

**DEB 9810218: The Niwot Ridge Long Term Ecological Research Program 1998-2004: Control on the Structure, Function and Interactions of Alpine and Subalpine Ecosystems of the Colorado Front Range**

**2001-2002 Annual Report**

Project Activities and Findings

During 2001 and 2002, we published or have in press 25 papers in refereed journals and had 4 articles published as book chapters. We have about 9 manuscripts in review. Approximately 23 LTER presentations were made at regional and local scientific meetings this past year. During this period we had 6 graduate students complete theses and dissertations. Among our publications are ---- from undergraduates, including both REU and honors thesis efforts. In addition to ongoing LTER measurements and experiments, scientists at our site have begun the new series of projects associated with an analysis of subalpine-alpine interactions. Collaborative projects and a new product of our outreach efforts is coming out this year.

*Research highlights:*

1. An important contribution to our understanding of how increased nitrogen availability affects soil carbon sequestration will soon be published in *Nature* (Neff et al., in press). A press release will be submitted upon publication of this important research finding. In general, the results show that microbial degradation of the various fractions of organic carbon shifts when nitrogen availability increases. The implications of this activity to both the amounts of soil carbon and the role that this carbon plays in other important ecological processes such as soil fertility are modified.
2. Phosphorus - Nitrogen interactions. Concurrently with the N deposition work, preliminary sampling for plant-available phosphorus in alpine and subalpine soils suggests that the age of these soils influences the strength of P limitation (Bowman et al., in press, Townsend et al., unpublished results). We see this line of research as one that's critically important to predict species composition shifts associated with the reduction of N limitation in these ecosystems.
3. A directional change in the alpine climate towards greater winter precipitation has been detected in a variety of NWT measurements (Caine 2002). However, the severe drought of 2002 has now resulted in a melt-out of snowfields that had not occurred during the entire duration of LTER measurements. Studies are now being initiated to understand the consequences of what is either a low-probability event or the harbinger of a reversal in climate patterns previously recorded at Niwot.
4. Understanding of alpine-subalpine linkages. Studies initiated or expanded in summer of 2001 included a) variation in ecosystem sensitivity to N additions, b) analysis of factors controlling treeline, c) comparisons of soil carbon and N characteristics across an altitudinal gradient and among ecosystem types in snow. A new study in 2001 included an experimental analysis of the role of N and P limitations to decomposition across this elevational and biotic gradient.

## Other Collaborators or Contacts:

Dr. Patricia Weigant from Peace College, North Carolina, returned to continue her work on the role of parent material impacts on species richness and local biodiversity of vegetation in the alpine. This study was funded this year by funds from her host institution, but was made possible by a LTER-ROA supplement in 2000. The study compares patterns of local richness and diversity across two different soil types found at Niwot and at Rocky Mountain National Park. She and Dr. Seastedt presented preliminary findings from this effort at a National Park Symposium.

Dr Lothar Schrott, a visiting scientist (Max Kade Fellowship) from University of Bonn, Germany has been working with Dr. Nel Caine on surface geomorphology questions. Dr David Dethier, Department of Geosciences, Williams College, also spent part of this field season working with Dr. Caine.

## Information Management

Niwot Ridge LTER site continues to be a leader on data availability and data transfer. Hydrological data from the Niwot Ridge LTER site has been published in *Water Resources Research*. This represents one of the first papers published in that journal to feature important data sets that are available to all scientists through the internet (Williams et al. 1999). We have initiated wireless data transmission from remote sites on Niwot Ridge and the Green Lakes Valley. Our plan is to connect these to a wireless transmission system to our central facility at the University. This should result in a superior, real-time data collection system and eliminate costs associated with phone line connections.

All GIS coverages have been converted into a common projection, and the metadata has been made FGDC compliant. An online metadata server has been installed, allowing a search on both keywords as well as spatial location of the data, also providing the ability to download the spatial data.

