence of lower biomass suggest that grazing losses of bacterial production form the basis of a microbial food web in VCR lagoons, a suggestion supported by measures of rates of bacterial consumption by nanoflagellates and microzooplankton. Grazing of bacteria in VCR waters is much greater than in nearby Chesapeake Bay where phytoplankton are abundant. Thus, in the VCR lagoons, the potential contribution of bacterial secondary production to overall carbon flow through the food webs is much greater than in Chesapeake Bay. Continued research will determine if these differences have important practical resource management implications. ◆ *Linda Blum, VCR*