CONSERVATION INTERNATIONAL

CONSERVING EARTH'S LIVING HERITAGE

A Proposed Framework for Designing Biodiversity Conservation Strategies




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FOREWORD

Biodiversity—the sum total of life on Earth—is our living natural heritage, our natural resource base, and our biological capital in the global bank. Its importance is profound and far-reaching, from the inherent value of the great diversity of Earth's species in their natural habitats, to the medicinal, nutritional, and economic benefits provided by individual species, to the invaluable role played by natural systems in controlling erosion, cleansing the air and water, storing carbon, enriching soil, and pollinating crops.

But human activities are causing the world's terrestrial, freshwater, and marine biodiversity to vanish. Species are becoming extinct and pristine landscapes are disappearing at unprecedented rates throughout the world. While tragic in their own right, these trends threaten severe consequences for humankind, as ecosystems lose their ability to provide the goods and services that generate irreplaceable economic, agricultural, public health, scientific, cultural, and spiritual benefits. Today we face not just the extinction of countless plants and animals, but also the loss of indigenous cultural knowledge and of whole natural communities and entire ecosystems upon which humanity heavily depends.

CI is responding to this crisis through a highly focused approach on biodiversity hotspots and high-biodiversity wilderness areas—regions that have been identified through scientific analysis at CI as being the highest global priorities for biodiversity conservation. Covering less than 2 percent of the Earth's terrestrial surface, the remaining habitat of the highly threatened hotspots count 44 percent of all vascular plant species and 35 percent of all terrestrial vertebrate species as endemics. The wilderness areas—regions of extremely high-biodiversity but under low threat—encompass an additional 6 percent of the Earth's terrestrial surface and harbor as endemics another 17 percent of all vascular plant species and 8 percent of all terrestrial vertebrate species. Through refinement of these analyses, and additional analyses to identify areas of significant conservation concern in the marine and freshwater realms, CI continues to establish global priority areas requiring conservation action.

Over more than 15 years of focused effort to conserve these key regions, CI has grown significantly, gained invaluable experience, and learned many important lessons. First among these is the need to define in clear and exact terms what is required to conserve biodiversity within a hotspot or wilderness area so that we have a clear path forward and an explicit set of objectives against which to measure our progress. From this we have developed a focus on conservation outcomes: the set of species extinctions that must be avoided, key biodiversity areas that must be protected, and biodiversity conservation corridors that must be consolidated if we are to ensure the long-term persistence of biodiversity within our global priority areas. Adopting these outcomes, we believe, will help focus our activities as never before.

Second, CI recognizes the vital role of NGO alliances and partnerships in achieving conservation at a meaningful scale. Ultimately, CI (or any other organization for that matter) can be active only in a handful of sites. Effective conservation at the hotspot or wilderness scale—let alone globally—requires strategic collaboration from multiple organizations. This explains CI's major investments locally and regionally in building alliances and supporting partners.

Third, CI must develop more sophisticated arguments for engaging key constituencies—namely, communities, businesses, and governments. Again, CI is adapting as an institution to respond to this reality. We have always held that conservation cannot succeed without the support of local people, and we continue to strengthen our commitment to this principle. Beyond this, we have scaled up dramatically our ability to engage the private sector and are looking to establish a significantly enhanced capacity to work effectively with governments.

Fourth, loss of biodiversity impoverishes the world and humankind. It reduces the quality of life for all people and may in fact be a survival issue for communities who depend directly upon healthy and productive ecosystems to meet their daily needs. Although we believe that we must protect the diversity of life for its own intrinsic value, we also believe that the future of human welfare hinges on our success. Conversely, we recognize that the long-term sustainability of the conservation outcomes we achieve today will depend on our ability to demonstrate the vital role that species, ecosystems, and ecological processes play in supporting human welfare.

Finally, conservation is a complicated business. With so much to do on so many fronts, one can easily become overwhelmed and diverted into a stream of activities that collectively fail to improve the bottom line. CI has produced this handbook for conservation planning with this in mind. It seeks to present a guide for conservation practitioners in developing a strategic and focused approach to their work of getting conservation done. One of our greatest lessons learned over the past 15 years is that conservation science is always evolving, with improved tools, techniques, and approaches appearing all the time. Given this dynamic element to our work, this is a proposed framework, with some elements more advanced in their thinking than others. It is our hope that we can continue to advance the science of conservation by testing, evaluating, and refining this framework both through our own efforts and through our partnerships with others.

There will be many successes along the way. Every extinction avoided, every key biodiversity area protected, every biodiversity conservation corridor consolidated represents an important achievement toward conserving Earth's living heritage. In the end, however, our challenge is to think bigger—to marshal the arguments, build the alliances, encourage the institutions, create the will, train the people, and deliver the resources that allow conservation to be achieved at a massive scale consistent with humanity's needs. We hope this handbook will be an important step on the road toward such an end.

Russ Mittermeier

President, Conservation International

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INTRODUCTION

It is Conservation International's mission to conserve the Earth's living natural heritage, our global biodiversity, and demonstrate that human societies are able to live harmoniously with nature. This handbook, *Conserving Earth's Living Heritage: A Proposed Framework for Designing Biodiversity Conservation Strategies*, outlines a process for turning this grand conservation vision into quantifiable and achievable goals—conservation outcomes—and a clearly articulated approach to securing them. The purpose of the handbook is to help everyone at CI focus their individual and collective efforts toward this vision.

How to make this happen is not an easy process to lay out in a single document. This handbook contains a lot of information. It encompasses the range of issues related to how we go about our work of conservation, describing everything from how CI sets its global conservation priorities to how to evaluate options for improving the management of a protected area to designing and implementing monitoring programs that will support informed adaptation of our priorities and conservation strategies.

The organizing concept for the handbook is conservation outcomes, which CI defines at three scales: species, areas, and corridors. We build our conservation strategies and articulate conservation outcomes in terms of avoiding species extinctions, protecting key biodiversity areas, and consolidating biodiversity conservation corridors. The framework presented in this handbook is built on defining conservation outcomes, developing and implementing strategies to attain them, and monitoring whether our actions are indeed resulting in the delivery of conservation outcomes (Figure I.1).

Chapter 1 lays out the process we follow to define our global priorities—biodiversity hotspots, high-biodiversity wilderness areas, and marine and freshwater priority areas—a process that relies on an understanding of both how biodiversity is distributed on the land, in lakes, in rivers, in streams, and in the sea, and how it is being threatened. It follows with a detailed methodology to be implemented by all of CI's regional programs to define conservation outcomes within our global priority areas.

To determine what actions are required to deliver our targeted conservation outcomes, we must first determine whose actions affect biodiversity, why they do what they do, and what can be done to change their behavior—this then determines what needs be done. Ultimately, three fundamental criteria must drive our decisions regarding what action to take. The changes in behavior we seek and the interventions we propose to achieve them must be:

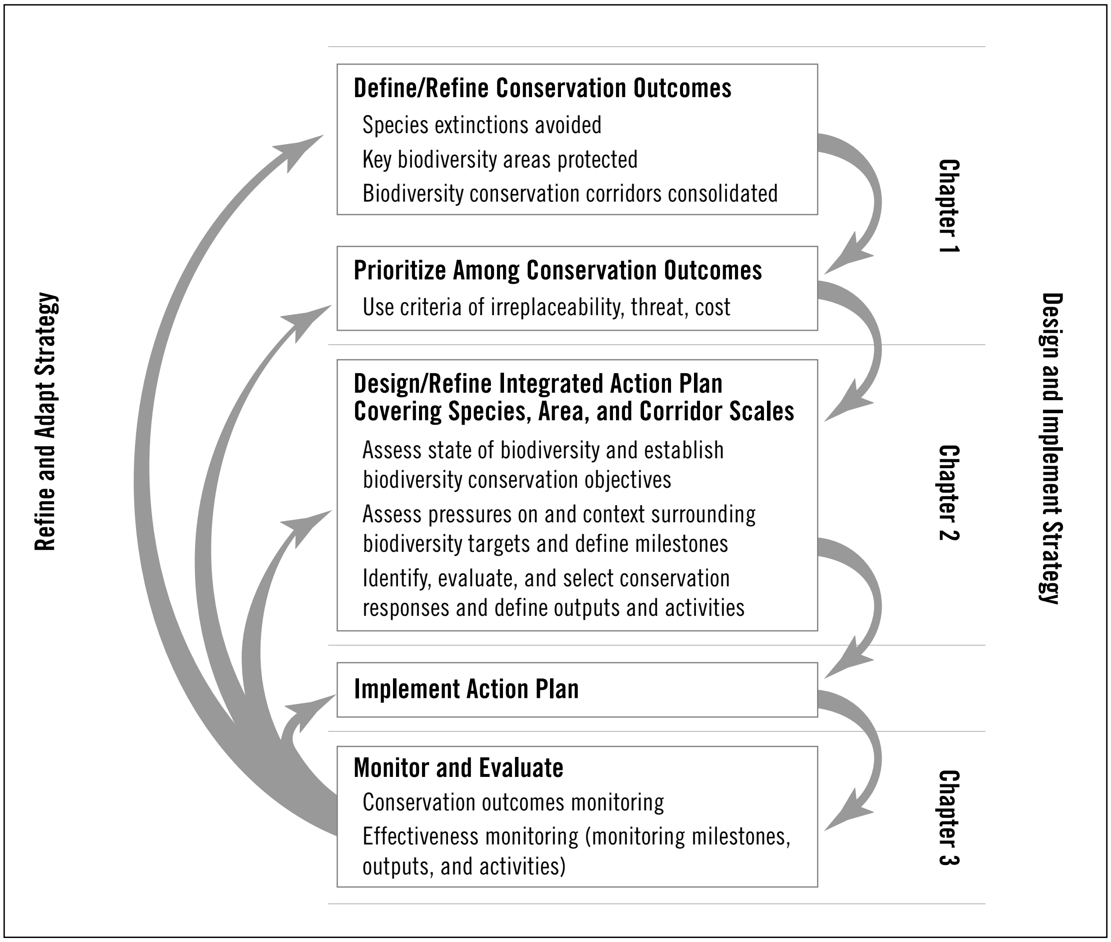
- *Necessary* to deliver a conservation outcome;
- The most *efficient* in terms of using available resources; and
- *Time sensitive* or, in other words, certain to make a contribution toward securing the conservation outcome before it loses its biological significance.

How to develop and implement effective conservation strategies is addressed in detail in Chapter 2.

Finally, we recognize that in order to improve our efficiency and effectiveness, to determine whether we are having the desired impacts on biodiversity, and to share learning across the conservation community, we must monitor and evaluate our actions as well as our targets. Chapter 3 provides detailed guidance on implementing the CI protocol for monitoring conservation outcomes, as well as general guidelines for monitoring both changes in context and the efficiency and effectiveness of our projects and initiatives.

Despite its ambitious scope, *Conserving Earth's Living Heritage* does not address everything that happens within CI, and you will notice that important issues that are operational in nature, like budgeting and financial management, human resource processes, legal issues, and development and fundraising, are not included. CI's operations, development, and communications divisions have developed and continue to develop separate manuals that provide guidance on these fundamental elements of our work.

FIGURE I.1: OVERVIEW OF PROCESS FOR PLANNING FOR BIODIVERSITY CONSERVATION WITHIN BIODIVERSITY HOTSPOTS AND HIGH-BIODIVERSITY WILDERNESS AREAS



Summary of Chapters

The following are key excerpts summarizing each of the three chapters that make up this handbook. Because the methods presented by the handbook are in various stages of development and testing, each chapter summary also provides an indication of how the methods described should be implemented.

Chapter 1: Defining Global Priorities and Conservation Outcomes

CI focuses on conserving those terrestrial, marine, and freshwater areas on the planet with the highest biodiversity, both those that are under the greatest threat—***biodiversity hotspots***—and those that are most intact—***high-biodiversity wilderness areas***. Within these global priority areas, we target our actions by focusing on those species that are most vulnerable to extinction: ***globally threatened species*** and ***geographically concentrated species***. Extinction of these species can be avoided only if the major threats to them are abated and the resources and ecological processes upon which they depend are maintained over the long term. CI therefore uses information on the distribution and needs of these species to define which sites will be critical to their survival. These are referred to as ***key biodiversity areas***. Finally, research has demonstrated that if biodiversity within individual sites is to persist over the long term, a matrix of "biodiversity-friendly" land use around them is necessary to allow the maintenance of natural ecological processes. For this reason, where possible and desirable, we pursue the conservation of networks of key biodiversity areas through the consolidation of ***biodiversity conservation corridors***. Ultimately, this entire approach is built upon the recognition that biodiversity occurs across multiple scales of ecological organization, from the genetic level all the way up to the scale of the entire biosphere. Knowing that to conserve biodiversity as a whole we must ensure the conservation of its key component parts, we use a tractable subdivision of this continuum that identifies targets at the level of species, sites, and land- or seascapes. Specifically, at each of these scales, we define conservation outcomes that must be achieved if we are to save biodiversity as a whole. We articulate our conservation outcomes as follows:

- ***'Extinctions Avoided' outcomes:*** the conservation of globally threatened species and geographically concentrated species (which have a high probability of extinction in the short- and medium-term future),
- ***'Areas Protected' outcomes:*** the conservation of key biodiversity areas, and
- ***'Corridors Consolidated' outcomes:*** the conservation of ecological function through the consolidation of biodiversity conservation corridors.

Finally, although we recognize that the full universe of conservation outcomes must be achieved if we are to conserve the Earth's living natural heritage, we also acknowledge that resource constraints require us to decide which areas should receive conservation attention first. A proposed approach to such a prioritization among key biodiversity areas incorporates considerations of irreplaceability, threat, and cost.

The analytical processes and methodologies presented in this chapter are well developed. The methodology for defining conservation outcomes is currently being applied or is to be applied in all of CI's priority regions. The methodology for prioritizing among conservation outcomes is in a preliminary stage of development and will be refined in 2004 and 2005 through testing and evaluation.

Chapter 2: Designing Strategies to Achieve Conservation Outcomes

The chapter is broken into three separate modules—Avoiding Species Extinctions, Protecting Key biodiversity areas, and Consolidating Biodiversity Conservation Corridors—but each is organized following the same basic three-element planning framework, beginning with the assessment of the state (or condition) of biodiversity, followed by and assessment of the pressures contributing to biodiversity decline as well as the context that surrounds and drives those pressures, and finally with the analysis and selection of a suite of conservation responses. We derive this planning approach from a commonly applied basis for many existing monitoring frameworks: the Pressure-State-Response (PSR) framework, which is based on the concept of causality. Simply put, human activities exert ***pressure*** on the environment through a range of social, political, and economic activities. This pressure changes the quality and quantity—or ***state***—of the environment. Society reacts to these changes through environmental, economic, and policy ***responses***. The human responses to these changes include any organized behavior that aims to reduce, prevent, or mitigate undesirable change or environmental results. Because CI places great emphasis on conservation outcomes, we have adapted the PSR framework by reordering it to follow the logic of ***State-Pressure-Response (SPR)***, to place consideration of the condition of biodiversity as the first step in our planning process.

To assess pressures on biodiversity, we first identify the current and anticipated pressures on our biodiversity targets and then qualify and quantify the severity and scope of these pressures. To assist us in assessing whether to tackle the pressures directly or their causes, we then identify the sources of the pressures and characterize each according to its significance in driving the pressure, recognizing that pressures on biodiversity can result from the combined effect of several sources. We also identify those individuals or groups of individuals driving the pressures and attempt to understand what factors may be driving their behavior. Using this information, we set specific, quantifiable, and measurable changes in current behaviors and conditions that must occur if our conservation objectives are to be achieved. In CI terminology, we label these changes ***milestones.*** Finally, we begin to devise a conservation action plan to reduce the pressures on the targeted biodiversity by asking, "What are the possible incentives and approaches that CI and its partners can use to bring about the desired changes in behaviors and existing conditions? Which of these incentives and approaches are most likely to have the greatest positive impact on the most influential stresses?" At CI, the conservation responses we choose through this process are termed ***outputs*** and the specific steps that must be taken to achieve our outputs, we term ***activities.***

The planning processes proposed in this chapter are all under development and need to be tested, evaluated, and refined in the coming year. Several regional programs are already applying these methodologies through the development of species conservation programs, site-based conservation strategies, and corridor planning initiatives, and efforts are underway to track these efforts and consolidate learning from them.

