CHAPTER 15

From conservation theory to practice: crossing the divide

Madhu Rao and Joshua Ginsberg

Conservation biology is continually developing new tools and concepts that contribute to our understanding of populations, species and ecosystems (Chapter 1). The science underpinning the field has undoubtedly made rapid strides generating more effective methods to document biodiversity, monitor species and habitats. Scientists have developed comprehensive priority setting exercises to help determine where and what to conserve in on-going attempts to identify which factors would best serve as the basis for triage for species and ecosystems (Wilson *et al.* 2007; Chapter 11). They are well positioned to track the loss of species and ecosystems in broad patterns even if precise details are not always available (Chapter 10). However applying the science effectively requires the efforts of conservation biologists combined with a diversity of other actors, most of whom are non-biologists and include local and indigenous communities, civil servants at all levels of government, environmental consultants, park managers, environmental lobbyists, private industry, and even the military (Box 15.1; Chapter 14). This amorphous group of practitioners will pursue a diverse set of activities which include putting up or taking down fences (literal and metaphorical), lobbying politicians, buying land, negotiating with members of local and indigenous communities, tackling invasive species problems, guarding against poachers and managing off-take of plants and animals.

There are many pressing challenges facing practical conservation. Forces affecting biodiversity in different ecosystems have altered over the past two decades. For instance, the nature of tropical forest destruction has changed from being dominated by rural farmers to currently being driven substantially by major industries and economic globalization, with timber operations, oil and gas development, large-scale farming and exotic-tree plantations being the most frequent causes of forest loss (see Chapter 4). A direct result of these changes is the need for engaging not just conservation minded individuals and organizations, but those in the largest, and most influential, of the world's corporations and multilateral institutions (Box 15.2). In addition, the changes in those factors driving loss– and in the scale of loss – requires that we diversify our approaches, and focus not just on biodiversity, but on the whole issue of those goods and services that natural systems provide for us (Daily 1997, Woodwell 2002; Box 15.3). Global threats, and opportunities, such as climate change (Chapter 8), are forcing conservation practitioners to work at a variety of scales to better integrate these challenges (Bonan 2008). Conservation science must meet the continually changing nature of threats to biodiversity (Butler and Laurance 2008); conservation biologists and practitioners need to design and leverage solutions in response to these global changes in threat.

Not only is the practice of conservation getting more complicated, but it has a stronger global presence, and increasingly large expenditures (Cobb *et al.* 2007). As a result, implementing agencies and specifically conservation organizations are being held to a higher standard in monitoring and evaluating their conservation success, and failure (Wells *et al.* 1999; Ferraro and Pattanayak 2006; see also Box 15.4). Another issue that

Box 15.1 Swords into ploughshares: reducing military demand for wildlife products
Lisa Hickey, Heidi Kretser, Elizabeth Bennett, and McKenzie Johnson

Illegal trade in wild animals and plants is one of the greatest threats to populations of many species. The impacts are diverse, and the direct impact in reducing wildlife populations is well studied, and often noted (Robinson and Bennett 2000; Bennett 2005). Indirect effects – including the global movement of emerging infectious diseases (Karesh *et al.* 2005) pose a different, but equally compelling case for better management of such trade. The economic imperatives are great as well, with current estimates of the value of illicit trade (estimated at US$6 billion; Warchol 2004) second only to narcotics and arms trafficking. Legal trade is clearly occurring at a much higher level (on the order of US$150 billion per year) if trade in commodities such as timber and ocean fish are included in these studies (Warchol 2004), but this also produces a significant threat since legal trade in many species is unsustainable.

US military personnel have a long-term presence abroad, including in countries of great biodiversity importance. These personnel and affiliates have significant buying power that influences local markets, including the ability to drive the demand for wildlife products. The Afghanistan Biodiversity Project funded by USAID (United States Agency for International Development) and implemented by the Wildlife Conservation Society (WCS) has found that US soldiers serving in Afghanistan are primary buyers of illegal wildlife products there, including big cat skins and other types of trophies. WCS has initiated a program focused on education and awareness-raising to reduce purchasing of wildlife products by the US military, and protect American soldiers from serious penalties related to the import of illegal wildlife. WCS, in conjunction with the Department of State, traveled to Bagram Air Base, the largest military base in Afghanistan, to educate soldiers on issues related to illegal trade in wild species. Military Police (MPs) received instruction on issues of biodiversity in Afghanistan and how to identify threatened and endangered Afghan species. The partnership between Bagram customs officials and WCS aims to reduce illegal buying of wildlife products by soldiers, and MPs have already shown an adept ability to identify and seize prohibited wild species before they leave the base, as well as enthusiasm to collaborate on the program.

To further address the demand for wildlife products by US military personnel, WCS is complementing its work in Afghanistan by working with the military in the US. As part of this effort WCS ran a booth at Safety Day, in Fort Drum, to raise awareness about illegal wildlife trade for both pre and post-deployment troops. A survey conducted at Fort Drum as part of this effort indicated that fewer than 12% of soldiers (n = 371) had heard of CITES, yet more than 40% had either purchased wildlife products while overseas or seen other members of the military purchase these items (Kretser, unpublished data).

To increase its effectiveness in working on wildlife trade issues with the military, WCS is planning to develop a template approach to begin addressing wildlife trade within all branches of the military. Activities include the development of pocket cards and playing cards for soldiers as well as handouts and power point slides for incorporation into military-run environmental training including officer training, pre-departure briefings, and in-theater briefings. The playing cards will communicate information about wildlife, wildlife products, and legal concerns pertaining to wildlife of Iraq and Afghanistan.

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Box 15.2 The World Bank and biodiversity conservation
Tony Whitten

The World Bank is well known as a development agency providing both concessionary credits and commercial-rate loans to governments to reduce poverty, but is less well known as a leader in biodiversity conservation. In fact, the biodiversity portfolio has grown steadily, especially since 1992 when funding from the Global Environment Facility (GEF) became available. In the last ten years the World Bank approved 598 projects that fully or partially supported biodiversity conservation and sustainable use (see Box 15.2 Figure). These are being executed in 122 countries and through 52 multi-country efforts and include activities in almost all terrestrial and coastal habitats, although more than half of all projects are directed towards the conservation of different types of forests. Many of these habitats provide critical ecosystem services and can be an important buffer to climate change, providing low-cost options for adaptation and mitigation actions. During the last 20 years, the World Bank has committed almost US$3.5 billion in loans and GEF resources, and leveraged US$2.7 billion in co-financing, resulting in a total investment portfolio for biodiversity exceeding US$6 billion. Protected-area projects account for more than half of the investments, but the Bank is increasingly seeking to mainstream biodiversity in production landscapes, especially where GEF-funded activities can be integrated within Bank lending.

Partner governments have borrowed just over 31% of the US$6 billion, whereas grants comprise 25%, mostly facilitated through Bank-executed GEF projects, as well as through trust funds, and carbon financing. The remaining 44% represents co-financing and parallel financing, and global initiatives, such as the IFC Small and Medium Enterprise Fund, the Critical Ecosystems Partnership Fund, Coral Reef Targeted Research, and projects funded under the World Bank-Netherlands Partnership Program's Forests and Biodiversity windows.

Box 15.2 Figure These villagers on Buton, Sulawesi (Indonesia), are members of a cooperative within a village which has developed a conservation agreement vowing not to encroach into the natural forest and not to hunt wildlife, with sanctions for members who go against the agreement. In return they get access to high prices for their cashews (*Anacardium* sp.) which became the world's first Fairtrade cashews. This World Bank project is executed by Operation Wallacea - see www.opwall.com and www.lambusango.com.

The scale and variety of Bank financing mechanisms provide many opportunities to integrate biodiversity concerns into development assistance, to address the root causes of biodiversity loss, and to develop local capacity and interest. The Bank's leadership and coordinating role within the donor community can help to promote biodiversity conservation within national sustainable development agendas. As well as being a major funding source for biodiversity projects in developing countries, the Bank is also a source of technical knowledge and expertise, and has the convening power to facilitate participatory dialogue between governments and other relevant stakeholders.

In addition to the biodiversity projects themselves, each and every World Bank project is subjected to a 'safeguard review' to ensure that they meet the requirements of the various policies it has on, for example, environmental assessment, resettlement, indigenous peoples, international waterways, physical cultural

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Box 15.2 (Continued)

property – and natural habitats (World Bank 1998). The last of these is an important tool by which biodiversity concerns are integrated into improved project design because the policy forbids the Bank supporting projects involving the significant conversion of natural habitats unless there are no feasible alternatives for the project and its sites, and unless comprehensive analysis demonstrates that overall benefits from the project outweigh the environmental costs. Likewise the Bank will not approve a project that would involve the significant conversion or degradation of a gazetted or approved protected area. Mitigation for anticipated project impacts on biodiversity might include conservation offsets or additional species protection.

For further information and details of projects, see Mackinnon *et al.* (2008) and www.worldbank.org/biodiversity.

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is increasingly taking the forefront in the application of conservation science to conservation practice is the often real, and sometimes, perceived, conflicting mandates of biodiversity conservation and poverty alleviation. While there are, clearly, situations in which development can facilitate conservation efforts, it cannot be assumed that economic development will automatically lead to conservation benefits (Redford and Sanderson 2003). Furthermore, we cannot impose the world's development needs on the relatively small (approximately 10%) part of the land surface that constitutes protected areas and doing so poses significant, and perhaps insurmountable, challenges to the effective management of these areas to achieve global biodiversity goals. The value of protected areas – and their costs to local and indigenous people – has often been framed as one of opposition – with protected areas seen by some as depriving local and indigenous peoples of resources, by others as potentially beneficial (Sodhi *et al.* 2008). As one would expect, the reality is that such relationships are complex, and often locally specific (Upton *et al.* 2008) and the problem is more subtle (see for instance West and Brockington (2006) for a more detailed discussion of some of the effects). That parks may actually benefit the rural poor and serve as an attractant with human growth at their boundaries is both an argument for such areas, and flags a concern for their future conservation. The much contested relationship between parks and people will continue to stimulate both better analysis of the reality of such conflict, and provoke the design of innovative approaches for reconciliation between human needs and biodiversity conservation (Sodhi *et al.* 2006).

