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Parks and Poverty

**Bird Migration and
Climate Change**

**A New Conservation
and Development
Frontier**

**Emerging Trends
in Biodiversity
Conservation**



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Cover Photo: Sudhir Shivaram

Greater Spotted Eagle (*Aquila clanga*). Breeds from northern Europe across Asia, and winters in southeastern Europe, the Middle East and South Asia.

Bird Migration and Climate Change

Niclas Jonzén, Torbjørn Ergon, Andreas Lindén and Nils Christian Stenseth

Climate changes expose organisms to novel environmental conditions with the potential to affect the life history and demography of individuals. If they are to stay alive and reproduce, organisms must be able to cope with such environmental changes—not least with (changing) environmental stochasticity. The expression of individual traits in variable environments provides a mechanism that links variable environments and parameters such as survival and reproduction. After all, how well a species is able to cope with environmental changes depends on its potential to adapt to new environmental conditions.

Some of the most striking examples of rapid changes in life-history traits due to climate change are found in migratory birds, especially in the timing of migration and breeding. The combined effect of the public's fascination for birds, a general interest in the phenomenon of migration, and the long history of systematic recording of arrival and departure of migratory birds have generated a wealth of potentially valuable data that can shed light on how bird-migration patterns are affected by climate change and variability. The general picture emerging shows that, for many species breeding in the northern hemisphere, spring arrival has advanced during the second half of the 20th century and similar patterns have recently been described in Australia. The direction of the observed changes is in agreement with glob-

al changes in spring temperature; however, detailed data revealing the underlying mechanisms have rarely been available.

In the recent contribution of Working Group II to the IPCC Fourth Assessment Report, it is stated with high confidence that 'Ecosystems and species are very likely to show a wide range of vulnerabilities to climate change, depending on imminence of exposure to ecosystem-specific, critical thresholds'. The wide range of vulnerability, as highlighted by the IPCC, is mirrored by the inter-specific variation in changing phenology patterns shown by migratory birds in the last few decades. Focussing on arrival time only, there is considerable variation among species despite the general trend towards earlier arrival. Moving beyond the simple demonstration of earlier spring migrations, more systematic studies are required if we are to understand the nature of variation both within and between species. In order to identify the ways in which birds can adapt to climate change, we need to investigate such issues as the extent to which adaptation differences reflect systematic differences between the migration strategies, food preferences or taxonomic grouping of birds.

A special issue of *Climate Research*, on Bird Migration and Climate Change (Vol. 35, No. 1-2) includes 13 contributions on various aspects of bird migration and climate change. Collectively these papers add significantly to our un-

derstanding of how climate change affects migratory birds. To begin with, Pulido demonstrates that we are still lacking conclusive evidence for evolutionary change despite selection for earlier arrival and the presence of genetic variation in the timing of migration, and Gienapp et al. point out that we need to investigate to what extent existing changes in phenology are consistent with evolutionary explanations. Among the contributions is also a review of why bird-migration dates are shifting (Gordo). Knudsen et al. note that further analysis will require methodological advances, and Hedenström et al. highlight the need for a properly developed theoretical framework for interpretation of patterns, as well as predictions of what to look for in the future.

The migration schedule of birds will be modulated by the environmental conditions experienced throughout the migratory journey. Both te Marvelde investigate how spatiotemporal spring temperature patterns affect geographical variation in laying date in 2 contrasting species, one spending the winter in Europe and the other migrating to West-Africa. We expect to find not only inter-specific differences with respect to change in timing of migration, but also differences between males and females migrating at different times of the season and facing different selection pressures. To what extent recent climate change has affected the degree of protandry — earlier arrival at reproductive sites of males relative to fe-

males — in migratory songbirds, is discussed by Rainio et al. There is a growing body of literature emphasizing the importance of seasonal interactions, such as the knock-on effects of winter climate on individual performance in the breeding season. Studds & Marra study how the amount and timing of rainfall influence the food abundance and non-breeding performance in the American redstart *Setophaga ruticilla*, a species whose seasonal interactions have previously been demonstrated. Whereas the winter ecology of American redstarts has been studied in detail for some time, much less is known about the climate impact on the non-breeding performance of birds wintering in Africa. Saino et al. focus on how rainfall and temperature patterns in Africa influence the timing of spring arrival of birds on the island of Capri in southern Italy.

Detailed studies of single species are often informative; coarse scale information on a wide range of species allows for interesting comparison and the search for general patterns. Rubolini et al. analyze a large amount of estimates of change in first arrival dates and mean/median arrival dates collected across Europe in the last 40 years and look for spatial and taxonomic variation as well as intra-specific consistency. As indicated by the impressive dataset which Rubolini et al. build upon, there has been a strong emphasis on the timing of spring migration. Considerably less is known about how climate change has affected autumn migration phenology. A contribution to the field is given by Péron et al., who analyse the timing of post-nuptial migration and stopover strategy in 2 insectivorous passerine species. The last 2 contributions provide a fresh reminder of the complexity of the problem at hand: to understand

and predict the ecological ramifications of climate change. Sparks & Tryjanowski study changes in spring arrival dates and how the response to temperature may change over time. In the final paper, Mustin et al. use migratory shorebirds as an example and discuss whether predictive models of climate impact at the species level may require ecological details that are difficult to include.

The temporal shifts in migratory phenology have already been well described, at least for spring arrival in Europe and North America, and now is the time to delve into the underlying mechanisms. Before doing that, let us have a closer look at the (rather) general patterns described so far. Rubolini et al. analysed data from both passerines and non-passerines. Overall there were rapid advances in arrival date, especially for first arrival dates in species spending the winter in Europe. The most important finding reported by Rubolini et al. was that change in spring arrival date shows a significant degree of intraspecific consistency, and can thus be regarded as a species-specific trait. In other words, different populations of the same species respond consistently, which motivates comparative analyses of interspecific differences.

The general findings reported above are complicated by the fact that there is considerable spatial variation in the observed changes in arrival time, which is true also for changes in the timing of breeding. Geographic variation is however expected, considering the spatio-temporal variation in climate change, which generates spatial variation in selection pressures and different possibilities for plastic responses depending on the time and route of migration.

