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Editorial

Resilience—Now More than Ever

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In the northern hemisphere, the cyclone season has just ended, whereas the southern season is beginning. The 2005 Atlantic season was especially severe, as indicated by the increase in total power developed and expended by hurricanes (Emmanuel 2005). Along with an increase in the ferocity of storms, this past year has seen an unprecedented magnitude of impacts from natural disasters, including hurricanes, tornadoes, earthquakes, fires, storms, droughts, and floods. In our most recent editorial, we wrote about the reorganization following the devastating tsunami that occurred just about a year ago in southeast Asia; this time we can point to recovery efforts in the south central United States in the wake of Hurricane Katrina. Worldwide, redevelopment from natural disturbances seems to be more and more frequent (Webster et al. 2005). At the heart of society's ability to adapt and reorganize is the property of resilience (Holling 1973, Gunderson 2000, Carpenter et al. 2001, Adger et al. 2005*b*).

The view of resilience as a nonlinear multiple domain, or ecological resilience sensu Holling (1996), arose from ecologists who studied ecosystem dynamics that were intertwined with human actions (Holling 1973). The early inclusion of humans as agents of ecosystem change distinguished this ecosystem-oriented branch of ecology from the mainstream, in which many still view resilience as the time needed to recover following a disturbance. This recovery view of resilience is rooted in the etiology of the word, literally meaning “to walk back.” The return time or engineering view of resilience has been extended into social systems, such as the ways in which cities and urban areas recover from natural disturbances (Vale and Campenella 2005). Because many ecologists and resource practitioners view humans and their actions as external to the system, they fail to take into account the interdependencies and feedbacks between ecosystem development and social dynamics, to say nothing of their cross-scale interactions.

Current thinking about ecological resilience evolved out of observation, using models as a tool for understanding and for incorporating stakeholders into adaptive management and learning about ecosystem processes. More recently, the focus has extended into the social domain, with diverse contributions and perspectives in understanding the dynamics of social-ecological systems reflected in several articles in this issue. This framework differs from current approaches that tend to take the self-repairing capacity of ecosystems for granted and stresses that it will not be sufficient to reduce pressures on ecosystems, e.g., pollution, overfishing, to sustain and develop the environmental resources base for societal development, a major challenge in research into global environmental change (Lambin 2005). Adaptability in a resilience framework implies the capacity not only to respond within the social domain but also to respond to and shape ecosystem dynamics and change in an informed manner (Berkes et al. 2003). The variables and processes that structure ecosystem dynamics and sources of social and ecological resilience have to be understood and actively managed to deal with the interplay of gradual and abrupt change, as described in other articles and special features in this issue.

Acknowledgment of ecological regime shifts requires new ways of linking management and governance. Recognition of alternative regimes requires confronting issues of thresholds, desirability, reversibility, and hysteresis. Thresholds are dynamic and difficult to ascertain, because they change as a function of local and global variables. Questions of desirability are contested in many institutional settings and cross scientific, social, economic, and political domains. Undesirable states may be extremely resilient, becoming traps that

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constrain future options, such as the $8 billion restoration plan for the Everglades (CERP 2005). Other restoration programs generally assume reversibility and rarely determine whether restoration is theoretically achievable. The success of restoration in the Everglades and other large-scale systems such as the Grand Canyon, the Chesapeake Bay, or the Mississippi Delta appear to be based upon whether they can solve these issues of problem domain management to avoid stalemate and inaction by bureaucracies and special interest groups. Finally, resilient approaches acknowledge that recovery of systems from one regime to another must acknowledge that the path back is likely to be very different from the one forward (Scheffer et al. 2001).

Ecological resilience, or the capacity for renewal in a dynamic environment, provides an ecological buffer that protects the system from the failure of management actions that are taken based upon incomplete understanding. This property gives managers the leeway they need to learn and change. Trust, cooperation, and other forms of social capital are necessary to implement management actions designed for learning as much as other social objectives. A major challenge in this context is to build knowledge, incentives, and learning capabilities into institutions and organizations for governance that allows for the adaptive management of local, regional, and global ecosystems and to incorporate actors in new and imaginative roles (Folke et al. 2005). Given the increasing frequency and severity of our world's natural disasters, one of the greatest challenges for humanity in the decades to come is not only to adapt to current conditions in the short term, but also to devise more sustainable development pathways. We think that the many contributions in this and previous issues of *Ecology and Society* will help guide these transformations to sustainable futures, as described in the next section.

THIS ISSUE

The regular articles in this issue provide lots of lessons and insights on social-ecological systems in turbulent times. Several of them are devoted to the management of animal populations and ecosystem dynamics, others deal with the management process, and some address the governance system that makes ecosystem management possible. There are also articles that explicitly analyze cross-scale linkages in ecosystems, management, and governance.