Avoiding Species Extinctions

For the most part, the ***state*** of the globally threatened species CI targets for conservation action has already been assessed to some degree under the IUCN Red Listing process, and we rely primarily on this resource for information on the status of species. From these and other assessments we know that current extinction rates are more than a thousand times the natural rate. The most significant ***pressures*** leading to these extinctions are, in order, habitat loss, unsustainable utilization, invasive species, and climate change and disease. Factors that compromise efforts to conserve species include: (a) lack of solid scientific data on the species themselves, the threats to them, and how these threats affect them; and (b) continued debate on how to best combat major threats. CI's primary response to avoid extinctions involves preventing habitat loss by creating and effectively managing protected areas and supporting landscapes; however, protecting habitat alone will not prevent the extinction of certain species. Thus, to combat the other major threats to species and promote effective conservation ***responses***, we recommend that CI programs:

- Actively support and participate in the IUCN Red Listing process;
- Support and initiate studies targeting globally threatened species and threats (e.g., ecology and status of species, and impact of threats on species);
- Evaluate and promote broad-level conservation tactics that contribute to the conservation of species (e.g., sustainable use and captive breeding); and
- Partner with global programs aimed at addressing species-level issues (e.g., bushmeat, illegal wildlife trade, and invasive species).

Protecting Key Biodiversity Areas

Protected areas are the single most important and successful tactic in avoiding species extinctions. Thus, we work to ensure that all key biodiversity areas are formally protected—whether that is through government designation or through formal agreement with the landholder (a community, an individual, etc.)—and effectively managed to conserve the biodiversity they contain. Regardless of whether we pursue creation or improved management of a protected area, our efforts must begin with an evaluation of the ***state*** of the biodiversity for which the site was identified as a key biodiversity area, which involves consolidating key data on and assessing the status of the globally threatened and geographically concentrated species for which site has been identified as important for biodiversity conservation. Using this information, we establish measurable and, where appropriate, spatially explicit biodiversity conservation objectives for the site. To assess ***pressures***, we consider both direct pressures that drive species and habitat loss (e.g., logging) as well as conditions that prevent effective response to these pressures (e.g., inadequate resources to manage a protected area). To the extent possible, we evaluate these pressures and conditions to clarify the significance they have in driving biodiversity loss, and we also establish measurable, explicit objectives for changing the underlying behaviors and conditions that drive the pressures. Finally, we evaluate and select ***responses*** that will bring about these changes by enabling managers to manage better (e.g., by facilitating access to training or sustainable financing), providing or eliminating options for using protected area resources (e.g., by supporting economic alternatives such as ecotourism or enterprise, or activities such as enforcement), or by influencing how decisions are made (e.g., by raising awareness, supporting environmental education, or promoting the creation of multi-stakeholder protected area management alliances).

Consolidating Biodiversity Conservation Corridors

A biodiversity conservation corridor is an integrated system of protected areas, connecting linkages, and compatible land and resource uses, designed and managed with the goal of ensuring the persistence of threatened species, key biodiversity areas, and ecological processes. Delineation of biodiversity conservation corridors should be based on one or more of the following: (a) the areas necessary to conserve globally threatened species that are not well conserved at the site scale alone; (b) the areas necessary to conserve wide-ranging species; or (c) the ecological processes on which the threatened species or key biodiversity areas depend. As a conservation tactic, corridor design should allow proactive response to existing and emerging threats to biodiversity and incorporate benefits and opportunity costs into conservation planning.

The ***state*** assessment at the corridor scale therefore begins with a review of the species requiring conservation action at the corridor scale, the key biodiversity areas within the corridor, and corridor-scale ecological processes. Scenarios are then developed to identify alternative pathways for ensuring that these targets are themselves conserved in addition to other areas that are deemed necessary to ensure that protected areas within the corridor are replicated, complementary, resilient, and viable, and that connectivity is created among key biodiversity areas as needed to support wide-ranging globally threatened species within the corridor. As with the site methodology, we assess direct ***pressures*** on biodiversity within the corridor as well as conditions that prevent effective conservation action, such as weak or nonexistent conservation legislation, perverse economic policies, or weak capacity to manage biodiversity resources. ***Responses*** we take to alleviate pressures on biodiversity, overcome obstacles to conservation action, and consolidate biodiversity conservation corridors are selected from the following possible options:

1. Ensure that the systems of protected areas meet the area requirements of wide-ranging threatened species and ecological processes by:
   - Promoting the establishment of additional areas to be managed for conservation; and/or
   - Promoting the management of protected areas as coordinated systems, as wide-ranging species may require multiple areas to survive.

2. Promote compatible land and resource uses as buffers to core areas, linkages within connectivity networks, and a forward defense against emerging threats, by:
   - Providing information to decision-makers and building support for biodiversity conservation;
   - Creating effective incentives for biodiversity conservation;
   - Establishing a supportive policy and legislative framework; and/or
   - Building capacity to manage biodiversity resources.

Chapter 3: Monitoring and Evaluating Conservation Outcomes and Strategies

We monitor and evaluate conservation targets and actions to ensure that planned results are achieved, improve and support management decisions, generate new knowledge, motivate stakeholders, ensure accountability, and foster public and political support. Within a conservation strategy, monitoring and evaluation must happen at every level, from outcomes to milestones to outputs to activities. This chapter presents a detailed protocol on outcomes monitoring that will be implemented by all regional programs in the near future with support from CI technical programs. The protocol specifies state, pressure, and response indicators for each of the three categories of conservation outcomes, as follows:

Indicators for 'Extinctions Avoided' Outcomes

- Percent change in number of globally threatened species in each IUCN Red List category, number of species downlisted, and number of species that have gone extinct (state).
- Percent improvement toward achieving downlisting of each threatened species, concentrating on rates of decline, starting with Critically Endangered species (state).
- Exploitation of species (pressure).
- Progress in defining targets (response).
- Research on threatened species (response).
- Legislative protection of species (response).

Indicators for 'Areas Protected' Outcomes

- Percent change in habitat cover at key biodiversity areas (state).
- Percentage and total number of all key biodiversity areas that are protected with (a) legal recognition and (b) biodiversity conservation as an official goal (e.g., national park, private protected area, easement, conservation concession, indigenous reserve, or land under corporate management) (response).
- Progress in defining targets (response).
- Species focus within management objectives (response).
- Permitted uses of protected areas (response).
- Implementation of management (response).

Indicators for 'Corridors Consolidated' Outcomes

- Change in fragmentation statistics (state).
- Percent change in suitable habitat cover for corridor-level species (state).
- Infrastructure development (pressure).
- Invasive species presence (pressure).
- Progress in defining targets (response).
- National conservation legislation (response).
- Land-use zoning (response).

While outcomes monitoring under this protocol is to be undertaken by all of CI's regional programs, the remaining guidelines in this chapter regarding effectiveness monitoring at the milestone, output, and activity scales are provided more as a reference or a starting point for developing a complete strategy monitoring program, rather than mandated practice.

Who Should Read the Handbook?

The primary audience of this handbook is regional program staff—both in Washington, DC, and in the field—who make critical decisions on a daily basis about where we should be working, what we should be doing there, and how we can go about getting it done. Technical staff from CABS, RCSG, and CELB will also be important users of the handbook because each of these programs exists in part to support regional program staff in making these decisions. We anticipate that partner organizations may also find the handbook valuable, both as an aid in understanding how CI approaches its work and as a resource for methods that can be adapted and used by others.

How Should the Handbook Be Used?

How is this handbook supposed to be used in practical terms? CI and other conservation organizations have produced many different "guides-to-conservation-planning" documents and often they end up gathering dust on a bookshelf. To prevent that from happening with this handbook, we have made every effort to create a practical, easy-to-use document that outlines planning elements that are well-developed, mandatory regional planning approaches—such as the methodology for defining conservation outcomes and the protocol for monitoring them—as well as straightforward proposed guidelines for developing strategies to achieve our species, area, and corridor conservation outcomes.

As with any planning framework, we anticipate that the guidelines presented herein will change as we apply them in the field and learn about what is useful, what works well, and what can be improved. This is particularly true for the species, area, and corridor planning frameworks. As an organization, we share the task of incorporating the planning framework presented in this handbook into conservation planning processes, meetings, and workshops and sharing our learning so that we might improve how we go about the practice of conservation.

Use of this handbook should not be limited to when a "major" planning meeting takes place. Strategic planning at CI must occur constantly as we adapt to changing circumstances, and the handbook should be used as part of this process. For example, staff with day-to-day responsibility for delivering conservation outcomes should make use of the species, area, and corridor planning guidelines presented in Chapter 2 as guides to conducting less formal, but critically important, planning sessions that are structured effectively and incorporate the best available information and analyses related to the delivery of conservation outcomes.

Ultimately, this handbook will be judged a success if it becomes this type of useful resource in the process of constantly refining our conservation strategies, and when the principles contained in it become part of our everyday decision-making. As you begin to read and use the handbook, keep in mind that it exists to help us as an institution and you as an individual conservationist answer these key questions that will determine the success or failure of CI's actions:

- Are our strategies built around conservation outcomes that have strong biological justification?
- Is what we are doing the most effective and efficient means to secure the identified conservation outcomes?
- Have we sought out and incorporated the best available information and advice into our decision-making processes?

Key Practices Necessary to Successfully Apply the Planning Framework

Several important factors will contribute to the effectiveness and efficiency of our strategic planning and implementation process. Although we initially attempted to build each of these factors into the planning framework, we determined that they instead resembled cross-cutting principles and practices rather than clear steps in a process. Nonetheless, these are extremely important considerations and should be built into any effort to design and implement a conservation strategy. These principles dictate that we:

- Effectively engage and support partners and key stakeholders;
- Deliberately consider and clearly define CI's role in the process;
- Design strategies reflecting that the three scales of planning and action—species, areas, and corridors—are interrelated, not distinct;
- Seek out and utilize the best available information and expertise; and
- Prioritize along the way.

Effectively Engage and Support Partners and Key Stakeholders

CI rarely has direct impact on, or control or decision-making authority over, the biodiversity we seek to conserve. Rather, we must work alongside and support partners and key stakeholders, such as indigenous and traditional communities (please refer to CI's policy statement below), government agencies, industry, and other conservation or development agencies, in their efforts to change the ways species are managed and protected, create or improve the management of a protected area, or influence development trends in favor of biodiversity conservation. These highly political processes must consider the needs and interests of a variety of people so that sustainable resource management strategies are designed and implemented in a way that promotes biodiversity conservation as well as human welfare.

Informing and educating stakeholders of the importance of biodiversity conservation is an excellent means of gaining their support and engagement and, often, of identifying and even defusing threats to conservation objectives. But in addition to being supportive, institutions and actors have to be well coordinated. Enforcement of conservation regulations, for instance, may often be more efficiently achieved by enlisting local community institutions and actors to defend the ecological services provided by functional protected area ecosystems. In such instances, the conservation managers and enforcement agents may be perceived not as agents of repression but rather as defenders of the public interest. Moreover, simply promoting better communication between the government agencies with authority over resource allocation may efficiently preclude conflictive actions, such as mining in protected areas, or policies, such as promoting agriculture and infrastructure development that would threaten key biodiversity areas. Effective collaboration between institutions overseeing land use, resource extraction, and conservation policies and actions is a prerequisite to long-term biodiversity protection.

As we learn repeatedly every day in our work, engaging partners and supporting key stakeholders in conservation initiatives is truly an art—there is no clear science or method to it—and so detailed guidelines on this topic are not provided in this handbook. Nonetheless, before embarking on conservation planning or taking action, a deliberate, thoughtful, and informed effort should be made to identify the various stakeholders involved and the roles they play currently or may play in the future. As described below, it is also fundamental that CI determine its own role in a given situation relative to others involved.

INDIGENOUS PEOPLE AND CONSERVATION INTERNATIONAL: PRINCIPLES FOR PARTNERSHIPS[1]

Conservation International's mission is to conserve the Earth's living heritage, our global biodiversity, and to demonstrate that human societies are able to live harmoniously with nature. Conservation International (CI) works in hotspots and tropical wilderness areas in over 32 countries. Since its inception, CI has believed that conservation must benefit people and that protecting and maintaining basic ecological processes and ecosystem services are the foundation for sustainable livelihoods and economic development.

Many of the places with significant biodiversity remaining are the traditional areas of indigenous peoples[2]. Indigenous peoples living within hotspots and wilderness areas often directly depend on the products of healthy ecosystems, harvesting wild plants and animals for their food, fuel, clothing, medicine and shelter. The economies, identities, spiritual and cultural values, and forms of social organization of indigenous peoples are often closely tied to maintaining the biodiversity and ecosystems that contain them, intact. However, multiple

[1]These principles have directly used and adapted portions of Indigenous Peoples: Draft Operational Policies (OP 4.10) Draft Bank Procedures (BP 4.10) March 23, 2001, and a review of WWF's Indigenous Peoples and Conservation: WWF Statement of Principles.

[2]The terms "indigenous peoples," "indigenous ethnic minorities," "tribal groups," and "traditional peoples" are among the terms used to describe social groups with an identity that is distinct from the dominant groups in society. CI places a particular emphasis on working with those groups tied to ancestral lands.

pressures exerted on indigenous and other rural communities have made this a challenging proposition in many settings. CI's mission and the goals and actions of many indigenous organizations to maintain biodiversity and intact ecosystems are therefore often compatible.

CI recognizes that the national context and the rights conferred with the term indigenous vary significantly among countries. Indigenous people often are ethnically different from the dominant national culture, and frequently their traditional territories, whether terrestrial or marine, are not recognized by national governments. While indigenous people have similar characteristics with other disadvantaged or marginalized rural population groups, they share a unique sets of rights that are increasingly part of the national constitutional and other legislation. Furthermore, many of the causes of their poverty differ greatly from other marginalized sectors, and are often related to their loss of traditional lands and resources, disintegration of their traditional economies, and from discrimination and marginalization that result from their unique language, culture and social organization. Because of this, issues related to indigenous peoples and development are complex and require special measures to ensure that indigenous peoples, like other local communities, are not disadvantaged and that they are included in and can benefit from activities supporting biodiversity conservation.

CI has engaged in partnerships with indigenous peoples worldwide in a range of different capacities, working together to support biodiversity conservation and ecologically sustainable livelihoods. Our actions have varied from community-based work to support the sustainable and traditional uses of medicinal plants and animals to working with indigenous groups to gain recognition of their ancestral lands to assistance in managing traditional lands to support biodiversity conservation and ecological processes that maintain their lives and livelihoods.

PRINCIPLES AND PRACTICES

CI adheres to a set of principles about how we work and what actions we support with indigenous communities. We believe that these principles of conduct for ourselves as an organization are vital for building long-term partnerships. Our partnerships with indigenous communities reflect the following.

1. We recognize that although there are many words that reflect what is meant by indigenous, national definitions vary from country to country, and may not fully coincide with self-identification of indigenous peoples. CI's work is largely tied to spatial settings. Therefore, we identify indigenous peoples in specific geographic areas by the presence, in varying degrees, of:
    a. Close attachment to ancestral and traditional or customary territories and the natural resources in them;
    b. Customary social and political institutions;
    c. Economic systems oriented to subsistence production;
    d. An indigenous language, often different from the predominant language; and
    e. Self-identification and identification by others as members of a distinct cultural group.

2. We support engagement with indigenous communities in a transparent, honest way. We believe in directly informing others of CI's mission and our primary emphasis on biodiversity conservation, so that there is no misunderstanding about our motives. We work with indigenous groups on a range of projects where there are common interests.

3. We believe in the full participation of indigenous groups, from consultation to action, inclusive of gender and generations, and in culturally appropriate ways. We will openly inform, consult and obtain the informed consent of formal representatives of indigenous groups prior to undertaking any actions that are directly tied to indigenous peoples, their territories or natural resources.

4. We recognize the role that indigenous peoples have played in maintaining biodiversity and that indigenous control over traditional lands and resources is a precondition for the maintenance of biodiversity, and we support efforts by indigenous groups to gain legal designation and management authority over ancestral lands and their resources, while respecting issues of national sovereignty.

5. We recognize and support the rights of indigenous peoples to retain their own cultural identity and traditional systems of land, forest, and marine resource tenure within a framework of equity and sustainability.

6. We recognize the traditional indigenous knowledge and practices that form the cultural heritage and intellectual property of indigenous groups and that are often closely intertwined with their biophysical environment.

