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Editorial

Introduction to the special issue: Are parks working? Exploring human–environment tradeoffs in protected area conservation

Protected areas, or parks, remain a major focus for biodiversity conservation globally. The goal of this special issue is to bring together a broad-based set of papers that examine the human dimensions of forest conservation in protected areas across the world. Park landscapes are often characterized by biological and socio-political dilemmas due to conflicts between biodiversity goals and local livelihood strategies. To best inform policy, research should seek to document the livelihoods of people in the landscapes around parks and investigate the impacts that parks and biodiversity outside the parks have on their livelihoods and activities in turn. Given the current debate on the effectiveness of protected area management, there is an urgent need for careful, quantitative evaluations that analyze the impact of exclusionary policies of protected area management on forest cover over time. Each of the four papers in this issue deals with a distinct case study, using different methods and questions. This research illustrates the utility of remote sensing, spatial statistics, fragmentation analyses and modeling for the study of parks, and for evaluation of the potential effectiveness of different management strategies in protected areas. These studies also underline the need for satellite image analysis to be supplemented by detailed field research to provide insights into the social and institutional processes that impact land cover change and forest conservation.

Introduction

For the past several decades, protected areas, or parks[1] have formed a major focus of conservation efforts across the globe, with a tenfold increase in the number of protected areas in the world over the past 4 decades, and over 18.8 million square kilometers currently under protection (World Conservation Monitoring Centre, 2003). Throughout the developing world parks are surrounded by landscapes that, while still containing considerable biodiversity, also have rapidly growing human populations (Child, 2004). The domesticated portions of these landscapes are zones of dynamic change in demography, land use, and land cover. In a majority of these areas, agriculture is already or is rapidly

[1]We use the term "parks" to refer to protected areas in general, including wildlife reserves: areas where land use is restricted mostly to wildlife and the preservation of "natural" existing habitat.

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becoming the main land use (McNeely & Scherr, 2001) and thus, the greatest threat to the protected area. As a result, there exists a substantial empirical overlap between parks and human land uses around the world (Pimbert & Pretty, 1995). Thus, park landscapes are largely characterized by biological and socio-political dilemmas not found elsewhere.

Most ecological research on protected areas has focused on wildlife within the park, with only a small number of comparisons with large mammal distributions outside those areas (Berger, 1998; Chapman, Lawes, Naughton-Treves, & Gillespie, 2003; Naughton-Treves, 1998; Onderdonk & Chapman, 2000; Treves & Naughton-Treves, 1999). The social science literature dealing with protected areas has focused to a greater extent on the contested processes of establishing and maintaining parks, and/or attempts to foster community conservation. To address the tradeoffs and dilemmas surrounding the conflicts between people and parks, research should seek to document the livelihoods of people in the landscapes around parks and investigate the impacts that parks and biodiversity outside the parks have on their livelihoods and activities in turn.

The goal of this special issue is to bring together a broad-based set of papers that examine the human dimensions of forest conservation in protected areas across the world—from Nepal (Nagendra, Pareeth, & Ghate, this issue), and the Philippines (Verburg, Overmars, Huigen, de Groot, & Veldkamp, this issue), to Mexico (Roy Chowdhury, this issue) and Brazil (Messina, Walsh, Mena, & Delamater, this issue). The issue developed from a series of organized sessions on People and Parks, at the Centennial Annual Meeting of the Association of American Geographers Meeting, Philadelphia, February 2004. The papers in this issue touch on a range of alternate governance mechanisms that can lead to successful conservation. In-depth case studies of the linkage between human process and forest conservation in protected areas is brought together to understand how the interaction between social and biophysical driving forces vary over time and space in different regions. Using empirical analyses from many different ecological, social and institutional contexts, papers highlight some institutional mechanisms most strongly related with successful conservation strategies.

Recent comparative studies that have evaluated the effectiveness of parks in tropical regions suggest that the creation of protected areas has had mixed outcomes. While exclusionary approaches can be successful in some instances at protecting forest cover, they do not account for the social ramifications of prohibiting local inhabitants from access to forest resources. A major concern for conservationists had been the "islandization" of parks (Child, 2004). Increasing human populations and the expansion of agriculture are viewed as major contributing factors. While areas around parks represent zones of risk and restriction, they are also potential zones of opportunity for current and potential migrant populations. This dual character of park landscapes will generate and/or intensify distinctive patterns of land use around parks, which will in turn have important consequences for the park itself.

