

were significantly lower than values obtained for non-fixing species ($+4.7 \pm 1.2$, $n=20$) and for soil total N ($+7.3 \pm 0.6$, $n=52$). ^{15}N mass balance calculations suggest that under field conditions, PG and AF obtain 50-80% of their N from fixation. Since PG is the dominant species in this ecosystem, symbiotic N_2 -fixation likely represents a significant flux in the biogeochemical N-cycle of this system.

BOWDEN, RICHARD D.¹, KNUTE J. NADELHOFFER², RICHARD D. BOONE³, JERRY M. MELILLO² and JASON B. GARRISON¹. (1) Allegheny College, Meadville, PA, 16335, U.S.A.; (2) The Ecosystems Center, Woods Hole, MA, 02543, U.S.A.; (3) The Harvard Forest, Petersham, MA, 01366, U.S.A. Contributions of root respiration and above- and belowground litter to total soil respiration in a temperate mixed hardwood forest.

Estimating contributions of root respiration and root litter to total soil respiration has been difficult due to problems in measuring each component separately. In the mixed hardwood Harvard Forest (MA), we added or removed aboveground litter inputs and terminated root activity with trenching and root barriers to determine contributions of root respiration and above- and belowground litter to total soil respiration. Based on an annual soil respiration of $371 \text{ gC m}^{-2}\text{y}^{-1}$, aboveground litter inputs ($138 \text{ gC m}^{-2}\text{y}^{-1}$), and differences in carbon dioxide effluxes among treatments, contributions to total soil respiration from aboveground litter (37%), belowground litter (30%), and root respiration (33%) were approximately equal. Nearly two-thirds of soil respiration in this forest is due to belowground processes, comparable to previously published estimates indicating 70-80% of soil respiration is due to belowground processes.

BOYCE, RICHARD L. and ANDREW J. FRIEDLAND. Dartmouth College, Hanover, NH, 03755, USA. Canopy uptake and allocation of atmospherically deposited nitrogen by high-elevation red spruce.

Over the past five years, we have measured and described atmospheric deposition and the nitrogen cycle and Whiteface Mountain, NY. We have detected substantial uptake of both nitrate and ammonium ions by the canopy. Mass balance studies have indicated that more than 50% of wet-deposited nitrate and ammonium is absorbed by the canopy. While seedling studies have shown that this process does occur, it has not been demonstrated in the field. During the 1990 growing season, we treated canopies of mature red spruce trees with ^{15}N -enhanced ammonium nitrate. Using ^{15}N as a tracer, we found evidence for direct canopy uptake and incorporation of nitrogen into the foliage. This may have important implications for nitrogen cycling in this high-elevation ecosystem.

BOYLE, SUSAN C., ROGER M. HOFFER, TERENCE P. BOYLE, AND ENRIQUE H. BUCHER. Colorado State University, Ft. Collins, CO, 80523, USA and Universidad de Córdoba, Córdoba, 5000, Argentina. Use of remote sensing and GIS to identify flamingo habitat in the Argentine altiplano.

The Argentine altiplano is a remote area which has never been adequately mapped. It is an arid region with harsh climate, little vegetation, sparse population, and an average elevation of over 3,500 feet. Little is known about the large populations of three species of flamingos which nest and feed in the altiplano lakes. In a study funded by the National Geographic Society satellite data (Landsat MSS and TM data) were used to map the location of major water bodies and to analyze the spectral characteristics of the aquatic ecosystems in the altiplano. A comparison of the two images revealed dramatic changes in the size, depth, and spectral reflectance of the lakes utilized by the flamingos.

BOYLE, TERENCE P. and NANCY J. HOEFS. National Park Service, Water Resources Division, Colorado State University, Fort Collins, CO 80523, USA. Use of ecological data in the defense of natural resources in parks and protected areas: scientific, social, and legal strategies.

The management of natural resources in parks and protected areas should be conducted with consideration of providing knowledge with scientific integrity and how that scientific information will be used. Stream ecosystems in six small National Parks in the prairie midwest were chosen for study to derive a monitoring program for