7. Our actions and activities with indigenous peoples should, through a consultative process, take the following into account:
    a. the cultural and spiritual values that these groups attribute to their lands and ecological resources;
    b. their individual and communal or collective rights to use and develop the lands they occupy and to be protected against encroachment;
    c. their customary uses of the natural resources vital to their cultures and ways of life and the institutions and mechanisms that exist to manage resource uses;
    d. their natural resources management practices and the long-term sustainability of these practices from both ecological and social perspectives, given internal and external opportunities and pressures;
    e. traditional and customary decision-making, authorities, and governance, as well as formalized representatives and authorities; and,
    f. both knowledge of and vulnerability to inappropriate uses of indigenous ethnopharmacology, ethnobotanical, and faunistic knowledge, products and technology;
    g. the legislative, legal, and administrative framework that form the framework for indigenous peoples, their territories, resources, and rights within a national context and the right to self determination of indigenous peoples within the full meaning of international law.

8. We support capacity-building of individuals and institutions to manage biodiversity and ecological systems sustainably, recognizing that indigenous peoples may have ultimate authority over how their territories and resources are used and managed. Our support includes enhancing the capacity of indigenous people's organizations and communities to prepare, implement, monitor and evaluate conservation activities or activities that are likely to have an impact upon conservation.

9. We recognize that there are often overlaps between lands set aside for legally designated parks and protected areas and lands customarily owned or used by indigenous peoples. CI recognizes both the significance of these customary rights and the need for long-term sustainable management of critical ecosystems. In legally designated parks and protected areas, CI will work with protected area and indigenous authorities to support collaborative management initiatives that recognize customary uses while ensuring that natural resources are not depleted and that actively involve indigenous communities in planning, zoning, and monitoring.

Deliberately Consider and Clearly Define CI's Role in the Process

Determining CI's form of participation in working toward a specific conservation objective should be a deliberate, thoughtful, and strategic decision based upon a consideration of the various strengths and potential roles that can be played by ourselves and others. An important element in evaluating levels of participation will be to determine CI's own role in the process. In many cases, other NGOs or government agencies may already be leading the effort, and CI will engage in supporting the process only. In other cases, there may be no leader, and CI may take on this role.

As a large, international conservation organization with tremendous experience and technical capacity, CI has some very specific roles that we generally play. These include:

- Providing access to the best available science;
- Building capacity through training and exchange of institutional knowledge;
- Creating financial means and incentives for conservation;
- Ensuring the design and implementation of comprehensive strategies for conservation outcomes; and
- Effecting change at all scales to influence conservation outcomes.

Providing Access to the Best Available Science

CABS, CI regional programs, and other departments are equipped with some of the top conservation scientists in the world. Moreover, CI has established a network of local to international partners and field practitioners that contribute cutting-edge science and strategies for decision-making. CI's research programs such as RAP™, RACE, Conservation Synthesis, Conservation Economics, and Spatial Information and Modeling offer invaluable contributions to identifying conservation targets, needs, opportunities, and innovative techniques to advance the conservation agenda in the countries in which we work. Making the best science available to decision-makers and conservation agents in these countries permits us to objectively and decisively influence the strategies and policies of local to national development and conservation. Our conservation strategies should benefit from our ability to deliver the best available science concerning ecological targets, ecosystem function, protected area and corridor design and management, incentives, policies, and practical approaches to linking human welfare with ecosystem integrity through enterprise, ecotourism, and community engagement.

Building Capacity through Training and Exchange of Institutional Knowledge

Building the capacity of institutions and individuals responsible for conservation is fundamental to improving the effectiveness of our conservation strategies. CI should establish partnerships and programs to identify and respond to the critical training needs of conservation agents, from administrators to managers and rangers. Providing direct training in planning, managing, and monitoring conservation activities and creating sustainable delivery mechanisms through institutional strengthening and financing are important means of addressing this need. Providing access to the most current and relevant science and practices for effective conservation is another critical means of fostering improved management. As conservationists innovate and continually learn more about promising strategies, techniques, and policies to achieve our outcomes, we must facilitate the exchange and adoption of this knowledge within CI and among our partners. CI is investing considerable effort in establishing information and communication tools necessary to get the most current and relevant information to field practitioners through the development and dissemination of technical guidelines and of lessons-learned publications and methodologies, and the establishment of learning networks.

Creating Financial Means and Incentives for Conservation

Often the greatest impediments to conservation are posed by economic constraints. Limited financial resources impel countries and private actors to maximize the immediate financial gains offered by the conversion of forests to agriculture and pasture, the depletion of valuable marine and terrestrial natural resources, and the development of infrastructure in undeveloped areas. Effective protection is commonly hampered by the lack of financial resources necessary to cover staffing, equipment, and recurrent operational costs. CI can respond to this important need by devising creative financing mechanisms, such as endowments for protected area creation and management costs, conservation incentive agreements, royalty payments from extractive industries, and direct investment in protected area conservation projects, and by identifying donors and channeling their investments accordingly. CI's important financial resources also provide us with greater ability to influence macro-level policies, donor investments, and private sector initiatives through matching grants, competitive incentives, and direct financing of technical support and conservation action.

Ensuring the Design and Implementation of Comprehensive Strategies for Achieving Conservation Outcomes

Often, planning for conservation objectives is reduced to addressing the most proximate and immediate threats because of constraints posed by technical, political, and financial conditions. CI's ability to offer the best science, to draw upon its global field expertise and experience, to leverage political solutions, and to provide financial support enables us to engage managers and stakeholders in designing comprehensive conservation solutions and supporting their long-term pursuit so that the actions we and our partners take today will have a lasting and sustainable impact.

Effecting Change at All Scales that Affect Conservation Outcomes

In many cases, conservation actions targeted at the site or corridor scale will not be sufficient to address large-scale threats. Some threats need to be addressed at a broad spatial scale, for example fires, changes in water flows, and changes in micro-climate due to deforestation in distant areas. Some threats need to be addressed at a higher political level than the local level, such as by changes in national policy on agricultural subsidies. To be effective in such contexts, conservation action needs to take place at broader scales and/or higher levels. In its position as an international non-governmental organization working at the species, site, corridor, national, and international scales, Conservation International is able to coordinate strategies for conserving multiple sites or multiple key biodiversity areas, take proactive approaches to mitigating threats beyond the boundaries of sites and corridors, and engage at the policy level to enable more effective, sustainable conservation solutions.

The Three Scales of Planning and Action—Species, Areas, and Corridors—Are Interrelated, Not Distinct

Although the guidelines for developing conservation strategies are divided to reflect the three scales of CI's conservation outcomes, this is not meant to imply that planning for species, areas, or corridors should be carried out through totally distinct and separate processes. Every effort should be made to integrate the various analyses proposed herein. Corridor planning should consider, incorporate, and complement area and species conservation strategies. Similarly, strategies to protect areas must be designed within the context of each area's contribution to the conservation of the species targeted therein. For example, guidance provided in the module Avoiding Species Extinctions recommends supporting the IUCN Red Listing process, which applies a globally accepted approach to assessing the state of and pressures on species of global conservation concern. Data resulting from these efforts should be incorporated into area and corridor planning efforts. Similarly, evaluations of pressures on an array of key biodiversity areas within a corridor could demonstrate that certain pressures initially believed to be site-specific are actually systemic throughout the corridor and may therefore be addressed most effectively at that scale.

Seek Out and Use the Best Available Information and Expertise

Many traditional planning methods describe simplified processes that support quick decision-making via participatory processes. Unfortunately, in some cases, this has promoted the practice of decision-making supported only by expert consultation in a workshop format. While expert consultation should certainly be part of any planning process, and we have emphasized above the need to strategically engage key stakeholders, the importance of collecting and analyzing the best available data should not be underestimated. Any rigorous and reliable planning process will include a mix of data collection and analysis as well as consultation and expert opinion, but, as with other elements of planning described in this section, determining this balance is something of an art. Spending too much time and money behind closed doors collecting and analyzing information and reaching conclusions shared only internally is unlikely to result in a solution that is acceptable to key stakeholders. Spending too little time on data collecting and analysis, however, can result in poorly informed decision-making. Before moving forward with a planning process, a decision should be reached on a balance of data collection and analysis, internal processing, and expert consultation that will be necessary and sufficient to produce a solid, well-informed conservation strategy.

Prioritize Along the Way

The planning methods outlined herein will appear to be very demanding in terms of time, data needs, and analytical requirements. Therefore, the potential exists for significant effort to be wasted if these planning methods are not themselves applied in a strategic way. Consequently, we recommend that the potential impact on biodiversity be used to prioritize data collection efforts, technical analyses, activities to engage stakeholders and other participants, and other similar activities throughout the process. For example, if it is quickly determined that illegal logging and forest fires will result in the destruction of a key biodiversity area within a short period, it would be pointless to collect infinite data on other, less significant pressures in the area.

DEFINING GLOBAL PRIORITIES AND CONSERVATION OUTCOMES

CHAPTER 1

In this chapter

- SETTING GLOBAL PRIORITIES: BIODIVERSITY HOTSPOTS, HIGH-BIODIVERSITY WILDERNESS AREAS, MARINE AREAS, AND FRESHWATER AREAS
- DEFINING TARGETS FOR ACHIEVING CONSERVATION OUTCOMES: ‘EXTINCTIONS AVOIDED,’ ‘AREAS PROTECTED,’ AND ‘CORRIDORS CONSOLIDATED’

Introduction

Estimates of the total number of species on the planet range from approximately 2 million to as high as 100 million (Mittermeier *et al.* 1999; May 1988). Ensuring that loss of this tremendous biological diversity is limited to natural extinctions is a huge task requiring that the conservation community as a whole—from the smallest communities and non-governmental organizations to the largest government agencies and conservation institutions—increasingly coordinate and collaborate in our role as caretakers. To this end, we must decide what to do first to conserve the most biodiversity in the fastest time and with the most efficient use of our scarce conservation resources. This translates into taking immediate action to prevent the loss of threatened species and areas, as well as being proactive in promoting the persistence of biodiversity over the long term.

With this in mind, CI has determined that its contribution to the conservation of global biodiversity will be directed by a focus on conserving those terrestrial, marine, and freshwater areas on the planet with the highest biodiversity, both those that are under the greatest threat—***biodiversity hotspots***—and those that are most intact—***high-biodiversity wilderness areas***. This constitutes a global strategy, but more focused targets must be define to inform how to proceed with conservation on the ground. Within CI's global priority areas, we therefore target our actions by focusing on those species that are most vulnerable to extinction: ***globally threatened species*** and ***geographically concentrated species***.[1] Avoiding extinctions of these species requires a conservation response that ensures both the abatement of major threats to these species and the long-term maintenance of the resources and ecological processes upon which their survival depends. CI therefore uses information on the distribution and needs of threatened and geographically concentrated species to define those sites that will be critical to their survival, referred to as ***key biodiversity areas***. Finally, if biodiversity within individual sites is to persist over the long term, research has demonstrated the need for a matrix of "biodiversity-friendly" land use around them to allow natural ecological processes to function, as, for example, by maintaining connectivity of natural habitat so that species are not restricted to single forest patches. For this reason, where possible and desirable, we pursue the conservation of networks of key biodiversity areas through the consolidation of biodiversity conservation corridors.

Ultimately, this entire approach is built upon the recognition that biodiversity occurs across multiple scales of ecological organization, from the genetic level all the way up to the scale of the entire biosphere. Knowing that to conserve biodiversity as a whole we must ensure the conservation of its key component parts, we use a tractable subdivision of this continuum that identifies targets at the level of species, sites, and land- or seascapes. Specifically, at each of these scales, we define conservation outcomes that are priorities for accomplishment if we are to save biodiversity as a whole (Figure 1.1):

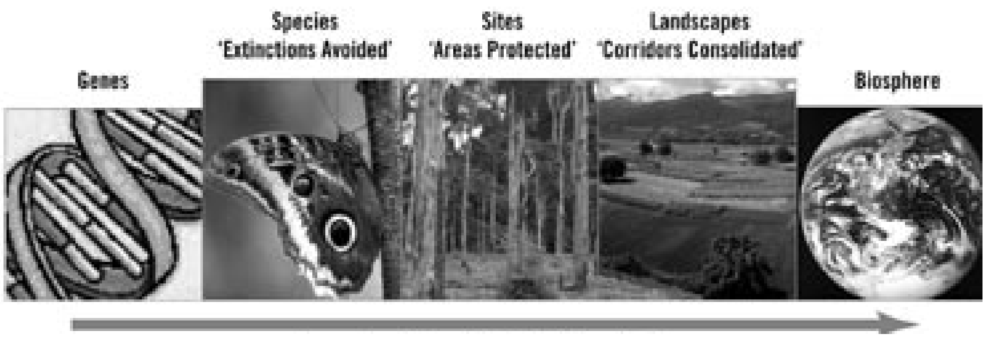
- 'Extinctions Avoided' outcomes—the conservation of globally threatened species and geographically concentrated species (which have a high probability of extinction in the short- and medium-term future);
- 'Areas Protected' outcomes—the conservation of key biodiversity areas; and
- 'Corridors Consolidated' outcomes—the conservation of ecological functioning through the consolidation of biodiversity conservation corridors.

This chapter explains in detail the methodologies and criteria CI uses to identify our global priorities as well as the species, areas, and corridors we target within them. We begin with an overview of the approaches that have been or are being applied to define terrestrial biodiversity hotspots, high-biodiversity wilderness areas, and marine and freshwater priority areas. We then go on to describe the methodology for defining conservation outcomes within global priority areas. Although the section on global priorities is intended simply to provide an overview of the approaches being applied, the section on defining conservation outcomes is presented in a format that is intended to facilitate the application of the methodologies by CI's regional programs and partners.

Setting CI's Global Priorities

Conservation International's mission is to conserve the Earth's living natural heritage, our global biodiversity, and to demonstrate that human societies are able to live harmoniously with nature. To implement this mission, we focus on regions where biodiversity is most concentrated and act strategically to defer threats and take advantage of or create opportunities for conservation. Biodiversity is not uniformly distributed across the planet's surface—some regions have a much larger share of the total number of species that inhabit the Earth. From a terrestrial perspective this is exemplified by the fact that most tropical rainforest and Mediterranean-type regions harbor a disproportionate share of biodiversity, and are therefore very important areas for targeting conservation efforts. Likewise in marine environments, coral reefs and other structurally heterogeneous systems are biotically very diverse. Consequently, CI uses scientific and analytical processes to set its priorities for investment and conservation focus. Our approach at the global scale has three components to date: biodiversity hotspots and high-biodiversity wilderness areas

FIGURE 1.1: CONSERVATION OUTCOMES



Biodiversity occurs across multiple scales of ecological organization, from the genetic level all the way up to the scale of the entire biosphere. To define targets for achieving conservation outcomes, we break this continuum down into three tractable scales of organization: species ('Extinctions Avoided' outcomes), key biodiversity areas or sites ('Areas Protected' outcomes), and landscapes ('Corridors Consolidated' outcomes).

[1]We should note from the outset that the process of defining targets for conservation outcomes outlined here tackles only those of global conservation concern. These will necessarily need to be integrated into regional and national priorities (for example, for nationally threatened species). Such regional and national conservation priorities should necessarily include all globally significant conservation outcomes, but will often include a number of other targets too (Vermeulen and Koziell 2002). However, focusing our investment in global conservation outcomes is particularly important for organizations like CI that have a global (rather than any particular national) responsibility.

for terrestrial systems; and coral reef hotspots for marine systems. A fourth component, for freshwater ecosystems, is in preparation.

Terrestrial Biodiversity Hotspots

Ecologist Norman Myers proposed the hotspots concept in 1988 as a way to designate priority areas for conservation. In his seminal paper, "Threatened biotas: 'hotspots' in tropical forests," he used vascular plants as indicators for biodiversity and identified ten threatened hotspots worldwide, all of which were located in tropical rainforests (Myers 1988). Since then, CI, Myers, and other collaborators have expanded on his original research, continuing to analyze and refine the hotspots concept and elevate awareness of the important role hotspots play in conserving global biodiversity (Mittermeier *et al.* 1998, 1999, Myers 1990, Myers *et al.* 2000).

