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Connectivity in Marine Seascapes: Predicting Ecological and Socioeconomic Costs of Climate Change on Coral Reef Ecosystems

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This research project seeks to integrate theory and data from ecology, biology, and the social sciences to address major questions about the potential consequences of climate change on coral reef ecosystems. The researchers will establish a general framework starting at the habitat scale that is linked with population biology and socioeconomic models. This structure will allow systematic exploration of several core questions, including: (1) How do local impacts, including overfishing and mangrove deforestation, affect the vulnerability of Caribbean coral reefs to climate change? (2) When do socioeconomic responses to changes in the ecosystem triggered by climate change stressors exacerbate the vulnerability of coral-reef ecosystems to future stressors? and (3) What are the critical ecological and/or socioeconomic uncertainties for predicting climate change impacts on ecosystem services that will yield the greatest returns from investigation? In all questions, ecosystem services will be measured through the effects on fisheries, biodiversity, and social/cultural systems.

The investigators will develop an integrated ecological-socioeconomic model that will be representative of Caribbean ecosystems and be formulated in discrete time and space. Data for estimating ecological and socioeconomic response functions are already being collected by this team in an ongoing National Science Foundation-funded biocomplexity project. This unique data set will allow the investigators to highlight and measure the effects of local processes that are typically averaged out in more aggregate climate change models. The model will include explicit spatial processes, such as larval and adult/juvenile dispersal and movements of fishers, along with dynamic adjustment responses to predict the vulnerability of coral-mangrove ecosystems to climate change stressors. Given the large uncertainties in both the nature of the relationships and measurement, the researchers will perform a value of information analysis to learn about the impacts of reducing uncertainties on various ecological and socioeconomic criteria.

Taking advantage of ongoing model development and data collection analysis of Caribbean coral-reef ecosystems, the goals in this study are to develop a new understanding of changes in ecological services due to climate stressors, provide a framework for evaluating different management scenarios on ecosystem services, and highlight mechanisms where climate stressors can cascade through the ecological and socioeconomic systems triggering responses that increase the vulnerability of the ecosystem.

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