Essay

Conservation and Adaptation to Climate Change

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Abstract: *The need to adapt to climate change has become increasingly apparent, and many believe the practice of biodiversity conservation will need to alter to face this challenge. Conservation organizations are eager to determine how they should adapt their practices to climate change. This involves asking the fundamental question of what adaptation to climate change means. Most studies on climate change and conservation, if they consider adaptation at all, assume it is equivalent to the ability of species to adapt naturally to climate change as stated in Article 2 of the United Nations Framework Convention on Climate Change. Adaptation, however, can refer to an array of activities that range from natural adaptation, at one end of the spectrum, to sustainability science in coupled human and natural systems at the other. Most conservation organizations deal with complex systems in which adaptation to climate change involves making decisions on priorities for biodiversity conservation in the face of dynamic risks and involving the public in these decisions. Discursive methods such as analytic deliberation are useful for integrating scientific knowledge with public perceptions and values, particularly when large uncertainties and risks are involved. The use of scenarios in conservation planning is a useful way to build shared understanding at the science–policy interface. Similarly, boundary organizations—organizations or institutions that bridge different scales or mediate the relationship between science and policy—could prove useful for managing the transdisciplinary nature of adaptation to climate change, providing communication and brokerage services and helping to build adaptive capacity. The fact that some nongovernmental organizations (NGOs) are active across the areas of science, policy, and practice makes them well placed to fulfill this role in integrated assessments of biodiversity conservation and adaptation to climate change.*

Keywords: boundary organizations, climate change, conservation planning scenarios, conservation practice, sustainability science

Conservación y Adaptación al Cambio Climático

Resumen: *La necesidad de adaptarse al cambio climático es cada vez más aparente, y muchos creen que la práctica de la conservación de la biodiversidad tendrá que alterarse para enfrentar este reto. Las organizaciones de conservación tienen interés en determinar cómo deben adaptar sus prácticas al cambio climático. Esto implica responder la pregunta fundamental de lo qué significa adaptación al cambio climático. La mayoría de los estudios sobre cambio climático y conservación, si acaso consideran la adaptación, asumen que es equivalente a la habilidad de las especies a adaptarse naturalmente al cambio climático en los términos del Artículo 2 de la Convención del Cambio Climático de las Naciones Unidas. Sin embargo, adaptación se puede referir a un conjunto de actividades que varían entre la adaptación natural en un extremo del espectro, y ciencia de la sustentabilidad en sistemas naturales y humanos en el otro. La mayoría de las organizaciones de conservación tratan con sistemas complejos en los que la adaptación al cambio climático implica la toma de decisiones sobre prioridades para la conservación de la biodiversidad frente a riesgos dinámicos y el involucramiento del público en estas decisiones. Los métodos discursivos como la deliberación analítica son útiles para la integración de conocimiento científico con las percepciones y valores del público, particularmente cuando implican grandes riesgos e incertidumbres. El uso de escenarios en la planificación de la conservación es una forma útil para construir el entendimiento de la interfase ciencia-política. Similarmente, las organizaciones frontera – organizaciones o instituciones que unen escalas diferentes o que median la relación entre la ciencia y la política – podrían ser útiles para el manejo de la naturaleza transdisciplinaria de la adaptación al cambio climático, para proporcionar servicios de comunicación y correduría y para ayudar a construir*

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capacidad adaptativa. El hecho de que algunas organizaciones no gubernamentales (ONG) son activas en las áreas de la ciencia, la política y la práctica las posiciona para desempeñar este papel en evaluaciones integrales de conservación de la biodiversidad y adaptación al cambio climático.

Palabras Clave: cambio climático, ciencia de la sustentabilidad, escenarios de planificación de la conservación, organizaciones frontera, práctica de la conservación

Introduction

Many conservation organizations are eager to determine how they should adapt their methods to climate change. This focus masks a more fundamental question, namely, What is adaptation? I discuss this question with reference to climate change and conservation practice and suggest a number of directions for future conservation efforts.

The latest estimates by the Intergovernmental Panel on Climate Change (IPCC) are that 20–30% of species are at high risk of extinction with a 2–3 °C increase in temperature. By 2100 atmospheric CO_2 levels will be substantially higher than in the past 650,000 years, and temperatures will be among the highest in the past 740,000 years (Fischlin et al. 2007). The implications of climate change for conservation have been studied in the context of protected areas (Barber et al. 2004; Hannah et al. 2007; Dunlop & Brown 2008), building ecological resilience (Hansen et al. 2003; Hughes et al. 2005), ecological connectivity (Soulé et al. 2004; Crooks & Sanjayan 2006), and the responses of species and ecosystems to climate change (Fischlin et al. 2007).