In the refined analysis, the main criterion for determining hotspots status was species endemism, which is a measure of *irreplaceability*. Species that are restricted to a particular geographic area, and as a consequence are found nowhere else on Earth, are known as endemic to that area. Obviously, species may be endemic to a small area (such as the Colombian Andes) or a large area (such as the African continent). Many of the species endemic to the hotspots and wilderness areas have particularly small ranges, and are known as restricted-range species if these ranges are smaller than a quantitative threshold. The use of endemic species as the main criterion to identify hotspots indicates that the survival of these species (or, conversely, their extinction) depends entirely on the fate of the hotspot. The refined analysis also examined what groups of organisms should be used to determine hotspot status and what portion of global biodiversity should be endemic to an area to qualify as a hotspot. The updated analysis built upon the original Myers study in using plants as the main taxonomic group for analysis. A cutoff point of 0.5 percent of total global vascular plant biodiversity endemic to an area was used in the analysis (Figure 1.2). Based on estimates of total vascular plant diversity (300,000 species), this translates into a requirement of 1,500 plant species endemic to an area for it to qualify as a hotspot. Building on the original study, animal data were also used to complement the hotspot identification process. The best information available was for birds, mammals, reptiles, and amphibians.

FIGURE 1.2: TERRESTRIAL BIODIVERSITY HOTSPOTS

Criteria:

- $\geq$ 0.5% of total global vascular plant biodiversity endemic to the area
- $\leq$ 30% of primary natural vegetation intact

25 Hotspots:

- Historically, covered 12% of land; remaining habitat now covers only 1.4% (2.1 million km^2)
- 44% of all vascular plant species as endemics
- 35% of all terrestrial vertebrate species as endemics

An integral component of the hotspot concept is threat or *vulnerability*. Consequently, only areas that have 30 percent or less of their original primary natural vegetation cover remaining intact were included after the plant endemism criterion was applied. This is because these are the regions where conservation is most urgent: without rapid action, the severe habitat loss to date threatens mass extinction of their surviving endemic species (Brooks *et al.* 2002).

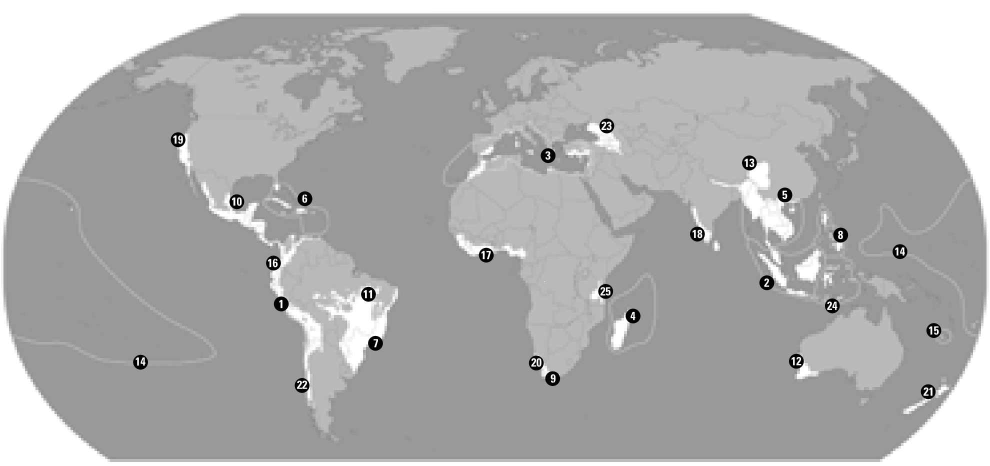
Overall, the new analysis identified 25 hotspots (Figure 1.3), which originally held primary natural vegetation covering over 17 million km^2 or about 12 percent of the Earth's surface. Of that original vegetation cover, 88 percent has been lost; the area remaining—2.1 million km^2—constitutes only 1.4 percent of the Earth's surface. Yet the hotspots hold over 130,000 endemic plant species (44 percent of all plant species) and nearly 10,000 endemic species of terrestrial vertebrate (35 percent) (Table 1.1).

TABLE 1.1: SPECIES ENDEMISM IN THE 25 HOTSPOTS

Taxonomic Group	# of Endemic Species	% of Global Total
Plants	130,000	44
Birds	2,800	29
Mammals	1,300	27
Reptiles	2,900	38
Amphibians	2,600	54

Of the 25 hotspots identified by Myers *et al.* (2000), 15 are located in tropical rainforest. This clearly underlines the importance of these ecosystems for conservation purposes. Current protection of biodiversity in the hotspots is fairly low considering the levels of endemism associated with these areas. In fact, only about 800,000 km^2 of the hotspots (or 0.7 percent of the Earth's land surface) are located in protected areas. Further, many of these reserves are located in areas that have already lost their natural habitat, and so overall maybe half of the remaining intact vegetation in the hotspots is currently

FIGURE 1.3 THE 25 BIODIVERSITY HOTSPOTS.



1 Tropical Andes
2 Sundaland
3 Mediterranean Basin
4 Madagascar and Indian Ocean Islands
5 Indo-Burma
6 Caribbean
7 Atlantic Forest Region
8 Philippines
9 Cape Floristic Region
10 Mesoamerica
11 Brazilian Cerrado
12 Southwest Australia
13 Mountains of Southwest China
14 Polynesia/Micronesia
15 New Caledonia
16 Chocó-Darién-Western Ecuador
17 Guinean Forests of West Africa
18 Western Ghats & Sri Lanka
19 California Floristic Province
20 Succulent Karoo
21 New Zealand
22 Central Chile
23 Caucasus
24 Wallacea
25 Eastern Arc Mountains & Coastal Forests of Tanzania & Kenya

Source: Myers et al. 2000

FIGURE 1.4: WHAT IS THE CURRENT STATUS OF THE HOTSPOTS ANALYSIS AND WHO AT CI IS RESPONSIBLE FOR DOING IT?

The Conservation Synthesis Department in CABS, under the supervision of the President's Office, is tasked with refining the hotspots and wilderness areas analyses. Currently, the department is assessing species presence and endemism for ten highly threatened regions that hold just under 0.5% of the world's plants as endemics, bringing these regions very close to meeting the criteria for hotspot status. The department also continues to update information on species endemism and presence in the existing hotspots and high-biodiversity wilderness areas.

under no form of protection. Moreover, if we consider just Critically Endangered and Endangered species, 57 percent of mammals and 81 percent of birds are found in the hotspots. Clearly, the continued loss of habitat in these areas will result in a disproportionately high number of global extinctions. While the estimated cost of protecting the hotspots, at $25 billion (Pimm *et al.* 2001), is not cheap, it is an incredible bargain to save more than half of the species on Earth, particularly when compared with the estimated $33 trillion annual value of biodiversity (Costanza *et al.* 1997).

High-Biodiversity Wilderness Areas

Biodiversity hotspots incorporate two key types of information for prioritization of CI's strategic focus: species endemism and level of threat. While this clearly allows us to narrow down the geography of conservation importance, it does not represent all of the areas of high endemism of the terrestrial biodiversity map. Fortunately, there still exist today large areas of relatively intact tropical rainforest and other habitats that easily match the first criterion of high endemism used in the hotspot prioritization process. With at least 70 percent of their area intact, these high-biodiversity wilderness areas are some of the largest remaining tracts of pristine habitat on the planet. They are vital to climate regulation and watershed protection, and they are among the last places where indigenous people can maintain traditional lifestyles. Most have population densities of five people per km^2 or less, and are therefore under much less pressure from encroaching human populations than areas like the hotspots. Such small populations mean that conservation in these areas is often cheap and cost effective.

The five high-biodiversity wilderness areas (each >750,000 km^2) are Amazonia (including the Guayana Shield), the Congo Forests, New Guinea, the North American Deserts, and the Miombo-Mopane Woodlands and Savannah region of southern Africa (Mittermeier *et al.* 2002, 2003) (Figure 1.6). Together, these regions cover an area of about 12 million km^2, of which 78 percent remains intact. This habitat represents about 6.1 percent of the land surface of the planet. In this relatively small portion, we have as endemics at least 51,000 vascular plant species, or 17 percent of the global total, and 2,300 terrestrial vertebrate species, 8 percent of the global total. This represents a large contribution to global biodiversity and highlights these areas as focal points for biodiversity conservation (only 13 percent of their habitat is formally protected, to date). However, it also highlights the even more crucial role of the hotspots. Even though remaining habitat in the hotspots is less than a quarter of the area of these five areas, the hotspots have 82,000 more endemic plant species and 7,300 more endemic terrestrial vertebrates!

We should note here that CI's wilderness study (Mittermeier *et al.* 2002, 2003) identified a number of additional wilderness areas with low threat, but holding very few endemic species. While we recognize that these areas may be of importance for matters such as the conservation of ecological processes, they are of relatively lower concern for conservation of globally threatened and geographically concentrated species, and so lie outside of CI's priorities.

FIGURE 1.5: HIGH-BIODIVERSITY WILDERNESS AREAS—CRITERIA AND

Criteria:

- $\geq$ 0.5% of total global vascular plant biodiversity endemic to the area
- $\leq$ 70% of original primary natural vegetation intact
- Human population $\leq$ 5 individuals/km^2

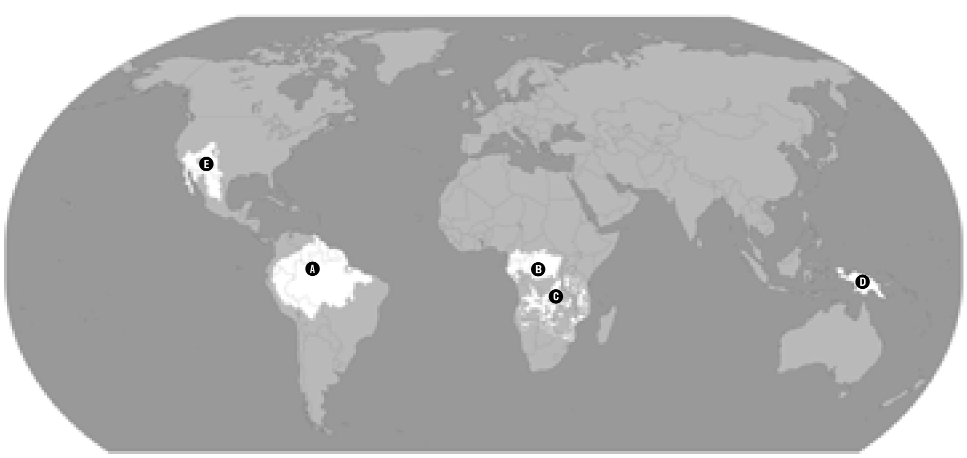
5 High-Biodiversity Wilderness Areas:

- 11.8 million km^2
- 6% of Earth's terrestrial surface
- 17% of all plant species as endemics
- 8% of all terrestrial vertebrate species as endemics

Marine Biodiversity Conservation Priorities

The world's oceans cover 70 percent of the planet's surface and are very rich in biodiversity. Indeed, although major portions of the marine realm remain little explored (e.g., deep ocean trenches), indications are that marine biodiversity, overall may be comparable to terrestrial biodiversity, and it is actually richer in terms of a range of invertebrate groups (e.g., there are 28 animal phyla in the oceans, compared with only 17 in terrestrial and freshwater systems).

FIGURE 1.6. THE FIVE HIGH-BIODIVERSITY WILDERNESS AREAS



A Amazonia
B Congo Forests
C Miombo-Mopane Woodlands and Savannahs of Southern Africa
D New Guinea
E North American Deserts Complex

Source: Mittermeier et al. *2002, 2003*

Historically, the marine realm has received far less conservation attention than terrestrial systems like tropical rain forests. CI has been involved in marine biodiversity conservation activities since the creation of the organization, but has now identified marine biodiversity as a major new growth area for the organization. As part of this effort, we have begun a series of marine conservation priority-setting exercises comparable to those for the land. Our role in the broader marine realm, including deep-sea trenches, sea mounts, and pelagic systems, is still being defined, but CI will likely use many of the same strategies included for terrestrial systems.

The first study of marine conservation priorities focused on identification of coral reef hotspots (Roberts *et al.* 2002) (Figure 1.8). This study mapped the distributions of 1,700 reef fish species (40 percent of all known species), all 804 known reef-building coral species, 662 mollusc species from the cone shell, cowrie, and volute families, and 69 important fishery species of lobster to identify multi-taxa centers of endemism based upon clustering of the species evaluated. In all, 18 centers of endemism were identified and then were evaluated and given a "Reefs at Risk" threat score (Bryant *et al.* 1998a). Those with particularly high scores were identified to be coral reef hotspots: the Philippines, Gulf of Guinea, Sunda Islands, South Mascarene Islands, Eastern

FIGURE 1.7: GLOBAL TERRESTRIAL PRIORITY ASSESSMENTS CARRIED OUT BY OTHER LARGE CONSERVATION ORGANIZATIONS

Several other assessments of global conservation priorities have been proposed. The most rigorous of these is BirdLife International's work on "Endemic Bird Areas" (EBAs). These are the 218 discrete biogeographic regions holding at least two of the planet's 2,623 bird species that have ranges of <50,000 km^2. All of the hotspots hold at least one EBA with the exception of the Succulent Karoo (desert ecosystems such as this, while often extremely rich in endemic plants, are rarely very important for birds). An introduction to the EBAs was published by ICBP (1992), and the full study was published by Stattersfield *et al.* (1998).

The World Wildlife Fund's (WWF) approach is based on "ecoregions." These are 867 biogeographic and abiotic regions that between them cover the surface of the globe (importantly, including marine and freshwater regions). As priorities, Olson and Dinerstein (1998) identified the "Global 200," 234 ecoregions that hold exceptional biodiversity. All of the hotspots overlap with at least one of the Global 200 ecoregions. WWF has also published a number of continental-level assessments of ecoregions, including for Latin America (Dinerstein *et al.* 1995), North America (Ricketts *et al.* 1999), North American freshwater (Abell *et al.* 1999), Africa (Burgess *et al.* 2003), and Asia (Wikramanayake *et al.* 2002), which are useful sources for regional information. Descriptions of all of the ecoregions are online at *www.nationalgeographic.com/wildworld.*

Overall, the similarities between EBAs, Global 200 ecoregions, and hotspots and wilderness areas are quite remarkable, given the differences in taxonomic coverage, geographic extent, and scale. In fact, almost all of the hotspots are also considered top priorities by both of these other systems. It should be noted that three other global assessments have been carried out: the Centres of Plant Diversity (CPD) study of WWF and IUCN (1994, 1995, 1997), which identified areas of important plant biodiversity; the "last frontier forests" of the World Resources Institute (Bryant *et al.* 1998b), which identified major undisturbed forests; and the "Last of the Wild" study by the Wildlife Conservation Society (Sanderson *et al.* 2002b), which identified areas of low human impact (these last two are very similar to CI's Wilderness Areas).

FIGURE 1.8: CORAL REEF HOTSPOTS—CHARACTERISTICS

Criteria/Characteristics:

- Multi-taxa centers of endemism based on distribution data for 3,235 reef fish, corals, molluscs, and lobsters
- High "Reefs at Risk" threats score (in the top two-thirds of the range of risk from human impacts)

South Africa, Northern Indian Ocean, South Japan, Cape Verde Islands, West Caribbean, and Red Sea and Gulf of Aden. Interestingly, eight of these lie adjacent to terrestrial hotspots, suggesting that geographic focus of conservation strategies could encompass terrestrial and marine conservation simultaneously.

Freshwater Biodiversity Conservation Priorities

The freshwater realm may be the most overlooked portion of the living world, and has not received sufficient attention in biodiversity conservation. In many ways, it is the ultimate biodiversity hotspot. Of all the world's water (marine and fresh), less than one percent is freshwater (excluding groundwater, ice caps, and glaciers) in rivers and lakes. Not only is this available water critical for the survival of our own species, it is also extremely rich in biodiversity. For instance, some 40–50 percent of the world's fish species are found in that 0.3 percent of the world's water that drains the land.

A number of important freshwater areas, especially for fish, are included in the world's hotspots and high-biodiversity wilderness areas. However, in other regions, freshwater will require a special focus separate from that of terrestrial systems. This is particularly the case for freshwater invertebrates, which may show rather different patterns of global biogeography from freshwater fish.

CI's actions in the freshwater realm have been confined mainly to AquaRap, a component of CI's Rapid Assessment Program™ dealing with freshwater systems. Aside from this, CI has focused to date on freshwater systems only where they have been included in terrestrial protected areas and corridors. Over the past year, however, we have identified these aquatic systems as a priority, and are now in the process of carrying out a freshwater hotspots exercise.