If we increase the resolution and go beyond the arrival patterns based on the mean response of a population, one could think of different segments of a population responding differently to climate change. For instance, males and females often migrate during different times of the season and may also use different habitats during winter. Furthermore, there are different selection pressures for arrival time in males and females. Increased spring temperatures could increase pre-breeding survival rate, thereby making it possible for early arriving males competing for territories to arrive even earlier. However, Rainio et al. found a parallel rather than divergent shift in the timing of male and female migration in 4 songbird species detected at 5 European bird observatories. Clearly, we need more studies before we can say anything definitive about differences in how males and females respond to climate change.

Until quite recently there seemed to be a common view that species spending the winter in Europe (often referred to as short-distance migrants) are more likely than long-distance migrants to vary migration timing in response to climate change simply because they are exposed to the warming in Europe all year round. The long-distance migrants, on the other hand, are only affected by warming while migrating through Europe, and any advancement to central or northern Europe can be explained by improved environmental conditions en route. Therefore, the adaptation of breeding time to an advancement of optimal conditions may be constrained by the migration strategy in long-distance migrants. We think that it is time to revise some details of that picture. Though the importance of endogenous control and photoperiod as

a trigger of migratory restlessness is beyond doubt, a growing number of studies point at the importance of interannual variation in winter climate as a predictor of arrival time in the summer quarters. Hence, the timing of migration may be pretty flexible even in long-distance migratory birds, and the detailed studies of the American redstart suggest that not only the speed of migration, but also the departure date can be affected by winter climate through its effect on habitat quality and thus the time needed to prepare for migration.

There are also observations that are not easily explained by a simple phenotypic response. For instance, the earlier arrival of African migrants on Capri cannot be fully explained by the climatic variables investigated so far. It has been suggested that the lack of explanation for the advanced arrival on Capri may be an indication of micro-evolution, but there are potential pitfalls to making premature claims about micro-evolution. Another interesting observation that is not easily attributed to phenotypic plasticity only is the increased response to temperature in SW Europe in the sand martin, *Riparia riparia*, which has resulted in earlier arrival in the UK at the same temperature as before. Again, the data at hand do not allow any formal test of the involvement of any micro-evolutionary processes, but they cannot be excluded either.

One may ask why we still lack conclusive evidence for evolutionary change despite selection for earlier arrival and the presence of genetic variation in the timing of migration, and plausible answers to this critical question are given by Pulido (2007). To some extent it is a data problem. Based on arrival data from bird observatories, we are not in position to differentiate between the relative roles of

phenotypic plasticity and evolutionary responses, data do not unambiguously support or refute either of the 2 (not mutually exclusive) hypotheses. Interannual arrival data on individual birds, measured with high precision, would be useful for this purpose. Unfortunately, those kind of data are very scarce. However, there are other reasons why it is inherently difficult to find conclusive evidence for micro-evolution. For instance, to what extent changes in wind directions and speed can explain the earlier arrival of migratory birds is largely unexplored. Furthermore, since the physical condition of birds can affect departure time, we clearly need experimental studies on the wintering grounds to better understand the importance of carry-over effects that may persist over several generations. Hence, we need to appreciate the whole life cycle of events and not only to study spring migration as an isolated phenomenon. In that respect, the timing of autumn migration and how it relates to the timing of spring migration, and the selection pressures involved is, of course, of interest and has not received the attention it deserves.

In conclusion, we are now moving beyond the mere description of patterns and starting to think about the underlying mechanisms. Therefore, it is not surprising that we find ourselves in a situation where the importance of different processes (e.g. phenotypic plasticity and micro-evolution) are being discussed, but no consensus has yet emerged. Theoretical modelling may help us to get a better idea about the selection pressures involved in adapting to climate change and to know what to expect. However, as several of the contributed papers have pointed out, what we also need are more individual-based data and clever experiments to reveal the relative importance of the range of processes affecting how

climate change shapes the timing of biological events, and consequently, the distribution and abundance of organisms.

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A New Conservation and Development Frontier: Community Protected Areas in Oaxaca, Mexico

David B. Bray, Elvira Duran, Salvador Anta, Gary J. Martin and Fernando Mondragón

Most protected areas in the world are inhabited by people. Recent figures suggest that around 11.5% of the global terrestrial area is under some form of protection but about 90% of these protected areas are in IUCN categories III-VI that allow degrees of human presence and use. In addition, some 11% of forests globally have been devolved to local communities to varying degrees by governments. Thus, the vast majority of protected areas in the world have human presence in them, although frequently with unclear rights to forests and their products when they are present.

Mexico is at the forefront of countries where local communities have direct ownership rights of their forests, with an estimated 56-80% of national forests directly owned by communities, within which extraction activities are regulated by Mexican environmental law. This process of devolution occurred as a result of a sweeping agrarian reform that took place through most of the 20th century. One outcome of this devolution has been that Mexican forest communities have gained decades of experience in managing their forests for the commer-



Photo: David Barton Bray

cial production of timber. A recent study suggested that an estimated 2300 communities have commercial logging permits with varying degrees of vertical integration and sustainable forest management.

However, not all Mexican forest communities have commercially valuable forests and others have forest areas that are mostly inaccessible. Further, the dominance of community ownership of rural lands means that there are few opportunities for expansion of Mexico's public protected areas that do not conflict with pre-existing community ownership. These realities have led some communities to become pioneers in taking advantage

of a new policy opening from the Mexican government, the possibility of officially recognized protected areas on community owned lands. According to government figures, 34 community protected areas have been recognized by the National Commission of Natural Protected Areas (CONANP) since 2003. Of these 34, 13 are in indigenous communities, and 12 of these 13 are in the state of Oaxaca, with several clustered in the Sierra Norte region. Further, a recent study by one of the co-authors and his colleagues found that Oaxacan communities are, in addition, informally protecting 236 'voluntary conservation areas' (an area of about 240,000 ha). The authors, in

varying combinations, have been supporting community efforts and conducting research in a subregion of the Sierra Norte known as the Chinantla for many years. The Chinantla region is home to the Chinantec indigenous peoples. The Chinantecs have resided here for at least a thousand years and have historically been isolated and marginalized. Our present work is with six Chinantec communities that have a total population of 2,039 inhabitants. The communities together occupy an area of 33,921 ha, with some of the largest intact tracts of montane tropical forest and cloud forest anywhere in Mesoamerica. These forests were first described by Mexico's most distinguished botanist, the Polish-born Jerzy Rzedoski, and are well known for their unique floristic associations and endemic species.

