WORKING PAPER NO. 36 DECEMBER 2008

WILDLIFE CONSERVATION SOCIETY

PROTECTED AREAS, GOVERNANCE, AND SCALE

Edited by Kent H. Redford and Catherine Grippo

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WCS Working Papers: ISSN 1530-4426
Online posting: ISSN 1534-7389

Copies of WCS Working Papers are available at www.wcs.org/science.

Cover images: © Kent H. Redford

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INTRODUCTION

Protected Areas, Ecological Scale, and Governance: A Framing Paper

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Defining the Problem

Humans have crisscrossed the Earth's entire surface with lines demarcating different claims of use, access, and sovereignty. The world has been divided into towns, provinces, states, logging concessions, agricultural fields, pastures, exclusive economic zones, hunting leases, private estates, and countless other categories of human use. These human boundaries rarely correspond to boundaries formed by natural processes but cut across forests, rivers, watersheds, mountain ranges, and even oceans. This is not surprising, as human-established boundaries are created mostly to manage the economic affairs of men and women and not to maintain the resilience, productivity, and function of natural systems. Such economic partitioning has allowed humanity to capture over 50% of the planet's photosynthetic output and to mold terrestrial and aquatic systems in ways that preferentially generate goods and services of value to people. Unfortunately, it has also delineated protected areas for biodiversity that fail to satisfy the ecological requirements of the plants, animals, and processes they were established to conserve over the long-term.

Protected areas are those spaces where biodiversity conservation is the primary, but not necessarily the sole, land use objective. They can be public places such as national parks and reserves, communally owned lands, or private property. Protected areas are essential to the conservation of biodiversity because, in all other places, concerns for the protection of species, ecosystems, and ecological phenomena are subordinated by concerns for direct and indirect human use. Producing commodities for human use is most economically efficient if complex natural systems are simplified so that a greater proportion of nutrients and energy flows through only those species or processes of value to humans. As a result, ecological simplification and biodiversity loss has occurred, and is still occurring, across all but 10% of the terrestrial surface of the planet—that small portion formally designated as protected areas. Even within many of these protected areas, human use continues.

In the 2007 World Conservation Monitoring Center global database, 50% of formally recognized terrestrial protected areas are smaller than 98 ha, and only 5% are larger than 14,000 ha. Given the typically small size of most protected areas it comes as no surprise that the ecological requirements (food, shelter, breeding areas, etc.) of many species are not met by the resources contained within a single protected area. Pioneering work by Newmark (1998), Woodroffe and Ginsberg (1998), and others show that species could go extinct, and are going extinct, despite existing within a protected area. The lessons from these studies show that even very large protected areas often are not large enough to contain self-sustaining populations of some kinds of animals. Working on conservation of the contiguous populations outside the limits of protected areas has become a requirement of effective conservation. As a result, there is a growing recognition within the conservation community that the future population status of large and mobile organisms in particular will require conservation actions and management systems that extend beyond protected areas into lands designated primarily for economic development and the production of commodities valued by humans. This recognition is further strengthened by the arriving impacts of climate change, which may very well force species to move outside of the boundaries of the protected areas established to try to save them.

Similarly, although a protected area may be of sufficient extent and appropriate ecological configuration to meet the current needs of some, most, or all resident species, some threats to their long-term persistence and functional roles originate from outside the protected area. These can only be abated by actions that operate at a spatial and political scale that extends well beyond the boundaries of an individual protected area. For example, acid rain, mercury pollution, and climate change often originate far outside of protected areas, but can have severe adverse impacts on the plants and animals resident within distant parks and reserves. For these threats to be abated they require actions within jurisdictions far outside the protected areas themselves, and often beyond the frontiers of the nation.

Current protected areas are not only insufficient in size and configuration for species, but also for ecosystems with large-scale or complex dynamics such as grasslands, wetlands, lakes, or marine systems. All too often the long-term conservation of viable segments of these systems depends on what happens beyond the protected area boundaries. As with species, conservation of these ecosystems within protected areas requires working beyond the boundaries.

Lastly, the delineation and legal establishment of individual protected areas is typically a one-off event, and rarely modified. As a result, protected areas are effectively stuck in place, and their integrity and conservation value can be jeopardized by shifts in ecological conditions associated with catastrophic physical events such as volcanic eruptions, tsunamis and hurricanes, or disease, and anthropogenic shocks such as climate change and human displacement as a result of civil strife.

If we are to conserve functional ecological systems representative of the planet's biodiversity, then we need to: 1) conjure governance mechanisms that can address the fact that protected areas are often too small to meet the needs of many species; 2) understand that threats to protected areas often originate far beyond their borders, and that future natural or anthropogenic shocks can

diminish or obliterate the conservation value of or isolate protected areas; and 3) develop and implement tools and approaches that take appropriate conservation action well beyond the boundaries of protected areas.

The century of working *inside* parks to conserve wildlife has ended. Conservationists have learned that to conserve wildlife and other valued biodiversity we must now work *outside* of parks and reserves in complex areas designated for economic development. This simple but elusive realization has brought a new world of work to conservation professionals, most of whom were trained in the sciences necessary to work on biological, not social, issues. Yet clearly, working outside parks means working in a world dominated by humans and their concerns and on a set of issues fraught with historical discord and modern rhetoric.

This paper focuses on only one piece of this complex challenge: the ways in which conservation action has been informed, and should be informed, by the interaction between ecological scale and governance. The published literature does not provide much guidance—most work on the biological dimensions has been modeling, done at small scales, or largely silent on the challenges of implementation. Social science work is largely critical of the work done by conservationists and offers little guidance about how best to proceed. This paper lays out a heuristic framework for analyzing where and with whom to work outside the boundaries of protected areas to achieve the conservation of specific elements of biodiversity. It is designed to help frame the work of practitioners who have been engaged in this work already and enable informed comparison of work done across sites. Ultimately, it is hoped that this analysis will provide tools to enable more effective conservation outcomes, both for biodiversity and for people.

Conservation Targets, Spatial Scale, and Governance

Effectively conserving biodiversity requires that conservationists specify clearly and explicitly the targets of conservation efforts. Setting conservation targets is essential if our investments are to be focused and the outcomes measurable and verifiable. Conservation targets are those attributes of the biodiversity of an area (species, ecosystems) that a project is explicitly committed to conserving, and the status of which will be used to assess whether or not the investment, over the long-term, has been successful. Conservation targets are chosen because their long-term conservation is a priority. They are also critical for prioritizing those actions most likely to abate key threats. Implicit in selection of conservation targets is the belief that conserving all of them and the habitats upon which they depend will achieve the overall conservation goal for the protected landscape, i.e., maintenance of intact and ecologically functional assemblages of native wildlife and plants.

The needs of the conservation targets help define if and why actions may be necessary outside of the boundaries of a protected area. Using these needs as a means of deciding where to work allows creation of a "management landscape" for each conservation target. This management landscape overlaps with multiple other geographies of governance which incorporate resource tenure, resource use, and resource control.

Understanding the needs of conservation targets also helps us to explicitly identify the conservation goods and services emanating from *beyond* protected area boundaries that are necessary to ensure conservation *within* the protected areas, and the patterns and processes of governance relevant to them. An illustrative list features: management of habitats that support migratory flyways or pathways, or seasonal habitats; management of landscape elements that allow movement of individual animals and plants both beyond the boundaries as well as between the protected areas and other habitat blocks; management of external habitat that supports parts of populations principally located within the protected area; land use and environmental management practices potentially detrimental to the survival of individuals moving beyond protected area boundaries; and management practices in the broader landscape that allow the continuity of required ecological dynamics within the protected area (e.g., wildfire and flooding).

In the past, conservation spaces have been determined less by the ecological requirements of the plants and animals and more by the expedience of aligning with land use or jurisdictional boundaries or simply for ease of delineation. This is clearly manifest in the unnaturally straight edges of protected areas such as Yellowstone and Everglades National Parks. Protected areas based primarily on political boundaries may reduce the number of local, state, and national agencies that have jurisdiction over their management, and thus the transaction costs associated with coordinating management across jurisdictions. However, they may be of insufficient size and inappropriate configuration to meet the needs of wildlife. In these cases, even substantial financial investments may come to naught as species populations decline or ecological phenomena such as migrations wink out for lack of adequate resources or sufficiently permeable movement corridors.

Growing demand for food, fiber, and fuel for human use is evident in the fact that already 83% of the terrestrial surface of the planet has been influenced by human use, as is 98% of all land where it is possible to grow rice, wheat, or maize (Sanderson et al. 2002). This means that it is highly unlikely that existing terrestrial protected areas will be substantially increased in size to meet the needs of the species they were established to protect, or that vast new protected areas will be set aside. Given this, effective conservation of most wildlife species will require management of larger landscapes that extend beyond the boundaries of protected areas into spaces dominated by human land uses focused on generating valued commodities. Managing these complex landscapes that combine areas that preference biodiversity conservation with areas that preference generating goods for human consumption is a new challenge to the conservation community and one that will require new skills, new partnerships, and new incentives to ensure that the spaces between protected areas remain permeable enough to provide wildlife with needed resources and safe passage, whilst simultaneously generating goods sufficient to meet human needs.

Making the conservation needs explicit will allow willing partners outside protected areas, including the public and private sector organizations and civil society groups, to understand and collaborate on the requirements.

Governance and Institutions

If conservation strategies are to incorporate the wider landscapes around protected areas, they must not only address the much larger physical areas beyond protected area borders, but also the human and natural processes that influence the ecology of these wider areas. In the wider landscape, human economic production activities will typically dominate, and so an understanding of the capacity of these landscapes to support the biodiversity of protected areas demands consideration of prevailing social, economic, and political processes. Above all it demands an understanding of the way land and other resources are used and governed. The governance of land outside protected areas can be surprisingly complex, as can the institutions that determine land use outcomes. Below we develop a framework detailing the most important dimensions of understanding and action necessary to achieve conservation anchored in protected areas but informed by ecological scale and governance outside of the protected areas.

What is Governance?

When thinking about governance, conservationists often distill this down to the question: Are protected areas well or badly governed, and as a consequence are they achieving their remit, the conservation of valued plants, animals, and ecological processes? Success is typically predicated on: 1) whether protected area managers have sufficient knowledge about the ecological requirements of the plants and animals resident in the protected area, and the processes and patterns that affect them, and 2) whether they can muster sufficient control to avoid or abate threats to species and ecosystems within the protected area (e.g., Bruner et al. 2001). In areas where biodiversity conservation is the primary, formal land use objective, land and resource rights are usually well-defined in legal terms (most commonly in terms of designated ownership by the national or local state, although private ownership is also important). Questions of governance then focus on the ability of managers to enforce regulations. Good governance is commonly interpreted as the inverse of corruption (e.g., Smith et al. 2003), or where rules or norms are not contested by rights bearers and rule enforcement is not abdicated by duty holders. If conservation requires that protected area managers extend their influence over land and resource use beyond the boundaries of a protected area, the governance problem might seem simple: how to geographically extend regulations and control rule-breaking. Such strategies can indeed be important (e.g., action against illegal hunting). However, the governance problem in the wider landscape is considerably more complex, as within these larger spaces the primary objectives of land-use are multiple and often contrary to those needed to conserve biodiversity.

An important distinction is to be drawn between formal governance as "the traditions and institutions by which authority in a country is exercised for the common good" (World Bank[1]), and the governance of resources ("the use of institutions, structures of authority, and collaboration to allocate resources and coordinate or control activity in society or the economy"[2]). The governance of landscapes outside protected areas typically involves the latter: the coordination or control of activities undertaken by a variety of actors across a wide spectrum of space, society, and economy.

Conservation outside parks is therefore a *common action* problem, familiar from work in political science and institutional economics (e.g., Pretty 2002; Dietz et al. 2003). An attempt to create forms of land and resource use outside parks that support conservation within them is likely to involve a range of different kinds of actors who value the land and its resources for different reasons, holding land and resources under a variety of different kinds of institutions.The word "institutions" here is not used in the popular sense of an established public organization (the Catholic Church, the US Navy, the Wildlife Conservation Society), but in the technical sense developed in economics: *the formal and informal rules and accepted conventions that regulate collective human action* (Bromley 1989).

There are three critical dimensions of the challenge of extending conservation-friendly management beyond protected area borders. First, we need to know **who** manages the land or ocean and its resources, i.e., what **actors** are involved. Second, we need to know **how** they hold the land, i.e., what **forms of tenure** are involved. Third, we need to know **what** they have tenure over, i.e., what kind of rights they hold. These are explored in the following sections.

What Actors are Relevant?

Land in parks is often owned and managed by single organizations, very often by the national state or local state (e.g., as a national reserve or state park), although increasingly, protected areas are being created that are in whole or in part privately owned or managed (Carter et al. 2008). Land immediately outside protected areas may be held by the state (e.g., as forest reserve). But as agriculture and other forms of intensive land use expand, protected areas are increasingly surrounded by land held by a variety of different kinds of state and private owners and occupiers with a range of different sets of rights and interests.

This section reviews the range of actors who may be relevant to attempts to bring about conservation management outside protected areas. This is important because when viewing wider landscapes beyond parks it is easy to underestimate the complexity of ownership patterns and to miss identifying key actors. Furthermore, different kinds of actors will have different rights, interests, and capacities, and will need to be approached in different ways. Thus, persuading a large state organization (e.g., a forestry or fisheries ministry) to change its policies to favor conservation is a very different task to engaging a small number of large ranch owners in managing their land differently, and different again from the challenge of engaging several thousand small farmers. If we do not understand whose management we need to influence, our efforts are unlikely to bear much fruit.

Individuals: It has become conventional to think of individual people as social actors of great importance in industrialized western economies. The discipline of economics has traditionally sought to explain human behavior in terms of aggregated individual decisions to maximize welfare. Individuals are relevant to extra-park management in several ways: as subsistence entrepreneurs, whose activities within the wider ecosystem affect the protected area (e.g., hunters

or fishermen); as landowners, whose decisions about the management of their farms, lands, or homes affect the park (e.g., use of pesticides within a catchment, felling of timber on surrounding land); as consumers who live far away, but whose decisions about what they buy, eat, or use can have profound effects on the incentives driving local actors' uses of biodiversity within and surrounding protected areas (e.g., Beijing consumers of Asian traditional medicine influence bear conservation in Idaho; U.S. consumers of soymeal-fed poultry influence land clearing for agriculture in Bolivia); and as citizens/voters, whose degree of support for environmental measures could affect the management of a protected area (e.g., attitudes to restrictions on infrastructure development; attitudes to human-animal conflict such as wolves around Yellowstone).

Households: It is often assumed (especially in studies of the rural developing world) that households operate as a unit. This may be a reasonable assumption for analytical purposes (e.g., in distinguishing between the livelihood options and strategies of richer and poorer households, those with access to livestock or without, or those with HIV-positive adults or without), although the technical difficulties of defining "who eats out of one pot" can be considerable. There can also be strong divergences in attitudes, material interests, and actions within households (e.g., between young and old, men and women, blood kin and in-laws).

Communities: Some groups of individuals and households may form communities, and there may be political structures (e.g., village heads or village councils) and shared formal institutions (e.g., local rules such as when and where resources can be used) or informal institutions (e.g., shared cultural norms related to ethnicity or religion). It is easy to assume that such institutions always exist in the rural developing world (in a way that we may not assume they exist in suburbia), but in practice many co-resident people are divided by ethnicity, wealth, or class, and many areas of land and resources are contested between groups living together (e.g., people of two ethnic identities in one village) or apart (e.g., between resident farmers and mobile pastoralists). When we talk of communities, we must make clear distinction among communities of place (folks that just happen to live near one another), communities of practice (folks that derive their livelihoods from similar activities (i.e., fishers, farmers, loggers, lawyers, conservationists, etc.), and communities of interest (folks that care about the same things). When seeking to identify groups that may together form a constituency for conservation in landscapes that extend beyond protected areas, *communities of interest* should be the focus, as such actors can be the best allies or the most challenging opponents.

Firms: Business corporations, either privately or publicly held, often hold land around protected areas (e.g., as farms, urban development land, mines, or forest concessions), or control or affect environments or resources relevant to the biodiversity in a park (e.g., by releasing pollutants or by managing logging concessions). Business and other corporate entities exist in a range of forms, including large transnational companies, family-owned businesses, and coop-

eratives that can include private sector, public sector, and civil society groups. In some cases it may be hard to distinguish between a "community" organization such as a cooperative and a "private" business, or (where the state is a shareholder) between private business and the state organizations. The prevalence of "tri-sector" partnerships in conservation (state/community/private) makes this more problematic.

Municipalities (Ward, District, Town, County): Local governments are important lawmakers, with powers devolved from (or more often abdicated by) central (national) government.

State/Provincial governments: In federal jurisdictions, various kinds of powers can be devolved from central (national) government, such as waste management and co-regulation of land use by zoning. For example, the power to limit pollution usually resides with national government, but state and local governments can set higher standards if their constituencies so demand, e.g., with respect to carbon pollution.[3]

National governments: Governments have power to legislate in a wide variety of ways that are directly relevant to conservation outside parks, e.g., hunting, forest management, pollution.

International governance: An array of international agreements limits or influences the power of states and their citizens to manage the environment. Some international agreements seek to control the global commons (e.g., Convention for the Conservation of Antarctic Marine Living Resources, UNFCCC).

What Forms of Tenure are Relevant?

Not only can a wide variety of actors hold land outside protected areas that is relevant to the biodiversity inside, but they can also hold it in a complex range of ways. It is easy to think of landholders as freehold "owners" of land who control almost very aspect of the land's use. However, there are in fact often a number of different rights, and they can be held by different actors. Similarly, in the developing world it is easy to think of smallholder farmers without written ownership documents as existing in some kind of limbo of "traditional" tenure. But here, too, there are usually quite specific bundles of rights held by identifiable people. In any attempt to extend conservation-friendly land management beyond park boundaries, it is as important to know **how** people hold their land as it is to know **who** holds it. This section sets out the different tenure regimes under which land and resources relevant to parks can be held:

Legal or formal tenure: Many parks are surrounded by land held under formal legal tenure. Legal tenure can either be privately or publicly held. The former does not solely mean individual tenure; rather, it means confined to particular persons or groups, i.e., tenure held by an individual, family, community, or firm. The latter is the state.

Customary tenure: In many places land and natural resources are held in common among a specified group of people and managed according to communal institutions, i.e., rules and regulations defined and enforced through tradition not the law of the land. Many areas of pastoral land and forest are held in this way (Ostrom et al. 1999, 2003; Dietz et al. 2003). The famous paper on "The Tragedy of the Commons" by Garret Hardin (1968) confuses such customary property regimes with open-access resources, which lack a defined management group.

Open-access: This category includes land and resources held by no one, without legal restrictions on entry and use. The open ocean and the atmosphere are the classic open-access resources, but many pieces of land of unclear or disputed ownership can be effectively open-access resources.

De jure and de facto tenure: It is important to distinguish between the legal basis on which land and resources are held, and the regime prevailing at any given time. *De jure* rights are those that exist in law. *De facto* rights are those that exist in practice. If the rule of law is closely maintained, the two should coincide. However, this is often not the case. Additionally, there can be problems where new resources are created (e.g., direct payment for carbon or other commoditized ecosystem elements, or payment for ecosystem services programs).

Very often, conservation faces the problem that *de jure* tenure regimes are either unclear, contested, or simply ignored. Thus, people occupy land or exploit resources illegally, either in direct contravention of known and accepted laws or because formal legal regimes contradict locally recognized traditions. Whatever the *de jure* tenure regime, it is relatively common for the *de facto* regime to be open-access (e.g., poaching by anyone of any amount). Such *de facto* open-access resource use can be fostered by corrupt payments to law enforcement officials and at times the complicit support of local people who may perceive the *de jure* regime to be illegitimate and counter to their material needs.

What Rights do Actors Have?

It is easy to think that the person who manages a piece of land has complete control of what is done on it. But things are often more complicated than that. Rights can be thought of as a bundle, and it is important to know which rights form part of the bundle and which do not. Quite a few rights relevant to conservation may be separated from rights to the land itself, e.g., rights to air and water, or to mobile species. Even where land ownership is formally and legally fixed (as in many industrialized countries), some rights can be held by other actors (e.g., subsurface rights), who then must be made part of the equation. In developing countries, where rights to land can be less firmly lodged in formal legal procedures, diverse ownership of such complex resource bundles can be very important. Even in industrialized countries, some rights may be subject to tradition (e.g., rights of access, or rights of commons in the UK). Where questions of rights are contested (e.g., in classic disputes between local people and park authorities, or between home owners and utility companies), it is often these wider bundles of rights that are in dispute rather than any simple claim to land ownership (e.g., rights of access to religious or ancestral sites).

Minerals: Landowners often do not have the rights to extract oil, gas, and other sub-surface minerals. Often these rights are retained by the state and licensed to private companies who have the power to enter land and search for or extract minerals. Such rights can conflict with other uses of the land, such as conservation.[4] Agreements with landowners around parks need to take account of the threat to biodiversity from mineral rights that they do not own, and agreements need to be extended to include these mineral rights holders.

Water: Rights to extract groundwater are often licensed separately from land ownership. In developing countries, rules about who can use wells or other water sources in drylands are often quite complex (e.g., relating to kinship, need, and other factors), but also quite specific. Rights to extract water from streams or rivers are subject to differing formal and informal legal regimes. Protected areas are often affected by upstream water extraction. The extension of conservation outside protected areas needs to address the powers of other parties to consume or access water in surrounding landscapes.

Timber: Rights to harvest timber (sometimes tied to the regeneration of forests, e.g., the Canadian Tree Farm License) are often retained by the state and leased to commercial enterprises. Such rights can conflict with other rights on the same land, e.g., the occupancy or use rights of indigenous people. Because of these rights, government licensing authorities and private corporations are important actors in wider landscape conservation efforts.

Hunting: Regulations may involve what species can be hunted (quarry species); when (seasons); by whom (licensed hunters versus indigenous rights); and how (e.g., issues of cruelty, snares, sportsmanship). These provisions often conflict so that, for example, formal hunting rights are retained by the state and licensed commercially, against the interests and traditional rights of local people. Engagements in wider landscapes must address commercial and state actors relevant to hunting rights.

Fishing: Fishing rights may be held by those with a government license (or marine quota), or those with membership of a fishing organization or specified community ownership of riparian land. Marine fishing is often poorly regulated or unregulated, even within the 200 mile coastal economic zone limit. Addressing marine fishing rights requires engagement with state agencies and commercial fishing interests, the latter potentially from a variety of nations (as in the case of EU fishing in territorial waters off Africa). Deep water fisheries are classically open-access, but may be subject to international agreements (e.g., the Southern Ocean, under the Convention on the Conservation of Antarctic Marine Living Resources).

Gathering/Harvesting: Rights to cut wood (or gather fallen timber), or to cut and collect thatching grass, medicinal herbs, or other plants may be held by people other than the nominal landowner. Such rights are common in rural

areas of developing countries (e.g., Jacoby 2001). In some countries such rights may extend to all citizens (e.g., Swedish rights to collect fungi or berries; British rights to gather shellfish from the intertidal zone).

Development: The rights of landholders to change land from rural to urban use may be restricted by the state in the common good (e.g., measures in the UK to control urban sprawl and building regulations that restrict building density or design). Alternately, the state may take land through eminent domain from a land owner, if that taking is declared in the public good (e.g., when land is obtained to construct a school or a new airport).

Access: Ostrom and Schlager (1992) define rights over resources in terms of progressively more inclusive rights. Access confers rights of entry to enjoy non-extractive benefits. Withdrawal rights allow users to obtain resources. Rights to enter and cross land often exist where systems of private property are well developed (e.g., in the UK).

Building Conservation Governance outside Protected Areas

The challenge of bringing about management regimes outside parks that support conservation within them is a complex commons problem, and it is inherently political. A number of different kinds of actors are likely to be involved (individual, corporate, public, private, communal). The range of actors relevant to the park and the spatial extent of the area required to conserve particular species or ecosystems may not be clear to all actors. The rights of those actors to land and other relevant resources can overlap. Those holding rights may not come from a single political or communal unit. Systems of communication among all relevant actors may not exist. Rights can be unclear or contested, so that *de facto* and *de jure* rights may diverge. The park management agency (or its advisers) may not have legal standing, political legitimacy, or effective voice in the wider landscape and community.

Scale is a critical factor in determining the extent of the challenge of securing conservation outcomes around parks, and the scale will vary with the conservation target. Broadly speaking, we might expected the number of actors, uses for land and natural resources, and motivations underlying land management regimes to increase with distance. Thus, the further you move outside a park boundary, the greater the complexity of the "common action" problem and therefore the challenge of achieving conservation-friendly management.

The diversity of issues that need to be addressed, and hence the scientific challenge of understanding threats (e.g., limits to knowledge of social or ecological conditions; the political challenge of communicating threats to other actors), is likely to increase with spatial scale, as are the number of factors that might complicate negotiations between interest groups (e.g., number of ethnicities and civil jurisdictions; the challenge of communication; limits of face-to-face democracy; trans-boundary problems).

Potential Strategies

Clearly the range of actors relevant to land and resource management around protected areas is large, and the systems of land and resource tenure in place are complex, requiring a range of strategies to engage constructively with these people and organizations. No simple systemic framework can be defined to structure this engagement, nor can a recipe book be compiled that is applicable to all circumstances. Instead, some menu suggestions are outlined here.[5] Most will already be familiar to those with experience in "community conservation" (e.g., McShane and Wells 2004; Brosius et al. 2005), although here they need to be applied to new actors in a geographically wider and institutionally more challenging terrain. Site-level actions will require mixing these different strategies as the circumstances and challenges vary—yet another challenge to conservation success.

Moral Argument

A range of well-tried techniques seek to promote conservation-friendly behavior among human communities. The simplest is conservation education: a generic attempt to win support for conservation, or a specific attempt to promote particular forms of behavior change. Such changes might include particular changes (e.g., to persuade local rural communities to stop hunting for the wider good), or wider changes (e.g., attempting to influence patterns of resource consumption such as car travel among regional visitors to popular protected areas). Such campaigns often focus on the general public or the immediate neighbors of a protected area (e.g., "Roots and Shoots" type activities). To address the wider landscape there may need to be something in between. Such work would include Landcare in Australia[6] or the UK Farming and Wildlife Advisory Group.[7] Such groups work on long-term relationships with rural landowners and occupiers. There is much to learn from this approach in the developing world, where conservationists routinely lump rural people together under umbrella terms such as "the community," and seek standardized approaches and quick gains.

Political Engagement or Campaigning

Sometimes local action in individual landscapes needs to be extended to the wider policy context. Policy reform may be important to work with local actors to promote change in wider economic policies. An example of this would be work by conservationists in the UK since the 1980s with farming organizations to develop agri-environment provisions of the European Union common Agricultural Policy. As in many tropical contexts (e.g., beef raising, oil palm, or *Jatropa*), the agricultural economy is the chief driver of rural landscape change, and agricultural policy is therefore critical to preventing harmful change and promoting benign change in landscapes around protected areas. Such policy change might extend to attempts to influence national legislation.

At these larger (often national) scales, political lobbying can be important: attempting to work with existing structures of power (e.g., state institutions, local powerful landowners, or political interests) to achieve outcomes that support conservation-favorable land uses. This might include issues such as transparency in government licensing of forestry or minerals, or taxation policy.

Such political negotiations may be difficult if governance is inadequate. Therefore promotion of democratic decision-making may be a necessary step to effective wider landscape conservation. Deliberative democracy (opening debate among residents about the place of nature or land use) may promote such outcomes (O'Riordan and Stoll-Kleeman 2002).

Market Mechanisms

The markets are leading drivers of land management, so intervention for conservation in the wider landscape around protected areas may be promoted by direct market interventions. These have become fashionable in conservation (Ferraro and Kiss 2002; Balmford and Whitten 2003), although experience is still being gathered on their long-term effectiveness. Approaches include direct payments for biodiversity: payments to landholders or other relevant groups (e.g., hunters) to ensure the survival of specified areas of habitat (e.g., forests) or species; and more general payments for ecosystem services: schemes where beneficiaries pay landholders for services provided (e.g., downstream, water consumers pay upstream landowners who keep forests), or where polluters pay others to change behavior in ways that reduce overall environmental problems (e.g., REDD).

Related economic measures include easements: payments for selected rights on land that remains private (e.g., to restrict owners' rights to develop). This approach has been widely used in the U.S., with some conservation organizations buying land, taking out easements, and selling to sympathetic private landowners.

There is also extensive international experience with land use incentives: schemes that compensate landowners who maintain production systems that maintain environmental features or who switch to more beneficial land use. The European Union Agri-Environment Programme has enabled a range of such initiatives, such as the UK's Countryside Stewardship scheme. This defines a complex set of management regimes designed to favour biodiversity (or traditional landscape), offering per-hectare payments to landowners who agree to abide by the rules.[8] The effectiveness of such approaches in ecological terms and the cost-effectiveness of the scheme compared to other strategies are widely debated.

Legislation and Law Enforcement

A range of forms of land management injurious to biodiversity can be addressed by legislation and law enforcement. Examples include legislation to control polluting activities by landowners (e.g., the release of pig slurry) or industrial activities (e.g., effluence from an industry such as leather tanning). Such approaches are especially useful where threats are diffuse.

Legislation is also relevant where specific activities are seen to be damaging, e.g., hunting or fishing. Such legislation can be national (e.g., to control what species may be shot or what methods may be used to control predators) or local (e.g., local by-laws to control where and when fishing is done).

Legislation is also important where the "wider landscape" relevant to conservation within protected areas includes open-access resources (notably the high seas). Here the challenge may be to fill a legislative vacuum, attempting to

promote the creation of political institutions to control destructive activities in open-access regimes, e.g., controlling fishing for krill or Patagonian toothfish in the Southern Ocean off Antarctica.

Conclusions

Conservation of functional populations of species and functional ecosystems demands that we look beyond the boundaries of protected areas to address the management of much wider areas. If protected areas are isolated islands they will not maintain their conservation value. Most protected areas are too small to meet the needs of the species they were created to protect, and while better management of protected areas themselves is a priority, it is just part of the challenge of management that faces conservation today.

Conservationists must acquire new skills to work *outside* protected areas on land subject to complex and conflicting demands of human economic development, and owned and managed by people and organizations that may not recognize conservation as a priority—or even as a valid goal. Focusing our efforts outside protected areas demands that we work with a wide range of partners in areas that may be currently impoverished in their diversity. We need to understand the disciplines of economics and law, and above all we need to understand human society and human decision-making. We need to develop a greater understanding of how ecological processes interact with economic activities, and how species and ecosystems are impacted by human behavior, at larger spatial and temporal scales. We need new skills if we are to create landscapes that can succor and support protected areas, and if we are to ensure that our protected areas provide the natural and cultural values to sustain the human populations that depend upon them. But more than those skills, we need passion and vision to engage in the challenge ahead.

[1] Governance includes (i) the process by which those in authority are selected, monitored, and replaced; (ii) the capacity of the government to effectively manage its resources and implement sound policies; and (iii) the respect of citizens and the state for the institutions that govern economic and social interactions among them. http://web.worldbank.org/WBSITE/EXTERNAL/WBI/EXTWBIGOVANTCOR/0,,contentMDK:20678937~pagePK:64168445~piPK:64168309~theSitePK:1740530,00.html

[2] After *Wikipedia*: http://en.wikipedia.org/wiki/Governance.

[3] For example, Boulder, Colorado's, vote for a carbon tax (http://www.msnbc.msn.com/id/15651688/) and California's 'Global Warming Solutions Act' 2006 (http://www.climatechange.ca.gov/).

[4] Even in national parks, such as Yasuni National Park in Ecuador, see http://www.corpwatch.org/article.php?id=14982.

[5] For a more detailed typology of conservation actions, see http://conservationmeasures.org/CMP/IUCN/Site_Page.cfm.

[6] See http://www.landcareonline.com/.

[7] See http://www.fwag.org.uk/.

[8] See http://www.defra.gov.uk/erdp/schemes/css/default.htm.

PART I: WCS CASE STUDIES—AFRICA

1.1 How Conkouati-Douli National Park is to Survive the 21st Century

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Introduction

Protected area management is heavily influenced by levels of economic stability and levels of institutional capacity (Bruner et al. 2001; Balmford et al. 2003; Smith et al. 2003; Dietz et al. 2007). Many protected areas (PAs) suffer from serious levels of illegal extraction of land and resources despite laws and conventions to protect them (e.g., Huber 2001; Scherr et al. 2004). Rapid economic development is favoured over slow durable development, especially in places where people are poor (Huber 2001). Immediate needs for poor people's survival are more important than worries about what will remain for their children if they survive. Economic benefits from conservation can improve community tolerance towards wildlife and conservation and reduce illegal exploitation (du Toit 2002; Balmford and Whitten 2003). This understanding has led to ideas of promoting controlled use of PA resources by the adjacent communities and extended to ecological economics, promoting exploitation of economic values of ecosystems to improve overall economic stability in developing countries (Smith et al. 2003; Ehrlich 2008). However, in countries with limited governance capacity, where conventions and laws are of little protective value on the ground, sanctioned resource use will lead to abuse and resource degradation and therefore can only work if combined with enough man power to strictly control sanctioned resource offtake (Soehartono and Newton 2001; Dietz et al. 2007).

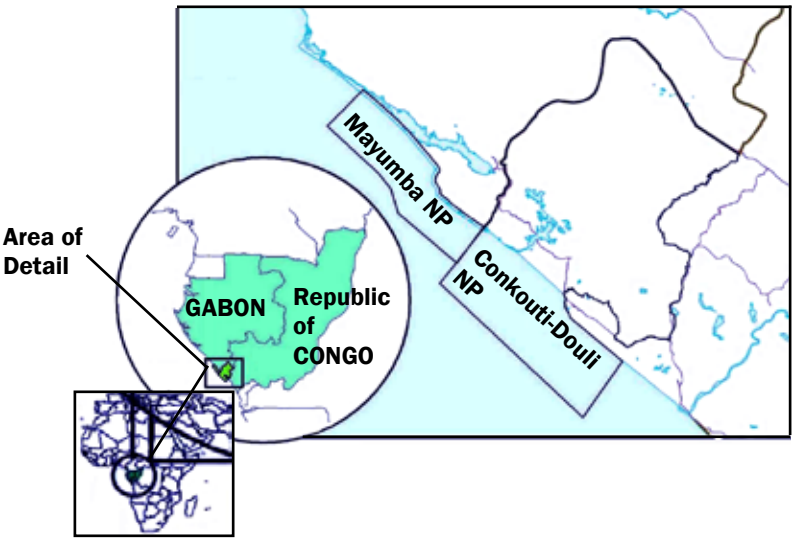
The Republic of Congo is a party to the Convention on International Trade of Endangered Species (CITES), Convention of Biological Diversity (CBD), Convention of Migratory Species (CMS), Framework Convention of Climate Change (FCCC), the Ramsar Convention on Wetlands, and of the African Charter of Human and Peoples Rights (ACHPR). Congo is also a

member of the Commission of Ministers in charge of the Forests of the Congo Basin (COMIFAC) and Congo Basin Forests Partnerships (CBFP), and has its own set of national laws governing forestry, wildlife, and the environment. Nevertheless, natural resources are extracted industrially and illegally from its PAs. Using Conkouati-Douli National Park (CDNP) as an example, this paper describes PA management challenges at different levels related to unsustainable resource exploitation and corruption.

The Site

CDNP lies on the coast of the Republic of Congo and borders the Mayumba National Park in Gabon (**Figure 1**). CDNP was created in 1999 by a presidential decree and has an area of 5,050 km^2. Uniquely, this park includes the only protected marine zone in Congo, an area of 1,200 km^2, and with neighboring Mayumba National Marine Park represents the only two officially protected marine parks along the entire coastline between Angolan and Equatorial Guinea. The large range of biotopes, including ocean, littoral forests, savannah, lagoons, mangroves, wetlands, and mountain forests render CDNP the most biologically diverse PA in Congo. A road leads from Congo's economic capital Pointe Noire to the boundary of CDNP, where it splits, traversing the park in two directions. Tarred for much of the route, this road provides easy and rapid access to the park's southern boundary. From the junction a "coastal road" runs parallel to the coast and a second "forest road" demarcates the southeast CDNP boundary through the Mayombe forests up into the Niari plains (**Figure 1**). Thirteen villages with a total population of approximately 3,000 are located along the coastal road and 12 villages with an additional 3,000 people are located along the forest road.

Figure 1: Conkouti-Douli National Park.



The PA Status, History of Establishment, and Relations with People

CDNP had been the Conkouati Wildlife Reserve on paper since 1980. It was upgraded to National Park by Decree N99-136bis in August 1999 and was provided with a five year management plan. The International Union for the Conservation of Nature (IUCN) has defined six protected area management categories; category 1 has the strictest protection levels. According to the IUCN definition, a "National Park" has a very rigorous protection status which under its current criteria the CDNP does not meet. Because the CDNP contained people when created, the park was divided into different zones with different types of protection statuses, which are described in the management plan as follows: integrally protected zones, set aside only for tourism and research and conforming with the IUCN status of a national park; ecodevelopment zones, set aside for controlled resident community development activities; multiple usage zones, representing active industrial concessions until the expiration of exploitation licenses; and temporarily protected zones, representing ex-concessions protected for a period of five years to allow restoration of natural resources, after which time they can be declared integrally protected or ecodevelopment zones. A 5 km buffer zone was created around the southeast park boundary and the ocean section was named a marine extension without a specific protection status.

The company COFIBOIS left CDNP in 2005. The other extant company, Man-Fai-Tai, was handed over to another company called SICOFOR in 2007 and is provisioned to be active until 2011. The CDNP Park Decree prohibits all types of industrial exploitation and exploration in the integrally protected zones.

PA management activities were being implemented by IUCN from 1994 through 1999 when the area was still the Conkouati Wildlife Reserve. Due to political instabilities and financial problems, IUCN left when CDNP was created in 1999, and in 2000 the Wildlife Conservation Society (WCS) took over management in partnership with the government of Congo (GoC), the latter represented on-site by a conservator and an assistant from the Ministry of Forestry Economy (MEF). The first anti-poaching efforts were made by WCS in 2000 but were confounded by local authorities involved in bushmeat traffic. These authorities encouraged aggression towards park employees, and WCS withdrew from CDNP in protest at the end of 2003. The GoC promptly condemned the behaviour and various local officials were removed from office. WCS returned in 2004, initially with the assistance of the Congolese army. By mid-2004 significant management funding was attained, the surveillance team was increased to 22 guards, and environmental education, socio-economic work, and biological research efforts intensified.

Relationships between CDNP management and park inhabitants differ for villages along each major road axis. About 95% of the population along the coastal road is of Vili ethnic origin, and they have occupied the area since at least the 13th century. Vili people are traditionally fishers but historically also traded slaves and ivory. The population on the forest road includes over 30

ethnicities from the Mayombe forests, and they live primarily by hunting, some agriculture, and agro-forestry. Their settlement in the area is coincident with the development of logging companies and spans fewer than 100 years. Several villages along the forest road are less than 20 years old.

When CDNP was created in 1999, many local people were involved in poaching and/or trafficking of bushmeat to the nearby city of Pointe Noire. When WCS arrived in 2000 the surveillance team was limited to seven eco-guards, and they were understandably overwhelmed by poaching. Fifteen more eco-guards were recruited and trained in 2004, and anti-poaching efforts intensified by 2005. Anti-poaching efforts along the coastal road did not negatively affect relations between the local communities and CDNP management as strongly as along the forest road because most poachers along the coast were not locally resident and they just left CDNP, whereas most poachers along the forest road are locally resident. Some locally resident hunters converted to other activities: some became merchants of legal goods between Pointe Noire and the villages, some are employed as guards and research assistants by CDNP, and some continue to hunt, although hunters are now a minority. Subsistence hunting is allowed at CDNP if the gun is locally registered (less than $2/year), and within the designated hunting season and hunting zones. People cannot hunt protected species nor can they sell legally hunted meat outside CDNP. Traffic of bushmeat has been strongly reduced along the coastal road but still remains intense along the forest road, mainly because there is much more vehicle traffic along this road, as it is also used by many logging companies from neighbouring Niari District to transport goods to Pointe Noire. The high demand for bushmeat comes from the nearby city of Pointe Noire (<120 km), with a population of approximately one million people. As Pointe Noire grows, so does the pressure on CDNP's natural resources. Bushmeat has a higher retail value than imported meats in the city but is consumed in large quantities. Amongst other motivations, the consumption of bushmeat is strongly associated with status, and the city boasts a large wealthy middle and upper class.

Conservation Targets of Focus

CDNP's features include:

- The most biologically diverse PA in Congo;
- The only Congolese PA to include a marine protected area;
- PA with five species of marine turtles and a beach that is amongst the most important in the world for the nesting of leatherback (*Dermatochelys coriaceae*) and olive Ridley turtles (*Lepidochelys olivaceae*);
- PA with important wetland areas (Ramsar site);
- PA with forest elephants;
- PA with a significant abundance of western lowland gorillas and chimpanzees.

The park's large variety of biotopes renders it the most biologically diverse PA in Congo. Its incomplete faunal lists include 79 mammal species in 28 families, 54 reptiles in 21 families, 175 bird species in 50 families, and 51 species of freshwater fish in 22 families.

CDNP includes about 1,200 km^2 of ocean, or <4% of Congo's Exclusive Economic Zone, and is the only marine protected area in Congo. Given industrial fisheries pressure, CDNP oceanic waters are an essential haven for marine wildlife that is heavily exploited elsewhere. Up to 34 species of rays and at least 15 species of cetacean are found in these waters (Vande weghe 2007). Sharks represent >40% of the catch by CDNP fishermen, but the small size of specimens caught strongly suggests that sharks are over-fished. Several dozen Chinese-built and operated trawlers systematically sweep the sea floor close to the coast (illegally), occasionally fishing solely for shark fins, the dismembered sharks thrown back into the water. This practice is clearly unsustainable.

CDNP includes 60 km of Congo's 170 km coastline. The sandy beaches host five of the six Atlantic marine turtle species, all of them listed on CITES Appendix I and classified as Endangered on the IUCN Red List. The most northern beach of CDNP is amongst the most important in the world for the nesting of leatherback turtles and olive Ridley turtles and is contiguous with similar beaches in Gabon. The other species observed are green turtles (*Chelonia mydas*), hawksbill turtles (*Eretmochelys imbricata*), and loggerhead turtles (*Caretta caretta*).

CDNP includes one large and several small lagoons, typically surrounded by mangroves. The wetlands are important for waterbirds and the reason why CDNP was declared a Ramsar site in 2008. Conkouati lagoon has a surface area of 65 km^2 and extends for 12 km inland. It is fed by several rivers and is connected to large inland lakes. The presence of both estuarine and fresh water systems supports a large variety of reptile, mammal, and fish species, including several protected species such as the manatee (*Trichechus senegalensis*), dwarf (*Osteolaemus sp.)* and Nile crocodiles (*Crocodilus niloticus*), hippopotamus (*Hippopotamus amphibius),* water chevrotain (*Hyemoschus aquaticus*), and python (*Python sebae*). About 200 fishermen fish on the lagoon, but destructive fishing techniques have had a serious negative impact on fish abundance. Local communities do not believe that fishing techniques affect abundance and believe that ancestral spirits determine the catch. Over-fishing of oysters at the lagoon outlet may have exterminated oysters from CDNP. The competition between fishermen is incredibly intense, and outbreaks of violence between fishermen occur each year.

The wetlands of CDNP grade into dense tropical rainforests on terra firma with large rocky outcrops on the Mount Kouboula mountain chain that reaches 800 m. The hills support a myriad of micro-biotopes like rock-pools and caves. Protected species include forest elephant (*Loxodonta africana cyclotis*), leopard (*Panthera pardus*), golden cat (*Felis aurata*), lowland gorilla (*Gorilla gorilla*), chimpanzee (*Pan troglodytes*), mandrill (*Mandrillus sphinx*), black colobus (*Colobus satanas*), sun-tailed monkey (*Cercopethicus solatus*), all pottos (*Perodicticus potto, Arctocebus calabarensis*) and galagos (*Galago elegantulus, G. alleni, G. demidovii*), waterbuck (*Kobus ellipsiprymnus*), sitatunga (*Tragelaphus spekei*), giant forest hog (*Hylocherus meinertzhageni*), giant pangolin (*Manis gigantean*), ant-eater (*Orycteropus spp.)*, and tree hyrax (*Dendrohyrax dorsalis*). Research on all species of mammals is completed during censuses that focus on charismatic target species such as elephants and great apes for which direct funding can be acquired.

CDNP's last total elephant and great ape census was conducted at the end of 2005. Results suggest elephant densities of only 0.2/km^2 or a total population size of 772 (± 189). The elephant distribution map is almost inversely correlated to the map of human impact distribution, although there is important elephant movement towards human inhabited areas when mangoes and other farmed crops are ripe. Despite the low elephant density at CDNP, elephant damage to crops can be substantial.

Gorillas in CDNP were recorded in densities of 1.7/km^2 (CV%35), but their distribution is very patchy compared to that of chimpanzees, the latter being found in high numbers throughout. Chimpanzee density was 3.2/km^2 for a population estimate of 12,160 (± 2,090). Within the integrally protected zones densities were as high as 4.4/km^2, making CDNP one of the most important chimpanzee sites in Congo. This high density is likely related to a local custom that prohibits consumption of chimpanzee meat. Nevertheless, at the road control posts of the park, smoked chimpanzee flesh and orphaned chimpanzee babies are sometimes confiscated by non-resident poachers. Gorillas fare worse as no similar taboo prohibition exists, and their bones are commonly used by traditional doctors to invoke strength.

Threats from Outside CDNP

Many of CDNP's mammals, reptiles, fish, and birds are migratory and are confronted with threats outside the PA. Resident species are also threatened by external threats, such as pollution on the CDNP beaches. All migrating oceanic species (marine turtles and whales) require conservation strategies that extend beyond CDNP boundaries. Importantly, threats from the industrial private sector are perceptibly increasing.

Several dozen foreign (Chinese) built and operated trawlers systematically fish close to the CDNP coastline. The parent companies are based in Pointe Noire, and the boats are operated indiscriminately, destroying near shore seafloor habitats and sinking nets of artisanal fishers. When intercepted by the park patrol boat, skippers present letters from the local government authorities that declare many of them "improved dugouts," a clearly erroneous phrase describing these industrial trawlers as artesian fishermen. This permits them to trawl kilometer-long nets within a near-shore zone (between 0-6 nm) set aside for artesian fishing, a zone where these activities are ordinarily illegal.

The beaches are routinely covered with oil spilled from offshore petroleum platforms, as well as from tankers cleaning oil storage tanks at sea. These events occur beyond the park boundaries, but prevailing local oceanography ensures that spills strand on CDNP and Mayumba beaches. The same is true for waste dumped at sea by platforms and boats and waste discharged into the sea by the city of Pointe Noire.