Guidelines for Defining Conservation Outcomes

Within all of the terrestrial biodiversity hotspots, high-biodiversity wilderness areas, and freshwater and marine priority areas, conservation action in some form is under way. Although many of these actions have had a positive impact, the conservation community has come to realize that biological diversity cannot be saved only by *ad hoc*, localized actions (Pressey 1994). In CI, therefore, we have developed a focus on what we refer to as *conservation outcomes*: the effective conservation of species, areas, and corridors that are conservation targets in order to ensure the long-term persistence of biodiversity within our global priority areas. Orienting our work around conservation outcomes enables us to measure and evaluate success of conservation investments and resulting progress toward conserving biodiversity. Defining the full set of conservation outcomes also provides a means by which CI and its partners can prioritize action and devise geographically specific strategies that will ensure complete coverage of biodiversity for wilderness areas and hotspots, including marine and freshwater priority areas.

The reason this focus has only recently emerged is, quite simply, the complexity of biodiversity (Royal Society 2003). As discussed earlier, biodiversity is not measured in any single unit, but rather is distributed across a hierarchical continuum of ecological scales (Wilson 1992). This continuum can be condensed into three levels at which conservation can realistically be carried out: species, sites, and land- or seascapes. These three scales are admittedly arbitrary, and although they interlock geographically through the presence of species in sites and of sites in land- and seascapes, they are nonetheless identifiable and discrete.

To define conservation outcomes within each of these levels, we begin by identifying those species most vulnerable to extinction: those that are globally threatened and those that are geographically concentrated. The effective protection of the full set of these species represents our 'Extinctions Avoided' conservation outcomes. Overlaying data on the spatial and temporal distributions of

FIGURE 1.9: THE PROCESS OF DEFINING CONSERVATION OUTCOMES: KEY ELEMENTS

Three key elements must be part of the process of defining conservation outcomes for a given region:

Data compilation and synthesis. Defining conservation outcomes at species, site, and corridor scales requires a variety of scientific and technical capabilities. The bulk of the work will necessarily be founded on solid biological research, largely through literature review supplemented by targeted fieldwork where knowledge gaps are present. Analysis of the IUCN Red List will help identify all globally threatened species occurring within a given region; comprehensive synthesis of species distributional data will help identify key biodiversity areas; and detailed assessment of area requirements and ecological processes will be needed to delimit corridors.

Data consolidation platform. To ensure data standards, accessibility, transparency, clear documentation of targets, and the ability to revise targets as more information becomes available, the data (including spatial data) compiled from such exercises must then be entered into a database operating from a distributed platform (**"outcomes database"**), and hence requiring considerable expertise in data management. This database has been developed by CABS-CI and is constructed around three modules, one each for species, sites, and corridors (the third of these is not yet active). The database will link to the **Biodiversity Hotspots Web site** (*www.biodiversityhotspots.org*) for public access to and download of (but not modification of) the data. It is planned that, as outcomes data are consolidated, programs will be able to access these through the **State of the Hotspots** book series. The definition of conservation outcomes also requires significant GIS capacity, to enable mapping of species distributions, existing and potential protected areas, and the configuration of biodiversity conservation corridors (**"outcome map"**). Cartographic standards for these maps are currently under discussion.

Stakeholder engagement. A key lesson from past experiences with conservation planning in CI and other organizations is that the greater the local participation in the strategy development, the greater the buy-in and hence the probability that the strategy will be implemented (Hannah *et al.* 1998). In addition, the process of outcomes definition defined herein is relatively data-intensive and will require that CI and its partners seek out and share data from many sources. Thus, the process of defining conservation outcomes should be led locally (i.e., by a CI Regional Program/CBC or partner organization), and it should involve key stakeholders who are currently working on biodiversity analysis and conservation in the region and with whom CI and its partners expect to coordinate to ensure that all conservation outcomes defined will be addressed. How other actors are involved in the process will be at the discretion of the leader of the process.

these species with current data on land use, vegetation cover, and land protection status enables us to identify areas that are key to both the near-term and long-term persistence of biodiversity. The conservation of the resulting set of sites represents our 'Areas Protected' outcomes. Finally, considerations of needs of wide-ranging threatened species, global change scenarios, and regional trends in human land use allow us to define the biodiversity conservation land- or seascapes that will be necessary to ensure the long-term persistence of the species and areas we are targeting for conservation. This gives us our 'Corridors Consolidated' outcomes.

An outline of the methodology for defining conservation outcomes in any given region (hotspot, wilderness area, country or countries) is presented below and is then described in detail in this section (Figure 1.10). Specific guidance on managing data and applying the methodology presented herein is not provided in detail, but is summarized in Figure 1.9.

1. **Define 'Extinctions Avoided' outcomes:** Identify, list, map, and consolidate data on globally threatened species and geographically concentrated species occurring in the region.
2. **Define 'Areas Protected' outcomes:**
   - Start with information on globally threatened birds and coverage of Important Bird Areas (IBAs), because these data are often available.
   - Analyze distributions of other globally threatened and geographically concentrated species occurring in the region.
   - Overlay data on environmental features, protected area boundaries, current land tenure, and land use.
   - Delineate key biodiversity areas for all taxa.
3. **Define 'Corridors Consolidated' outcomes according to the following principles:**
   - The areas to include are those necessary for conserving (1) globally threatened species that cannot be well conserved at the site scale, or (2) non-threatened species and/or ecological processes essential to the persistence of key biodiversity areas and the species in them.
   - As conservation tactics, biodiversity conservation corridors should be designed to take into account existing and emerging threats to biodiversity, benefits, and opportunity costs.
4. **Prioritize among conservation outcomes for investment and action.**
5. **Repeat and refine 1–4 above as new data become available or as focus at finer geographic scales allows.**

Note—detailed approaches for prioritizing among conservation outcomes are still under development and are therefore not presented in detail in this handbook. Initial thinking regarding prioritization among outcomes is summarized at the end of this chapter.

Altogether, the adequate protection of the species, areas, and corridors that are defined following the above methodology will mean achieving all of conservation outcomes within any given region.

Defining 'Extinctions Avoided' Conservation Outcomes: Globally Threatened and Geographically Concentrated Species

Although it is true that extinctions are a natural part of the Earth's history—the fossil record suggests that the average lifetime of a species is about a million years—the effects of humans through habitat destruction, unsustainable harvest, the introduction of invasive species, and disruption of natural ecological processes have increased extinction rates at least a thousand-fold

FIGURE 1.10: PROCESS FOR DEFINING CONSERVATION OUTCOMES: CASE STUDY FROM THE PHILIPPINES

Defining 'Extinctions Avoided' Outcomes

Targets for achieving 'Extinctions Avoided' outcomes are globally threatened and geographically concentrated species. Data are compiled for each species on conservation status, distribution, threats, and needed conservation actions. The set of 'Extinctions Avoided' outcomes for the Philippines includes 396 globally threatened species, according to the IUCN Red List, of which 83 are Critically Endangered, 74 Endangered, and 239 Vulnerable. The photographs illustrate four species targets for 'Extinctions Avoided' outcomes.

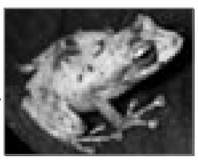


Photo by Rafe Brown

Hazel's forest frog *Platymantis hazelae*
Vulnerable. According to the IUCN-SSC/CI-CABS Global Amphibian Assessment, this species is restricted to the high-elevation mountains of Negros and possibly Masbate Islands in the Philippines. Threats include deforestation and habitat conversion. There is an urgent need to protect remaining rain forests of Negros and Masbate.


Photo by Larry Heaney

Visayan spotted deer *Cervus alfredi*
Endangered. The Visayan Spotted Deer is restricted to the islands of Panay and Negros in the Philippines. It has been extirpated on Cebu, Guimaras, and probably Masbate. The few hundred animals remaining in the wild are threatened by hunting.


Photo by Thomas Brooks

Flame-templed babbler *Dasycrotapha speciosa*
Endangered. This lowland forest bird is endemic to the islands of Negros and Panay in the Philippines. It has a small, severely fragmented, declining range. BirdLife International recommends further surveys to locate additional sites.

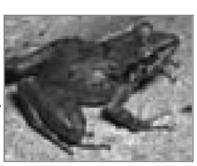
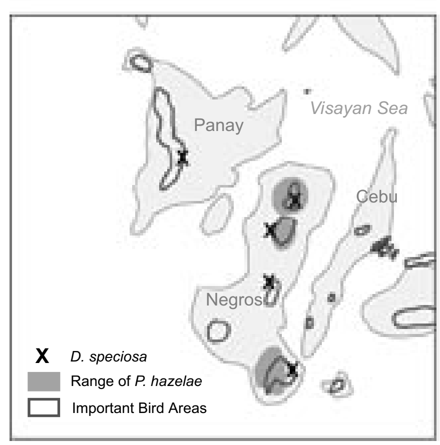


Photo by Rafe Brown

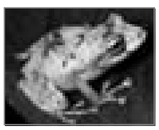
Island forest frog *Platymantis insulatus*
Vulnerable. The Island Forest Frog is known only from the tiny South Gigante Island in central Philippines. It is threatened by guano mining and limestone quarrying. Experts involved in the recent Global Amphibian Assessment recommend designation of the island as a special protected area.

Defining 'Areas Protected' Outcomes

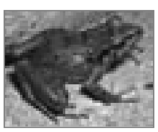
Targets for 'Areas Protected' outcomes are key biodiversity areas—sites that are needed to conserve globally threatened and geographically concentrated species. Key biodiversity areas are delineated and mapped using biological and geophysical data. The boundaries are further refined using sociopolitical data, such as existing protected areas and other management units. Information is compiled for each site on threats, protected status, and key conservation actions. Maps below andat right show the definition of targets for 'Areas Protected' outcomes in the Philippines, building from the Important Bird Areas (IBA) identified by the Haribon Foundation.



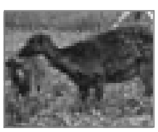
As illustrated at left, *Dasycrotapha speciosa* only occurs in four sites on Negros and one on Panay designated as Important Bird Areas. The presence of locally threatened bird species, including *D. speciosa* makes these sites key biodiversity areas and targets for 'Areas Protected' outcomes.



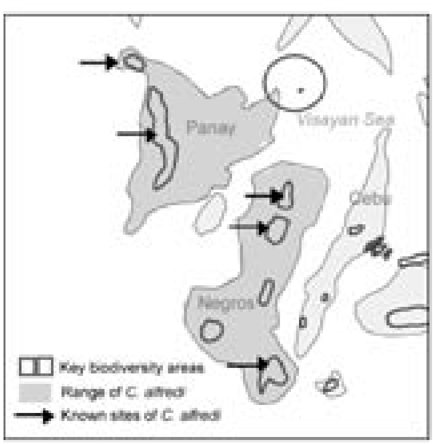
The Global Amphibian Assessment found that *Platymantis hazelae* occurs in three areas already designated as key biodiversity areas.



Platymantis insulatus is known only from the tiny South Gigante island, which is not an IBA. A new key biodiversity area should be identified for this species.



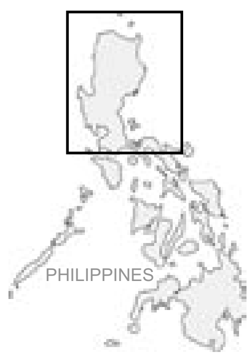
As illustrated below, the range map of *Cervus alfredi* alone does not provide enough information to determine in which sites it occurs. Further research is required to identify existing or new key biodiversity areas for this species. A literature review confirms it occurs in 5 of 7 key biodiversity areas on Panay and Negros (see arrows on map).



Defining 'Corridors Consolidated' Outcomes

A system of key biodiversity areas provides the backbone for biodiversity conservation corridors. Targets for 'Corridors Consolidated' outcomes include key biodiversity areas and threatened species and ecological processes that cannot be effectively conserved at the site scale alone. Corridors are designed to meet conservation targets and address existing and emerging threats, while generating socioeconomic benefits and limiting opportunity costs.

Some wide-ranging threatened species cannot be conserved at the site scale alone. The Sierra Madre Biodiversity Conservation Corridor was designed to conserve species like the Philippine Eagle *(Pithecophaga jefferyi)*, a Critically Endangered species that has large home ranges and hunts over large distances. Breeding pairs of eagles defend territories as large as 50 km^2, which is larger than most key biodiversity areas. Like for key biodiversity areas, the delineation of corridors is a dynamic process as new data become available. The definition of additional species-, site- and corridor-level conservation targets for this region will influence the boundary of the Sierra Madre Corridor.



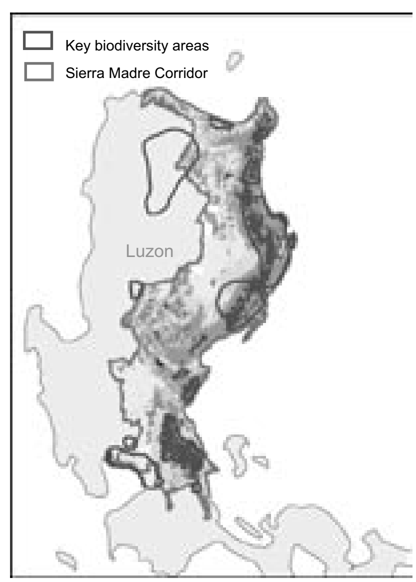


FIGURE 1.11: CONSERVATION PLANNING APPROACHES USED BY OTHER ORGANIZATIONS

The **BirdLife International** partnership aims very explicitly to achieve four conservation goals, of which the first three correspond to CI's conservation outcomes. At the species scale, BirdLife's goal is to prevent the extinction of any bird species (equivalent to CI's 'Extinctions Avoided' outcome). At the site scale, BirdLife's goal is the conservation of Important Bird Areas (see Appendix II); this is equivalent to CI's 'Areas Protected' outcome. At the landscape scale (equivalent to CI's 'Corridors Consolidated' outcome), BirdLife's goal is to conserve habitats for common birds; implementation toward this goal has to date been largely restricted to Europe (Tucker & Evans 1997). In addition, BirdLife has a fourth conservation goal—to develop a motivated constituency of birdwatchers as a voice for bird conservation.

The Nature Conservancy's (TNC) writings on concerning conservation planning are voluminous. TNC's seven-step approach is summarized by Groves *et al.* (2003) as follows: (a) identify conservation targets (meaning communities and ecosystems, abiotic characteristics, and species); (b) collect information and identify information gaps; (c) establish conservation goals; (d) assess existing conservation areas; (e) evaluate ability of conservation targets to persist; (f) assemble a portfolio of conservation areas; and (g) identify priority conservation areas. These seven steps parallel CI's process of defining outcomes and prioritizing among them, although with an emphasis on environmental rather than taxonomic surrogates for biodiversity, probably because the system is designed for use in the relatively species-poor United States. The TNC manual *Designing a Geography of Hope* (Groves *et al.* 2000), maps out how these seven steps of "ecoregional planning" are followed by site planning and conservation action, and then by measurements of success.

The planning frameworks of other conservation organizations are as yet less well developed. The **Wildlife Conservation Society's** recent thrust has been to identify landscape species (Sanderson *et al.* 2002a), which has some close parallels with CI's definition of 'Corridors Consolidated' outcomes. Conservation planning in the **World Wildlife Fund** concentrates on developing biodiversity visions for ecoregion-based conservation, at least traditionally through specialist workshops.

(Pimm *et al.* 1995). This is equivalent to the extinction spasm caused by the impact of a huge meteor 65 million years ago that devastated the planet and exterminated the dinosaurs (Alvarez *et al.* 1980). Many areas, particularly oceanic islands—such as New Zealand—in the Caribbean and the Pacific, have already suffered massive extinctions due to human impact over the last couple of millennia, and the species that remain are in desperate need of conservation management (Steadman 1995). Similarly high extinction rates have plagued many freshwater systems over the last two centuries (McAllister *et al.* 1997). On the continents, mass extinctions have not yet struck, but the wave of these species losses is on the verge of breaking in the hotspots (Brooks *et al.* 2002).