The technical and financial capacity for biodiversity conservation is significantly limited in developing economies harboring high levels of biodiversity (for example, most tropical countries). Such human resource deficits have been at the root of the changes in the way that conservation NGOs (Non-governmental Organizations), local governments, and international donors have implemented conservation projects over the last four decades (Cobb *et al.* 2007). Effectively tackling this issue – and empowering both local and national governments and institutions – will require visionary and far-sighted approaches that are able to justify investment of scarce resources to long-term capacity building objectives in the face of immediate conservation problems.

The gap between conservation science and its application has been long acknowledged (Balmford *et al.* 1998) and there are numerous efforts directed at bridging it (Sutherland *et al.* 2004).

Box 15.3 The Natural Capital Project

Heather Tallis, Joshua H. Goldstein, and Gretchen C. Daily

The vision of the Millennium Ecosystem Assessment is a world in which people and institutions appreciate natural systems and the biodiversity that constitutes their principal working parts as vital assets, recognize the central roles these assets play in supporting human well-being, and routinely incorporate their material and intangible values into decision-making. This vision has now caught fire, fueled by innovations worldwide – from pioneering local leaders to the belly of government bureaucracy, and from traditional cultures to a new experimental wing of Goldman Sachs – a giant investment banking firm (Daily and Ellison 2002; Bhagwat and Rutte 2006; Kareiva and Marvier 2007; Ostrom 2007; Goldman *et al.* 2008). China, for instance, is investing over 700 billion yuan in ecosystem service payments over 1998–2010 (in early 2009, US$ 1.0 = 6.85 yuan) (Liu *et al.* 2008).

The aim of the Natural Capital Project is to act on this vision and mainstream ecosystem services into everyday decisions around the world. Launched in October 2006, the Project is a unique partnership among Stanford University, The Nature Conservancy, and World Wildlife Fund, working together with many other institutions (www.naturalcapitalproject.org). Its core mission is to align economic forces with conservation by: (i) developing tools that make incorporating natural capital into decisions easy; (ii) demonstrating the power of these tools in important, contrasting places; and (iii) engaging leaders globally.

Making conservation mainstream requires turning the valuation of ecosystem services into effective policy and finance mechanisms – a problem no one has solved on a large scale. A key challenge remains that, relative to other forms of capital, assets embodied in ecosystems are often poorly understood, scarcely monitored, typically undervalued, and undergoing rapid degradation (Daily *et al.* 2000; Heal 2000; Balmford *et al.* 2002; MEA 2003; NRC 2005; Mäler *et al.* 2008). Often the importance of ecosystem services is recognized only upon their loss, such as in the wake of Hurricane Katrina (Chambers *et al.* 2007).

To help address this challenge, we have developed a software system for integrated valuation of ecosystem services and tradeoffs (InVEST; Nelson *et al.* 2009). This tool informs managers and policy makers about the impacts of alternative resource management choices on the economy, human well-being and the environment, in an integrated way.

Examples of urgent questions that InVEST can help answer include:

- Which parts of a landscape provide the greatest carbon sequestration, biodiversity, and tourism values?
- Where would reforestation achieve the greatest downstream water quality benefits?
- How would agricultural expansion, climate change and population growth affect a downstream city's drinking water supply or flood risk?

InVEST is designed for use as part of an active decision-making process. The first phase of the approach involves working with decision makers and other stakeholders to identify critical management decisions and to develop scenarios to project how the provision of services might change in response to those decisions as well as to changing climate or population. Based on these scenarios, a modular set of models quantifies and maps ecosystem services in a flexible way. The outputs of these models provide decision makers with maps and other information about costs, benefits, tradeoffs, and synergies of alternative investments in ecosystem service provision.

InVEST is now being used in major resource decisions in Bolivia, Brazil, China, Colombia, Ecuador, Mexico, Peru, Tanzania, and the United States (California, Hawaii, Oregon, and Washington; see Box 15.3 Figure). The tool has proven useful with stakeholders as diverse as national governments, private landowners and corporations, and increasing demand for the tool indicates that the time is ripe for ecosystem service thinking to change the face of management across sectors and around the globe.

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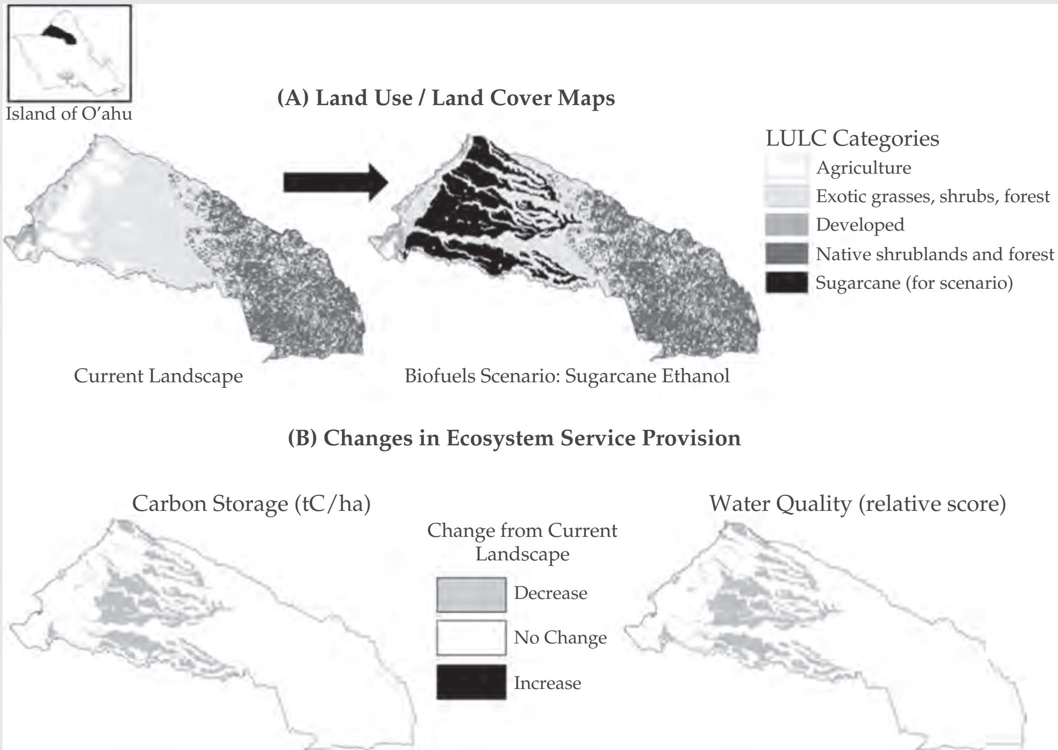
Box 15.3 (Continued)



Box 15.3 Figure Application of InVEST to a planning region on the Island of O'ahu, Hawaii. The parcel covers approximately 10 500 ha from mountaintop to the sea, including 800 ha of developed rural community lands along the coast, 3600 ha of agricultural lands further inland, and 6100 ha of rugged forested lands in the upper part of the watershed. While many of the agricultural fields have been fallow for over a decade, stakeholders are exploring using the fields to grow sugarcane for ethanol biofuel (among other options). InVEST was used to assess how this land-use change scenario would affect the ecosystem services of water quality and carbon storage. Part (A) shows land use/land cover (LULC) maps for the current landscape and the sugarcane ethanol scenario. Part (B) shows the projected changes for water quality and carbon stock. The dominant effect is a decrease in service provision relative to the current landscape. Water quality decreases by 44.2%, driven by increased fertilizer application on the fallow fields returned to crop production. Taking advantage of next-generation sugarcane breeds, however, could greatly reduce these impacts. Carbon stock decreases by 12.6%, which is due to clearing of woody exotic species that grew while the fields were not in production. This "carbon debt" (Fargione *et al.* 2008) could be repaid through time by using sugarcane ethanol to offset more carbon intensive fuel sources. The information generated from this InVEST analysis elucidates ecosystem service tradeoffs apparent in undertaking biofuel production, which can inform land use decisions alongside economic and other benefits not shown here. Furthermore, the analysis helps land managers identify where to focus efforts, spatially for each ecosystem service, to improve management practices. See also Figure 3.1.

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Box 15.3 (Continued)

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These efforts are based on the assumption that effective conservation is dependent not only on science catching up with the dynamic aspects of a changing world (Chapter 13) but also on conservation practice catching up with science (Pressey *et al.* 2007). There is a recognized need to integrate the activities of conservation biologists (and other conservation minded scientists) with those of practitioners, with conservation biologists interacting more frequently with practitioners and the latter better documenting their actions (Sutherland *et al.* 2004). This chapter provides a glimpse into the realm of practical conservation with examples and case studies to illustrate some of the diverse approaches that are being implemented to conserve biodiversity and how these approaches benefit from, and offer opportunities to, the science that underlies them.

15.1 Integration of Science and Conservation Implementation

A good example of integrating conservation science with implementation is a project that is being undertaken in South Africa (Balmford 2003). Richard Cowling and his colleagues have successfully attempted to build the input of decision-makers and local people into scientifically rigorous conservation planning for the Cape Floristic Region in South Africa (Cowling and Pressey 2003; Cowling *et al.* 2003; Pressey *et al.*

Box 15.4 Measuring the effectiveness of conservation spending
Matthew Linkie and Robert J. Smith

Conservationists can only develop cost-effective strategies by evaluating the success of their past efforts. However, few programs measure project performance adequately: most carry out no assessment at all or rely on descriptive analyses that cannot distinguish between the confounding effects of different covariates. In response, Ferraro and Pattanayak (2006) have presented a counterfactual design for determining conservation success. This involves comparing similar sampling units, e.g. villages, people or forest patches, which receive conservation intervention (the treatment group) with those that do not (the control group). Here, we describe two studies that have used this approach to evaluate conservation effectiveness.

