

## LIST OF PARTICIPANTS AND REPORT

Working Group Title: The Sensitivity of Ecosystems to Climate Change: Bringing LTER Observations and Experiments to Bear on Predictive Capabilities

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## WORKING GROUP REPORT

This working group focused on the following four questions:

- (1) What have LTER observations told us about the climate sensitivity of ecosystem processes at different time scales?;
- (2) What have LTER experiments told us about the climate sensitivity of ecosystem processes at different time scales?;
- (3) What progress has been made in bringing LTER observations and experiments to bear on improving the ability to predict the response of ecosystems to scenarios of future climate change? (e.g., using process-based models); and
- (4) How do we improve observational and experimental studies to improve the ability to predict the responses of ecosystems to scenarios of future climate change?

The working group was composed of two hour long sessions. The first session included presentations by Dave McGuire (Bonanza Creek), Gus Shaver (Toolik), and Bill Fraser (Palmer Station) that discussed (1) relationships between the temporal variability of climate and ecosystem processes that have been identified in LTER observations and experiments, and (2) process-based modeling studies that have made use of LTER observations and experiments in predicting ecosystem responses to scenarios of future climate change. Deb Peters (Jornada) also presented information on how the TRENDS Project might interface with the activities that might be recommended by this working group. The second session was a product-oriented discussion aimed at developing recommendations to address the four questions considered by the working group.

The presentations and follow-up discussion identified a number of challenges related to interpreting climate sensitivity of ecological processes from observations: (1) relationships between ecological processes are not simple, (2) spatial heterogeneity often confounds interpretation; (3) life histories and legacies may affect ecological responses, and (4) ecological responses to temporal variability in climate cannot be estimated with space-for-time substitutions.

The presentations and follow-up discussion also identified a number of challenges in interpreting climate sensitivity of ecological processes from experiments: (1) short-term responses may be quite different from long-term responses, (2) experimental responses may depend on the spatial scale of experimentation, (3) experimental responses may depend on variability within and among species, (4) it may take a long time for feedbacks to manifest themselves in responses, and (5) conceptual models often need to be modified after a number of years of experimental observations and may require new experiments or additional years of experimentation to refine the new conceptual model.

The presentations identified that progress in using observations and results for experiments to improve predictions of ecological models is primarily limited by our understanding of the long-term responses of ecological processes and detailed knowledge of the life history strategies of component species. In general, models are generally better at predicting short-term responses than long-term responses because of our poorer understanding of slow processes in ecosystems. As we learn more from observations and

processes, process-based models often require modification. This modification does result in improvements in the ability of models to make predictions.

A key point that emerged in discussion of recommendations is that activities related to the questions of the working group need to be (1) addressed synthetically across the network, (2) should have an overall goal of being relevant to mitigation and adaptation of the effects of climate change, (3) and should have a strong education and outreach component. There were two recommendations for activities that emerged from the discussion: (1) synthesis of observations across the network with an objective of understanding the sensitivity of ecological processes to climate change and variability; and (2) the design and implementation of coordinated experiments across the network to study the sensitivity of ecological processes to climate change and variability. Below, we discuss these recommendations in more detail.

*Recommendation 1: Synthesis of observations across the network with an objective of understanding the sensitivity of ecological processes to climate change and variability.* There is clearly an opportunity to conduct this activity now that the network is approximately a quarter century old. The primary obstacle to developing this activity is the availability of derived data sets appropriate to conducting analyses. The TRENDS Project is currently making progress in developing derived data sets to support synthesis. The Editorial Committee of the TRENDS Project will also conduct some initial studies to evaluate the sensitivity of ecological processes to climate change and variability. It is important that these initial efforts be expanded so that the derived data progressively become richer and the analysis of climate sensitivity to address a broad spectrum of ecological responses. It is anticipated that such efforts would require modest resources (primarily coordination and workshops) if the network office and the TRENDS Project are primarily responsible for organizing the data to be analyzed in these efforts. Once the data are in place, the success of these expanded analysis efforts primarily depends on the dedication of the organizers and participants.

*Recommendation 2: The design and implementation of coordinated experiments across the network to study the sensitivity of ecological processes to climate change and variability.* There was a lot of enthusiasm for this recommendation and there was a lot of discussion about the challenges in conducting coordinated experiments. It was suggested that cross-site experiments need to focus on functional groups and not species. It was also suggested that the experiments should be large enough so that they can include linkages with hydrologic and atmospheric processes. It was recognized that the implementation of this recommendation will require substantial new resources over a number of years. It was generally felt that this recommendation is consistent with the direction of the planning grant and perhaps can be embraced by the planning grant.