Thus, the first level of ecological organization that we must target for conservation is that of species. To define CI's species-level 'Extinctions Avoided' conservation outcomes, we first identify globally threatened species in the hotspot or wilderness area—those listed with threatened status on the most recent IUCN Red List of Threatened Species™ because these are species known to have a high probability of extinction in the short- or medium-term future (on the time scale of decades to centuries). In addition, we know that geographically concentrated species are more vulnerable to extinction than those with large ranges (Brown 1984), and so these species are a second category of targets for 'Extinctions Avoided' outcomes. These are not mutually exclusive categories; many geographically concentrated species in the hotspots are also threatened. However, it is convenient to maintain these categories, because the ways in which we identify them differ. Thus, we use two major elements to define our species-level 'Extinctions Avoided' conservation outcomes:

1. Identify, list, map, and consolidate data on globally threatened species; and

2. Identify, list, map, and consolidate data on geographically concentrated (endemic) species.

Only these criteria—threat and endemism—qualify a species as a target for an 'Extinctions Avoided' outcome. Species not meeting these criteria—even those that are considered to be flagship, keystone, umbrella, indicator, or landscape species—are not included as targets among CI's 'Extinctions Avoided' outcomes, although many of these species will be represented in the areas and corridors CI targets for conservation action (Figure 1.12).

It should be noted that although the majority of 'Extinctions Avoided' conservation outcomes are relevant primarily to hotspots—the fact that threat and endemism are used to define these ecoregions leaves it inevitable that they hold many globally threatened and geographically concentrated species—species-scale outcomes are also relevant to the high-biodiversity wilderness areas. By definition, wilderness areas do tend to hold relatively few threatened species, but they also by definition contain globally significant endemism—large numbers of geographically concentrated species.

Identify, List, Map, and Synthesize Data on Globally Threatened Species

Identifying species in a region of interest that are currently considered to be threatened on a global scale requires querying the IUCN Red List of Threatened Species™. The Red List has been developed over the last 40 years by the Species Survival Commission (SSC) of IUCN—the World Conservation Union—and partners (Fitter and Fitter 1987) and represents the best global standard regarding evaluations of the conservation status of species (Lamoreux *et al.* 2003). Over the past decade, these evaluations have been strengthened further through the application of quantitative criteria under which the probability of extinction is estimated for each species (Mace and Lande 1991).

The Red List indicates a conservation status of globally "threatened" for those species that are "considered to be facing a high risk of extinction in the wild" (IUCN 2001), and nearly 20,000 species have now been assessed to be threatened worldwide (IUCN 2003). These threatened species include all species listed on the global IUCN Red Lists as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or Extinct in the Wild (EW). It excludes species that are Extinct (EX), although should wild populations of these species be rediscovered, they would clearly move immediately into one of the threatened categories and hence trigger the criterion for 'Extinctions Avoided' outcomes.

In defining 'Extinctions Avoided' outcomes, we exclude species listed as Near Threatened (NT) because this category of threat is not quantitatively defined and is in any case much less serious than for threatened species. We also exclude species listed as Data Deficient (DD) because these species are research priorities, which may or may not prove to be conservation priorities. Finally, we do not include as targets those species considered to be only nationally threatened, as the object of the definition of 'Extinctions Avoided' outcomes is to avoid global extinctions (while almost all globally threatened species will also, of course, be nationally threatened, the converse is not necessarily true). Recognizing that national red lists are important in promoting conservation action at the national and regional levels, in countries with national red lists that have adopted IUCN's revised *Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0 (www.iucn.org/themes/ssc/redlists/regionalguidelines.htm)*, these should be used as tools for decision-making regarding country endemics.

Clearly, not all species have been evaluated against the IUCN Red List criteria (Figure 1.13), but the taxonomic coverage of the list is rapidly expanding, and it represents the finest resolution and most comprehensive measure of the state of biodiversity available. An important area of work for the conservation community is to continue to gather data on poorly known species so that their status can be assessed. In particular, capturing data on nationally threatened species is an important endeavor because many of these species—especially nationally endemic invertebrates and plants—have yet to be assessed for the global Red List. By comparing national with global

FIGURE 1.12: SPECIES-SCALE 'EXTINCTIONS AVOIDED' OUTCOMES: WHY THEY ARE DIFFERENT FROM OTHER COMMONLY USED DESCRIPTIONS OF SPECIES

Species targeted through CI's 'Extinctions Avoided' outcomes are all species identified on the IUCN Red List of Threatened Species™ as having a high probability of extinction in the medium-term future, plus those that (as data become available) are quantifiably shown to be geographically concentrated. They may be, but are not necessarily:

a) **Flagship Species.** These are popular, charismatic species that serve as symbols and rallying points to stimulate conservation awareness and action. For example, flagship species are important conservation tactics in environmental awareness and education campaigns (Leader-Williams and Dublin 2000).

b) **Umbrella Species.** These have large home ranges but specific habitat requirements, such that their conservation is often assumed to save many other species automatically. However, the empirical evidence for this is scanty at best (Andelman and Fagan 2000).

c) **Keystone Species.** These are species whose impacts on their community are greater than expected from their relative abundance (Simberloff 1998). A subset of these are engineer species, which actually modify their ecosystems (Jones *et al.* 1994). While conservation of these species will be very important for achieving corridor-scale conservation outcomes, they are not necessarily targets for species-scale conservation in themselves.

d) **Indicator Species.** The presence or fluctuation of an indicator species is believed (or hoped) to reflect either that of other species in the community or a change in the environment (Landres *et al.* 1988). However, it is uncertain that any species can serve as a consistently good indicator. In addition, when using indicator species, it is important to note that specific conservation action targeted at an indicator species is likely to change its indicator ability (Simberloff 1998).

e) **Landscape Species.** The Wildlife Conservation Society has recently defined species that "use large, ecologically diverse areas and often have significant impacts on the structure and function of natural ecosystems" as "landscape species" (Sanderson *et al.* 2002a). This effectively combines the above terms of umbrella and keystone species, and has much potential to assist the definition of corridor-scale outcomes, but does not necessarily identify species-scale conservation targets.

FIGURE 1.13: EVALUATION OF THE CONSERVATION STATUS OF SPECIES OF VARIOUS TAXA

All birds have now been assessed under the IUCN Red List Criteria (BirdLife International 2000), and these data are held in the World Bird Database (*www.birdlife.org/datazone*), which will be fully interoperable with the Species Information Service (SIS) when this comes online. Thus, all threatened birds already have been identified on the IUCN Red List.

For mammals, the IUCN Global Mammal Assessment (GMA), for the world's roughly 5,000 mammal species is currently under way. For those large mammal groups represented by IUCN specialist groups, threat assessments are comprehensive and up-to-date on the Red List. For small mammals, however, the only comprehensive threat assessment remains Baillie and Groombridge (1996); these species have been added to the Red List but the assessments are somewhat out of date. The initial collection of range information has been completed, mainly by research groups at the University of Virginia and the Institute of Applied Ecology/University of Rome, with help from a wide range of other people and organizations. Taxonomy follows the forthcoming third edition of *Mammal Species of the World*, although some taxonomic groups still follow the second edition (Wilson and Reeder 1993, *www.nmnh.si.edu/msw*), because not all draft chapters of the new edition are currently available. Extent-of-occurrence range maps are available for all species, and for many species point data have also been compiled, although for many species there are still inadequate maps and taxonomic problems. The data for each species are stored as ArcView™ shapefiles, with an associated information table for all the maps. Marine species (sirenians, cetaceans, pinnipeds, and a few other carnivores) have been excluded, although these will be addressed in the near future; they have been assessed for the Red List. The next step for the Global Mammal Assessment will be thorough review and revision of threat status, distribution, habitat preference, wildlife trade, and other information, and incorporation of this information into the SIS. This review process is critical for ensuring appropriate data quality, especially for the many small mammal species lacking published information.

For amphibians, the IUCN Global Amphibian Assessment (GAA), hosted by CABS-CI, is currently compiling data on the world's approximately 5,600 species. The GAA is essentially complete for South, Southeast, and East Asia, the Papuan Region, Australia, the former Soviet Union, Mesoamerica, South America, Africa, and Madagascar—in other words, the data have been fully reviewed and edited for about 5,250 species. The current priorities are to complete the data reviews for Europe, North America, and West Asia, and to complete a final consistency check of the data. The GAA launch and publication will probably be delayed until September 2004. All geographic data have been compiled as ArcView™ shapefiles and are stored in a prototype version of SIS; taxonomy follows *Amphibian Species of the World* (Frost 2002, *research.amnh.org/herpetology/amphibia/index.html*).

Comprehensive evaluations of other taxa have yet to be undertaken, although plans for global assessments of reptiles, fish, plants, and other taxa are in preparation, and comprehensive data from these groups will be integrated when they become available. Many species (although still a small proportion of all species) from these taxa have already been assessed, and 300 reptiles, 2,000 invertebrates, and nearly 6,000 plant species (including many of those endemic to Mediterranean-type hotspots holding few terrestrial vertebrate species) are already on the Red List. Numerous aquatic taxa, including 750 fish, have also already been assessed as threatened, although only 328 specifically marine species have been assessed; doubtless many more threatened aquatic taxa will be identified as assessments progress.

Red Lists, sets of mismatches will be produced, and those that result from species that are truly globally rare but which have not yet been evaluated for the global Red List can be submitted directly to IUCN for addition to the next global Red List (see *www.iucn.org/themes/ssc/redlists/petitions.html*).

Once the globally threatened species in the region in question have been identified, key information on those species must be consolidated to support later definition of key biodiversity areas and biodiversity conservation corridors as well as to define specific necessary conservation actions. The outcomes database (described earlier) provides a platform in which to consolidate these key elements of information, which include altitudinal range, proposed conservation actions, contacts and references relevant to the species, and, crucially, occurrence in specific key biodiversity areas and landscape species status (see below). Habitats and threats are also core data to synthesize and cross-check with the information on the Red List.

To obtain this information, the best starting point is the IUCN Red List, which provides a free, public searchable online database containing data (with the exception of distribution maps) on all globally threatened species assessed to date (*www.redlist.org*), along with full details of methodology and criteria. In addition, the IUCN Species Information Service (SIS) is currently under development to manage these data over the long term (Gimenez-Dixon 2000). Outcomes definition teams are also encouraged to reference other reliable sources. Many online searchable databases of species information are listed in Appendix III. These should be complemented with more detailed information obtained from local experts and locally available data sources.

Identify, List, Map, and Synthesize Data on Geographically Concentrated Species

Species that have geographically concentrated ranges should also be targets for 'Extinctions Avoided' conservation outcomes, because these provide a measure of irreplaceability—if their range is lost, there are no other options anywhere else for their conservation. Such geographic concentration encompasses several possible situations. First and most obvious are species that have small ranges in an absolute sense: we refer to these as restricted-range species. Species that occur in a single ecoregion or biome alone are also geographically concentrated; this will generally incorporate all species that have absolutely small ranges too. Finally, some species congregate geographically at particular times, and so these congregatory species should also be viewed as geographically concentrated.

Several problems face the definition of 'Extinctions Avoided' outcomes for geographically concentrated species, however. For restricted-range species (often known as "endemics") the complication is whether to set an absolute or a percentage threshold for incorporation. The former option was used by BirdLife International (Stattersfield *et al.* 1998) in considering species with extents of occurrence of <50,000 km^2—about 25 percent of all birds—as having restricted ranges (see Text Box #3). Applying this threshold to other higher taxa is problematic, however, because range size scales with body size and dispersal capability, so most small flightless species will likely have smaller distributions. An alternative option for defining "restricted range" is to use the lowest quartile of extents of occurrence (EO) as a percentage cutoff for any given higher taxon, which would match the percentage of birds with ranges of <50,000 km^2. For ecoregion- or biome-restricted species, the complication is what system of biogeographic classification to use: WWF's ecoregions (Olson *et al.* 2001), on which CI's hotspots and wilderness areas are based, seem to be the most likely possibility. For congregatory species, the problem is again what numeric or percentage threshold of individuals congregating in a single place at a single time to use for incorporating a species. Much important applied research is therefore necessary to address these issues. This research will be particularly complex for aquatic species, because most freshwater species typically occupy only a small fraction of their extents of occurrence, while marine taxa often occupy a three-dimensional habitat space much larger than their two-dimensional extent of occurrence would indicate.

Nevertheless, in order to ensure that the most geographically concentrated species are not lost while this research is underway, we set an interim threshold to consider any and all species with known global extents of occurrence of <20 km^2 as targets for 'Extinctions Avoided' outcomes. This is in any case a criterion for triggering the VU D2 criterion of the IUCN Red List. At present, this is the only criterion that will be used for identifying geographically concentrated targets for 'Extinctions Avoided' outcomes. Appendix I addresses frequently asked questions regarding 'Extinctions Avoided' outcomes.

Defining 'Areas Protected' Conservation Outcomes: Key Biodiversity Areas

As discussed in the introduction to this chapter, CI defines site-level, 'Areas Protected' outcomes on the basis of the distributions of the globally threatened and geographically concentrated species targeted for conservation under 'Extinctions Avoided' outcomes. We refer to these habitat areas as ***key biodiversity areas***, sites within which biodiversity can be managed for conservation. Thus, the targeting of 'Areas Protected' outcomes requires both (1) the definition and delineation of key biodiversity areas—those areas comprising critical habitat important for the survival of globally threatened and geographically concentrated species, and (2) refinement of these key biodiversity areas based on information on land tenure, protection status, and other socioeconomic variables. Depending on the resolution of analysis, in many cases a key biodiversity area may be an area that can be managed as a single unit (e.g., a national park). If, however, the outcomes definition analysis is being conducted at a large scale (e.g., hotspot or wilderness area), limitations on sufficiently fine-resolution data on land use and land tenure may inhibit our ability to identify sites that can truly be managed as single units.

It should be noted that, in its usage here, the concept of 'Areas Protected' is intended to be somewhat expansive, to include not only government-designated strict protected areas, but also any area that has legal or binding contractual protection and is managed with conservation of biodiversity as an official goal. Thus, these areas could be a national park, wild river, marine reserve, or any other category of protected area. They could exist on government lands such as military reservations, or on indigenous reserves, community lands, or a private farm or ranch. Indeed, in regions with no clear system of land tenure or water rights, they could be areas delimited physically rather than socioeconomically: an island, a mountaintop, a patch of forest, a wetland, a lake, or a coral reef.

Identification of Key Biodiversity Areas

The identification of key biodiversity areas must follow strict criteria based on the presence of apparently viable populations of species requiring urgent conservation action. Thus, the fundamental criteria for identifying key biodiversity areas are vulnerability and irreplaceability; *vulnerable* areas are defined as those that support the regular presence of significant numbers of one or more globally threatened species, and *irreplaceable* areas are defined as those that support geographically concentrated species, as follows:

a) ***Vulnerability: globally threatened species.*** The most important criterion for the identification of a key biodiversity area is the regular presence of viable populations or significant numbers of one or more globally threatened species. As described in the criteria for defining 'Extinctions Avoided' outcomes, these are species for which conservation status has been quantitatively assessed against the standard IUCN Red List criteria, with the result that the species in question is "considered to be facing a high risk of extinction in the wild" (IUCN 2003). The main complexity concerning this criterion involves estimating whether the population of a given threatened species at a given site is viable. In the absence of detailed ecological information—as will generally be the case—this will have to be judged according to the best available knowledge and through informed specialist opinion based on the life history, home-range size, reproductive mode, and longevity of the species in question. As noted earlier, not all species have been evaluated against the Red List criteria; however, until such assessments are made, species cannot trigger the identification of key biodiversity areas under this criterion, because of the need to have a global standard upon which species-level targets are based.
b) ***Irreplaceability: geographically concentrated species.*** In addition to elements of vulnerability, the presence of geographically concentrated species (restricted-range, biome-restricted, and congregatory species) is a trigger for the identification of key biodiversity areas. For the short term, only species with global ranges of <20 km^2 will trigger the irreplaceability criteria for most taxa (for birds, as discussed above, existing work in IBA identification will also be used to trigger these criteria for key biodiversity areas).