On land a total of 3,704 animals were confiscated at the two CDNP road control posts in 2007. Of these, 49% were duikers, 33% porcupines, 5% small primates, and 13% (n=480) were protected animals. Among these were the remains of 11 chimpanzees and 23 gorillas. The most commonly confiscated protected species are water chevrotain (n=121), dwarf crocodiles (n=111), and mandrills (n=78). We estimate that approximately 80% of the confiscations at

the forest road control post are not sourced from within CDNP but from neighboring districts, as vehicles from well beyond CDNP utilize the forest road. This poaching is fuelled by a high demand for bushmeat in Ponte Noire.

Perhaps the largest threats originating from beyond the PA boundaries are: the active interest of international companies engaged in extractive enterprises; the non-enforcement of environmental laws; lax policies that permit or even promote these activities; and inconsistent national policies governing the establishment of agreements with the private sector. At CDNP rapid economic development overrides every environmental concern. Managers at CDNP (MEF/WCS) are not consulted and are usually unaware of the establishment of agreements between the GoC and the private sector. All recent industrial concessions within CDNP were established without prior notice to CDNP management. No environmental Terms of Reference (TOR) are provided by the companies, and in most cases effective environmental impact assessments (EIAs) are not available. These EIAs are completed independently by local consultancies, and the documents are typically weak. However, oversight of environmental abuses by the private sector and active enforcement of national laws and conventions is completed almost exclusively through on-site policing by CDNP management.

Issues within the PA Related to Scale and Governance

Congo has three national parks and nine reserves that together represent around 10% of Congo's total land surface. Three of the national parks and four of the reserves receive protection through the support of international donors, who provide over 95% of PA management funding. Nevertheless, the governing mandate of PAs by international conservation institutions partnering with the GoC is limited to their involvement in actions on-site. Government support in the PAs and the remaining six reserves is negligible or nonexistent. Annual funding provided by the GoC for park surveillance efforts is insufficient. The GoC says that Congo does not have sufficient finances and as environmental degradation is the result of foreign exploitation, the international community needs to pay for any restoration and management.

Many foreign industries are culpable for environmental degradation and for feeding corruption by using it to their advantage to extract natural resources as cheaply as possible. In turn the governing elite exhibits little empathy for its citizens. Congo is wealthy and has a small population, but the governing elite and many civil servants monopolize these financial benefits. Most banks and large companies are directed by the ruling fraternity who alone seem to benefit from economic growth. Education standards are poor, and local businesses are excessively taxed. Most roads, bridges, ferries, schools, hospitals, railways, or airports are financed with donor money.

Conservation donors and private companies are welcomed, regardless of how their activities may conflict. Little heed is paid to whether industrial activities violate national or international environmental laws and conventions. Protests by major conservation donors lead to minor efforts by the companies and the GoC to counter bad press. It encourages the GoC to seek easy partners who do not criticize the way the GoC does business and may explain why Chinese foreign investment in Congo (and Africa in general) has multiplied

many-fold in the past decade (Michel 2008). Chinese companies are actively engaged in infrastructure development in Congo; reciprocal agreements for natural resources are also prevalent.

The lack of GoC financial support in PA conservation is exacerbated by a general permissiveness to natural industrial resource exploitation inside PAs. Some companies operate inside PAs regardless of conflicts with international and national laws and of the companies' environmental histories, and without effective strategies to mitigate impacts. CDNP is a perfect example. The CDNP Park Decree prohibits all types of industrial exploitation and exploration in the integrally protected zones. Despite this, new activities are rife: offshore petroleum explorations were conducted in December 2005 by the French company PERENCO with the active support of several Ministries; onshore petroleum explorations were conducted in 2006 and 2007 by Zetah Maurel & Prom with the agreement of the Ministry of Hydrocarbons. Maurel & Prom is also French and currently finances five guards at CDNP. Zetah is a Congolese agency of Maurel & Prom, said to be owned by members of the ruling elite. During a regular forest patrol in 2006, CDNP guards intercepted a party of 16 people from the Chinese mining company Lulu who were exploring a "new concession," armed with an agreement signed by the Minister of the Ministry of Mines. CDNP managers were able to stop these activities, but the same Ministry signed another permit for another concession inside CDNP in 2007. Several dozen trawlers were declared "improved dugouts" by the Ministry of Fisheries, allowing them to trawl in the near-shore waters set aside in law for artesian fishing. A logging concession operated by the Chinese company Man-Fai-Tai expired in 2007. Despite clauses forbidding it, the same concession was re-awarded by MEF to another Chinese forestry company named SICOFOR. This despite active complaints from park management about the involvement of these companies in illegal logging, poaching, and bushmeat trafficking. Barely one month after their arrival the SICOFOR camp was searched by eco-guards and over 80 poached animals were recovered from a freezer, stored there for a nearby military camp. The MEF governs both forest exploitation and PAs in Congo.

At regional and district levels the ruling elite (governors) clearly benefit from supporting industrial exploration and exploitation. Senior officials in the army are commonly involved in bushmeat traffic. Many police accept and force bribes at all levels. As observed in other countries where villages benefit from PA revenues (e.g., Archibald and Naughton-Treves 2001), financial benefits at village level in CDNP tend to be monopolized by the village elite. Everything is for sale. When CDNP management consulted village elders and the lands chief about constructing a guesthouse at the lagoon outlet to sea, the party retired for internal discussions and offered to sell the outlet and its sacred site for a bottle of whiskey, a case of wine, and $100.

Some officials and public servants clearly strive for honesty and real conservation effort. The CDNP conservator is a good model, but he functions in a highly corrupted system and is largely outnumbered by those with other priorities. In 2007 the GoC promised to recruit, train, and pay 60 people from local communities to become guards at CDNP. The conservator was ordered to

find 60 applicants from local communities and to demand a CFA20,000 ($40) administration fee per applicant. One year has passed and these applications have not progressed any further. The applicants feel robbed, and the conservator in turn wonders where the cash went.

Corruption permiates local governance and daily life and is considered normal. It is not uncommon for CDNP employees to be chastised by local people and for CDNP/MEF staff to be chastised by government partners for being too influenced by expatriates (specifically whites) when refusing to accept bribes. Bribes constitute a meaningful portion of many civil servants' income. For those who pay, it provides a negotiating position. Hard sentiments emerge when bribes are not accepted.

Successes and Challenges

CDNP competes poorly with the private sector, but nevertheless 50 workers are permanently employed from local communities and an additional 20 to 30 are temporarily employed for six months a year during the marine turtle nesting season. CDNP activities include surveillance, research (fisheries, ecological, socio-economic), environmental outreach, and education and community development. Each activity has had its successes and challenges. The two main challenges are 1) the dependence on international donor funds that determine which activities and how much of each activity can be completed and 2) dealing with the effects of Pointe Noire and institutional corruption. Important donors at CDNP are USAID/CBFP-CARPE, UNESCO/CAWHFI-FFEM, and USFWS. Losing any of these donors would have significant consequences for conservation efforts at CDNP. WCS-unrestricted funds, small private sector contributions, and minimal revenues from ecotourism are used to pay for the most essential activities for which there are insufficient funds.

Surveillance at CDNP is extremely important given the industrial pressures and associated local pressures. Donor policies limiting the support of armed guard surveillance tends to be restrictive, and securing funds for these critical activities is an ever-present challenge. The understandable expectation is that the GoC should invest in PA surveillance. In reality CDNP has a skeleton surveillance team: 25 of 28 guards are available at any given time to patrol 5050 km^2. Although CDNP would need to double its surveillance teams and posts to control the many threats, efforts to counter poaching and bushmeat traffic have been successful. Day and night, vehicles passing the road control posts are searched for bushmeat; these search efforts discourage bushmeat traffic from beyond the CDNP boundary. Forest missions use locally sourced intelligence. The guards are trained by professional soldiers and also receive training in ecology, environmental law, human rights, and first aid, and are paid bonuses for confiscations of illegal products. Bonuses are calculated to avoid abuse. For example, the bonus for a snare trap is CFA50, a price too high to pay as a bribe by poachers but not sufficient to make a snare trap. The main challenge for surveillance is to secure sufficient long-term funding to increase the size of the surveillance team, and, more importantly, to avoid at all costs any reduction in the size of this team. The second largest challenge is staying on top of the con-

tinuous sources of threat linked to the nearby city of Pointe Noire and industrial exploitation of natural resources, both on land and offshore.

Surveillance of the marine waters requires specialized people and equipment. CDNP has a vessel, but it is currently disabled until finances can be secured to buy new engines. Marine patrols are very efficient at keeping trawlers out of the CDNP marine section but increase pressure at the CDNP boundaries where they then focus effort. As long as the Ministry of Fisheries continues to classify trawlers as improved dugouts, the risk of depleting the near-shore zone of fish and of local fishermen losing nets and becoming poorer is all too real. Mass complaints by local fishermen and diplomatic discussions with conservation NGOs have not led to any efforts by the Ministry of Fisheries to change the situation. The failure of the fishery or international attention may be the only solutions.

Enforcement of high minimum environmental standards for offshore oil industry operations is required to control the chronic pollution on CDNP beaches. Most oil industry companies are international and operate at much higher standards in western waters. Commonplace spills in Congo are headline news elsewhere. Beached plastic waste on CDNP beaches are the focus of a new campaign to import an industrial plastic recycling machine. The machine has been offered by a Belgian NGO (Kerasud) and can produce plastic buckets, chairs, plates, and cups from waste plastic. CDNP is actively seeking support from a donor in Pointe Noire. The machine has the capacity to resolve the waste plastic problems of the entire country, and collectors could profit from waste plastic collection.

A dozen agriculture and agroforestry micro-projects have been launched within CDNP. One fisheries project exists, and some 200 of 1,000 families benefit from a poultry project that provides households with opportunities to farm laying hens for egg consumption and sale. To counter random wood cutting for charcoal production, CDNP has started a fuel wood plantation on the park's periphery for legal charcoal; this will be expanded. When trees reach exploitable size an oven will be built that ensures a better wood-to-charcoal conversion than local techniques. Slash and burn agriculture and associated human-elephant conflict is being addressed through the raising of Congo's first two-strand community-based solar powered electric fence around a large farming tract that will allow three villages to be protected from elephant crop raiding. In return, the fence will group slash and burn fields currently spread all over the coastal area of CDNP. Conversely this should improve range habitats for elephants. The entire fencing project (education through implementation) is being filmed to make it easier to repeat the effort should the fence prove a success, or to document any causes of failure. Education and sensitization efforts are being implemented at the 26 villages and 17 schools within and around CDNP. WCS-Congo is in the process of standardizing these efforts between sites and is also collaborating with the Jane Goodall Institute, which is much advanced in its environmental education efforts.

Industrial exploitation threats can only be managed through the best efforts of the available surveillance staff. On several occasions donors have threatened to pull out of CDNP if the GoC does not demonstrate more commitment to its protection. In practice this has resulted in increased pressures on local managers

because associated losses of funds mean a reduction in manpower when most needed. Is a conservation dollar better spent in a PA without pressure when the same dollar can control the continued existence of a PA with huge pressures like CDNP?

Lessons Learned

Top-down approaches to conservation lead to disrespect for conservation by local communities because conservation principles conflict with many traditions (e.g., consumption of gorillas) and do not improve economic conditions. Education and outreach efforts to promote conservation and protect wildlife have only a marginal effect. The idea of valuing ecosystems for the economic benefits they can produce, thus improving overall economic stability and thus reducing dependence on donor funds, is not new (Armsworth and Roughgarden 2001; Hutton and Leader-Williams 2003; Smith et al. 2003; Ehrlich 2008). Studies on the detrimental and unsustainable effects of sanctioned resource use in the hands of poor people and/or corrupted governance are equally plenty (Abbot and Mace 1999; Archabald and Naughton-Treves 2001; Dietz et al. 2007). As corruption is considered normal at all levels in Congo, sanctioned use of resources and ecological economics can only protect the environment as a dual strategy with strict law enforcement.

At CDNP, officially sanctioned industrial exploitation inside the PA is a reality. It has never been a choice and has taught CDNP management to deal with associated problems in terms of compromise; conservation solutions need to be compatible with resource exploitation. A lesson learned at CDNP is that negative journalism designed to expose perceived failings of government and abuses by the private sector does not always yield desired effects. When newspapers focused on petroleum explorations by Maurel & Prom and associated Park Decree violations at CDNP, a joint letter was drafted by WCS-Congo, the ambassadors of the U.S. and France, and USAID (CDNP's most important donor). The letter requested the GoC to show some sign of interest in the conservation of CDNP; if it failed to do so, USAID would retract donor funding from CDNP. The petroleum company engaged in some conciliatory efforts, but the GoC failed to react. The threat to pull USAID finances put massive additional pressure on CDNP management. They were faced with the potential of losing funds and staff whilst having to counter the additional threats associated with petroleum exploration. The conservator of MEF/CDNP negotiated a resolution (as a civil servant he also represents the GoC), obtaining an agreement with the petroleum company to finance five eco-guards as a means to show GoC interest in CDNP conservation. Paradoxically, efforts were made by MEF-CDNP Management staff to ensure that finances did not pass via MEF offices in Brazzaville because of fears that funds would not reach CDNP if they did.

The prospect of bad press can also promote agreements with "simpler" partners; many Chinese companies operating in Congo have very poor reputations for environmental management, and Chinese investments and exploitation agreements with the GoC are on the rise. Agreements awarded to the Chinese for Congolese natural resources are reciprocated with infrastructure developments (Michel 2008). With the exception of the two petroleum compa-

nies Parenco and Maurel & Prom, all industrial forestry, fishing, and mining companies active within CDNP are Chinese (Man-Fai-Tai, SICOFOR, Lulu, Ngiri Peche). If Congolese PAs are to survive the 21st century, managers need to effectively address industrial exploitation and corrupted governance. Potential solutions include securing sufficient funding for on-site surveillance to counter abuse, promotion of carbon credits, tourism, and environmental education. An effective middle-ground solution may be to promote exploitation within PAs by responsible companies only. International donor funds for conservation are relatively durable and likely to become more so as global warming occupies a more central focus in governance globally. However, for the time being these funds are minimal when compared to those available from the private sector, and it is the scale of these funds that generally determine the extent and rates of employment and material benefits. Alongside international funding, conservation institutions could partner with the "green" private sector, a partnership in which the "green" private sector exploits resources in a sustainable fashion and partners with conservation institutions in impact mitigation and surveillance.

To some extent this model has been achieved in northern Congo, through an agreement between WCS and the logging company Congolaise Industrielle de Bois (CIB), and between WCS and the logging company Industrie Forestiere de Ouesso (IFO). CIB and IFO are the only private sector companies in Congo that engage in genuine efforts to make wood exploitation sustainable and work together with conservation organizations to achieve this goal. Large international donors with significant investments in Congo, such as USAID and UNESCO, could give the green light to private sector industrial resource exploitation inside PAs (as opposed to threatening to pull out of PAs) and help in the establishment of agreements with the GoC to only allow responsible companies to operate inside PAs.

For the GoC to endorse such an agreement, "green" taxes could be levied for exploitation inside PAs so that the financial benefits for the GoC are better than for normal exploitation agreements. Green-labeled companies already set aside budgets in their work plans for community development, conservation, and the restoration of the environments they work in. Such companies are generally open to conservation organization involvement, recognizing that it will strengthen their "green" label. In northern Congo for example, IFO invited Greenpeace into their operations to complete an evaluation. Both IFO and CIB contribute financially and in-kind to surveillance and PA management. If obtaining the "green" label has proven advantages, more companies may be encouraged to seek this label.

1.2 Conservation of Landscapes in the Albertine Rift

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Introduction

The Albertine Rift is an Ecoregion, part of the Eastern Afromontane Biodiversity Hotspot (Brooks et al. 2004) and Endemic Bird Area. Extending from the northern tip of Lake Albert and Murchison Falls National Park down to the southern tip of Lake Tanganyika and encompassing the mountains on either flank of the rift valley, the Albertine Rift covers about 313,000 km^2 (Plumptre et al. 2003a; 2007a). This region has more vertebrate species than any other in Africa and more endemic and threatened species than any other ecoregion on the continent. More than 50% of Africa's birds, 39% of mammals, 19% of amphibians, and 14% of plants and reptiles are found here (Plumptre et al. 2007a).

Landscapes of the Albertine Rift

A process for developing a strategic plan for the conservation of the Albertine Rift was initiated with support from the John D. and Catherine T. MacArthur Foundation in 2001. Over a three year period, this process brought together protected area authorities from Burundi, Rwanda, Uganda, Democratic Republic of Congo and Tanzania, national and international NGOs, and donors interested in the region. The Wildlife Conservation Society (WCS) was one of the steering committee members and focused on three main areas during the strategic planning process and subsequently:

1. Compiling existing data on the biodiversity of the Albertine Rift;
2. Undertaking biological surveys of areas where few data were available;
3. Defining the boundaries of conservation landscapes in the Albertine Rift.

Six main landscapes (ARCOS 2004) were identified during the strategic planning session:

1. Murchison-Semuliki Landscape: Encompassing Murchison Falls Park and associated wildlife reserves, forest reserves, and forest outside protected areas that potentially can act as corridors down to the Toro-Semuliki Wildlife Reserve at the southern end of Lake Albert.
2. Greater Virunga Landscape: A core landscape in the Albertine Rift, containing more vertebrate species than any other contiguous landscape in Africa. It includes three World Heritage Sites (Bwindi Impenetrable, Virunga, and Rwenzori Mountains National Parks), a Ramsar site (Lake George), and a Man and Biosphere Reserve (Queen Elizabeth National Park). It straddles the international borders of Uganda, DR Congo, and Rwanda and is comprised of 13 contiguous protected areas.
3. Maiko-Itombwe Landscape: Extending from Maiko National Park in DR Congo down through Tayna Community Wildlife Reserve, Kahuzi-Biega National Park (a World Heritage Site), and Itombwe Community Wildlife Reserve, this is the largest landscape, with endemic species found nowhere else in the Rift.

4. Congo-Nile Divide: Encompassing the Nyungwe-Kibira forest block straddling the Rwanda-Burundi border and associated isolated forests, this landscape straddles the mountain chain that separates streams flowing east to the Nile and west to the Congo River.
5. Greater Mahale Ecosystem and Gombe: Located in western Tanzania, this landscape includes Mahale Mountains and Gombe Stream National Parks and extensive natural habitat to the east of Mahale. This landscape contains most of Tanzania's chimpanzee (*Pan troglodytes*) populations and the endemic Kungwe apalis (*Apalis argentea*).
6. Marungu-Kabobo Landscape: Least known, this landscape encompasses most of the escarpment above the western side of Lake Tanganyika in DR Congo. Surveys of this region were last undertaken in the 1950s.

Since 2003, WCS has been using its biological surveys to refine the boundaries of these landscapes and identify more realistic and manageable borders with our conservation partners. The Congo-Nile Divide is the only landscape confined to protected areas because all other natural habitat outside has been converted to agricultural production. All other landscapes include areas of unprotected natural habitat that link protected areas and act as corridors for species such as elephants, lions, gorillas, and chimpanzees.

Threats

The threats to these landscapes are many and varied, but they stem mainly from two underlying factors: 1) high human population pressures due to fertile land that allows high densities of people, and 2) poverty resulting from lack of land and high fertility rates. These factors have led to much conflict between local people and protected area authorities and more broadly to larger conflicts within countries over access to natural resources, e.g., the civil wars in Uganda (1978-1986), Rwanda (1990-1994), Burundi (1990-2006), and DR Congo (1996-2006).

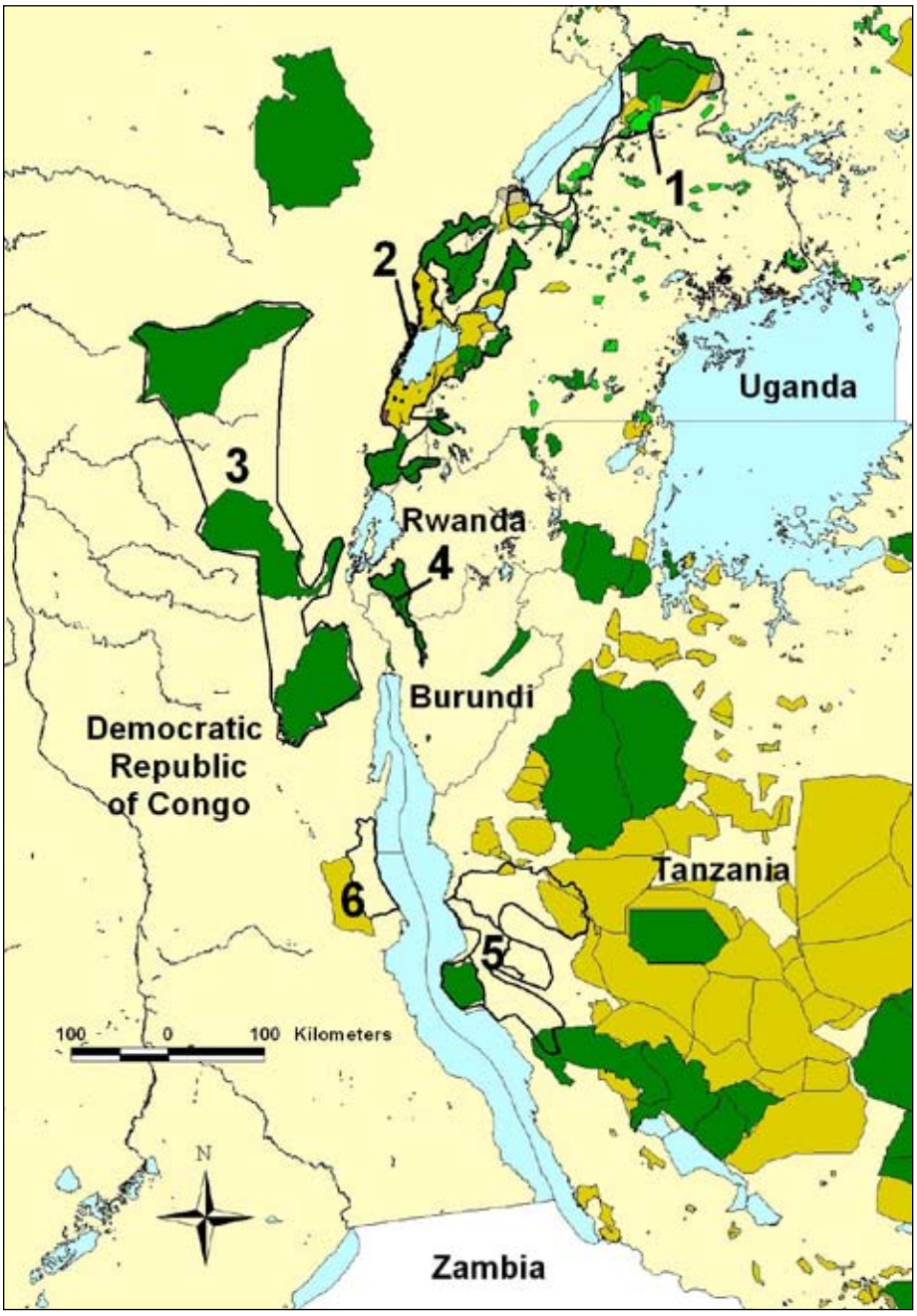
War leads to an almost complete breakdown of governance. Customary chiefs have maintained some control during the civil war in DR Congo, but often they have had to compromise their behavior to gain the support of local people. Other forms of governance have usually completely broken down as people in senior positions have had to flee.

Civil strife has led to large-scale movements of people who have often settled within or near protected areas, with subsequent impacts on those protected areas (Plumptre et al. 2001; Plumptre 2003; Shambaugh et al. 2001). People move into areas of natural habitat to escape conflict or to find alternative livelihoods. Artisanal mining for gold, columbo-tantalite, and other minerals has been common in natural habitat in eastern DR Congo. Similarly, fishing has increased on the lakes because of a breakdown in the enforcement of fishing regulations. Where livelihood options are scarce, people have resorted to hunting large mammals (elephants and hippos) for meat and ivory.

Defining Boundaries and Supporting Governance of the Albertine Rift Landscapes

The threats and governance issues vary widely for each landscape, so each needs to be addressed differently. WCS has been conducting biological surveys to better define what boundaries constitute an ecologically functional landscape, and how much of each landscape realistically can be conserved given the numbers of people living in and around it (**Figure 1**). **Table 1** summarizes the areas of the current landscapes and the proportion of each which are protected.

Figure 1: The landscapes of the Albertine Rift following WCS surveys and better definition of landscape boundaries (2008).



1 Murchison-Semuliki Landscape
2 Greater Virunga Landscape
3 Maiko-Itombwe Landscape
4 Congo-Nile Divide
5 Greater Mahale Ecosystem and Gomb
6 Marungu-Kabobo Landscape

Table 1: Total areas of the six landscapes and the areas protected as park, forest reserve, or wildlife/hunting reserve. Areas are rounded to the nearest 50 km^2 because of inaccuracies in area measurement on the ground for many sites in DR Congo.

Landscape	Landscape Area (km^2)	Area Protected (km^2)	Percentage protected
Murchison-Semuliki	10,500	7,350	70.0
Greater Virunga	15,700	13,800	87.9
Maiko-Itombwe	40,300	16,500	40.9
Congo Nile Divide	1,450	1,450	100.0
Greater Mahale Ecosystem	14,700	1,600	10.9
Misotshi-Kabogo-Luama	4,850	2,300	47.4
Total Albertine Rift Area	**87,500**	**43,000**	**49.1**

Murchison-Semuliki Landscape: Much support has been given to the rehabilitation and management of protected areas in this landscape since the end of the civil war in Uganda, but few activities have focused on natural forest/woodlands outside the protected areas. A WCS study of this region showed that creation of corridors was feasible and should be supported, but that forest was rapidly disappearing (Plumptre 2002). Corridors are particularly important for chimpanzee conservation, as surveys show that most forests in this region have populations of fewer than 500 animals (Plumptre et al. 2003b), a ballpark lower limit for long-term viability (Soulé 1987). A Global Environment Facility project was designed to address forest loss in this region, but funds have only become available 13 years later. More than 350 km^2 of forest has been converted to agriculture in the meantime. The project will assess corridor creation and incentives that might encourage land owners to plant trees that could help widen/link the corridors. Carbon funding and the lack of timber in Uganda are both possible mechanisms that could stimulate the creation of plantations. Changes in the Uganda Land Act are allowing more private ownership of land, which will promote longer term investment in crops such as trees.

Greater Virunga Landscape: Most of this landscape includes existing protected areas bordered by agricultural land and a relatively high density of people (particularly in the south, where densities reach up to 600 people per square kilometer [Plumptre et al. 2004]). WCS activities have promoted management at the landscape scale rather than at the scale of individual protected areas. Some landscape species, including elephants, hippopotamus, lions, leopards, hyenas, golden cats, chimpanzees, gorillas, giant forest hogs, and topi, require the whole landscape if they are to survive in the long term.

WCS has been supporting transboundary collaboration in the central and northern parts of the landscape between DR Congo and Uganda (Plumptre et al. 2007b), while the International Gorilla Conservation Programme has

supported similar collaboration in the south. The transboundary collaboration initially started between the protected area authorities in DR Congo and Uganda, but it was broadened in 2004 to include other law enforcement institutions such as the police, judiciary, customs, immigration, and military, bringing together all the players who could support the protected area authorities in the conservation of this landscape. As a result of these wider collaborations it has been easier to enforce the laws of the countries and provide better deterrents to people who want to break the law. For instance, the judiciary in Uganda now know the real value of the country's wildlife when it is killed (about $1,000 for a hippo and $13,000 for a lion; Plumptre and Roberts 2006). As a result, they have increased fines to an amount greater than the value poachers could obtain from the sale of the meat and other body parts.

In 2005, after 15 years of collaboration in protected mountain gorilla habitat and another 2 years of collaboration throughout the rest of the landscape, a trilateral agreement was signed between Uganda, DR Congo, and Rwanda. Subsequently, in 2006 a 10 year transboundary strategic plan (which is currently being implemented) was developed for the landscape by the three protected area authorities.

Applied research has focused on the corridors linking the protected areas within this landscape and the ways in which more land could strengthen the corridors' functionality (Nampindo and Plumptre 2005; Nampindo et al. 2006). In collaboration with the Jane Goodall Institute, a process is underway to purchase land from some farmers to widen one of the corridors between Kyambura Wildlife Reserve and Kasyoha-Kitomi Forest Reserve.

A recent survey was conducted of a potential extension of Virunga Park to Mt. Hoyo Reserve to the north of the landscape in DR Congo. Natural forest relatively undisturbed by man occurs between these two sites. In the 1960s a proposal was made to link the two protected areas, but nothing came of it. WCS surveys show that the link still exists and that species such as chimpanzees and okapi use this region. How an extension such as this would be created is uncertain at present, but we would involve the customary chiefs, local communities and indigenous groups, the Parks Authority for DR Congo (ICCN), and the local and national government to identify the best solution.

Maiko-Itombwe Landscape: Maiko-Itombwe is the largest landscape in the Albertine Rift, and Itombwe Massif contains more endemic birds (the best taxon surveyed) than any site in the Rift. This landscape consists of two national parks (Maiko and Kahuzi-Biega) and two community reserves (Itombwe and Tayna) set in a matrix of forest variously impacted by man. Species targets in this landscape include the forest elephant, eastern chimpanzee, and Grauer's gorilla (most of the world's population of Grauer's gorilla occurs here). WCS has been involved with wildlife surveys in Maiko and Kahuzi-Biega National Parks (Hart et al. 2007) both before and after the civil war; the surveys documented the decline in large mammals as a result of the war. We also conducted surveys of the Itombwe Massif prior to the civil war (Omari et al. 1999) and are in the process of conducting surveys again. This massif contains a mosaic of forest and montane grasslands inhabited by people. A community wildlife reserve

has been created in law, but the boundaries are not yet accurately defined. Over the coming years, ICCN, WCS, and other partners will need to work with the people living within the reserve to refine the boundaries and create mutually acceptable land use zones.

Forest partially degraded by man links these protected areas. The Dian Fossey Gorilla Fund International has been working with local communities between Maiko and Kahuzi-Biega Parks to create community managed protected areas, notably the Tayna Reserve, which will conserve linkages between the parks. These community reserves are managed by the community for conservation of Grauer's gorilla and other key species (DFGFI and UGADEC 2006).

Congo-Nile Divide: This landscape is managed entirely for its protected areas which include the contiguous Nyungwe and Kibira National Parks and several forest reserves in Rwanda and Burundi (Mukura, Gishwati, Bururi, Monge, Rumonge, Vyanda, and Kigwena). Conservation of the Nyungwe-Kibira forest block is important for the conservation of viable chimpanzee populations, which number about 390 in Kibira and 380 in Nyungwe (Barakabuye et al. 2007). Transboundary collaboration between Rwanda and Burundi has been established by the parks authorities of each country (ORTPN–Rwanda; INECN–Burundi) with WCS support. A transboundary strategic plan has been developed by the two protected area authorities, and they have signed a formal agreement.

The high human population pressure around these parks leads to much demand on park resources, and poaching is intense. The people here are some of the poorest in the world (Plumptre et al. 2004) and rely on the forests to increase their incomes. In this landscape the greatest need is to work with local communities and ensure that they derive some benefit from the protected areas.

Greater Mahale Ecosystem: Except for Mahale Mountains National Park and the Ugalla Forest Reserve, most of this landscape is outside protected areas (**Figure 1**). The landscape has survived because it is relatively remote, the soils are poor, and the climate is much drier. Surveys by Japanese researchers (particularly Kano 1971, 1972) and WCS in 2005 showed the extent of chimpanzee distributions east of Mahale Mountains National Park. This area is also important for several endemic species (Moyer et al. 2006). The 2005 surveys helped to define the boundaries of the Greater Mahale Ecosystem. Frankfurt Zoological Society has been working with the Jane Goodall Institute to look at ways of protecting the larger landscape around Mahale, including developing a strategic plan for the landscape.

Human population density in this region is low; most of the people settled in a refugee camp after fleeing from the civil wars in Burundi. These people recently have been returning to Burundi, so there are relatively few people left on the landscape. This makes it possible to think about creating new protected areas and working with the mineral prospecting companies operating here to conserve the landscape for wildlife. At present, explorations are being made for titanium, copper, and zinc to the east of Mahale Mountains Park.

Marungu-Kabobo Landscape: A large area on the western shore of Lake Tanganyika is completely unprotected. Halfway along the lake, the town of Kalemie separates a relatively sparsely inhabited region to the north from a more intensively settled region in the Marungu Massif to the south. In 2006, WCS conducted some aerial reconnaissance flights over this landscape to assess where intact natural habitat still exists. Surveys were made in the 1950s, but rebel activity from 1960 onwards prevented any access to the region since then. The Luama Hunting Reserve is the only protected area in this region but has not had any staff based in the reserve for 50 years.

The aerial surveys showed that most natural habitat in the Marungu Massif on the border with Zambia had been converted to agriculture. However, a large (1,000+ km^2) intact forest block was found north of Kalemie. In 2007, biological surveys of this forest block by WCS, Field Museum of Chicago, and WWF showed it to be very important for conservation with the discovery of six new vertebrate species (Plumptre et al. 2007c). It also became clear that this region, which once had been called Kabobo, was not recognized by name by the local people, who preferred to call it the Misotshi-Kabogo forest block. This forest block lies close to the Luama Hunting Reserve, and, along with gallery forests in miombo woodland and the hunting reserve, holds populations of elephants, buffalos, chimpanzees, and bongos. Informal interviews with customary chiefs in this region indicated a willingness to create some form of protected area, as they believed it would bring attention to their part of DR Congo. USFWS funding is supporting follow-up surveys of local people to gauge the level of interest in conservation of the forest around the whole of the potential protected area and to assess what type of land use option would be most acceptable. WCS will work with national, provincial, and local authorities, as well as the villages in the Misotshi-Kabogo-Luama landscape, to define acceptable landscape boundaries.

Governance and Scale

For the most part, the governance of these landscapes depends upon the protected area authorities in each of the respective countries. However, these same authorities have recognized the need to work with other government institutions and local communities to tackle the many threats that affect these areas.

There is a need in most of these landscapes to create benefits from the protected areas for the local communities. These are the most densely populated regions of Africa with some of the poorest people, and pressures would be too great if the people don't support the conservation of the protected areas. In Uganda and Rwanda, a revenue-sharing scheme exists where the protected area authorities share 20% of their gate fees with local communities. Funds are channeled through district authorities to projects within two parishes of the park boundaries determined by the local authorities. To some extent this has created better relations between park authorities and local people, but there is still a need to target some of these funds to those communities that bear most of the costs from crop raiding animals or predators taking their livestock, or to those that are so poor, particularly pygmy groups, that they have not benefited

from the support thus far. At some sites, local communities are benefiting from income-generating projects and provisions of health and education facilities.

Where human population densities are lower, it is possible to envisage the creation of additional protected areas to conserve wide-ranging landscape species (e.g., landscapes 3, 5, and 6 above). Plans for new protected areas are underway with the collaboration of local communities and local and provincial governments in these landscapes.

Conservation practitioners have changed their approaches over time in the Albertine Rift. They have learned to use a wide set of tools designed to improve governance, including conflict resolution techniques, transboundary collaboration, community conservation committees, revenue sharing, community development associations, land use planning techniques, and enterprise development skills.

There is a need to be flexible, however. The governance structures conservation practitioners can work with vary by country. In Uganda and Rwanda, a local council system operates from village to district level and consists of elected members at five different levels. In DR Congo, customary chiefs still have a good deal of power over what takes place under their jurisdiction; in some areas of DR Congo, they are the only governance institution that functions due to the presence of armed groups such as ex-Rwandan forces (FDLR) and *Mai Mai* militias. These chiefs often can help to control the illegal activities of the military, police, and other law enforcement organs. Corruption is a key factor leading to wildlife loss in some of the landscapes, but it is possible to combat corruption by identifying and targeting those who are causing the main threats and working with the institutions that have leverage over these people to minimize their activities.

WCS has refined the landscapes' boundaries thereby reducing the scale over which conservation needs to operate, but the landscapes are still very large. The governance structures required to ensure the long-term conservation of these areas will vary within and between the landscapes. Over the coming years we will be working with partner NGOs, protected area authorities, local communities, and government institutions to develop mechanisms of governance that can ensure the survival of the wide-ranging and rare species of the Albertine Rift.

Acknowledgements

Many people have been involved in the work reported here. WCS's field staff and field assistants have conducted numerous surveys and worked with parks authorities, other institutions, and local communities. In particular, Isaiah Owiunji, David Nkuutu, Fidele Amsini, and David Moyer should be thanked for their major contributions to the work reported upon here. Funding for this work was provided by USAID, U.S. Fish and Wildlife Service, the U.S. State Department, the John D. and Catherine T. MacArthur Foundation, the Daniel K. Thorne Foundation, and WCS private funds.

PART 2: WCS CASE STUDIES—ASIA

2.1 Conserving the Grasslands of Mongolia's Eastern Steppe

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Introduction

Mongolia has a territory of nearly 1.6 million km^2, lies at 42^o-52^o N between the boreal forests of Siberia and the Gobi desert, and spans the southernmost border of the permafrost and the northernmost deserts of Central Asia (CIA World Factbook 2008). The Eastern Steppe of Mongolia is perhaps the world's largest intact grassland ecosystem. At 250,000 km^2, the area is roughly the size of the state of Oregon, and is bordered by Russia to the north and by China to the east and south. Treeless flat plains, rolling hills and a significant number of important wetlands characterize the Eastern Steppe. This vast wilderness is home to the Mongolian gazelle (*Procapra gutturosa*)—one of the world's last great spectacles of migrating ungulates (Finch 1996)—estimated at a population of over one million, based on surveys conducted between 2000 and 2005 by the Wildlife Conservation Society (WCS) (Olson et al. 2005a; Olson et al. 2005b). Numerous other mammals live on the steppe, and the region is one of the most important habitats in eastern Asia for migratory birds (Chan et al. 2004).

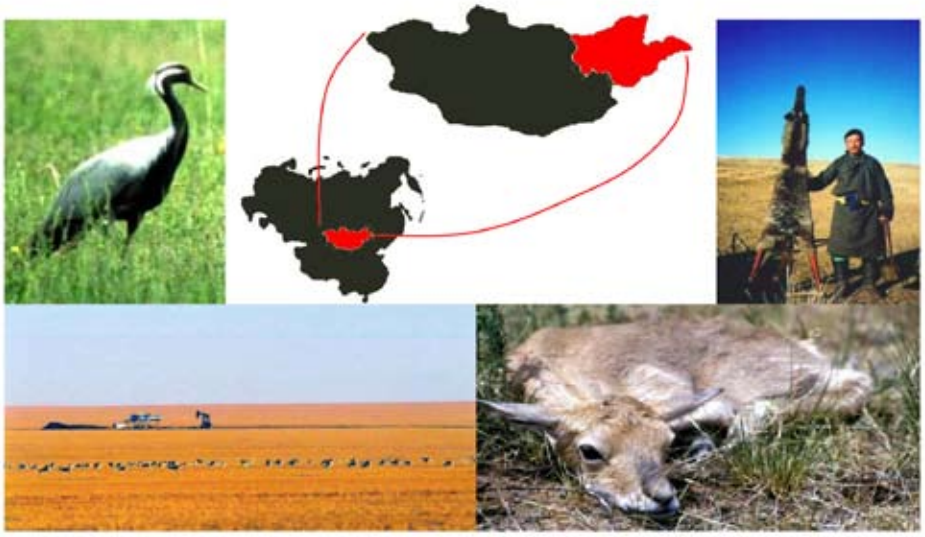
The Eastern Steppe is characterized by a temperate climate with scarce precipitation and marginal resources. Human populations on the steppe historically have been sparsely distributed and engaged in traditional nomadic livestock production, an adaptation to the natural conditions. Approximately 200,000 people live on the steppe, where they herd approximately 4 million head of livestock (Enkhbaatar 2006). The low human population density, the relatively low-impact extensive livestock agriculture, and a traditional respect for nature have meant that much of the landscape has remained relatively untouched. Wildlife have had the intact habitat and space they need to survive and flourish, making Mongolia and the Eastern Steppe one of Central Asia's last wildlife refuges.

However, this historic pattern of sustainable use of the steppe's resources is changing. One of the consequences of Mongolia's transition from a centrally controlled command economy to a free market system has been the opening of trade borders with China and other Asia countries. The demand of wildlife and wildlife products has fueled a commercial trade in wildlife across Mongolia and major declines in the numbers of wildlife due to hunting pressure have been recorded on the Eastern Steppe (Wingard and Zahler 2006). Government development plans for the region include the intensification of the livestock production system and large-scale crop-based agriculture which will undoubtedly disrupt the fragile balance of life for both nomadic pastoralists and wildlife on the grassland steppe. The country's economic needs are also driving oil, coal, gas and mineral exploitation in the region, threatening to fragment the grassland with the infrastructure these industries will require.

WCS and Mongolia's Eastern Steppe

The Mongolian gazelle has defined WCS's work in the Eastern Steppe. Studies of Mongolian gazelle ecology and population dynamics have documented the huge land requirements of this species and the need for conservation actions and management systems that extend well beyond the boundaries of protected areas (Leimgruber et al. 2001; Mueller et al. 2008). In 2003, with support from the United States Agency for International Development (USAID), the Eastern Steppe became a WCS Living Landscapes Program site. WCS is now in its final year of implementing this USAID-funded, participatory, wildlife threats-based strategy for landscape conservation. This paper will largely draw upon the experience gained and challenges faced as we have worked to address threats to biodiversity and shape wildlife management strategies and conservation policy in Mongolia's Eastern Steppe. The location of the Eastern Steppe and some characteristics of the landscape for wildlife and human use are illustrated in **Figure 1**.

Figure 1: The Eastern Steppe Living Landscape. Center: Map of Mongolia and highlight of Eastern Steppe region. Clockwise from map: Livestock herder with wolf skin; Mongolian gazelle calf; oil well with Mongolian gazelle in foreground; demoiselle crane (*Anthropoides virgo*).



The Protected Areas System

The importance of Mongolia's Eastern Steppe is internationally recognized. It has been designated a Global 200 Ecoregion, a Last Wild Place, and is the location of Mongolia's first Ramsar site. Multiple locations across the Eastern Steppe have been designated as Important Bird Areas, and recent surveys have identified many more proposed sites.

There are 13 nationally protected areas on the Eastern Steppe; another 2 areas have been proposed. The total area of the Eastern Steppe under national protection is 28,000 km^2 or 11% of the grassland region (Enkhbaatar 2006). If the proposed areas are officially designated and the buffer zones of the strictly protected areas are included, the total area under national protection will be close to 70,000 km^2 or 28% of the Eastern Steppe region. The challenge for the steppe's protected area system is not the amount of land area it encompasses, but (1) the lack resources dedicated to protected area management and enforcement and (2) the existence of biodiversity that rely on habitat far beyond existing protected area boundaries (e.g., Mongolian gazelle, wetland birds).

In addition to the national protected areas there are a series of locally protected areas and community managed areas which have been designated as community conservation partnerships. These locally and community protected areas have the potential to contribute significantly to the land and resources under some form of protection on the Eastern Steppe if management and governance systems that are supported by the local communities and local administrations can be put in place.

Identification of Conservation Targets

The WCS landscape species selection process was used to identify conservation targets for the Eastern Steppe. Landscape species are "defined as biological species that use large ecologically diverse areas and often have significant impacts on the structure and function of natural ecosystems" (Sanderson et al. 2002). By conserving landscape species, we also hope to maintain the key ecological functions of a landscape and provide substantial protection to other biodiversity.

A set of landscape species was selected for the Eastern Steppe according to methods described in Coppolillo et al. (2003) and Strindberg et al. (2006) and using Landscape Species Selection Software (v2.1). We first identified a list of 30 native candidate species for which sufficient ecological information was available and that largely reflected the selection criteria. Necessary information on these species, including area requirements, habitat use, use of management zones, vulnerability to threats, ecological functions, and socio-economic importance, was then collected from experts and literature and input into the selection software. The selection process and draft suite of species was peer-reviewed by a set of international and national wildlife experts. The draft suite was also presented to a group of national-level stakeholders including representatives from government agencies, multi-lateral and bi-lateral donor organizations, academic and research institutions, and the broader conservation community. Recommended changes included adding reptiles and amphibians to the list of candidate species and reassessing data on distribution and threats of particular

species. The final suite of eight species was selected to represent 11 habitats, 20 management zones, and 13 threats. The suite included the Mongolian gazelle (*Procapra gutturosa*), grey wolf (*Canis lupus*), eastern moose (*Alces alces*), Siberian marmot (*Marmota sibirica*), white-naped crane (*Grus vipio*), Asiatic grass frog (*Rana chensinensis*), saker falcon (*Falco cherrug*), and taimen (*Hucho taimen*).

Species and Ecosystem Requirements

Conserving the grasslands of the Eastern Steppe and the wildlife it supports clearly requires interventions and management that fall well beyond the borders of protected areas. The Mongolian gazelle is a classic example of a large and mobile species that requires very large areas of habitat for its survival. The tremendous spatiotemporal variability in food availability necessitates long-distance and irregular movements of gazelle across the landscape in search of high quality forage (Leimgruber et al. 2001; Mueller et al. 2008). Intactness defines a functional grassland ecosystem, and the current relative lack of fragmentation of Mongolia's Eastern Steppe enables it to support the long-distance nomadic movements of Mongolian gazelle, the most abundant wild large mammal on the steppe. Maintaining this intact habitat is one of the greatest challenges to wildlife conservation in the region. Studies of Mongolian gazelles in an area of their range bisected by the Ulaanbaatar-Beijing railway, for example, have shown that the species is particularly sensitive to barriers (Ito et al. 2005). If an ecologically functional population of Mongolian gazelle is to be conserved, the steppe landscape, with few roads, barriers, or fences that hinder the gazelles' movements, must be maintained.

In an attempt to more clearly define the potential for conservation of the Eastern Steppe's landscape species, spatial models of the distribution of selected species and human-caused threats that affect them have been created using guidelines in Didier et al. (2006, 2008). For Mongolian gazelle, saker falcon, and white-naped crane, models of their "potential" distributions (i.e., the distribution as it would be if threats were mitigated) were created. Our biological landscapes (and human landscapes, below) are expert-based models similar to the U.S. Fish and Wildlife Service's habitat suitability index models (USFWS 1981). Based on the best available information, we identified life-long habitat requirements of the species and constraints on their distributions, including food, water, security, and reproductive requirements, and biotic interactions. We then represented these factors with GIS layers (including grassland productivity based on NVDI and water and prey distributions), weighted them according to their importance to the species, and combined them.

In addition to the biological landscape modeling, WCS has attempted to model the human-caused threats to biodiversity on the Eastern Steppe. Those human activities identified as threats to the white-naped crane, saker falcon, and/or the Mongolian gazelle include livestock competition, livestock disease, hunting and poaching, and fire.