The community of Santa Cruz Tepetotutla, the only one of the six communities which is accessible by road, has emerged as the leader of a six-community organization, the Natural Resource Committee of the Upper Chinantla (CORENCHI). The micro-political history of Santa Cruz is of particular note. This community has spent most of its many centuries in existence far from the nearest road, achieving direct communication with the outside world only in 2003. Since the 1980s, there have been intense micro-political struggles amongst different factions in the community over land-use policy connected to varying economic interests. More recently, this has led to the emergence of new conservation-oriented institutions and rules.

In the 1990s a coalition of community reformers rose to dominance in the community. This group had been inspired by its association

with ecologists who had conducted vegetation surveys in the region, and by other factors, and began to push for very conservation-oriented community land-use policies. As a result of this process, new regional management institutions are beginning to emerge, and a remarkable portfolio of sustainable land use practices and projects has been assembled. In recent years, some community members have made the transition to growing organic coffee and have banned hunting except for pest animals that attack their corn fields. Four of the communities have been certified by the government as placing over 20,000 ha of their lands in community protected areas, with additional areas in the other two communities in the process of certification. They also successfully competed for a Mexican government program for payment for hydrological services for the period 2004-2008 that covers 7,860 hectares. The National Forestry Commission (CONAFOR) also recently approved a 5-year renewal of the hydrological services program for nearly 1.5 million dollars for the six communities of CORENCHI. In addition, CORENCHI is also in discussions over hydrological service payments with Mexico's largest brewery, which depends on water generated by this watershed; the brewery is also currently co-financing the construction of a research and ecotourism center in Santa Cruz.

CORENCHI has received significant support over the years from several non-governmental organizations, the Oaxaca-based NGO, Geoconservación, currently being the most important. Among other alliances, Geoconservación has recently joined with the Interdisciplinary Research Center for Integral Regional Development (CIIDIR-Oaxaca), Florida Inter-

national University (FIU), and the Global Diversity Foundation, to conduct research, build capacity, and carry out training projects in support of CORENCHI's efforts to sustainably and profitably manage the lands they have protected.

With funds from the U.S. Fish and Wildlife Service granted to Geoconservación, the CIIDIR-FIU program is currently working with students documenting the history of how Santa Cruz came to adopt remarkably conservation-oriented land use policies, analyzing community attitudes towards wildlife, carrying out camera-trapping surveys of wildlife, particularly jaguars and their prey, and studying potential habitat for jaguars. It is also beginning studies of interactions between emigration, land use, land-use and land-cover change, vegetation mosaics and landscape ecology.

The Global Diversity Foundation (GDF), a UK-based charitable organization, has received funding through the British Embassy in Mexico to build local capacity to manage the CORENCHI community conserved areas. Under the program, which is part of the UK government's Sustainable Development Dialogues, British and Mexican specialists will offer training for community members on the sustainability of non-timber forest product extraction, scientific tourism, participatory video, and legal frameworks for community conservation. The effort will foster collaboration between local people and outside researchers at the community biological station and refuges that are being established. One result of the project will be participatory biodiversity registers that will assist communities to defend their traditional resource rights and to identify plant resources of potential

economic value. Selected community members will be able to broaden their experience by participating in cross-visits with other communities in Oaxaca that are also working on community-based conservation and scientific tourism.

We will be exploring the issue of establishing a carbon sequestration project in voluntary markets in this region. Under the Kyoto Protocol, the forests of the Chinantla, although of great value for a variety of ecosystem services, do not qualify for carbon credits because they are both intact and unthreatened due to community protection. Under current Kyoto rules, carbon credits can only be given for "additionality", i.e., new forest plantings, or, possibly in the future, for "avoided deforestation" projects that reduce the risk of deforestation.

The forests of CORENCHI, the larger Chinantla region, and others like them throughout Mexico and elsewhere present a challenge for the world community.

Here we have intact forests with high biodiversity value, which are owned and actively protected by poor indigenous peoples. Yet these people are being told that the forests have no value in terms of carbon maintained in standing stock, because of the requirement of additionality and avoided deforestation. This is a situation of carbon storage and biodiversity protection being provided free of charge by poor rural people, and raises issues of environmental justice in the context of carbon markets. This case underscores the need for more creative thinking about mechanisms to collectively address global warming, forest and biodiversity conservation, poverty alleviation, and environmental justice. One possible response is that of receiving payment for 'environmental services' for the protection of the region's unique biodiversity or payments for 'pure preservation' now being developed by the Chicago Climate Exchange. The communities of the Chinantla of Oaxaca, through their own efforts and the efforts of outside supporters, have placed themselves in a

leadership role in forging solutions to these and other dilemmas of the emerging planetary crisis.

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Parks and Poverty: The Political Ecology of Conservation

William M. Adams and Jon Hutton

In 2004, the government of Ethiopia moved 500 people out of the Nech Sar National Park in the south of the country, before handing it over to be managed by the Dutch NGO,

African Parks. The following year, African Parks signed another contract to manage the Omo National Park. The issue of evictions in these parks quickly became the subject of intense lobbying by international

human rights NGOs. Such problems have been reported from many countries as the area protected has risen, doubling in the 1970s, 1980s and 1990s. By 2005, over 100,000 protected areas (PAs) covered more

than 2 million sq. km., or 12 per cent of the Earth's land surface. Systems of protected areas existed in every country, wealthy and poor alike. The place of people in protected areas has been much discussed by academic researchers and human rights activists. For whom are parks set aside? On whose authority? At whose cost?