Case study 1

Linkie *et al.* (2008) studied a US$19 million project that ran from 1997–2002 in and around Kerinci Seblat National Park, Sumatra. Part of this project involved spending US$1.5 million on development schemes within 65 villages (the treatment) that border the park, in return for the villagers signing agreements to stop the illegal clearance of their forest (see Box 15.4 Figure). Thus, determining the success of this strategy involved measuring subsequent village deforestation rates. However, deforestation patterns are often explained by covariates relating to accessibility, such as proximity to roads, and some project villages were chosen for logistical or political reasons. Linkie *et al.* accounted for the influence of these different factors by using a propensity score matching technique. This approach used data on ten socio-economic and biophysical covariates from a village profile dataset to identify the factors that best predicted forest loss, and to identify the 65 non-project villages (the control) that most closely matched the project villages in terms of these factors. Deforestation rates between these two groups were then compared and no difference was found, showing that project participation had no effect. In contrast, a questionnaire survey conducted by the project found stronger conservation support in project villages than non-project villages, and on this basis alone the project might have been considered a success.

Box 15.4 Figure Small scale logging in Sumatra (Indonesia). Photograph by Jeremy Holden.

Case study 2

Andam *et al.* (2008) evaluated the effectiveness of protected areas (PAs) in avoiding deforestation in Costa Rica. They also used a propensity score matching technique to identify similar unprotected areas (the control) that most closely matched the PAs (the treatment), based on similarities of accessibility and land use opportunities. From 1960–1997, the PAs were found to avoid about 10% of the deforestation that was predicted to have occurred if they had not been present. In addition, Andam *et al.* tested a commonly used method for evaluating PA effectiveness, which compares deforestation in PAs against that in adjacent unprotected areas. Such comparisons can be problematic because PAs tend to be located on land that is less

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Box 15.4 (Continued)

accessible and less suitable for agriculture and therefore has a lower risk of clearance. This was illustrated by their results, which showed that not controlling for these confounding effects led to a threefold over-estimation of deforestation reduction within the PAs.

These two case studies illustrate the importance of using statistically robust approaches for measuring conservation success. Such an approach should be widely adopted, as it provides vital information for donors, policy developers and managers. However, this will depend in part on developing a conservation culture that discusses and learns from failure, instead of hiding it from scrutiny (Knight 2006).

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2007). The Cape Floristic Region, covering 90 000 km^2 of the south-west tip of Africa, contains over 9000 species of plants and is globally recognized for its biological significance (Davis *et al.* 1994; Olson and Dinerstein 1998; Stattersfield *et al.* 1998; Myers *et al.* 2000). Over 1400 of the plant species found here are Red Data Book listed and nearly 70% are endemic to the region. Conversion to intensive agriculture, forestry, urbanization, infestation with alien plants and widespread grazing are key threats in the region with 22% of all land protected in conservation areas (only half in statutory reserves) and 75% in private ownership (Balmford 2003).

Against this backdrop of escalating threats, declining institutional capacity, and a biologically unrepresentative reserve system, a project known as the Cape Action Plan for the Environment (CAPE) was launched (Cowling and Pressey 2003). The project has since expanded into a 20-year implementation program addressing three broad themes: (i) the protection of biodiversity in priority areas; (ii) the promotion of its sustainable use; and (iii) the strengthening of local institutions and capacity. From its inception, the project engaged not only the statutory agencies that would ultimately be responsible for implementation, but also land-owners, local communities and the non-governmental sector. Building these partnerships early on enabled a diversity of local actors and external practitioners to work with planners in developing broad project goals and strategies. The approach of integrating the involvement of stakeholders and practitioners with scientifically rigorous planning not only earned the project credibility with external donors but the resulting wide ownership of the conservation plan has been crucial to its ongoing implementation (Balmford 2003).

15.2 Looking beyond protected areas

During the past century, the standard practice for safeguarding biodiversity (Chapter 2) and reducing the rate of biodiversity loss has been the establishment of protected areas (Lovejoy 2006). The steady and significant increase in the area protected and number of protected areas created over the past three to four decades has been accompanied by an evolution of protected areas from being small refuges for particular species to the protection of entire ecosystems. But even large protected areas can be inadequate to ensure the persistence of some wildlife populations, particularly large carnivores (Woodroffe and Ginsberg 1998). Furthermore, biodiversity conservation, or the preservation of ecological integrity, are only two reasons for establishing and maintaining protected areas. Other goals may relate to sustainable development, poverty alleviation, peace and social equity. The disparate and often conflicting global mandates for protected areas pose the greatest challenge for the design and implementation of effective conservation strategies. The need for reconciliation of conflicting mandates will drive the design and implementation of innovative approaches to management, governance, financing and monitoring of protected areas, all of which will directly and indirectly impact their effectiveness in conserving biodiversity.

One such approach involves the design of strategies aimed at managing protected areas as components of a larger landscape. Given that wildlife, ecological processes and human activities often spill across the boundaries of protected areas, conservation that is focused solely within the limits of protected areas is often faced with difficult challenges. The management of protected areas therefore cannot occur in isolation from the surrounding human- dominated landscapes. Box 15.5 provides a description of a landscape approach to conservation where protected areas are managed as one component of a larger conservation landscape that is traversed by land uses where biodiversity conservation is not the primary objective (see Box 5.3). The entire field of countryside biogeography, of course, focuses on this key issue (see Box 13.4).

15.3 Biodiversity and human poverty

There is a considerable degree of spatial overlap of poverty, inequality and biodiversity with high levels of biodiversity occurring in some of the world's poorest countries (McNeely and Scherr 2001). The creation of protected areas in order to restrict the use of biodiversity in such countries therefore has impacts on communities and other user groups who benefit economically from directly utilizing biodiversity or converting the land to a more profitable form of use such as oil palm plantations. Protected areas established to conserve biodiversity in regions of high poverty are under tremendous pressure to serve the dual purpose of economic development and biodiversity conservation. Consequently, there is much contention surrounding the relationship between protected areas, people and economic

Box 15.5 From managing protected areas to conserving landscapes

Karl Didier

The Ewaso Ecosystem is a vast (40 000 km^2) and diverse savanna region in central Kenya. It is relatively intact, with most of its biodiversity and all of its megafauna still present, including elephants (*Loxodonta africana*), lions (*Panthera leo*), giraffe (*Giraffa camelopardalis reticulate)*, the endangered African wild dog (*Lycaon pictus*), and the last populations of the critically endangered Grevy's zebra (*Equus grevyi*). The relative intactness of the Ewaso is owed, in large part, to a large network of protected areas covering 6000 km^2 (~15% of the region), including national parks and reserves, and provincial forest reserves (see Box 15.5 Figure and Plate 18). However, even with so much of the land in protected areas, conservation goals have yet to be met: populations of some species remain dangerously low (e.g., <300 wild dogs), many other biological species and communities are threatened with imminent decline due to increasing habitat fragmentation (Chapter 5) and conflict beyond the boundaries of the protected area network (e.g., elephants; see Box 14.3), and basic ecosystem services (Chapter 3), such as production of clean water, are threatened by land development (e.g., logging and agriculture) (Chapter 4) and climate change (Chapter 8).

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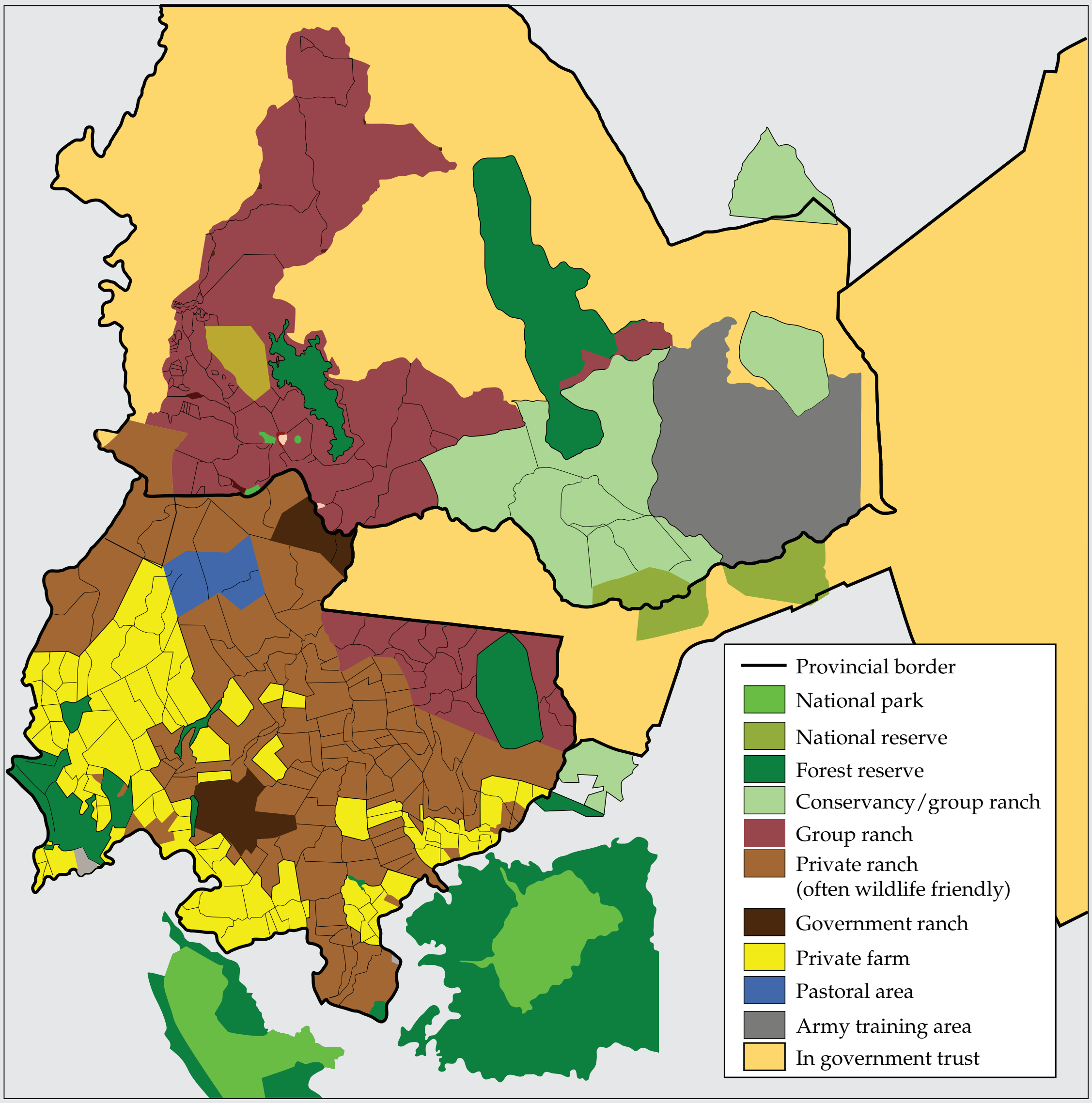
Box 15.5 (Continued)