Development of Landscape-level Conservation Strategies

The visual displays of potential wildlife habitat and the impact of human activities have proven very useful as we have engaged stakeholders in conversations about species and ecosystem requirements. As part of the Eastern Steppe Living Landscapes Program, WCS has worked to set population goals for the landscape species as a critical first step to developing landscape-level conservation strategies. In 2008 we held a series of provincial-level stakeholder workshops designed to facilitate local participation in landscape-level conservation planning and strategy development. Participants included representatives from the provincial government (environmental policy, land use planning, and law enforcement departments), veterinary and public health agencies, the Protected Area Authority, the private sector industry, the State Border Defense Agency, local NGOs, and members of livestock herding communities. Participants were asked to set population targets for their region for the Mongolian gazelle, saker falcon, and white-naped crane. Most of the population targets set involve maintaining or increasing current populations as shown in **Table 1**. Addressing the requirements of species, especially in light of these population targets, has underscored the need to work across jurisdictional boundaries, and in the case of the white-naped crane and Mongolian gazelle, across international borders.

Table 1: Population targets (number and time span) for a subset of Eastern Steppe landscape species set at provincial-level stakeholder workshops.

	White-naped crane	Saker falcon	Mongolian gazelle
Khentii Province	Goal: 2-3 times increase Time: 3-5 years	Goal: 800 – 1,000 individuals Time: 5 years	Goal: 30% increase annually Time: 10 years
Dornod Province	Goal: 25% increase to 700 breeding pairs Time: 10 years	Goal: 50% increase Time: 2 years	Goal: 1 million Time: 2 years
Sukhbaatar Province	Not Applicable	Goal: 10%-20% increase (80-100 breeding pairs) Time: 5 years	Goal: 25% increase annually Time: 3 years

In addition to setting landscape species population targets, the participants in the provincial-level stakeholder workshops were asked to articulate the reasons for conserving the species at the numbers indicated, the current threats or potential impediments to reaching those goals, and the interventions necessary to ensure success. For example, participants identified the white-naped crane as a marker of healthy wetlands and identified preserving habitat and maintaining ecological balance and integrity as reasons for conserving the species. The need to prevent the extinction of white-naped cranes and the potential for developing bird watching-based tourism in the region were also mentioned.

Stakeholder-identified challenges or impediments to reaching set population targets for white-naped cranes included: drying up of wetlands caused by global warming and/or water diversion for agricultural use; cutting of willow trees in riparian zones for use as fuel; disturbance caused by increases in numbers of livestock, particularly cattle; human-induced steppe fires; and limited financial resources for conservation activities. Interventions needed to address these challenges included re-planting willow trees and investigating the use of alternative fuels; increasing the production levels of individual livestock to decrease the need for maintaining large herds; reduction of carbon emissions in developed countries; and raising funds to broadly promote the conservation of white-naped cranes, making individuals and governments aware of the global importance of the Eastern Steppe habitat for white-naped cranes and promoting the region as an eco-tourism "crane sanctuary" destination.

A component of the participatory conservation strategy planning workshops involved mapping the occurrence of key threats and identifying specific sites where interventions are needed. The exercise was designed to identify habitat or human activities in need of immediate conservation and management action. Participants in each provincial workshop created a map for each landscape species. Together they form the beginning of a plan for conserving the entire landscape by identifying species-specific objectives, conservation priorities, and important actions.

Land Use, Scale, and Governance

The Eastern Steppe grasslands span three Mongolian aimags (provinces) with 285,000 km^2 within their political boundary: Dornod (123,600 km^2), Sukhbaatar (81,200 km^2), and Khentii (80,300 km^2). Private land ownership is rare on the Eastern Steppe and the vast majority of land is government owned pasture utilized by nomadic pastoralists for livestock production. Wildlife management and habitat conservation within nationally protected areas is under the jurisdiction of the Protected Area Authority of the Mongolian Ministry of Nature and Environment. The policy for wildlife management and habitat conservation outside of protected areas is set by the provincial Environmental Protection Agencies who ultimately report to the Minister of Nature and Environment. The Environmental Department of the State Specialized Inspection Agency (SSIA) has the authority to enforce wildlife and environmental law outside of protected areas and the SSIA reports to the Office of the President.

There has been a relatively recent move on the part of the Mongolian government to devolve the authority over natural resources, and wildlife in particular, to local communities of livestock herders on the Eastern Steppe and across Mongolia. Legislative changes and new regulations have outlined a process by which groups of livestock herders can apply for natural resource use rights, secured for a five year period, which make them responsible for the management and protection of those resources.

Laws and regulations are generally drafted by the central government and handed down to the provincial-level governments for implementation. The laws and regulations governing wildlife and natural resource use are often not enforced due to a mix of factors including limited inter-agency coordination, a lack of resources for patrol activities, and limited information flow.

Stakeholder Consultation and Participatory Conservation Planning

WCS uses stakeholder workshops to bring together representatives from various government agencies, academic and research institutions, NGOs, and communities of resource users (including both the private companies involved in extractive industries and livestock herders) to engage them in the conservation planning process. These stakeholder meetings are often the first time that representatives from the private sector, the State Border Defense Agency, and the Land Management Agencies, for example, have ever been invited to the table when wildlife conservation issues are under discussion. We have tried to encourage dialogue and working relationships across these sectors outside of WCS-led efforts, but opportunities for these individuals to interact are limited. Formal relationships do not exist between many of the agencies with jurisdiction over wildlife and natural resources, and both large physical distance and a lack of a tradition of inter-agency collaboration makes maintaining this kind of exchange difficult.

Collaborative Wildlife Protection

As a way to address the issues of inter-agency collaboration, limited flows of information, and limited resources for patrolling, WCS has been piloting a "Collaborative Wildlife Protection Program" in a Strictly Protected Area called Nomrog in the far eastern corner of the Eastern Steppe. The work has been designed to engage the State Border Defense Agency, a group that is not traditionally involved in wildlife management or wildlife protection, and improve their relationship with the Protected Area Authority and the Environmental Inspection Agency through joint training in wildlife monitoring and wildlife law enforcement. The pilot project has been successful in relationship-building among these organizations, and the border guards have become much more involved in wildlife monitoring and protection in the region that they routinely patrol. The evaluation of the impact this collaborative wildlife protection program is having on reducing threats to wildlife has yet to be completed. Scaling up these activities beyond a pilot program will require time, an investment in capacity building, and significant financial resources to monitor and evaluate its impact on wildlife conservation targets.

Community Partnerships for Conservation

Over the past two years, WCS has been working with livestock herder groups on the Eastern Steppe who have formed community partnerships for conservation under the new regulations allowing community management and ownership of natural resources across the steppe. These herders have in essence taken on the role of local wildlife managers. WCS has been providing technical assistance to these community groups, engaging them in conservation planning activities, providing training to volunteer rangers in wildlife monitoring and protection techniques, and facilitating communication and collaboration between community partnerships and local officials.

We believe that herder community partnerships are ideal entities for sustainable wildlife and natural resource management because their members 1) reside in areas of conservation concern, 2) have a direct impact on natural resources such as wildlife, and 3) can monitor and manage wildlife and natural resources in their community-managed areas. Most importantly, herder communities are motivated to conserve natural resources because they depend on them for their livelihoods; these resources include wildlife and their products, water sources, pasture for livestock production, fuel sources such as willow and dung, and wild plants for food and medicinal purposes. Anecdotal evidence suggests that livestock herder communities are acutely aware of the need for sustainable management of their natural resources, but the degree to which they identify the importance of local control and management of those resources is less clear.

Policy and decision makers are recognizing the importance of local community institutions for developing sustainable livelihoods and natural resource management in Mongolia and are using their experiences to formulate policies and regulations. The change in the Mongolian Environmental Law allowing for community ownership of some natural resources is a clear example of the evolution of this policy. In addition, the local institutions themselves (e.g., the Eastern Mongolian Community Conservation Association) are developing mechanisms to scale up community empowerment. These are all very positive developments, but significant challenges remain. Communities of livestock herders, as pastoralists, are mobile, and the resources they have been charged to manage and protect are often stationary. Mechanisms for resolving conflict in the community partnership areas have not been identified, and the government's role in supporting these community partnerships is still unclear.

Successes and Challenges

WCS has been successful in introducing the concept of a wildlife-based strategy for landscape scale conservation on the Eastern Steppe. National-level policy makers in Mongolia are talking about the need for "landscape-level" conservation plans and initiatives that address wildlife and environmental conservation needs across landscapes. There was initial resistance to the idea of selecting only a small group or suite of conservation targets, but the need to focus resources and prioritize interventions, as well as the need to evaluate the impact of the interventions based on the monitoring of a relatively small group of conservation targets, has slowly gained interest and support.

One of the major challenges of working on the Eastern Steppe has been its size. The physical distances are great, and our own ability to communicate with stakeholders on a regular basis has been limited. Working across sectors and agencies has also stretched our resources, and we have only been able to build effective working relationships with a handful of individuals from key agencies and institutions. Implementing these conservation plans and monitoring the conservation targets over time will be challenging across a region as large as the Eastern Steppe, but efforts on a smaller scale are very likely to fail in conserving the grassland resource and the species it supports.

Lesson Learned and Applications

Relationships take a long time to build, and demonstrating a long-term commitment to a site is important in Mongolia. Local government officials and community members alike are weary of conservation projects which come and go. As a conservation organization, our effectiveness in influencing policy, wildlife management, and conservation initiatives on the ground is dependent on how we are perceived by key stakeholders and conservation partners in the region.

Moving forward we will apply this lesson learned in two ways. The first will be to continue our commitment to the small-scale interventions that we have initiated. It is important to carry these efforts through to a point when we can evaluate their effectiveness and demonstrate the usefulness of monitoring conservation targets and the steps to adapting management plans and interventions based on results. The second will be to consolidate the contributions stakeholders have made to the conservation planning process for the Eastern Steppe and identify the links to regional sustainable development strategies, with the goal of delivering the plan to national-level policy makers. Eastern Steppe stakeholders have expressed an interest in WCS playing this role, and it is one way we can demonstrate our long-term commitment to the conservation of the grasslands of the Eastern Steppe.

2.2 Conflicts of Interest in the Process of Establishing Protected Areas in Myanmar with Particular Reference to Hukaung Tiger Reserve

U Than Myint
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Introduction

Myanmar is the largest country in mainland southeast Asia, with a land area of 676,553 km^2, a coastline of 2,832 km, and a population of 50 million people. Myanmar shares borders with five other countries—Bangladesh, India, China, Lao, and Thailand (**Figure 1**)—and has a tropical monsoon climate with a rainy season from May through September, followed by a dry season from October through April. The mean annual rainfall of the country ranges from 500 to 6,000 mm.

Figure 1: Myanmar and neighbouring countries.

Myanmar lies within the Indo-Burma hotspot, along with Cambodia, Lao P.D.R., Thailand, Vietnam, and parts of northeastern India, southeastern Bangladesh, peninsular Malaysia, and southern China (van Dijk et al. 2004). Within this hotspot is a high diversity of flora and fauna, including many endemic species, found throughout the varying latitudes, climates, and land forms. Myanmar still maintains some intact natural forests and a number of globally threatened species that are either rare or have disappeared altogether from other parts of the world. The country is home to approximately 300 mammal species, 1,000 bird species, 146 snake species, 59 lizard species, 72 frog and toad species, 27 turtle and tortoise species, and 2 crocodile species. There are also approximately 7,000 plant species, including 1,347 large trees, 741 small trees, 1,696 shrubs, 841 orchids, 96 bamboo, 36 rattan, and 2,243 flowering plants.

The protected area system (PAS) has been the best tool for long-term biodiversity conservation in Myanmar. However, as a developing country, substantial conflicts of interest exist between stakeholders regarding development versus conservation of natural resources. This paper reviews the conflicts of interest associated with the establishment of the PAS in Myanmar, using Hukaung Tiger Reserve as a case study.

Protected Areas in Myanmar

Protected area management in Myanmar dates back to 1859, when a wildlife sanctuary was established near Mandalay (Clarke 1999). The establishment of Pidaung, Shwe U Daung, and Pyin Oo Lwin Wildlife Sanctuaries followed in 1918 (Clarke 1999). The legal basis for wildlife protection and protected area management was implemented with the support of the Forest Act of 1902 and Wildlife Protection Act of 1936. In 1994, the government established the Protection of Wildlife and Protected Areas Law, with the main objectives of protecting wild animals and plants, conserving natural areas, and fulfilling Myanmar's obligations under international agreements. The law recognized seven categories of protected areas: scientific nature reserves, national parks, marine national parks, nature reserves, wildlife sanctuaries, reserves of geophysical significance, and other nature reserves as designated by the Minister.

Under Myanmar forest policy promulgated in February 1996, it was stated that "30% of the total land area of the country [shall be gazetted] as reserve forest and 5% under [the] protected area system." Presently, there are 39 protected areas (18,911 square miles) representing 7.37% of the total land area of Myanmar. However, the Nature and Wildlife Conservation Division (NWCD) has been able to staff only 20 of the protected areas, while the rest are being managed with the help of the township forest department. **Table 1** shows the list of protected areas and their management status.

Like other developing countries, Myanmar has faced intense pressure on its biodiversity due to a growing population, improper land use, and mismanagement and overexploitation of natural resources. Two main direct threats to Myanmar's biodiversity exist: over-exploitation of natural resources (including wildlife, plants, and fishes) and habitat loss and degradation (including logging, agricultural expansion, and conversion of forests to plantations) (BirdLife International 2005). Pollution and invasive species are also significant threats. The underlying causes of all of these threats are economic growth, high demand on natural resources, poverty, limited capacity, lack of environmental safeguards, comprehensive land use polices, and plans, lack of grassroots support for conservation, and global climate change.

The Procedure for Setting up a Protected Area in Myanmar

Specific steps are taken for the gazettement of a protected area in Myanmar. First, the area is explored and its flora and fauna surveyed. Using available data, a proposal for establishment of the protected area is then written in

consultation with the Forest Department. This proposal is submitted to the Ministry of Forestry. If the Ministry agrees and approves, the establishment of the proposed area as a wildlife sanctuary, national park, reserve, etc., is announced.

When notification is issued by the Ministry of Forestry, the land settlement process commences. A land settlement committee is formed and chaired by the Township General Administration Department; the secretary will be warden of the proposed or neighboring park, and the committee members are officials from the Township Land Record Department and Forest Department. This committee will visit villages within the proposed area to determine the rights and privileges of the public and compile a draft notification and preliminary demarcation. If no villages exist in the proposed area, there is no need to conduct this settlement procedure and thus the gazettement of the protected area might be much faster. According to procedure, if there is no application of rights and privileges, the settlement issue could be finished within 150 days after notification is made.

After all stakeholders agree upon the settlement procedure, the chair and the committee members sign a declaration of gazettement. The secretary (the warden from the Forest Department) will forward the document to the Director General Office's of the Ministry of Forestry through the NWCD to get approval from the Minister. If the Minister approves the declaration, he will submit it to the government cabinet for their approval. Once the cabinet approves, the area is finally notified as a gazetted protected area.

Northern Forest Complex

The Northern Forest Complex (NFC) supports a very high floristic diversity, including a large number of endemic species (Kingdon-Ward 1944-5). It also supports a number of animal species that have characteristics of the eastern Himalayas, such as the red panda (*Ailurus fulgens*), takin (*Budorcas taxicolor*), and Blyth's tragopan (*Tragopan blythii*). The NFC is defined by four protected areas (Hkakaborazi National Park, Hponkhanrazi Wildlife Sanctuary, Bumphabum Wildlife Sanctuary, and Hukaung Tiger Reserve), comprises some of the largest contiguous expanses of natural forest remaining in the region, and is part of the Northern Triangle Subtropical Forests Ecoregion, ranked as globally outstanding by the World Wildlife Fund (WWF and ICIMOD 2001). Together the four protected areas constitute the largest contiguous block of protected areas in mainland Indo-China, covering an area of 30,269 km^2. This region contains the headwaters of the country's most important river system, the Chindwin and the Ayeyarwady, that drains vast expanses of agricultural lands and helps sustain extensive rice production areas. Since this area borders an expanse of contiguous forest areas in China and India, it plays an important role in transboundary conservation initiatives with those countries. For instance, Namdapha National Park in India shares a border with Hukaung Tiger Reserve in Myanmar.

Table 1: Myanmar's protected areas and their management bodies.

No.	Name	Area (Sq mile)	Area (Sq km)	Managed by
1	Pidaung WS	269.5	697.9	Nature and Wildlife Conservation Department
2	Shwe U Daung WS	125.9	445.1	Nature and Wildlife Conservation Department
3	Shwesettaw WS	213.4	552.7	Nature and Wildlife Conservation Department
4	Chatthin WS	104.0	269.4	Nature and Wildlife Conservation Department
5	Htamanthi WS	830.4	2,150.7	Nature and Wildlife Conservation Department
6	Hlawga WP	2.4	6.2	Nature and Wildlife Conservation Department
7	Inlay Wetland BS	248.0	642.3	Nature and Wildlife Conservation Department
8	Moyungyi Wetland BS	40.0	103.6	Nature and Wildlife Conservation Department
9	Popa MP	49.6	128.5	Nature and Wildlife Conservation Department
10	Alaungdaw Kathapa NP	616.8	1,597.6	Nature and Wildlife Conservation Department
11	Meinmahla Kyun WS	52.8	136.7	Nature and Wildlife Conservation Department
12	Hkakaborazi NP	1,472.0	3,812.5	Nature and Wildlife Conservation Department
13	Lawkananda WS	0.2	0.5	Nature and Wildlife Conservation Department
14	Natmataung NP	279.0	722.6	Nature and Wildlife Conservation Department
15	Indawgyi Wetland BS	299.3	775.2	Nature and Wildlife Conservation Department
16	Minzontaung WS	8.7	22.6	Nature and Wildlife Conservation Department
17	Kyaikhtiyoe WS	60.3	156.2	Nature and Wildlife Conservation Department
18	Hukaung Tiger Reserve	8,418.0	21,802.6	Nature and Wildlife Conservation Department
19	Rakhine Yoma Elephant Range	677.9	1,755.7	Nature and Wildlife Conservation Department
20	Panlaung-Pyadalin Cave WS	128.9	333.8	Nature and Wildlife Conservation Department
21	Pyin Oo Lwin BS	49.1	127.2	Forest Department
22	Moscos Islands WS	19.0	49.2	Forest Department
23	Kahilu WS	62.0	160.6	Forest Department
24	Taunggyi BS	6.2	16.1	Forest Department
25	Mulayit WS	53.5	138.5	Forest Department
26	Wethtikan BS	1.7	4.4	Forest Department
27	Kelatha WS	9.5	24.5	Forest Department
28	Thamihla Kyun WS	0.3	0.9	Forest Department
29	Minwuntaung WS	79.5	205.9	Forest Department
30	Lampi Island Marine NP	79.1	204.8	Forest Department
31	Loimwe PA	16.5	42.8	Forest Department
32	Parsar PA	29.7	77.0	Forest Department
33	Kyauk Pan Taung WS	51.2	132.6	Forest Department
34	Hponkan Razi WS	1,044.0	2,704.0	Forest Department
35	Maharmyaine WS	455.8	1,180.4	Forest Department
36	Lenya NP	682.0	1,766.4	Forest Department
37	Taninthayi NP	1,000.0	2,590.0	Forest Department
38	Bumhpabum WS	719.0	1,862.2	Forest Department
39	Taninthayi Nature Reserve	656.4	1,700.0	Forest Department
	Total	**18,911.5**	**49,100.0**	

During a 1999 biological expedition in the NFC jointly conducted by the Wildlife Conservation Society (WCS) and the Forest Department, four new mammal species were found in Myanmar: stone marten (*Martes foina*), blue sheep (*Pseudois nayaur*), black muntjac (*Muntiacus crinifrons*), and lead deer (*Muntiacus putaoensis*) (Rabinowitz et al. 1998; Amato et al. 1999).

Hukaung Tiger Reserve

Background

After the 1999 biological expedition conducted by WCS and the Forest Department of Myanmar, WCS submitted a proposal to the government to set up the 2,460 square mile Hukaung Valley Wildlife Sanctuary. When the Ministry of Forestry notified this area, the settlement procedure moved forward with no problems since there were no villages inside the proposed areas. Then it was approved by the cabinet of the Myanmar government and became a gazetted wildlife sanctuary in 2004.

In 2003, a second expedition to Hukaung Valley was jointly conducted by WCS and the Forest Department. After this trip, an additional 5,958 square miles were proposed as an expansion of the existing Hukaung Wildlife Sanctuary to create the Hukaung Tiger Reserve. The total proposed tiger reserve area was 8,418 square miles. The idea was that the already gazetted Hukaung Valley Wildlife Sanctuary would become the core area for tigers and other wildlife, and the newly proposed area would serve as a buffer zone. However, the new proposed area was so large that it fell administratively in six townships. The land settlement process began in 2004 and was finished for five townships within nine months, approved by the respective township land settlement committees because there were no villages within the proposed area, nor any extensive resource extraction.

Conflicts of Interest

Because numerous villages exist within the proposed extension area of Tanai Township, the land settlement process has been problematic. Delays continue to the present time, and WCS staff are still working with the local authorities to get the document signed by the chair of the land settlement committee, also the Tanai Township chairman. Conflicts of interest between the township authorities and the protected area are the reasons for the township chairman's reluctance to sign. By the government's orders, it is his obligation to sign. However, the following factors are viewed as conflicts of interest concerning Hukaung Tiger Reserve:

National- and state-level policy makers view the proposed area for Hukaung Tiger Reserve as potential land for agricultural development since there are vast level plains. National-level decision makers have already given 400,000 acres of concessions to two giant plantation companies in the proposed area.

At the township level, a GDP target set by the higher authorities has to be met by the end of the fiscal year. The Tanai Township chair of GAD is responsible for coordinating with relevant government departments to reach the GDP targets. To meet these targets, government departments have to increase extrac-

tion of natural resources such as timber, rattan, and fish, and expand agricultural lands. If the proposed area is gazetted, local authorities and government departments will find it difficult to meet the annual official GDP targets.

The Kachin Independence Organization (KIO) and other armed forces such as the Naga army have historically been involved in resource extraction such as gold mining, timber extraction, lucrative non-timber forest product (NTFP) extraction, and other resource extraction to earn income and sustain their organizations. If the proposed area becomes a protected area, continued income from resource extraction to maintain these armed forces in Hukaung Tiger Reserve will be in question.

In contrast to other stakeholders, local villagers have been interested in sustainable use of natural resources. They expect to have secure land ownership and stipulated rights and access to natural resources. The flow of immigrants across the country into Hukaung Tiger Reserve to find quick money from gold mining, hunting, and other resource extraction, as well as resource extraction by businesses, has been jeopardizing the sustainable resource use of local villagers.

In summary, we can see two groups among the key stakeholders—conservation-oriented groups (e.g., the NWCD and local villagers) and consumption-oriented groups (e.g., local authorities, some government departments, armed forces, and businesses). In terms of political, influential, and decision-making power, the consumption-oriented group is much stronger than the conservation-oriented group. Therefore, a good strategy and adaptive management are necessary to mitigate conflicts of interest between the two groups.

Hukaung Tiger Reserve is large enough to conserve key ecosystems such as seasonally inundated grasslands, lowland tropical forests, and semi-temperate forest, and key wildlife species such as tiger (*Panthera tigris*), Asiatic leopard (*Panthera pardus fusea*), elephant (*Elephas maximus*), and Hoolock gibbon (*Bunopithecus hoolock*). But as we expand the ecological scale of the reserve, we will have to deal with more governance issues. It will require a long process of bargaining, compromising, coordinating, and cooperation to gain consensus among the different interests of institutions and organizations.

To tackle all these issues and to set priorities, a series of meetings were organized to draw a conceptual framework and prioritize activities for Hukaung Tiger Reserve (**Figure 2**).

Mitigating Conflicts of Interest

Conservation requires understanding and compromise. In Hukaung Tiger Reserve, there is a wide range of stakeholders—state-level departments of the Kachin state and Sagaing Division, township-level departments for six different townships, various military commands, the Kachin Independent Organization/Army (KIO/KIA), Naga insurgent forces, a variety of local ethnic groups such as Kachin, Naga, Shan, and Lisu, different businesses such as rattan extraction, timber extraction, gold mining, and NTFP collection, and several INGO, NGO, and UN agencies. Thus, different approaches are being taken with different

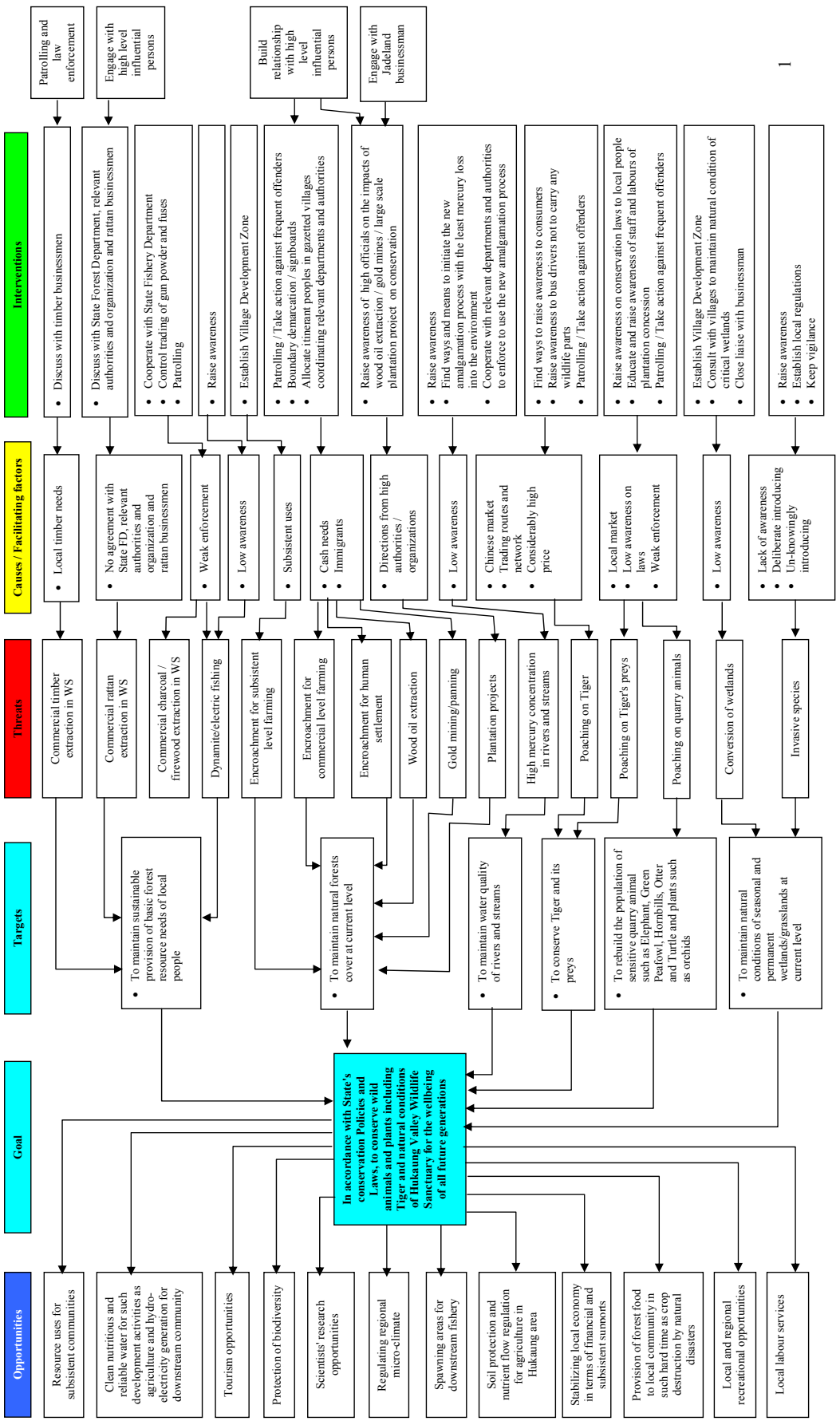

Figure 2: Hukaung Tiger Reserve conceptual model.

key stakeholders to mitigate conflicts of interest and to get consensus for our conservation goals.

National-level policy makers: WCS senior staff meetings with national-level policy makers such as the Prime Minister, the Minister of Forestry, and various Director-Generals have been an important tool for raising the political commitment of the government for conservation. The declaration of Hukaung Tiger Reserve indicates the commitment of the government towards sustainable goals. Awareness-raising across policy maker levels will help towards achieving a balance between conservation and development.

State and divisional authorities: WCS senior staff hold meetings with state-level authorities such as the Northern Commander of the Kachin State, the State Police Officer, the Director of the General Administration Department, State Forest Officers, etc. Multi-stakeholder meetings show the commitment of WCS and the NWCD to reduce threats, and allow state-level policy makers to provide input. These meetings help to raise the awareness of mid-level decision makers about conservation activities in Hukaung Tiger Reserve and increase their commitment to such activities.

Local army commanders and district and township authorities: Small stakeholder meetings have been used as a tool to gain cooperation from local army commanders and the district and township authorities. Since these stakeholders are quite busy and have their own priorities, meetings are held once or twice a year. If the meetings are informal, stakeholders are more likely to be candid and open about their perceptions. If formal meetings are organized, the stakeholders are more likely to simply echo national policies and commands from higher authorities. To address the real issues on the ground, we need frank, open discussions.

Individual departments are consulted if a particular threat is relevant to them. Fishing concessions in the wildlife sanctuary are a case in point. Fishing is controlled by the District Department of Fisheries. Each year fishing rights for all major water bodies are auctioned to the highest bidder, who then controls extraction rights for the next 12 months, after which the process is repeated. Once a businessman controls a fishing concession, s/he subcontracts fishing rights to a smaller business or a group of locals, not necessarily those from a village adjacent to the area. This system is flawed from a management perspective because it actively encourages over-harvesting and disengages local communities. Since there is no guarantee that the same businessman will get the same area the following year, there is no incentive for concessionaires to moderate their activities in the interests of maintaining mid- or long-term harvest levels. The concession system institutionalizes an unsustainable attitude—take as much as possible during the time allowed and do not worry about the future of the fishery. This is exemplified by the frequent use of dynamite as a harvesting technique by legally-permitted fishing groups. The concession system also directly conflicts with local access to fish. Since almost all profitable fisheries are controlled by external businesses, local villagers are forced to fish in peripheral areas or must pay to take fish from the streams that run past their village.

Lengthy consultation with the District Fishery Department and eventually with the state and Director-General's Office led to agreements to exclude streams and water bodies in the wildlife sanctuary from this bidding and permit system. Consensus was reached, and the District Department of Fishery issued a letter expressing that they would not permit fishing concessions in the wildlife sanctuary.

Peace groups: Trust-building with peace groups such as the KIO is an important activity for mitigating conflicts of interest. Since there are always suspicions between peace groups and government, trust-building with both sides, particularly with peace groups, is a necessary although time-consuming process and includes a variety of activities such as WCS staff visits and collaboration in conservation activities. Senior WCS officials' visits with peace groups to build trust have enhanced the peace groups' commitment to conservation and convinced them of WCS's and NWCD's dedication to conservation. Peace groups have also participated in workshops and the management planning process, an effective way of raising their awareness and increasing their coordination with other organizations. Their involvement in wildlife research and eventually in patrolling and law enforcement can enhance the protection of wildlife and the area. Community outreach activities can also be used to raise the interest and participation of peace groups in conservation activities by providing basic medicine, health, and educational facilities to remote communities.

Businessmen: Since most businesses are backed by local or state authorities, they seem less willing to cooperate in conservation activities. Therefore, any conservation-oriented endeavor needs to engage with the business community whenever opportunities arise. Businesses are monitored by relevant departments as a check and balance mechanism to reduce over-extraction of natural resources.

Local peoples: Village consultation has been used as a tool for improving the livelihoods of local people, while empowering them to manage their natural resources in sustainable ways. Village land use zones and Community Based Natural Resources Management (CBNRM) are two different components of this process.

Community outreach activities are an essential component for proving our commitment not just to wildlife, but to the local people. Providing for the basic health and education needs of local villages can enhance their participation in conservation. Providing basic medicines, piglets, and animal husbandry training can create alternative income sources for local communities and mitigate hunting pressures on wildlife. These provisions can be used as incentive packages to motivate villagers to participate in conservation activities. Education needs and all threats which potentially can be reduced by education and awareness-raising have been assessed, and a village education program has been developed to identify awareness problems and to target groups with appropriate messages.

A law enforcement program has also been established to reduce threats such as commercial timber extraction, dynamite and electric fishing, encroachment for commercial-level farming and human settlement, wood oil extraction, gold mining, and poaching. The program's main purpose is to reduce threats posed by immigrant people and businesses and to ensure that local people use natural resources sustainably.

Conclusion

We continue to face many challenges as we pursue our goal of getting this area fully gazetted and keeping it protected. Ultimately, our objective is to see a day when authorities at the township and state levels will work hand-in-hand with the warden and staff of the Huakung Tiger Reserve. The continued support of local people is also essential for better protection of the area. By all expert accounts, Hukaung Tiger Reserve is one of the world class areas that needs protection for its flora and fauna. We will never be able to eliminate all conflicts, since people are part of the reserve mosaic. However, if the people's interests can be managed and we can reduce the level of conflicts, we strongly believe that the reserve can be a win-win situation for both humans and wildlife.

2.3 Use of Community-based Natural Resource Management Principles to Promote Tiger Conservation in the Russian Far East: The Tiger Friendly Certification Program

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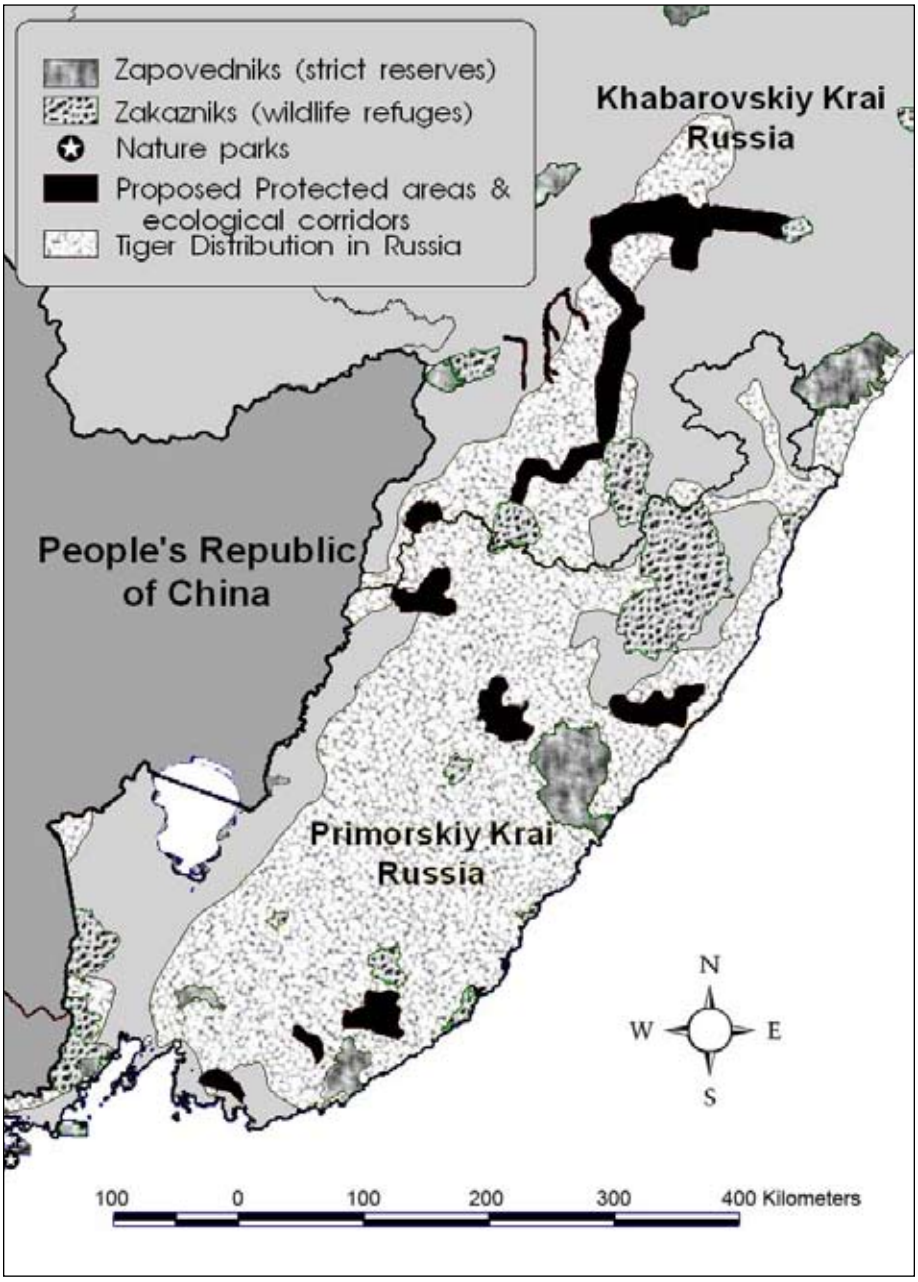
Introduction

It is impossible to conserve biodiversity in much of today's world by relying solely on a protected areas network. While protected areas often offer the best hope for retaining the integrity of natural functioning ecosystems and protecting wildlife species, in many situations the landmass available for protection is limited by the politics and the natural resource demands of both local and global human populations. Where the protected areas network is insufficient to protect conservation targets, the only solution is to consider how multiple-use lands outside the network can assist in achieving conservation objectives. In many instances, the success of such an approach will depend on how local communities relate to conservation targets, or how they use and relate to those components of the natural environment that are critical for achieving those targets.

A community-based natural resource management (CBNRM) approach attempts to empower local communities as the primary conservation agents (Child and Lyman 2005). Implementation of CBNRM principles is expected to automatically precipitate practices congruent with conservation of natural resources (Hanna et al. 1996). However, CBNRM may be successful from the community's perspective and still not achieve conservation objectives. Therefore, community development should be directly and explicitly linked to conservation objectives to ensure long-term sustainability of natural resource-based development.

The southernmost Russian Far East (RFE) retains a unique assemblage of natural communities and high numbers of rare and endangered species. A portion of this region was designated as a UNESCO World Heritage Site in 2001 for its rich biodiversity and high endemism (UNESCO 2008). One of the most well known and highly endangered wildlife species here is the Amur tiger (*Panthera tigris altaica*). Currently, tigers are distributed across approximately 128,000 km^2 in the RFE, where only 8% of the land is afforded protected status (**Figure 1**). Even under the most optimistic scenarios for habitat protection (Miquelle et al. 1999), it is unlikely that more than 20% of the area required to conserve Amur tigers will be protected because these lands must provide economic sustenance to local people. Therefore, managing habitat outside protected areas is a key issue in Amur tiger conservation efforts.

Figure 1: Southern Russian Far East where Amur tigers survive, and the protected areas network, as of 2003.



The Tiger Friendly Certification (TFC) Program represents an attempt to provide socio-economic incentives for local communities to conserve tigers and the landscapes they depend on. In this paper we review the existing management framework for natural resources in the RFE, and how the TFC fits within it and the CBNRM principles. We also review the socio-economic and political variables existing in the RFE to determine whether they are compatible with CBNRM principles.

Natural Resource Management in the Russian Far East

Under the Soviet regime natural resource management decisions were centralized in Moscow, excluding local village communities and hunters from the decision-making process. In 1992 the situation changed dramatically when all existing state hunting enterprises were abolished and new legislature provided opportunities for local people to create non-governmental "hunters' societies" that could lease hunting lands. As of 2005, in place of the 12 huge state-controlled operations of the Soviet era, there were 102 registered wildlife management leases (WMLs) of different types in Primorskiy province.

For the first time in Russian history, local people were given responsibility to manage wildlife resources. While this new arrangement does not provide ownership rights to land, it nevertheless represents a revolutionary change in wildlife resource management in Russia. Local people now theoretically have a vested interest in properly managing this natural resource.

However, poverty in local communities has spiraled upwards in the post-perestroika era, with unemployment rates often reaching more than 50%. Nearby forests provide non-timber forest products (NTFPs) that could comprise a basis for the economic development of these communities, but limited access to markets and lack of marketing and product development skills preclude this possibility. For those resources that do find their way to markets, local harvesters seldom reap a fair share of the benefits, and if demand is sufficiently high, extraction becomes massive, unsustainable, and often destructive for the ecosystems. Therefore, key to the process of achieving sustainable economic development for local people and retaining conservation value of forest lands for biodiversity will be the implementation of mechanisms and policies that would help local products reach legal markets and obtain fair market values but also include incentives for local people to conserve biodiversity. However, these incentives need to be explicitly defined, as it has been demonstrated repeatedly around the world that poverty alleviation does not necessarily reduce impacts on natural resources and in many cases increases the rate of depletion of those resources. Thus, clear linkages between economic and conservation benefits are essential for reaching conservation objectives.

One potential for sustainable development is the extraction of NTFPs. In the Soviet times, ferns, nuts, berries, and medicinal plants and roots were all harvested on a large scale. The massive state structure that existed for both harvesting and distributing these products collapsed in the early 1990s. Since then, reconstruction of NTFP businesses in the RFE has proven difficult, despite substantial efforts and financial investment by both local and international organizations (HRF 2002). Nonetheless, several studies have shown that harvest of

these NTFPs could provide larger incomes over longer periods than simply cutting the forest for short-term timber sales (UNDP 1997) and could potentially provide a sustainable and secure source of revenue for forest communities.

The Tiger Friendly Certification Program

The goal of the TFC Program is to foster sustainable development of local communities with socio-economic incentives linked to biodiversity conservation. The Wildlife Conservation Society (WCS) certifies those wildlife management leases which demonstrate a concerted effort to conserve tigers and their habitat. In return, we provide access to markets for their NTFPs at prices higher than would otherwise be possible, thus providing added value to the products. TFC uses tigers as an indicator of ecosystems' integrity and as a charismatic marketing tool to evoke "green" consumer behavior.

TFC certifies both the land base and the natural resource management practices on it. By purchasing TFC products, consumers are assured that they are conserving tigers while supporting sustainable and fair socio-economic development of local communities. Local communities derive direct benefits unavailable to uncertified producers by ensuring tigers are retained on their land. Thus, TFC achieves biodiversity conservation and sustainable development objectives.

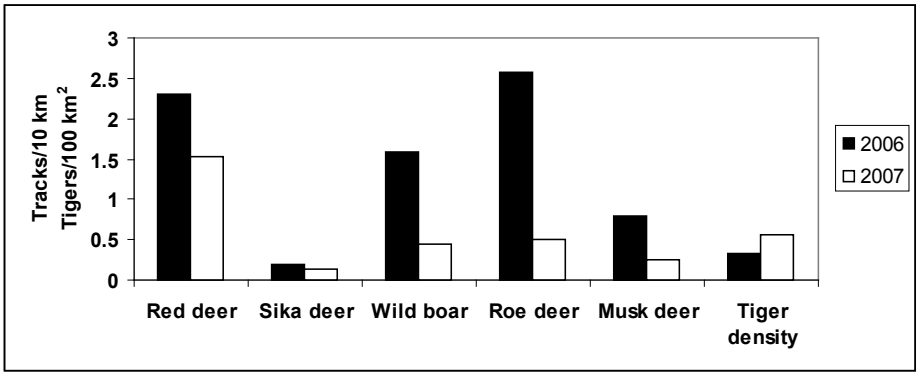
TFC is structured as a business enterprise to ensure its economic sustainability and is based on robust science for environmental sustainability. It is open to any community that meets the certification criteria for maintaining tiger populations on its land, sustainable harvest rates and methods of NTFP extraction, and fair distribution of profits.

Validating TFC Compliance

To ensure compliance, regularly monitoring certified sites is essential. One of our experimental wildlife management leases, Chin Sun (Tazy indigenous people's WML), has been part of our program for two years. We briefly review how we have applied a monitoring program to this particular WML.

Tiger Monitoring: Estimates of tiger numbers are based on collection of track data from two sources: 1) pre-determined routes covered on foot, snowmobile, or vehicle within a few days of each other; and 2) supplemental data provided by hunters and trappers who fill out field data forms when encountering tiger tracks. WCS provides training, oversight, and a small amount of money to cover the costs of conducting surveys (fuels, vehicles, etc.), while the WML provides trained members to conduct the actual work. Tiger numbers have been estimated in Chin Sun for two years. In both years, 11 routes totaling 157 km were followed, and 12 field data forms were filled out by trappers each year. A total of 28 tracks representing 3 tigers (1 adult male, 2 adult females) were reported in 2006, and 38 tracks representing 5 tigers (1 adult male, 2 adult females without cubs and 1 adult female with 1 cub) were reported in 2007. In 2006, tiger density in Chin Sun, at 0.33 tigers/100 km^2, was actually lower than certification requirements (0.4 tigers/100km^2). However, in 2007 densities were over the minimum requirements at 0.55 tigers/100 km^2 (**Figure 2**).

Figure 2: Ungulate track density (fresh tracks/10 km of routes covered) and tiger density (animals/100 km^2) in Chin Sun hunting lease for the first two years TFC surveys were conducted.



Ungulate Monitoring: Along the same routes where data on tiger tracks are reported, fieldworkers also collect data on fresh (< 24 hours) ungulate tracks, an index directly related to actual animal abundance. Surveys conducted in Chin Sun suggest that ungulate numbers actually dropped in 2007 in comparison to 2006 (**Figure 2**). Indices of ungulate abundance can vary due to other factors, and we therefore will require additional years to determine if there is a trend. However, this situation requires an admonition to the WML to be concerned about status of ungulates.

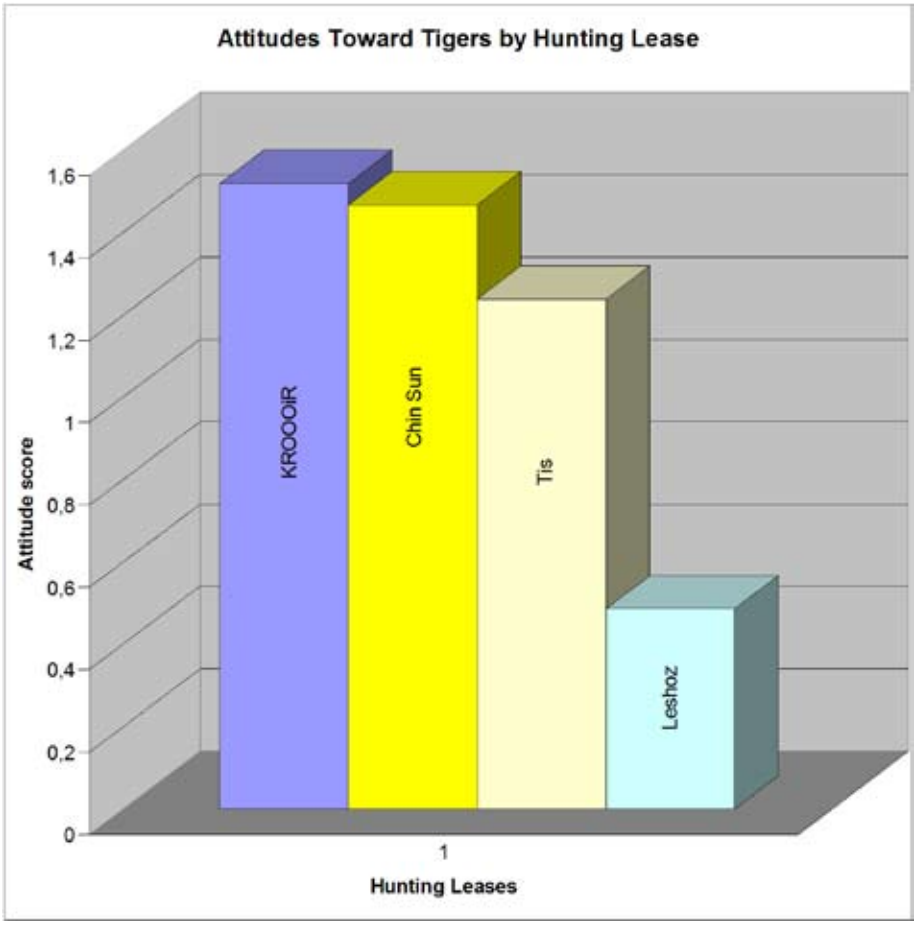
Monitoring Local Attitudes: To assess attitudes of local people towards tigers and their conservation, we developed a social monitoring program that provides regular feedback on changes in local attitudes. For these purposes we developed a Likert scale to measure general attitudes towards tigers and five attributes of that construct to assess specific attitudes towards intrinsic values, economic values, poachers, conflict tigers, and competition with hunters. This approach allows us to compare a variety of attitudes of communities targeted by TFC to those of similar non-certified communities, and also to track changes over time within each community for every attitude type. The first survey results showed that within Chin Sun people demonstrated significantly more positive attitudes ($P<.001$) towards tigers than nearby similar non-certified WMLs (Kazakov 2008 unpublished) (**Figure 3**).