Three main biogeographic criteria are used to identify a key biodiversity area characterized by such *irreplaceability*:
i) ***Restricted-range species.*** The first irreplaceability criterion is determined by a threshold definition of endemism: a cutoff area of global range size (extent of occurrence). As discussed above, birds have been fully evaluated following a cutoff range size of 50,000 km^2 (Stattersfield *et al.* 1998), which reveals that roughly 25 percent of all birds have such "restricted ranges." Given the complexities discussed above, we set only a very low threshold for other taxa for the present time: any species with known global extents of occurrence less than 20km^2 will also trigger this criterion. The regular presence of viable populations or significant numbers of restricted-range species will generally be the criterion second in importance (to that of globally threatened species) for the identification of a key biodiversity area.
ii) ***Biome-restricted species.*** BirdLife International uses the concept of biome restriction to ensure that sites important for species endemic to large biogeographically homogeneous units (e.g., desert) are not omitted (Peterson and Watson 1998). Thus sites can be identified on the basis of their holding a "significant component" of species restricted to a given biome. The definition of "biome" has been derived by BirdLife International and could usefully be revised to ensure consistency with CI's hotspots (Mittermeier *et al.* 1999) and wilderness areas (Mittermeier *et al.* 2003) and WWF's ecoregions (Olson *et al.* 2001). Further research is necessary to assess the use of this criterion, and so it is not at present being used for identifying key biodiversity areas, except for birds.
iii) ***Congregatory species.*** A third irreplaceability criterion for the identification of key biodiversity areas is the presence of a high proportion of the individuals of a single species at a single site at a particular time of year (Gómez de Silva Garza 1996). Examples are shorebirds and diadromous fishes on passage at certain estuaries, wildfowl wintering on particular lakes, raptors migrating over narrow straits, spawning aggregations of snappers and groupers, and migrations of large-bodied riverine fishes. The cutoff threshold for this criterion is that

1 percent of the total global population of a species must be present at a single site at the same time (BirdLife International's criteria for congregatory species are rather more sophisticated than our simple 1 percent threshold, because better data are available for birds). Such congregations are currently the subject of a CABS-CI assessment.

All key biodiversity areas, and thereby all targets for 'Areas Protected' conservation outcomes, must meet at least one of these criteria.

The process for applying these criteria to generate the set of key biodiversity areas and then delineate the conservation management sites that will be targets for our 'Areas Protected' outcomes includes the following steps and datasets:

1. Start with information on globally threatened birds and coverage of Important Bird Areas (IBAs), as these data often already exist from BirdLife International and partners.
2. Analyze distributions of other threatened and geographically concentrated species occurring in the region to identify and document the sites in which each species occurs, using data from the peer-reviewed and gray literature, museum records, and other trustworthy sources.
3. Overlay environmental data (e.g., vegetation classification and elevation), boundary data for existing protected areas, and data on current land tenure and land use to help delineate key biodiversity areas for all taxa.

Start with Information on Globally Threatened Birds and Coverage of Important Bird Areas (IBAs), Wherever Possible

Important Bird Areas (IBAs) represent the site-level targets for a significant number of our target species. IBAs are based upon global criteria organized according to vulnerability (threatened species) and irreplaceability (restricted-range, biome-restricted, and congregatory species). Thus, IBAs represent the ornithological subset of key biodiversity areas. CI's programs and partners should work with the relevant BirdLife partners in a given region, where these exist, to access full IBA datasets and maps. The data can also be imported directly from BirdLife International's World Bird Database. A summary of existing IBA directories is given in Appendix II. Note that in Europe, IBAs have been identified by using regional and national and global criteria; regional and national IBAs should not be incorporated in the set of targets for global conservation outcomes.

Analyze Distributions of Other Threatened and Geographically Concentrated Species Occurring in the Region to Identify and Document the Sites in Which Each Species Occurs

We next overlay data layers that represent the presence of globally threatened, restricted-range, and congregatory species not already included in the IBA definition. Ideally these data are spatially explicit, delimiting known localities for each species on the basis of the best scientific knowledge. In practice, however, they may simply be loosely georeferenced data points or generalized extent-of-occurrence species range maps. For species beyond birds, possibly the hardest step in the process of identifying key biodiversity area outcomes is compiling the data necessary to move from these generalized species range maps to known localities. However, several potential data sources exist for such synthesis.

Among the most important are secondary sources that have the potential to produce large quantities of data for non-bird taxa, and the most accessible of these are online searchable databases, several of which are summarized in Appendix III. For plants, the Centers of Plant Diversity series (Davis *et al.* 1994–97) is indispensable. Numerous regional monographs exist, in particular for vertebrates, and these will require species identification on a case-by-case basis. Where these do not reveal the necessary data, it will often be necessary to comb gray literature (such as national park checklists), or to track back through citations—through online databases, generalized search engines, or library research. Finally, it may sometimes be necessary to trace data back to its primary source, most often a specimen in a museum collection or herbarium, or through unpublished specialist knowledge. Ultimately, of course, further fieldwork (for example, through CI's Rapid Assessment Program—Figure 1.14) will also bring in many more data for use in the definition of site-level outcomes.

Overlay Environmental Data, Boundary Data for Existing Protected Areas, and Data on Current Land Tenure and Land Use to Help Delineate Key Biodiversity Areas for All Taxa

The final stage of the identification of key biodiversity areas requires that biological, environmental, and socioeconomic data be incorporated to identify a discrete unit of land, freshwater, or ocean as a target for an 'Areas Protected' outcome. The first of these, biological data would ideally include information on the viability of populations in question. In general, viability data do not exist, but nevertheless simple principles can be followed; for example, when a site is being considered for key biodiversity area status, records of globally threatened or geographically concentrated species that are clearly vagrant individuals would be excluded. The same would be generally true for sites where records are historical only and the species in question is known to have been extirpated from the site (although this is useful information to retain, not least to keep the possibility of reintroduction open). In cases where only a handful of individuals are known to occur at the site, and the population is strongly suspected not to be viable while other populations are, it will generally be preferable to exclude the site from consideration as a key biodiversity area, although where the species is Critically Endangered (CE) or Endangered (EN)

FIGURE 1.14: RAPID ASSESSMENT PROGRAM (RAP)

For most of the planet, biodiversity information is insufficient or completely absent. It is impossible to define the importance of such areas without obtaining more in-depth information from field assessments. CI's Rapid Assessment Program (RAP) was created in 1990 to organize and carry out such assessments. The late Ted Parker and Nobel Prize-winning physicist Murray Gell-Mann conceived RAP in 1989. As they sat around the night campfire, they brainstormed: "how can we quickly learn enough about unknown tropical areas to make recommendations and catalyze conservation action in the face of impending destruction?" The result was an innovative biological inventory program designed to collect scientific information to catalyze conservation action. RAP assembles teams of expert scientists to produce rapid assessments of the biological value of poorly known areas that are potentially important biodiversity conservation sites. The combined knowledge of the RAP scientists allows them to assess the uniqueness and conservation value of an area over three to four weeks, and to make recommendations about its management. This information is quickly made available to local decision-makers through daily Internet broadcasts, press releases, media coverage, and written reports. Since 1990, RAP's teams of expert and host-country scientists have conducted 32 terrestrial, freshwater, and marine rapid biodiversity surveys and have contributed to scientific capacity for local scientists in Peru, Bolivia, Guyana, Papua New Guinea, Botswana, and Indonesia.

there is a strong justification for including even such sites as key biodiversity areas. Finally, where no biological or socioeconomic data are available, it may be necessary to resort to environmental data to delineate key biodiversity areas. Thus it may be useful to overlay information such as vegetation classifications, forest cover, habitat, or elevation, to identify a key biodiversity area as (for instance) a mountaintop, offshore island, or isolated patch of forest.

The next step necessary to delineate key biodiversity areas is to overlay boundary data for protected areas—for example, from the World Database on Protected Areas (WDPA Consortium 2003). Not all protected areas will be key biodiversity areas (although many will be), and conversely, many key biodiversity areas are as yet unprotected; nevertheless, existing protected area coverage is clearly an important dataset. As many protected areas are conserved for reasons other than their importance to global biodiversity (e.g., for their cultural, anthropological, or aesthetic importance), or following biological criteria different from those used by CI, existing protected areas do not necessarily translate into targets for 'Areas Protected' conservation outcomes; the significance of an area to biodiversity first must be verified. An existing protected area, however, will be a key biodiversity area (or part of a key biodiversity area) only if it meets the criteria of vulnerability and/or irreplaceability as defined above.

Much of the information used to define any given key biodiversity area will not necessarily be biological. To the extent possible, we then overlay data on current land tenure and land use for those key biodiversity areas (or portions thereof) not captured by existing protected areas. Socioeconomic data such as these will give us some sense of the social and legal feasibility of expanding or creating new protected areas. How data on land tenure are obtained will vary greatly across regions. In some cases, national and local government agencies may be excellent resources, while in other cases, on-the-ground surveys may be needed. Although remote sensing and aerial photography may provide data on current land use, these tools may not provide a sufficiently thorough understanding of how resources are used and managed. Ultimately, for our 'Areas Protected' outcomes to be meaningful, they must correspond to areas that can be managed for biodiversity conservation as single, contiguous, legally protected units. Consequently, as a final step in the process for defining 'Areas Protected' outcomes, we utilize data on current protection status, land tenure, and land use to identify sites that can or do meet these criteria. In some cases, a key biodiversity area already will be a single management unit under legal protection. In other cases, 'Areas Protected' outcomes will need refinement over time as better, finer-scale data become available. Further guidelines for delineating key biodiversity areas, based on experience with IBAs, are given in Figure 1.15.

Overlaying data on protection status, tenure, and use also enables us to identify the major tactics for attaining 'Areas Protected' outcomes, that is, the long-term conservation of the key biodiversity areas. These tactics can be divided into three main categories. First, for key biodiversity areas (or areas within them) that are already protected and are of sufficient size and design to meet the habitat and other resource requirements of the targeted species, our efforts will focus on ensuring that they are managed effectively to meet biodiversity conservation objectives. Second, for areas that are already protected but are not of sufficient size and design to meet the habitat and other resource requirements of the targeted species within them, our efforts will focus on expanding the area under formal protection. Finally, for areas that are not yet formally protected, we will seek the creation of new protected areas. During the process of defining 'Areas Protected' conservation outcomes, the major tactic to be pursued should be determined for each area identified. Whenever applicable, data on threats to globally threatened species should inform this decision; these threats are identified as part of the IUCN Red List assessment, and addressing them is clearly indispensable toward achieving outcomes. Clearly, the feasibility of reaching these objectives will be determined by current tenure and use of the areas in question combined with other legal, social, and economic considerations. These issues are addressed in Chapter 2, which includes guidelines on designing site-based conservation strategies.

In the aquatic realm, identifying key biodiversity areas raises several new challenges. For inland waters (freshwater, brackish water, and hypersaline lakes), the identification of discrete conservation units will often be straightforward (e.g., lakes, marshes, rapids, springs, caves, and estuaries). Small headwaters may qualify as outcomes at the site scale, but rivers will generally require corridor-scale conservation interventions (as developed, for example, through the Wild and Scenic Rivers Act in the USA). Likewise, in marine systems, key biodiversity areas should be relatively simple to delimit in most situations associated with protection of substrates (e.g., coral reefs, seagrass beds, mangroves, offshore banks, and seamounts). It may also be possible to identify pelagic key biodiversity areas, for example, seabird feeding aggregations, migratory bottlenecks for cetaceans, and large-scale gyres for tuna, but this will be complicated by the evanescent nature of many of these areas (e.g., individual pelagic gyres eventually disappear and are replaced by new gyres elsewhere). The three-dimensional complexity of the marine realm creates an obvious difficulty in identifying pelagic key biodiversity areas; this is an important area of research.

FIGURE 1.15: DEFINING THE BOUNDARIES OF A KEY BIODIVERSITY AREA

A key biodiversity area is defined so that, as far as possible, it:

i) It is different in character or biodiversity importance from the surrounding area;

ii) It exists as an actual or potential protected area, with or without buffer zones, or is an area within which biodiversity can be managed for conservation;

iii) It is, alone or with other sites, a self-sufficient area that provides all the requirements of the species, when present, for which it is important.

- Where extensive tracts of continuous habitat occur that are important for a given species, only characteristics (ii) and (iii) apply. This does not apply to migratory bottleneck sites.
- Practical considerations of how best to conserve the site are the foremost consideration.
- Simple, conspicuous boundaries such as roads and rivers can often be used to delimit site margins, while features such as watersheds, ridgelines, and hilltops can help in places where there are no obvious discontinuities in habitat (transitions of vegetation or substrate). Boundaries of ownership are also relevant.
- There is no fixed maximum or minimum size for key biodiversity areas—the biologically sound should be tempered with the practical. Neither is there a definitive answer on how to treat cases where a number of small sites lie near each other. Whether these are best considered a series of separate key biodiversity areas, or as one larger site containing some areas of low biodiversity significance, depends upon the local situation with regard to conservation and management.

Adapted from Fishpool and Evans 2001.

Defining 'Corridors Consolidated' Conservation Outcomes: Biodiversity Conservation Corridors

While protecting areas is at the center of CI's strategy to conserve biodiversity, we recognize that over the long term, these areas, even the largest of them, will not persist if the ecological and evolutionary processes that sustain them across the land- or seascape as a whole are not also conserved (Schwartz 1999). This land- and seascape vision of conservation can best be realized through managing and protecting biodiversity conservation corridors.

Biodiversity conservation corridors are both a management response to the critical problems of species loss, habitat loss and fragmentation, and a proactive response to foreseeable and current development scenarios (Sanderson *et al.* 2003). Conservation at the land- and seascape scale has the dual objective of providing sufficient, protected habitat in a spatial pattern that is conducive to the persistence of threatened species of animals and plants, and of key biodiversity areas, while at the same time responding to or guarding against the major threats to biodiversity that arise from regional disturbances. Accordingly, in this section, biodiversity conservation corridors are treated as both targets and tactics.

The definition of targets for 'Corridors Consolidated' outcomes is the most complicated of the three levels of conservation outcomes. Although strict criteria have yet to be developed, numerous conservation corridors have already been defined qualitatively; an initial overview is given by Sanderson *et al.* (2003). At the core of corridor definition is the tenet that biodiversity conservation corridors must contain key biodiversity areas as "anchors," many of which will be formally protected, with other areas of connectivity forming part of a matrix of compatible land and resource use. Here, we describe a set of key principles for defining 'Corridors Consolidated'

FIGURE 1.16: THE RELATIONSHIP BETWEEN PRIORITY-SETTING WORKSHOPS AND CONSERVATION OUTCOMES DEFINITION

Until recently, distribution maps for many of the world's globally threatened and geographically concentrated species have not been available for the conservation community, so CI has assigned area-based outcomes through conservation priority-setting workshops in a dozen regions over the last 12 years, including the Amazon Basin, the Atlantic Forest of Brazil, Madagascar, West Africa, Papua New Guinea, the Philippines, and the Guayana Shield. In the absence of good distributional data, these workshops have relied upon expert knowledge to help identify potential key areas for protection. The results of these workshops, which primarily take the form of delineated and prioritized areas and associated information, may be useful in identifying key biodiversity areas for species not yet accounted for through the processes described above. In cases where sites have been highlighted by specialist opinion but for which no data are available to justify meeting key biodiversity area criteria, it is possible to allocate candidate sites. This will be the case particularly for sites likely to be triggered by irreplaceability criteria (i.e., geographically concentrated species) for non-bird taxa (e.g., mammals, reptiles, amphibians, fish, plants, invertebrates), for which systematic data are not yet available. Specialist knowledge remains a fundamental part of conservation planning, particularly in poorly known areas. But primary emphasis should be on obtaining data to allow the application of the criteria defined above (e.g., expert knowledge on the distribution of particular species). This improves the accountability of the conservation planning process, as all subsequent decisions can be traced back to the criteria and available data.

outcomes, but we caution that the definition of corridor-scale outcomes should remain flexible as the science develops to support this process:

- Biodiversity conservation corridors should be based on the areas necessary to conserve globally threatened species not well conserved at the site scale (for example, those that are wide-ranging or have low population densities), or
- Biodiversity conservation corridors should be based on the areas necessary to conserve wide-ranging species and/or ecological processes essential to the persistence of a particular key biodiversity area.
- As a conservation tactic, biodiversity conservation corridors should be designed to address and proactively respond to existing and emerging threats to biodiversity; planning should incorporate benefits and opportunity costs.

We should note that even when fully defined, corridors will not encompass all species-level 'Extinctions Avoided' and site-level 'Areas Protected' outcomes. Some key biodiversity areas, for example, will be small, isolated islands or mountaintops where it is not desirable or practical to do conservation at the land- or seascape scale.

