

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: Very Good

Review:

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

This proposal puts forth a very strong framework for using the uniqueness of LUQ to examine integrated forest-aquatic responses to climate forcings (hurricanes, drought) in human-dominated landscapes in the wet tropics. Historical data from the LTER provide a foundation to conduct both observational and manipulative, hypothesis-driven experiments that aim to discern mechanisms of forest and stream response to hurricane disturbance and to extended drought. LUQ is the flagship location to examine hurricane effects on tropical wet forest systems. Existing experimental treatments (trimming) provide a powerful context to examine disturbance effects on tropical wet forests in the context of 'successional stage' (time since last disturbance). Superimposing the effects of climate-driven drought intensity provides a framework that can generate new and important insights into wet forest ecosystem response to climate change. Given the mixed land uses in tropical forest regions, a better understanding of how different stages of forestation respond to, and recover from, hurricane disturbance and drought could lead to new management insights.

The forest experiment will manipulate soil moisture to evaluate short-term 'drought' and will investigate the feasibility of longer-term rainfall exclusion, which is stated as difficult to achieve in forest ecosystems. The stream drying experiments will examine short-term effects in spatially unreplicated fashion. One intent is to gather information on natural gaps in shading that would inform future, longer-term drought experiments that would couple with riparian shading (and leaf-litter) manipulation. These proposed experiments are intended and aimed at developing a better integrated understanding of aquatic-terrestrial subsystems to hurricanes and projected droughts. Measurements on terrestrial-aquatic linkages (riparian controls on stream productivity, export of stream invertebrate production to terrestrial predators) is a key strength of this proposed work. This appears to be new effort at LUQ, and it is significant.

The proposed experiments are 'pilots' to provide initial understanding that can lay foundation for future, more long-term experiments. This seems very reasonable given the large deficit in existing knowledge about drought responses, the relatively poor local understanding of terrestrial-aquatic linkages, and the abbreviated 3-yr funding period. These pilot experiments will provide critical information on guiding experimental design under future funding cycles.

The proposed work speaks to some mechanistic basis for understanding hurricane and drought response - dispersal ability and shade-tolerance of tree species for example. However, in my view,

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probably the greatest weakness in understanding species responses to drought and warming is a lack of analysis of physiological performance of terrestrial and aquatic species. It seems mechanisms of projecting species responses will be based effectively on niche modeling, which is a good approach as far as it goes. However, under novel circumstances (i.e., extended drought coupled with warming), extension of niche models has well known limitations. A more process-based, physiological framework would allow more confident prediction.

Overall, this is a very strong proposal that builds on historical strengths of the LTER and presents a new, interesting framework to transform those observations into a research program that can address questions about ecological responses to climate change in the wet tropics.

The research team appears very well qualified, with well established and productive terrestrial and aquatic scientific investigators.

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

My view is that this proposed work will advance basic scientific understanding of coupled forest-stream sensitivity and response to changing thermal, precipitation regimes and to extreme disturbance events, such as hurricanes. This will be of broad interest, and especially relevant to wet, tropical forest regions of the world.

The PIs have an excellent record of using LUQ as a learning laboratory for the public through effective outreach programs. Training of undergraduate and graduate students in integrative ecological responses to climate change is a strength and LUQ can be a leader in this regard.

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

Summary Statement

I think this is a very strong proposal that leverages the strengths of long-term data at LUQ and recasts the research in a new hypothesis-driven framework of ecological response to climate forcings that is of broad ecological and social relevance.