Assessment of TFC in Relation to CBNRM Criteria

We analyze the relevance of CBNRM principles in the context of the TFC Program as a basis for assessing the potential for success of the TFC project.

Devolution of rights: According to CBNRM theory, the devolution of rights over natural resources to local communities is the most important condition (Murphree 1997; Child and Lyman 2005) because ownership rights over natural resources shape the interaction between people and their natural environment in a way congruent with sustainable use and conservation of these resources (Hanna et al. 1996).

Figure 3: Attitudes towards tigers in four wildlife management leases. The two on the left-hand side of the graph, KROOOR and Chin Sun, are Tiger Friendly Certified leases, and even in the first years of the program, have more positive attitudes towards tigers than adjacent similar WMLs.



In the RFE, WMLs obtain the rights to access, extract, and manage wildlife on a specified forest tract for a 5-25 year period of time. WMLs have the responsibility of protecting the wildlife from illegal use (exclusion right) and therefore can be defined as "proprietors" (Schlager and Ostrom 1992). However, without adequate financial rewards associated with high ungulate numbers and ownership rights in place, poaching is common. TFC puts economic and intrinsic values on healthy wildlife populations, thus providing incentives to effectively manage the resource. Certification could prove to be a powerful tool as a substitute to full ownership rights where governments are reluctant to fully devolve rights over natural resources to people.

Open and participatory decision-making: Local community-based WMLs are built on democratic principles. All management positions are elected by and report back to members. Each WML has open meetings at least two times a year: before and after the hunting season to provide information to the members and report back to them on activities, accounting, and potential problems. Major decisions for a WML require passage by a majority at these meetings. TFC also requires WML management to ensure fiscal transparency of TFC activities to their members.

Natural resource markets and marketing: Markets and marketing are of critical importance for successful community-based enterprises because greater sales lead to greater profits and hence greater incentives to abide by certification requirements and greater capacity for conservation.

The inability to access markets has been a critical gap preventing development of NTFP industries in the RFE in the post-Soviet period. Currently, local markets for these products are small and where they exist, profits are marginal (Gerasimenko et al. 2003). Despite international demand for certain NTFPs available in the RFE, international markets are practically inaccessible for local communities since obtaining legal harvest and export licenses involves a very complicated and costly process. TFC invested in writing a marketing plan and developing contacts with international NTFP wholesalers. The TFC marketing plan is based on the assumption that a charismatic endangered species such as the tiger will induce green consumerism, generating added value. If successful, the added value will be transferred to local community harvesters, eliminating the need to sell to the illegal middlemen at lower profits, and infusing value to tigers for local communities.

TFC offers additional potential advantages via development of other TF products, such as ecotourism, local products such as herbal teas, baskets, wool hats, etc., and even international sport hunting of legal game species. Once a land base becomes certified and the WML continues to meet certification criteria, communities can market all these products and services to generate revenue while improving conservation. As long as added value is used for conservation purposes, the conservation values would be imbedded into those products/services (Bahram 2002; Murdoch et al. 2000). These advantages provide much wider opportunities for both conservation and development.

Fair distribution of profits: TFC approaches the issue of fair profit distribution from several angles. First, there is an attempt to make the production chain as short as possible by directly linking local communities to international wholesalers, thereby cutting out unnecessary middlemen and increasing the percentage of profit reaching communities.

Secondly, the TFC Program attempts to ensure high profits for harvesters from local communities by accessing western markets. Currently, we are using local market prices as an indicator and adding 10-20% to the high end of those prices for TF and organic certifications.

There is always a danger of local elite derailing the community-based process by usurping both the power and profits. There is a fine line between effective leadership and usurpation by the elite. TFC deals with this issue by explaining to local leaders that the program can only work if the money trickles all the way down to the local people to create sufficient incentive for the targeted behavioral change. Transparency in financial statement requirement provides a mechanism to blockade usurpation of funds and to build trust in the communities, an important part of a community's capacity to successfully participate in the program.

Community capacity: Community capacity is the local ability to successfully mobilize resources for effective community action (Wilkinson 1991). Exogenous resources (existing legislature, economic situation, etc.), though important, are largely out of local villages' control. Endogenous resources are capacities that allow communities to successfully perform the necessary project functions (e.g., develop a management plan, conduct wildlife surveys, implement adaptive management, etc.). TFC actively builds these capacities and monitors them through the certification process.

One specific and important local capacity is the positive local attitudes toward tigers. They signify the sustainability of the project results. Usually it is just expected that attitudes would eventually improve under a CBNRM project. TFC requires WMLs to improve local attitudes through education and awareness programs. Measuring attitude changes is also important for adaptive management purposes. Like any CBNRM project, TFC attempts to change the behavior of local communities by changing beliefs. Those changes precipitate changes in attitudes, and shaping of an intention triggering changes in behavior (Ajzen and Fishbein 1980). If changes in behavior do not happen, it could be a failed effort in changing beliefs (and therefore attitudes) or exogenous factors (e.g. a law, economic crisis, etc.) precluding a targeted behavior. Measuring the changes in attitudes provides an excellent indicator of whether the intervention is effective and where potential problems could be.

The TFC builds many aspects of local community capacity. In this respect it is an important intervention aimed at developing local institutions, power structures, social and community capacities, and human and physical capitals—all important components of effective CBNRM. Increased capacity for community action signifies long-term changes on the local level. This means more sustainable use of resources and more long-term conservation on the most effective level—locally.

Clear linkages between community objectives and conservation objectives: Upon becoming TF certified, WMLs receive the right to use the Tiger Friendly logo (**Figure 4**) on products harvested by local communities from their lands, thereby increasing the value of those products and expanding the potential market for sales. By ensuring fair distribution of profits, we hope to improve the livelihoods of local people in a way that links those benefits directly to conservation of tigers. WMLs are responsible for explaining the connection between the profits and the well-being of tigers to the communities. TFC also requires development of a NTFP use plan based on rigorous science for volumes, sites, and methods of extraction. By this we ensure that forest ecosystems are not negatively impacted (as often happens when a specific resource becomes highly valuble and is overexploited) and will provide long-lasting benefits to local communities on a sustainable basis.

Figure 4: The Tiger Friendly logo links tigers and people by creating economic incentives for those communities that can demonstrate commitment to conservation of tigers and the forest landscapes that both humans and tigers rely upon for sustenance.

We realize that conservation of tigers will not ensure that the full spectrum of conservation targets in the RFE will be protected, but because tigers require large tracts of intact forest, they should act as an effective umbrella species in conservation of forest ecosystems. In effect, the TFC Program provides WMLs and the local communities they serve a feasible alternative source of income that encourages sustainable economic development of local communities and links it directly to conservation of their precious natural heritage.

Discussion

CBNRM has proven successful in conserving natural resources and promoting socio-economic development of local communities in some parts of the world (Murphree 1997). Devolution of rights over the natural resources to the local communities is the first and foremost condition upon which success of this approach is built. Although it appears to be a very logical approach with proven benefits for local people and the environment, very few governments around the world have relegated such rights to local communities.

Such is the situation in the RFE. Although local communities have recently obtained rights to manage and exclude others from using their leased wildlife resources, the lack of full ownership rights has hampered effective management. If a community-based resource management approach is to be successful under these conditions, the environmental certification process can, to a significant degree, substitute for ownership rights. Therefore, WCS is trying to create market-based economic incentives for local communities to foster the CBNRM approach through participation in TFC.

Overcoming bureaucratic hurdles and ensuring that small local businesses can access international markets will be critical to success of this program. TFC is used as a tool to make the products more attractive to western consumers and to provide added value to the communities. If there is sufficient appeal for such products, TFC also has the potential to become an effective conservation tool to ensure sustainable management of natural resources and overall health of ecosystems.

An important product of the TFC program is that it requires increased capacities of communities to successfully manage their resources. Despite the fact that some capabilities are already present in these communities, there is a definite need for more capacity building, including a buildup of skills and knowledge. On one hand the high levels of community capacity require a great deal of effort and resources to build them. On the other hand they ensure higher levels of development and conservation and long-term sustainability of the program.

One potentially serious threat to environmental certification programs such as TFC is that they are dependent on a large consumer base that is willing to pay the added value for certified products. Willingness to pay will partly be a reaction to effective marketing, but the global and regional markets will also play a large role in determining the success of this approach.

Nevertheless, if carefully developed and properly used, environmental certification programs such as TFC enjoy critical advantages as conservation tools over reliance on strictly protected areas. Such programs involve and engage local communities, and if successful, change attitudes towards local resources and how those resources should be managed. As such, they have the potential to initiate long-term benefits both to local people and to a larger and more complex conservation landscape in a world where establishment of new protected areas is becoming more and more difficult.

Acknowledgements

The Liz Claiborne and Art Ortenberg Foundation has provided most of the support for our work with community-based wildlife management leases. A grant from the World Bank Marketplace Development Program provided support to initiate the Tiger Friendly Certification Program. Additional support has come from the Banovich Wildscapes Initiative. We especially thank Steve DePuis and the DePuis Company for development of a Tiger Friendly Logo, and John Fraser, who provided guidance in many forms during the early implementation phases. The attitude survey was developed under the auspices of the University of Florida with much appreciated help by Dr. Marilyn Swisher and Dr. Mark Brennan. Important assistance in survey data analysis was provided by Dr. Glenn Israel.

PART 3: WCS CASE STUDIES—LATIN AMERICA

3.1 Marine Protected Areas and Seabird Conservation in Patagonia

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Introduction

Seabirds are important components of marine ecosystems, as well as valuable economic resources. They are long-lived, have delayed maturity, and exhibit low fecundity and high adult survival (Furness and Monaghan 1987). Given their life-history traits and colonial habits, seabirds are highly vulnerable to some human impacts (Croxall and Rothery 1991; Boersma et al. 2002). They are also wide-ranging: several seabirds disperse hundreds to thousands of kilometers during foraging trips or winter migrations (Schreiber and Burger 2002; Gaston 2004). The current main threats to breeding seabirds worldwide include commercial fisheries, pollution, human disturbance, alien species, and global climate change.

Marine protected areas (MPAs) have been proposed and used as a tool for seabird conservation across the globe (Duffy 1994; Hyrenbach et al. 2000; Yorio 2000; Johnston 2001; Wienecke and Robertson 2002; Airamé et al. 2003; Garthe and Skov 2006; Lombard et al. 2007). Of the 31 marine protected areas in Argentina, 21 include colonies of one or more seabird species (Yorio et al. 1998; P. Yorio, unpubl.). Moreover, the main objective of the designation of some of these areas, particularly favored by ecotourism development, has been the protection of seabird breeding sites. Seabirds are colonial and thus concentrate, often in large numbers, to nest at specific locations along the continental shore and on islands during the breeding season. Many existing MPAs may thus provide relatively good protection for seabirds while they are on land during the nesting season by controlling human visitation or preventing habitat modification.

However, MPAs are generally ineffective for the protection of highly mobile species or species with relative site fidelity but high dispersal abilities like seabirds (Boersma and Parrish 1999; Hyrenbach et al. 2000; Yorio 2000).

Interestingly, few marine reserves were designed to explicitly address movement of top predators such as seabirds (Gerber et al. 2003; Hooker and Gerber 2004; but see Louzao et al. 2006). In addition, because of their large-scale movements, seabirds often cross jurisdictional boundaries, and, thus, their protection needs an integrated approach at different spatial scales. Here I will use the recent designation of a new MPA in Golfo San Jorge, Patagonia, as a case study, and I will discuss the challenges of protecting breeding seabirds given their different spatial scale requirements, the complexities derived from their use of different jurisdictions and vulnerability to wide-range and large-scale human activities, and the opportunities and limitations of using protected areas as a tool for their conservation.

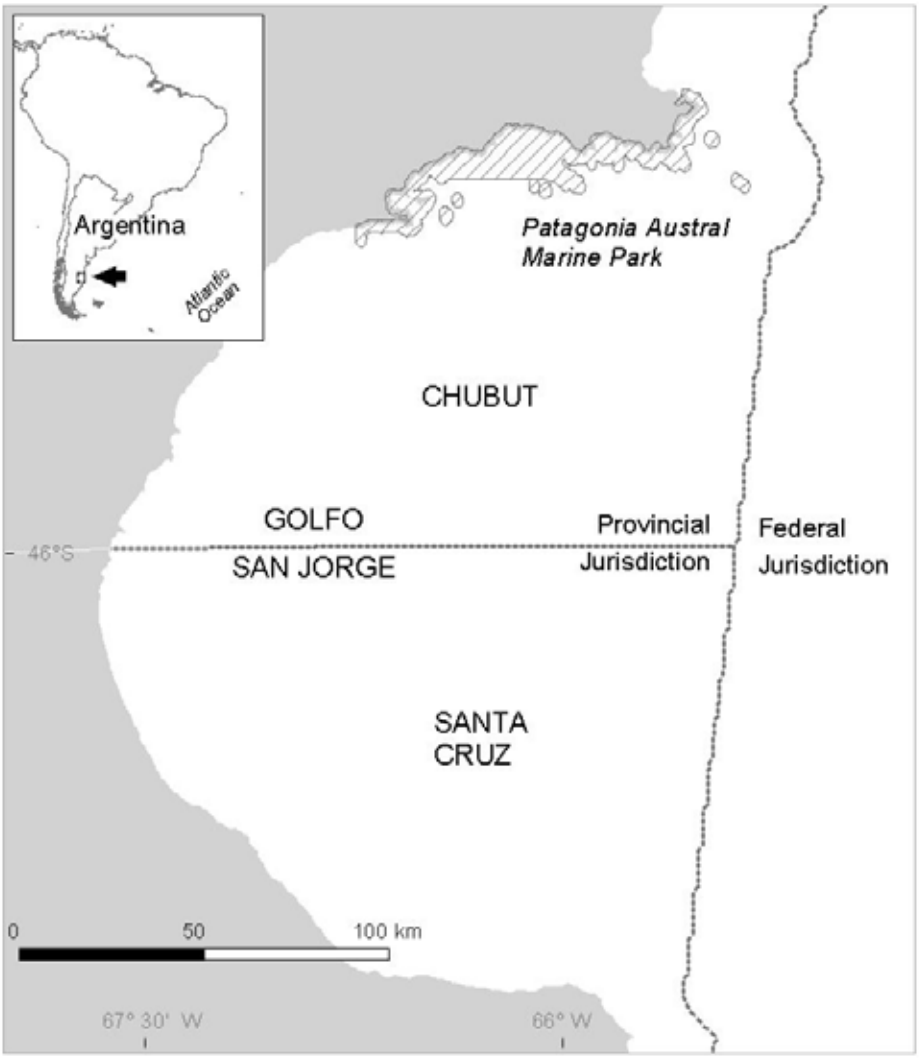
Breeding Seabirds of Golfo San Jorge

During the last decade, Golfo San Jorge was identified as a key area in coastal Patagonia as a result of joint work by the Wildlife Conservation Society (WCS) and Fundación Patagonia Natural (FPN) (**Figure 1**). The northern sector of the gulf is one of the most important coastal areas in terms of marine biodiversity (Fundación Patagonia Natural 1996), and one of the priority seabird areas in Argentina. Thirteen of the 16 Patagonian breeding seabirds nest on more than 50 islands in this coastal sector. For example, this sector holds 25% of the near threatened Magellanic penguin (*Spheniscus magellanicus*), 80% of the near threatened southern giant petrel (*Macronectes giganteus*), and 28% of the imperial cormorant (*Phalacrocorax atriceps*). It is also one of two breeding grounds for the vulnerable Olrog's gull (*Larus atlanticus*). Magellanic penguins and imperial cormorants are important targets for ecotourism and guano production, respectively (Yorio et al. 1999).

On September 21, 2006, an agreement was signed between the Chubut Province government, the National Parks Administration, and the Wildlife Conservation Society, enabling the creation of a marine park in Golfo San Jorge. WCS and FPN served as lead technical advisors during the process. However, biological and environmental issues were not the main focus of the negotiations. Argentina is strongly federal in its form of government and the waters of Golfo San Jorge, along with their natural resources, are under provincial rather than national jurisdiction. The creation of a joint management body including the National Parks Administration and the provincial government proved challenging for all involved, and legal, administrative, and political constraints strongly influenced decisions during the design and designation of this new protected area. Although an extraordinary success for conservation, the resulting protected area was significantly smaller than originally planned. An area of 750 km^2, one quarter of the size defined in the original proposal, and extending from the high tide mark one nautical mile offshore, was finally included in the marine park under the federal direction of the National Parks Administration.

Despite the designation of the marine park and the governments' willingness to conserve this important sector, the area still faces major threats. Increased interest in offshore oil development, ecotourism, and artisanal fisheries in the northern portion of the gulf are sources of concern, but the area's status as a

Figure 1: Geographic location of Golfo San Jorge and jurisdiction limits for the study area. The management of waters and seabird populations of the San Jorge Gulf are shared by the provinces of Chubut (north of 46ºS) and Santa Cruz (south of 46ºS). Waters east of the provincial limit shown are under the management of the federal government.



primary fishing ground for the region's growing commercial fisheries represents the most critical threat to seabird populations today. About 70 freezer trawl vessels targeting Argentine red shrimp (*Pleoticus muelleri*) and 20 ice trawlers targeting Argentine hake (*Merluccius hubbsi*) operate from about September to May, usually from 20 to 50 km offshore, although they occasionally fish in waters outside Golfo San Jorge to distances over 100 km offshore.

Seabird populations worldwide may be both positively and negatively affected by fishing activities (Duffy and Schneider 1994; Montevecchi 2002). For example, many seabirds make intensive use of fishery discards (Tasker et al. 2000), and it has been argued that this has contributed to the expansion of several populations (Furness 2003). However, seabird attraction to fishing vessels and their discarded waste often leads to increased mortality as the birds get tangled in nets and drown or collide with the vessels or fishing gear cables

(Weimerskirch et al. 2000; Baird and Thompson 2002; Sullivan et al. 2006). Over 17 seabirds, including Magellanic penguins and imperial cormorants, regularly scavenge this waste, and this often leads to incidental mortality (González-Zevallos and Yorio 2006; González-Zevallos et al. 2007). Total mortality at both trawl fisheries during the 2004 fishing season in northern Golfo San Jorge, for example, was estimated at over 1,600 Magellanic penguins and 420 imperial cormorants. Unfortunately, insufficient information is available to evaluate the effects of fisheries on seabird trophic resources.

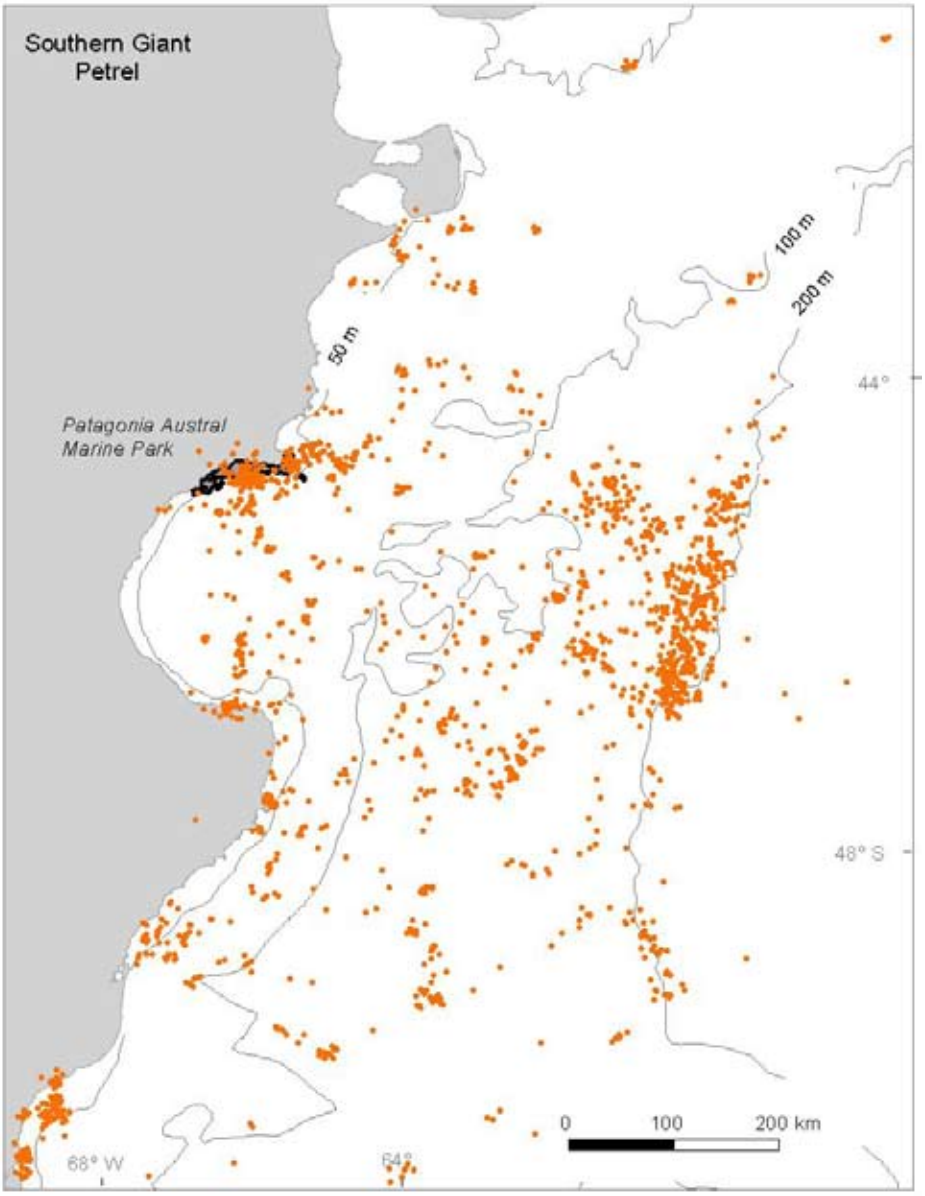
Oil pollution is also a major threat for the marine environment in the area—Golfo San Jorge is one of the richest oil basins in Patagonia)—and may affect several seabird species, including valuable tourist resources such as the Magellanic penguin (Gandini et al. 1994; García-Borboroglu et al. 2006).

Seabird Foraging Ecology and Spatial Scales

Research on the foraging ecology of several species that breed at Golfo San Jorge has shown that different species have distinct foraging strategies with differing ranges, and that the size of the marine areas upon which they depend can be very variable. The threatened Olrog´s gull, for example, has a fairly specialized feeding ecology during the breeding season, consuming mainly crabs along the intertidal zone relatively close to its colony (Yorio et al. 2004; Herrera et al. 2005). Other seabirds such as the rock shag (*Phalacrocorax magellanicus*) and neotropic cormorant (*P. brasilianus*) forage within a few kilometers of their breeding sites in relatively shallow waters (Quintana et al. 2004; Sapoznikov and Quintana 2003). Imperial cormorants and Magellanic penguins, in contrast, have been recorded foraging up to approximately 70 and 120 km respectively (Quintana et al. 2007; F. Quintana and P. Yorio, unpubl. data), while southern giant petrels forage across large extensions of the ocean up to 600 km from their colony (Quintana and Dell'Arciprete 2002)(**Figure 2**).

The observed diversity in foraging ranges suggests the importance of considering different spatial scales when evaluating the needs of this seabird assemblage, and highlights the complexity of spatial management. Although one of the goals for the designation of the new marine park was the protection of breeding seabird populations, the defined boundaries do not appear to be adequate for the effective protection of some species. The feeding grounds of the rock shag, neotropic cormorant, and Olrog's gull are located relatively close to shore, within the waters protected by the new marine park. Thus, the park provides spatial protection to both the nesting and feeding grounds of these species, and a better setting for the management of existing small-scale development activities such as ecotourism, artisanal fisheries, guano extraction, and macroalgae harvesting. In contrast, imperial cormorants, Magellanic penguins, and southern giant petrels forage mostly beyond the limits of the park, and the main challenges then include the resolution of conflicts derived from the interaction of these populations with commercial fisheries and oil development activities in the adjacent waters. Foraging imperial cormorants and Magellanic penguins commonly overlap with trawl fishing operations within the gulf, often resulting in incidental mortality (see above; Yorio et al. 2007). Similarly, oil

Figure 2: Foraging locations of southern giant petrels breeding at Golfo San Jorge, Chubut. (Source: F. Quintana, unpubl. data.)



pollution may negatively affect seabird populations, as occurred in December 2007 when a spill in an area south of the marine park and within the foraging range of breeding Magellanic penguins resulted in the mortality of over 1,000 individuals.

The importance of conservation and management actions directed at economic activities outside the protected area boundaries should not be underestimated, as, given their life-history traits, seabird populations are highly sensitive to slight changes in adult mortality (Furness and Monaghan 1987). The information on seabird foraging ecology suggests the need to re-evaluate the spatial design of the park and/or the definition of management actions beyond the boundaries of the protected area in order to complement the current protection afforded by the marine park. Seabird conservation and management issues concerning spatial scales in Patagonian marine environments are not restricted to the newly created marine park, however. For example, penguins and cormorants regularly make foraging trips that take them far beyond the boundaries of protected areas at most of their main breeding locations in Patagonia, including Península Valdés, Punta León, Punta Tombo, Ría Deseado, Bahía San Julián, and Cabo Vírgenes (Wilson et al. 2005; Stokes and Boersma 2000; Boersma et al. 2007; F. Quintana et al., unpubl. data).

Scale and Governance: Complementary Tools to Marine Protected Areas

The diversity in seabird foraging habits suggests that careful consideration of spatial scales is essential for the correct design of conservation actions and for evaluating the role of protected areas in contributing to the overall conservation strategy. The effectiveness of marine protected areas is dependent upon their ability to protect different life stages and distributional ranges (nesting, feeding, and migrating grounds), as the vulnerability of a population may be stage- and habitat-specific (Hooker and Gerber 2004). Increased protection of seabird breeding populations could be achieved by including relatively small extensions of sea adjacent to colony locations because these birds are central place foragers. If large enough, MPAs may also help protect habitat-demanding seabirds, at least during part of their annual cycle (Wieneke and Robertson 2002). However, in most cases breeding populations of seabirds with large foraging ranges can not be adequately protected by MPAs alone, although the identification and implementation of MPA networks and corridors could increase the effectiveness of conservation efforts by linking spatial protection for different life stages (Roberts et al. 2003). In addition, seabirds within protected areas also may be negatively affected by outside factors, given the connectivity of marine systems and their linkages with terrestrial areas (Carr et al. 2003; Stoms et al. 2005). Thus, as for other wide-ranging top predators, broad-scale conservation activities at the seascape often may be needed to protect seabird breeding populations (Sanderson et al. 2002; Boyd et al. 2008).

As indicated by the case of Golfo San Jorge, the large scale and connectivity of marine ecosystems and the variety of economic pressures on the marine environment require the participation of several agencies from different levels of government on issues related to both protection and management. Seabirds such as the imperial cormorant, Magellanic penguin, and southern giant petrel often extend their feeding ranges well beyond the jurisdiction of the park (in this case, the responsibility of the National Parks Administration), travel into waters under provincial jurisdiction, and, in the case of the latter two, often move further offshore again into federal waters (**Figure 1**). Southern giant petrels may even fly into international waters to the east of the shelf break (F. Quintana, unpubl. data). In Argentina, biotic resources within gulfs and bays and from the coast up to a 12-mile offshore limit are under the domain and jurisdiction of provincial governments, while those in the rest of the exclusive economic zone fall under federal control. This has major implications, for example with respect to widely distributed and mobile fish and invertebrate resources upon which wide-ranging seabird populations depend. Given the scale of foraging habits of many seabirds, commuting between areas under different jurisdictions during foraging trips is very likely a common trait of several of their populations in many countries worldwide, resulting in similar governance issues.

In Argentina, coordination between agencies and administration levels is often inefficient and in many cases lacking altogether. This is mostly a result of the overlapping spheres of authority between administrative bodies and the lack of public organizations responsible for coordinating the various agencies and institutions (Esteves et al. 2000; Barragán-Muñoz et al. 2003), compounded by the fact that Argentina has a strongly federal form of government in which provinces retain full jurisdiction over their natural resources. Conflicts of interest between administrative bodies and different governments may curtail important conservation initiatives. During the designation of the marine park in Golfo San Jorge, governance conflicts between provincial and federal levels in relation to the administration of natural resources were partially resolved by the development of an inter-jurisdictional treaty which helped generate consensus. This treaty is innovative because it will allow the co-management of a protected area by both federal and provincial governments, and, if successfully implemented, may be used as an example to be applied in similar situations along the coasts of Argentina. This kind of cooperation between government levels will be required in most protected areas on the Patagonian coast under provincial jurisdiction that include breeding seabird populations dependent on offshore marine resources. However, in the case of Golfo San Jorge, conflicts of interest between administrative bodies concerning fisheries issues resulted in a marine protected area that is simply too small and does not include a large enough portion of ocean to fulfill its conservation goals.

Limited communication and lack of mechanisms for effective coordination between agencies may also jeopardize seabird conservation and reduce management effectiveness. For example, Magellanic penguins that breed in the Península Valdés protected area in the Chubut Province often feed in the nearby waters of the San Matías gulf (Wilson et al. 1995; R. Wilson and F. Quintana,

unpubl. data), waters that are under the jurisdiction of the Río Negro Province. Interestingly, representatives of the Río Negro Province have not participated in any discussions related to the management or protection of the Península Valdés protected area and its penguin breeding population since its designation in 1983, nor were they invited to do so during a recent update of the protected area's management plan.

One of the challenges for the long-term preservation of marine resources in Argentina, including seabirds, is achieving effective joint efforts by different agencies, both within and between government levels (Esteves et al. 2000). In addition, given the dynamic nature of the marine environment and the current expansion of human activities outside the limits of protected areas, the participation of stakeholders is a key factor if the goal is to minimize negative impacts on seabird populations. For example, the implementation of mitigation measures to reduce incidental mortality in fishing gear (Gandini et al. 2003; Sullivan et al. 2006; González-Zevallos et al. 2007) is highly dependent on the participation of fishing companies and fishers. Similarly, a reduction in oil dumping into the ocean will greatly depend on the compliance of current legislation by oil companies. These actions may be successfully implemented through sectoral planning and the regulation of certain economic activities, but in this respect, as well as in cases requiring the interplay of several agencies, integrated coastal management may be a valuable tool to complement the use of protected areas, as it allows for the coordination of different management or conservation actions across sectors and levels (Hildebrand and Norrena 1992; Post and Lundin 1996). The promotion of specific policies and laws concerning integrated coastal zone management and planning is urgently needed in Argentina (see Barragán et al. 2003). However, as has been suggested for similar scenarios, the complexity of problems resulting from the diversity of spatial scales, environmental problems, and actors at different levels will also require the exploration of new hybrid modes of governance structures (Lemos and Agrawal 2006).

Finally, it should be noted that careful consideration of ecological scale is not restricted to seabird conservation issues during the breeding season alone. Many seabirds from breeding sites in Patagonia migrate or disperse over very large distances and cross international boundaries outside their breeding season. For example, Magellanic penguins and Olrog's gulls migrate north, many as far as Uruguay and southern Brazil (Escalante 1984; Boersma et al. 1990), while southern giant petrels disperse over wide oceanic areas reaching even New Zealand's waters (F. Quintana, unpubl. data). Conservation efforts directed at breeding populations will be largely ineffective if negative impacts on individuals occur once they leave their breeding areas for wintering grounds. Magellanic penguins, for example, are regularly killed because of oil pollution during their migration in the waters of northern Argentina, Uruguay, and Brazil (García-Borboroglu et al. 2006). International conventions, treaties, and agreements, such as the Convention for the Conservation of Migratory Species and the Convention for the Conservation of Albatross and Petrels (both ratified by the Argentine government), can greatly contribute to integrated efforts to protect seabird populations.

The above examples from Patagonia highlight the importance of considering spatial scales and show the value of ecological information in the design of effective conservation and management actions for seabirds and other marine organisms. Although protected areas can be a valuable tool for the protection of breeding seabirds, increased efforts are needed to design alternative and complementary strategies for spatial protection so as to deal with the biological, social, and political complexities of marine systems. In particular, there is an urgent need for mechanisms of effective participation by different actors in ocean management planning. The protection of many seabird populations, and very likely of other marine organisms that are specific conservation targets of marine protected areas, will require the implementation of actions beyond the boundaries of protected areas and wider stakeholder participation.

3.2 Consolidating Protected Areas as Part of a Strategy for Landscape and Species Conservation: Lessons from Bolivia

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Introduction

For many years, conservation efforts have rightly concentrated on the establishment of protected areas and the consolidation of sufficiently robust management capacity to allow them to fulfill their conservation mission. Despite some shortcomings, which have been widely discussed in the conservation literature (e.g., Terborgh 1999), protected areas provide spaces for protecting wildlife, and the habitats and ecosystems on which they depend, that would not otherwise survive today. Even "paper parks," where basic management functions may be most notable for their absence, provide opportunities to invoke legal and political arguments to defend biological diversity from threats posed by hydrocarbons, mining, logging, colonization, and large-scale infrastructure. If an area has been judged to contain national patrimony worthy of protecting on behalf of an entire population, there is at least a basic expectation that a government must explain why it is in the national interest for that patrimony to be damaged or sacrificed to activities that will provide tangible benefits to only a portion of the population that seldom resides in the area to be affected.

If it can be demonstrated that an area is fulfilling its role of protecting biodiversity on behalf of the population, and that there are benefits to society as a result, this argument becomes stronger. Ideally, reasonably well-managed protected areas should be able to play a leading role in their own defense against the kinds of external threats noted above. Thus, we have tried to fortify the management of protected areas, to lay the groundwork for why they are worth defending and to strengthen their ability to defend themselves. However, as our understanding of both the overall level of effort and the specific actions that must be taken to successfully conserve biological diversity has grown, the inadequacies of focusing on protected area creation and management have also become apparent. To improve the effectiveness of our conservation efforts, we need to place the creation and management of protected areas within a broader geographical and sociopolitical context.

The pressures for change have been both biological and social. Methodologies for selecting landscape species and the definition of conservation landscapes based on these species' spatial and habitat requirements (Coppolillo et al. 2004; Sanderson et al. 2002), reconsiderations of our understanding of minimum viable population size and the areas required to sustain such populations (Reed et al. 2003; Brook et al. 2006; Traill et al. 2007), and the linking of conservation landscapes to form corridors (Hilty et al. 2006) have driven home the understanding that conventional protected areas, no matter how well managed, are not adequate for achieving biodiversity population goals (e.g., Painter et al. 2006). Strategies that call for the conservation of viable populations across a species' range also force us to consider multiple approaches for achieving con-

servation goals on lands characterized by diverse tenure arrangements defining rights of ownership, access, and use (e.g., Ray et al. 2005).

Improved understanding of the social processes that shape conservation has resulted in mixed incentives to reconsider our focus. We have learned that strong partnerships with local people who share some of our conservation interests are an essential ingredient of conservation success, creating options for local stewardship, building local conservation constituencies, and expanding options for sustainable financing of conservation initiatives (Noss and Castillo 2007; Redford and Painter 2006). We have also learned that we pursue conservation objectives without building partnerships at our peril, and that while there are many actors in the landscapes where we work who identify key aspects of their quality of life as being linked to conservation, those actors are not going to subordinate their agendas to ours, nor allow conservationists to determine their access to land and other natural resources (Arambiza and Painter 2006). Finally, as we begin to think about how to conserve critical habitats outside of protected areas, we are confronted with lands that fall under different and sometimes conflicting jurisdictions, diverse tenure arrangements, and a variety of land use designations (Salinas 2007).

Thus, as we move from creating and managing protected areas to constructing conservation landscapes, or attempting to conserve species across defined ranges, our concerns about the management issues confronting protected areas need to be assessed from a different perspective. Clearly, it is preferable that protected areas be well managed rather than poorly managed. However, the Wildlife Conservation Society's (WCS) experience in the two major landscapes that form the bulk of its Bolivia Program—the Kaa-Iya del Gran Chaco Landscape in Santa Cruz and the Greater Madidi Landscape in northern La Paz—suggests that a protected area's relationship with other jurisdictions in the landscape, and the capacity of key actors to process information and use the resulting conclusions to plan actions and assess progress, may have more of an effect on conservation success than how well protected areas are faring in conventional management assessments.

Lessons from Bolivia

Two magnificent Bolivian landscapes are long-term conservation sites in the Wildlife Conservation Society's Latin America and Caribbean Program. WCS has been working in the Kaa-Iya del Gran Chaco Landscape since 1991 and in the Greater Madidi Landscape since 1999. The core of each landscape is a national protected area: Kaa-Iya del Gran Chaco National Park and Natural Area of Integrated Management (KINP) and Madidi National Park and Natural Area of Integrated Management (MNP), both created by Presidential Supreme Decree in September 1995.

Based on our experience in these two Bolivian landscapes, the following five conditions should be met in order to have a reasonable expectation that a protected area will be able to fulfill basic functions and ensure effective long-term conservation:

1. Formal definition of conservation purpose, legal authority, and management mandate;
2. Resolution of land conflicts and a clear definition of land tenure;
3. An integrated management plan, including specific management plans for each area and resource to be utilized and for connectivity with areas of influence;
4. Formal incorporation into the development plans of relevant jurisdictions; and
5. A long-term financial plan.

Most schemes for tracking and assessing the consolidation of protected areas generally underestimate the importance of the institutional and political issues underpinning this list of critical factors, while assigning too much weight to the infrastructure of protected area management. This encourages the declaration of some protected areas consolidated when, in fact, they may be in critical need of external support, and also may lead to underestimating the resiliency of areas that have modest resources but a strong institutional and legal base that confers political legitimacy.

Formal Definition of Conservation Purpose

The formal definition of a protected area may take several forms, including a supreme decree or law, a municipal ordinance, or a formal decision by an indigenous organization to define land use rules in the different areas of its territory. Normally, the definition includes a statement about the kind of protection extended (e.g., strict preservation versus sustainable production under defined conditions). In many cases this is the first, and arguably the easiest, step taken. However, many protected areas do not progress far beyond the "paper park" stage.

Land Tenure Definition

Without a clear definition of land rights, an area created by supreme decree or even law is subject to having its boundaries disputed and the authority of the entity responsible for its management questioned. A land title defines the exact limits of the protected area and ratifies its designated purpose by identifying legitimate rights over the area and establishing agreements so that formally recognized owners can also be joint stewards (together with the national government) of the physical integrity and conservation of the area. Land titling is also a prerequisite for establishing private reserves within larger private properties. More extensive indigenous territorial lands (TCOs, or *Tierras Comunitaria de Origen,* in Bolivia) are also proceeding in this direction, particularly the Tacana and Leco TCOs neighboring MNP and the Isoso and Santa Teresita TCOs which neighbor KINP. *Capitanía de Alto y Bajo Isoso* (CABI), the indigenous organization that proposed the creation of KINP and co-manages the area under an agreement with the Bolivian government, has proposed that the Kaa-Iya protected area be titled to CABI in order to secure management of the area based on its conservation purpose, in the event that the national government is unable to meet its commitments or national priorities for conservation change.

Management Plan

A management plan defines the geographic spaces in which prioritized interventions will be carried out to fulfill a protected area's conservation purpose. It provides the management entity with technical support to determine that a particular area is suitable for certain types of activities (e.g., regulated tourism) but not others (e.g., grazing livestock), and defines the specific parameters within which the impacts of interventions like roads and gas pipelines need to be assessed. Zoning is a key element of the management planning process involving local actors and integrates environmental and socio-economic criteria.

Unfortunately, management plans are often produced as technical documents for meeting legal or donor requirements but are then shelved rather than implemented. This was not the case with the Kaa-Iya management plan which was developed from 1997-2000. The region initially decreed as a core protected area with three integrated management areas later came to include six categories of protection/use based on environmental and socio-economic priorities. Similarly, the Madidi zoning process included a proposal to improve the protection of pristine montane forests by categorizing them as national parks. It also proposed changes to some areas from strict national park to an integrated management category in order to respect the rights and socio-economic needs of local communities. Finally, regions within the integrated management category were zoned into areas allowing different degrees of intervention, such as agriculture, timber and non-timber forest extraction, tourism, and strict protected areas.

Formal Incorporation into the Development Plans of Relevant Jurisdictions

The authority and responsibility of municipalities, prefectures, and other entities that may exercise jurisdiction over parts of a protected area is often ambiguous. As a result, these other planning and development actors frequently ignore the presence of a protected area when they develop land use plans and make decisions about resource allocation. This may leave the protected area a vulnerable pawn in jurisdictional disputes. It also means that development investments are frequently at cross-purposes with the objectives of the protected area.

The first three steps outlined above pave the way for ensuring that the development plans of these different jurisdictions reflect the existence and mission of the protected area, so that even if the protected area does not rank high among their priorities, their development investments tend to reinforce rather than undermine it. Inclusion of relevant territorial actors in protected area management committees provides one mechanism for advancing this step, but direct alliances promoted by the protected area to address shared concerns and define shared objectives can be more effective in generating resources and commitment to conservation. CABI and the KINP have developed alliances with ranchers' associations, hydrocarbon exploration and transport companies, municipalities, and the departmental government. Technical and financial support for formal municipal planning initiatives and TCO management plans has also ensured that these are consistent with the national park management plan. MNP has developed alliances with the indigenous territories found in and around it on the

basis of responding to shared threats, largely from illegal logging and colonization attempts. Furthermore, the indigenous organizations have received support from conservation organizations because of their proximity to the protected area. The tourism potential of the area has also served as a way to engage municipal authorities and local stakeholders.

Long-term Financial Plan

Protected areas must assume responsibility for their own financial futures as an integral part of planning for the implementation of their missions. State funding is always vulnerable to changes in short-term political priorities, and many donors are fickle, with funding cycles that rarely extend beyond five years and some functioning with time horizons of 1-3 years. Protected areas must develop their own revenue streams, via user fees, corporate sponsorship, and other means, to increase the diversity of their funding sources and the stability of overall funding levels. They should also have specific contingency plans for carrying out essential tasks at minimum levels in the event of revenue shortfalls.

Both KINP and MNP have generated additional resources through trust funds, while KINP has also negotiated in-kind and financial support from hydrocarbon exploration and transport companies on the basis of shared long-term strategic objectives in favor of regional conservation. Madidi has a dedicated trust fund managed by *Fundacion para el Desarrollo del Sistema Nacional de Areas Protegidas* (FUNDESNAP); the first contribution came via a species-naming opportunity for a recently discovered primate (Wallace et al. 2006).

Relevance beyond Bolivia

We have shared our experiences in Bolivia with the coordinators of the remaining conservation landscapes composing WCS's Amazon Program (**Table 1, Figure 1**). While the relative weight they may assign to the above five factors varies, and some landscapes may derive slightly different lists based on local conditions and priorities, consensus exists that how the areas we want to protect fit within a broader landscape—characterized by different land units and managed by different actors with varying land management rights and responsibilities—is the key issue underlying long-term conservation success. Based on this perspective, we assessed the other landscapes in the Amazon Program in terms of the five conditions defined as important to the long-term success of Bolivia's protected areas. The results of this exercise are summarized in **Table 2**.

The seven landscapes in the WCS Amazon Program are at different stages in meeting all five conditions. At one end of the continuum is Caura, which is beginning to delineate the core area that should be placed under protection and to devise a strategy for defining its conservation status and purpose. There is no management plan, and no consideration of a protected area as such in the development plans of any of the relevant jurisdictions. In the absence of these, we have not yet begun working on a long-term financial plan. In the case of the Chaco, on the other hand, the core protected area, KINP, has been created, a management plan is in place, a long-term financial plan is in development, and important areas have been titled. At the same time, additional key areas are in the process of being brought under protection as part of the titling of the

Table 1: WCS Amazon Landscape Conservation Program.

Landscape	Country	Key Habitats	Landscape Size (km^2)	WCS Presence Initiated
Mamirauá and Amanã SDRs	Brazil	Terra firme forest, flooded forest	36,000	1986
Gran Chaco Landscape	Bolivia	Dry forest, palm swamps, flooded forest	73,000	1987
Greater Madidi Landscape	Bolivia	Terra firme forest, flooded forest, dry forest, palm savanna, paramo, puna cloud forest	110,000	1999
Greater Yasuní Landscape	Ecuador	Terra firme forest, flooded forest	20,000	1996
Caura River Watershed	Venezuela	Moist forest, flooded forest, tepuis	45,000	1985
Greater Yavarí Miri Landscape (Loreto)	Peru	Terra firme forest, flooded forest	31,000	1984
Purus SDR (initiating)	Brazil	Terra firme forest, flooded forest	15,000	2001
TOTAL			**330,000**	

Figure 1: WCS Amazon Program landscapes.

Table 2: Relationship of protected areas to larger landscapes in WCS Amazon Program.

