

NATIONAL SCIENCE FOUNDATION
Review (PI Copy)

Proposal:1546686

PI Name:Zimmerman , Jess

Title: LTER: LTER5: Understanding Ecosystem Change in Northeastern Puerto Rico

Institution:University of Puerto Rico-Rio Piedras

NSF Program:LONG TERM ECOLOGICAL RESEARCH

Principal Investigator:Zimmerman, Jess K.

Rating:Excellent

Review:

In the context of the five review elements, please evaluate the strengths and weaknesses of the proposal with respect to intellectual merit.

LUQ is unique among long term tropical research sites worldwide because other long terms studies have a narrower focus (tree demography) and span only about 2 decades. Long term research in the LEF spans 9 decades and includes a legacy of terrestrial and aquatic ecosystem, community and population studies. The LUQ LTER built on this legacy starting about 25 years ago.

LUQ is critical in providing bandwidth across the LTER network needed to make inferences about ecological processes across latitudinal gradients. Specifically this site allows comparisons of temperate to tropical montane forests. LUQ has been a strong participant in cross-site activities (section 2.2). It was short-sighted of NSF to allow a gap in funding for LUQ.

The legacy work of LUQ I-IV on how disturbance shapes ecological processes provides an ideal context for the very timely research questions framing this LUQ V proposal. This proposal focuses on the effects of increased climate variability and extremes -- drought, hurricane intensity and frequency -- that are anticipated in the climate change forecast for the region. Further, the proposal included synthesis research that examines the combined effects of multiple global change factors that are expected to interact in the tropics and elsewhere û land use land cover change (LULCC) in the form of urbanization, deforestation and reforestation, interacting with climate change, and both affecting or interacting with disturbance regimes. Previous work at LUQ has shown that ecological responses to disturbance are mediated by historical contingencies of land use.

The proposal establishes, as background and justification, the importance of tropical forests in global biogeochemical cycles and in supporting hyper-diversity. Montane tropical forests are squeezed between land use change at low elevations and climate change effects at high elevations. LUQ is a montane site which allows for the use of the elevation gradient as a surrogate for climate change effects. Mountains are considered sentinels of climate change.

Previous work under the auspices of LUQ IV included a canopy trimming experiment to simulate the effects of hurricanes and isolate the effects of light versus litter. They monitored the effects of two major hurricanes on biogeochemical dynamics in two experimental watersheds. The Forest Dynamics Plot showed that ecological traits determined dynamics of juveniles and adults, while seedling dynamics were conditional on phylogenetic relatedness, pointing to the importance of secondary chemistry (phylogenetically conserved) in pathogen and herbivore resistance. Simulation modeling

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showed the disturbance frequency had a strong influence on forest species composition over the long term. LUQ is a tropical forest with high NPP and carbon stock, both of which are sensitive to climate change.

They propose to build on these ongoing activities and add additional experiments, measurements and modeling to address three major research questions and 8 hypotheses. The first question concerns the short- and long-term effects of drought on biota and biogeochemical cycles. They will examine seedling survival experimentally by planting seedlings in rain out shelters (TEE), and they will incorporate those results into models simulating long term consequences for forest dynamics. They will also examine consequences of drought for soil carbon storage, hypothesizing short term gains and long term losses. This is the kind of question an LTER is uniquely positioned to address. LUQ will build on their long terms studies of biogeochemical cycling by soil microbes, and of the dynamics of sentinel soil and litter fauna, and continue those measurements in rain out shelters. The effect of drought on aquatic ecosystems will be studied with a Stream Diversion Experiment.

The second question concerns the effects of increasing frequency and intensity of hurricanes on forest tree community dynamics and on carbon and nutrient cycling. They will continue their Canopy Trimming Experiment with additional treatments in order to study the effects of multiple, sequential disturbances. They will simulate long term effects using the SORTIE model. Their long term monitoring in the Forest Dynamics Plot will allow them to evaluate the model predictions.

Question 3 concerns interactions among global change factors \hat{u} climate change, hurricane disturbance and land use legacies. They will monitor and analyze climate trends in the study region. (The work plan related to Hypothesis 7 contained few references and was difficult for me to evaluate because it is outside my area of expertise. This lack of clarity was an exception within the proposal.) They will use modeling scenarios to examine interactions among the factors.

Overall, the prior work by LUQ I-IV has been highly productive and informative about ecological processes in tropical forest landscapes. The team is highly qualified to carry out the proposed research. The proposed research is creative and original. The questions are timely and can best be addressed in the context of long term ecological research.

In the context of the five review elements, please evaluate the strengths and weaknesses of the proposal with respect to broader impacts.

This proposal includes a stunning amount of outreach and education and therefore is likely to yield very positive broader impacts (benefiting society and advancing desired societal outcomes). These include Schoolyard LTER, Journey to El Yunque, REUs, a volunteer program, and extensive support of graduate students. Many of the students trained are underrepresented minorities. There are also synergies with other projects and networks including the Caribbean Landscape Conservation Cooperative aimed at sustainable resource management.

Please evaluate the strengths and weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if

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applicable

The proposal supports data collection in the five core LTER areas. The proposal presents an integrated research plan that addresses a set of focused questions. The proposal describes suitable plans for information management, project management, outreach and education. LUQ, as a tropical forested site, plays a critical role in the LTER network, facilitating inferences about ecological processes across latitudinal gradients through inter-site comparisons and experiments

Summary Statement

LUQ V will focus on the effects of increased climate variability and extremes -- drought, hurricane intensity and frequency -- that are anticipated in the climate change forecast for the region, on tropical forest ecosystems. Further, synthesis research will examine the combined effects of multiple global change factors that are expected to interact in the tropics and elsewhere -- land use land cover change (LULCC) in the form of urbanization, deforestation and reforestation, interacting with climate change, and both affecting or interacting with disturbance regimes. These are timely and highly relevant ecological research questions and LUQ is uniquely poised to answer them with a 9-decade legacy of long term ecological research. LUQ, as a tropical forested site, also has a critical role in the LTER network facilitating inferences about ecological processes across latitudinal gradients through inter-site comparisons and experiments.