Climate change will also affect the practice of conservation, which will need to alter fundamentally to face the challenge. Barber et al. (2004) point out that we cannot fulfill our duties as stewards of the Earth's last natural ecosystems if we plan and manage for a world that no longer exists. Current methods of conservation management have been criticized for treating biodiversity and human economic systems as static (Hannah et al. 2002; Meir et al. 2004) and for not paying sufficient attention to social and cultural landscapes (Bawa & Seidler 2004). In addition to a consideration of future change, biocultural history (i.e., past human interactions with the environment) may be an important aspect of understanding biodiversity preservation in the future (Callicott et al. 2007). Such calls for changes in conservation thinking are not necessarily new, however. Lee (1999) talks of the search for new meaning in conservation, for an approach that is bioregional in scope, collaborative in governance, and adaptive. Clark et al. (1999) suggest that a new conservation paradigm involves recognition and legitimization of knowledge by the public, and analysis at multiple spatial and temporal scales. The emergence of postnormal science (Ravetz & Funtowicz 1999) has implications for conservation management because a systems-based perspective accepts complexity and uncertainty and calls for flexibility, anticipation, and adaptation (Lister 1998). The emerging interest in adaptation to climate change provides an opportunity to discuss tools and methods for achieving these aims.

What Is Adaptation?

Most studies on climate change and conservation, if they consider adaptation at all, assume it to be equivalent to the ability of species to "adapt naturally," as stated in Article 2 of the United Nations Framework Convention on Climate Change. Adaptation, however, can refer to an array of activities that range from natural adaptation at one end of the spectrum to sustainability science in coupled human and natural systems at the other. For many organizations involved in undertaking practical projects or priority setting, most of the answers to how to adapt lie at the complex end of this spectrum. Determining how to adapt is complex because it involves planning for dynamic threats; exploiting opportunities, such as emerging markets for carbon and ecosystem services; addressing changing ecological relationships and the possibility of no-analog ecosystems; determining resilience and thresholds of change in coupled human and natural systems; and understanding the links between sustainable livelihoods, human vulnerability, and biodiversity in a rapidly changing world.

Adaptation to climate change is fundamentally linked to the concept of vulnerability. Vulnerability refers to the degree to which a system or unit is likely to experience harm due to exposure to perturbations or stresses (Kasperson et al. 2005). One thing to understand about climate change vulnerability and adaptation is that the underlying science has emerged from several different disciplines and is founded on multiple epistemologies (Adger 2006). A number of reviews trace the evolution of the concept of vulnerability (Brooks 2003; Kasperson et al. 2005; Adger 2006). Eakin and Luers (2006) distinguish 3 main research traditions: risk or hazard; political ecology or political economy; and frameworks inspired by resilience in ecology. The study of vulnerability is divided along a number of theoretical fracture lines that reflect deeply rooted divisions in Western conceptualizations of nature and society (McLaughlin & Dietz 2008). A wedge between natural and social systems has resulted in limited analyses of coupled human and natural systems and few studies have exploited the detail, nuances, and

more recent developments in the theory of resilience (Kasperson et al. 2005). Many overly linear vulnerability and adaptation methodologies assume we know much more about future climates and extreme events than current models can deliver; thus, the entire chain of assessment is built on a shaky foundation (Downing et al. 2003).

In the field vulnerability communities, such as those involved with climate change and disaster reduction, have not been good at working together (Thomala et al. 2006). Although the diversity of vulnerability and adaptation assessment methods has enriched understanding of complex dynamics that produce vulnerability and adaptive capacity, it poses a challenge for practitioners such as NGOs and communities (Vogel et al. 2007). There has been a limited flow of scholarly knowledge into assessment and practice, and overly context- or case-specific research has made it difficult to accumulate learning from empirical findings (Kasperson et al. 2005). The end result of this complexity is that those not familiar with the theoretical evolution of the subject can be forgiven for not understanding the breadth of adaptation to climate change or the magnitude of the challenge.