Conservation Landscape	Definition of Conservation Status	Land Title	Management Plan	Incorporated into Development Plans of Relevant Jurisdictions	Long-term Financial Plan
Caura	State land under different management categories including 1 national park, 3 national monuments, a protective zone, and a forest reserve. None are under active management.	No	No	No	No
Yasuní	• YNP created via Ministerial Decree. • YBR created via Ecuadorian government request to UNESCO. • Potential for expansion of protection via municipal protected areas. • Waorani Ethnic Reserve created via Presidential decree. • Kichwa community lands titled under Ministry of Environment. • Tagaeri-Taromenane Intangible Area declared by Presidential decree.	• YNP no. • YBR no. • Waorani Ethnic Reserve yes. • Kichwa community lands in YNP yes. • Oil concessions within YNP and Waorani Ethnic Reserve yes, as concessions.	• YNP has a management plan that was never implemented and has now expired. • YBR no. • Waorani Ethnic Reserve has a management plan, unimplemented and unpublished. • Kichwa community lands in YNP yes. • Oil concessions in YNP and Waorani Ethnic Reserve yes.	No. There is preliminary collaboration with municipal government of Orellana.	No
Yavarí Miri	• ACRCTT defined as a regional communal reserve. Elevation to national status in progress. • RNPS is national reserve • Proposal to create reserved zone in Yavarí under discussion by regional and national authorities.	No	• ACRCTT has for specific topics (e.g., wildlife management, aguaje palm management, control and vigilance by management committee). Overall plan in preparation. • RNPS yes. • Yavarí no.	No	No
Mamirauá/ Amanã	Yes, as SDRs under jurisdiction of State of Amazonas.	No	Mamirauá yes. Amanã no.	Yes, at state government level.	Yes.
Piagaçu Purus	Yes, as SDR under jurisdiction of State of Amazonas.	No	No	Yes, at state government level.	No

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Conservation Landscape	Definition of Conservation Status	Land Title	Management Plan	Incorporated into Development Plans of Relevant Jurisdictions	Long-term Financial Plan
Chaco	• Yes. KINP exists via Supreme Decree. • Isoceño TCO recognized as a claim by INRA. • Work underway to expand areas under protection in neighboring TCOs and municipalities.	• KINP no, but planned. • Isoceño TCO in progress.	• KINP yes. • Zoning proposal and draft management plan completed for Isoceño TCO pending completion of titling process. • One municipality has completed PMOT.	Partially.	Elements exist, but not a complete plan.
Madidi	• Yes, all three national protected areas exist via Supreme Decrees. • TCO claims recognized by INRA. • Work underway to expand areas under protection in neighboring TCOs and municipalities.	• National protected areas incomplete. • Tacana I yes. • Other TCOs in process.	• National protected areas Pilon yes, Madidi in review, Apolobamba in process. • Tacana I TCO yes. • Other TCOs in process. • Apolo PMOT completed. • Ixiamas Municipal Reserve in process • Ixiamas, San Buenaventura, Guanay PMOTs in process, Pelechuco pending.	Partially. So far in the cases of the Tacana TCO and the Apolo Municipal Land Management Plan.	No. Initial steps in progress.

Acronyms used: ACRCTT—Área de Conservación Regional Comunal Tamshiyacu Tahuayo (Tamshiyacu Tahuayo Regional Communal Conservation Area), Peru; INRA—Instituto Nacional de Reforma Agraria (National Agrarian Reform Institute), Bolivia; KINP—Kaa-Iya del Gran Chaco National Park, Bolivia; MNP—Madidi National Park, Bolivia; PMOT—Plan Municipal de Ordenamiento Territorial (Municipal Land Use Plan), Bolivia; RNPS—Reserva Nacional Pacaya Samiria (Pacaya Samiria National Reserve), Peru; SDR—Sustainable Development Reserve, Brazil; TCO—Tierra Comunitaria de Origen (term used in Bolivia to refer to indigenous territories); YBR—Yasuní Biological Reserve, Ecuador; YNP—Yasuní National Park, Ecuador.

Isoceño indigenous territory and other lands adjacent to the park. Some preliminary work has been done to integrate the park into the development plans of relevant jurisdictions.

Conclusions

While the factors discussed above include elements of internal management, they primarily relate to the insertion of a protected area into the multiple jurisdictions that occur between the local (usually municipal) and national levels, and the construction of a conservation constituency that can be mobilized on behalf of issues related to biodiversity conservation and the sustainable use of renewable resources. Most efforts to measure the consolidation of protected areas take the formal definition of conservation purpose as a point of departure and include management plans as an indicator, but do not adequately consider issues of relations with municipal and departmental authorities or the resolution of land and land use conflicts.

Our experience is that in the face of a land invasion or other organized action that challenges a protected area's physical integrity, legitimacy, and perhaps its legality, the degree of consolidation of the internal management structures are not decisive factors. At the same time, to the extent that the five institutional conditions are met, protected areas can function relatively well even with suboptimal resource endowments, and their options for improving conditions by means of their own initiative, without depending on governments and donors, are considerably expanded. Thus, these five factors are critical as we assess the quality of protection afforded by existing protected areas in our landscapes and set priorities for bringing additional areas under protection.

In other words, as our conservation objectives are increasingly expressed in terms of preserving landscapes that are large enough, wild enough, and diverse enough in habitat types to serve as strongholds for landscape species or conserve priority species across a defined range, issues of management give way to issues of governance as keys to long-term conservation success. While this does not mean that management is not important, it does mean that it has become increasingly easier to win the battle to consolidate the management of a protected area, while losing the war to achieve critical conservation objectives.

This shift in focus brings a combination of opportunities and challenges. We are in a better position to effectively identify, assess, and address issues that play a decisive role in conservation success. By considering critical governance issues as we define conceptual models and monitoring frameworks, our efforts to conserve landscapes and species will improve as we plan and implement actions at scales appropriate to our conservation objectives, and our conservation tools will become more powerful and cost-effective.

The major challenge is to maintain focus, because while governance issues are critical to conservation success, addressing them effectively takes us into areas where agendas other than conservation are active, and where we need to assess carefully the extent to which the interests of the actors with whom we must work coincide with ours. Thus, while contributing to good governance in land use and land management may advance our conservation objectives, specific decisions about how we should become involved are more complicated.

This added level of complexity underscores the importance of building effective partnerships. First, we seek to construct a conservation constituency that can mobilize itself in defense of interests that coincide with our conservation objectives. We do this by strengthening actors with whom we share key interests and working with them to construct shared agendas that can be better advanced by working together. Over time, we seek to help build a core institutional base of local support for conservation that has the political strength, technical capacity, and financial stability to form an effective partnership. This constituency can then hold authorities accountable to ensure that the creation of protected areas is followed up with the actions required to enable them to fulfill their missions; support land titling for protected areas as part of region-wide processes of land use planning that will increase security and encourage investment; insist on local involvement in creating and revising management plans; promote the positive roles that protected areas can play in development strategies; and become actively involved in generating financial support.

Second, we need to develop partnerships with organizations that seek to improve education and health care and promote the economic development of the people we work with in our field programs. This can be a complex process because it involves defining areas of common ground with those whose goals are different than our own and whose activities may sometimes work at cross-purposes with our programs. While we may seek out partners whose interests overlap substantially with ours, shared interests alone are not sufficient for effective partnerships. Strong partnerships arise out of the experience of carrying out activities together, overcoming disagreements in a way that contributes to building mutual trust, and developing a shared vision that includes elements that may be a higher priority for some than for others.

Thus, it is crucial to place our objectives in the context of the aspirations and priorities of people's desire to improve the quality of their lives and to demonstrate how what we do contributes to a better quality of life for many people. Building partnerships with organizations whose missions and visions are different from our own provides a way to define more easily the areas where we will play a clear leadership role and the areas where we will support the efforts of our partners. In so doing we can continue to focus on our own priorities while contributing in meaningful ways to our partners' efforts.

PART 4: WCS CASE STUDIES—NORTH AMERICA

4.1 Culturally-based Wildlife Conservation on Native American Lands: A Challenge of Scale and Governance

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+Wildlife Conservation Society, North America Program, and Hoopa Tribal Forestry, *Wildlife Department, Hoopa Tribal Forestry, ^Wildlife Conservation Society, North America Program

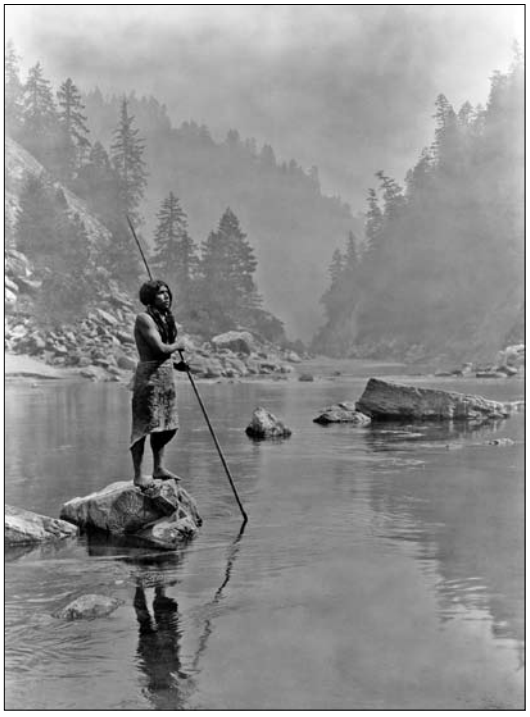
Introduction

A Hupa tribal elder once said a healthy forest is the sign of a healthy people. The Hupa people living on the Hoopa Valley Indian Reservation (Hupa refers to the people and Hoopa refers to the land) in northwestern California have led several other tribes in exercising significant tribal sovereignty rights won over the last two decades. This experience has been shared by many other Native American and First Nations communities throughout the United States and Canada. These sovereignty rights have included the infusion of many culturally-based conservation ethics into land management practices, as the responsibility of natural resource management on many reservations is being transferred from federal agencies to sovereign tribal governments. On the Hoopa Valley Reservation, this has included the transfer of forest management and a timber extraction-based economy from the U.S. Bureau of Indian Affairs (BIA) to the Hoopa Tribal Council, the governing body of the Hoopa Valley Tribe. In assuming management responsibilities, the tribe has worked diligently to develop a better understanding of the needs of threatened, endangered, and culturally significant wildlife and plant species. The need to fill information gaps for such species has led the Hoopa Tribe to cultivate a collaborative relationship with the Wildlife Conservation Society (WCS) in order to develop management recommendations for the imperiled, culturally significant, and forest-dependent fisher (*Martes pennanti*).

Indigenous Communities and the Hoopa Valley Indian Reservation

Native American and First Nations peoples are generally land-based societies that have historically tended to the natural world through sustainable dependence. The European colonization of North America led to a significant loss of tribal lands and relegation of indigenous peoples to reservations and reserves. Socio-economic pressures to keep pace with a modern economy have led to deviations from traditional land use practices and to the exploitation and extraction of natural resources on tribal lands. Despite these pressures, many tribal lands still represent some of the largest intact habitats and deeply committed community-wide conservation ethics in North America. Native American tribes have a controlling interest in more than 210,400 km^2 of tribal trust lands across the lower 48 states, with an additional 161,875 km^2 held by Alaskan Native Corporations. Much of this land is relatively undisturbed, providing a significant amount of rare and important fish and wildlife habitat (USFWS 2006). In Canada, the issue of land control is much more complex due to the structure of treaties and land claims made between First Nations and the Canadian government. While exact acreage is hard to quantify, First Nations hold shared resource rights on much Crown land where major development decisions are pending. They are also the principal human occupants on huge tracts of undeveloped land in the north (some of the largest intact ecosystems in the world) and as a result are being given an increased voice in how the land is managed.

Figure 1: Hupa man with spear standing on rock in the Trinity River.



Many Native American and First Nations communities identify, conserve, and manage their lands for the *maintenance of biological diversity, and of natural and associated cultural resources…through legal or other effective means*, as identified in the IUCN (1994) definition of a protected area. By adhering to culturally-based conservation beliefs, indigenous communities have historically and currently moved important wildlife conservation forward within and beyond reservation (U.S.) and aboriginal land claim (Canada) boundaries. Native American and First Nations peoples are working to address contemporary conservation concerns by identifying and understanding critical issues, crafting science-based solutions that incorporate traditional ecological knowledge, and taking conservation actions that benefit both nature and people.

Indigenous communities have led many successful conservation initiatives on and off reservations and aboriginal land claims, and today are increasingly recognized for their scientific, political, and cultural contributions to conservation. In addition, some indigenous communities have developed sophisticated natural resource programs providing the most capable scientific and technical experts in rural communities.

Figure 2: Hupa man in White Deerskin Dance regalia.

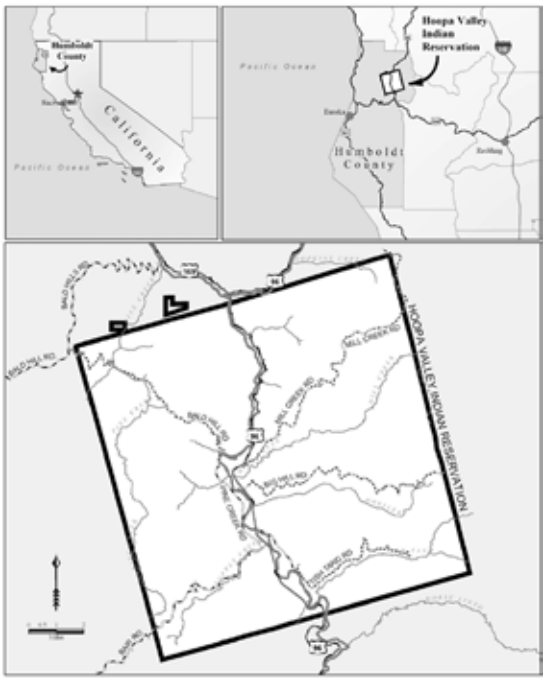
The Hoopa Valley Tribe has been taking conservation actions that benefit both nature and members of the native community. Most, if not all, of the Hupa's material culture is directly linked to the forest ecosystem: timber and planks for housing, fuel wood for heating, plants for making renowned Hupa baskets, staple food items such as acorns, game animals, a wide array of cultivated and managed edible plants and mushrooms, and a full suite of medicinal and sacred herbs, roots, and plants all come from the forest (Baker 2003). The spiritual beliefs of the Hupa people are deeply connected to what the land provides and are practiced through ritual cleanliness and ceremonies that include the entire tribal membership (Cramblit 2003). The Hoopa Tribe practices the annual White Deerskin Dance (a World Renewal Ceremony) and the Sacred Jump Dance. The purpose of these rituals is to renew the world or "firm the Earth," and they include songs and dances that have been preserved for countless generations (Cramblit 2003). Most of these rituals are considered to have a connection with medicine. Medicine includes not only that which is administered to cure sickness, but anything—root, herb, stick, or bark—used to promote both physical and spiritual health. The Brush Dance also continues to be practiced and is both a social event and a healing ceremony in which the Hupa people dance, sing, make medicine, and pray to bless a sick child or infant. The dance takes place in the Brush Dance pit and involves men, boys, and young girls. Each of these rituals uses a wide array of regalia harvested from local wildlife and plant species and handed down from generation to generation. Thus, for millennia the Hupa people have had a strong conservation ethic aimed toward the persistence of wildlife and plant species that provide a critical cultural link for the community.

While a strong conservation ethic is prevalent among the Hupa community, economic pressures of the modern world have challenged this ethic both within and beyond the boundaries of the reservation. Natural resource extraction activities have brought the greatest economic benefit to local communities and are one of the greatest threats to wildlife and wild lands in the region. The Hoopa Tribe has served as a regional leader in developing and maintaining a sustainable timber extraction-based economy with strong wildlife protections. The Hoopa reservation could best be classified as a Category IV IUCN Protected Area, although only approximately 40% of the reservation remains unmodified (i.e., undisturbed by timber harvesting) (IUCN 2002). Despite pioneering protections for wildlife and wild lands within an industrial forest, the 364 km^2 of the Hoopa reservation does not provide a large enough land base to support sustainable populations of many culturally significant wildlife species. Thus, sustaining populations of culturally significant wildlife depends not only on the land management practices of the tribe, but also of neighboring land owners who do not necessarily share the Hupa's cultural and conservation beliefs and are held, in many cases, to a lower conservation standard by federal and state management regulations.

The Hoopa Valley Indian Reservation is the largest land-based reservation in California and is located in Humboldt County, approximately 480 km north of San Francisco and 144 km south of the Oregon border. The reservation, comprised of 364 km^2, is surrounded by mountains and divided by the

Trinity River, which flows through the valley. The tribe has a membership of 2,200 people. Approximately 1,700 tribal members reside on the reservation. Additionally, 1,200 non-Hupa Indians and others with no tribal affiliation reside on or adjacent to the reservation. The Hoopa Valley Tribal Council was first seated as the governing body in 1933 and assumed self-governance in 1989, providing an effective community infrastructure, including health and dental clinics, public utilities services, police and fire protection, a tribal court system, recreation, and forestry, fisheries, fiscal, and education departments.

Figure 3: Location of the Hoopa Valley Indian Reservation in northwestern California.



The Hoopa Valley Tribe is well-established, federally recognized, and identified as one of the most progressive and foremost self-governance tribes in the U.S. The Hoopa Tribe was one of the first nine tribes in the U.S. to participate in the Self-Governance Demonstration Project in the 1990s. As such, the Hoopa Tribe has helped to create and determine federal policy used in defining and determining self-governance functions for other tribes. For the Hoopa Tribe, the tribal government to U.S. government relationship results from its strong sovereignty. Its recognition and accountability are due to excellent leadership, sound administrative operations, and proven ability.

Although the tribal government is flourishing, statistics paint a dismal picture about the quality of life on the reservation. Demographic health, education, and job market surveys demonstrate a need to improve living conditions on the Hoopa reservation. According to the 2000 census, the reservation suffers from an unemployment rate of 27% (4.0 to 6.5 times the county, state, and national averages) and a poverty rate of 30% (1.9 to 2.6 times the county, state, and national averages). The extreme socio-economic conditions of the Hupa people have a direct impact on their quality of life and their means to achieve self-sufficiency.

Forest Management

The mission statement of the Hoopa Valley Tribe's Forestry Division is to *provide for the conservation and development of natural resources for the present and future benefit of the Hoopa Tribe, while promoting cultural integrity*. Cultural and ecological integrity are nearly synonymous in this instance, since the tribal culture evolved over many thousands of years in harmony with the environment and its natural resources. Many species of fish, wildlife, and plants are extremely important to the tribe for cultural and traditional subsistence. These species are equally dependent on ecologically healthy forest and aquatic systems.

With the invasion of the Europeans and subsequent economic pressures, exploitation of the Hoopa reservation's forest resources began in earnest in the 1950s under the direction of the BIA. Although the BIA's intentions were good, their management of the reservation's forest was extremely one-dimensional, focusing solely on economic benefits. For three decades following World War II, timber harvest levels exceeded sustained yield (Baker 2003). Despite an early timber inventory by a BIA forester in 1947 that suggested the timber resource base could support an annual allowable cut of 15 million board feet/year, actual harvest levels for the next 30 years were 2.3 to 4.0 times greater (Baker 2003). Under the BIA's management, every acre capable of supporting commercial timber could be slated for harvest regardless of its importance to the tribal culture or the wildlife. Intensive clear-cutting, primarily during the 1970s and 1980s, has virtually eliminated old growth structural diversity on approximately 40% of the reservation's forested land base. This economic focus was similar on federal and private lands during the same time period and is one of the primary reasons that species such as the northern spotted owl (*Strix occidentalis caurina*) and marbled murrelet (*Brachyramphus marmoratus*) have become threatened with extinction (Franklin et al. 2000; Ralph et al. 1995).

The tribe assumed the responsibility for management of the reservation's forest resources from the BIA in 1989 and completed the first tribal-based forest management plan (FMP) in 1994. The FMP planning process took three years to complete, but resulted in a truly community-based plan recognized as a model to be followed at the national and international level. The tribe was asked to present their FMP to the United Nations in 1995 as an exemplary community-based forest management plan.

One key component of the success of the FMP was the establishment of two important committees: the policy committee, appointed by the Tribal Council, and the cultural committee, composed of tribal elders and cultural leaders. The cultural committee has persisted and has been involved in all aspects of forest management planning since the FMP was adopted. As a result of the tribe's emphasis on managing for cultural and ecological sustainability, its FMP was certified as Ecologically Sustainable by Smartwood, a representative of the Forest Stewardship Council, in April 1999. Since initial certification, Hoopa Forestry has successfully passed the annual Smartwood audit through 2007.

Today, timber management is the single largest source of revenue and employment for the Hoopa Tribe. Consequently, it has a direct impact on the Hupa people's quality of life and ability to achieve self-sufficiency.

Figure 4: Hupa foresters.

© Hoopa Valley Tribe

The Hoopa Valley Tribe's Forestry Division and Wildlife Department are committed to sustainable timber management and the conservation of natural resources for the present and future benefit of the Hoopa Tribe.

Explicit Identification of Conservation Targets for the Hoopa Fisher Project

The Wildlife Conservation Society is working collaboratively with the Hoopa Tribe to address the continued desire of the Hoopa Wildlife Department to develop a more comprehensive understanding of the needs of the imperiled, culturally significant, and forest dependent fisher (*Martes pennanti*). One of our primary objectives is to implement changes to the tribe's forest management plan to more effectively protect fisher on the reservation. WCS is also engaging with ongoing multi-agency fisher conservation efforts and with neighboring public and private land managers to extend the conservation benefits we are working to achieve on the reservation to benefit fisher populations throughout the region.

The fisher is a forest-dependent member of the weasel family, approximately the size and shape of a house cat with shorter legs. The fisher's range was reduced dramatically in the 1800s and early 1900s through over-trapping, loss and fragmentation of forested habitats, fire, farming, development, and predator and pest control campaigns (Douglas and Strickland 1987; Powell 1993; Powell and Zielinski 1994). The range in the U.S. was reduced to a handful of relatively small and in some cases isolated locations. Concern for the loss of the fisher as a valuable furbearer, an effective porcupine predator, and a native species has prompted translocation of fishers to 13 states and 6 provinces since the late 1940s (Lewis 2006). Translocations succeeded in re-establishing or aiding in the re-establishment of fisher in at least 10 states and 6 provinces, and resulted in re-occupation of portions of their historical range. The current range of

the fisher in eastern North America includes most of the species' historical range in the U.S., which is largely restricted to the northeastern states and the lake states, including northern Minnesota and Wisconsin and the Upper Peninsula of Michigan. In western Canada, the fisher's range has contracted northward from its southern limits in British Columbia, Alberta, and Saskatchewan. In the western U.S., fishers are confined to disjunct populations in Oregon, California, Idaho, and Montana.

Figure 5: Female fisher on the Hoopa Valley Reservation, CA.

One of the most challenging threats to fishers in the west coast states, where WCS efforts are focused, is that fisher populations are generally small and isolated. The current distribution of fishers on the west coast largely reflects the effects of past anthropogenic stressors. During the 19th century, trapping, in conjunction with predator poisoning and the loss and fragmentation of habitat, likely contributed to the current distribution of fishers. The three extant populations (two native and one reintroduced) have either continued to decline, have not expanded, or have failed to recover the range contractions that apparently occurred during the past two centuries. It is unknown whether population processes, distribution, suitability of habitat, or some other factors currently limit population growth.

Reduction of structural elements, overstory reduction, and habitat fragmentation are three anthropogenic activities identified as consistently high threats to small and isolated fisher populations across the west. As a result of these continued threats, a distinct population segment (DPS) of the fisher in the Pacific states has been petitioned for listing U.S. Endangered Species Act (ESA) three times in the last decade, and is currently considered a candidate for endangered species status (Beckwitt 1990; Carlton 1994; Greenwald et al. 2000; USFWS 2004). The fisher is also a culturally significant species to the Hupa people and still occurs in relatively large numbers on the reservation. Since the tribe's economy is almost entirely based on timber harvest, and because the fisher is

Figure 6: Young Hoopa tribal member with a quiver made from a fisher pelt.

© Nolan Colegrove, Sr.

dependent, at least in part, upon forests with old growth characteristics, it is of mutual benefit to the fisher and the tribe to determine crucial fisher habitat components which can be maintained or enhanced while implementing the tribe's forest management plan.

WCS and the Hoopa Tribe are working collaboratively to identify, maintain, and promote habitat conditions that can support fisher on the Hoopa Valley Indian Reservation. We are also working to train the next generation of conservationists within the Hupa community. Additional technical skills could increase the capacity of tribal members to manage wildlife in a sustainable manner. Therefore, the Hoopa Fisher Project has and will continue to provide younger tribal members with employment opportunities and technical skills training to monitor and manage species and habitats, and help them to pursue careers in natural resource management and conservation. Our shared broader conservation goal is to assist in the re-establishment of fisher populations and restore connectivity of fishers throughout the historic range of the west coast population. Our collaborative efforts will produce sound conservation benefits and build capacity on the Hoopa Valley reservation by enabling tribal foresters and wildlife managers to more effectively protect dens, rest sites, and active habitats for fisher on the reservation and provide employment and training opportunities for tribal members working on the project.

Surrounding Land Use and Governance Types

Land uses within northwestern California and southwestern Oregon include forestry, agriculture, recreation, water impoundments, mining, housing, and industrial corridors such as power lines. Most (76%) of the land in the northern California coastal area is privately owned. Nine percent of this area is land administered by the U.S. Forest Service (USFS) and Bureau of Land Management (BLM), in addition to Redwood National and State Parks. Federal

land (primarily USFS land) covers 64% of the land area in the further inland California Klamath province (Moeur et al. 2005).

Land use and ownership patterns in Oregon are a diverse patchwork. Oregon's Coastal Range consists primarily of forest woodland (90.7%). Sixty percent of the land within this region is under private ownership, 28% public-federal, and 12% public, state, and local ownership. The Willamette Valley is 96% privately-owned, and the predominant land use is agriculture (41%), forest, and woodland (34.8%), and much of the state's urban and suburban centers (10.3%) make up the balance. The Klamath Mountains are split approximately 47% to 53% private and federal public lands, with over 70% of the region as forest and woodland. The West Cascades are 23% privately owned and 76% federally owned, with 96% of the region in forest and agricultural use. As a result of Oregon's increasing population, conversion of natural areas, farmland, and forestland to other uses is increasing. Eighty percent of land-use changes between 1973 and 2000 were from agriculture or forest to low-density residential or urban uses. Increases in population have caused concomitant increases in demand for recreational opportunities.

Working Between Different Land Uses and Governance Types

The focus of the collaborative WCS/Hoopa Tribe effort is to provide improvements to the Hoopa Tribe's forest management plan for the continued conservation of fisher on the Hoopa reservation. However, WCS and the Hoopa Tribe recognize that to maintain a sustainable population of fisher on the reservation and protect the remaining small, isolated west coast fisher populations from stochastic events, neighboring land managers outside of Hoopa will also need to commit to land management practices that will sustain fisher. Thus, WCS is working to assist the Hoopa Tribe in maintaining its leadership position in fisher research and conservation throughout the western range of the fisher.

Engaging the wider conservation community through these efforts enables the Hoopa Tribe to bring field-based science and conservation recommendations to private, state, and federal regional land managers for more effective regional fisher conservation. The multi-agency Fisher Biology Team, headed by the U.S. Fish and Wildlife Service and in cooperation with the Fisher Science Team, is in the process of drafting a fisher conservation assessment and strategy for west coast fisher populations. The overarching goal of these efforts is to provide an effective, integrated regional approach to achieve self-sustaining, interacting populations of fishers within their historical west coast range. The California Department of Fish and Game is also currently reviewing a petition submitted by the Center for Biological Diversity in January 2008 to list the fisher under California's Endangered Species Act. Each of these efforts is looking to the Hoopa Tribe for recommendations to guide fisher conservation on and off tribal lands.

On a regional level, the professional wildlife community working to conserve the extant west coast fisher populations has coalesced into three working groups representing geographically distinct parts of the range. Each working group is a cooperative of researchers, wildlife managers, land managers, and

regulatory and other biologists, working for research institutions, resource agencies, and private, state, federal, and tribal landowners, consultants, and non-governmental organizations. The focus of each working group is to address forest meso-carnivore conservation issues to ensure the protection and maintenance of fisher, marten, and other meso-carnivore populations and habitat. The WCS Hoopa Fisher Project Director is co-directing the Coastal Martes Working Group which is working toward: a) developing information and establishing research and monitoring needs; b) providing assistance to ensure the conservation (including recovery where needed) of fisher and marten populations; c) promoting communication and collaboration between all parties working on fisher and marten issues, as well as with other stakeholders studying or managing forests; d) conducting public and professional outreach to heighten awareness, increase understanding, and promote support for the conservation of forest meso-carnivores in general and fisher and marten in particular; e) developing and promoting regional conservation strategies for coastal fisher and marten that incorporate state, federal, tribal, and private lands; and f) developing partnerships to facilitate funding to support research, conservation, and outreach goals.

Conservation Issues within the Hoopa Reservation Related to Scale and Governance

It would be inaccurate to assume that the entire Hupa community believes a balance should be maintained between traditionally-held conservation values and the economic gains provided by a timber extraction-based economy. During the 1991-1994 forest management planning process in Hoopa, alternatives were drafted by Hoopa forestry professionals which would have continued the industrial style timber management practiced on the reservation by the BIA (i.e., larger unit sizes, fewer trees left on the landscape following a harvest, harvesting in culturally sensitive areas). Although the majority of the tribal membership aligned itself behind an alternative that was much more culturally sensitive, it was and remains well within the sovereign rights of the tribe to move toward a more industrial style of management than what is practiced today. Because of the unsustainable harvest practices of past and current management limitations, tribal forestry professionals have come to recognize that some existing conservation measures may need to be compromised to maintain the level of economic benefits provided by forest management over the last decade and half. Currently the tribe is revising its forest management plan and is faced with the option of reducing its annual allowable cut (i.e., the number of trees harvested) and attempting to minimize the negative economic impact, or maintaining the existing annual allowable cut through the erosion of some of the conservation measures currently in place.

These are the critical economic and conservation issues that tribal leaders are faced with in exercising the tribe's sovereignty and their responsibility to the impoverished Hupa community. The Hoopa forest management plan revision is also at the forefront of the WCS/Hoopa Wildlife Department collaboration as it relates to wildlife, particularly fisher, conservation. We will draw from the strength of our collaboration with the tribe through the FMP

revision process to implement strong conservation measures that will provide for more effective fisher and fisher habitat conservation on the reservation.

Successes and Challenges on the Hoopa Fisher Project

WCS and the Hoopa Tribe have successfully forged strong relationships and collaborations with a wide range of public and private land managers interested in providing an effective, integrated regional approach to achieving self-sustaining, interacting populations of fishers within their historical west coast range. Yet the conservation efforts on the Hoopa Valley reservation are challenged by the small size of the reservation, which requires that fisher utilize adjoining lands, and the management practices of its neighbors.

The partnerships that WCS/Hoopa have forged with the multi-agency Fisher Biology Team, the Fisher Science Team, the California Department of Fish and Game, and the Coastal Martes Working Group have put the Hoopa Tribe in a leadership position to guide fisher conservation efforts on and off tribal lands. Without these external collaborations, we would be working to conserve what would likely become another very small, isolated, and possibly unsustainable fisher population on the Hoopa reservation, and the larger conservation community probably would not be able to achieve its conservation goals for fisher in this region.

Conservation efforts on the Hoopa Valley Indian Reservation are challenged by the small area of the reservation and land management decisions made by neighboring managers. A self-sustaining population of fishers in the region depends on a much larger area than the 364 km^2 of the Hoopa Valley Reservation, and thus the persistence of fisher on the Hoopa reservation cannot be achieved through conservation action on the reservation alone. Specific threats to regional fisher populations from non-tribal land managers include the forest and fire management practices of regional forest managers. In 1999 lightning ignited and burned over 560 km^2 of the mature and old-growth forest of Six Rivers National Forest and spread over the eastern border of the Hoopa Valley reservation. Over one third of the old-growth forest in the effected area had over 80% tree mortality, which significantly reduced the area's habitat quality for fisher. The Hoopa Tribe has an aggressive prescribed fire program to reduce fuel loads on the reservation in an effort to promote timber production and prevent catastrophic wild fires. However, successful fire exclusion on forested public lands has created severe fire problems throughout the region (Agee and Skinner 2005). Forests on the reservation are now threatened by catastrophic fires that start beyond its boundaries and then encroach onto the reservation (e.g., the 1999 Megram fire). This threat was exacerbated by the Northern California Wilderness Heritage Act of 2006 which extended the Six Rivers National Forest Wilderness boundary to the eastern boundary of the reservation (U.S. House of Representatives 2006). While a wilderness designation for this neighboring forest protects fisher habitat from threats like timber management and road development, it limits the amount of fuel reduction and fire suppression that can occur on the boundary of the reservation, increasing fire risk to both reservation forests and fisher habitat.

Unsustainable timber management practices in the region pose another significant threat to fisher and their habitat. While the Hoopa Tribe's forest management plan has in place strong conservation elements, sustainable practices are not the norm for regional timber managers. The Pacific Lumber Company owns 854 km^2 of forest in the region. Following the takeover of this once sustainably managed, family-owned company by the Maxxam Corp. in 1986, the company doubled its previous harvest levels in order to pay off the takeover debt and threatened to increase logging of more old-growth stands. In the course of its operations as a subsidiary of Maxxam Corp., Pacific Lumber received 128 citations for over 200 violations of California's forestry rules from 1996 to 1999, and was found guilty of illegally logging endangered marbled murrelet habitat (Heaton 1999). This type of land management seriously threatens the conservation goals of the Hoopa Valley Tribe and the maintenance of sustainable fisher populations in the region.

Lessons Learned and Their Application in Future Work

The Hoopa Tribe and WCS embarked on this project knowing that no matter how well we managed fisher and fisher habitat on the reservation, the fate of the fisher population would not be influenced significantly through the management of an area as small as the Hoopa Valley Indian Reservation alone. The project, therefore, was designed from the outset to investigate significant knowledge gaps regarding fisher biology, an objective that the Hoopa Tribe was particularly well placed and motivated to achieve. The information collected could then be used to guide management decisions at a much larger ecological scale. Other critical actions included our engagement with formal and informal research and management collaboratives, which allowed us to leverage our limited resources and expand our sphere of influence. Our investment in building the internal capacity of the tribe to achieve conservation has proven to be a successful model for the WCS North America Program Partnerships with Indigenous Peoples initiative.

The Hoopa Tribe's concern for the fisher and its conservation is based in part on the cultural significance of the fisher to the Hupa people and in part on the potential for the fisher to be listed for protection under the ESA. This kind of situation is not uncommon for tribes. Tribes generally have done well at maintaining the ecological integrity of their lands, so threatened and endangered species are often found on reservations. However, the listing of species under the ESA adds an unwanted layer of bureaucracy to tribal resource management programs. Collaborations with tribes and First Nations can therefore often provide opportunities to gather important data needed for the conservation of imperiled species before the species become candidates for ESA listing or are listed as threatened or endangered. Once the data is available, conservation recommendations can then be made to other land managers to maintain or recover habitat and thereby avoid the need for ESA action.

Engaging with other land managers across different jurisdictional authorities within the region presented one of our largest conservation challenges. Long-term conservation of ecosystems and species in this multi-jurisdictional land-

scape requires formal legal mechanisms or informal collaborative networks. We employed both of these methods to influence management decisions. The Hoopa Tribe has been represented in several multi-agency efforts aimed at developing legal mechanisms for fisher conservation. One example is the development of Candidate Conservation Agreements (CCA) in cooperation with the U.S. Fish and Wildlife Service. The Hoopa Tribe's biologist has served as a reviewer of CCAs being developed between individual landowners and the U.S. Fish and Wildlife Service. He is also encouraging the Hoopa Tribe to enter into its own CCA for fisher conservation. CCAs are formal agreements between the Fish and Wildlife Service and one or more parties to address the conservation needs of proposed or candidate species, or species likely to become candidates, before they are listed as endangered or threatened. Landowners voluntarily commit to implementing specific actions that will remove or reduce threats to species, thereby contributing to stabilizing or restoring the species so that listing is no longer necessary. CCAs encourage actions that will remove threats to the species and preclude any need for federal listing. A single property owner's activities alone may not be sufficient to eliminate the need to list, but activities conducted in conjunction with owners of other critical properties throughout the range of the species may make a difference. Our conservation efforts have led directly to the tailoring of fisher conservation actions outlined in CCAs currently being drafted.

The Hoopa Tribe has also engaged with several informal collaborative networks focused on developing conservation assessments and strategies and identifying specific regional fisher population research and conservation needs. These networks serve an important role in developing collective buy-in, agreements between stakeholders, and even law and policy implementation. The conservation strategy being developed by the multi-agency Fisher Biology Team, headed by the U.S. Fish and Wildlife Service and with representation by the Hoopa Tribe, will set the stage for law and/or policy implementation including and beyond CCAs for the long-term conservation of fisher in the region.

A final but equally important part of WCS' work with the Hoopa Valley Tribe has involved building the internal capacity of the tribe and tribal members to achieve conservation. We were fortunate that the tribe's wildlife biologist shared our interest in increasing tribal capacity on conservation issues and worked with us early on to reach out to the California Indian Manpower Consortium, Inc., to provide internship opportunities for younger and unemployed tribal members. Unfortunately we have not been able to capitalize on this and other capacity building efforts more comprehensively due to of lack of coordinating resources between the field project and collaborating organizations. However, the lessons we have learned from our Hoopa collaboration have helped to establish our credibility as an organization trusted by indigenous communities. As WCS continues to develop its organizational capacity to engage with tribes and First Nations, we foresee significant conservation successes emerging from indigenous lands in the coming years.

4.2 The Biggest Wild: Ecological Scale and Conservation in Northern Latitudes

Donald Reid
Wildlife Conservation Society Canada

Introduction

Protected areas such as national parks are the keystone areas for wildlife conservation in most jurisdictions. There is often an implicit assumption that these areas will be sufficient to conserve viable populations of the full suite of biodiversity. In boreal and arctic Canada, federal, territorial, provincial, and First Nations governments have established many protected areas, and continue to do so, through land use planning and attempts to get representation of all ecoregions in the national parks system (e.g., Parks Canada 1997; Deh Cho Land Use Planning Committee 2006). This paper addresses the likelihood that these protected areas will conserve the full suite of vertebrate species within their mandate of maintaining ecological integrity, and what governance processes might be necessary to achieve such conservation. The context for this assessment is the large temporal and spatial scales through which key ecological processes operate at northern latitudes.

Northern Ecologies

The Boreal Forest Biome

The boreal biome is the largest terrestrial biome, a vast, circumpolar region comprising about 32% of the Earth's forests (Burton et al. 2003). This is a relatively young forest, having developed in its present configuration and distribution only since the retreat of the continental glaciers 10 to 14 thousand years ago. Its ecologies also seem young, full of flux and change. Considering the regional distributions and habitat associations of most boreal biodiversity, the dominant organizing processes have been wildfire and insect outbreaks (Heinselmann 1981; Johnson 1992; Kurz and Apps 1999). For wildlife conservation, the critical issues here are the spatial and temporal scales of ecosystem change induced by such disturbances.

The effects of fires on forest life are immense because they completely restructure the vegetation at a variety of scales and force various patterns of plant community succession with fairly predictable chronologies. Thereby they create varied, though somewhat predictable, evolutionary environments and habitats for wildlife. Species have evolved life histories, body sizes, and consequently home ranges and habitat preferences to fill the specific niches created by the spatial mosaic of fire-created forests (Holling 1992). Boreal fires range from a few hectares to many tens of thousands of hectares (Eberhardt and Woodard 1987; Bergeron et al. 1999; Johnson et al. 2003), and the return interval of stand-replacing fires typically ranges from 50 to 250 years (Johnson 1992). With regard to the current management horizon of a protected area (e.g., 50 to 100 years) and in the absence of extensive suppression of wildfire (generally the case because fire is correctly considered a natural process), forest fires will certainly burn a substantial part of the land base. If we take a conservative

estimate of 2,000 ha for a moderate fire, and 0.4% of the forest burnt annually, then we would require a protected area of at least 500,000 ha (5,000 km^2) to have a good chance of maintaining substantial representation of most forest age classes. Only one national park in boreal Canada, Wood Buffalo, is large enough to satisfy this scenario (**Table 1**).

Table 1: Sizes of boreal and arctic national parks in Canada (Parks Canada 1997).

BOREAL BIOME		ARCTIC BIOME	
Park Name	**Area (km^2)**	**Park Name**	**Area (km^2)**
Vuntut	4,345	Ivvavik	10,168
Nahanni	4,765	Aulavik	12,200
Wood Buffalo	44,802	Tuktut Nogait	16,340
Elk Island	194	Auyuittuq	19.707
Prince Albert	3,874	Ukusiksalik	20,500
Riding Mountain	2,973	Sirmililk	22,252
Pukaskwa	1,878	Quttinirpaaq	36,430
Gros Morne	1,805		
Terra Nova	400		

As a natural disturbance in boreal forests, fire is rivaled in size only by outbreaks of insects such as the mountain pine beetle (*Dendroctonus ponderosae*) and the eastern spruce budworm (*Choristoneura fumiferana*) (Johnson et al. 2003). These insects kill host-specific canopy tree species and induce new successional pathways over vast areas (up to millions of hectares through an epidemic) (Kurz and Apps 1999). Because insect epidemics can spread across large swaths of land through successive years, they have an ability to affect all stands of a specific host tree in many of the Canadian boreal national parks.

Perhaps because they experience such extensive and relatively frequent natural disturbances coupled with their relative youth in evolutionary terms, boreal forests have low taxonomic diversity and low functional redundancy (Pastor et al. 1996). Most constituent species go through wide and often cyclic fluctuations in abundance, both locally (when driven directly by stand-scale disturbance dynamics) and regionally (when synchronized across the grain of landscape-scale disturbance dynamics by as yet incompletely understood processes) (Sinclair et al. 1993; Krebs et al. 2001; Johnson et al. 2003). Among vertebrates, the most iconic of these fluctuations occurs in the snowshoe hare (*Lepus americanus*) cycle. Over a period of typically 8 to 11 years, hares can vary in density by two orders of magnitude, and directly or indirectly drive similar oscillations in various predators and alternative prey (Krebs et al. 2001). Predators such as the Canada lynx (*Lynx canadensis*) and the great-horned owl (*Bubo virginianus*), which specialize on hares, show the most dramatic numerical responses (O'Donoghue et al. 2001; Rohner et al. 2001). The lynx population continues to decline through the low phase of the hare cycle to less than three animals per 100 km^2 as it becomes somewhat nomadic, ages, and virtually fails to recruit young for 2 or 3 years (Mowat et al. 2000). A relatively large

boreal protected area of 4,000 km^2 (see **Table 1**) would support at most 120 lynx at this stage of the hare cycle, with smaller parks supporting significantly fewer lynx. At such low numbers, the possibility of local extinctions is quite high, and the capacity for population recovery when prey numbers rebound will likely depend on recruitment from outside the protected area.

The Arctic Tundra Biome

The extensive arctic tundra of northern Canada emerges from the taiga woodlands of the northern boreal forest and spreads across large areas of mainland and the entire arctic archipelago. There are no disturbance processes working at the scale of forest fires in this biome. However, the vertebrate wildlife community is characterized by wide seasonal and cyclical fluctuations in abundance. Cycles of abundance over 3 or 4 years are evident for some species (Krebs et al. 2002), and cycles with much longer periods may occur in others.

Seasonal migrations of arctic breeding birds are legendary, and their conservation requires insights into the factors affecting viability on wintering grounds, migration stopovers, and tundra breeding grounds (Meltofte 1985). Their conservation also requires international collaboration, often involving protected areas in numerous jurisdictions (Donaldson et al. 2000). Seasonal migrations of barren-ground caribou (*Rangifer tarandus*) are similarly impressive—herds range over areas from about 75,000 km^2 up to 400,000 km^2. No national park, and frequently no single jurisdiction, can accommodate the full annual range requirements of such a herd.

Three to four year cycles in the abundance of brown (*Lemmus trimucronatus*) and collared lemmings (*Dicrostonyx groenlandicus*) have direct effects on the abundance of a suite of predators, from arctic fox (*Alopex lagopus*) and red fox (*Vulpes vulpes*), to rough-legged hawks (*Buteo lagopus*) and snowy owls (*Bubo scandiacus*) (Krebs et al. 2003). During periods of low lemming abundance, the most specialized predators (e.g., arctic fox and snowy owls) frequently fail to breed and become semi-nomadic or even migratory, moving, sometimes in groups, over many hundreds or even a thousand kilometers within a year (Garrott and Eberhardt 1987; Fuller et al. 2003). In fact, the full circumpolar range of snowy owls probably represents one panmictic population, the only substantive break in gene flow being the North Atlantic Ocean (Marthinsen et al. in press). Although they may have originated within a protected area, these foxes and owls move well beyond that space, most likely because of the difficulties of accessing prey during the low phase of the lemming cycles. A protected area may support a viable breeding population one summer but rarely host successful breeding in the same species for a few subsequent years. The ability of a protected area to support breeding predators through successive cycles depends mostly on the survival of sufficient individuals moving around the large regions outside the protected area, and the probability that some of those individuals will find the next irruption of lemmings within the protected area. Wiersma et al. (2004) have similarly concluded that the strongest determinant of continued mammal population viability within Canadian national parks is the extent of high quality habitat around the parks.

Governance

Good governance to achieve wildlife conservation depends on adequate knowledge of the ecosystem, including human participation, well-reasoned prescriptions regarding the bounds of allowable human action, and solid compliance with these prescriptions. To understand the conditions that might result in such good governance in northern latitudes, we need to come to grips with institutional bases for acquiring knowledge, deriving prescriptions, and ensuring compliance. In northern Canada (Yukon, Northwest Territories, and Nunavut), this generally means dealing with at least two layers of government which have joint jurisdictional responsibility for lands and wildlife: First Nations governments, resulting from the settlement of aboriginal claims to title and rights on the land, and the government structure derived from European origins (Ray and Reid 2007).

Knowledge: There are generally two knowledge paradigms regarding ecology and wildlife in northern human communities. The first is the **local ecological knowledge** (LEK) of people who have relied on wildlife for sustenance and cultural identity for various periods of time ranging from thousands of years (for aboriginal peoples, for whom this is sometimes called traditional ecological knowledge) to decades (for recent immigrants). The second is **western science** (WS) as directed and practiced by trained professionals, generally in the context of government direction. Much discussion has occurred about the relative strengths of these two paradigms, and their potential complementarities and integration in decision-making (e.g., Gilligan et al. 2006). Their mutual roles are still evolving. Within each paradigm, the scope of knowledge of the natural world can be categorized in various ways, but two stand out for their long-term and recent utility: (a) the species or species-population scope and (b) the regional ecosystem scope. For this discussion, I will focus on the species-population scope.

Wildlife conservation requires the following knowledge, at a population scale: (a) abundance and distribution; (b) human harvest rate; and (c) ecological interactions (the dominant limiting factors, or direct effects) and other interactions (from which indirect effects most likely derive). Human harvest is worth addressing independently of other direct limiting factors because most northern communities are still strongly dependent on subsistence harvest of wildlife.