Box 15.5 Figure The biodiversity of the Ewaso ecosystem in central Kenya is relatively intact due in large part to a strong set of protected areas. However, even these are not sufficient to preserve the patterns and processes of biodiversity and to reach conservation objectives. To do so, conservationists are working in the complex matrix of land uses beyond the protected areas, with a vast array of stakeholders, and using actions that benefit both people and biodiversity.

Why protected areas are not enough?

In the Ewaso and in most areas around the globe, there are two reasons why protected area creation is an incomplete strategy to meet the conservation objectives. First, protected areas, whether they cover 5 or 50% of a region, simply cannot represent the enormous array of biodiversity out there. Existing protected area networks tend to be biased toward representing a small subset of species,

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Box 15.5 (Continued)

such as large mammals, and fail to represent other taxa well, such as plants. This is especially true in western Africa (see Gardner *et al.* 2007).Second, even for the elements of biodiversity that are represented (i.e. occur at least once) in protected areas, their long-term persistence is rarely ensured by management of the protected area alone. The problem is that both biodiversity and the threats to biodiversity move freely across protected area boundaries. For example, elephants and wild dogs in the Ewaso rely on habitats and corridors well beyond protected areas, bringing them into conflict with humans. Also, although many threats have their source outside of protected areas, like pollution added to the Ewaso River by flower farmers or wandering livestock, they manage to directly impact biodiversity inside parks. Mitigation of such threats cannot be achieved by park management alone, and expansion of protected areas is untenable. To ensure that ecosystem services are maintained and that viable and functional populations (i.e., at appropriate densities) of species persist, conservation practitioners need to work beyond park boundaries, into the surrounding human-dominated matrix.

Defining a "landscape" for conservation practitioners

The term "landscape" has been defined as "a heterogeneous land area composed of a cluster of interacting ecosystems that is repeated in similar form throughout" (Forman and Godron 1986) or "an area that is spatially heterogeneous in at least one factor of interest" (Turner *et al.* 2001). These are interesting from a theoretical perspective, but are not very useful for a park manager or conservation practitioner. An alternative definition of a "landscape" for conservation practitioners could be 'an area sufficient in size, composition, and configuration of land elements (e.g., habitats, management types) to support the long-term persistence and functioning of all conservation features of interest, including ecological communities and processes, ecosystem services, and functional populations of species'.

Most frequently, this kind of landscape will be heterogeneous in many aspects, including human land uses, ecosystems or ecological communities, political units, and management units. In the Ewaso, the "landscape" includes protected areas, private lands, villages, community-owned lands, untenured lands, parts of at least 10 districts, and a diversity of habitats that include rivers, montane forests, acacia savanna and moorlands (see Box 15.5 Figure). A typical landscape will also include a diversity of stakeholders. In the Ewaso, this includes local ranch owners and farmers, non-governmental development organizations [e.g. CARE (Cooperative for Assistance and Relief Everywhere)], powerful "county councils" who control large community-owned areas, industrial-scale flower farmers often from Europe, and poor, nomadic pastoralists who graze their livestock on tracts of government-owned land. While defining the boundaries and users of a landscape are difficult tasks, implementation of conservation activities at the landscape scale presents an enormous challenge.

Implementing landscape conservation

Conservation at landscape scales requires, first and foremost, that practitioners engage communities and landowners and implement activities that meet their needs while improving the situation for biodiversity. In the Ewaso, several organizations such as the Laikipia Wildlife Forum (LWF) and the Northern Rangelands Trust (NRT) spend much of their resources working outside the boundaries of protected areas, with community-owned ranches and conservancies. For example, NRT helps communities obtain formal land ownership from the Kenyan government. Once this occurs, they implement a suite of activities to help communities generate sustainable income and improve conditions for biodiversity. For example,

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Box 15.5 (Continued)

NRT helps pastoralists on community-run ranches improve their access to livestock markets. Improved market access means that owners receive a higher price per head, can reduce total number of livestock on their lands, and, therefore, improve rangeland quality for wildlife. NRT and LWF also help local communities develop ecotourism enterprises, which supplement local incomes, make owners less susceptible to the vagaries of livestock management, and gives them incentive to conserve biodiversity. A further example of conservation action outside protected area boundaries is the work being done by organizations under the banner of the Laikipia Elephant Project (see also Boxes 5.3 and 13.4). This project aims to decrease incidents of crop raiding by elephants in several ways, including providing farmers with "early warning systems", training them how to plant and sell chili peppers (a crop that elephants hate and which is valuable on international markets), or even training people to make paper out of elephant dung. As conservation in the Ewaso demonstrates, to implement landscape-scale conservation practitioners need an expanded set of tools and skills. Just to name a few, they need skills in the ecological and social sciences, law, business and finance, facilitation and negotiation, conservation planning, zoning, geographic information systems, remote sensing, and fund raising. While the creation and management of protected areas will remain a cornerstone strategy for biodiversity conservation, there is an increasing need for traditional strategies to be augmented with new tools and approaches to implement landscape scale conservation.

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development, with conservationists and those concerned with human welfare locked in debate (West and Brockington 2006; Vermeulen and Sheil 2007; Robinson 2007). Conservationists argue that environmental regulations are essential to ensure the sustainability of the planet's biological systems and the health and welfare of people, especially local people, and that protected areas are an indispensable tool in that regulatory toolbox (Peres 1995; Kramer *et al.* 1997; Brandon *et al.* 1998; Terborgh 1999). Some social advocates, on the other end of the spectrum, contest the establishment and management of protected areas, and support the beliefs that: (i) only initiatives related to poverty alleviation will lead to successful biodiversity conservation since poverty is the root cause of environmental destruction (Duraiappah 1998; Ravnborg 2003); and (ii) Protected areas have been frequently established at the expense of local communities (in and around protected areas) through displacement and dispossession, and are responsible for perpetuating poverty by the continued denial of access to land and other resources (Ghimire and Pimbert 1997; Colchester 2004). In addition, others contend that even if parks do generate economic value, the distribution of these benefits is so skewed against poor rural people that the role of parks in local development is negligible, and they neither justly compensate for lost property and rights nor contribute to poverty alleviation (Brockington 2003; McShane 2003).

In an analysis of programmatic interventions aimed at achieving both biodiversity conservation and poverty alleviation, Agrawal and Redford (2006) indicate that there is basic lack of evidence on the extent to which the two goals can be simultaneously achieved. While the role of poverty in destroying biodiversity in poor countries is indisputable, one should never lose sight of the overwhelming role that the rich, through their overconsumption, play in extinguishing life forms all over the Earth (Ehrlich and Ehrlich 2005).

Identifying win-win strategies that simultaneously benefit biodiversity and people continues to dominate the agenda of researchers and practitioners alike and the integration of poverty alleviation and biodiversity conservation goals has been approached in various ways. Biodiversity use may not be able to alleviate poverty, but may have an important role in sustaining the livelihoods of the poor, and preventing further impoverishment (Angelsen and Wunder 2003). Furthermore, while the vast majority of the world's poor live in semi urban areas, significant progress in poverty alleviation will not be affected by most conservation activities (Redford *et al.* 2008). Biodiversity-rich tropical forests subject to high deforestation rates nonetheless harbor some of the poorest, most remote and politically disenfranchised forest dwellers offering distinct opportunities for joint conservation and development initiatives, and have drawn advocates for new approaches to "pro-poor conservation" (Kaimowitz and Sheil 2007).

Box 15.6 Bird nest protection in the Northern Plains of Cambodia
Tom Clements

Cambodia is identified by many global assessments as a conservation priority: for example it lies within the Indo-Burma hotspot (Myers *et al.* 2000) and contains four of the Global 200 Ecoregions (Olson and Dinerstein 1998). Although it does not support high species diversity, Cambodia is of particular importance for conservation because it contains some of the largest remaining examples of habitats that previously spread across much of Indochina and Thailand, which still support almost intact species assemblages. Many of these species are listed as Globally Threatened by IUCN due to significant declines elsewhere in their range. Following the restoration of peace in Cambodia in 1993, conservation strategies have primarily focused on the establishment of Protected Areas (PAs). These PAs generally have a small number of poorly paid staff with limited capacity or infrastructure, i.e. they are 'paper parks' (Wilkie *et al.* 2001). Moreover, PAs usually contain existing human settlements, in some cases with >10 000 people, whose rights are respected under law but with varying degrees of implementation. Such a situation is not uncommon: 70% of a non-random sample of global PAs contained people, and 54% had residents who contested the ownership of some percentage of the PA area (Bruner *et al.* 2001). Since limited site information was available when PAs were declared many areas of importance for biodiversity conservation lie outside the system, emphasizing the importance of adopting a landscape approach. This requires tools to engage local communities in conservation (see Chapter 14).