Adaptation as Sustainability Science

At its most sophisticated, climate change adaptation falls within the emerging field of sustainability science (Kates et al. 2001). Sustainability science aims to understand the dynamic interactions between nature and society (i.e., how social change shapes the environment and how environmental change shapes society) (Clark & Dickson 2003). It seeks to analyze the coupled human-environment system in ways that are useful to different communities of stakeholders (Turner et al. 2003). Lessons from research in the area to date are that people and nature interact reciprocally and form complex feedback loops; systems are often nonlinear, with temporal and spatial thresholds and differing degrees of resilience; and prior human behavior creates legacy effects that can have consequences for decades or even centuries (Liu et al. 2007*a*). Integrative research on complex sustainability issues is best carried out in a place-based context because use of the local scale facilitates assessment as a social process where there is an exchange of information and understanding between investigators and stakeholders (Wilbanks 2002). Nevertheless, although much of what sustainability science is trying to explain has a regional character, it also aims to integrate across scales. How then can research on the implications of climate change for conservation contend with the complexity of adaptation in complex systems? There are a number of potential paths for future efforts in the area of adaptation to climate change and conservation, including deliberation and participation, scenario planning, and the use of boundary organizations.

Deliberation and Participation

Adaptation to climate change involves making decisions on risks, defined broadly as situations or events where something of human value has been put at stake and where the outcomes are uncertain (Rosa 1998). Ultimately, risk decisions are public-policy choices (Stern & Fineberg 1996), so methods are needed to integrate scientific knowledge with this decision process. Satisfactory risk characterization involves a number of steps: getting the right science; getting the science right; getting the right participation; getting the participation right; and developing an accurate, balanced, and informative synthesis (Stern & Fineberg 1996).

Analytic deliberation refers to a structured discussion among scientists, decision makers, and stakeholders that aims to define problems, identify values and outcomes of concern, and distinguish issues that must be addressed through compromise and trade-offs from those that might be resolved with better information (Dietz & Stern 1998). There are 5 key characteristics of environmental policy problems that make broadly based deliberative processes necessary. These are multidimensionality (i.e., diverse outcomes means that every policy produces winners and losers); scientific uncertainty; value conflicts; mistrust; and urgency (Dietz & Stern 1998). Discursive processes that recognize that the public's view is multifaceted and often embedded are needed to reduce conflicts in biodiversity management (Fischer & Young 2007).

Although public participation in adaptation processes is a worthy aim, it is important to recognize the tendency for preexisting power relations to persist in participatory fora despite the claims that they promote bottom–up decision making. Few et al. (2006) stress the need to be sensitive to the critiques of participatory processes in order to avoid an overly managed form of inclusion that is unlikely to satisfy either participatory or instrumental goals. They note that there may be an inherent tension between deliberation and anticipatory adaptation strategies, with deliberation unlikely to produce a consensus strategy if the consequences of climate change are uncertain, long term, and of low immediate salience to stakeholders.

Scenario Planning

One method of deliberation that can be used in the context of climate change adaptation and conservation is scenario planning. Scenarios are plausible, challenging, and relevant stories about how the future might unfold, which can be told in both words and numbers (Raskin et al. 2005). *Normative scenarios* describe a prespecified future and a set of actions that might be required to achieve it, and s*torylines* are qualitative, internally consistent narratives of how the future may evolve (Carter et al. 2007). Scenarios are an important tool when complex

and uncertain science predominates because they can contain information from many perspectives and integrate different epistemologies (Peterson et al. 2003; Bennett & Zurek 2006). For instance Manning et al. (2006) suggest the use of "stretch goals" that create a unified vision for ecological restoration that conservation managers, decision makers, and the wider community can understand and work toward.

Participatory scenarios are being used in climate change adaptation projects (Downing et al. 2003; Bales et al. 2004; Kok et al. 2006). Scenarios allow individuals within an organization to engage in a wide-ranging analysis, and they can accommodate the politico-institutional pressure to constrain uncertainty and the epistemological recognition of uncertainty (Shackley & Deanwood 2003). Thus, scenarios serve as "boundary objects" (Star & Griesemer 1989) or useful tools for shared understanding at the science–policy interface. Adaptation to climate change is not only a question of how stakeholders act but who should act and what is required for action to take place (Cohen et al. 2006). It is essentially a process of stakeholder learning and institutional development, rather than just an evaluation of specific measures and risk (Downing et al. 2003).