Debate about people and parks is typical of much wider questions about the social impacts of conservation on human welfare, including the compatibility of conservation and poverty alleviation and the feasibility of 'win-win' policy strategies. Action to conserve biodiversity, particularly in the creation of protected areas, is inherently political. Yet most writing about conservation draws, to only a limited extent, on an explicit understanding of the political and economic dimensions of conservation policy. There are various reasons for this. One is the profound and long-standing disciplinary gulf that exists between predominantly natural science-trained conservation planners and predominantly social science-trained critics of conservation. The field of political ecology offers productive possibilities for developing that engagement. Political ecology is a diverse and trans-disciplinary field. It first emerged in the 1970s, and developed through the 1980s, particularly in work by Piers Blaikie on the problem of soil erosion.

Political ecology views the environment as fundamentally social and political. The use, overuse, degradation, conservation and restoration of the environment are inherently social and political processes. Political ecology considers the interactions between ecology and the politics and impacts of social action affecting the

environment. It takes from ecology a concern with environmental dynamics and change, and from political economy a concern with the control of resources and labour. Moreover, in recent formulations (notably the work on 'liberation ecology' by Richard Peet and Michael Watts) it takes from social theory an interest in the way nature is understood and represented. It recognises the power of science and policy discourse to channel the way people combine to control the environment, and each other. Therefore not only does the actual state of nature need to be understood as the outcome of political processes, but the ways in which ideas about nature are formed, shared and applied are also inherently political, even those ideas that result from formal scientific experimentation.

The political ecology of conservation is now recognised as important in a variety of ways. A key issue is the social impacts of protected areas, particularly on people displaced (either through physical removal or denial of access), and the impacts of the ways such displacements are organised, particularly the issue of involuntary displacement and coercion. A related set of problems concerns the social impacts of conservation regulations (e.g., controls on hunting, fishing or forest use). Third, there are important political questions about the way the economic benefits of conservation activities (e.g., the revenues from tourism) are shared between people. This leads on to a fourth set of issues concerning the links between poverty and conservation, the debates about possibility of 'win-win' strategies that both conserve nature and reduce poverty. Behind all of these lies the issue of the power of ideas about nature to dictate the way conservation is thought about and practiced (for

example, in the concept of wilderness as a way of describing areas of forest or savanna with low human population densities).

Conservation has become a powerful political force, at least in the rural districts of poor developing countries. Large international NGOs have undertaken sophisticated exercises in conservation planning (such as Conservation International's 'hotspots'). Through such science and the funds they raise from supporters in developed countries, conservation organisations can wield considerable influence with governments and donor organizations. They can both initiate and drive forward conservation programmes on the ground with profound social and economic significance for rural people.

An understanding of the politics of conservation is vital if policy is to be effective and any potential harm is to be minimised. To achieve this, better dialogue is needed between conservationists (who are mostly trained in natural science) and critics of conservation, many of whom are social scientists. The emphasis of political ecology on the links between political economy and the actual state of the environment offers some potential to improve their conversation.

There is no doubt that politics matters for conservation. In December 2007, African Parks (now called the African Parks Network) withdrew from Nech Sar and Omo National Parks in Ethiopia, citing the unresolved issue of resettlement. The rights and needs of the many people resident in these parks could not be wished away. Such issues are fundamental to conservation planning. The political ecology of conservation offers a way of considering the conceptual

and material place for human society within, and not outside, nature.

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Satellite-tracked Migrations by Galápagos Green Turtles and the Need for Multinational Conservation Efforts

Jeffrey A. Seminoff and Patricia Zárata

Over the last two decades there has been a dramatic increase in the application of satellite telemetry to track the movements of threatened and endangered species. Among the taxa that have benefited the most from these efforts are sea turtles. Every few years, adults of most sea turtle species undertake long-distance migrations between nesting sites and foraging areas; satellite telemetry is an ideal tool for determining where these areas are, and the migratory routes followed by adult turtles as they move between them. More importantly, for conservation purposes, this tool provides a better understanding of the amount of time turtles spend in international waters and economic exclusive zones (EEZs) of various nations, and thus can highlight the

potential susceptibility of sea turtles to human impacts (i.e., fisheries bycatch and hunting) that occur in these areas. This understanding is critical for improving conservation measures and maintaining healthy sea turtle populations.

In a recent study by Seminoff et al. (2008), the movements of 12 green turtles (*Chelonia mydas*) were tracked by satellite telemetry after nesting in the Galápagos Islands. Turtles were tracked for up to 100 days (mean = 64 days) and moved between 75 and 1540 km away from their nesting sites. Three distinct post-nesting migratory strategies were observed, including residency within the Galápagos, migrations to Central America, and movements into oceanic waters southwest of the Galápagos (Fig. 1).

Green turtles occupied international waters as well as EEZ of Colombia, Panama, Costa Rica, Ecuador and Nicaragua. In two cases, green turtles apparently reached coastal foraging area destinations (in Nicaragua and Panama).

As the first-ever satellite telemetry research on Galápagos green turtles, novel insights gained about this insular nesting stock will be useful for the justification and implementation of conservation measures throughout the region. For example, with 10 of the 12 tracked turtles departing the Galápagos after nesting, the results of this study indicate that threats to the Galápagos nesting population, such as bycatch in high-seas fisheries gear, may be much more substantial in overall impact to the population

than previously considered. These wide-ranging movements (see Fig. 1) underscore the need for conservation efforts to be multinational in scope and multidisciplinary in action.

While no single law or treaty can be 100% effective at minimizing anthropogenic impacts to sea turtles in these areas, there are several international conservation agreements and laws in the region that, when taken together, provide a framework under which sea turtle conservation advances can be made. In addition to protection from the Galápagos Marine Reserve (GMR), green turtles may benefit from the following:

1) the ETP (Eastern Tropical Pacific) Marine Corridor (CMAR) Initiative agreed to by the governments of Costa Rica, Panama, Colombia, and Ecuador, which is a voluntary effort to work towards sustainable use and conservation of marine resources in these countries' waters;

2) the Eastern Tropical Pacific Seascape Program managed by Conservation International that supports cooperative marine management in the ETP, including implementation of the CMAR;

3) the Inter-American Tropical Tuna Commission (IATTC) and its bycatch reduction efforts that are among the world's finest for regional fisheries management organizations;

4) the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC), which is designed to lessen impacts on sea turtles from fisheries and other human impacts; and

5) the Permanent Commission of the South Pacific (Lima Convention), which has developed an Action Plan for Sea Turtles in the Southeast Pacific.