Even as the area under protection continues to increase worldwide (Harcourt & Sayer 1996; World Conservation and Monitoring Center, 2003), there is an ever greater awareness of the social consequences of creating protected areas that exclude local inhabitants from traditional ways of life. People–park conflicts are particularly acute in tropical regions where people depend upon high biodiversity regions for their livelihoods. The interest in alternative, decentralized methods of forest management in several countries across the world can be traced to these concerns. Sustainable levels of use have been proposed as a more effective alternative, based on the argument that resources are

better conserved when people can use and therefore value them as part of their livelihood (Bates & Rudel, 2000; Brandon, Redford, & Sanderson, 1998).

Thus, the trend has shifted towards encouraging decentralized, local and participatory forms of governance in contrast to the heavily top-down, state-centered systems of management that were extensively promoted in the 1950s (Agrawal & Ostrom, 2001). However, critics of these approaches argue that exclusionary approaches are the most effective way to conserve habitats and protect biodiversity (Bruner, Gullison, Rice, Gustavo, & da Fonseca, 2001; Terborgh, 1999). Although this issue continues to be hotly debated in the academic and practitioner communities, there is a significant lack of careful quantitative evaluations of the various management approaches. It is interesting to note that while research on the scientific basis for reserve selection and design has developed rapidly (e.g. Bishop, Phillips, & Warren, 1995; Schwartz, 1999), there is a real need for studies that evaluate the range of conservation strategies currently deployed throughout the world. One key problem is the difficulty of acquiring baseline data to evaluate the impact of management regimes through time. In light of the recent debates over the potential of participatory approaches, it is particularly important to consider whether the inclusion of local populations in decision-making processes does lead to improvements in park conditions.

One goal of this special issue is to explore the complex web of interactions among different forms and intensities of land use, local communities, and the maintenance of a park or protected area. These studies are grounded in geographical theory that effectively incorporates data on multiple social and ecological processes. The integration of remote sensing and spatial analytical techniques into existing field-based studies can prove particularly effective in enabling geographers to analyze and interpret social activities and incentives that relate to conservation. The additional step of spatial modeling, both as a method to predict future land cover change and to better identify drivers of current change is also discussed in two of the four papers in this issue. The role of modeling within the land use/land cover change arena, especially in relation to the issue of protected areas, will certainly increase in the future. Each of the four papers in this issue deals with a distinct case study, using different methods and questions. However, there are also some similarities and nice contrasts to be pulled out of these papers. Some of the more interesting ones will be discussed briefly here.

Park history, development and land tenure

Each region has a distinct history and often a tale of shifting identities in terms of variable boundaries and land tenure regimes. There are a handful of studies which have undertaken comparative analyses of the effectiveness of protected area establishment across multiple regions (Bates & Rudel, 2000; Bruner et al., 2001; Child, 2004; Sanchez-Azofeifa, Daily, Pfaff, & Busch, 2003; Terborgh, 1999). Such analyses have suggested that the parks that adopt exclusionary approaches tend to be most successful at maintaining forest cover. However, issues of human involvement are complex, and cannot be studied using a single axis of evaluation. It is necessary to combine approaches from the social and natural sciences to address this multi-faceted issue of the human dimensions of forest change.

Exclusionary approaches do not account for the social ramifications of prohibiting local inhabitants from access to the resources. Often parks are created in areas where poor

people depend upon the natural resources for their livelihoods, thus exclusionary management raises issues of social justice and equity (Bates & Rudel, 2000; Brockington, 2002). Moreover, local populations may oppose or resist protected areas that are created without their participation; this can contribute to degradation in park conditions (Wells & Brandon, 1992).

A recent study evaluated the effectiveness of 93 parks in tropical regions (Bruner et al., 2001). All of the sample parks were exclusionary in their management. The study made an important contribution by attempting a broad, comparative analysis and it concluded that exclusionary parks are successful at limiting land cover transformation when compared to the surrounding landscape. However, by focusing only on exclusionary forms of management, the research fails to consider whether alternative approaches, such as community-based arrangements, private ownership, or participatory park management, might have similar or better results (Stern, 2001). Further, this study draws largely on qualitative perceptions of park effectiveness recorded using surveys, and there is a clear need for such valuable large-N analyses to be supplemented by research that integrates findings from careful quantitative assessments across multiple sites. In order to assess the conclusions of comparative studies to date, and to address the concerns that such studies have raised, new studies that incorporate additional data collection methods are needed.

The papers in this issue look at a range of tenure regimes both within parks, park buffer regions and surrounding landscapes and then evaluate park effectiveness. Messina et al. (this issue) study the Cuyabeno Wildlife Production Reserve, created in 1979, in the northeastern Ecuadorian Amazon. They find that changes in land tenancy and the implementation of protection buffers around and within the Reserve have increased the process of deforestation and fragmentation. Changes in the reserve boundary in 1993 and the creation of "patrimony forest" which allowed colonization and communal land title were significant tenure shifts, although the patrimonial forest creation did appear to help maintain forest cover within the park as a whole. These boundary transformations clearly illustrated how the failed cross-linkages between national interests, local interests and institutions resulted in a spatially diverse outcome in the landscape.

