MEMORANDUM

To: LTER Principal Investigators and Others
Fr: Nel Caine, Fred Swanson
Re: Topic for LTER/CC Proposal
Date: 29 July 1987

We enclose some notes on Landform - Vegetation Interactions as a potential LTER collaborative effort. The notes obviously reflect our own interests and biases and would benefit from the addition of others if they are to be more widely useful in the network. For that reason, we would like to request any suggestions, corrections, additions and improvements that you or your co-investigators can make. We feel that these topics should be put in the following order of priority:

1. Patch dynamics and stability
2. An integrating analytical protocol
3. Boundary (riparian) studies
4. Snow and ice concerns (delay for a year ?).

If you could get comments to us (both at Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, OR 97331) by August 14, we will then be able to revise the document, estimate a budget and guess at a schedule prior to the LTER/CC meeting of August 25-26.

DRAFT 31.7.87

ASSOCIATIONS BETWEEN LANDFORMS AND VEGETATION

Here, we suggest four related topics for consideration as part of the LTER/CC proposal. They relate to the general question of interactions between landforms, landforming processes and the biota through two influences: an edaphic one and a disturbance one. The mechanisms of these interactions has been treated in more detail by Swanson et al. (1988) and our intention in thism presentation is to develop further (especially quantitatively) the themes presented in that paper.

In terms of the general mandate of LTER, the topics presented here address concerns about material flows, disturbance and recovery, and biologic productivity. As part of a coordinating effort in LTER, they could be the focus of workshops or symposia or, preferably, be points of scientific collaboration among a group of sites, all leading to the statement of general principles and publications.

Patch Dynamics and Stability

Landform characteristics influence the disturbance dynamics of the associated vegetation and respond, in their turn, to changes in that vegetation. At the LTER sites with which we are most familiar, the first of these is evident, for example, in topographic limits to the spread of wildfire (e.g. at ridge crests or at the edge of talus and boulder fields). The second is revealed in the direct landforming influence of processes such as root throw and in the regulation of the frequency/magnitude of geomorphic events like landslides (via root strength). Over time-scales of years to centuries, the mutual interactions among vegetation, landforms and landforming processes give rise to a landscape mosaic with spatial dimensions that seem to be related to the size of the biotic and topographic elements and the nature of the disturbance.

We suggest the need to examine the nature and dynamics of this interaction on a variety of sites and scales, perhaps in a manner which recognizes the size and longevity of the dominant organisms as well as the geomorphic units. This topic clearly addresses problems of ecosystem structure and probably requires treatment in a heirarchical context (e.g. French 1986; O'Neil et al. 1986). It should involve questions of the management of ecosystems as well as the LTER concern with the basic science of disturbance and recovery.

Material Flows through System Boundaries

Implicit in the working of a mosaic-like structure is the operation of patch boundaries across which material, energy or information is transmitted. The boundary with which we have most experience and which is often well defined is that which occurs in the riparian zone. The interaction between stream and surrounding slope systems is important in both ecology and geomorphology and supports a variety of basic concepts in both sciences. It is central to catchment-type material budgeting and is critical in the study of response to disturbance and later recovery. Other boundaries have equal significance, e.g. in channeling wind flow and the materials which move with the atmosphere or in influencing patterns of wildlife movement.

These topics are presently being addressed in a variety of ways at many LTER sites. Our own work is especially involved with cross-boundary transfers of a geomorphic nature and those that are modulated through the adjacent geomorphic environment. In the riparian case, many of these later become evident as landform and habitat change within the channel or on the adjacent slopes. Here, we suggest an LTER emphasis on the dynamics of equivalent boundaries as they contribute to patch dynamics and stability in systems of different dimensions.

Snow and Ice in LTER Systems

The LTER network presently includes a variety of sites at which the snow and ice conditions are important, especially with the addition of Alaskan sites. Snow distributions, and the meltwater they provide, are greatly influenced by topography and vegetation. In turn, and over a much longer temporal scale, the pattern of repeated snow accumulation exerts considerable influence on both vegetation and surface topography. Thus, snow is one set of acting and reacting conditions in the interplay between landforms and vegetation. Icing conditions on lakes and streams are clear edaphic controls on biologic activty that are influenced by the topography and vegetation of the riparian zone and which influence in their turn that topography and vegetation. In light of potential expansion of the LTER network, we suggest that snow and ice studies within the context of a patch dynamics model be considered for a future LTER collaborative effort. This could involve as many as half the network sites.

Integrative Analysis

This variety of topics addressed to a general concern with the interactions between geomorphology and vegetation at a range of LTER sites requires explicit integration. We suggest that this be done in a spatial context which would ensure that the scale concerns of patch dynamics are retained. A series of spatial correlations based upon existing map and survey information of landform and vegetation distributions could provide a start. For example, the relation of landforms to the structure of vegetation patches defined on the basis of time since disturbance could be used as a measure of the strength of the landform - disturbance relation. Correlations between landform elements and vegetation habitat units may reveal edaphic and snow hydrologic links between landforms and vegetation. Initially, this could be done at a two-dimensional level involving linear features such as drainage lines and hillslope profiles but there is no intrinsic problem to extending this to a three-dimensional surface coverage. Beyond correlation, the procedures of fractal geomoetry and the evaluation of self-similarity may give a mechanism for identifying the spatial scale constraints on our work.

This effort should obviously be coordinated with other GIS and remote sensing efforts within LTER. However, we see it as an evaluation of the landform - vegetation system, not an exercise in the use of a geographic information system.

Logistics

Budget