In the 1980s and 90s Integrated Conservation and Development Projects (ICDPs) were a popular methodology for combining the needs of local communities with conservation, both inside and outside of PAs. However, there is very little evidence of conservation success (Wells *et al.* 1999; Chape 2001; Ferraro and Kiss 2002; Linkie *et al.* 2008). One of the principle reasons suggested for this failure is that the linkages between project activities (benefits) and biodiversity conservation were weak, i.e. benefits were not contingent on conservation outcomes. Ferraro and Kiss (2002) have therefore proposed that community conservation interventions would be more effective if they concentrated on initiatives where these linkages are much stronger. 'Direct

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Box 15.6 (Continued)

payments' and 'conservation easements' are actually much more accepted in the USA and Europe and have been recently established in other countries such as Costa Rica (Zbinden and Lee 2004). This section describes a direct payment scheme established by the Wildlife Conservation Society (WCS), an international non-governmental organization, in Cambodia. The scheme is evaluated against some of the original claims made by Ferraro and Kiss (2002), specifically that direct payments schemes would be simpler to implement and therefore have: (i) efficient institutional arrangements; (ii) be cost-effective; and (iii) deliver substantial development benefits, in addition to the conservation benefits.

Methods

The Northern Plains support probably the largest breeding global population of giant ibis (scientific names in tables) (Critically Endangered), a species known from only a handful of records in the 1900s until it was rediscovered in 2000 by WCS in the area. Some of the only known nesting sites in mainland Asia of another Critically Endangered species – white-shouldered ibis – are also located in the Northern Plains. These two ibises are amongst the most endangered bird species in the world. In addition, the Northern Plains supports breeding populations of three Critically Endangered vulture species – white-rumped, slender-billed, and red-headed vultures – and eight species of large waterbirds: greater adjutant, lesser adjutant, white-winged duck, sarus crane, Oriental darter, black-necked stork, and woolly-necked stork. This unique assemblage of nine globally threatened large bird species means that the Northern Plains is of exceptional importance for conservation.The primary immediate threat to all these birds is collection of nest contents by local people, often for sale to middlemen who trade with Thai and Lao border markets. This is especially true for both adjutant species and the sarus cranes – the latter is known to fetch a high market price (>US$100 in Thailand). The collection is mostly done by people from local communities, who then re-sell the eggs and chicks on to middlemen. The Bird nest Protection Program was launched in 2002 by WCS in order to locate, monitor and protect the nesting sites. Initially the research, protection and monitoring was undertaken by WCS staff and rangers. However increasingly it has been discovered that a much greater number of nests can be found and successfully protected by working in cooperation with the local communities, who were originally the principal threat. Under the program, local people are offered a reward of up to US$5 for reporting nests, and are then employed to monitor and protect the birds until the chicks successfully fledge. The protection teams are regularly visited every one to two weeks by community rangers employed by WCS and WCS monitoring staff to check on the status of the nests and for the purposes of research and data collection. The program operates year-round, as some species nest in the dry season and others during the wet season. It started in four pilot villages in 2002 at one site and was extended to a second site in 2004. By 2007 it was operating in >15 villages. In 2003 and 2004 nest protectors were paid US$2/day at the end of the month, assuming that the nest went undisturbed during that period. In 2005 the payment system was changed following community consultations to US$1/day for protecting the nest with a bonus $1/day provided if the chick(s) successfully fledged. The payment values were based on an acceptable daily wage, rather than compensating for the opportunity cost of not collecting, which would be much greater. Local people were concerned about natural predation, and it was decided that payments would still be made in these cases.

Results and Conclusions

The scheme has been extremely successful (see Box 15.6 Table 1), protecting over 1200 nests of globally threatened or near-threatened species since 2002, including 416 nests in 2007–8. The numbers of nests monitored and protected have increased by an average of 36% each year since 2004. Most of this increase is due to greater numbers of sarus crane, vultures (three

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Box 15.6 (Continued)

Box 15.6 Table 1 Bird Nest Protection Program: Nests Protected, 2002-2008.In some cases nests were protected but there is no data available. '-' indicates species that were probably present, but were not protected in that year. Initially the program started at one sites and operated in two sites from 2004. Numbers found have grown by 36% per year since 2004.

Species	*Global Status*	*2002-3* (1 site only)	*2003-4* (1 site only)	*2004-5* (2 sites)	*2005-6* (2 sites)	*2006-7* (2 sites)	*2007-8* (2 sites)
		Nests (Colonies)	*Nests (Colonies)*	*Nests (Colonies)*	*Nests (Colonies)*	*Nests (Colonies)*	*Nests (Colonies)*
White shouldered Ibis *Pseudibis davisonii*	Critical	1	1	2	3	4	6
Giant Ibis *Pseudibis gigantea*	Critical	-	5	27	28	28	29
Sarus Crane *Grus antigone*	Vulnerable	-	6	19	29	37	54
Vulture spp. (*Sarcogyps calvus & Gyps spp.*)	Critical	-	-	1	4	5	5
Black-necked Stork *Ephippiorhynchus asiaticus*	Near-threatened	-	-	-	2	3	2
Oriental Darter *Anhinga melanogaster*	Near-threatened	13	-	-	-	26(1)	33(1)
Greater Adjutant *Leptoptilus dubius*	Endangered	-	(present, no data)	21(2)	17(2)	18(2)	10(2)
Lesser Adjutant *Leptoptilus javanicus*	Vulnerable	-	34(5)	97(16)	134(15)	221(22)	277(27)
Totals, both sites		**14**	**46+**	**166**	**219**	**342**	**416**

species), white-shouldered ibis, Oriental darter, and lesser adjutant being found, suggesting that persecution and nest collection were the main factors limiting populations of these species. Local awareness regarding the importance of bird conservation has substantially improved, with an almost complete cessation of collection activity at one site, and significant reductions at the other. The direct payments scheme has therefore been very effective at delivering conservation results.

Reviewing the first of the claims of Ferraro and Kiss (2002), the scheme involves a very simple institutional arrangement: with contracts made directly between WCS and the protectors without involving any other institution. Under Cambodian Law collection of bird nests contents is actually strictly illegal, but Government authorities are not directly involved in the scheme, although they do participate in regular reviews of results. The scheme therefore reinforces national law by providing an incentive to villagers not to collect bird nests, but not fully compensating for the opportunity cost.

A detailed breakdown of the payments made in the 2005–6, 2006–7 and 2007–8 seasons is given in Box 15.6 Table 2. The total cost to WCS of the program is around US$25 000 per year, with an average cost of $60–$120 per nest protected. The average cost has declined as the number of nests has increased, partly because monitoring costs can be shared between adjacent sites and also due to the

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Box 15.6 (Continued)

Box 15.6 Table 2 Bird Nest Protection Program: Costs, 2005-2008. WCS, Wildlife Conservation Society. Currency in US dollars.

	2005-6	2006-7	2007-8
Local Payments	$ 19850	$ 19119	$ 17434
(%)	(78%)	(74%)	(69%)
Nest Protection Payments	$ 12597	$ 11248	$ 9786
Community Rangers	$ 7253	$ 7871	$ 7648
WCS Monitoring	$ 5603	$ 6800	$ 7747
(%)	(22%)	(26%)	(31%)
Expenses	$ 2506	$ 3640	$ 4192
Salaries	$ 3098	$ 3160	$ 3555
Total	$ 25453	$ 25918	$ 25180
Nests Protected	219	342	416
Average Cost/Nest	$ 116.22	$ 75.78	$ 60.53

greater number of nests at colonies. Of the cost of the program, 69–78% of payments went directly to local people, with the remaining expenditure being monitoring costs incurred by WCS. The program is therefore very cost-effective, with an overhead of only 22–31%, substantially less than other conservation approaches (Ferraro and Kiss 2002). Average payments per family are around US$120/year, with considerable variation depending upon how long people were employed. Some individuals are specialist protectors, switching species depending on the season and receiving continual employment for several months. The amounts paid, sometimes >US$400/individual, are substantial in villages where annual cash incomes are $200–$350/year. Evaluations have shown that this money is used to pay for clothes, schooling, housing improvements and to enhance food security. The scheme therefore does provide substantial development benefits, although these are not a primary objective of the program. It is also very popular with villagers because they are able to decide for themselves how to spend the money (i.e. benefits are not in-kind).

The initial scheme was based upon 'payments for work' (i.e. US$2/day) rather than 'payments for success'. This led to perverse situations where WCS was perceived as an employer with responsibility for protectors' well-being, whilst the protectors shared little of the risk and were not responsible for the final outcome. In 2005 the payment system was changed to increase the risk shared by the protectors. That is, they are paid $1/day for their work and $1/day for results upon successful fledging. This revised payment system delegates decision-making to local people, who are probably more familiar with the situation and more aware of threats.

Payments are also entirely dependent on money raised annually by WCS, although the scheme is relatively inexpensive in comparison with the substantial conservation benefits. However, given the extreme level of threat to many of these species, with average population sizes <20 pairs per site when the scheme was initiated, these were judged acceptable risks. In the longer-term financing could become more sustainable through direct sponsorship, for example through websites or exhibits in zoos. One risk is that collection would resume if the payment scheme was stopped.

The bird nests protection scheme is linked to a community-based ecotourism program. Under this, communities receive rights to locally manage ecotourism enterprises in exchange for active protection of the biodiversity that tourists come to see. The ecotourism enterprises employ additional groups within the communities, including more marginal groups such as women and poorer households, reinforcing the value of the birds. In addition, as the community enterprises become more empowered they have begun to take over local payments for bird nest protection, funded from tourism receipts. This provides a long-term sustainable financing mechanism for the initiative.