Scenarios have also been applied in conservation efforts. For instance, scenarios of the risks to biodiversity have been developed at the global scale (Sala et al. 2000; Carpenter et al. 2005) and for specific regions such as the European Union (Spangenberg 2007; Verboom et al. 2007) and Florida (Gentile et al. 2001). The most comprehensive study, the Millennium Ecosystem Assessment, specifically addressed some of the major challenges with scenarios (Carpenter et al. 2005). It attempted to blend the replicability and clarity of quantification with the richness of narrative (Raskin et al. 2005) and to bridge the global-local gap by conducting local analyses of ecosystem effects (Nakicenovic et al. 2005). When used as a tool in climate change adaptation projects in specific regions, scenario processes could be enhanced by new developments and techniques in the area of landscape visualization. Provided full consideration is given to the professional and ethical aspects of the use of visual imagery, potential benefits include the integration of science and intuition, engagement of lay people, personal salience, and flexibility (Sheppard 2005).

Boundary Organizations

Sustainability science is grounded in the belief that for knowledge to be useful it needs to be coproduced through collaboration between scholars and practitioners (Clark & Dickson 2003). Early attempts at implementing sustainability science and ecosystem management have benefited from the presence of boundary organizations (Cash et al. 2003; Berkes et al. 2006). These are organizations or institutions that bridge different scales or functional levels (Cash & Moser 2000) or mediate the relationship between science and policy (Guston 1999). This relationship is a complex 2-way process shaped by multiple relations and reservoirs of knowledge (Vogel et al. 2007). One of the functions of boundary organizations is to provide a forum where information can be coproduced by actors on different sides of the boundary through boundary objects such as models, scenarios, and assessment reports (Cash et al. 2003). Many climate adaptation projects aim to be transdisciplinary, involving academic researchers from different disciplines and nonacademic participants, such as land managers, user groups, and the general public, so as to create new knowledge (Tress et al. 2007). Nevertheless, in general, much of the promise of working across disciplines has not been realized and barriers remain high (Liu et al. 2007*b*). For instance, differences among the core beliefs of disciplines about how the world functions were identified as a critical issue for the Millennium Ecosystem Assessment scenarios (Nakicenovic et al. 2005). Boundary organizations can provide communications and brokerage services between scientists, practitioners, and interested publics (Vogel et al. 2007).

The growth of conservation NGOs over the past decades and their increasing involvement in science (da Fonseca 2003) makes them well placed to act as boundary organizations in integrated assessments of biodiversity conservation and adaptation to climate change. Nongovernmental organizations have, for example, been instrumental in formation of the cross-sector alliances needed for large-scale landscape connectivity activities (Sanderson et al. 2006). In such endeavors, social aspects such as community participation, capacity and commitment, trust, communication, and education often pose a similar or greater challenge to effective project implementation than the scientific aspects (Bennet et al. 2006). The networking activities of boundary organizations can create social capital, which refers to the norms and networks that allow people to act collectively (Woolcock & Narayan 2000). Different types of social capital include bonding social capital (between members in a group), bridging social capital (between groups) and linking social capital (between scales) (Woolcock 1999). Social capital, and relations of trust and exchange, are central to adaptive capacity (Adger 2003).

Conclusion

Within the conservation community, there seems to be a marked resistance to dealing with climate change adaptation as anything other than species adaptation or human adaptation. At least 3 things are at play here. The first is a deep-rooted division in our conceptualization of nature

and society, which, despite widespread recognition of the problem, persists. The second is perhaps a reluctance to accept that deliberative processes in which the public is strongly involved in discussions about climate change, conservation priorities, and risk means conservationists may need to do things differently. The third is the issue of resources: adaptation at its most sophisticated is at the cutting edge of sustainability and resilience science, and the number of people working in these areas—particularly with a conservation focus—is comparatively small.

A number of tools and methods exist to deal with the complexity of adaptation to climate change. Discursive methods such as analytic deliberation have been used to manage the tensions between scientific knowledge and the decision-making process. Another potentially useful tool is scenario planning. Scenarios can build shared understanding of the possible implications of climate change. Boundary organizations could prove useful for managing the transdisciplinary nature of adaptation, providing communication and brokerage services. They can facilitate discussions on conservation management in the face of future risk and help build adaptive capacity. The fact that some conservation NGOs are active across science, policy, and practice arenas means they have a central role to play in adaptation.

The tough questions being asked with regard to biodiversity conservation in a changing climate demand that we start thinking about adaptation as a process that takes place in coupled human and natural systems. Moreover, we need to start actually doing more integrative research on climate change and conservation, building our collective capacity through networks, and drawing lessons from coordinated empirical studies. Integrative research that combines conservation planning, climate change, adaptive capacity, human livelihoods, and implementation must become the rule rather than the exception.

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