The conservation of green turtles in the ETP will require successful implementation and greater integration among the region's international instruments and accords. New legislation and enforcement of existing laws that curb the flow of turtle products in the region's coastal communities is also necessary, although it is increasingly clear that any such instruments will only be effective if the underlying human social drivers, such as local demand for sea turtle products or increasing fleet sizes despite lower target species catch rates, are also addressed. By implementing both new and existing conservation measures in an integrated manner, management efforts may be more effective at providing habitat protection that extends from nesting beaches and inter-nesting habitats within the GMR to far off coastal and offshore foraging areas, thereby conserving all life-history phases of green turtles in the ETP.

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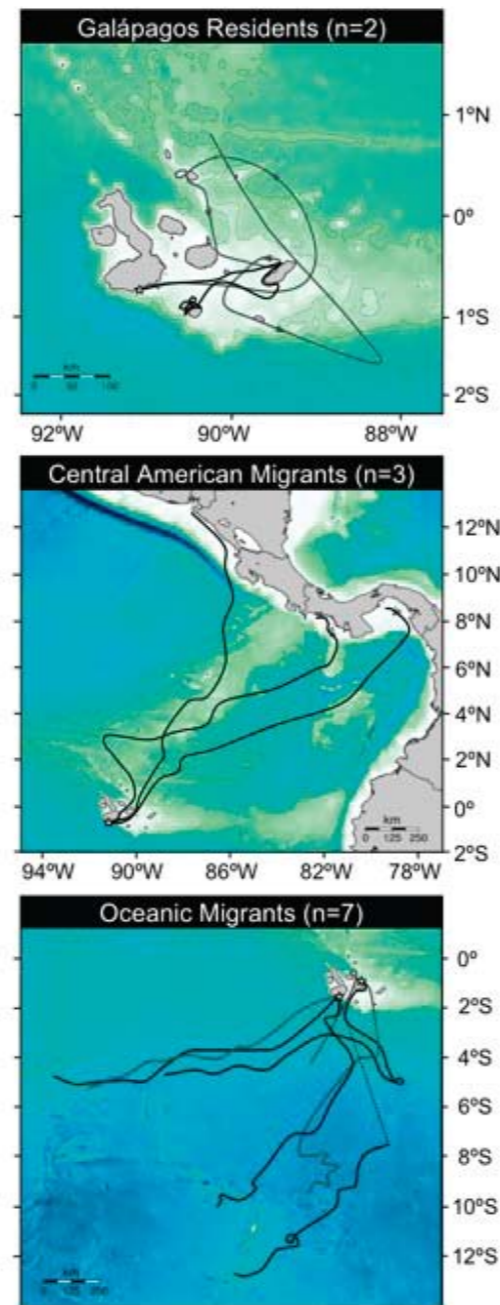


Fig. 1. Satellite-tracked movements of green turtles after nesting in the Galápagos during the 2003 (grey) and 2005 (black) nesting seasons. Satellite data processed in STAT (courtesy Michael Coyne) and maps constructed with MapTool.

The Burden of History and the Mirage of Permanent Boundaries

Ashwini Chhatre

In the summer of 1999, approximately 750 sq. km. of territory in the Western Himalayas, in the district of Kullu in the northern Indian state of Himachal Pradesh, was declared closed to local populations and notified as the Great Himalayan National Park. Following the procedure laid down in the Indian Wild Life (Protection) Act, the rights of any claimants to the resources inside the Park were extinguished; out of the more than 15,000 users, a small compensation was ordered for those whose names appeared in the records that were consulted to determine legitimate users. Curiously, this legitimacy was derived from records dating to 1897, from the first forest settlement in the region that determined and codified the nature and extent of rights in all of these forests. Following the notification and the extinguishing of rights, local populations immediately organised themselves to lobby their political representatives for redressal. Through a combination of claims to a moral economy and electoral arithmetic, local residents were successful in securing access to the legally denied resources inside the Park, circumventing the restrictions and threats posed by the Forest Department and the law. This result resonates with a similar

effort in the 1880s, when the Forest Department attempted to reserve large tracts of forest in the same region and was frustrated in similar fashion.

In 1876, a team of three high-level forest officials led by the Inspector-General of forests, Dietrich Brandis, surveyed the area and provided detailed suggestions for the demarcation of the best forests in Kullu. They estimated that of the total area of approximately 1,200 square miles (~3108 sq. km.), only about 400 could be said to be under forest. In their report, they suggested that about 150 square miles (~388 sq. km.) be demarcated and subsequently managed for timber production. They also emphasised the need to separate the lands that could be made available for the expansion of cultivation from those to be maintained permanently as forests. Over the next two decades, actors at the local, provincial and national levels interpreted the report differently in light of the brand new Indian Forest Act of 1878. The legal categories were deliberated, interpretations were disputed and fault lines emerged within the state apparatus. A strict application of the legal categories prescribed in the 1878 law was thwarted by the provincial Revenue Department

through a characterization of Kullu as anomalous. Besides the Forest Department-Revenue Department rivalry, there emerged a strong local bureaucratic response to central direction, in interaction with the resistance of the local populations to the proposed restrictions on forest use. As the debate moved from an inter-departmental conflict, through the center-local tensions, to the formulation of a compromise during 1882-86, overt peasant resistance in the late 1880s again foiled attempts to implement and enforce the new boundaries around permanent forests.

The case throws light on historical contingencies in the evolution of property rights in forests, and their influence on the success of current conservation policies. The three dimensions of conflict – between departments, between center and states, and between conservationists and local populations – continue to define the contours of debate around conservation in India today, as evident in the case of the Great Himalayan National Park and numerous other protected areas.