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Box 15.6 (Continued)

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Increasingly, conservation practitioners try to provide incentives to individuals and user groups to prevent the degradation of biodiversity. These incentives lie on a spectrum from indirect to direct with respect to their link with conservation objectives (Ferraro and Kiss 2002). The least direct approaches include support for the use and marketing of extracted biological products (e.g. logging, non-timber forest product extraction, hunting) and subsidies for reduced impact land and resource use (e.g. sustainable agriculture). Performance based payments for biodiversity conservation represents one of the most direct approaches of providing incentives. Box 15.6 outlines an example of this approach that has been implemented to conserve endangered bird species in Cambodia.

The evolving relationship between parks and people will continue to dominate international and national dialogues on biodiversity conservation and stimulate the evolution of innovative

Box 15.7 International activities of the Missouri Botanical Garden
Peter H. Raven

The Missouri Botanical Garden (MBG) is the oldest botanical garden in the United States, established in 1859. Modern botanical gardens were first developed in Europe in the early 1500s as adjuncts to schools of medicine, since the physicians the medical schools trained had to be able to recognize those kinds of plants that would be effective in treating their patients. Consequently, botanical gardens are often associated with universities: they have carried out research on plants over the years, as they still do at the present time. During the era of colonization, the colonial powers often established botanical gardens as places where they could grow and investigate what crops of economic value might be useful in that particular area. The botanical gardens in Sydney, Singapore and Bogor are examples of institutions of this kind that have survived from the nineteenth century. Botanical gardens came from very different beginnings from zoos, which started as carnivals and displays, became permanent facilities under first royal and later municipal or state patronage, and are not historically connected with universities. In the modern era, both botanical gardens and zoos have recognized their common interest in conservation, since the organisms in their care often are becoming increasingly rare in nature. The kinds of research collections, herbaria, libraries, and associated databases that are associated with comprehensive botanical gardens are not mirrored in the holdings of zoos. Such research collections of both plants and animals are found as part of the holdings of natural history museums, including those in universities.

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Box 15.7 (Continued)

The research program of the Missouri Botanical Garden, which initially was centered on the central United States and eventually spread to the Pacific Coast and into Mexico, has since the first part of the twentieth century been largely devoted to the tropics. A comprehensive account of the plants of Panamá begun in 1927 was completed in 1981. From this base, the research program of the garden spread north to southern Mexico and south throughout South America, to Africa, especially Madagascar; to China, Vietnam, Lao, and Cambodia, and to New Caledonia. Our style has often resulted in the preparation of comprehensive databases, and we are pushing increasingly towards a state in which all of the information about plants would be on the web and available for use or revision directly. Over a third of the plants of the world, more than 100 000 species, are being treated through one or more of the projects of the Missouri Botanical Garden.

Since the 1970s, the Garden's program has been organized around the activities of botanists resident in individual countries whose plants we are studying. We decided early on that it would not be possible to investigate the plants of any area thoroughly enough by means of intermittent expeditions and that we would be far more able to help in building institutions and training people if we lived on the ground with them. Thus our work in Nicaragua was based on Doug Stevens' residence of 11 years in the country, starting in the 1970s, that lead to the formation of substantial library and herbarium resources, and has, then and subsequently, resulted in the training of dozens of Nicaraguan botanists and conservationists. Through our continuing interactions with the government and many visits since, we have been able to do a great deal not only in technical botany but more importantly in building institutions through collaboration and by keeping in touch with individuals in our fields of study. Conservation and sustainability have become landmarks of our long-term intentions. In Peru, for example, empowering the Yanesha, indigenous people who want to use their resources sustainably, has been a major effort that continues to the present. Similar efforts are underway in Ecuador and Bolivia, and of course they are complementary in building knowledge of the plants of a particular region. In Costa Rica, resident MBG botanist Barry Hammel collaborates with the National Institute of Biodiversity (INBio) and the Museo Nacional in the production of a Manual Flora of the Plants of Costa Rica, one of the countries in the Neotropics where the most varied and comprehensive biological research is being conducted – we are sure that our manual will fill a gap by providing complete and up-to-date information on all kinds of plants found in the country.

In Madagascar, where MBG has been active for more than 30 years, we maintain a staff of more than 50 people, all but one Malagasy, and many trained in our joint Masters' degree programs with the University of Antananarivo. We are preparing a comprehensive, highly revised database on all the plants of the country, and finding about a third more kinds than had been recorded earlier, so that this island, which is about 50% larger than California, may be home to more than 13 000 species of plants. More than 90% of these are found nowhere else, and more than 80% of the natural vegetation in Madagascar has been destroyed, so that our team is literally engaged in a race against time, finding the places where plants grow and determining which are most critical for conservation. By Presidential Decree, the amount of preserved land in the country is being greatly increased at present, and it is of key importance to make the best choices concerning what should be set aside. The sustainability of certain communities, such as Mahabo, is being enhanced through collaboration with the Scandellaris Center of the Business School at Washington University in St. Louis, so that poor people may have alternatives to simply taking products unsustainably from an ever-diminishing forest – the key to biological conservation on a large scale.

The world will achieve sustainability only if efforts of this kind are repeated everywhere and the local efforts are united as a basis for common action. Along with sister institutions such as the Royal Botanic Gardens, Kew, and The New York Botanical Garden, we are contributing what we can toward the solution of our common challenge.

approaches for reconciliation (Koh and Wilcove 2007). Solutions for capturing opportunities that simultaneously protect biodiversity and reduce poverty, often boil down to improving institutions and governance, but there are no easy generalizations (Chomitz 2007).

15.4 Capacity needs for practical conservation in developing countries

In many developing economies with rich tropical biodiversity, government agencies responsible for the management of protected areas lack the necessary technical capacity to stem biodiversity loss effectively. These gaps in capacity occur at all levels, from the need for direct management of natural resources, to the compliance requirements of multilateral agreements (Steiner *et al.* 2003). At the ground level, managers of natural resources including biodiversity within protected areas often have limited access to the vast and dynamic body of knowledge and tools in conservation science. There is an urgent and critical need to transfer the advances in conservation science to individuals and institutions in biodiversity-rich countries. Building the capacity needed to implement conservation strategies and apply conservation principles represents one of the greatest challenges facing the field of conservation biology (Rodriguez *et al.* 2006).

Increasing capacity in applied conservation is complex: it involves not only the training of in-service conservation professionals but also the enhancement of university graduate and undergraduate programs that will generate a cadre of future conservation professionals. In order to be effective in the field of conservation, graduates of such training programs need relevant multidisciplinary knowledge and practical skills such as problem-solving and conflict resolution to tackle the complexities of biological and societal issues that characterize applied conservation (Noss 1997).

The urgency of the biodiversity crisis coupled with the general scarcity of funds and short project timelines make on-the-job training of individuals the most common approach to tackle the lack of capacity. NGOs for instance, work with individuals on specific projects and attempt to build capacity that is often quite specialized. However, a longer-term approach to building capacity would necessarily involve targeting relevant programs at universities and professional training institutions. Lack of financial resources and educational infrastructure are key limitations facing universities with regard to training for conservation. Addressing these issues will require concerted investment in financial and human capacity, but important initiatives are underway to begin this process.

Strong linkages between international NGOs and academic/professional institutions in countries such as Lao PDR are often key to provide field training opportunities in applied conservation research and management. Organizations such as zoological societies, natural history museums, and botanical gardens (see Box 15.7) are increasingly engaged in long-term conservation and capacity building efforts. In certain situations, such linkages may be the only means for students as well as staff of natural resource management agencies to gain valuable field experience in project design and management to complement theoretical knowledge and skills they may have acquired in the classroom.

For instance, the Network of Conservation Educators and Practitioners (NCEP, http://ncep.amnh.org), a project led by the Center for Biodiversity and Conservation of the American Museum of Natural History, aims to improve training in conservation biology through innovative educational materials and methods that directly target teachers of conservation biology. NCEP is a global initiative, currently active in Bolivia, Lao PDR, Madagascar, Mexico, Myanmar, Peru, Rwanda, the United States and Vietnam. The project seeks to create and make widely available a variety of resources to teach biodiversity conservation, and develop networks and resource centers to increase mentoring and training opportunities in biodiversity conservation worldwide. A central goal of the project is to increase teachers' and trainers' access to high quality and free of cost teaching materials. To meet this goal, NCEP develops collaborations with partner institutions and individuals including conservation practitioners to develop a series of multi-component teaching resources called modules adapted for local use. For example, in the Lao People's Democratic Republic (Lao PDR), a densely forested, land-locked country with high levels of biodiversity in Southeast Asia, NCEP established a partnership with The Wildlife Conservation Society and the National University of Laos (NUoL) to help develop the capacity of trainers in the science and forestry faculties to teach topics in conservation biology to undergraduates. Most young professionals employed in natural resource research and management agencies in the country today have graduated from the science or forestry faculties at the NUoL. These faculties have a critical need for up-to-date relevant materials in the Lao language for teaching biodiversity conservation principles.

Local adaptation is an important feature of the NCEP project, empowering in-country partners and making the materials immediately useful for faculty, students, and professionals who are already working in or associated with the field of biodiversity conservation. The project also found it useful to couple module training with applied research for students and faculty at field sites. The applied research served to reinforce learning and comprehension of new biodiversity conservation topics and terms in addition to providing critical exposure to real-world conservation.

A second phase of the NCEP project in Lao PDR involves building the capacity of university trainers to teach relevant aspects of applied conservation to protected area managers from seven National Protected Areas across the country. During this process, conservation science principles and case studies of applied conservation approaches will be adapted to make them more accessible to instructors to use as training materials for protected area managers who could apply those principles to achieve conservation results on the ground.