LEK and WS differ somewhat in their relative abilities to provide such categories of knowledge (**Figure 1**). Sufficient knowledge is generally lacking from either paradigm for species and populations that occupy large areas (i.e., geographic scope extending beyond the annual experience of a human community), and species whose ecologies operate through long time scales (i.e., long-lived or fluctuating over a long period). Key examples are individual herds of barren-ground caribou (*Rangifer tarandus*). Considering knowledge of abundance, WS can sometimes solve the monitoring or inventory constraint, at least in the short term, because the species or population migrates and coalesces in an open habitat where scientists can obtain a population estimate, and/or because we

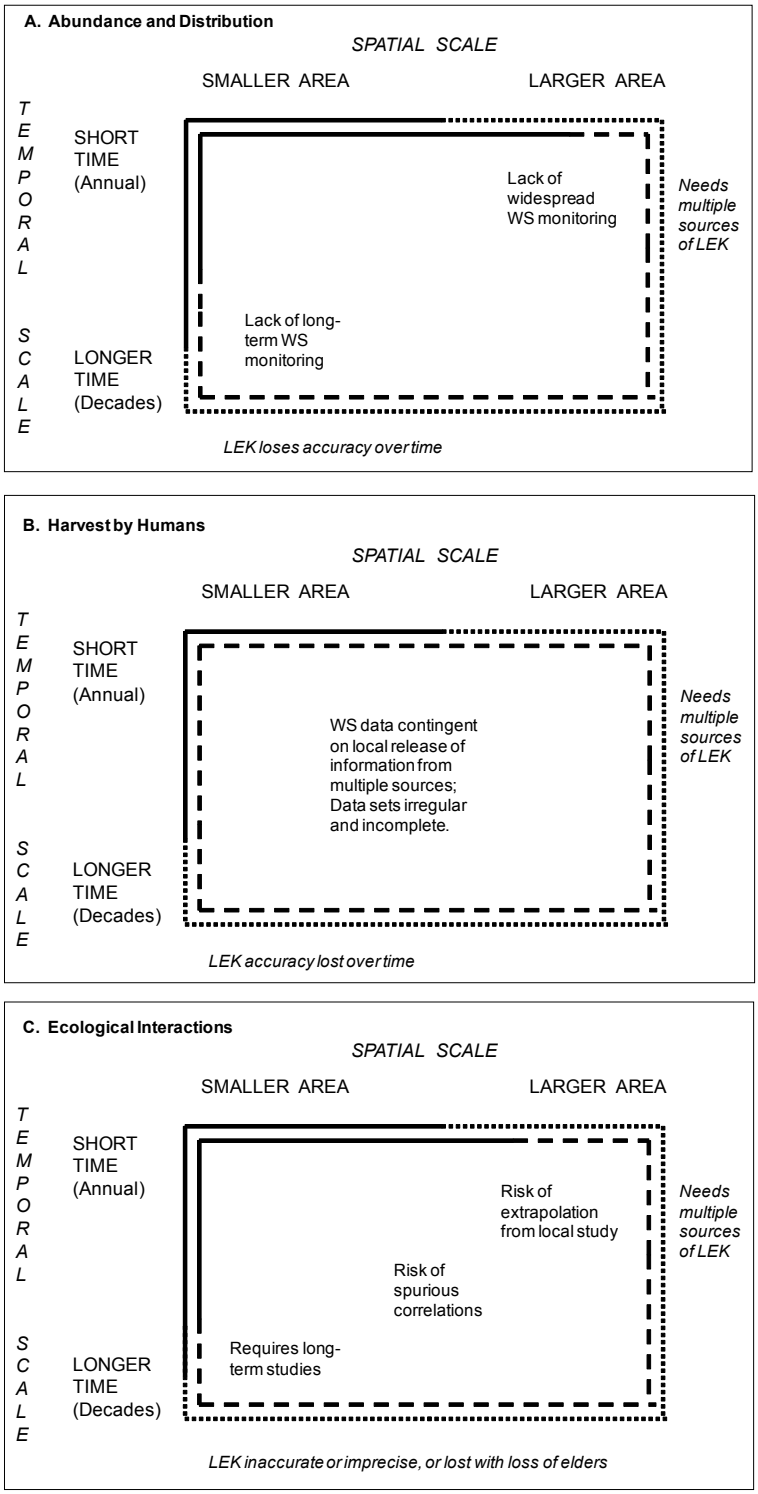
have novel remote sensing technologies (e.g., Lydersen et al. 2008). An alternative is to obtain updated LEK from as widespread a set of human communities as possible. Considering knowledge of harvest, we have the same problems of scale, but WS is more comprehensively constrained by the fact that most data are locally held by individual members of First Nations communities and considered private property unless these individuals agree to its release. Even when harvest data are made available, we need it from diverse sources geographically and over time periods sometimes rivaling the memories of harvesters to paint a full picture. Considering knowledge of ecological interactions, the long-term natural history experiences of generations embedded within LEK can still build more insights on diverse topics than can the detailed investigations of WS, especially when LEK is gathered from widespread communities before it is lost. However, both knowledge paradigms run the risk of drawing incorrect conclusions by inferring spurious cause and effect from observed correlations. An example of this may be the conflict between Inuit communities' and some western biologists' interpretations of changes in the frequency of polar bear (*Ursus maritimus*) observations near northern communities (Dowsley and Wenzel 2008).

The strength of LEK is threatened because fewer northerners are spending much time on the land, and the long-term experience and memory of those who do spend time on the land is at risk of being lost in the absence of recording it in narrative or databases. WS has become more common as a knowledge paradigm in the last 50 years, but it is very expensive, and governments may be unable to invest in it sufficiently, with the rising costs of energy and labor. These risks are recognized and have spurred increased efforts to document LEK through mechanisms such as annual interviews (e.g., Arctic Borderlands Ecological Knowledge Cooperative 2008; Gagnon and Berteaux 2006), annual harvest records, and the process of western scientists training local people to take on ecological monitoring in association with their travel and activities on the land (e.g., Dyck 2007). Many of these fairly recent efforts to bolster the quality and sustainability of LEK have required significant government investment. A big question in times of decreasing resources will be whether or not annual recording of local experience and harvest, along with formalized community monitoring of ecological phenomena, can become sustainable on a volunteer basis, as is typical of many bird monitoring programs (e.g., breeding bird surveys) in southern latitudes.

Deriving Prescriptions: In these northern ecological contexts, conservation prescriptions ideally should come from institutions that can best deal with the constraints of spatial and temporal scales on knowledge. The following institutional characteristics seem necessary:

- Representation from as many as possible of the affected communities and institutions with designated authority for land and wildlife management. (This could include diverse jurisdictions and representatives from protected areas, especially those from a different government than that which has responsibility for lands outside protected areas.)

Figure 1: The relative strengths of Local Ecological Knowledge (LEK) (outer boxes) and Western Science (WS) (inner boxes), and some of their likely constraints (LEK in italics) in providing knowledge regarding (A) abundance and distribution, (B) harvest rate, and (C) ecological interactions in the context of diverse spatial and temporal scales of species-population ecologies. Conditions supporting strong knowledge are indicated with solid lines, while conditions leading to weak knowledge have dotted lines.



- Strong focus on the collection, archiving, and reporting of LEK, both historical/traditional and current, regarding key ecological elements and processes.
- Strong focus on the collection of WS data, especially regarding abundance and ecological interactions.
- Mandate to collect, archive, and report on harvest data on an ongoing basis.
- Power to make policy and management recommendations to government entities with direct legal authority for land and wildlife management, and having prestige and respect so that recommendations are acted upon by government(s).
- Strong public relations and information dissemination program.
- A mandated recognition of the risks of resource development in regions where the ecologies are so dependent on healthy ecosystem function over vast areas, and so an active application of the precautionary principle.
- Mandated direction of long-term ecological monitoring via WS data and the experience of local people on the land.

In northern Canada, many of these mandates and characteristics have been granted to various co-management boards, some of which were established as part of land claims settlements (e.g., Wildlife Management Advisory Council for the Northwest Territories), and others with recognition of the central importance of caribou herds in local economies (e.g., Beverly-Qamanirjuaq Caribou Management Board) or the particular value of national parks in ecological conservation (e.g., Joint Park Management Committees). These boards are quintessentially products of the joint jurisdictional approach to natural resource management on "public" lands. They derive from recent or anticipated settlement of northern land claims and the legal need to formally institute ongoing consultation and accommodation processes with aboriginal communities. Both the historically colonizing government structures and the relatively recent First Nations government structures have their own bureaucracies, resulting in a top-heavy government structure throughout northern Canada. Co-management boards, although often comprised of civil servants and receiving technical support from established governments, also have their own administrative staff, adding to the "thickness" of the bureaucracy. The strong legal and moral imperative to consult and accommodate has pushed many government departments to establish co-management structures independent of one another, compounding the problem of bureaucratic weight. The interests of protected areas may be partially satisfied through Joint Park Management Boards established between communities and individual national parks, but when such boards have no legal mandate beyond park boundaries, we are left with the question of how protected area interests are represented in bodies with a legal mandate, and whether some of the components of the co-management regime are redundant.

Some co-management bodies are oriented toward particular geographies within which they have diverse scope and sometimes legal authority (e.g., Inuvialuit Environmental Impact Screening Committee; Wildlife Management Advisory Council for the Yukon North Slope; Gwichin Renewable Resources Board), while others are focused on one valuable resource, notably one of the

barren-ground caribou herds. This can result in overlap of scope and responsibility; for example, the Wildlife Management Advisory Council for the Yukon North Slope oversees land use issues in a substantial part of the range of the Porcupine Caribou herd, which has its own Porcupine Caribou Herd Management Board. This also leaves open the question of how to deal with species other than caribou, especially when they become high profile. This usually falls to the co-management bodies with specific geographic focus.

In addition to co-management bodies, most communities have local organizations whose mandate is to act as stewards of wildlife and the land. In the Northwest Territories and Nunavut these are typically Hunters and Trappers Committees or Associations, but in Yukon and elsewhere they are often Renewable Resources Boards. Members are elected and provide substantial leadership and advice to governments, both directly and sometimes through their representation on co-management bodies. The great potential value of these organizations, often realized in their historical recommendations to governments, is the pursuit of caution and vigilance when natural resource development is contemplated. In the jargon of resource management, this might translate into regulated "thresholds" on the scale of development, a concept that needs a great deal more application in the future.

Sometimes other organizations are also influential players in the governance structure. These include science-based conservation bodies, such as the Polar Bear Specialist Group of the Species Survival Commission of the International Union for the Conservation of Nature. Without a legally mandated role within the government-to-government bureaucratic structures, such a group must rely on the force of its ability to provide novel and insightful knowledge (primarily through WS) for its impact, and engage personally with local communities and government bureaucrats in the policy arena.

There exists a real opportunity and need to rationalize the overlaps and scopes of the various co-management institutions and associated community organizations within the context of both sets of government bureaucracies. The goal would be to derive a co-management system that minimizes redundancies, satisfies as many as possible of the mandates listed above within the fewest institutions, and ensures the representation and voice of protected area managers directly within the co-management bodies with legal mandates.

Compliance: In the western model of governance, compliance is largely about individual responsibility for adherence to regulation and law, and the impartial enforcement of regulation and law by mandated authority. In many traditional aboriginal models of governance, compliance largely results from derivation of consensus through community discussion and collective adherence to the consensus decisions at the risk of loss of status, local sanction, or perhaps ostracism. The western model, with its emphasis on individual action, has taken hold in northern communities, largely because of the power of the colonial government. Colonization has also brought novel livelihoods, frequently derived from the free market economy, with an additional emphasis on individual action and competitive interactions.

Active enforcement of laws and regulations, such as those pertaining to harvest quotas and the harvest season, is expensive and divisive in relatively small communities, and generally rests with the western government structure. Although such ultimate legal enforcement cannot be rescinded, local compliance through collective decision-making and community monitoring is certainly complementary, and may be a more sustainable approach. Co-management bodies, and especially community-based Hunters and Trappers Committees, have a major opportunity to rekindle the value and force of the collectivity in deriving compliance to various decisions regarding wildlife conservation. The pertinent issues embedded in any strengthening of the collectivity include free provision of harvest data by harvesters to the committees, consensus derivation of harvest quotas and harvest timing, and sanction of various wildlife harvesting actions (such as the sale of meat beyond the local community, or exceeding quotas).

4.3 Yellowstone, Scale, and Wolverines: Challenges and Opportunities

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Introduction

Yellowstone's history tracks that of the evolution of the conservation movement. Over the 136 years since its inception, the role of Yellowstone as a protected area has advanced from that of a public space for viewing natural wonders to a core area that anchors biodiversity among the public lands of a "Greater Yellowstone Area." As such, the figurative boundaries of Yellowstone have gained breadth and depth. When we initiated our telemetry-based study of wolverines (*Gulo gulo*) in Greater Yellowstone, the boundary of the protected area (GYA) was in large part based on efforts to conserve grizzly bears (*Ursus arctos*). Our wolverine data provide the most concrete example to date of the necessity to further widen the figurative boundaries of Yellowstone and other protected areas in the Rocky Mountains. Wolverine persistence here will require developing a socially acceptable and biologically suitable network of protected areas throughout the Rocky Mountains.

Creating a network of protected areas capable of conserving the native terrestrial fauna of a major bioregion will hinge on creative solutions that emphasize robust local communities. Yellowstone is often recognized as the world's first protected area; with the right effort it can be a model protected area that has addressed the issue of scale successfully for its native terrestrial fauna.

Case Study Site

Yellowstone National Park (YNP) was established as the first national protected area in 1872 (Yellowstone Organic Act) and set aside approximately 8,600 km^2 as a "public pleasuring ground." It is the first national park and often cited as the first modern example of a protected area (Eagels et al. 2002; Shadie and Epps 2008). The U.S. National Park Service (NPS) declared that "Yellowstone Park is one of the largest and most successful wildlife refuges in the world" (NPS 1937).

Although the general public still identifies YNP as the historic "protected area" at the center of the Greater Yellowstone Area (GYA), protected status has now extended far beyond the boarders of YNP. Our work in the GYE began in 2001, at which point the protected area known as Yellowstone National Park had evolved into the Greater Yellowstone Area (GYA). This 108,000 km^2 area spans portions of Wyoming, Montana, and Idaho in the Rocky Mountains of the western U.S. (Marston and Anderson 1991; Patten 1991; Noss et al. 2002). The GYA is the headwaters for three major continental-scale river systems: the Missouri-Mississippi, Snake-Columbia, and Green-Colorado. Elevations range from approximately 1,400 to 4,200 m. It is governed by a mix of federal land management and natural resource agencies, land management and wildlife agencies from 3 states, 20 counties, dozens of municipalities, and a diverse suite of private landowners with varied interests, beliefs, and values.

Yellowstone's history and development tracks the evolution of conservation ideals and theory in North America. Major developments in national and conservation history affecting Yellowstone as a protected area are briefly described here to provide a context for the development of current conservation programs in the GYA.

The period following the civil war (1865-1880) yielded a heavy toll on wildlife throughout the western U.S. Advances in hide-tanning technology, demand for hides for industrial uses, and the advance of modern transportation (steam ferries and a continental railroad) led to bison being killed at an industrial scale. The great bison decline reflected a social transformation in the west from one of cultural coexistence with nature to one of human dominance and exploitation of seemingly endless natural resources, including wildlife. Despite designation as a park and limited Euro-American settlement nearby, the lack of adequate financing, political resolve, and a national conservation conscience meant that Yellowstone was not exempt from industrial-level and local scale over-exploitation. The park's wildlife resources took a heavy toll despite early attempts to protect them. Thousands of elk that migrated from summer range inside the park to winter range outside the park were killed in or adjacent to YNP each year (Robbins et al. 1982). Bison and elk were still pursued for meat, hides and heads within Yellowstone throughout the late 1800s. In addition, park visitors were allowed to kill wildlife in the park for sport hunting or to provision their trip with food, and they often killed in excess (Schullery 1997). Predators were also pursued aggressively, both by citizen visitors as well as park administration throughout the 1870s (Murie 1940). Superintendent P. W. Norris in his 1877 report on YNP described an orgy of big game hunting during the winter of 1874-75 and stated that many of these carcasses were strychnine-poisoned for wolf and wolverine (Murie 1940). Although the early years as our first officially designated national park yielded increased awareness of the many natural wonders of Yellowstone, they were also marked by rampant poaching of wildlife, aggressive pursuit of predators, illegal squatters occupying park lands, and geysers being filled with trash.

By 1879, a single law-enforcement ranger patrolled the park on horseback but his effect was minimal. The number of trails in the park was greatly increased by 1882 to encourage visitation but also enabled better access for poaching. By 1883, awareness of the continued widespread destruction of wildlife inside Yellowstone led to the elimination of sport or subsistence hunting within the park. (However, it is important to note that this did not include protection of predators. To the contrary, predators were eagerly persecuted until 1935 [Barmore 2003]). Even though a significant problem was identified, it was not until 1886 that the secretary of war sent 50 soldiers to "make order out of chaos." The military presence in Yellowstone was an improvement, but many conservation challenges still remained for another decade. In an interesting turn of events during 1894, the army caught an infamous poacher red-handed, and as they escorted him out of the park, they passed a visiting journalist from a prominent New York magazine. This story presented in Forest and Stream in that same year caused a national outcry and within months the Lacey Act, which enabled criminal prosecution of wildlife violations, was established. This

story and others about poaching wildlife in Yellowstone gave individuals and newly formed organizations like Boone and Crockett Club grist for their citizen efforts to obtain legal protection for wildlife in these protected areas and to increasingly engage the politics of wildlife conservation (Trefethen1975). The U.S. army remained the leading authority in Yellowstone until 1916 and eventually began to control the slaughter within the park boundaries. Thus during the first 40 years of its existence as a national park, Yellowstone evolved from a lawless landscape loosely sketched on late 19th century maps into an iconic symbol and model for the emerging national conservation movement. During this period the Yellowstone story spawned a national conservation consciousness and catalyzed the formation of the first conservation organizations (e.g., Boone and Crockett Club, American Bison Society, New York Zoological Society) and activist citizens that influenced government to act on the behalf of wildlife.

During the first half of the 20th century numerous and significant conservation milestones occurred which dramatically influenced management in and around Yellowstone. At the turn of the century the U.S. Forest Service (USFS) (1905 Transfer Act) was established, and significant additional lands around Yellowstone entered into the public domain. The states also established Fish and Game Departments and hired a few law enforcement officers (there were 18 in Montana by 1906). The Association of Fish and Wildlife Agencies held their first meeting in Yellowstone in 1902, an early indication of the important link between establishing Yellowstone Park and the emerging wildlife conservation movement. In 1912 Congress established the National Elk Refuge in Jackson, Wyoming. By 1916 the National Park Service had been established "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." In 1929 Congress established the 388 km^2 Grand Teton National Park in northwestern Wyoming, providing another protected area within the GYA. These park boundaries were further expanded in 1943 by presidential proclamation. The Bureau of Land Management was established in 1932 and began administering areas used for grazing livestock (grass and sagebrush lands). This again significantly increased the lands under federal management around the Yellowstone region. Other critical wildlife legislation was enacted and influenced the greater mission of conserving wildlife throughout the country. The Migratory Bird Treaty Act of 1918 was established to protect bird species during a time when commercial trade in birds and their feathers posed a significant threat to many populations. The Pittman-Robertson Act of 1937 placed a sales tax on all hunting equipment, and the funds were used to establish, restore, and protect wildlife habitat. Thus the early 1900s brought about significant protections for wildlife and changed the status of additional lands in the GYA, establishing a unique opportunity for cooperative management of natural resources on a greater scale than was previously imagined.

During the latter half of the 20th century, conservation efforts in North America and the GYA evolved even further, shifting in emphasis toward the ecological management of landscapes, maintaining biodiversity, and protecting ecological processes. As far back as 1968, YNP embraced an experimental wild-

life management policy termed "Natural Regulation" (Cole 1971). This policy was an initial attempt by the National Park System to look at preserving ecosystem processes as opposed to managing conservation problems by constant and heavy-handed intervention. The Wilderness Act (1964) established a new scheme for landscape management of some federal lands, and many large-scale wilderness designations were eventually established in the GYA. The effect of this federal land designation was to increase the effective size of the core protected areas far into adjacent landscapes of Montana, Idaho, and Wyoming. A new National Environmental Policy Act in 1970 suddenly required all federal agencies to prepare an analysis of potential environmental impacts for any action that they proposed to undertake (e.g., timber sale, road project). As a result of this analysis, an environmental impact statement (EIS) is made available to the public for comment and describes potentially adverse environmental impacts, how the activity influences the long-term productivity of the resources, secondary and cumulative affects of the activity, and alternatives to the proposed activity. The need to connect protected areas (an emerging concept) led to the establishment of the Rockefeller parkway in 1972, linking forever the management of Yellowstone and Grand Teton National Parks.

The 1973 Endangered Species Act also dramatically influenced the management of public and private lands by requiring agencies to maintain rare and endangered species and protect biodiversity. In the GYA this act greatly impacted the size and scale of the protected ecosystem based on spatial needs of rare and endangered species like grizzly bears and wolves. The 1976 National Forest Management Act directed the USFS to develop transparent plans for development and resource extraction on public lands, while describing how management would protect soil, water, plant, and wildlife resources. In 1994, the NPS published an EIS and plan for wolf restoration and in 1995 reintroduced a large predator that had long been missing. That population grew rapidly and now fully occupies habitats throughout the GYA. Newly acquired ecological knowledge for many of these wide-ranging rare species is now inspiring a new vision for conservation efforts in the GYA. Hence, throughout the latter half of the 1900s, as modern conservation theory and practice evolved, the scale and dimension of conservation in the GYA was reshaped once again.

With the dawn of the 21st century, the most significant issues on the GYA conservation agenda focused on balancing nature and human interests (particularly the economics and commerce of humans) (Howe et al. 1997) at the margins of an expanded protected area. Although the Greater Yellowstone conservation story resulted in a working model for large-scale ecosystem management (connected protected areas managed collaboratively by various jurisdictions) and increased biodiversity (recovery and protection of swans, wolves, bears, or wolverines), it also produced a new suite of conservation challenges. Recent public discussions and/or pending legal battles over snowmobile use in Yellowstone and adjacent forest lands, oil and gas development on crucial ungulate habitats, protection of migration corridors, control of brucellosis in wild ungulates, management of the livestock-wildlife interface, and human conflicts with wolves and bears where they have not been seen for 100 years are testimony to this new suite of challenges. The millennial celebration in 2000 marked

a major transformation for the GYA from a simple protected landscape with a somewhat narrow but well-defined mission into a mature, collaboratively-managed, and complex ecosystem protecting ecosystem processes, biodiversity, and human cultures on a large scale. Perhaps in 2008 it is more appropriate that the GYA be called "one of the largest and most successful wildlife refuges in the world."

Conservation Target

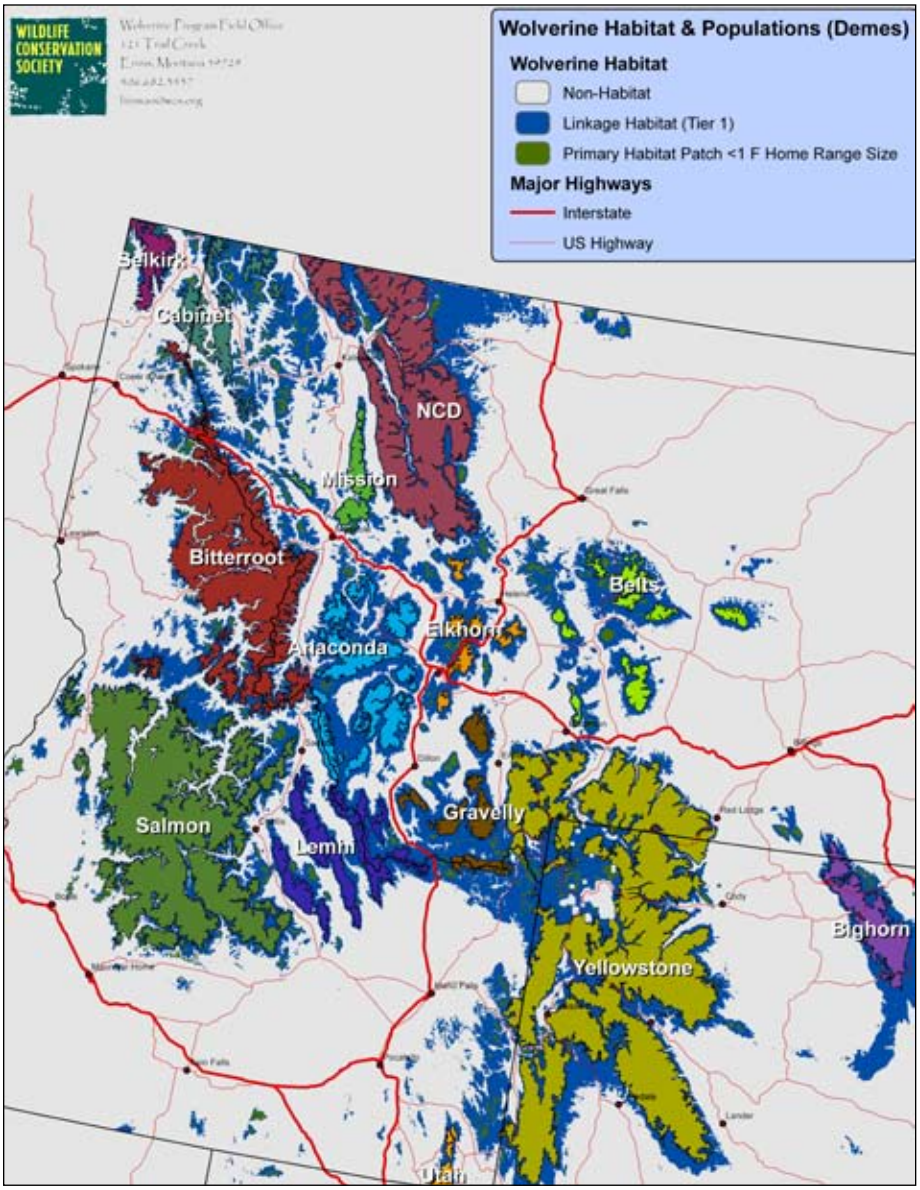
When we initiated our telemetry-based study of wolverines (*Gulo gulo*) in Greater Yellowstone, the boundary of the protected area (GYA) was in large part based on efforts to conserve grizzly bears (*Ursus arctos*). Our wolverine data provide the most concrete example to date regarding the necessity of further widening the figurative boundaries of Yellowstone and other protected areas in the Rocky Mountains.

Wolverines of the Rocky Mountain States exist as a metapopulation whose persistence depends on successful dispersal. Here at the southern periphery of the species' global distribution, resident adult wolverines utilize high-elevation, alpine habitats which exist in island-like fashion. The patchy nature of these suitable or "primary" habitats along with the huge territory requirements of adults and naturally low densities of the species often result in small local populations.[1] For example, the Madison, Gravelly, Henrys Lake, and Snowcrest Ranges of southwestern Montana appear to contain 2 adult male and 5 adult female territories.[2] Together these local populations or "demes" make up a metapopulation whose viability depends upon successful dispersal among the mountain ranges of Montana, Idaho, and Wyoming. The need for successful dispersal is made even more critical by the fact that wolverines do not typically reproduce for the first time until ≥3 years of age, they reproduce infrequently thereafter (1 cub/2–3 yrs), and longevity appears to be less than 15 years.[3]

Facilitating dispersal among the demes of the tri-state area requires an understanding of the metapopulation function of the various habitat patches, i.e., their spatial arrangement, patch size (habitat fecundity), and relative connectivity. During June 2007, we convened a group of 30 agency biologists from Montana, Idaho, and Wyoming at the Greater Yellowstone Wolverine Workshop to attempt to define management units suitable for landscape-level, metapopulation management. Participants suggested that the traditional use of a Greater Yellowstone Ecosystem, a Northern Continental Divide Ecosystem, and a Salmon-Selway Ecosystem, as was done with grizzly bears, is likely inappropriate for wolverines. Rather, the biology of wolverines provides an obvious example of why the traditional borders of these separate ecosystems should be expanded such that they overlap. The resulting overlap forms a "Central Linkage Ecosystem" (CLE), which the participants suggested receives relatively little conservation attention although it appears critical for wolverine persistence.

Since that workshop, we have put additional effort into defining wolverine demes, potential management units, and the area that would compose the CLE by identifying all primary wolverine habitat patches >100 km^2 in size in Montana, Idaho, and Wyoming,[4] and then aggregating these patches into

Figure 1: Potential wolverine metapopulation demes/units of the northern Rocky Mountain states, based on the presence of primary wolverine habitat patches large enough to support at least one adult female, the degree of apparent connectivity via smaller patches of primary habitat and Tier 1 linkage habitat, geographic features, and major roads.



"major demes" based on the degree to which they appear to be linked by smaller patches of primary habitat (<100 km^2) and Tier 1 linkage habitat. We also considered the presence of major roads and geographic features. This resulted in 14 major demes in the northern Rocky Mountain states (**Figure 1**).

Wolverine population size is likely >25 individuals within only four of these major demes: the Yellowstone, Salmon, Bitterroot, and Northern Continental Divide.[5] These four areas likely function as cores, or "Regional Population Centers." The vast majority of wolverine habitat within each of these four ecosystems is in public ownership (Brock et al. 2007). However, in order for wolverines to disperse successfully among these 4 Regional Population Centers, the areas in between must function appropriately. These in-between areas compose

the CLE (the Anaconda, Gravelly, Elkhorn, Lemhi, Belt, and Mission demes, **Figure 1**).

Management strategies for and conservation efforts in the CLE are paramount to successful wolverine dispersal and metapopulation persistence. The CLE contains a significant amount of primary wolverine habitat in public ownership, and it does support reproductive females. These areas are critically important because successful reproduction within the CLE is the most likely means of achieving successful dispersal among the Regional Population Centers. While the Regional Population Centers are large blocks of publicly owned wolverine habitat, the CLE consists of smaller habitat patches often separated by privately owned valley bottoms. Thus, because the CLE consists of a matrix of publicly/privately owned lands and numerous roads it is particularly susceptible to the rapidly increasing pressures from exurban development and traffic volumes (Gude et al. 2007). These factors likely result in higher mortality risk and reduced permeability for dispersing wolverines. Maintaining an appropriately functioning Central Linkage Ecosystem requires successful management strategies for 1) areas of primary habitat capable of supporting reproductive females, and 2) areas that serve as functional linkage zones between primary habitats.

Proactive, science-based conservation efforts in the CLE are critical to the wolverine metapopulation. Collaborative solutions for retaining open space in areas where increasing levels of development could inhibit wolverine dispersal will be key. Appropriate metapopulation management strategies will also be important. Wolverine persistence here will require developing a socially acceptable and biologically suitable network of protected areas throughout the Rocky Mountains.

Challenges and Successes

Protecting the Core

Although much of the Greater Yellowstone ecosystem is now protected through various landscape designations and policy regulation, significant internal and external threats to long-term conservation remain. The protected areas within the ecosystem are routinely threatened by actions that are not permitted within the system but that influence the system from beyond its borders (i.e., "a scale issue"). The most prominent of these external threats are invasive species, diseases that threaten wildlife, livestock conflicts or competition with wildlife, human-large predator conflicts, and external/internal human development.

Specific examples of some of these threats in the GYA include: the introduction of exotic weeds within and near the protected areas; introduction of non-native fish species into natural lakes and aquatic systems; management of elk and bison to prevent brucellosis transmission into adjacent livestock; the spread of Chronic Wasting Disease through Wyoming; wolf and bear depredation on livestock near the park; and human injury from dangerous animals. The development of recreation sites within established protected areas to meet the demands of growing visitation to the area and exurban development on landscapes adjacent to protected areas are also introducing new threats to species and habitats.

Maintaining functional predator populations within the GYA is and will continue to be a major conservation challenge. The recovery of the grizzly bear has been a major success story and demonstrated that conservation at a large scale is achievable and that wide-ranging species can be recovered by collaborative efforts of public and private sectors. Wolf reintroduction and recovery followed soon on the heels of the grizzly bear. Since wolves have been reintroduced into Yellowstone there have been evident changes in the ecological relationships with ungulates and vegetation, as well as subsequent effects on biodiversity through interactions with other predators and scavengers (Berger and Smith 2005). Predator/scavenger function in the ecosystem has been restored through intensive management during the past few decades as all key predators and scavengers were recovered. However, long-term conservation of these species must be maintained at the current scale or greater within a dynamic and changing system. Significant challenges to this effort come mostly from external sources including conflicts with livestock on unprotected landscapes, continued threats from established human developments within protected areas, and the impact of humans living within or visiting the ecosystem. The key to success will ultimately have a distinct human dimension as it is people that pose the ultimate threat to maintaining these species in the GYA.

Ecological Connectivity

Creating a suitable and acceptable network of protected areas will be challenging. The potential benefits as well as challenges associated with maintaining or restoring connectivity depend a great deal on the environmental, social, and historic context. Because context is so important, no one strategy for ecological connectivity will fit all circumstances (Hilty et al. 2006). Foremost among the challenges associated with ecological connectivity is developing incentives for maintaining open space on the privately owned lands that lie between islands of publicly owned lands. Other significant obstacles include managing the complexity of public land ownerships and agency mandates; inter-dependent jurisdictions (i.e., one agency manages a wildlife population while another manages the population's habitat); resistance to collaborate based on negative historical interactions among organizations; large expenses associated with both private property protections and highway mitigations; difficulty pinpointing the best private properties and most-likely highway crossings; and the uncertain affects of climate change. Last but certainly not least, the local public's perception of and desire for a "network of protected areas" is critical.

Despite these significant challenges, some successes have been achieved and the potential to create a network of protected areas is feasible. Wolverines likely represent the largest scale over which any terrestrial animal native to the Rocky Mountains should be conserved. Recently gathered research data provides a compelling and easily understood example of the necessity for conserving beyond the traditional protected area border. Yellowstone is an internationally recognized conservation site, thus the public's desire to succeed in balancing human and wildlife needs in the area is strong. Numerous public and private organizations that desire to work toward sustainable communities and ecosys-

tems already influence conservation of the region and are beginning to focus on the issue of ecological connectivity. Recently the Western Governors passed a resolution calling for protection of wildlife corridors and crucial habitat and implemented a Western Governors initiative to begin identifying and mapping wildlife corridors across the west. State wildlife agencies are also introducing corridor protection in their State Wildlife Action Plans. Even larger scale ecoregional connectivity initiatives such as "Yellowstone to Yukon" are gaining traction. The issue of ecological connectivity is now frequently discussed in conservation forums and at many levels of society and science in the GYA and beyond.

The Human Element

Despite a voluminous literature, both biodiversity and ecosystem conservation remain relatively abstract concepts to the public (Entwistle and Dunstone 2000; McNeely 2000). As it relates to the GYA there have been massive public outreach campaigns to profile the need for biodiversity and landscape conservation by government agencies, conservation NGOs, and individual conservation activists. Despite these intensive public relations campaigns the main challenge to successful conservation is building a broad understanding of conservation needs at these large scales and coalescing public opinion and support around those major conservation needs. Three key attributes of the human element may be impeding our efforts to successfully market large-scale conservation needs and programs in the GYA. These are: historic social context, public trust, large time scales, and competing land-use interests.

The lack of public trust regarding large-scale conservation issues stems from both the historical context and current social dynamics in the GYA. People living around the core protected areas have mixed histories and exposure to the evolving management framework of agencies and conservation frameworks advocated by various conservationists. Long-term residents may have witnessed agency promises made and not kept or recall ecological predictions for outcomes that proved wrong. In addition, humans tend to form attitudes and think about conservation at a provincial or local scale, challenging the elevation of conservation practice to the scale of an ecosystem. The messages from various conservation entities are also confusing and mixed (Redford et al. 2003). Agencies and conservation organizations often seem to be competing and conflicted. The dynamics between conservationists, society, and government has always resulted in an uncomfortable relationship regarding governance and the scale of conservation in the GYA, often resulting in local resistance to large-scale conservation theories and practice and a public trust that is hard to earn and keep.

The time lapse (time scale) between implementing a conservation program and observing visible outcomes is often great when working with many conservation target species or at a large landscape scale. It is difficult to maintain public interest and long-term commitment to conservation programs when most outcomes may not be experienced within a lifetime or even a generation. It is also difficult to retain political attention for a long-range conservation program when most politicians would not see the benefits while in a position

of influence. In the GYA it took many decades to see positive outcomes from the grizzly bear recovery effort. The means for keeping focus on conservation of this species was the heavy weight of the Endangered Species Act. Keeping the public and political eyes on a long range and large-scale conservation vision will require dynamic and persistent communication programs and test the resolve of agencies, society, and conservation organizations.

Humans value wildlife and habitat in many different ways (Gray 1993). As a result of different attitudes and beliefs there are often competing interests regarding wildlife, wildlife habitat, and land use across the GYA. Gateway communities are interested in maintaining the natural wonders of the GYA for the benefit of commerce and marketing the value of quality of life in their communities (Howe et al. 1997). The expected outcome of increased marketing of quality of life is increased visitation and population growth in the area. In fact, many counties in the GYA are experiencing the fastest growth rates in the west (Howe et al. 1997). Exurban development will be a major conservation issue in portions of the GYA far into the future as people rapidly move to these landscapes for their great amenities and quality of life. Conservationists need to be as aggressive in helping communities find the right places for development as they are at stopping development in the wrong places (Johnson and Klemens 2005). Local community planning and county zoning will become an increasingly important conservation vehicle for balancing wildlife needs against human needs as communities in the GYA grow and expand.

Recently there has been a dramatic shift in the economy of the GYA away from extractive resources to services and government (Howe et al. 1997). Although there is an evident shift in the economy, there is great interest in access to much of the GYA for timber and grazing activities. Increasingly, those interests do not see their activities as threats but advocate the benefits of these actions as landscape treatments to maintain or even improve the habitat for select wildlife species. The value of ranching is often regarded as beneficial to wildlife (open space) as well, especially when weighed against the alternative of subdivision. Mining and oil and gas interests remain a prominent feature in some portions of the GYA, and industry is exploring ways to mitigate for impacts to wildlife while contributing to a diverse economy. Recreation industries are increasing and richly support many of the gateway communities in the area. The bottom line is that although the economy is shifting away from commodity industries, the need to balance conservation and human needs remains a very important issue. Creative and innovative ways to balance nature and commerce will need to be explored, and despite best efforts some intense social conflicts over land use will persist in the GYA.

Coordinating Conservation Efforts

Conservation programs' interactions among the surrounding land use types and various forms of governance are extremely complex in the GYA. There is a lack of a unified mission and coordinated governance, which is a major impediment to effective conservation action. The GYA is and always will be a multi-jurisdictional landscape and the challenge to conservationists is finding ways to disentangle this complexity to achieve coordinated and focused conservation action.

There is no unified conservation plan for the GYA but rather an umbrella of many state/federal regulatory and enabling acts that impose restrictions on various agency interests and actions. Beneath that umbrella is a full arrangement of agency management plans primarily aligned with the various agency directives, policies, and missions. Active conservation planning at an ecoregional scale is primarily being conducted by private conservation organizations in the form of large-scale conservation initiatives. Despite good intentions, these conservation efforts often appear to compete and sometimes confuse the broader publics (Redford et al. 2003). Conservation organizations must work more closely to convince the world of the importance of their cause (Redford et al. 2003). In addition to private conservation organizations, there are a suite of individual private landowners with various values and interests. This community of private landowners is always shifting according to individual, social, or economic motivations, creating a very dynamic form of land governance on those critical small parcels. This complex arrangement of various forms of governance over public and private lands and wildlife in the GYA creates a serious challenge to defining major conservation targets, coordinating conservation action, and implementing effective conservation at a large scale.

Conflicting agency missions and institutional momentum are major impediments to achieving coordinated conservation in the GYA. Most state and federal agencies are committed to a specific agency mission and often these are in direct conflict with other agency missions when trying to achieve coordinated management over a large conservation landscape. These agencies are routinely engaged in long-range planning and build institutional capacity and cultures that are not easily changed or redirected. The result is reduced opportunity for power sharing across the various agencies, resulting in strong internal battles among governing agencies and the publics they serve. A recent example of institutional battles in the GYA centers on the management of brucellosis in bison and elk of the GYA. Conflicting agency missions and directives at federal and state levels have created an inconsistent management program for two keystone herbivores in the GYA. Efforts to bridge these institutional barriers through the formation of the Greater Yellowstone Interagency Brucellosis Committee have been marginally successful at ecosystem-wide coordination. This GYA-specific example provides insight into the difficulties that lie ahead when attempting to manage something, such as wolverines, over an even larger geographic (and therefore political) scale.

Some coordination of conservation direction has been achieved through forceful intervention at the highest levels of the federal government to create programs, policies, or regulations that influence various forms of governance on a much broader scale. Examples include the Endangered Species Act and National Environmental Policy Act. These acts enforce, through law, the need to address conservation issues by state and federal agencies. However, these acts are often perceived as heavy-handed and can disenfranchise segments of society. As a result they may prove to be a disincentive for cooperation and power sharing. An example of this was demonstrated with the reintroduction of wolves in the GYA, which remains highly controversial and emotionally charged as wolves expand beyond the boundaries of Yellowstone National

Park. As wolves moved onto landscapes adjacent to YNP, many segments of the public feel they are forced to coexist with an uninvited guest, and some state agencies feel required by federal coercion to address management of wolves on these areas without broad public support. This top-down approach to restoring and protecting rare species to create biodiversity or managing critical habitats is often met with determined resistance.

Another conservation model operating at a smaller scale in the GYA is characterized by building community-based conservation efforts that embrace the power of individuals and local communities to establish conservation goals and priorities for themselves. This bottom-up conservation model has been attempted in various parts of the GYA and seems to have been successful to date. Recent success has been achieved by building smaller scale coalitions such as the Madison Valley Ranchlands Group (www.madisonvalleyranchlands.org). These efforts can achieve extraordinary conservation by bridging across jurisdictions and are exceptional at bringing the private landowner, communities, and counties into conservation planning.

Uncertainty of Climate Change

Scientists predict that global climate change will become the greatest threat to biodiversity in some regions of the world (Thomas et al. 2004). There is little debate that climate change will affect the GYA and its biodiversity. State and federal wildlife and land management agencies are in the very preliminary stages of incorporating management strategies that consider climate change into long range plans. Furthermore, very little is known about how species will adapt and what mitigations are likely to help maintain biodiversity in the GYA. Few, if any, local land use plans or county planning efforts are considering the potential impact of climate change on wildlife or habitats affected by their planning decisions. Land use and human development will likely play a key role in mitigating or exacerbating climate change influences. The extent of poorly planned development and its juxtaposition to natural habitats will determine how climate change affects a landscape and the extent to which it affects biodiversity (Johnson and Klemens 2005). Because of its topography and diversity of habitats the GYA is vulnerable to large effects from climate change, and a great deal of work is needed to understand the effects of various climate change scenarios. This understanding needs to be considered when developing conservation planning at the federal, state, and local levels.

Lessons from the GYA

Conservation of biodiversity at a large scale has been achieved in the GYA by both top-down and bottom-up conservation initiatives. Although the top-down approach may be needed for immediate protection of a species on the brink of extinction or its habitats, we prefer to emphasize the bottom-up approach to species and landscape conservation. By including people early on in the development of local conservation strategies, it is more likely they will support implementation and cooperate in achieving long-range conservation goals. In order to address issues of scale for YNP as a protected area, we need to create

an open social-political environment where local communities and counties are willing to invest in conservation programs for species and habitats adjacent to and within the core protected areas of the GYA.

A landscape-species focus is valuable for establishing the appropriate scale and scope of conservation at an ecosystem level. Wide-ranging species such as grizzly bears, wolves, and wolverines motivated the conservation community to re-examine what is the appropriate size and shape of the GYA. These focal species have amplified the conservation vision for the GYA and redefined the appropriate scale and size of the ecosystem and ecosystem processes needing conservation at that scale. The Wildlife Conservation Society's wolverine research has further enhanced this vision by identifying the need for considering not only scale but also a network of protected areas to assure species persistence and gene flow across connected ecosystems. The wolverine is a particularly great ambassador for promoting this level of ecological connectivity and protected area networks because the species is not as controversial as other low density, wide-ranging species (e.g., grizzly bears, wolves). Wolverines illustrate that although intense conservation has been practiced in the GYA, the issue of scale has not yet been fully addressed.

Collaborative processes and clear conservation targets at all levels of governance would help us achieve landscape-scale conservation in the GYA. Due to the complex mix of jurisdictions and competing human interests this is going to be very difficult to accomplish on such a large scale. When reviewing global collaboration among conservation organizations at landscape levels, Redford (2003) noted that "To date, cooperation has been sporadic at best. Because there is no single definition of what we are trying to save, there are therefore no simple prescriptions about what to save or how to do it. Building a coalition therefore will be time-consuming but not impossible." This remains a major challenge among the agencies and conservationists in the GYA, resulting in delayed progress on many conservation issues. As management evolves in the GYA a new model of multi-jurisdictional governance that encourages public participation, breaks down agency barriers, reduces internal and external threats, and concentrates on clear conservation targets will be necessary to open a pathway to protected area networks. We are uncertain what that new model of governance will look like but are convinced the GYA is the conservation landscape most likely to spawn a novel governance model as it has done so often throughout its history.

The role of science in conservation planning is also very important in the GYA. The more scientifically defensible a conservation plan, the more open it is to public participation and less vulnerable it is to political subversion (Noss et al. 1997). We believe a good science platform is very important to inform policy decisions and build communities of interest around landscape-scale conservation programs. In the GYA, high quality ecological data from grizzly bears, wolves, wolverine, elk, bison, and pronghorn have inspired agencies and conservation organizations to implement specific "on the ground" actions that preserved habitat and protected wildlife species. Furthermore, research data from these species presented a colorful picture and marketable story about the conservation scale and spatial dynamics needed to maintain biodiversity in the

GYA. Aside from species data, science also can play a significant role in evaluating the impacts and designing mitigation for the effects of climate change. Good science appropriately presented supplies a degree of credibility to conservation planning that helps the public understand and accept specific conservation actions. With broad public support, desirable conservation outcomes are more likely to be achieved.

Although there remain many conservation challenges in the GYA, we have great reason for hope. We have seen great successes in the recovery of species once thought to be lost, and we have seen the gradual expansion of the core protected area to form a more complete ecosystem. We have witnessed the advance of new ecological data regarding species and habitats to inform conservation planning and policy making. We anticipate enthusiastic conservation efforts to identify and protect corridor networks between the GYA and other large protected areas in Montana and Idaho. We acknowledge a great resolve by the public, states, and federal government to maintain a viable, world-renowned ecosystem for the benefit and enjoyment of future generations. The rich and inspiring conservation history of the GYA, a committed conservation community, enormous public commitment, consistent political attention, and a healthy quantity of good science are conspiring to make the GYA model a continuing conservation success.

[1] Annual home range size averaged 400 km^2 for adult F wolverines and 1,200 km^2 for adult M, and wolverine density was estimated to be 1 wolverine/212 km^2 of primary habitat in the Madison, Gravelly, and Centennial Ranges of southwestern Montana (Inman et al. 2007a).

[2] Based on 7 years of field study including captures, telemetry data, den searches, tracking surveys, etc.

[3] Estimates of reproductive parameters and longevity from Persson et al. 2006 and Inman et al. 2007b.

[4] The minimum adult female home range size in the conterminous U.S. is approximately 100 km^2 (Hornocker and Hash 1981; Copeland 1996; Squires et al. 2006; Copeland and Yates 2006; Inman et al. 2007a).

[5] Based on the total area of primary wolverine habitat within each major deme and a density estimate of 1 wolverine/212 km^2 of primary wolverine habitat obtained in the Madison, Gravelly, and Centennial Ranges of Montana and Idaho (Inman et al. 2007a).

