

of new habitats, 2) use of resources and energy, 3) human and cultural policies, or 4) movement and dispersal. Questions were considered to be either an identification of critical components or basic ecological questions. Analysis of the data indicated that 166 papers (49%) focused on new habitats created by urbanization, and 77 references (23%) addressed the use of resources and energy. Only 52 studies (15%) addressed questions regarding the movement and dispersal of non-native species, and even fewer tackled the issue of the effects of human and cultural policies (44 papers, 13%). With regards to the type of questions that have been asked, only 15% of the papers addressed basic ecological questions. This indicates that there is a need for more research, which goes beyond the identification of various components, and addresses the effects of urbanization on ecological processes.

HALL, D. L., B. S. BERGTHOLD, R. W. SITES and M. J. LINIT. University of Missouri, Columbia, MO 65211 USA. **Aquatic macroinvertebrate assemblages of small headwater streams: Effects of adjacent landuse.**

Aquatic macroinvertebrates are used as indicators of water quality and, more recently, to assess the impact of adjacent landuse practices. However, most studies of lotic environments focus on high gradient or higher order streams. Our research examines effects of adjacent landuse on macroinvertebrate assemblages in three low gradient, headwater streams in the Prairie Region of Missouri. We sampled 17 sites on three streams in September, 1999. Collection sites were adjacent to forest, pasture or row crops. Significant differences in macroinvertebrate familial abundance among landuses and a strong interaction with site location was revealed via ANOVA. Familial richness approached significance with the same interaction. Multiple regression analysis revealed that most variation in abundance and richness was a result of decreased variation in canopy cover and dissolved oxygen. In contrast, most variation in familial diversity was attributable to decreased canopy cover and increased variation in water temperature. Discriminant function analysis indicated compositional differences between sites adjacent to different landuses and at different reach locations (up-, mid- or downstream). Cluster analysis based on presence/absence data showed compositional similarity among upstream sites. In summary, we found significant differences in macroinvertebrate assemblages attributable to adjacent landuses and expect additional relationships to become apparent with finer taxonomic resolution.

HALPERN, C. B. University of Washington, Seattle, WA 98195-2100 USA. **Montane and subalpine meadows of the Three Sisters Wilderness Area/Biosphere Reserve, Oregon: A community classification and gradient analysis.**

Meadows occupy a small portion of the largely forested central Cascade region, but support a large proportion of the regional flora. Despite the ecological importance and aesthetic value of these non-forested ecosystems, there have been few studies of their composition, distribution, and environmental correlates. I present a plant community classification and gradient analysis of the montane and subalpine meadow vegetation of the Three Sisters Wilderness Area, Oregon, a UNESCO Biosphere Reserve representing the northern half of the Sierra-Cascade Province. Species composition and environmental data were collected in 152 plots representing a broad array of elevations, landforms, and hydrologic conditions; many of these sites had experienced sheep grazing during the early to middle portion of the 20th century. Classification (TWINSPAN) and direct (CCA) and indirect (DCA) gradient analyses were used to define 21 plant communities and to describe and interpret relationships with measured environmental variables. Among the full array of plots, ordination axes were strongly correlated with elevation, slope, and various landform attributes. Ordinations of subsets of the data revealed strong associations with topographic position (lower slopes to ridgetops in the montane zone), and microtopographic variables that influence the duration of snowpack and seasonal availability of soil moisture (in the subalpine zone). Although gradient analyses suggest strong environmental controls on community composition, effects of intensive grazing on floristic composition are still evident at some locations.

HARRELL, S. M.,¹ J. G. SMITH² and M. A. HUSTON.^{1,2} ¹University of Tennessee, Knoxville, TN 37996 USA; ²Oak Ridge National Laboratory Oak Ridge, TN 37831-6335 USA. **Effects of streamflow variability on population and community dynamics of benthic invertebrates in Upper Bear Creek, Oak Ridge, Tennessee.**

The relative influence of physical versus biological processes on ecological communities is a major issue in ecology. Streamflow may affect invertebrate community structure by operating as both a medium that provides resources and as a mortality-causing disturbance in the form of drought and floods. We use a 13-year dataset to evaluate the effects of temporal variation in streamflow conditions on invertebrate population and community dynamics along a spatial gradient of sites. The sites represent a continuum of decreasing productivity, flow, and substrate diversity, and increasing disturbance in the form of periodic drying as one moves up stream. We found that invertebrate community structure in Bear Creek appears to be disturbance-driven, although the intensity and frequency of disturbance varied spatially. Downstream sites were characterized by higher richness and biomass than upstream sites, likely reflecting the long-term higher stability and productivity of these areas. Due to the gradient of increasing flow downstream, wet periods tend to produce floods at downstream sites while producing favorable flow conditions at upstream sites. Richness generally decreased at downstream sites following floods, but increased or remained unchanged at upstream sites. Sensitivity to disturbance apparently constrains many rare species to downstream sites. The high population densities and stable conditions required for biotic processes to negatively affect species richness occur very rarely, as indicated by a general lack of negative correlations between taxa, particularly at upstream sites. By influencing the abundance and biomass of individual taxa, temporal fluctuations in waterflow structure the invertebrate community, maintaining a perpetual state of disequilibrium.

HARRINGTON, R. A. and J. H. FOWNES. University of Massachusetts, Amherst, MA 01003 USA. **Effects of light and nitrogen availability on the growth, photosynthetic performance and resource use of regenerating tree species in New England forest ecosystems.**

We examined how light and nitrogen (N) affected growth and resource-use efficiency in seedlings of six northern hardwoods forest tree species. *Betula papyrifera*, *Betula lenta*, *Pinus strobus*, *Acer rubrum*, *Quercus rubra*, and *Tsuga canadensis* seedlings were collected from the field and grown for five months in a greenhouse under two light levels (full sun and 15% incident) and two levels of N availability (Control and N enrichment equivalent to 150 kg/ha) in a split plot design. Relative growth rate and light saturated photosynthesis (area-basis) increased with increasing N availability but did not differ significantly with light treatment. Leaf area ratio increased and leaf mass per area decreased in shade, but were unaffected by N availability. Above:below-ground biomass ratio increased under low light or high N availability. A surprising result was that *Betula papyrifera*, usually considered shade-intolerant, responded strongly to N but not light, suggesting that its strategy is actually opportunist for high N in gaps. In conclusion, N availability affected photosynthetic plasticity and growth, while light affected morphological plasticity.

HARROD, J., B. HALL, D. R. FOSTER, G. MOTZKIN and R. W. HART. Harvard University, Petersham MA 01366 USA. **The forest vegetation of Cape Cod: A regional-historical analysis.**

Our study documents changes in land use and forest cover in Cape Cod, MA over the past 400 yr and evaluates influences of historical land use, regional position, and geologic substrate on modern forest composition and structure at landscape to regional scales. Pollen and witness tree data suggest that the Cape was largely forested and that pitch pine and oaks were the most abundant trees at the time of European settlement in the 17th century. Fuelwood cutting and land clearance led to a rapid loss of forest cover by the 18th century, wood shortages and severe soil erosion occurred in several towns. Landcover maps from the mid 19th C show the Cape as largely forested, with most areas near the coast cleared and large patches of forest remaining in the interior. Forest cover increased following farm abandonment and afforestation efforts, exceeding 65% in 1951, but then decreased due to residential and commercial development to 48% in 1990. Our study

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ABSTRACTS

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The **ECOLOGICAL**
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85th ANNUAL MEETING
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