Verburg et al. utilize two modeling approaches, at the national and landscape scales. The national scale includes the entire Philippines at a resolution of 2.5×2.5 km. The landscape scale approach is more focused, addressing a small case study area at the border of the Northern Sierra Madre Natural Park, the largest and ostensibly the most important protected area in the country in terms of biodiversity, and composed of 20 villages of mixed ethnicity.

Roy Chowdhury studies the Calakmul Biosphere Reserve, Mexico, in terms of the core, buffer, and surrounding landscape region. This reserve was established in 1989 and both communal and private lands are encompassed. While biophysical and infrastructure-related factors, most notably soils and distance to markets and nearest open agricultural lands, are strong predictors of deforestation probability, the study reveals that institutional factors are also important in driving landscape change. Finally, Nagendra et al. study the Tadoba-Andhari Tiger Reserve (TATR) in India, a national park and wildlife sanctuary. Established in 1935 there have been a number of boundary changes, village resettlements, and changes in rights, with six villages now located within its boundaries, and 53 on its periphery. The study segmented the park into zones for study along these lines as park interior, entire park area, surrounding landscape, and the six regions around each internal village. Significant differences in terms of land cover amount and fragmentation were

found with stable forest in larger patches located within the park interior, and stable nonforest within the surrounding landscape.

Methods employed across the four study areas

One commonality to all studies is the use of remotely sensed imagery as a base data source. This is indicative of the role of this technology in the land use land cover change research arena. Remote sensing provides a particularly effective tool for such an analysis (Nagendra et al., 2004). Applications of remote sensing techniques to analyze social incentives and actions, and explore environmental and social change have been increasingly explored over the past few years (Fox, Rindfuss, Walsh, & Mishra, 2003; Liverman, Moran, Rindfuss, & Stern, 1998). In order to evaluate the outcome of conservation strategies, comprehensive information on the distribution of species habitats, as well as information on changes in distribution with time, is required. It is nearly impossible to acquire such information purely on the basis of field assessment and monitoring (Heywood, 1995). Satellite data from several time points allows the creation of land cover maps over greater spatial extents and more frequent time steps than is possible with expensive and detailed field studies (Jensen, 2000). Since these classifications are spatially explicit, they not only provide information on percent changes in forest cover, but also allow for evaluation of the spatial location of these changes and their association with environmental and biophysical landscape parameters that may be critical associates of this change (Nagendra, Munroe & Southworth, 2004; Nagendra et al., 2004).

Messina et al., Nagendra et al. and Roy Chowdhury utilized Landsat Thematic Mapper (TM) data for the creation of their time-series analyses. Verberg et al. used SPOT data. All four research groups relied on satellite data for an integral part of their research. Messina et al. and Nagendra et al. also incorporated landscape ecology and landscape metrics into the analysis, using their land cover classifications, as derived from the Landsat TM data. Landscape ecological analysis is based on the principle that the spatial pattern of land cover within a landscape is closely linked to the underlying biophysical and social processes that influence landscape change (Forman, 1995; Turner, 1990). Landscape spatial metrics are commonly used, in association with remotely sensed data, to quantify a landscape matrix in terms of its spatial structure within designated boundaries, for specific time periods and land cover types (Southworth, Nagendra, & Tucker, 2002). The use of such analyses allows us to determine a spatially specific response of a landscape to an event, a time period, or something such as a policy or tenure change. Messina et al. and Nagendra et al. clearly illustrate the utility of such tools in their research.

At the same time, analysis of remotely sensed data requires fieldwork to interpret human activities and incentives that relate to land cover change (Fox et al., 2003; Schweik & Green, 1999). A single land cover class (e.g., forest) could have many different land uses, e.g., a park reserve, a communal woodlot, and area of regrowth post-fire, orchards or agroforestry. Likewise, many forms of land tenure could be found for a single land cover class, e.g., family owned, communal, government, and yet all would be associated with very different kinds of management practices. It is therefore important to recognize that satellite image analyses need to be grounded in careful field research in order to understand the underlying socio-economic and institutional factors that drive forest cover change in these regions (Moran & Brondizio, 1998, pp. 94–120; Rindfuss & Stern, 1998, pp. 1–27). All four of the papers here clearly illustrate this point with careful, context setting, social

and institutional data analysis, and interdisciplinarity of methods, analyses and discussions.

