Introduction to the proposal including goals and an overview of the project -

This proposal is for a "small-scale pilot study" to develop a simulation model to study the biocomplexity of tropical Island ecosystems. Specifically, this project will develop an integrated simulation model that links the biocomplexity of terrestrial ecosystems, with special attention to human activities, with the biocomplexity of coral reef ecosystems. The simulation model will include the ability to input exogenous factors such as scenarios of future climate change. The model is intended to facilitate research and education about how policy decisions and future economic changes will impact the terrestrial, near-shore marine, and reef ecosystems.

This project will include several components that are integrated into a single simulation model. An input-output model of the economy will be used to model economic changes such as the growth of tourism. A geographic information system (GIS) modeling approach will be used to analyze the spatial effects of economic changes on land uses and to distribute environmental impacts of pollution from economic activity and of the environmental effects of land use changes spatially over the terrestrial, near-shore marine, and reef ecosystems. Direct impacts of tourism on reefs will be combined with the indirect economic and land use change impacts as inputs to coral reef models.

link landuse

The model will be developed for the island nation of Aruba because of offers of cooperation from the Aruban government and previous work completed by some of the Co-PIs on both the economy and land uses of Aruba and on the coral reefs of Aruba. The goal is a model that will be applicable to any tropical island upon the input of island-specific data. If the pilot model is judged a success, we will seek funding to also specify the model for Bonaire, a nearby island with a distinctly different economic base, to study and better understand the different dynamics in these complex ecosystems.

The simulation model will have several goals. The modeling effort will help identify significant gaps in our knowledge of the dynamics of integrated human and natural systems. The model will help us identify where further research is needed on the dynamics and consequences of economic and land use changes and on the vectors linking these changes to reef ecosystems.

The simulation model will be useful for policy analysis. It can be used to assist political leaders, business leaders, and land-owners understand the implications of their decisions on coral reefs as well as terrestrial, estuarine, and near-shore marine ecosystems. Tourism is the fastest growing economic activity on most tropical islands, and tourism has both direct and indirect effects on the

environment. The coral reefs of these islands are both the primary natural capital that attracts tourists and an essential component of the fragile ecosystem that can be damaged by tourism. This model will simulate both the growth of tourism and other economic activities on the island and the environmental impacts on the biocomplexity of terrestrial, estuarine, near-shore marine, and reef ecosystems.

The simulation model will serve as an educational tool in several ways. Undergraduate and graduate students will be involved as research assistants in developing the simulation model. We will present our work on this model at academic conferences, and published our work in academic journals. The model will be used in undergraduate and graduate courses at the University at Buffalo and made available to instructors at other universities. We will install an operational and downloadable version of the simulation model on a web site to assist dissemination. We will use contacts we have in Aruba and other tropical islands to test methods of using the simulation model for educational purposes ranging from use in the government, private sector, university, and high schools.

We recognize significant difficulties in achieving our goals for a simulation model to study the biocomplexity of tropical Island ecosystems. We are proposing a “small-scale pilot study” to start this work. In the course of this one-year project we intend to develop a functioning simulation model, but a model that is not well-specified and will be missing significant components. Indeed, one of our major goals for this pilot project is to identify the specific components for which we lack sufficient information on mechanisms and data to include in the model.

We intend a two-pronged approach to identify significant missing components for the simulation model. The first approach will be constructing a crude model. Building the model will force us to clearly think through the complex relationships at both a theoretical and operational levels. The second approach we intend to use to identify gaps in knowledge will be holding at least two planning and development meetings of several days with our core project team and a several outside experts. These meetings will review the work accomplished on the model, critically evaluate where the most significant gaps exist, where information and expertise on these gaps may exist, and how this project can best proceed.