## Outreach Activities

### K-12 Outreach

Our outreach program is a continuation of the involvement of teachers from the Boulder/Denver area achieved through our LTER Schoolyard LTER program. This program has four aspects: 1) teaching in-service and pre-service teachers alpine ecology in a summer course at the Mountain Research Station (MRS) 2) bringing elementary and middle school students to the MRS for field trips in the summer 3) development of a schoolyard monitoring program for streams on the lowlands to follow the spring flush of colored organic material (DOC) from the alpine and sub-alpine and 3) development of instructional materials about the Colorado alpine to be used by educators that complement the summer field programs.

***Children's book: "My Water Comes from the Mountains"***- Another accomplishment of the NWTLTER K-12 program has been the completion of a text for a children's book describing the ecology of the Green Lakes valley and the hydrologic cycle which supplies water from the valley to the City of Boulder. A former student from the MRS summer course prepared the text. The publisher

of the book will be Roberts Rinehard Publ., Rowman and Littlefield Publishing group, with a publication date scheduled for --- 2002. One area of specialization for this publisher is books for children about natural environments, many of which are sold in visitor centers in parks around the world. The funding for this supplement includes support for the professional children's book illustrator who will prepare the realistic images to be used in the book, along with the brilliant water colors painted by students in the author's third grade class. The City of Boulder Water Department has been involved in revisions to the text and will support the publication of the initial edition by purchasing copies to distribute as class sets for the to the elementary schools in the Boulder Valley School district.

### Cross-site, Synthesis and LTER Network Activities

Our LTER site is preparing to host the 2002 fall LTER Coordination Committee meeting, which will include a science presentation. The topic of this presentation "Causes and consequences of species change in ecosystems: An LTER perspective" will highlight LTER contributions to our understanding of both why changes in dominant species composition occur, and the consequences that these changes have on biotic conservation and ecosystem services issues. Two NWT-LTER investigators will be presenting summaries from LTER-cross site working groups.

Work continues on two network research projects:

Dr. Mark Williams et al. continue work on a cross-site project quantify the relationships between organic N and organic carbon in soils and streams of diverse ecosystem types. This effort follows up on the creation of an organic N and organic C analytical facility at CU-INSTAAR. This ambitious project has six co-PIs and involves 11 LTER sites. The work involves testing six specific questions concerning the importance of dissolved organic nitrogen as an important component of input and flux across very different ecosystem types.

Dr. Alan Townsend and collaborators have initiated a cross-site study of soil carbon-soil nitrogen dynamics. Soil organic matter (SOM) decomposition is one of the most basic and fundamental of ecosystem processes. However, while we know fairly well how it responds to changes in temperature and moisture, a surprising amount of uncertainty remains over how nitrogen regulates decomposition rates. We have used a variety of analytical tools in long term N fertilization plots at the Niwot Ridge LTER, including  $^{14}\text{C}$  and compound-specific  $^{13}\text{C}$  analyses, to show that SOM responses to added N appear to be driven by an interplay between SOM energetics and nitrogen content. Most notably, N additions clearly stimulate decomposition rates for a large fraction of SOM dominated by material with higher C:N ratios, and residence times of roughly 10-40 years. In contrast, added N appears to slow the turnover of more recalcitrant but N rich SOM pools. These data suggest complex and important feedbacks in SOM decomposition in response to human-induced changes in the global N cycle. This project will collect soil radiocarbon data from two other LTER sites in which long-term N fertilization plots exist: Konza Prairie and Harvard Forest. These data will demonstrate whether our results from Niwot Ridge are general across three very different ecosystems, or whether the responses of SOM turnover to long-term N additions are strongly dependent on ecosystem type.

National and international activities.

Besides the network activities described above, Dr. Patrick Bourgeron has completed his interactions with the French and produced a final project report on a US-French LTER cooperative agreement. In October, 2001, he coorganized an urban ecology workshop with Dr. Morgan Grove on French-US collaboration. The final draft of his workshop effort, "Fench (Zones Ateliers) and United States (LTER) Network-to-Network Collaboration in Long Term Integrated Environmental Research and Management," was produced in March, 2002. During the time of this activity the French formally joined the ILTER network.