Robert Lessard et al. (2005) evaluate the feasibility of controlling predator abundance in a wide range of ecosystem types, from forests to rivers, to achieve conservation and management objectives. Gabriele Bammer (2005) argues for a combination of systems thinking and complexity science with participatory methods and with knowledge management, exchange, and implementation. Ioan, John, and Della Fazey (2005) provide insights on linkages between learning and experience in resource management from individuals to organizations. Susan Manring and Sam Pearsall (2005) demonstrate how interorganizational networks and learning organizations can evolve in the adaptive management process to guide stakeholders in creating a shared framework for generative learning, consensus building through collaboration, and decision making. John Ludwig and Mark Stafford Smith (2005) examine cross-scale resilience in Australia's rangelands.

The research articles report on models that address resource issues in social-ecological systems. Takashi Amemiya et al. (2005) examine the use of biomanipulations to achieve lake restoration. Cynthia Neudoerffer and co-authors (2005) present a diagrammatic approach to understanding social and ecological interactions in Nepal. Andrea Martínez-Ballesté et al. (2005) use demographic models to assess the sustainable use of palms. Niels Martin Schmidt and Per Moestrup Jensen (2005) examine changes in the body lengths of animals in Denmark. Finally, Ludwig et al. (2005) present many caveats and cautions regarding the estimation of the discount rates used in cost-benefit analyses.

In addition to the regular articles in this issue, a number of articles have been added to special issues in progress. Lessons on *Restoration of Riverine Landscapes* continue in the special issue edited by Christer Nilsson, with an article by Ellen Wohl (2005) on the role of history and restoration options and on the importance of social learning processes in river restoration; in addition, David Dudgeon (2005) looks at river rehabiliation for the conservation of fish biodiversity in monsoonal Asia. The special issue on *Assessing Risks to Wildlife Populations*, edited by Matt Nicholson, has another article by Lawrence Kapustka (2005), who examines opportunities and technical limitations to landscape-scale assessments. The special issue

Strengthening People's Adaptive Capacity for Ecosystem and Human Well-Being with contributions from the Millennium Ecosystem Assessment has four new contributions from cases around the world. Georgina Cundill et al. (2005) discuss the application of multiple modes of knowing to navigating dynamic systems. Stephan Barthel and co-authors (2005) examine the management history of Stockholm, Sweden. Elvira Pereira and colleagues (2005) study the relationships between ecosystem production and human well-being in mountainous agricultural communities in Portugal. The use of sacred knowledge for achieving conservation objectives in China is reported by Jianchu Xu et al. (2005).

Two new special issues are now open. The first is on *Scale and Cross-Scale Dynamics: Governance and Information in a Multilevel World,* edited by David Cash. Two articles introduce the issue, including work on cross-scale networks in co-management by Neil Adger, Kate Brown, and Emma Tompkins (2005*a*) and a study of the politics of scale in the governance of fresh water in the Mekong regions by Louis Lebel and co-authors (2005). The first article from scenario work within the recent Millennium Ecosystem Assessment appears in the special Issue on *Scenarios of Global Ecosystem Services,* which is edited by Steve Carpenter, Elena Bennett, and Garry Peterson. In this article, Joseph Alcamo et al. (2005) estimate changes in global ecosystem services under alternative scenarios.

THE JOURNAL

As we close this issue and another year of publication, we'd like to recognize some changes to the journal and relay our thanks to the many people who contribute. We are pleased to welcome Marco Janssen as the new Associate Editor-in-Chief of *Ecology and Society.* This is to recognize his contribution as the Editor of the Ralf Yorque and Sustainability Science competitions as well as his outstanding performance as a Subject Editor. Marco will continue to operate and coordinate these competitions in a way designed to attract ever more novel and creative entries. We also welcome Jon Norberg as our newest Technical Editor and thank him for his previous service on our editorial team. Jon will be responsible for evaluating and making recommendations to make better use of the technology of the Internet and World Wide Web to help our authors communicate the results of their research, syntheses, and insights.

Of course, we are in more debt than we can ever repay to the growing list of subject editors on our editorial board, who do most of the heavy lifting associated with the publication of scientific articles. We take this time of year to thank our Managing Editor, Michelle Lee, who does such an exceptional job every day to keep the operations running so smoothly. Finally our thanks and best wishes to you, our readers and subscribers, for your contributions and support to *Ecology and Society.* To all of you, best wishes for a prosperous and productive 2006!

Responses to this article can be read online at:
http://www.ecologyandsociety.org/vol10/iss2/art22/responses/

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