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The Fire-Lantana Cycle Hypothesis in Indian Forests

Ankila Hiremath and Bharath Sundaram

Anthropogenic fires in Indian forests probably date back to the arrival of the first people on the Indian subcontinent. Fires were used to clear areas for habitation, and quite likely, to facilitate hunting. People continue to use fires today for several reasons. For instance, early-summer fires are lit to promote the growth of fresh forage for livestock. Fire is also used to facilitate the collection of several important non-timber forest products such as leaves of *Diospyros melanoxylon* or tendu, that are collected to make bidis, and flowers of *Madhuca indica* or mahua. With shrinking forest areas but a large forest-dependent population, there is evidence that the frequency of fires in our forests today is greater than it has been in the past. Thus, contemporary fire regimes are probably qualitatively different from historical fire regimes in the effect that they have on forests.

Fires can affect forests at multiple spatial scales. Fires can alter species composition. For example, the increased abundance of thick-barked, fire resistant species, or of species that can tolerate fires by resprouting, can be a legacy of frequent burning. Fire can also alter vegetation structure by killing standing trees, opening up the canopy, and converting once closed forests to open woodlands. Finally, very frequent fires can result in soil degradation.

Such frequently disturbed, degraded landscapes may be vulnerable to invasion by exotic species. Elevated levels of disturbance can result in an increased availability of space and resources that could be preempted by invasive species. We hypothesise that there may be a positive feedback between contemporary fires in Indian forests and invasion by *Lantana camara*, leading to a fire-lantana cycle analogous to the invasive grass-fire cycle seen in other parts of the world. We propose that lantana invasion may be facilitated by fire, and that lantana, once established, fuels further fires, setting up a self-feeding fire-lantana cycle (see flowchart).

Lantana was introduced to India during the mid-to-late 19th century as an ornamental plant and has since become widespread, ranging from dry-to-moist deciduous forests of southern India, all the way to the Himalayan foothills. It grows profusely, forming dense thickets, suppressing the regeneration of native vegetation, affecting animal habitat, and potentially affecting the supply of other ecosystem goods and services on which society depends. Lantana has several characteristics that might give it an advantage under conditions of frequent fire. It resprouts on being burnt, it flowers and fruits year round, and its seeds are widely dispersed by birds and animals enabling it to readily germinate following a disturbance. Studies from

Australia confirm that lantana is favoured by disturbances such as fire and grazing. There is also anecdotal evidence to suggest this. According to local Soliga elders in the Biligiri Rangan Hills in South India, for example, the initial spread of lantana coincided with the last mass-flowering and die-back of bamboo, which was followed by widespread fires.

Surprisingly, there are few empirical studies in India that look at lantana and its invasive ability, especially in response to fire, despite its pervasive distribution. There is an urgent need to empirically understand the effects of fires at multiple spatial scales and to understand the ecological mechanisms of lantana's success. It is only with such information that we can hope to attempt restoration and management and to find a way out of the fire-lantana cycle.

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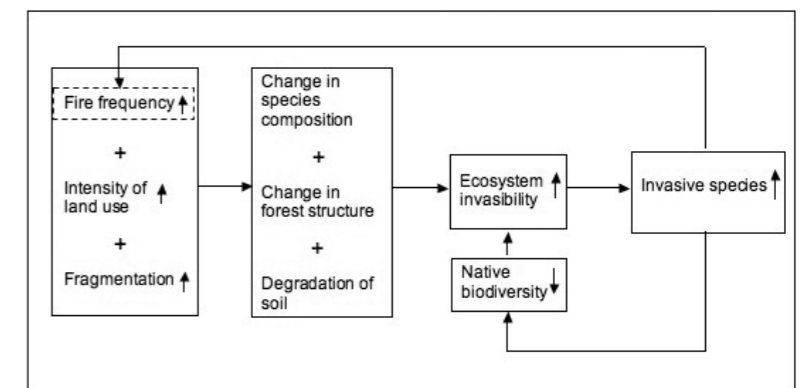
Hiremath, A.J. and B. Sundaram. 2005. The Fire-Lantana Cycle Hypothesis in Indian Forests. *Conservation and Society* 3(1): 26-42.

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Photos: Bharath Sundaram



The hypothesised fire-lantana cycle

Effect of Rural Biomass Extraction on Bird Communities in Sariska Tiger Reserve

Raman Kumar and Ghazala Shahabuddin

Forests are extensively used by rural people for subsistence in the tropics. Biomass extraction (like grazing, fuelwood collection and collection of non-timber forest produce) is arguably the most widespread form of anthropogenic pressure in developing countries like India. Persistent extraction may alter forest structure and composition, which in turn may affect the resident forest fauna. Our knowledge about the ecological impacts of forest resource extraction is quite deficient, especially in the case of tropical dry forests, which form nearly half of the world's tropical forests. We undertook a study to investigate the effects of extractive activities on forest biodiversity. We focussed on birds as they may be sensitive to habitat alteration by human activities.

The study was carried out in Sariska Tiger Reserve that covers 866 sq. km. of dry deciduous forests in northwest India. The reserve, although earmarked for tiger conservation, has many human settlements located within its core and also around its periphery. The resident people are primarily livestock herders who earn their livelihood by selling milk. They use the forests extensively to graze their buffaloes and goats, and commonly lop trees for fodder and fuelwood.

We selected thirty locations spanning the reserve's core,

facing varying levels of disturbance, measured on the basis of degree of lopping, number of trails, and presence of livestock dung. Based on these disturbance indices, the locations were classified into 17 disturbed and 13 undisturbed sites. At these locations, we recorded the structure of the vegetation components (trees, shrubs and ground flora) and conducted periodic surveys for birds from March to May 2005, coinciding with most birds' breeding season.

We found that bird species diversity declined in disturbed areas, even though the net number of birds was similar. The effects of extraction on vegetation structure, mainly canopy cover, tree density, and tree height, changed bird community composition. More than half of the 48 bird species recorded were affected directly or indirectly by human-caused changes in habitat. Eight species were found to be very sensitive to disturbance, and emerged as reliable indicators of undisturbed areas. Insectivorous birds like Tickell's blue flycatcher and White-browed fantail appeared to be most affected by changes in the forest resulting from extraction. Such birds may disappear locally under sustained habitat degradation.

Certain inherently rare birds like Brown fish owl and Crested serpent eagle, which were restricted to tracts along perennial

springs, are also at risk. Conversely, four birds that were evidently encouraged by disturbance (e.g. Laughing dove and Indian robin) were hardy species that adapt well to human activities.

