FUTURE SCENARIOS: LANDSCAPE VULNERABILITY AND RESILIENCE TO CLIMATE AND LAND USE CHANGE

Science to understand, anticipate, and adapt to global change, including land use and climate change, is driving new integration among disciplines. Overarching questions include (1) How will global change alter the futures of regional social-ecological systems? (2) How and why do regional social-ecological systems differ in vulnerability, resilience and adaptability to global change? Such questions cannot be addressed by discipline-bound thinking, require new approaches, and must be answered through broad-scale comparative investigations of dissimilar systems. Scenario thinking is among the most promising approaches to emerge (e.g. the 2005 Millennium Assessment). Scenarios begin as suites of qualitative narratives—developed by regional stakeholders including social and ecological scientists—that describe an envelope of plausible futures based on contrasting assumptions. The narratives inform and are, in turn, informed by integrated spatial models of socio-ecological change (e.g. agent-based models or linked land change, econometric, and ecosystem models). This approach for coupling qualitative and quantitative scenarios has informed planning and policy and generated a rich set of fundamental research questions.

Our overarching questions evoke a host of specific research questions, including:

1. How does the connectivity of social and ecological systems change over time and space, and what are the consequences of connection strength for change?
2. Are social-ecosystems more vulnerable or resilient to press versus pulse disturbances, and do these responses vary across ecosystem types? Do human societies display greater adaptability to press versus pulse disturbances?
3. What ecological and social factors affect the characteristics of thresholds where cumulative small effects trigger large changes in system?
4. What are the unintended consequences of optimizing particular structures or processes of social-ecological systems?
5. How are adaptive behaviors, perceptions of risk, and decision making influenced by policies and institutions, and what is the potential for those institutions to influence resilience of socio-ecological systems?

Addressing these questions in a scenario framework is an effective way to achieve the research goals set out by the ISSE, which lack a cogent protocol.

Approach

To advance a broad comparative analysis of these critical questions requires an integrated network of sites distributed across a contrasting array of physical, biological, and cultural environments and characterized by extraordinary ability to collect, analyze, and synthesize diverse data. The core strengths of the LTER network – its history of long-term, place-based studies, its commitment to integrative research across disciplines, and its diversity of landscapes, stakeholders, and disturbance regimes – make it ideally suited to address these questions. Accordingly, we propose a network of scenario analyses to address and expand theories of social-ecological change, vulnerability, resilience and adaptability.

Our proposed activity would operate through two simultaneous coupled activities: (1) the production of qualitative, stakeholder-driven narratives at all participating sites, and (2) quantitative socio-ecological landscape-change modeling across a focused set of site clusters to address the consequences of land use/urbanization and environmental change on critical ecosystem services, including carbon sequestration, water availability and regional to national habitat quality and continuity. The integrated modeling would engage and contrast results across clusters of sites that share common problem space (e.g., similar biomes, land use issues, stakeholder groups, etc.) and would complement existing regional efforts.

In Year 1 we will establish a web-based graduate seminar at participating LTER sites and universities that will train graduate students and lead scientists in socio-ecological scenario development. Based on an established LTER model, the seminar will link scenario experts directly with sites to advance their efforts and will encourage network-wide exchanges. Leaders will hold videoconference exchanges to enhance coordination. Also in year 1, we will assemble historical narratives describing past landscape change for all sites and surrounding regions to inform current understanding and the development of future scenarios. Stakeholder participants for scenario-development workshops will be initiated and site clusters will identify existing modeling capacity. We will hold cluster workshops that include the leaders of the narrative efforts to identify directions for comparative and synthetic activities.

In Year 2 we will describe site-scale narratives and visualizations for plausible future landscapes. The temporal and spatial scope of these scenarios will vary with site and regional-specific settings, research agendas and knowledge bases. We will also solicit feedback on the visual and textual narratives through quantitative surveys and semi-structured interviews with broad groups of stakeholders. Regional modeling and synthesis will continue. A workshop of all lead scientists from all regional efforts and their narrative counterparts will convene for cluster and inter-cluster discussion, coordination and integration. In years 3 and 4 we will produce synthesis products based on historical and future scenario narratives and we will parameterize, run, and refine regional and cluster-wide quantitative scenario models.

In Year 5 we will complete and publish findings from regional modeling, and produce a synthetic publication that compares the qualitative and quantitative scenarios and identifies themes and gradients that expose common ecological futures across LTER regions. We will additionally organize an integrative symposium with the tentative theme of 'Vulnerability and Resilience of American Landscapes.' The symposium will highlight both the scientific output of this research program and provide opportunities for reflection on the use of scenario planning as an approach to the study of socio-ecological systems and their integration into education.

Throughout the research program both the qualitative and quantitative work will inform the development of additional focused experimental and observational research initiatives across the LTER Network. In summary, the project will advance the development of new socio-ecological theory, models and approaches; will identify critical issues and geographies for study in and beyond LTER; and will measurably advance network-wide cohesion and research towards decadal goals.

Lead Coordinators
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Initiating LTER Participants
We encourage all interested to participate. The Harvard Scenario Workshop, SC meeting and emails identified 21 interested sites to date (AND, ARC, BES, BNZ, CAP, CDR, CWT, FCE, HBR, HFR, KBS, KNZ, JRN, LUQ, NTL, NWT, PAL, PIE, SEV, SGS, VCR).

Potential Partners
USFS, NOAA, NRCS, EPA, NASA, USGS, HUD, TNC, TPL, Lincoln, Pew, Shell Scenarios, UNEP

Cyber infrastructure needs: Video-conferencing capacity, landscape modeling & visualization capacity.

Potential Budget
$1.6M/yr for 5 years, primarily site based activities (grad students, workshops, leader support; 35%), graduate web seminars (lecturer participation, cyberinfrastructure, course prep; 5%), postdocs (6 annually for regional modeling; 40%), and network-wide activities (workshops, publications, visualization; 20%).