PART 5: WCS CASE STUDIES—MARINE

5.1 Protected Areas and Highly Migratory Marine Species: A Management Quandary

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Introduction

Each stage in the sea turtle life cycle, whether terrestrial or marine, is susceptible to different causes of mortality, in both space and time. The 1% of the life cycle occurring on land is relatively easy to protect, as beach nesting habitat tends to be accessible and easy to demarcate. But 99% of sea turtles' highly migratory life cycle is spent at sea, making them "a common property in the global commons" (Frazier 2004). Hence, conservation efforts in one country may be jeopardised by activities in another, or in the high seas, beyond the jurisdictional control of any individual country. Conversely, threats which may appear geographically limited may actually have much wider-range implications. The tragedy of the commons is particularly relevant to sea turtles: frequent bycatch of industrial fishing fleets throughout the world's oceans, incidental victims in the over-exploitation of our marine resources:

> "… the oceans of the world continue to suffer from the survival of the philosophy of the commons. Maritime nations still respond automatically to the shibboleth of the 'freedom of the seas.' Professing to believe in the 'inexhaustible resources of the oceans,' they bring species after species of fish and whales closer to extinction" (Hardin 1968).

It is crucial that sea turtle management and conservation efforts are undertaken collaboratively on local, regional, global, and long-term scales, not only within national jurisdictions but also in the open oceans, outside national sovereign boundaries. In this respect, sea turtles can acquire the status of flagships for entire land- and sea-scapes. This paper will discuss the complexities of sea turtle conservation as they relate to management and the relevant spatial and temporal scales. It will illustrate aspects of the Wildlife Conservation Society's (WCS) work in the Gulf of Guinea, as well as provide significant examples from other regions and populations.

Life Cycle and Threats

Sea turtles have been shown to exhibit natal homing (or philopatry), returning to reproduce at the same beach or region where they were born (Meylan et al. 1990; Bowen et al. 2005), although occasional imprecisions may lead to the colonisation of new nesting habitat. Females lay approximately 80-120 eggs in the sand, around 3-7 times per season. Although mating usually takes place near nesting beaches, these areas are often difficult to pinpoint. The location of internesting habitat is also often unknown. While females breed every two or more years, males may travel to the nesting beaches more frequently, but their marine nature makes them even more difficult to monitor. After approximately two months of incubation, hatchlings emerge from the nests and crawl toward the sea, which they recognise by its brighter night glow. A "swimming frenzy" takes them offshore, where predation risks are lower. Imprinting, either to the beach or offshore chemical and physical cues, is believed to be responsible for the return of hatchlings to the same beach as adults. Both on the beach and at sea, hatchlings and juveniles are highly vulnerable to predation.

The post-hatchling stage, referred to as "the lost years," is the least known of the life cycle. It is thought to involve epipelagic feeding and drifting in oceanic currents, followed by a benthic juvenile stage in nearshore habitat, and recruitment to adult foraging grounds at species and site-specific sizes. Juveniles have been shown to exhibit seasonal shifts in temperate regions or site fidelity throughout the year in areas with stable seasonal temperatures. Adult feeding habitats vary widely depending on species and populations, and may include residence in distinct continental feeding grounds (such as seagrass beds for green turtles *Chelonia mydas*), pelagic habits in wide areas associated with prey items (such as jellyfish feeding for leatherbacks *Dermochelys coriacea*), seasonal coastal migrations (such as loggerheads *Caretta caretta* in North America), or even local residence in the vicinity of nesting areas (such as hawksbills *Eretmochelys imbricata* in Australia) (Godley et al. 2007). Reproductive migrations between nesting and foraging grounds may span thousands of kilometers. Individuals of most species reach maturity around 20-30 years of age, but age and size at maturity may vary between populations, and may be influenced by growth rates and diet. Even in pristine conditions, the proportion of hatchlings which survives to adulthood is extremely small (perhaps as little as 1 in 1,000; Frazer 1986); human-induced threats decrease this figure even further.

Due to their migratory nature, sea turtles are subject to countless threats over wide spatial and temporal scales (Frazier 2004). In addition, several characteristics inherent to their biology make them particularly sensitive to threats. For instance, temperature-dependent sex determination means they are highly susceptible to changes in incubation conditions; light sensitivity leads to high impacts from light pollution; philopatry makes them more vulnerable to habitat disturbances such as coastal development, litter and washed-up logs on the beach, oil spills, coastal erosion, and sand-mining. Nesting populations are also threatened by egg collection and capture of females for meat. High demand for sea turtle products from urban areas and impoverished coastal villagers means that exploitation is often commercially lucrative. While sea turtles are easily and frequently exploited on land, they are even more vulnerable during their time

at sea, when their habits and whereabouts are still largely unknown. Marine threats include incidental and deliberate capture by artisanal fishermen, incidental capture by industrial coastal and pelagic fisheries, marine pollution and habitat destruction, boat collisions, sewage and floating debris (discarded fishing gear, plastic, tar, styrofoam), as well as oil exploration and exploitation.

Gabon's Sea Turtles

Gabon hosts the largest leatherback population in the world (Witt et al. in review), possibly as much as 35% of the global population of this critically endangered species, and the highest nesting density in Africa. Some evidence suggests that, while the Pacific leatherback populations have declined by as much as 95% in the last 20 years due to fishery mortality and overexploitation at the nesting beaches (Spotila et al. 2000), the leatherbacks in the Atlantic may not yet be on the same downward spiral. And Gabon's large leatherback population could potentially drive the recovery a species that is critically endangered throughout much of its range. In August 2002, the Gabonese government created 13 new national parks, at least two with the specific purpose of protecting leatherback nesting sites, and four encompassing all the major sea turtle nesting beaches.

However, population data must be interpreted with caution; early indicators of a substantial decline may be too easily overlooked. Strong interannual variation has been observed in the numbers of Gabon's nesting leatherbacks, apparently natural cycles but which may be masking a real decline in population size. Sufficient long-term data is not yet available to detect population trends, and threats continue to mount.

Most of the threats affecting sea turtles along the Atlantic coast of Africa are not exclusive to this part of the world, although their accumulated effect makes the situation particularly challenging for the well-intentioned conservationist. Poverty of coastal inhabitants is often associated with the absence of basic infrastructure and services, such as clean water, health care, transportation, and access to basic commodities. Hence, where sea turtles are relatively abundant, they are considered significant sources of food and income, and villagers depend on them to supplement their fishing and crop harvests. In areas with large aggregates, such as green turtle feeding or nesting grounds (Equatorial Guinea, Gabon, São Tome, and Principe), organised market systems have developed around exploitation of meat, eggs, and other products. In addition, commercial fisheries operating in the Gulf of Guinea (many from east Asian and European countries) are thought to incidentally capture a large number of sea turtles in their gear. Overharvesting and damage of marine ecosystems by industrial trawlers may lead to decreases in fish catch by small-scale fishermen and, in turn, lead to greater dependence on other resources such as sea turtles.

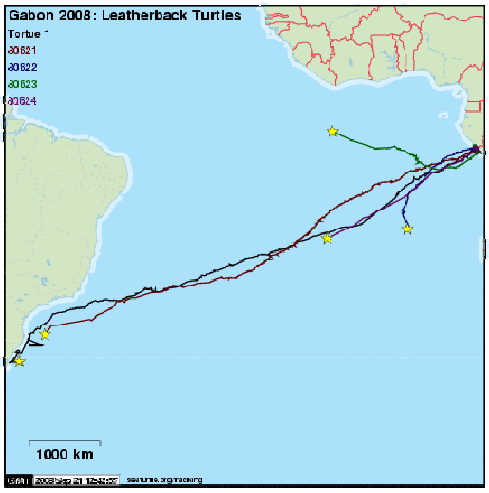
Spatial Scales

As described above, the sea turtle life cycle encompasses numerous different habitats, including terrestrial nesting colonies, nearshore courtship and mating areas, oceanic or coastal migratory corridors, pelagic and neritic developmental

and adult foraging areas, spanning tropical, temperate, and even arctic latitudes (in the case of leatherbacks). Evidence has shown that foraging aggregates tend to be composed of individuals originating from many rookeries, and that site fidelity occurs at both nesting and feeding sites. Vice versa, individuals originating from a single nesting beach may travel to several different foraging grounds. In addition, feeding ground composition may vary within years and between years (Formia et al. unpublished data). As a consequence of this high degree of connectivity, it is difficult to define the range of a nesting population, or to determine the threats impacting it throughout its distribution. Hence, it is perhaps more accurate to speak of metapopulations, composed of a web of links between rookeries, and developmental and adult aggregates.

Research through flipper tagging and satellite and genetic tracking is helping to elucidate the structure of sea turtle metapopulations and to fill in the gaps in the matrix of sea turtle distribution and its overlap with the distribution of threats. The sheer extent of sea turtle metapopulation distributions is extraordinary. One well-known example is Adelita, a loggerhead female fitted with a satellite transmitter and released at her feeding grounds in Baja California (Mexico). She was then tracked during one year over almost 15,000 km across the Pacific to the Japanese coast, where she is believed to have been caught by a Japanese fishing fleet (Grupo Tortuguero, http://www.seaturtle.org/tracking/adelita). Similarly, a leatherback named Zoe is being tracked over 15,500 km along the South American coast in seasonal migrations between Rio de la Plata and northern Brazil (PRICTMA and Karumbé, unpublished data). Thanks to a collaboration between WCS, seaturtle.org, and the University of Exeter, several leatherback nesting females have been satellite-tagged in Gabon since 2006. Two of these were tracked to the coast of southern Brazil, a distance of almost 7,000 km over seven months (**Figure 1**).

Figure 1: Foraging migrations of five leatherbacks followed with satellite telemetry from Mayumba National Park, Gabon. (WCS, seaturtle.org; and Marine Turtle Research Group-University of Exeter. Do not use without permission. http://www.seaturtle.org/tracking/index.shtml?tag_id=80621.)



Satellite tracking as a spatial tool also aids in describing habitat use. For instance, it has shown that post-nesting loggerheads in Cape Verde may exhibit distinct foraging strategies possibly linked to body size, with larger adults foraging in coastal waters and smaller ones oceanically (Hawkes et al. 2006). Since the oceanic feeders are more numerous and more widely dispersed in fishery hotspots, they represent an alarming challenge for conservation. In Gabon, Witt et al. (2008) tracked seven leatherbacks from Mayumba National Park at the beginning of the nesting season to determine their internesting habitat use and found that 62% of their time was spent outside the limits of the park. A seasonal Fisheries Exclusion Zone was thus proposed to better protect nesting females during their internesting interval offshore, offering additional protection for a vast area on the border between Gabon and Congo which is currently affected by intense fishing pressure.

Evidence suggests that sea turtles may follow migration corridors during their post-nesting movements, a behaviour which may, in fact, facilitate the design of protection zones in the open ocean. For instance, leatherbacks tracked from Costa Rica were shown to migrate within a narrow corridor approximately 500 km wide and extending out as much as 2,700 km (Morreale et al. 1996). Similarly, leatherbacks tracked from Gabon appear to converge along certain pathways at higher frequencies than would be expected by chance, from which they then diverge into wide-ranging movements (Witt et al. in review; **Figure 1**). Differential habitat use is not only represented by geographic distribution but also by vertical depth in the water column. For instance, Hays et al. (2004) show that most leatherback dives are less than 250 m in depth, which tends to increase the chance of interactions with long-line fishing hooks.

Different directions of foraging migrations from the same nesting beach have also been shown through mark-recapture methods. For instance, green turtle females tagged in Bioko (Equatorial Guinea) were recaptured in Ghana (northwest of Bioko), Cameroon (northeast of Bioko), and at several sites in Gabon (southeast of Bioko) (Tomas et al. 2001). Hawksbills have been shown to cross the Atlantic from Brasil to Senegal (Marcovaldi and Filippini 1991) and twice from Brasil to Corisco Bay (Equatorial Guinea/Gabon) (Bellini et al. 2000; Grossman et al. 2007). Green turtles move from one foraging ground in Brasil to another in Nicaragua (Lima et al. 1999). In the case of leatherbacks from the Gulf of Guinea, tag returns have come from Brasil, Argentina, Namibia, and South Africa (Billes et al. 2006; Fretey et al. 2007; PROTOMAC, unpublished data), all of them captured by fisheries or stranded-dead onshore.

A third way to assess the spatial scale of sea turtle ecology is through molecular tracking, genetic analysis techniques used to assess the population structure of rookeries and the composition of mixed stocks (Bowen et al. 2005; Formia et al. 2006). We have shown that the green turtle nesting aggregates in the Gulf of Guinea represent distinct management units experiencing limited gene flow (Formia et al. 2006), and that the most important green turtle foraging ground in Central Africa, Corisco Bay (border between Equatorial Guinea and Gabon), is composed of individuals originating from at least nine different Atlantic rookeries (Formia 2002). A tenth rookery contributing to the Corisco mixed stock is Comoros, in the Indian Ocean, almost 9,000 km around the tip

of southern Africa (Formia 2002). In addition, mixed stock analysis showed that almost 50% of the Corisco aggregate consists of turtles from the Ascension Island rookery, almost 2,500 km westward in the mid-Atlantic (Formia 2002 and unpublished data). Significantly, the Ascension population is well protected by strict UK legislation, while there is virtually no protection for these same individuals in Corisco Bay, where they are targeted by traditional and commercial turtle hunting (Formia 2002).

It is difficult enough to attempt to assess the spatial scale of sea turtle metapopulations, their threats, and the areas of highest vulnerability. This overlap becomes even more intricate when threats cannot be pinpointed spatially. Marine pollution, for instance, is seldom attributable to a specific source; identifying culprits and holding them accountable is often unrealistic. While some oil spills can be ascribed to specific activities or accidents, marine debris such as plastic and discarded fishing gear tends to be a chronic and pervasive problem in the world's oceans. Leatherbacks are known to confuse jellyfish and floating plastic bags. A single sea turtle has been found with 1 kg of plastics in its stomach, and another, stranded in the UK, contained in its stomach an entire black bin liner, an American chicken wrapper, and a Spanish sauce packet! The impact of climate change on temperature and sea level rise on sea turtle habitat is still unclear. While it is possible that sea turtle populations may be able to shift their range with climate change (they have, after all, survived several ice ages), undisturbed habitat may no longer be available. Besides, the accumulated effect of current anthropogenic pressures may have compromised their resilience. In addition, since the sex of hatchlings is determined by nest incubation temperature, an increase in sand temperatures may lead to skewed sex ratios at certain latitudes (female-biased) and even hatchling mortality due to lethal temperatures (Hawkes et al. 2007).

Temporal Scales

Sea turtles exhibit long generation times, slow growth, and delayed maturity, and are thus particularly vulnerable to anthropogenic pressures (Crouse 1999a). Temporal scales must therefore be considered when designing protection strategies for sea turtles. As mentioned above, different life stages occupy different habitats, but not all populations of the same species behave the same way; behaviours, movements, and growth rates vary with habitat type and are influenced by environmental fluctuations over time.

There are links between sea turtle ecology and oceanography whose mechanisms are not yet clearly understood. Seasonal shifts in prey availability may affect shifts in foraging behaviour, body size and condition, remigration intervals, and, without doubt, susceptibility to anthropogenic pressures (Witt et al. 2007). Some species, such as the herbivorous green turtle, are more sensitive to environmental stochasticity due to their diet and trophic status, exhibiting greater variability in reproductive output and interannual nesting numbers (Broderick et al. 2001; Broderick et al. 2003). In Gabon, the observed interannual variation in nesting leatherback numbers may be caused by variable conditions at the feeding grounds, affected in turn by global weather patterns (such

as the southern Atlantic oscillation). One of the consequences of this temporal variability is its potential for masking population trends. Hence, assessing the conservation status of a population becomes more difficult and long-term monitoring essential.

Differential mortality of life stages may have particularly grave consequences in long-lived and slow-growing sea turtles, impacting population viability and its ability to recover. In the case of high juvenile mortality, for instance, large adults might temporarily replenish a population, giving the mistaken perception of stability, but decreased recruitment would eventually lead to a sudden crash (Crouse 1999a). In the case of Caribbean hawksbill turtles, population modelling has shown that benthic (large) juveniles and adults must have high annual survival rates in order to maintain population sizes, especially in view of the high mortality of eggs and pelagic juveniles (Crouse 1999b). A similar situation occurs in loggerheads, where protection of large juveniles may be more effective in maintaining population numbers, rather than the egg and hatchling stages that are more commonly targeted for protection (Crouse et al. 1987).

As mentioned above, threats to different life stages lead to different population survival impacts. In Terengganu (Malaysia), 100% egg poaching over a number of years is thought to have caused the decline of the leatherback nesting population from more than 3,000 nesting females in 1968 to the present-day 0 (Spotila et al. 1996). In Gabon and Congo, strandings due to trawl fisheries bycatch tend to affect mainly adult olive ridleys, often males. Nothing is known about demographic parameters and survival rates of the population, so it is difficult to determine how sensitive this life stage is, how mortality will impact viability, and the time lag before it becomes evident. Indeed, it is possible that beach protection and maximisation of hatchling production may not be sufficient to stop population decline. Bycatch reduction, through the establishment of area or seasonal fishing zones or the installation of Turtle Excluder Devices (TEDs) in nets, may be more effective management actions.

It is clear that different management strategies are necessary for different life stages. However, due to the difficulties of estimating population size, status, and structure, sea turtle conservation often lacks a direct measure of success for its various protection efforts. Data-gathering to detect decline or recovery of a population, or even information on long-term cycles, must occur at temporal scales that make biological sense, hence at least one turtle generation. But inevitably these timeframes tend to outlast most grant periods for research funding and even most governments.

Finally, if we are to consider sea turtles on an evolutionary time-scale (after all, they have inhabited the earth for 100 million years), we must tackle the concept of the shifting baseline. Historical data shows a great abundance of large consumer species in coastal ecosystems in the past, such as sea turtles on seagrass beds (Jackson et al. 2001). In fact, it is fabled that Christopher Columbus walked ashore by stepping on turtles' backs! Humans have altered these systems to such an extent that we no longer recognise the magnitude of the losses, skewing our perception of the baseline to strive for toward recovery. Even in Africa one of the most common justifications of turtle hunting is "they won't run out, they cannot, there has always been many"; the sea is perceived

as a never-ending resource (Pauly et al. 2000). However, sea turtles are commonly taken as bycatch by the world's fishing fleets in great numbers (Wetherall et al. 1993), as they tend to frequent the same areas as fishing fleets, often in search of the same prey. Lewison et al. (2004) calculate that as many as 200,000 loggerheads and 50,000 leatherbacks were caught in one year alone by global pelagic longlines. Sea turtles are incidental victims of overfishing in the global commons, targeting high-demand species such as tuna, shrimp, and swordfish. Even historical perspective on past stock abundance is apparently not compelling enough to change current fishing practices.

In Gabon, although aerial surveys have shown that approximately 77% of nesting occurs within the system of protected areas (Witt et al. in review), and although this protection is largely effective against poaching, sea turtle managers still face a difficult quandary. Traditionally-conceived protected areas, even marine ones, will only ever be able to address a relatively limited portion of the problem. Conservation efforts too often focus on the more easily accessible life stages, implementing measures that sometimes confuse natural with anthropogenic mortality, sometimes fixing a human-induced imbalance by reducing natural mortality, and potentially interfering with long-term population fitness. On Gabon's nesting beaches we are protecting only 1% of the turtles' life cycle. Having attained this goal, our priorities must now shift to address mortality at sea, to identify oceanic hotspots, either within Gabon's territorial waters, or other areas where Gabonese turtles migrate (Hays 2008). It is essential to also describe the overlap between turtle distribution and threats, refining this analysis temporally and spatially, as well as understand more about the differential sources of fishery threats (Caillouet et al. 1996; Camiñas et al. 2006; Wetherall et al. 1993).

Governance

Conservation of marine turtles can be summarised as relating to three main governance scales. Firstly, the local coastal community plays a small-scale role on its nesting beaches and artisanal fishing areas and is often responsible for local exploitation and habitat disturbance, although wider market demand or development forces may also be at play. The key managers at this scale include local authorities, fishermen, park managers, NGOs, and villagers of all ages. Conservation at this scale is perhaps the easiest to implement; many projects today are based on involving communities in the stewardship of their natural resources. Successes are often immediately visible and measurable in decreased egg poaching, increased hatching success, or fewer captures. At this scale it may not matter whether national protective legislation is in place, because local authorities and villagers themselves can be empowered to take control in managing resources. However, due to its very nature, this level of conservation is relatively powerless outside the local scale. Also, it can be argued that the terrestrial small-scale successes may not be sufficient to halt the decline of a population whose threats range over vaster scales. In addition, community participation is often dependent on economic means, and turtles are often used as sources of food or income when no alternatives are available.

Because turtles invariably move through the sphere of influence of many different communities in their lifetime, management must coordinate and integrate among them (Frazier 2004); unilateral solutions can only have limited success (Frazier 2002). The national-scale focuses on the terrestrial sphere, territorial seas (12 nautical miles), and Exclusive Economic Zone (EEZ, 200 nautical miles). The forces active here include national governments, commercial fisheries, oil companies, mining companies, developers, as well as NGOs and other international organisations. In Gabon, the government has national responsibility over the largest leatherback nesting population in the world. But all governements are subject to economic interests and influence, such as development aid offered in exchange for resource rights (often without prior assessment of available stocks); economic rather than biological imperatives are often given priority. Exploitation itself is often not quantified accurately, enforcement agencies are scarce and ill-equipped, and high levels of turnover limit accountability. Coastal trawling and pelagic longline fisheries, for instance, are thought to be particularly damaging for sea turtles, with high levels of discard of non-target species and lack of compliance with many regulations, including fishing zones and park limits. However, their actual impact is almost entirely unknown.

But the picture is not all bleak. Government actions can lead to effective large-scale protection. Gabon created 13 national parks in 2002, four of them coastal or marine, protecting 11% of the national territory. The potential for trans-border treaties with neighbouring Congo and Equatorial Guinea to enhance protection is being explored. Gabon's government has also signed several international conventions concerned with endangered species, some legally binding. Governmental and non-governmental organisations are working together to develop new legislation and strengthen the implementation of existing legislation, including fishing zones and closed seasons, construction regulations, antipollution laws, bycatch mitigation, enforcement of standards of environmental impact, and mitigation for natural resource use. A pilot study recently was successfully completed testing the use of TEDs on Gabonese trawlers.

The third jurisdictional level relevant to sea turtles is concerned with international waters, i.e., the high seas outside national sovereignty. Wold (2002) reminds us that "no rule of international law and no single international environmental agreement adequately protects sea turtles… The migratory nature of sea turtles is at the heart of law's failure to protect them." In fact, according to international law (a norm known as Permanent Sovereignty over Natural Resources), while states have sovereign rights to use natural resources within their territories, on the high seas no state has sovereign rights, and thus all states have the right to exploit all species, which are the property of no state (Wold 2002). The tragedy of the commons appears fully relevant, but assessing the impacts of practices in the open seas is difficult at best. Several economically important fish stocks have already crashed and been replaced, and the drastic leatherback decline in the Pacific has been attributed almost entirely to bycatch mortality due to longline and gillnet fisheries (Spotila et al. 2000). However, there is some cause for hope. Consumer pressure and public opinion worldwide have been successful in the past at demanding certification for low-impact fishing. In addition, bycatch reduction methods have been researched and are

being implemented, including the use of circle hooks instead of J-hooks in longlining, fishing at depths greater than 40 m (turtles spend most of their time above this depth), and TEDs. The United States recently won a World Trade Organization ruling to ban exports of shrimp from any country which does not utilise TEDs.

Controversy has recently arisen regarding the acknowledged need to establish marine reserves in international waters. In addition to the countless legal ramifications generated by such a proposal, the issue centers around which international body would be entrusted to manage high seas marine reserves. One alternative is the Regional Fisheries Management Organisations whose primary goal is to manage fishery activities, including high seas resources, highly migratory species, and straddling fish stocks, but who have also acknowledged the ecological impacts of fisheries and bycatch (Bache 2002).

The other entity regulating international waters is the 1982 Law of the Sea Convention (UNCLOS), which says that a state must use the resources of the high seas consistently with the interest of other states and must conserve the living resources of the high seas. With respect to bycatch (described as "species associated with or dependent upon harvested species"), states must take measures designed to maintain or restore these species "above levels at which their reproduction may become seriously threatened" (Wold 2002). Although UNCLOS is relatively promising in this respect, Wold (2002) reminds us that "the seas are vast and no State has the authority to enforce a conservation obligation on the high seas." While states can enter into voluntary international treaties and agreements regulating resource use, "the fundamental legal status of the sea turtles as property to be exploited by the individual States remains unchanged" (Wold 2002).

One of the international agreements relevant to sea turtles in Africa is the Memorandum of Understanding (MoU) concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa, under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and signed to date by 23 African states. Its objectives are to endeavour to put in place strict protection of marine turtles, including any necessary legislation, and the implementation of a conservation plan with the aim "to improve basic knowledge of species and migration routes, reduce mortality of marine turtles, enhance co-operation among Range States and secure funding for the initiation and/or continuation of conservation programmes." One advantage of this MoU, if not its political clout and implementation (it is non-binding and funding has not been made available to undertake relevant country conservation initiatives), is that it forms a framework within which to structure regional conservation efforts on wide geographic scales and provides standardised guidelines for implementation of sea turtle initiatives in each country.

There are numerous other international conventions and treaties relevant to sea turtles: the CMS is a global intergovernmental treaty concerned with the conservation of migratory species and the habitats on which they depend (Hykle 2002). There are also the Convention on Biological Diversity, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Inter-American Convention for the Protection and Conservation of Sea Turtles,

etc. In fact, there are so many, and international law is so convoluted, that it sometimes even "defies the comprehension and consensus of specialists" (Frazier 2002), and the result is sometimes management paralysis.

Conclusions

Many mechanisms and triggers inherent to sea turtle biology are still unknown: how they find their rookery of origin after decades at sea, how they navigate as hatchlings or adults, what is their natural sex ratio, and how they will respond to climate change. So how can conservationists make management decisions when so much is still unknown, and relevant temporal and spatial scales so vast and ill-defined? Even population sizes and status are the subject of heated debates, ongoing within the IUCN Marine Turtle Specialist Group. Sea turtles are so ill-suited to the rigid criteria for Red List assessments that it was suggested that these criteria be drastically revised, or that assessments become regional rather than global (Seminoff and Shanker 2008).

In addition, environmental awareness, the concepts of finite natural resources, and the importance of protecting biodiversity for future generations are not widespread in West and Central Africa. In fact, relevant authorities have only very recently become aware of the presence of sea turtles along their coasts. Generally, governments along the Atlantic coast of Africa have inadequate regulatory legislation focusing on environmental issues, and enforcement of species protection laws is often scarce or absent. In addition, sea turtle conservation initiatives may be precluded by difficulties in establishing safe, long-term projects and enforcing national legislation, or by shifting pressure on natural resources. Many countries where endangered sea turtle populations occur are also areas of internal social and political strife. This is often associated with and fueled by greed and wreckless exploitation of natural resources by profit-driven individuals or companies with relative impunity and disregard for natural equilibria. Displaced populations from the interior will sometimes settle along the coast and increase pressure on coastal and marine resources such as sea turtles. Many countries are ruled by authoritarian regimes; human rights violations, corruption, and ethnic and political oppression are widespread; oil-generated wealth (or wealth from exploitation of other resources such as timber) has not yet filtered through to the majority of people. In many developing countries, conservation initiatives must operate within the daily constraint of coastal inhabitants needing the sustenance provided by the species being protected. It is essential that any proposed protection measures be associated with campaigns stressing the socio-economic benefits of conservation and of sustainable use of natural resources, as well as initiatives providing viable, sustainable livelihoods. The latter is often too easily ignored in favour of blanket bans on exploitation of threatened resources. Seed funds and expertise are seldom available to set up stable alternatives and bring basic services improving the quality of life.

In conclusion, beyond the specifics of endangered species or ecosystem protection, it is essential for governments to address internal issues of corruption and political instability and to work toward economic and social well-being. Due to short-term political and economic pressures, governments often do

not prioritise conservation on their agendas. And while local people are often driven by poverty to exploit resources in already scarce supply, fisheries in international waters view resources as a property they have a right to exploit. The paradox, therefore, seems to be that it is only through international instruments that conservation can be implemented at all levels of scale, from local to international. The challenge now is addressing this scalar mismatch (Campbell et al. 2002), and the fact that international bodies or conventions tend to be so far removed from the ground that they are often perceived as ineffective or irrelevant (Tiwari 2002).

Who will take responsibility for our shared sea turtles? According to Frazier (1990), "the inhabitants of a territory, or even 'the government in power,' may not be the deciding factor in establishing patterns of resource utilization in an area. Sovereignty is basic to conservation, for obviously those who use and control natural resources must be involved in their conservation. But in reality the concept of sovereignty is incredibly complex because of the intricacies of national and international relations. It is unrealistic and irresponsible to simply assume that the sovereign power of a resource can be looked up in an atlas." The issue is particularly complex when, as in the case of turtles, temporal and spatial scales are so vast, species decline is not clearly attributable to clear causes, and there is often no direct accountability for the sources of threats, or an obvious management authority responsible for implementing conservation. Perhaps, as Hardin (1968) suggests, the only viable solution is the closing of the commons; we must find the courage to do this.

PART 6: WCS CASE STUDIES—TRANSLINKS

6.1 Governance of the Global Carbon Market: Does Scale Matter?

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Introduction

The growing carbon market combined with the proposed policy mechanism known as Reducing Emissions from Deforestation and Degradation (REDD) could represent an opportunity to establish a new type of forest protected area that would conserve large blocks of tropical forest through sustainable financing. Although wildlife conservation is not the primary goal of these new forest carbon reserves, the habitat of many species of flora and fauna found in biologically rich tropical forests could be protected through these measures. However, a significant challenge to making the vision of such sustainably financed forest carbon protected areas a reality involves developing governance systems to manage investors' risks across ecological scales.

Background

Tropical deforestation accounts for approximately 20% of global carbon dioxide emissions (Houghton 2005a). For this reason, considerable international momentum has grown around creating emissions reductions credits from carbon sequestered by forests or stored in forest biomass. Payments for emissions reductions resulting from avoided deforestation, reforestation, and afforestation activities are now established and growing primarily through the voluntary market.1 Through these payment mechanisms, emitters of carbon dioxide pay project developers to plant trees for carbon sequestration or to refrain from deforestation so that carbon stored within forest biomass will be conserved rather than released into the atmosphere as carbon dioxide. Such payments could represent a significant source of funding for forest restoration and conservation of vast stretches of tropical forests in poor countries, where resources for forest management are often lacking and/or inconsistent. It is

Credibility, Leakage, and Permanence

Credibility: Investors seeking to offset emissions through afforestation, reforestation, and/or reduced deforestation want to know that their emissions reductions are credible and thus desire a clear sense of the quantity of emissions reductions that have occurred in a particular investment location due to their payments. Generally, the planned planting of a known number of species in afforestation/reforestation activities leads to more precise estimations of biomass/carbon content than estimates of carbon conserved from avoided deforestation activities because it remains difficult to estimate biomass across large forest areas (Houghton 2005b).

Leakage: Leakage refers to the possibility that payments for forest carbon sequestration and/or storage succeed in the target area, but do not alter the underlying drivers of forest clearing, and so may simply shift forest loss from the project area to another location. Thus, leakage may undermine the credibility of emissions reductions if activities in one place displace and/or increase pressures to another landscape, region, or country because net global carbon dioxide emissions have not truly been reduced.

Permanence: Permanence refers to how long emissions reductions resulting from an investment will last. The underlying question is whether lowered emissions rates in one year are likely to result in raised emissions rates in a future year (suggesting an impermanent reduction), or whether the reduction will lead to permanently lower levels of carbon dioxide in the atmosphere (Myers 2007).

thought that the regulated market for forest carbon will significantly increase if avoided deforestation is accepted as a credible source of emissions reductions through the adoption of a policy resembling REDD in a post-2012 international climate agreement. However, selling forest-based carbon as an emissions reduction is a challenge, as the markets are relatively new and the risks to investors are largely unknown. For markets to work, investors must both understand the risks associated with buying forest carbon as a certifiable emissions reduction and feel that those risks can be managed (Peskett and Harkin 2007). In turn, it is also important for potential sellers of emissions reductions associated with forest carbon to understand these risks so that risk mitigation measures can be incorporated into project design at an early stage of development.

Key Investor Issues

Typically, a purchaser of emissions reductions is seeking *credible* sources of emissions reductions that have *permanence* and do not cause *leakage* (Peskett and Harkin 2007). These issues are among key sources of risk in the purchasing of forest carbon credits[2] and are linked to the ecological scale at which carbon is being sold and the governance structures that are in place to manage the forests where carbon is stored or sequestered. These three issues do not comprise an exhaustive list of risks or challenges associated with forest carbon as a tradable emissions reduction unit, but provide a foundation for the examination of how ecological scale and governance structures may interact to influence risks faced by buyers and sellers participating in these nascent markets. This paper will outline ecological scale and governance issues related to these risks, present three

case studies in which emissions reductions from forest carbon have been sold at varying spatial and temporal scales, and explore how different governance mechanisms have been put in place to manage risks unique to each project.

Risks and Spatial Scale

Risks associated with the credibility of emissions reductions, in avoided deforestation projects particularly, are largely associated with the spatial extent of the forest. Mean biomass of a large forest block is typically extrapolated from a few small survey plots using a range of different assessment methods (Houghton et al. 2001), making it difficult to get a representative sample necessary for deriving an accurate estimate of mean forest biomass. Furthermore, often a variety of assessment methods are used across surveys, making it difficult to compare measurements across sites or throughout time. These uncertainties may be amplified at coarser spatial scales where variations in topography, climatic gradients, and other variables that influence forest biomass may increase.

Although increasing spatial extent of a natural forest may introduce a certain degree of uncertainty in biomass estimates, the permanence of emissions reductions may be more secure with larger spatial extent due to higher resiliency to certain stressors, such as fire or storm damage, since larger forest blocks may be less likely to be completely destroyed when natural disasters strike. However, regardless of forest size, when selling forest carbon, setting aside a proportion of forest as a buffer for insurance purposes is a useful way to reduce risks.

The spatial configuration of the forest block is also important for promoting the permanence of emissions reductions. For example, Laurance et al. (1997) showed that large trees near the forest edges were much more prone to biomass collapse through dying and falling over than those within the forest interior. Adjacent land uses are also likely to exert a strong influence on the permanence of woody biomass. Permanence of an investment may be more threatened in a forest surrounded by pastures that are burned annually when compared to a landscape dominated by tillage agriculture, where burning is not a threat. Thus, all other things being equal, investors may reduce risk by buying carbon in forest areas with less edge and/or surrounded by a landscape that poses lower degrees of threat.

Leakage management requires understanding the nature and scalar dimensions of the pressures acting upon a forest. For example, landscape-scale threats to forest cover such as slash and burn agriculture may be managed at the landscape scale by supporting alternative agricultural practices locally, thereby reducing deforestation without encouraging displacement of people or pressures elsewhere. At coarser scales, referred to as market-based leakage, leakage may be more difficult to identify and manage. For example, smallholders may be paid by carbon investors not to convert their forest lands into oil palm plantations locally, which may simply divert a biofuel company to develop a plantation in another region or country. Such a displacement of emissions is difficult if not impossible to control by forest carbon project developers working at a local scale. Generally, large-scale forests may face more risks related to leakage, due to the higher number of people, stakeholders, and competing uses that may

be affected by the project. Thus, as an investor it would be important to have a clear understanding of the variety of threats facing forest carbon in a project area and the spatial scale at which they act so it is possible to determine if leakage can/will be managed by proposed project activities. Ultimately, leakage is a very difficult property to define and prove beyond the landscape scale, and thus, risk management may require contracts to relinquish investors or sellers from responsibility for leakage that occurs beyond the scale at which they are able to exert influence.

Risk and Temporal Scale

Credibility and permanence of emissions reductions of an avoided deforestation, reforestation, or afforestation contract are determined largely by the temporal scale at which forest ecosystems are affected by both natural and anthropogenic factors. Like any investment, it is unlikely that the value of carbon in forest biomass will be constant over time even in the absence of human pressures. In fact, understanding of the temporal dynamics of forest biomass is still relatively poor (Houghton 2005b), even though it is often assumed that total above ground biomass oscillates minimally around a long-term average due to the balancing processes of death, decay, and regeneration. Yet recent studies in the tropics have shown that this is not necessarily the case (Hoshizaki et al. 2004; Chave et al. 2003). In both studies, researchers found more death than recruitment in the largest size classes, the stems with the highest biomass and carbon content. These natural fluctuations in biomass are amplified by potential changes in biomass that may occur due to anthropogenic pressures and/or climate change.

Governance for Managing Risks across Scales

Good governance—a process where groups of actors negotiate decisions and enforce their implementation—plays a central role in managing sellers' and buyers' risks. With a growing number of projects in the voluntary market it is becoming clear that a range of types and combinations of governance mechanisms, structures, and actors working across spatial and temporal scales are necessary for markets to function effectively and result in emissions reductions.

One of the first and most fundamental questions to ask when investing in forest carbon as an emissions reduction credit is: Who owns or manages the forest and its carbon? In many tropical developing countries, the owner and the manager of the land often are not the same, as national governments may own the forest but communities may collectively manage it. This is problematic for an investor, who may not want to directly pay the national government and risk that the payments for carbon conservation get lost in government treasuries rather than reaching the stewards of the forest, who more directly affect its management and conservation. Although certain risks may be diminished by directly paying forest stewards, if the "sellers" consist of multiple villages living around community forests, governance risks might increase with increasing spatial extent if a buyer must interact with a higher number of sellers and collective-culpability mechanisms are not in place to promote group compliance with contract conditions.

There clearly are risks of paying national governments, especially in tropical developing countries where capacity, and at times desire, to enforce contract law may be low. However, managing risk associated with permanence and leakage will, in most cases, require national government involvement. Typically, governments have a longer time horizon for decision making than households, indicating that a contract between buyers and sellers with a maturity date of 30 or more years might be more secure with government enforcement. Additionally, national government involvement may be critical for preventing leakage within the country through the maintenance of a national-scale carbon accounting system. This is particularly important when households or communities may not have the resources or capacity to manage leakage beyond the extent of their villages or districts. Finally, the national policy context of the country will largely determine how viable and secure an investment will be. If carbon finance through forestry activities reinforces the government's existing environment and development objectives, rather than running counter to them, then the investment is likely to be more secure because of government support.

Third parties or intermediaries are also playing an important role in the governance of the voluntary carbon market by monitoring and certifying forest carbon content, brokering deals, and supporting activities that decrease pressure on forest resources. For example, many concerns associated with uncertainties surrounding credibility can be diminished by contracting internationally recognized organizations such as WinRock International to conduct forest biomass inventories and assessments of deforestation using a standardized set of methods. Additionally, obtaining internationally recognized certification verifying that certain protocols and standards have been met at various stages of project design may further minimize investor concerns. Groups like the Voluntary Carbon Standard (VCS) and the Climate, Community, and Biodiversity Alliance (CCBA) have developed such standards for voluntary carbon projects that can be applied to forestry. The former can be used for any type of voluntary emissions offset project, while the latter is designed for land-use projects that support community development and biodiversity conservation while achieving emissions reductions.

As the following case studies demonstrate, the type and combination of governance mechanisms involved in a project will largely be determined by the nature of the emissions reductions activities and the scales at which they are delivered.

Case Studies

"Carbon Farming" in Busheyni, Uganda: Individual Carbon Sales

In June 2003, 31 small-scale land owners living in and around the town of Busheyni, Uganda, entered into an agreement to plant native trees on their land in exchange for payments for the carbon sequestered through afforestation (Orrego 2005). To qualify for the program, farmers were required to verify ownership of at least one hectare of land. The contract was between individual landowners and EcoTrust, a Ugandan non-governmental organization (NGO). Each contract stipulated that participating farmers must maintain trees on their land for at least 10 years, but during that time, activities not directly influencing

tree carbon content under the forest canopy, such as the grazing of goats, would be allowed. Only 90% of the carbon sequestered on each plot is sold, with 10% set aside for insurance. However, for plots of a few hectares in size, this buffer does not significantly reduce risks from large-scale disturbances such as fire or disease outbreak. The project has been certified as a Plan Vivo project, which signifies that a particular system and set of standards has been followed for developing the project with respect to creating land use plans, assessing carbon value, and developing monitoring programs. Sixty percent of the total carbon payments go to the farmer, while the remaining 40% go towards project administration and technical support. The payments are based on a carbon value of $8/ton and are distributed over a 10 year period, based on project performance assessed through regular monitoring by EcoTrust. The first payment is equivalent to 30% of the total payment owed to each farmer and occurs once the land is planted; 20% is to be paid a year after the planting; 20% is to be paid in year 3; an additional 10% is to be paid after year 5; and the final 20% is to be paid after year 10. Payments stop if there is tree mortality or the carbon is lost by fire or other unforeseen causes.

Permanence and leakage: Assuring permanence in the face of natural threats for the life of the contract within such small lots could be a challenge since a fire from an adjacent agricultural field could destroy the whole wood lot and release the carbon it had sequestered. Furthermore, the farmer can cut the trees at the end of the project cycle and sell them for timber or other purposes; thus, emissions reductions resulting from project activities are not permanent. All of the tree species planted for payments are native and chosen by the community and third-party technical advisors. However, many of the trees may not be cut for several years after the project payments stop at year 10 because they will not have reached a size that would generate maximum profits for timber. Beatrice Ahimbisibwe, one of the pioneers of "carbon farming" in Busheyni, is using the trees she planted for carbon as her retirement fund. She is willing to receive modest payments for the carbon stored in her trees in the short-term now through the voluntary market mechanism, with the expectation that she will receive much higher payments from timber sales of the trees when the contract comes to an end (Bayon 2005).

Within the Plan Vivo system, projects must demonstrate that they have addressed and managed leakage for a proposal to be certified. Thus, most of the leakage risks have already been resolved when payments begin. In this case, as the land where tree plantings occurred is privately owned and can still be used for other activities, the risk of leakage is relatively low.

Governance: The governance structures involved in a Plan Vivo project typically rely on existing structures and policies while emphasizing host-country leadership in the project. Plan Vivo projects provide a guarantee to investors that a project has been developed using a particular protocol and has met a suite of standards and requirements such as land ownership (Orrego 2005). In the Busheyni example, the Ugandan NGO EcoTrust was chosen as the project administrator and trust fund manager because it was already working on

rural environment and development issues in Uganda and in Busheyni specifically. Working with a local, trusted intermediary, such as a host-country NGO, for liaising with communities, organizing training, and managing funds has proven to be a critical component in the success of the project. Furthermore, in Busheyni, the 31 farmers who were a part of the first phase of the project were already involved in community agricultural cooperatives and other community groups prior to the Plan Vivo project. These pre-established networks have been especially useful and effective for disseminating information and maintaining communication with farmers engaged in selling of carbon. Another critical element to the success of this project was that project activities were complementary to national policy. In Uganda, Plan Vivo worked with the local forest department to develop a tree nursery because this was already a part of the department's existing mandate. In addition, the project fit within the larger context of a national policy on environment and development activities.

Risk factors: Certification as a Plan Vivo project helps mitigate investor risks, as it signifies that certain measures and standards have been applied to the project related to permanence, leakage, and governance. Additional risk reduction strategies in this project included leaving aside 10% of the carbon that could be sold as insurance, even though this may not significantly reduce some potential risks on small farms. Furthermore, structuring payments throughout time reduces risk as each payment is conditional on continued compliance with the contract (i.e., the presence of trees on the woodlots).

Makira: Carbon Conservation at a Landscape Scale

The Makira Forest is located in the northwest portion of Madagascar and, until recently, was the largest unprotected humid forest in the country. Over the last decade, the Wildlife Conservation Society (WCS) and other conservation organizations have been working to explore ways to finance the conservation of these forests. In 2001, a USAID-funded study explored the feasibility of conserving the Makira forests through payments for carbon stored in the forest's biomass (Meyers 2001). Several years later, this idea is becoming a reality. To date, the equivalent of 40,000 tons of Makira carbon have already been sold as carbon offsets in the voluntary market. An additional 9,486 ha will be protected from deforestation through conservation and livelihood activities resulting in 9.1 million tons of CO_2 equivalent that can be marketed as emissions reductions in the near future. Payments from an imminent sale would go towards managing the Makira Forest Protected Area Project, supporting rural development activities, monitoring, and establishing a national carbon accounting registry. The total size of the forest that will be protected through carbon financing is 401,000 ha (Holmes 2008, pers. comm.).

Permanence and leakage: In Makira, emissions reductions from avoided deforestation have been calculated for a 30 year period (Martin et al. 2004) and are predicated upon reducing deforestation from a rate of 0.15% per year to 0.70 % per year. Because this is an avoided deforestation project, rather than

tree planting, the permanence of these emissions reductions will depend on regulating human pressures to ensure that the estimated amount of forests remain intact throughout the life of the contracts with future investors. Thus, supporting sustainable land management practices that decrease pressure on the forests and create alternatives to forest-dependent livelihoods is a primary strategy being pursued by WCS for supporting long-term emissions reductions in parallel with conservation. The large spatial extent and varied topography of Makira provides a natural insurance mechanism against natural disturbances and climate change, which are not a significant risk in an avoided deforestation project of this size.

The large spatial scale of the project could mean, however, that there is a higher variability in biomass across the forest and, thus, potentially less certainty in measurements of total carbon. WCS is managing the uncertainty surrounding this issue by contracting WinRock International to conduct assessments of forest carbon content using an internationally recognized suite of methods and by applying for CCBA and VCS certification, which also requires that certain methods have been used for estimating forest carbon content and that leakage management provisions have been developed. The support for sustainable land management activities of communities in the areas immediately surrounding Makira is a primary way that leakage risks are being managed by the project.

Governance: In contrast to the project in Busheyni, the issue of whom to pay for emissions reductions is more complicated in Makira, where the forest has historically been used by multiple rural communities surrounding it (*de facto* tenure*)* but is owned by the national government (*de jure* tenure). Recently, the government pursued a national policy of devolving management authority of forests to local communities. Currently, the newly formed community-based governance structures surrounding Makira have a three year contract with the national government to co-manage (with WCS) the landscape that buffers the boundary of the Makira conservation project. At the end of three years, this contract may be renewed depending on how well the communities have managed their resources and upheld their obligations under the contract. WCS has an agreement with the government to manage the Makira protected area and to market the carbon credits generated from avoided deforestation. In turn, the government may use the funds to develop a national strategy for forest carbon, which could support leakage management at a national scale.

Within the proposed contract between WCS and the national government to sell emissions reductions, the distribution of payments has been designed to reduce risk by ensuring that different parties receive appropriate incentives to conserve forest carbon at their different scales of influence: 50 % of the funds will go towards community activities for promoting sustainable natural resource management practices; 25% will go towards protected area management; 2.5 % will go towards third-party verification and monitoring; 5% will go towards marketing of forest carbon; 2.5 % will go towards management of the funds; and 15% will go to the national government's Minstry of the Environment for strategic development.