Our study demonstrates that even low levels of chronic biomass extraction may lead to changes in forest condition resulting in the local extinction of certain bird species. This underscores the need for inviolate areas for conserving a wide spectrum of species. At the same time, sustainable alternatives to forest-based livelihoods need to be explored urgently. To formulate such strategies it would be necessary to find out how much extraction can be sustained in forests without compromising the aims of conservation.

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How Natural Resources Agency Personnel View Black-tailed Prairie Dogs

Lauren McCain, Richard P. Reading and David Stern

Black-tailed prairie dog management is one of the most conflict-laden wildlife issues in the United States today. To resolve this problem, one must find common ground among stakeholders. As a step towards doing this, we surveyed one key stakeholder group: government agents responsible for managing prairie dogs. Our mail survey assessed their values, attitudes, and knowledge about prairie dogs.

Black-tailed prairie dog colonies once spread across the western Great Plains. The area originally occupied by prairie dogs declined to a mere 1-2% of its historical size within 100 years. Livestock ranchers tend to believe that rodents are pests. Current threats to these animals include poisoning, shooting, sylvatic plague, and habitat loss. Despite the long-held belief that prairie dogs out-compete cattle for forage, recent studies have shown that well-managed livestock operations and prairie dogs can be compatible. Though ranchers want to eliminate or at least control them, conservationists want to recover and protect prairie dogs. Prairie dogs are 'keystone' species, whose activities, such as burrowing and vegetation clipping, create rich habitat patches that attract a diversity of wildlife. Some animals

eat prairie dogs and others use their burrows for shelter, for example.

Attitudes vary from extreme dislike of to intense support for prairie dogs. The values, attitudes, and knowledge of various stakeholders likely exert a strong influence over policy related to prairie dogs — especially the attitudes of agency personnel directly responsible for their management. Public land managers, wildlife officials, and agriculture field agents can have broad discretion in policy development and implementation. A better understanding of agency personnel perspectives can provide insights into agency behaviour.

We designed our survey to measure similarities and differences among and between national, state, tribal, and local government officials, and also between those who manage wildlife and those who manage public lands, such as employees of the Departments of Interior or Agriculture. We asked respondents their gender, age, education level, years worked in current job, residence type (rural or urban), and if they had ever lived on a ranch or farm. Some questions tested respondents' prairie dog knowledge.

Survey respondents who scored higher on the knowledge



Photo: Richard P. Reading

scale held more positive attitudes toward prairie dogs. Generally, people from rural areas displayed more negative attitudes than did people from towns and cities. Respondents whose families farmed or ranched provided more negative responses than those whose families did not. People working in agricultural professions held more negative attitudes towards prairie dogs than did land managers and people working in wildlife fields. People working locally displayed more negative attitudes than individuals working at the state or national level.

Respondents from all groups strongly valued wildlife. They agreed that prairie dog management should focus on financial incentives to citizens for protecting prairie dogs, implementing

conservation on public lands, and controlling populations that exceed certain sizes. Knowledge about these shared values could serve as a foundation for improved relationships. Collaboration between agencies could start with projects that advance conservation on public land and promote incentive programmes while also improving attitudes about prairie dogs. Successful initial collaborative efforts might then help agencies productively tackle more controversial management issues, such as promoting conservation on private land and supporting strict protection with the Endangered Species Act listing. We hope this study helps agencies with currently competing prairie dog-management goals and forges more cooperative relationships.

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Fire and Sub-tropical Deciduous Forests of India

Sonali Saha

Fire plays an important role in tropical deciduous forests across the globe. Most fires are deliberately or accidentally set by people. Records of natural lightning-caused fires in tropical deciduous forests exist, but are rare. My colleagues and I have conducted a series of experimental and observational studies on fire and its effects on vegetation in sub-tropical deciduous forests of central and south India. We have monitored the patterns of tree diversity and size-class distribution in forests that represent varying disturbance histories: secondary forests, plantations, and long-undisturbed deciduous forests.

We examined the effects of fire on diversity and stature of seedlings and juvenile trees. Effects on seedling diversity were simple: seedlings either survived fires, or were killed, with more seedlings surviving in plots protected from fire after 2 years of fire exclusion. The effects of fire on diversity of juvenile trees were less straightforward. The effects were mediated by a greater proliferation of resprouted shoots, or ramets, in repeatedly burnt forest areas. In plots that were burnt, species composition was biased in favour of those species that could resprout, and these at times produced hundreds of shoots within a small area. Plots protected from fire, on the other hand, had a lower density of ramets. Our study

also showed that the relative height growth of juvenile trees and seedlings was adversely affected by fires. Plant growth was stunted, and we hypothesized that this would have a strong effect on the future development of the forest canopy and the understory light environment in these deciduous forest ecosystems. We also found that as little as two years of fire-exclusion was sufficient to have a positive impact on the diversity of seedlings and juvenile trees.

Fire eliminated an entire functional group of plants, those that allocated relatively less biomass to roots than to shoots. Examples of these plants included several species of *Gardenia*, and *Stereospermum suaveolens*. Biomass allocation in these plants contrasts with allocation by fire-tolerant species such as *Madhuca indica*, *Diospyros melanoxylon*, and *Terminalia bellerica*. We also found that many seedlings died back even when they were not exposed to fire. They died back to the ground in response to drought and sprouted from buried vegetative buds following the onset of the rains. Such seedling die-back followed by successful sprouting suggests that many tree species could be pre-adapted to fire at the seedling stage, sprouting after being burnt to the ground. However, juvenile trees do not show a similar ability to die back in response to

drought and sprout, and thus may not be pre-adapted to withstand fires, which top-killed juvenile trees even as tall as 1 metre.

Fire can have important effects on forest structure and diversity in deciduous forests. It is equally important to understand the role of fire in altering ecosystem functioning. For example, research focusing on soil moisture and nutrient dynamics in relation to fire might enhance our understanding of conservation needs in Indian deciduous forests. Deciduous forest plants exhibit an exceptional diversity of structure-function relationship. Plants demonstrate a variety of drought tolerance and drought avoidance strategies, and utilize a range of mechanisms to minimize water loss. Thus the conservation of deciduous forests will not only protect the integrity of species composition but also ensure the maintenance of mechanistic diversity, which is the origin of the diversity of plant functional groups.