Roy Chowdhury and Verburg et al. take their analyses one step further with the use of models. Roy Chowdhury utilizes a parcel-level spatial econometric model to identify the driving forces of land use change within two of her study communities. Verburg et al. undertake a dual-scale analysis. At the national scale, a spatial allocation model is used to identify the dominant threats to protected areas, and highlight areas of deforestation. A more detailed analysis of the spatial dynamics of such deforestation is then undertaken at the local scale, using a rule-based model that is grounded in observed behavior. At a higher spatial resolution the model analyzes deforestation at the protected area boundary and the degradation of forest patches in the agricultural area. All four papers highlight the importance of the household level, as that at which decision-making occurs, and actions are taken. The paper by Verburg et al. innovatively links their local-based study to land use dynamics at the national scale.

Is the park a success?

Many previous studies have suggested that if a park is not exclusionary then the success of that park is unlikely. In the research presented here a gradient of different tenure regimes were presented and results are promising. All four regions are under threat from agricultural extensification and all four identify the household level as the key scale for analysis, remote sensing as a useful tool, and land tenure or institutions as key driving forces and issues of importance to managers.

Messina et al. found that four of the five areas they studied had significant reductions in primary forest during the 16-year study span. Notably though within the Cuyabeno Reserve itself primary forest actually increased in total area. There are signs of increased fragmentation, as reflected by an increase in forest patch density, while mean patch size decreased. Despite the continuous processes of deforestation, agricultural extensification and fragmentation, the patrimony forest does have lower rates of change (compared to the rest of the study area not in patrimony forest), suggesting it does act to constrain the process of forest conversion. Therefore, as a policy, with the aim of minimizing deforestation and fragmentation of the Cuyabeno Reserve, the creation of the "Patrimony Forest" was successful as a barrier to land transformation, within an inhabited park region. This case study illustrates the co-existence of protected area and communities with rights to the land.

Roy Chowdhury found that the reserve did appear to have had some success in terms of curtailing deforestation. Of the 421 km^2 of mature and secondary forests which were deforested between 1987 and 1996, only 7% occurred in the buffer zone of the reserve and even less, only 3%, within the reserve core. In addition, significant reforestation of agricultural regions back into secondary forests occurred on reserve lands. Roy Chowdhury points out that while the biophysical and infrastructure or accessibility-related measures were strong predictors of deforestation probability, both institutional factors and local household characteristics were also important drivers of landscape change in this study region.

Nagendra et al. represent a situation of conflict with six communities currently residing within the forest reserve, which receive much of the blame for continued deforestation. However, Nagendra et al. found that forest cover within the park was not only maintained

but also actually increased slightly during the study period, a very promising sign for the survival of the park and the communities within it. Further, the overall impact of villages outside the park boundaries on forest fragmentation is much greater than that of the villages within the reserve. Pressure on areas surrounding the park is undisputed though, with increased deforestation and fragmentation occurring closer and closer to the park boundary, which has some serious implications for the park's future. Such studies do, however, bring hope for a change in perception: from humans as perpetrators of deforestation and fragmentation to agents of change, potentially positive change, within the "people and parks" debate.

Future directions and needs within the people and parks debate

Land-change research has moved from more simplistic, single causal explanations of land use land cover change, and towards the study of multiple, interacting factors occurring simultaneously, and often at different scales, within the landscape (Lambin, Geist, & Lepers, 2003). In addition, this research group also exhorts place-based studies of land use change, or "case-studies", undertaken at the local scale and the linkage of the human–environmental system such that it is studied as a single, coupled system.

In order to ensure greater cooperation between state authorities and local communities, there is a need to provide local inhabitants with incentives for conservation, and to seek economic alternatives for farmers adjacent to the park. Tourism provides one promising source of income in many locations, although this money often does not filter back to the local communities.

The research presented in this issue illustrates the utility of remote sensing, spatial statistics, fragmentation analyses and modeling for the study of parks, and for evaluation of the potential effectiveness of different management strategies in protected areas. The study also underlines the need for satellite image analysis to be supplemented by detailed field research to provide insights into the social and institutional processes that impact land cover change and forest conservation (Messina et al., this issue; Nagendra et al., this issue). Given the current debate on the effectiveness of parks, there is an urgent need for careful, quantitative evaluations that analyze the impact of different forms of protected area management on forest cover over time. Through the integration of such tools (as are illustrated here in this special issue) into existing, fieldwork-based studies, the analyses of protected area efficacy will improve greatly. The role of modeling for scenario development (Verburg et al., this issue), management plan implementation analyses, and analysis of the drivers behind larger landscape dynamics (Roy Chowdhury, this issue), will only increase in the future. Cumulatively, these tools and techniques will help us not only to better understand the protected area system but also to better protect it.

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