Workshop Report

Toward a framework for ecosystem consequences of extreme climate events in all seasons: from deserts to temperate rain forest

Organizers: Amber (Amy) Churchill (NWT), and Laura Ladwig (SEV)

Twenty three people representing 15 LTER sites too part in two hours of presentations and discussion at the 2015 LTER All Scientists Meeting (ASM). This was the first edition of this working group gathering at ASM, although a previous group with a related topic (Extreme Events Working Group- XEWG) has existed.

Session synopsis

There is much evidence to suggest that while mean global temperature and precipitation are being affected by climate change, it is through local scale changes in temperature and precipitation extreme events that the greatest ecosystem change will occur. Much research has been focused on these 'event' style drivers of ecosystem change over the last decade, with both observational and experimental studies across many ecosystem types. Indeed, many of these studies have been conducted in association with previous and current LTER sites, and due to the long-term climate data available in these areas, these sites are ideal for initiating studies to examine the mechanistic linkages between variability in climate and ecosystem responses. In this session, we will build upon the framework proposed by the previous LTER Extreme Events Working Group (XEWG) to fit a variety of biomes from desert to forest, and consider climate anomalies at different times throughout the calendar year, including winter events that have not enjoyed the same research focus as growing season manipulations. To reach this goal, we will first provide a review of some of the ecosystem responses to pulse style climate events, then highlight some of the major findings from LTER sites engaging in these studies. Participants will be asked to work in small groups focused on types of event disturbance across biomes, and then compare models with other groups to identify key areas of needed future research in these areas for ecosystems at risk of increased variability in climate.

Session Outline

(2 min) Welcome (Amy/Laura)

(15 min) Overview of existing framework (Amy)

- Ecosystem consequences of anomalous weather events (state of the literature)
- Review for audience members less familiar with known consequences for event based climate change (starts with overview of existing framework, perhaps followed by a plant/ higher trophic level consequences overview:

(50 min) Experimental manipulations/natural disturbances examining event style climate change within LTER

1. Precipitation based studies

- KNZ: Climate extremes experiment / Smith 2011 framework summary (Melinda Smith)
    - Overview of using statistical climate extremes for ecosystem manipulations in a tall grass prairie
- CDR: Does biodiversity buffer changes in ecosystem productivity during or after climate extremes (Forest Isbell)

    - Results from a meta-analysis (Isbel et al, 2015 Nature) looking at the effects of plant biodiversity on ecosystem recovery and response to statistical climate extremes
- AND: Climate extremes- ecosystem effects: a view from the HJ Andrews Exp. Forest (Julia Jones/Fred Swanson)
    - Highlighted importance of interacting drivers (i.e. rain on snow) to produce large scale ecosystem responses to climate anomalies

2. Temperature based studies
- ARC: snow/freeze manipulations (Syndonia Bret-Harte)
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- HBR: Understanding the impacts of ice storms on forest ecosystems on the Northeastern US (John Campbell)
    - A pilot winter manipulation of ice accumulation on branches during mid-winter freeze in a temperate forest
- SEV: Regrowth of desert shrubs following a natural extreme cold event (Laura Ladwig)
    - A winter freezing event that initially produced large apparent die-off in shrubs, although ecosystem processes were able to recover within two years with new growth.

(40 min) 3. Checking in: Synthesis and discussion of conceptual framework by participants

Future directions

1. A group of session attendees (including the organizers) collaborated to submit an organized oral session at the Ecological Society of America 2016 meeting. This session, titled "Extreme climate events across diverse ecosystems" was organized by Laura Ladwig (principle organizer; KNZ), Ross Boucek (FCE), Amy Churchill (NWT), and Zak Ratajczak (KNZ). Additionally, five of the proposed talks in this session are invited working group member contributions.

2. Stemming from high interest in a working group synthesis paper during the ASM 2015 meeting we have initiated a collaborative group of attendees headed by Ross Boucek (FCE) to move forward in writing. This synthesis focuses on applying many of the points raised during the ASM session, and at present will involve six of the original session attendees. Our working title is "A functional approach for linking ecosystem responses to extreme climate events" and our current timeline will be to submit this paper to Ecology Letters in August/September 2016. Regular meetings of this synthesis group will be held via teleconference, and we hope to apply for funding to organize a working group session in the future.

Report prepared by Amy Churchill 9/28/2015

Participants at workshop

(Including organizers and speakers; ^ ESA OOS participant; * Synthesis paper co-author)

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