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Photos: Ghazala Shahabuddin

Emerging Trends in Biodiversity Conservation

Bram Büscher



Photo: Bram Büscher

Despite much recent attention, biodiversity conservation and protected area management remain, in large part, subservient issues in the world today: they need to continuously adapt themselves to 'larger' issues of the global political economy to remain politically acceptable.

Based on this assumption, we argue that it is possible to identify three major trends in conservation and protected area management that are likely to influence policy and practice for a long time to come. We have termed these 'neoliberal conservation,' 'bioregional conservation,' and 'hijacked conservation.'

Neoliberal conservation is based on the major political-economic trend of the fall of communism and the subsequent ideological hegemony of neoliberalism. Since the beginning of the 1990s, more and more facets of human life have been brought under the influence of market thinking, and conservation is no exception. Several consequences can be noted. The

first obvious one is the marketisation of nature: the management of biodiversity according to the economic principles of demand and supply. A second and related – yet farther reaching – consequence is the commodification of nature. This entails changing the inherent value of nature into monetary value. Nature thus becomes an 'environmental service' whereby its existence is legitimised by market demand. A last consequence is the increasing private sector involvement in nature conservation. One example is private companies buying up park land and running parks as businesses.

The second trend we have identified is 'bioregional conservation,' which is influenced by globalisation and the information and communication technology (ICT) revolution. Bioregional conservation is, first, characterised by the decreasing importance of boundaries for conservation. Bioregional, ecosystem, landscape, and trans-frontier approaches to conservation have all seen a steep rise in popularity over the past decade. A second development under this

trend is the increasing impact that outside agents are having on local environments. Due to the possibilities offered by the ICT revolution, it has become easier for resource-rich agents to intervene in far-away natural settings; and an increasing number, especially rich western philanthropists, even feel entitled to do so. Yet, while they do so with the aim of conservation, they often have great impact on local power dynamics. A last tendency under the trend of bioregional conservation is the issue of localisation, without which globalisation cannot be understood. Nature can be interpreted in multiple ways and the global-local dialectic will have a clear impact on this struggle for the foreseeable future.

The third and last trend we have identified is 'hijacked conservation,' a consequence of the recent international emphasis on security. Paradoxically, this has led to a re-emphasis on borders, making the implementation of trans-frontier and bioregional conservation approaches more difficult. A significant development that is more worrying, however, is that nature is

further marginalised by being made a strategic pawn in the 'war on terror', and in international security discussions. Thus, besides the commodification of nature, its value has further been co-opted for security reasons rather than for the conservation of biodiversity.

Although the influence of these large-scale global political and economic trends on biodiversity conservation and protected area management is not a new phenomenon, participants in the conservation debate tend to lose sight of this bigger picture. By calling attention to these trends, we aim to enhance the understanding and appreciation of macro-social, economic, and political dynamics – both constraints and opportunities – that impinge on conservation and development. Such an understanding could, in turn, enhance the success of initiatives that aim to improve conservation of biodiversity and protected areas management.

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Madagascar: Where Community-based Water Resource Management Has Gone Too Far

Richard Marcus

Since coming to power in 2002 President Marc Ravalomanana has both reformed and accelerated the path to decentralisation in Madagascar, granting new roles and responsibilities to regional and community leadership. We thus see the role of the national government diminishing in favor of resource management at the community level. This sort of decentralisation is intended to empower the local population to improve accountability, civic engagement, and equity. It addresses the greater capacity of local authorities for responsiveness to local population needs, while improving efficiency, equity and local "ownership" of the governing process.

I have explored the impact of increased responsibility for water management and decision-making in the communes within Madagascar's southern district of Ambovombe-Androy. Ambovombe-Androy is a semi-arid district that comprises 17 communes with marked levels of poverty. Limited water supply, extreme demand, and predatory operators drive water prices up to unaffordable levels. Decentralisation has served to exacerbate, rather than ameliorate, the problem.

Donors have attempted to alleviate

– or at least mitigate – the Ambovombe water crisis. Despite certain differences in approach, they have all focused on the community level to manage a micro-level water facility. While a conceptually strong effort, in practice the amount of water obtained has been limited and the community-based organisations have often been troubled by their own inefficiencies or corruption. The one significant macro-effort, in which Japan funded two dozen water trucks and a pumping facility in neighboring Amboasary, and in which a government agency was put in charge of managing and maintaining the new equipment and intervening in the Ambovombe water market, was an ill-conceived design. Water delivery by truck is necessarily inefficient. In this case, offering a limited quantity of the resource exacerbated existing class cleavages as water became a commodity for those who could afford to pay for it in large quantities. Supply challenges have led to the rise of private water markets with a seasonal variation of as much as 1500 percent in rates.

A finer optic needs to be employed for determining the relationship between state and local

institutions. The state is using the trend towards decentralised water management as an opportunity to reduce reasonable levels of responsibility, though it is needed to regularise supply and pricing of piped water via infrastructure development. Water is most cost-effective by scale; even standpipes are not cost-effective if they do not ensure regularised supply. Community associations can be valuable but only below the turnout. We also need to better understand and adapt community level organisations. This requires management and human capital, as well as state engagement and investment. Ambovombe's communities need to be viewed as a complex mosaic of relationships that both enhance and detract from the power of the state in a dynamic fashion. We need to know more about the dynamics of each community including leadership type, acceptability of cost recovery schemes, type of labor inputs, and suitability of enforcement mechanisms. In contrast to the universal use of the commune administrative level, careful disaggregation of community advantage may lead to diverse definitions of community for the purpose of creating water users groups. We can then figure out which responsibilities are best suited for each community and what is needed of a state that tends to be at best inefficient, and at worst predatory.



Photo: Richard Marcus

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Reference styles in list:

Articles from journals: Pomeroy, M., R. Primack and S.N. Rai. 2003. Changes in four rainforest plots of the Western Ghats, India. *Conservation and Society* 1:113-136.

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