LTER All-Scientists Meeting 2015

Estes Park, Colorado, USA

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**Using Long-Term Data to Expand Ecological Theory**

Co-Organizers:

John Kominoski, Florida International University, Florida Coastal Everglades LTER

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Participants: 32 individuals from 14 LTER sites of which 7 individuals were from non-LTER affiliations (see complete list below).

Abstract:

As LTER enters into its 35th year as a network, the opportunity for long-term data to address critical questions that advance general ecological theory and understanding has never been more informed.  In accordance with this meeting’s theme “From Long-term Data to Understanding: Toward a Predictive Ecology”, this proposed working group will build on current, network-level syntheses that integrate long-term data to inform LTER’s core research areas (primary production, population studies, movement of organic matter, movement of inorganic matter, and disturbance patterns).  Our objective is to identify important, general ecological questions that a) derive from key theories, b) are motivated by the analysis of long-term data, and c) require additional, long-term data collection to be answered. We will 1) review current developing syntheses of long-term primary productivity and inorganic nutrient data, 2) discuss the merit for continuation of long-term data at LTER sites for enhancing forecasts of future ecological patterns, 3) discuss the essential components of a successful integrated framework for LTER long-term core datasets with NEON core datasets that enable regional data and forecasts to be downscaled and related to observed changes at LTER sites, and 4) outline important general ecological questions and theories that are only tenable through continued long-term data collection and analysis of both LTER and NEON core data.

Summary of Working Group Outcomes:

Ecological theory consists of foundational concepts that organize a set of principles of pattern and process in socio-ecological environments. Theories need the structural support of testable questions, data, and synthesis across space and time. Some theories do not require long-term data (e.g., metabolic theory), but long-term data have introduced surprises and insights in our understanding of how certain ecological drivers interact and vary with time. For 35 years, the LTER Network has collected data from diverse ecosystems distributed across all of Earth’s biomes at 25 sites. These network-level, long-term data focus on five core research areas: primary production, populations, inorganic nutrients, organic matter, and disturbance patterns. Site-level, long-term data have increased our ability to understand patterns in variance structures from small-to-large spatial scales, as well as organismal-to-ecosystem level adaptations to both manipulated conditions and global environmental changes. Space-for-time substitutions do not permit measurements of temporal variance, which is critical to understanding the drivers and responses of diverse ecological systems and enables us to characterize context-dependencies that inform general ecological theories. Key questions that inform and advance general ecological theories have been tested as a result of the network of LTER sites, through the five core research areas. Long-term data from individual LTER sites have been used to further our understanding of how site-level variance drives those context-dependencies that further advance theoretical frameworks.

Recent integration of multiple theories that incorporate hierarchical scales of ecological organization (e.g., metabolic theory, metapopulation and metacommunity dynamics, ecological stoichiometry, ecosystem development and nutrient retention) have enabled us to discover emergent properties that would not otherwise be observed when examined independently.

Key general ecological questions continue to develop, and we highlight a few questions that have arisen from our long-term observations across the LTER Network.

* Net Ecosystem Productivity: How does organic matter priming affect the activation energies of primary production and respiration throughout terrestrial and aquatic ecosystems?
* Ecosystem Nutrient Retention and Loading: What stoichiometric mechanisms explain how resistant and resilient ecosystems differentially cycle carbon and limiting nutrients after short- and long-term responses to disturbance?
* Metapopulation Dynamics: How do abiotic and biotic drivers of dispersal explain meta-population dynamics at small, short versus large, long scales?

Working Group Products:  
1) Perspectives paper in Frontiers in Ecology and the Environment that: a) highlights key ecological theories that were used at the onset of LTER (1980) and which led to the development of the 5 core research areas of LTER, b) demonstrates how long-term data have advanced or fundamentally challenged these theories, c) outlines critically important questions needed to be pursued with continued long-term data to advance and inform specific ecological theories.

Co-leads: John Kominoski (FCE), Sara Baer (KNZ)  
  
2) Distributed LTER Network graduate workshop/course that pursues points 1a-c, using time series data to investigate theoretical support or challenge of key ecological theories.  This workshop could also have a seminar component to it, whereby individual ecologists who developed specific theories could speak on behalf of the robustness of these theories give current ecological knowledge generated from LTER's long-term data.

Co-leads: John Kominoski (FCE), Evelyn Gaiser (FCE), Jennifer Rudgers (SEV)

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