Risk factors: In many respects, the design of the Makira Forest Protected Area Project based on carbon financing is a low risk project from both the seller and the investor perspective. Although the estimated amount of carbon stored in forest biomass may be less accurate than was possible with the type of project developed in Busheyni, the high carbon content of an old growth forest combined with verification from WinRock and a pending CCBA certification may temper investors' sense of risk. The large spatial scale helps insure permanence in the face of natural disasters by acting as an effective form of insurance against natural stressors and provides a buffer for low levels of deforestation that can not be completely eliminated. Furthemore, a portion of the avoided deforestation emissions reduction credits are not being sold so as to be set aside as a buffer. Leakage risks are minimized by strong government support, as this effort is complementary to a national policy aimed at expanding the country's protected area coverage to encompass 10% of the island's land surface and generate a sustained stream of "green" financing.

Guyana: National Scale Carbon Sales

Recently, in an effort to conserve Guyana's 50 million acres of rainforest, President Bharrat Jagdeo offered management rights of the country's forest to the British government in return for funds to support conservation and sustainable development in the country (Howden 2007). One of the challenges in attracting forest carbon investors to Guyana has been the low historical rate of deforestation in the country, meaning little additionality would result from the purchase of carbon offsets. Although there have been multiple negotiations on this proposed deal to date, no formal arrangement has been made between the two governments. However, an investment has been made by Canopy Capital, a British company. This deal is not directly an official part of President Jagdeo's offer, but may be a precursor to how deals envisioned by the president may look in the future.

The investment by Canopy Capital was not an actual purchase of emissions reductions, but a license permitting the company to sell multiple ecosystem services, rather than just carbon, (Canopy Capital 2008). The partnership is based on an agreement that requires Canopy Capital to make an annual payment to the Iwokrama Institute for Conservation (IIC), which manages approximately 370,000 ha of Guyana's forests on behalf of 700,000 forest dwelling communities. The contract allows Canopy Capital to measure, value, and market the ecosystem services of the forest over a five year period. If the forest suffers significant degradation through natural or human induced causes during the life of the contract, Canopy Capital can suspend its payments and, similarly, the IIC can suspend the contract if Canopy Capital does not meet its obligations. Approximately 90% of any ecosystem service sales will go back to the IIC for rural development and forest conservation activities, and the remaining 10% will go back to Canopy Capital. Although Canopy Capital now has the rights to market the ecosystem services provided by the rainforest over the next five years, they do not have rights to the land.

Permanence and leakage: Loss of the ecosystem services generated by the 370,000 ha of forest leased by Canopy Capital is unlikely because of the large spatial extent of the forest, the short-term nature of the contract, and the historically low rates of deforestation in Guyana. To deal with possible leakage issues, approximately 50% of the area has been set aside as forest that is to remain strictly conserved. Within the remaining 50% of the forest (approximately 185,000 ha), highly selective timber harvesting is permitted which is estimated to represent a total annual removal of less than 1% of the entire forest area. The degree and nature of selective timber harvesting in this area was certified by the Forestry Stewardship Council (FSC), an internationally recognized certification for sustainable forestry practices.

Governance: The national government is not involved in this sale, although the national policy environment is supportive of the investment. The deal is between Canopy Capital and the IIC, not the local communities. The Makira example also involves a third party as a broker; however, checks and balances are insured by integrating multiple parties into various contracts associated with managing the forests and developing a payment structure that distributes funds across multiple parties. Due to the bi-lateral nature of this agreement between Canopy Capital and IIC, there may be some risk resulting from the fact that local communities are not involved in the transaction, and thus, that the selling of services may not be in their cultural interests or contribute to their economic welfare. Integrating the participation of communities who are the stewards of a resource is a key way to reduce investment risk. However, external governance structures and international standards are invoked through the IIC structure, which has an international board of trustees, and through the FSC certification.

Risk factors: There are several ways in which risk is being managed across this project. First, the selling of multiple ecosystem services hedges risks associated with a decline in any single ecosystem service or changes in unpredictable ecosystem service markets, like the carbon market. The coarse spatial scale, short temporal scale of the contract, and low rates of national deforestation significantly reduce risks of impermanence. Leakage is not a considerable risk because there are very low deforestation pressures in the reserve, and 50% of the forest can still be used for selective harvesting, as certified by FSC, which confers international standards on the project. The arrangement reflects national-level policies, which reduces risk of competing land use practices such as biofuel development. Overall, it is a low risk project for the investor and the seller since it does not require significant changes in the way resources are currently being used, and either party can withdraw from the contract if obligations are not being met. It is an especially low risk agreement for IIC because they are essentially being paid to do what they were doing prior to the deal, managing the forest resources, but for which they did not have sufficient funding.

Conclusions and Summary

Risk mitigation is a key issue for investors purchasing emissions reductions from forestry-related activities and will be of heightened concern once emissions reductions from avoided deforestation are accepted within the regulatory market. Like any investment, forest carbon investments are risky but may be more so than other sources of emissions reduction credits for which it may be more straightforward to quantify and manage risks. Thus, understanding how risk related to credibility, permanence, and leakage varies with ecological scales and how governance structures (in the forms of institutions, certification, contracts, partnerships, and local, national, and international policy mechanisms) can be put in place for managing those risks will be a critical part of securing investments within the forest carbon sector.

As the case studies have demonstrated, many different types of governance mechanisms are being deployed to sell carbon from forest based activities. Farmers, community groups, governments, third-party brokers in the form of NGOs or the private sector, and forestry consultants and project certification programs are working together across spatial and temporal scales to make emissions reductions from forest carbon lucrative investments that achieve the desired objectives of climate change mitigation. Incorporating multiple levels and types of governance may help increase transparency and insure internationally recognized standards are met, but may also decrease the efficiency of deals and reduce payments available for individual stakeholders. Clear ownership of forests and carbon, prior experience in collective governance of natural resources, and supportive national policies are all factors that may help attract investments in voluntary carbon markets. This was the case in Busheyni, where project organizers were attracted to the community because of the clear land ownership, well coordinated farmer cooperatives, and other community governance structures that could be leveraged for implementing and sustaining the project. In cases where such governance structures are not in place, third parties, such as WCS in Makira and IIC in Guyana, may have to play a more active role in program leadership and designing transactions in a low risk, effective way.

It will be impossible to make forest carbon a risk free investment across all of the spatial and temporal scales at which such deals will be made. However, a range of different governance structures and mechanisms may help manage these risks to make markets related to forest carbon work for the buyers and sellers as well as climate, conservation, and poverty reduction.

[1] Currently, the trading of emissions credits from forest carbon can already occur through 1) the regulated market by means of the Clean Development Mechanism (CDM), which includes reforestation and afforestation activities but not avoided deforestation and 2) the voluntary market, which includes reforestation, afforestation, and avoided deforestation. Emissions reductions through forestry-related activities as permitted within the CDM have not been very successful due to high transaction costs and other complicated restrictions (Luttrell et al. 2007). For this reason, most of the carbon trading associated with forest-related projects—such as forest

conservation, reforestation and/or afforestation activities—have occurred within the voluntary carbon market. Since there are so few forestry-related projects that are operational within the CDM, this aspect of the carbon market will not be discussed within this paper.

[2] Additionality and establishment of baselines are also key issues associated with emissions reductions projects but will not be dealt with here.

PART 7: PERSPECTIVES FROM OUTSIDE WCS

7.1 Beyond the Boundaries of Protected Areas: Selected Nature Conservancy Approaches to Conservation in Complex Seascapes and Landscapes

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Introduction

As a land trust with its origins in the United States, The Nature Conservancy (TNC) has a long history of focusing on private land conservation, a substantial portion of which has been connected to the creation, expansion, or conservation along the borders of governmental protected areas. In its early years, much of the Conservancy's work was small in spatial scale by today's conservation standards and was dominated by acquisition of relatively small tracts of land to save disappearing natural areas or rare species with localized distributions (Birchard 2005). As the organization grew, especially in the 1980s and 1990s, so too did the spatial scale of its conservation projects. For example, in the 1980s the Conservancy undertook two of its largest land acquisitions to date with the purchase of the Tallgrass Prairie Preserve in Oklahoma and the Gray Ranch in New Mexico. The origins of both of these projects can be traced to plans for the creation of a new national park and new national wildlife refuge, respectively, by U.S. natural resource agencies, plans that became politically intractable over time and necessitated different conservation approaches.

The diversity of conservation settings on a global scale and the increasing spatial scale of conservation projects have made the conservation community's efforts to conserve the world's biological diversity even more challenging and complicated. A whole host of other factors have more recently aligned themselves to add to this complexity: globalization; impacts and uncertainty associated with climate change; increasing human influence and alteration of the Earth's natural systems; and international debates on the role of poverty and people in

nature conservation, just to name a few. As a result, the Conservancy and other major international biodiversity conservation organizations are responding in a dynamic way, evolving their conservation strategies and approaches to face these challenges. In this paper, we provide a brief overview of three broad strategies that the Conservancy is applying to address the challenge of conserving biodiversity within and beyond the boundaries of traditional protected areas: marine ecosystem-based management, ecosystem services, and conservation easements.

Marine Ecosystem-based Management

A relatively new approach to conservation in the marine realm, ecosystem-based management (EBM) is increasingly gaining traction in the scientific and conservation community (Scientific Consensus Statement on Marine Ecosystem-based Management 2005; Ruckelshaus et al. 2008). There is a rapidly growing body of literature and tools associated with this field (see www.ebmtools.org; www.marineebm.org; www.compassonline.org/marinescience) which incorporate many familiar principles[1]:

- Conservation of ecosystem structure, functioning, and key processes.
- A site-based focus on specific ecosystems and the range of factors affecting that ecosystem.
- The interconnectedness of physical systems such as among air, sea, and land.
- The integration and interdependencies of social, ecological, and economic perspectives.

Implementing EBM involves a variety of strategies, actions, and tools. Chief among these are ecosystem-level planning, cross-jurisdictional management, zoning (including the creation of networks of marine protected areas or MPAs), habitat restoration, co-management, adaptive management, and long-term monitoring and research. The Nature Conservancy has organized its support to partners in the Coral Triangle around an ambitious program that embodies all of the principles and actions of EBM.

Coral Triangle Program

The Coral Triangle region is arguably the center of global marine biodiversity and one of the world's top priorities for marine conservation. Spanning an area of 5.7 million km^2 (parts of Indonesia, Philippines, Solomon Islands, Malaysia, Papua New Guinea, and Timor New Leste), the Coral Triangle is home to over 600 species of coral (75% of the species known to science) and more than 3,000 species of reef fish (**Figure 1**). Some of its reefs are among the most threatened in the world by over-fishing, destructive fishing practices, coastal development, and impacts from global climate change. At the same time, other reefs are in remarkably good condition and only moderately threatened. Detailed information on the Coral Triangle and its conservation programs can be found at http://www.nature.org/wherewework/asiapacific/coraltriangle/.

Figure 1: The Coral Triangle.

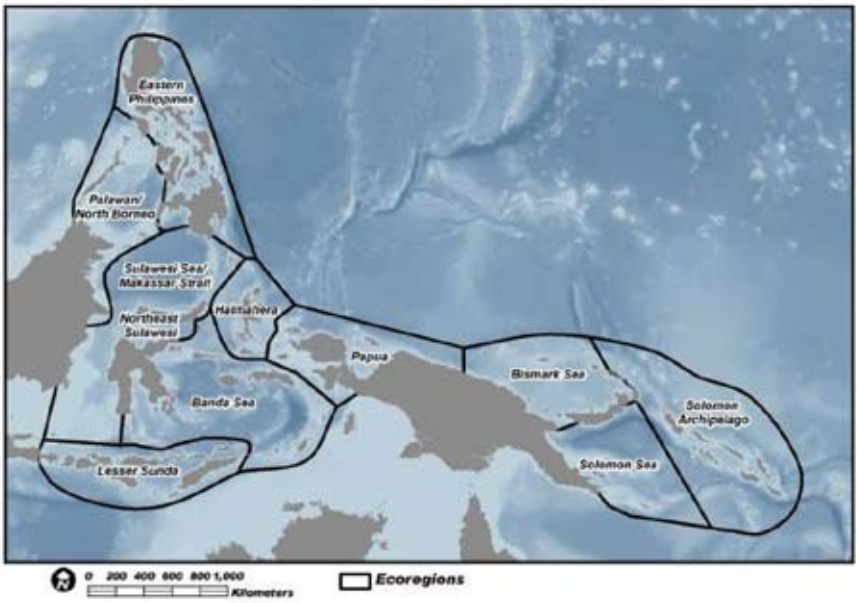


Figure 2: Seventeen planned networks of marine protected areas (MPAs) in the Coral Triangle.

The Conservancy and its partners have launched an ambitious 10 year Coral Triangle Program with goals that include:

- 3.3 million ha of tropical nearshore and shelf effectively managed in seven large established MPAs.
- A total of 8.4 million ha of tropical nearshore and shelf conserved by expansion of these seven established MPAs into resilient networks and addition of 10 MPA networks in seven priority ecoregions (**Figure 2**).
- At least 10% of tropical nearshore and shelf in all 11 Coral Triangle ecoregions conserved through application of resilient MPA networks as the central strategy guiding conservation; sustainable funding, integrated coastal management, and sustainable harvest practices in place to support management of these areas.

- Fisheries threats reduced over an additional 3.8 million ha of tropical nearshore and shelf through an ecosystem approach to fisheries management policy and practice to achieve a total of 15% of the coral reef systems of the Coral Triangle protected.

The principal conservation strategy of the Conservancy's Coral Triangle Program is the establishment and conservation of networks of MPAs that will be resilient to a variety of threats but particularly to coral bleaching events related to global climate change (see Resilience Model in **Figure 3**). The networks are being identified through a series of ecoregional assessments (Beck 2003) across the Coral Triangle and by site-based Conservation Action Plans or CAPs (The Nature Conservancy 2007) for each network which specifically identify conservation targets, threats, and strategies. Although there are a variety of conservation targets depending upon a particular MPA network, the most significant conservation targets in the overall program are coral reef systems, including their associated seagrass beds and mangrove forests.

Although conservation strategies are being deployed at regional, national, and local scales throughout the Coral Triangle, efforts to confront the challenges of protected areas, scale, and governance are most pronounced at the scale of individual MPA networks. For example, in Kimbe Bay, New Britain Island, Papua New Guinea (PNG), the Conservancy has been working with the PNG government and local conservation organizations since 1999 to establish a network of MPAs. Kimbe Bay is globally significant in terms of its marine resources due to the existence of shallow-water reef, mangrove, and seagrass beds adjacent to a deepwater drop-off with possible upwellings. Key threats include runoff and sediment from timber harvest and oil plantations, destructive fishing practices and overharvest by local fishermen, and commercial harvesting of marine resources such as sea cucumbers.

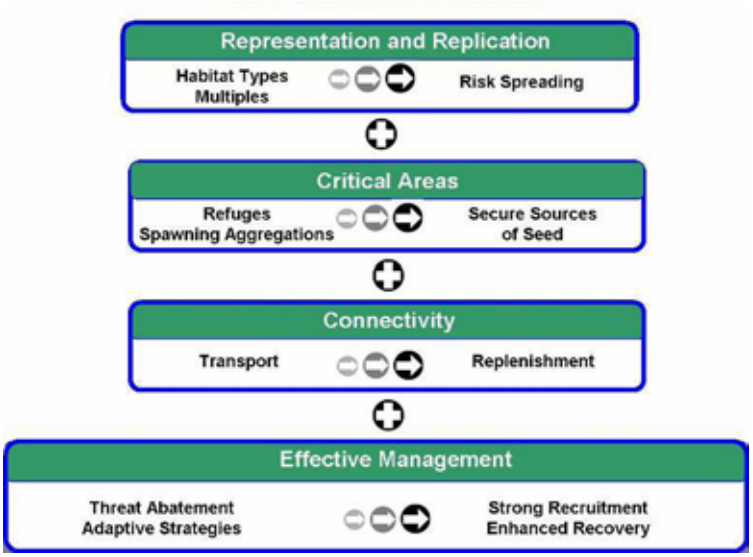
The Conservancy is implementing three core strategies in the face of these threats: (1) design and establishment of a network of MPAs resilient to climate change, (2) abatement of threats from current land-use practices, and (3) sustainable marine management resource use. In particular, the Conservancy is working with local villages and a local marine conservation organization to pilot the establishment of several locally-managed marine areas that are based on local customs and tenure arrangements and provide the governance structure for several of the MPAs. The network of MPAs itself has been specifically designed to deal with the scale of the conservation targets and threats. It is functionally connected by currents that facilitate dispersal and recruitment from source reefs to sink reefs, contains sites that are naturally resistant to coral bleaching, and incorporates sites critical to specific species such as sea turtles and reef fish that spawn in large aggregations.

Ecosystem Services

Ecosystem services have been defined as "the processes by which the environment produces resources that we often take for granted such as clean water, timber, and habitat for fisheries, and pollination of native and agricultural plants" (Ecological Society of America, www.actionbioscience.org/environment/esa.html). Since the 1997 publication of Gretchen Daily's edited book *Nature's Services: Societal Dependence on Natural Ecosystems*, ecosystem services have

Figure 3: The resilience conceptual model of MPAs.

TNC Resilience Model



1. Representation and Replication
Protect multiple examples of a full range of reef types, seeking to represent the area's total reef biodiversity. Replication within each type reduces the chance of any one type being completely compromised by an unmanageable impact such as a major bleaching event.

2. Critical Areas
Identify and fully protect coral communities that are naturally positioned to resist bleaching because of the presence of factors that mitigate heat or light stress as these refuges can provide secure sources of larvae to enhance the replenishment and recovery of seriously bleached areas.

3. Connectivity
Identify patterns of connectivity among source and sink reefs so that these can be used to inform reef selection in the design of MPA networks and provide rich stepping-stones for reefs over longer time frames.

4. Effective Management
Manage reefs for both health and resilience and monitor multiple indicators of the effectiveness of current actions as the basis for adaptive management. Effective management is the foundation for resilience.

gained prominence as a conservation strategy, particularly as a potentially sustainable financing mechanism. The Millennium Ecosystem Assessment (2005) concluded that over half of the world's ecosystem services are being degraded while at the same time promoting a greater understanding of the status of ecosystem functions globally and the sustainable use of these services (Tallis and Kareiva 2005). Despite widespread interest in the application of ecosystem services as a strategy by conservation organizations, government agencies, and academicians, substantial challenges exist to developing these services into a frequently used tool in the conservation toolbox. Two are worth mentioning here: (1) attaching an economic valuation to different services, and (2) establishing markets of interested parties who are willing to pay for services that they have long received for free. A great deal of work is currently underway in the conservation and academic community to address these challenges.

The Nature Conservancy has made and continues to make significant investments in pursuing the valuation and marketing of ecosystem services as a conservation strategy and financing tool. Below, we provide a brief overview of one large-scale conservation project involving several protected areas—the Condor BioReserve—in which an ecosystem services strategy is being applied with some success. Following that overview, we briefly describe the National Capital Project, a new cooperative program among Stanford University, The Nature Conservancy, and World Wildlife Fund that is focused on a much broader scale application and understanding of the potential of ecosystem services as a conservation strategy.

Condor BioReserve

For many years, The Nature Conservancy and several local partners in Ecuador (Fundación Antisana, EcoCiencia, Fundación Páramo, Fundación Sobrevivencia Cofán, and Fundación Ecológica Rumicocha), in collaboration with the Ministry of the Environment, have been working to link six protected areas and their buffer zones in the northeastern Andes of Ecuador under one management unit, the Condor BioReserve. The conservation targets for the project include wide-ranging species (giant river otter *Pteronura brasiliensis*, Andean bear *Trenarctos ornatus*, Andean tapir *Tapirus pinchaque*), species assemblages (amphibians breeding along montane rivers), and ecosystems (low montane forest, paramo, foothill forest, high Andean montane forest). Major threats to these targets are agricultural expansion, hunting, timber extraction, infrastructure projects (transportation corridors), agro-chemical pollution, mining, and overgrazing. Lands between protected areas are owned and managed by numerous private landowners, ancestral communities, and local villages, including several large haciendas. The Conservancy and its Ecuadorian partners are using several strategies to improve conservation on the lands between protected areas, including signing management agreements with private landowners and villages, land acquisition, establishment of longer-term conservation easements, the declaration of a new protected area, and payments for ecosystem services. Although all of these strategies focus on the conservation of wide-ranging species and the issues of varied governance across the project boundaries, our emphasis here is to provide some additional information on the ecosystem services strategy.

In 2000, The Nature Conservancy helped establish the Quito Water Protection Fund (FONAG). Over 80% of Quito's water supply originates in three protected areas of the Condor BioReserve—Cayambe, Antisana, and Cotopaxi. FONAG, which today is a trust fund with over $US 3 million in capital, brings together water users to pay for conservation efforts on a voluntary basis to help protect Quito's water sources. FONAG is an inter-institutional organization governed by a board composed of users who have committed resources to the trust fund. Its initial investments in watershed projects around Quito began in 2003. Today it invests in a range of activities both inside the protected areas and in the buffer zones between them, with a focus on sustainable natural resource management, increased park protection and management, environmental education, and hydrological monitoring. This model has proven successful enough to date as a financing mechanism for conservation that it is being proposed at six other sites in Ecuador, Colombia, and Venezuela, all sites with overlapping goals of watershed protection, biodiversity conservation, and improved management of protected areas. In addition, the Northern Andes Program of the Conservancy (of which the Ecuador program is part) has mapped ecosystem services in portions of the Amazon basin (in cooperation with the Natural Capital Project [below]) and is currently mapping a variety of ecosystem services (water, carbon, recreation, pollination) throughout Colombia and Ecuador in hopes of influencing the location and development of large-scale infrastructure projects.

Mapping and Valuing Ecosystem Services as a Conservation Strategy in TNC

The Nature Conservancy, in collaboration with Stanford University and the World Wide Fund for Nature (WWF), have initiated the Natural Capital Project (www.naturalcapitalproject.org) to foster a better understanding of the intrinsic and economic values that natural systems provide to human communities. The goals of the Natural Capital Project are to map a variety of ecosystem services, assess their economic values, and ensure that these values are captured in decision-making processes relative to natural resource management. The project has developed and uses a toolbox known as InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) for quantifying ecosystem services to allow for their inclusion in natural resource decision-making.

A recent survey of ecosystem services in The Nature Conservancy and WWF documented 103 projects across 38 countries that are using ecosystem services as a strategy (Tallis et al., in press). Sixty percent of these projects specifically involved working with protected areas. In 2008, The Nature Conservancy established a "swat team" of ecosystem service modelers and mappers who will utilize InVEST and work with Natural Capital staff members to bring the valuation of ecosystem services into the policy and decision-making realm in several conservation projects where the Conservancy is already working in Puget Sound (states of Washington and California) and Mexico. The swat team includes a leader who coordinates between the swat team and the local conservation project team, a GIS technician who maps ecosystem services, a hydrologist for developing more specialized valuations of water use, and an economist

for incorporating economic data into InVEST models. In essence, these pilot efforts are focusing on how the mapping and valuation of ecosystem services can inform decisions about large-scale ecosystem management. Although the science of mapping and valuing ecosystem services remains in the formative stages, such work has real potential to help decision makers understand and incorporate important tradeoffs between, for example, agricultural expansion and public drinking water supplies or timber harvest projects and carbon sequestration markets.

The Nature Conservancy is exploring a range of circumstances and means by which ecosystem services may serve in some cases as a valuable conservation strategy, a sustainable financing mechanism for conservation work, or both. At the same time, we acknowledge that there are both advocates for and objections to the arguments for ecosystem services as a conservation strategy (e.g., Ridder 2008). It is beyond the scope of this working paper, however, to explore the merits and details of these discussions and debates.

Conservation Easements

It is well established that many national parks in the U.S. and throughout the world are not sufficient in size to conserve viable populations of many species (Newmark 1995). In many cases, such as in some African or U.S. national parks, there are wide-ranging or migratory wildlife species that routinely utilize or move through lands adjacent to protected areas such as national parks. These adjacent areas are often privately owned lands that fall under many different land uses. In some cases, the ecological values of these private lands remain largely intact, and securing them from development and promoting their ecological stewardship will have great benefits to many target species.

In the United States and increasingly elsewhere outside the U.S., conservation easements are one of the most widely used tools in the conservation toolbox to secure private lands from future development. Easements are legal agreements between landowners and land trusts or government agencies that place permanent restrictions on certain land uses in order to maximize specific conservation values. In many situations, landowners donate conservation easements and receive important tax deductions (generally through reduced property values) in return. As of 2005, over 2.5 million ha of land in the U.S. had been placed under conservation easements (Land Trust Alliance 2005). Between 2000 and 2005, the amount of land under easement in the U.S. increased by nearly 150%.

Madison Valley in the Greater Yellowstone Ecosystem

The Greater Yellowstone Ecosystem (GYE) has been the focus of a substantial body of scientific and conservation work by many organizations and institutions (Noss et al. 2001). It remains one of the most ecologically intact natural systems in the temperate world. Multiple natural resource agencies and governmental bodies (3 states, 21 local county governments) are responsible for managing this 11 million hectare ecoregion, which is approximately 75% in public land ownership and 25% in private.

In many respects, Greater Yellowstone can be viewed as a central high elevation plateau surrounded by isolated mountain chains in public land ownership that are separated by privately owned valley bottoms. The majority of these valleys have experienced substantial urban, ex-urban, and agricultural development. The Madison Valley in the northwest portion of the GYE is somewhat unique in this regard in that it remains to a large degree ecologically intact. The valley is surrounded on three sides by high mountains, nearly all of which are under the management of the U.S. Forest Service and include substantial amounts of federally designated wilderness, arguably the highest degree of legal protection afforded any public protected area in the United States. Grizzly bears (*Ursus arctos*) and gray wolves (*Canis lupus*), both recently taken off the U.S. Endangered Species list, roam these mountains as does another wide-ranging carnivore, the wolverine (*Gulo gulo*); see chapter in this volume by Inman et al.). These three species, nearly always the targets of conservation in almost any natural resource plan in the GYE, also occupy and/or move across the Madison Valley.

The fact that these species still roam the Madison Valley while being long extirpated or persecuted in other valleys in the GYE is due, in part, to the efforts of many land trusts, natural resource agencies, concerned landowners, and various other conservation organizations (including the Wildlife Conservation Society [WCS] and the Madison Valley Ranchlands Groups; see Brock et al. 2006) who have focused a great deal of attention on the valley. The result of this attention is the greatest concentration of conservation easements in the state of Montana. Of the 142,000 ha of private land in the valley, 40% of it is under conservation easement, including some of the most important wildlife habitats and corridors. Although the valley is threatened by rural residential development, much of that development has been limited through conservation easements. The result is that wolverines still move across the valley, grizzly bears are routinely seen with cubs on ranchlands adjacent to the forested mountains and are known to disperse from one mountain range to another across the valley, and numerous wolf packs have occupied the valley over the last decade. The public and private lands of the Madison Valley watershed remain one of the best North American examples of how multiple governance types, including a variety of protected areas, across relatively large ecological scales *appear* (see below) to be providing for the persistence of wide-ranging carnivores that have long disappeared from other portions of their historic range in North America.

Results from TNC Easement Study

Despite the widespread use of conservation easements in the U.S., until recently there has been little critical evaluation of their effectiveness as a tool for conserving biodiversity. The Nature Conservancy evaluated 119 easements that it established over a 20-year period across a random sample of eight states. Over 95% of these easements had identifiable conservation targets, 84% were within high priority conservation sites of the Conservancy, and 79% were adjacent to protected areas (Kiesecker et al. 2007). More recently established easements were larger in size and more likely to have a conservation plan with a focus on biodiversity targets. Nearly half of these easements were on lands with contin-

ued ranching, forestry, or farming activities, and the compatibility and tradeoff of these uses with biodiversity values of the easement lands was not always clear (Rissman et al. 2007). In addition, although legal compliance monitoring of these easements was in place for a large majority of the lands, only about 20% were conducting any biological monitoring of conservation targets. In fact, this is the case in the Madison Valley, where only a few select conservation targets are occasionally monitored. Despite anecdotal and apparent success stories of easements as conservation tools, the biological evidence for their success as a tool in securing a long-term future for many conservation targets, especially those that require higher levels of management, remains weak.

Discussion

We have known for quite some time that for protected areas to be successful in conserving biodiversity, they must be well managed and integrated with conservation efforts beyond their boundaries. A whole series of case studies of neotropical parks demonstrated this quite convincingly, as have numerous similar projects worldwide (Brandon et al. 1998). This paper has touched on three broad strategies for helping to improve conservation efforts across large scales and a diversity of governance types: marine ecosystem-based management, ecosystem services, and conservation easements. Fortunately, there a number of other strategies being undertaken by conservation organizations which address this same issue. One such strategy is re-establishing ecologically sustainable flows on rivers that help conserve biodiversity in protected areas.

Strong arguments can be made that freshwater ecosystems are the most endangered natural systems on Earth. Yet, ironically, freshwater protected areas have received little attention as a conservation strategy (Abell et al. 2007). Conserving freshwater biodiversity, especially for vertebrate species, often involves working across multiple management jurisdictions in situations where numerous institutions govern the use of water through complicated sets of laws and policies. The Nature Conservancy established and has maintained a global freshwater program for over a decade that is addressing many of these challenges, particularly those related to ecologically sustainable water management (see http://www.nature.org/initiatives/freshwater). One project that the Conservancy is currently undertaking may be especially relevant to WCS—restoring ecosystem services to the Zambezi River Basin by working with a variety of partners (including WCS) to integrate water resources management across eight nations, develop and implement environmental flows below major impoundments, and strengthen the Basin's protected area network.

This paper has mentioned several ways in which the conservation community can better address the issues of protected areas, scale, and governance. We have little time to waste. What may be the greatest challenge to conserving biodiversity within and beyond the borders of protected areas is now upon us—adapting to the impacts of climate change. How we work beyond the borders of parks and protected areas to address this challenge will likely determine the fate of many species for decades to come.

[1] From the COMPASS Scientific Consensus Statement.

7.2 Requiem for the Zambezi Valley: Conservation and Protected Areas under Climate Change[1]

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Introduction

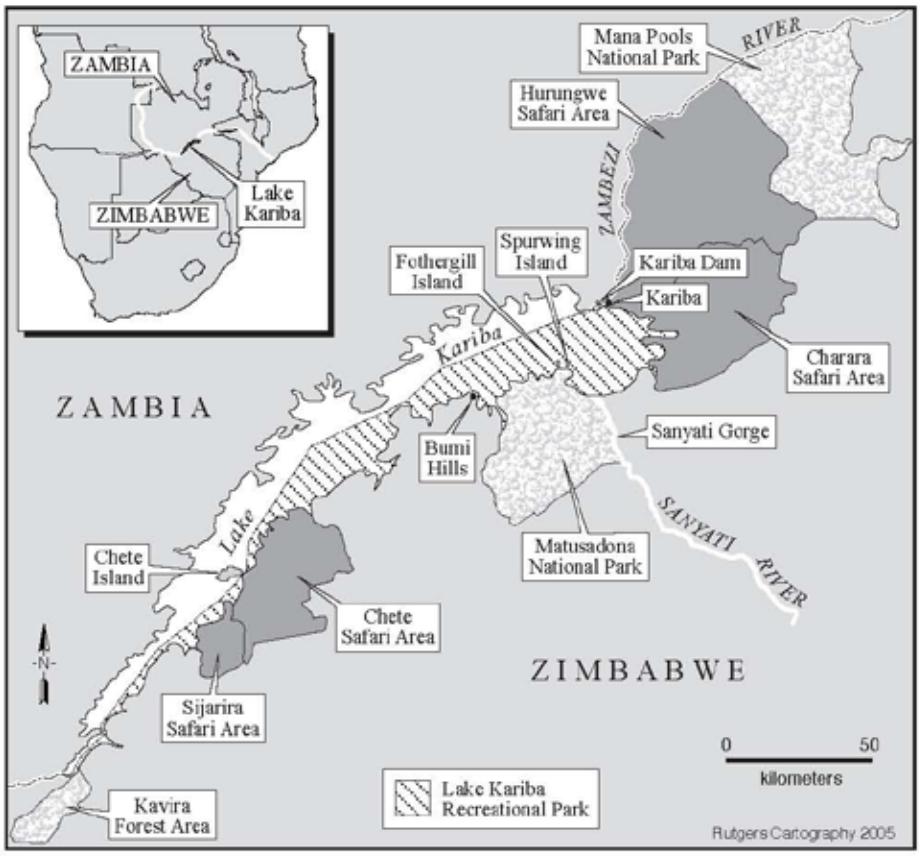
Global climate change is the bomb in conservation's basement. At current rates, carbon emissions will push ecosystems and species beyond the breaking point. More than a decade ago, Louis Pitelka and the Plant Migration Workshop Group raised the specter of widespread extinctions (Pitelka, et al 1997). Recent research suggests that a profound and rapid reconfiguring of regional climates is already underway (Williams et al. 2007). If this continues, protected areas will be rendered moot.

More optimistically, one might anticipate that industrial societies will shortly embark on an emergency program of climate stabilization. Scientific consensus now suggests that an 80% global cut in carbon emissions by 2050 may keep average surface temperatures at 2ºC above pre-industrial levels. Such a contained warming would avert planet-level catastrophe but still modify ecosystems everywhere. It would also overturn many of conservation's successes, including the protected area network. The global parks estate has relied upon a hidden fossil fuel subsidy. Coal- and petroleum-based industries transport carbon from the lithosphere to the atmosphere, occupying virtually no space on the planet's surface. In other words, Shell, ExxonMobil, and so on free up land for conservation. A more sustainable energy system, however, would begin and end at the ground level. Solar panels, wind turbines, and biomass farms, as well as carbon sequestering forests, would blanket landscapes. This widening platform of energy sources and carbon sinks could crowd out protected areas. Local-level conservation, some will surely argue, is a luxury the world can no longer afford. A more multi-scale conservation could both contribute to climate stabilization and blunt its secondary effects.

This paper conducts a thought experiment for the Zambezi Valley. In its 2,500 km course from Central Africa to the Indian Ocean, the Zambezi River touches or passes through six national parks and numerous lesser protected areas (**Figure 1**). Three parks cluster just upstream of Victoria Falls in what is known as the Four Corners Transboundary Conservation Area. Downstream, Matusadona National Park abuts the Lake Kariba reservoir, and two more national parks (Mana Pools and Lower Zambezi) flank the river before it empties into Mozambique's Cahora Bassa reservoir. This entire complex has enjoyed enormous attention and protection on the part of public and private conservation agencies. Now, however, climate change poses two sets of challenges: those related to adaptation and those related to mitigation.

To adapt to the anticipated agro-ecological crisis, Africans will surely migrate across local jurisdictions, national boundaries, and even oceans. To mitigate carbon emissions, policy-makers may install further hydropower dams in addition to those currently operated at Kariba and Cahora Bassa along the Zambezi River. More likely still, the rationing of jet fuel would decimate the

Figure 1: The Zambezi Valley.



long-distance tourism industry. Possibly the world's least sustainable sector, mass air travel cannot persist under an emergency program of cutting carbon emissions. Grounding planes would remove the Zambezi Valley's chief source of formal employment and in turn undercut the political justification for protected areas altogether. In short, these human responses to climate change will set conservation against sustainability. To forestall that outcome, this article suggests compromises and a resetting of priorities for the Zambezi and beyond.

Coping with Adaptation

In Southern Africa, climate change is dispensing drought and flood simultaneously. The region depends on a weather pattern known as the Intertropical Convergence Zone, under which moist air from the Indian Ocean travels southwest towards the Cape of Good Hope and then returns. Until recently, rain fell in the Zambezi basin over a five-month season, from October/November to March/April. Lately, the Convergence Zone has been arriving late and leaving early. The wet season has shrunk to four months and is heading towards a mere three months. Nonetheless, annual total precipitation, while varying more and more, appears likely to decline by only 10 to 20% (Arnell et al. 2003). This degree of continuity gives less solace than one might think: compressed into a shorter interval, this rainfall should contribute to increasingly severe storms and floods. In short, the agroecology of the Zambezi basin is changing dramatically and disastrously.

Such environmental insults will surely undermine the fragile alliance between local communities and conservation agencies. The compromise of community-based natural resource management relies upon local people's ability to live within a narrow geographical range. For instance, Zimbabwe's Communal Areas Management Programme for Indigenous Resouces (CAMPFIRE) succeeded when people withdrew from national parks—as hunters and herders. In some cases, income from tourism was to offset this loss of strategies and resources. Mostly though, agriculture in confined pastures and fields bore the full load of household survival and reproduction. Yet critical research suggests that agriculture has not borne the load alone. Peasants have continued to hunt and graze, if with greater stealth. In Zambia, for example, residents of the Luangwa Valley traded the gun for the snare (Marks 1999).

As maize harvests fall, smallholders must revert to tried-and-true strategies (Jones and Thornton 2003). Like any investor, they will distribute risk across ecological zones, land designations, and political jurisdictions (Scoones et al. 1996). Zimbabwe provides a dramatic case in point. Since 2000 the government has dismantled the economy, while climate change has undercut one in three rainy seasons. In response, people have squatted in protected areas, established a thriving market in poached meat, and sought work in South Africa in unprecedented numbers. Local, legal livelihoods have been reduced to polite fictions.

Climate change jumps scales in a fashion that overturns all community-based approaches to conservation. Combating, co-opting, and/or compensating local human populations has become the central project of most conservation agencies (e.g., Agrawal and Redford 2007; Terborgh 1999). All three tactics assume that rural Africans, Asians, and Latin Americans invest intensively in communities of place (Hughes 2005; 2006a: 194). That assumption no longer holds. Poor Africans, in particular, are increasingly exchanging the local dream of progress for a more extensive dream of egress (Ferguson 2006). Analyses of the increasingly desperate flight from the Global South to the Global North do not isolate climate change, drought, and so on as variables. Yet surely they play a role. If so, then perhaps one can anticipate an extension of what one might call *the Tuvalu appeal*.

Doomed to inundation as sea level rises, the Polynesian island nation of Tuvalu is attempting to resettle its entire population in Australia or New Zealand. So far unsuccessful, this effort relies upon international rather than community-based institutions and global rather than local forms of governance. In Africa and the Zambezi Valley, climate is changing more insidiously, and no one has suggested a coordinated boatlift. Rather, as is already happening, people will survive (or not) by over-taxing the increasingly fragile ecosystems in which they live and then abandoning them (Magadza 2000). Where will ecological refugees go, and how will conservation agencies facilitate, regulate, or impede their movement? Such legal and moral questions lie well outside the scale and scope of present-day conservation. Particularly in North America and Europe, as well as in Australia and New Zealand, agencies might prefer to ignore climate-induced immigration. But for those who dare, climate change presents an opportunity to jump scale and think big.

Coping with Mitigation

Sustainability in respect to energy is both essential and profoundly disruptive. Indeed, in this unprecedented application, the very notion of sustainability requires translation. Industrial societies have been managing the carbon cycle *de facto*, shaping photosynthesis, respiration, decay, and other processes throughout the biosphere, but they have regulated this exchange so clumsily that it has ceased to function as a cycle. The problem lies in an additional, entirely artificial process: the combustion of fossil fuels, which imports carbon from the lithosphere into the biosphere. Over geological time, that transfer is irreversible. Engineers and entrepreneurs have proposed to inject CO_2 underground, but no such technology seems capable of sequestering large volumes in perpetuity. Similarly, afforestation only sequesters carbon in the short term. Unmanaged forests reach a biomass climax where they fix roughly (although sometimes stochastically) as much carbon as they release. Plantations also fail to keep carbon in the solid state. How will climate managers prevent gargantuan harvests of pine, far in excess of timber demand, from simply rotting? In short, no method can compensate for or undo the artificial uplift of ancient carbon deposits. Sustainability, therefore, requires that industrial societies cease burning fossil fuels. Consequently, it also demands that they develop alternative sources of energy (Pacala and Socolow 2004). This responsibility will fall first and most severely on the Global North. Proposals for "climate justice" grant the South, and Africa in particular, a substantial grace period for their business-as-usual (Baer et al. 2007). Still, the sneeze of European energy policy may well cause the Zambezi Valley to catch cold.

Decarbonizing industry in the North Atlantic will hit the tourism sector hardest, and in so doing, throw conservation policy into crisis. Despite its disarming prefix, *eco*-tourism frequently pollutes as or nearly as much in carbon terms (Gössling et al. 2002). For all but land- and sea-based travelers, jet fuel is the great equalizer. Any robust climate regime would dissuade people from burning carbon merely for the sake of leisure. Indeed, public opinion in some countries is already shifting in this direction. Although environmentalists suffered defeat, the recent debate regarding Heathrow's Terminal 5 marks a watershed in Europe (Friends of the Earth 2008). Flying is no longer "green."

These political undercurrents should concern conservationists as well as businessmen far to the south. In the 1990s, many proponents of protected areas in Africa linked their fate to that of tourism and airlines (Oates 1999). Arguably, there was no alternative. Independent Zimbabwe, Zambia, and Mozambique would not maintain protected areas—and tolerate the continued displacement of smallholder communities—unless they enriched the nation materially, immediately, and directly. Elite, camera-toting Europeans and North Americans offered such quick cash. Soon—if climate is to be stabilized—they will recreate by rail. Will governments then protect unvisited, unremunerative landscapes? Probably not: the poached paper parks of current Zimbabwe, Zambia in the 1990s, and Mozambique in the 1980s provide a bleak model of the future.

Or conservationists may craft a different model of wildlife-related benefits and of wildlife itself. The "myth of wild Africa," as Jonathan Adams and Thomas McShane (1992) famously termed it, removes much of the continent from productive, local use. The most naïve conservationists imagine the Zambezi Valley and much of Africa as a Pleistocene remnant, empty of people but abundant in nonhuman biodiversity (Hughes 2006b; Schroeder 1999). If they are correct, "the bush" logically belongs to the spectator, the same Euro-American jet-setter who so damages the atmosphere. The wilderness myth, in other words, facilitates a dangerous—one may soon say, reprehensible—activity in the name of a misanthropic fantasy.

Clearly, this notion of nature has outlived its usefulness. In its place, some have suggested a diametrically opposed approach to nature: domestication. Such an intervention would seem to surpass or violate nature. Indeed, conservation groups, like tourists, largely disavow the tame in the tropics. But the tame survives. Asian elephants (*Elephas maximus*) frequently provide direct, material, and immediate benefits—not by browsing photogenically, but by moving timber and other loads. Such beasts of burden actually *work* for people, proving their value every day. Such labor is the best anti-poaching method, a guarantee against extinction. With a similar eye towards labor, Zimbabwean ranchers have experimentally domesticated the African elephant (*Loxodonta Africana*). On commercial farms in the 1990s, *Loxodonta* proved capable of plowing fields and transporting fence posts.[2] These skills may save the Zambezi's elephants from pressures sure to come as tourism collapses and agriculture declines. A drought-tolerant, low-expense workhorse capable of tilling large hectarages could also conceivably save rural communities. At the landscape level as well, Peter Kareiva of The Nature Conservancy has recently suggested a "science of domestication," whereby policy-makers would consider the trade-offs among ecosystem services (Kareiva et al. 2007; cf. Ellis and Ramankutty 2008). However imperfectly, domestication, rather than protection, may better preserve aspects of nature and humanity at the same time.

Less hypothetically, policy-makers would like to invest in carbon-friendly sources of energy. The Zambezi countries have advanced farther along this path than most—far enough to imperil their protected areas. Gorges and gradients give the river enormous potential for hydropower. To the frustration of the Zambezi River Authority (the engineering body in charge of hydropower), only Kariba, Cahora Bassa, and a small station at Victoria Falls currently draw power from the river. For economic rather than ecological reasons, the Authority has long hoped to insert more impoundments upstream and downstream. Indeed, its grandest design would leave scarcely a kilometer of wild river between Victoria Falls and Tete, in central Mozambique. More modestly, in the 1980s the Authority proposed two dams, both of which alarmed conservationists in the region. Most Zimbabwean organizations eventually accepted the Batoka Gorge Dam, a run-of-river barrage that would have filled a narrow, mostly unvegetated chasm upstream of Kariba. The second proposal, for a Mupata Gorge Dam below Kariba, provoked lasting furor. Although the reservoir would not displace large human populations, it would inundate large swathes of Mana pools and Lower Zambezi National Parks. Under threat,

conservationists manned their barricades. "Lake Mupata," wrote Raoul du Toit in 1984, "…would have very adverse impacts on wildlife resources of international significance…" (du Toit 1984: 4). He could not have anticipated then that the dam might have a *beneficial* impact on *atmospheric* resources of an equally international significance.[3] Zimbabwe's economic and political collapse has postponed both projects indefinitely, perhaps long enough for regional conservationists to think through the trade-offs.

Meanwhile, the shortened wet season may well decrease Kariba's generating wattage. According to one model, the reservoir lacks capacity to store water during a repeatedly prolonged dry season. It might essentially empty out before the replenishing floods. Increasingly variable rains might exacerbate this possibility. In order to guarantee constant electric generation, therefore, the Zambezi River Authority will need to raise Kariba's dam wall and enlarge the reservoir (Salewicz 1996: 319-20). Such flooding, over a mostly flat shoreline, will surely destroy large portions of the seven protected areas on Kariba's littoral, including Matusadona National Park. As we know it today, conservation in the Zambezi Valley will not survive sustainable energy.

These preliminary speculations suggest a need for new thinking and new scales of thinking. Conservation has long defended the local. Winning battles over myriad habitats, one assumed, would protect the Earth. Now the thousands-strong network of protected areas rings the globe. But it does *not* constitute a broader framework for planning and adjudication. Because the parts sum to *less* than the whole, protected areas do not guarantee general environmental security. This planetary-scale policy deficit drags conservation into contradictions. Witness much of the movement's embrace of ecotourism, what one might call the Kruger-KLM axis. Also in southern Africa, parochial loyalty sets conservationists against hydropower. The U.S.—where bird-lovers oppose wind turbines—suffers from even greater provincialism. A more geographically nimble conservation would grapple with larger scales and with the trade-offs between scales. It would attempt to balance the incommensurables of large local benefits and small global damages or of large local damages and small global benefits. This is difficult work, not entirely resolved by the notion of the Earth as a protected area. Perhaps one should settle for a domesticated Earth, but questions still abound. How would institutions govern planetary decisions with respect to jet fuel, sustainable energy, migration, and a host of other intercontinental issues? These are, at least, the right questions to ask. By asking them, conservationists will increasingly become part of the solution in mitigating climate change.

[1] Paper presented at the White Oak workshop on protected areas, governance, and ecological scale, Wildlife Conservation Society, 4-7 June 2008. I thank Bill Adams, Stella Capoccia, and Sarah Wise for their helpful comments.
[2] Interview with Gary Hensman, Harare, 14 April 2003 (cf. McNabb 2000).
[3] The flooding of a dense forest, as in the Amazon Basin, might exert less positive, or even negative, effects, due to the release of methane from submerged, decaying vegetation (Fearnside 1995).

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