Capacity building activities can consume vast resources, potentially diverting already limited conservation funds away from other, more immediate conservation problems that involve direct actions at the site-level to reduce threats (for example, monitoring and enforcement). Moreover, justifying investment in capacity building activities is sometimes challenged by the difficulties involved in measuring success in the short-term. Yet, building capacity is vital to a longer-term vision of enabling responsible stewardship of biodiversity.

15.5 Beyond the science: reaching out for conservation

Globally, a key challenge to achieving conservation goals is the need to capture the interest of local people in a manner that stimulates cooperation and positive conservation actions (Brewer 2002). This need, sometimes defined as a form of social marketing, is a compelling reason for conservation biologists to work more closely with local communities to mobilize support for conservation through better informed and carefully designed outreach (Johns 2003). The process of involving local communities living adjacent to threatened species and their habitats helps build a constituency that is more aware of its role either as part of the problem or sometimes, as part of the solution, in a protected area (Steinmetz *et al.* 2006). This awareness is crucial to the effective implementation of conservation strategies. Field-based research outreach and partnership programs facilitate a two-way dialogue: local participants learn firsthand what scientists do, how they do it, and why they do it and by working with local communities, scientists can learn how local residents relate to the threatened species and habitats they study.

In the Thung Yai Naresuan Wildlife Sanctuary (3622 km^2) in western Thailand, commercial hunting contributed heavily to extensive population declines for most species and subsistence hunting was locally significant for some carnivores, leaf monkeys (*Presbytis* sp.), and deer. Workshops with local communities clarified which species were at highest risk of local extinction, where the most threatened populations were, and the causes of these patterns. Scientists, protected area managers and local people worked together to assess wildlife declines and jointly define and understand the scale of the problem during workshops. As a result, local people and sanctuary managers increased communication, initiated joint monitoring and patrolling, and established wildlife recovery zones.

While conflict between local people and the park authorities has not completely disappeared, there is interest to work together on wildlife issues (Steinmetz *et al.* 2006).

15.6 People making a difference: A Rare approach

Recognizing the important role that communities can play in conservation, a US based conservation organization known as Rare has adopted a mission to "conserve imperiled species and ecosystems around the world by inspiring people to care about and protect nature" (www.rareconservation.org; see Box 12.2). Rare fulfills this mission by addressing some of the most pressing needs of the global conservation movement. Rare trains and mentors local conservation leaders in the use of proven outreach tools, builds partnerships to leverage their investments and evaluate lessons learned to continuously improve the practice of conservation.

Rare's flagship program for constituency building is known as the Rare Pride campaign (Box 12.2). A hybrid of traditional education and private sector marketing strategies, Rare Pride campaigns inspire people who live in the world's most biodiverse places to take pride in their natural heritage and embrace conservation. Pride campaign managers are local conservationists who make two year commitments to inspire environmental protection at every level in their communities. Campaign managers are trained by the organization during a university-based program in social marketing culminating in a Master's degree in Communications for Conservation from the University of Texas (El Paso).

Pride campaigns utilize a charismatic flagship species, like the Saint Lucia parrot or the Philippine cockatoo, which becomes a symbol of local pride and acts as a messenger to build support for needed behavior changes for habitat and wildlife protection. Marketing tools such as billboards, posters, songs, music videos, sermons, comic books, and puppet shows make conservation messages positive, compelling, relevant, and fun for the community. Campaigns aim to generate an increased sense of pride and public stewardship that goes beyond mere awareness-raising. Pride campaigns involve and engage several segments of the community: teachers, business and religious leaders, elected officials, and the average citizen. Rare Pride is currently being employed on a global scale, and has been successfully replicated by partner organizations in over 40 countries.

15.7 Pride in the La Amistad Biosphere Reserve, Panama

The farming town of Cerro Punta, with a population of 7000, lies at the gateway to a forest corridor between Barú Volcano National Park in Panama and La Amistad Biosphere Reserve shared with Costa Rica that encompasses one of the largest tracts of undisturbed rainforest in one of the most biologically diverse regions in the world. The corridor between the two parks is important for the movement of globally significant species including ocelot (*Leopardus pardalis*), puma (*Puma concolor*), Baird's tapir (*Tapirus bairdii*), white-faced capuchin monkey (*Cebus capucinus*), and the Resplendent Quetzal (*Pharomachrus mocinno*). The land is under threat. The mild climate and rich volcanic soil creates fertile conditions that include four growing seasons a year for agricultural crops. Consequently, Cerro Punta produces 80% of all the vegetables grown in Panama (population 3.2 million). Crops are cultivated on the steep mountainsides without any terraces causing heavy erosion during the rainy season. Given the farmers' heavy reliance on synthetic chemical pesticides and fertilizers, erosion and run-off from the cultivated slopes leads to downstream water pollution with deleterious health impacts for residents. Furthermore, the erosion slowly forces farmers to clear more land for new fields, closer and closer to the two parks and the corridor between them. In addition to the threat of agricultural expansion, there is persistent pressure to build roads or highways through the La Amistad Biosphere reserve as exploitation for coal and minerals increases. Deforestation, cattle ranching, hunting, and commercial extraction are also serious threats to the Park's rich flora and fauna.

La Amistad needed a strong constituency lobbying for conservation, as well as significant change in community farming methods. Luis Olmedo Sanchez Samudio, a Sunday school teacher from a farming family in Cerro Punta, knew that creating real change in his community would require a dramatically different approach. Sanchez Samudio completed Rare's program at the University of Guadalajara in Mexico to learn how to implement a full scale Pride social marketing campaign in La Amistad. The Fundacion para el Desarrollo Integral del Corregimiento de Cerro Punta (FUNDICCEP), with Sanchez Samudio on their staff, allied with Rare and one of the biggest International NGOs, The Nature Conservancy, in this effort. Sanchez undertook the formidable task of reaching out to radio stations, schools, fairs, and the farmers themselves in a relentless effort to change decades-old customs and attitudes. Panama's Resplendent Quetzal was chosen to serve as the campaign's flagship species and used to talk about a range of conservation issues. Named "Quelly", an image of the Resplendent Quetzal appears on all campaign materials, reminding people of the importance of habitat protection. After several months of formative research, including surveys and focus groups with local farmers, Sanchez Samudio launched his campaign with over 30 outreach vehicles including posters, advertisements, bumper stickers, radio shows, mascots, classroom visits, sermons, workshops, festivals, and much more. Sanchez encouraged farmers to adopt sustainable agricultural practices while garnering support from clergymen, legislators and other relevant sources. Post campaign survey data to measure effectiveness showed that 52% of the respondents were aware of the benefits of living near a protected area, up from just 15% at the beginning of the campaign; 85% said they were ready to petition the government for better controls of agricultural chemicals, up from 61% at the beginning. Other indicators, such as whether respondents knew of alternatives to agricultural chemicals, remained flat at around 30%. Promoting alternatives became the central focus of Sanchez' follow-up efforts to conserve the La Amistad Biosphere Reserve—his local pride. To learn more about Rare's social marketing methodologies for conservation, visit www.rareconservation.org.

15.8 Outreach for policy

While local communities and protected area officials are important targets for outreach activities, an equally challenging need is for scientists and practitioners to engage in outreach that influences policy goals (Noss 2007). However there is acknowledged lack of clarity regarding advocacy in conservation biology which influences the ability of conservation biologists to effectively direct their expertise to policy decisions (Chan *et al.* 2005, 2008). At the core of this debate is the degree to which conservation biologists honor their commitment to the inherent value of biodiversity.

Given that scientists are still trained almost entirely in research methods, not public communication or policy intervention (Lovejoy 1989), there is some fear that engagement in public education and policy intervention can reduce credibility (Blockstein 2002). One thread of this debate is based on the need to relinquish commitment to the inherent value of biodiversity while another thread suggests that conservation biologists should explicitly advocate for values (e.g. biodiversity) and are obligated to step well beyond research to recommend solutions to policy goals (Chan 2008).

15.9 Monitoring of Biodiversity at Local and Global Scales

Monitoring is critically essential to determine the extent to which protected areas are effective in conserving biodiversity or achieving other management objectives. Monitoring that provides assessment of threats in a manner that allows managers to respond effectively, is central to good conservation management (see Chapter 16). Danielsen *et al.* (2000) define 'monitoring' as data sampling which is: (i) repeated at certain intervals of time for management purpose; (ii) replicable over an extended time frame; and (iii) focuses on rates and magnitude of change. Monitoring helps identify priority areas for research and conservation, and to quantify the response of plant and animal populations to disturbance and management interventions. Countries contracting to the Convention on Biological Diversity are obliged to monitor

Box 15.8 Hunter self-monitoring by the Isoseño-Guaranı´ in the Bolivian Chaco

Andrew Noss

The 34 400 km^2 Kaa-Iya del Gran Chaco National Park (KINP) in Bolivia was created in 1995 to protect the Gran Chaco's natural resources and the traditional use areas of the indigenous residents surrounding it, the Isoseño-Guaraní, Chiquitano and Ayoreo (and a group of non-contacted Ayoreo living within it). It is the largest dry forest protected area in the world, and contains high levels of biological diversity, particularly mammals, with at least 10 endemic mammal taxa, most notably the Chacoan guanaco (*Lama guanicoe voglii*) and the Chacoan peccary (*Catagonus wagneri*) (Ibisch and Me´rida 2003). KINP is the first protected area in South America co-managed by an indigenous organization, the Capitanı´a del Alto y Bajo Isoso (CABI) which is the political authority representing the 10 000 Isoseño-Guaranı´ inhabitants of the Isoso. Isoseño livelihoods are based on agriculture, livestock, hunting, fishing and permanent and seasonal wage labor. Prior to the creation of the KINP, most of the 23 Isoso communities had legal titles of their lands as community lands covering an area of 650 km^2, encompassing settlements, farming, and livestock lands. In 1997, based on their historical occupation of the area over the past 300 years, CABI formally demanded 19 000 km^2 as a 'Tierra Comunitaria de Orı´gen' or TCO adjacent to, but not overlapping, the KINP. Principal threats to both the TCO and KINP include illegal settlements and inappropriate management of land and natural resources with the conversion of Chaco forests to soybean farms and extensive cattle ranches (overstocking, no management of forage, minimal veterinary care), sport hunting by city-based hunters, and large-scale regional infrastructure programs that include international gas pipelines and highways.

Like other indigenous groups, many traditional beliefs and local practices among the Isoseño influence their hunting behaviors to favor wildlife conservation. A hunter must follow certain rules in order to retain the favor of the spirits that guard wildlife. For example, hunters should not hunt young animals, hunt excessively or beyond family needs, or mistreat animals by wounding them and allowing them to escape. Additional local practices that favor wildlife conservation include seasonal rotation of hunting areas that respond to seasonal movements of animals according to availability of food, as well as the accessibility of different areas, no hunting of certain vulnerable species (primates, guanacos) and the substitution of other activities (such as fishing and farming) to hunting in particular seasons. Seeking to integrate these traditional beliefs and local knowledge of wildlife with political/administrative requirements and scientific management, in 1996 a joint team of an international NGO, the Wildlife Conservation Society, and CABI personnel initiated a wildlife and hunting monitoring program in the 23 Isoseño communities. The principal objectives were to: (i) determine whether subsistence (armadillos, peccaries, brocket deer, tapir) and commercial (parrots, tegu lizards) hunting by Isoseño communities was sustainable;
(ii) generate management recommendations to ensure that hunting would be sustainable in the indigenous territory, thereby reducing potential pressure on the KINP; and
(iii) consolidate the concepts and practices of wildlife management together with hunters and communities (Painter and Noss 2000). The principal method to estimate hunting offtakes was a hunter self-monitoring program with voluntary participation: hunters carried data sheets with them on hunting excursions to record information on the hunt and on any captured animals, and they collected specimens (skulls/jawbones, stomach contents, fetuses) of hunted animals. Community hunting monitors assisted the hunters to record, collect and analyze the data for the entire community on a monthly basis (Noss *et al.* 2003, 2004).

The communities selected Isoseño parabiologists and hunting monitors, the majority with an elementary and some with high school education. Following an initial six month volunteer period, those who expressed the most interest and initiative were hired by the program. Monitors (seven to ten individuals each living and working in their home community) were hunters hired part-time to support the recording of hunting data in communities (by encouraging hunters to participate in the self-monitoring program, and

continues

Box 15.8 (Continued)

by periodically collecting information from hunters in their community). Parabiologists (six to eight individuals working in their home community or other research sites in the Isoso) were hired full-time to support wildlife research according to their individual specialization. Through field courses and practical experience, these Isoseño technicians began to assume greater responsibility for designing and implementing research programs with hunters.

Hunter self-monitoring (100–150 hunters per month) combined with monthly activity records for potential hunters (7637 observed hunter-months) permitted estimations of total offtakes of subsistence game species for 1996–2003, as well as catch-per-unit-effort over the same time period. These data showed considerable fluctuations from year to year and no declining trends that would suggest over-hunting.

Experience from the monitoring project suggested that even simple approaches such as hunter self-monitoring or line transect surveys required considerable effort by both project staff and volunteers in order to provide sufficient information for management interventions. Thus, precise and detailed population density estimates are difficult to obtain in situations with a large number of species and/or large study areas such as the Isoso with only basic tools and non-professional personnel.

Ideally, adaptive management would include continuous population monitoring over long time periods using selected indicator species assemblages, detailed studies of ecological principles and processes, and studies of population trends in sink and source areas (Kremen *et al.* 1994; Hill *et al.* 2003). Such detailed monitoring is prohibitively complex and expensive not only for territories under the jurisdiction of indigenous peoples but also for most protected areas in general.

Instead, it may be more useful to consider adaptive management in a broader context focusing on fundamental requirements for informed decision-making. Assuming that communal decision-making is the key, detailed scientific information and sophisticated analyses may not be as important as ensuring that: (i) information familiar to resource managers is used; and (ii) participatory methods provide the inputs and framework for discussion (see also Danielsen *et al.* 2005). Hunter self-monitoring provides a means to engage large numbers of community members in data collection. By generating the data themselves, people become conscious of underlying problems, for example perceived or actual over-hunting of a certain species, and can thus think about solutions to address the problems. In turn, reflection processes may lead to preliminary management action that can be consolidated in an adaptive management process. Approaches that integrate traditional customs and knowledge with scientific methods, bringing together community members with specialists can have positive outcomes for conservation (Becker *et al.* 2005; Townsend *et al.* 2005). In the Isoso case, this integration took place at several levels. At a first level, community members indicated through discussions the most important game species and described hunting practices and traditions regarding wildlife management. In turn, through hunter self-monitoring and observation of hunting activities, hunters themselves and trained community members (parabiologists and monitors) confirmed and quantified what hunters did in practice. Strong traditional authority structure and community organization, a favorable legal/institutional framework, the ability of government authorities to appropriately implement their responsibilities, and financial and technical support from private partners to the process were all important determinants of effective engagement of communities in this wildlife monitoring program.

This box is adapted from Noss *et al.* (2005).

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Box 15.8 (Continued)

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biodiversity (Article 7.b), and donors increasingly demand accountability and quantifiable achievements in return for their assistance. Given that biodiversity conservation is one of the key objectives of protected areas, the development of biodiversity monitoring systems for protected areas now attracts a significant proportion of the international funding for biodiversity conservation.

However, conflicts between the scientific ideals and practical realities of monitoring influence the implementation and effectiveness of monitoring systems. For instance, most practitioners agree that in an ideal world, monitoring programs would always be spatially and temporally comprehensive, rigorous in their treatment of sampling error, and sustainable over the time scales necessary to examine population and community level processes (Yoccoz *et al.* 2001). Nevertheless, monitoring of biodiversity and resource use in the real world is often costly and hard to sustain, especially in developing countries, where financial resources are limited. Moreover, such monitoring can be logistically and technically difficult, and is often perceived to be irrelevant by resource managers and local stakeholders. Many suggest the need to identify some middle ground between the need for scientific rigor and goals for program sustainability. Practitioners disagree about whether such a balance exists, and the issue has become a source of debate. At the centre of this debate is the fact that where suggestions or examples of 'appropriate' monitoring in developing countries exist, they generally are unproven in their ability to detect 'true' trends. On the one hand, poor statistical power and bias may turn overly simplistic monitoring schemes into wastes of time and precious resources – yet equally wasteful are programs so intensive they cannot be sustained long enough to address questions fundamental to effective management (Yoccoz *et al.* 2001, 2003; Danielsen *et al.* 2003; Chapter 16). Box 15.8 examines the issue of biological monitoring within the context of a community wildlife management program in the Kaa Iya Del Gran Chaco in Bolivia.

The technical and statistical problems of monitoring at a local level are relatively benign when compared to the problems of tackling monitoring at a global scale. Under the terms of an agreement signed at the Johannesburg Summit on Sustainable Development in 2002, 190 countries committed to "a significant reduction" in the current rate of loss of biodiversity. But the challenges of estimating global rates of loss are enormous (summarized by Balmford *et al.* 2005), and as the target of 2010 is approached, most indicators developed inevitably involve the use of indirect or surrogate data on habitat loss, protected area overlays with known patterns of biodiversity or with targeted studies of well known vertebrate taxa.

In this brief review we have touched on a number of the challenges in translating conservation science into practical, field based conservation actions. Conservation action lags behind conservation science for a number of reasons. Inevitably, there will be time lags in the dissemination and application of new ideas to real world situations, and the way in which theory informs practice will not always be clear at the outset. But there will also be gaps between the interests and needs of conservation practitioners, and the issues and areas of intellectual pursuit that are valued by academic departments, and institutional science donors.

Summary

- Integrating the inputs of decision-makers and local people into scientifically rigorous conservation planning is a critically important aspect of effective conservation implementation.
- Protected areas represent an essential component of approaches designed to conserve biodiversity. However, given that wildlife, ecological processes and human activities often spill across the boundaries of protected areas, designing strategies aimed at managing protected areas as components of larger human-dominated landscapes will be necessary for their successful conservation.
- Identifying strategies that simultaneously benefit biodiversity conservation and economic development is a challenge that remains at the forefront of applied conservation. Biodiversity use may not be able to alleviate poverty, but may have an important role in sustaining the livelihoods of the poor, and preventing further impoverishment. Strong institutions and good governance are prerequisites for successful conservation interventions.
- Capacity needs for practical conservation in developing countries occur at many levels from skills needed for management of natural resources to the compliance requirements of multilateral agreements. Filling gaps in capacity involves a diversity of approaches from on-the-job training of individuals to restructuring academic and professional training programs. Prioritizing capacity needs is vital to a longer-term vision of enabling responsible stewardship of biodiversity.
- The engagement of local communities in planning and implementation is critical for effective conservation. Carefully designed social marketing approaches have proved to be successful in capturing the interest of local people while achieving conservation goals.
- Monitoring is a central tenet of good conservation management. Conflicts between the scientific ideals and practical realities of monitoring influence the implementation and effectiveness of monitoring systems.
- Many of the key issues and barriers to effective conservation that face conservation biologists are inherently political and social, not scientific. Thus efforts to close the gap between conservation biologists and conservation practitioners who take action on the ground will require unprecedented collaboration between ecologists, economists, statisticians, businesses, land managers and policy-makers.

Suggested reading

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Relevant websites

- Cape Action Plan for the Environment (CAPE): http://www.capeaction.org.za/
- Centre for Evidence-based conservation: http://www.cebc.bangor.ac.uk/ and http://www.conservationevidence.com/
- Network of Conservation Educators and Practitioners: http://ncep.amnh.org

- RARE: www.rareconservation.org
- Living Landscapes: http://www.wcslivinglandscapes.com/
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