Biodiversity Conservation Corridors Should Be Based on the Areas Necessary to Conserve Threatened Species Not Well Conserved at the Site Scale

While species-scale 'Extinctions Avoided' outcomes are being defined, careful note should be made of those globally threatened species that range too widely to allow their successful conservation to be based on site conservation alone (Tewksbury *et al.* 2002). Thus, this criterion should encapsulate both regional-scale migration and the minimum-area home range requirements of globally threatened species. Corridors should therefore be designed to maintain dispersal among populations of species that otherwise would be isolated (Lens *et al.* 2002). Such gene flow also helps to maintain population genetic diversity, thus reducing the probability of species extinction caused by the negative effects of inbreeding (Saccheri *et al.* 1998). This criterion will also be extremely significant in aquatic systems. Rivers holding populations of species that range up- and downstream will necessarily require corridor-level conservation, while in marine systems regional-level processes such as migration will require the conservation of entire seascapes to ensure their persistence. Globally threatened species that occur at low densities because of scarce (natural or remaining) adequate habitat may also not be well addressed at the site scale, and may require conservation action at the level of the land- or seascape.

The viability of each population needs to be considered and, for conservation purposes, the size, structure, and degree of isolation of the different populations identified within the corridor. Note that even isolated populations considered to be too small themselves to be viable in the long term may play a crucial role in conservation of the species as a whole, by interaction with other populations and maintenance of genetic diversity.

In many cases ensuring connectivity will actually require habitat restoration, which raises a new set of serious complexities. First, habitat restoration is extremely expensive—orders of magnitude more so than the conservation of natural habitat. Even more important is the question, "Restoration of what?" Australia provides a good example of how complex the goals of restoration can be (Flannery 1994): should restoration aim to rebuild pre-human ecosystems of 60,000 years ago, before megafaunal extinction; or should it aim to rebuild pre-European ecosystems of 200 years ago? Despite these difficulties, habitat restoration to rebuild connectivity will sometimes be necessary, but as a guiding principle, it should be targeted as tightly as possible to the maintenance of current biodiversity, and should be given priority for investment only when intact areas are already receiving sufficient resources.

Biodiversity Conservation Corridors Should Be Based on the Areas Necessary to Conserve Species and/or Ecological Processes Essential for the Persistence of One or More Key Biodiversity Areas

We know that protecting sites also will not be sufficient to conserve biodiversity in the long term (Janzen 1983). Conversely, and equally clearly, the conservation of land- or seascapes necessary to allow the persistence of biodiversity must be anchored on core areas, embedded in a matrix of other natural habitat and anthropogenic land uses (Soulé and Terborgh 1999). Thus, a key principle for the delineation of land- and seascapes as targets for 'Corridors Consolidated' outcomes will be the maintenance of processes on which key biodiversity areas depend. These processes either may be explicitly driven by species (e.g. keystones and engineers), or assemblages of species (e.g., pollinators and seed dispersers), or they may be more generally environmental or ecological.

Numerous wide-ranging keystone species are locally but not globally threatened. Nevertheless, the persistence of these species may be of particular importance for the ecological role that they play in maintaining key biodiversity areas, through, for example, predation, herbivory (for seed dispersal in particular), and pollination. Such keystone species have impacts in the ecosystem that are far beyond those expected based on their abundance or biomass (Simberloff 1998). The local extinction of keystone species leads to cascading extinctions of other species, or directly affects the structure of the physical environment (Terborgh *et al.* 2001). Essentially, preventing these extinctions requires maintaining ecological communities in as intact a state as possible. Human impacts—especially hunting—can easily wipe out local populations of the large-bodied species necessary to maintain these processes over large areas. Large predators (bears, wild dogs, cats, and birds of prey) and game species (turtles, ungulates, primates, and galliform birds such as guans and pheasants), many of which are keystones, are usually the first groups of species to be affected by even low levels of human disturbance. The "empty forest" syndrome (Redford 1992) is a manifestation of this, where forests are structurally intact but missing species—particularly large birds and mammals. This issue is equally important in the marine realm (Jackson *et al.* 2001).

The Wildlife Conservation Society has defined a broader concept, landscape species, as those species that "use large, ecologically diverse areas and often have significant impacts on the structure and function of natural ecosystems" (Sanderson *et al.* 2002a). This holds much potential to assist in defining corridor-scale outcomes, over and above those necessary for wide-ranging threatened species (see above). Keystone and landscape species will often also be flagship species, the conservation of which is an essential tactic for motivating public support (Leader-Williams and Dublin 2000). Note, however, that there is little evidence that these should be considered umbrella species or indicators of biodiversity generally (Andelman and Fagan 2000). Further explanations of these concepts are given in Figure 1.12.

The ecological processes necessary for the persistence of key biodiversity areas may be more general than those keystone species-driven processes of predation and competition. Thus, environmental processes more generally should be considered in the definition and design of corridors. The simplest such situation would involve regions necessary for maintaining essential ecological processes that stand to be lost from a specific threat (e.g., deforestation of a mountain leading to the destruction of key biodiversity areas in rivers and onshore coastal areas through siltation). Additionally, information on regions of ecological transition may be important. The exact role of ecological transitions in maintaining biodiversity over the long term remains debated

(Smith *et al.* 2001, Brooks *et al.* 2001). What is clear, however, is that over more immediate time scales, corridors should incorporate ecological gradients (e.g., in elevation or depth) in order to bestow resilience to ongoing global changes, including climate change.

Clearly, the area requirements of wide-ranging threatened species, and of keystone species and critical ecological processes, will vary within any given region. Thus, the targets for 'Corridors Consolidated' outcomes will necessarily require the land- or seascape produced by the union of these areas.

Biodiversity Conservation Corridors Should Be Designed to Address Existing Threats and Proactively Respond to Emerging Threats to Biodiversity; Planning Should Incorporate Benefits and Opportunity Costs

Planned development projects such as roads and dams in and around biodiversity corridors often expand the development frontier into priority conservation areas. Corridors can be oriented so they not only conserve threatened species and key biodiversity areas but also counter development schemes and protect biodiversity in surrounding areas.

Tactics for achieving 'Corridors Consolidated' conservation outcomes will vary, but will involve land-use coordination or zoning of some kind or other. This will generally encompass the same geographic extent covered by the corridor target, although situations may arise where regional planning covers a slightly larger or smaller area through social, political, or institutional necessity. Planning for the tactics of biodiversity conservation corridor outcomes is covered in detail in Chapter 2.

Initial Thinking on Prioritizing Among Conservation Outcomes

In the same way that biodiversity hotspots and high-biodiversity wilderness areas define the realm of Conservation International's action at the global scale, threatened species, key biodiversity areas, and biodiversity conservation corridors represent the priorities for action within these regions, and our ultimate goal is to conserve them all. Nonetheless, we must accept that resources available for conservation efforts are scarce, and therefore need to be invested strategically to maximize the persistence of all biodiversity. Thus, once a base set of conservation outcomes has been defined for a region, we need to determine which conservation outcomes should receive attention and investment first. Note, this process is not triage—selecting which elements of biodiversity deserve conservation attention and which do not—as no element of biodiversity is dispensable or redundant.

The proposed criteria and process outlined in this section represent the current thinking within CI regarding prioritization among outcomes. At this time, these methods are outlined for setting investment priorities for key biodiversity areas only; there is little need for additional prioritization among species beyond consideration of IUCN Red List status, and the criteria and process for delimiting and defining 'Corridors Consolidated' outcomes is in a relatively early stage of development.

Key Considerations in Prioritization: Irreplaceability, Threat, and Cost

This proposed framework for prioritizing investment among key biodiversity areas is based on the rationale that biodiversity elements do not warrant the same conservation needs. Two main variables influence how different elements require different levels of attention (Margules and Pressey 2000):

- ***Irreplaceability*** (or uniqueness) of a biodiversity element is the degree to which options for conservation are lost if that element is lost (Pressey *et al.* 1994). Endemism is the most common currency of irreplaceability. For example, a site containing one or more species that occur nowhere else cannot be replaced by any other site. In contrast, if a site harbors only species that are widely distributed, alternatives exist for protecting those species.
- ***Threat*** to (or vulnerability of) a biodiversity element is the likelihood that the element will be lost or degraded in the near future (Pressey and Taffs 2001). This can be seen as a temporal (rather than spatial) measure of irreplaceability. Indeed, the options for conserving elements (such as species or sites) that face high levels of threat are limited in time: they are protected either now or never. In contrast, for elements facing low threat, options exist for conserving them in the future.

Which elements end up receiving attention first are highly influenced by a third variable:

- ***Cost*** is a measure of the difficulty that must be overcome in order to conserve a given biodiversity element. Cost is frequently an economic matter (e.g., some sites are more expensive to conserve than others) but it may also be a social/political issue (e.g., the protection of some sites creates high social conflict whereas for others there is wide community support).

Pragmatic conservation is unavoidably highly influenced by cost and opportunity. But if conservation planning is driven mainly by these considerations, it results in *ad hoc* decisions that ultimately compromise the main objective of biodiversity conservation (Pressey *et al.* 1994). Indeed, cost is frequently inversely related to threat, so a purely cost-driven strategy that focuses on elements easier to conserve tends to ignore those that most need conservation attention. This factor is responsible for the current bias of protected area networks toward remote and infertile regions (e.g., rock and ice), which are often not very valuable from a biodiversity perspective. Cost and opportunity will always influence prioritization, as, for example, by a donation toward the protection of a particular site or species, or favorable political will at a given time. But they can be directed best if they serve sound conservation strategy aiming at maximizing biodiversity protection, based on solid and transparent criteria of irreplaceability and threat.

Irreplaceability and threat interact in a complex way to determine which biodiversity elements are priorities for conservation action (Figure 1.17). Elements of high irreplaceability and high endemism must always be the top priorities for conservation investment. These are areas for which there are few options for protection in both space and time: they are sites that need to be protected right there, right now, to prevent irreversible and imminent biodiversity loss.

Low irreplaceability or low threat can mean increased flexibility in conservation options. This flexibility can be explored to minimize cost and take the maximum advantage of conservation opportunities. As a consequence, areas of high endemism and low threat deserve higher conservation attention than areas of high threat and low endemism. The latter are places difficult to conserve and for which there are currently other spatial options (maybe less expensive ones) for the protection of their share of biodiversity. In contrast, the former are "conservation bargains," where a large fraction of unique biodiversity can be protected at low cost and with minimum conflict. Given that threat status changes more quickly than does irreplaceability status (it is more likely that non-threatened areas become threatened in the near future than low endemism areas become places of high endemism), the protection of high-irreplaceability/low-threat areas is an excellent investment to preempt these areas from becoming places of high threat (and more costly conservation) in the future.

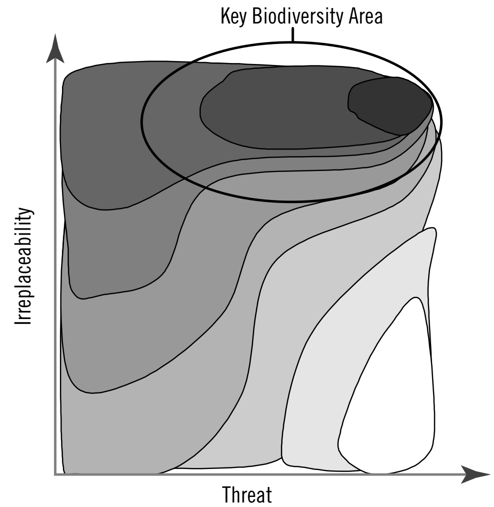
Elements of low irreplaceability and low threat are typically the lowest priorities. For these, there are many spatial and temporal options for protection, typically dictating that scarce conservation resources should be best directed elsewhere.

Conducting Prioritization Processes

Prioritization is a dynamic and ongoing process, which should be repeated as conditions and data change. For example, information on species threat status and distribution (and, hence, irreplaceability) improves; the conservation status of species and sites changes as some sites are protected and others degraded; and better information becomes available on the viability of each species' population in each site.

In addition, there is no finished recipe book for how prioritization should be done in a given region, as regions differ significantly in their biological traits, socioeconomic characteristics, and the quantity and quality of data available on each one of those. For example, some regions will have many endemic and threatened species, while others will not. Some regions will be highly fragmented (most hotspots), with many species currently restricted to single sites, while others will contain large tracts of contiguous natural habitat (particularly wilderness areas). Some regions will have well-established protected area networks adequately managed by competent national authorities, while in others, protected areas may exist on paper alone. Consequently, the purpose of prioritization exercises also varies significantly. For example, it could be a definition of priorities for expanding an existing protected area network (a gap analysis); or a selection of existing protected areas that require most investment in terms of consolidation measures (Brandon *et al.* 1998); or a set of sites of global importance for a particular taxon, irrespective of whether they are already protected or not. Figure 1.18 describes a preliminary prioritization exercise carried out by the Andean Center for Biodiversity Conservation.

FIGURE 1.17: SCHEMATIC INTERACTION BETWEEN IRREPLACEABILITY AND THREAT IN DEFINING PRIORITIES FOR CONSERVATION ACTION.



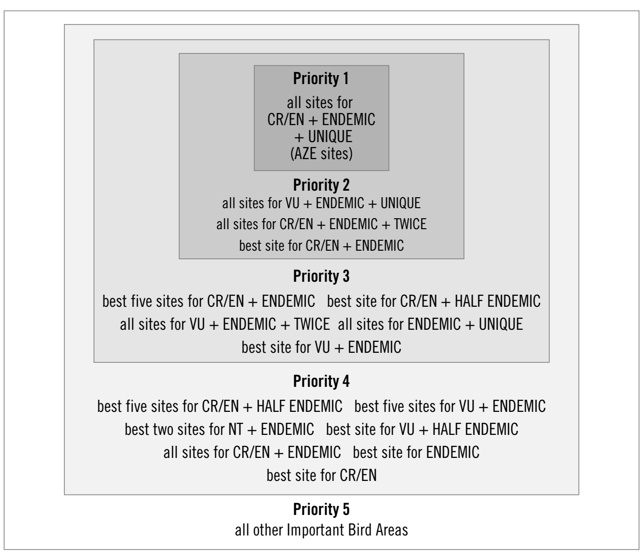
Sites of higher threat and higher irreplaceability are the top priorities. However, for lower levels of irreplaceability there is flexibility in the sites that can be chosen, and in this case, sites of high threat (if related to high cost/conflict) should be avoided. All key biodiversity areas are by definition in the top right corner of high irreplaceability and high threat; therefore, defining investment priorities among key biodiversity areas is about setting priorities within a set of sites already given high priority.

FIGURE 1.18: PRIORITIZATION AMONG KEY BIODIVERSITY AREAS IN THE ANDEAN REGION

The identification of Important Bird Areas, IBAs, (key biodiversity areas for bird species) in the Tropical Andes region is an ongoing process led by BirdLife International in collaboration with CI's Andean Center for Biodiversity Conservation. The Tropical Andes hotspot has remarkable levels of endemism and has suffered widespread habitat loss and degradation, resulting in the concentration of many globally threatened species. In regions such as these, the top priorities for conservation are AZE sites: those identified by the Alliance for Zero Extinction (*www.zeroextinction.org*) because they contain the last remaining populations of Critically Endangered (CR) or Endangered (EN) species. These are sites that, if lost, would be single-handedly responsible for at least one species extinction. The figure below presents an example of a prioritization exercise of key biodiversity areas.

With top priorities being extremely high irreplaceability and threat, the prioritization in the Tropical Andes proceeded through a set of nested criteria (below), which extend to cover progressively less irreplaceable sites and less threatened species. However, given the region's notable degree of endemism and threat and the criteria for the selection of IBAs, each site is highly irreplaceable and/or threatened. For example, 91 percent of all sites harbor restricted-range species, 26 percent of sites hold species that are present in only one or two sites, and 78 percent of sites harbor at least one globally threatened species.

In the case of the Tropical Andes, the next step will be to investigate whether the sites identified as top priorities are indeed adequate for the protection of the species that trigger their high classification. Furthermore, an assessment of the current protection level at each IBA (including protected areas, community support, local threat levels, and ongoing conservation programs) will support a gap analysis to identify which sites are already well covered by existing conservation efforts and which ones are not. These additional data will be integrated in a second stage of the prioritization process and are likely to change the current classification to highlight which sites are most adequate for the protection of all target species (particularly the most threatened ones), which require most immediate conservation attention, and which best complement ongoing conservation efforts.



Classification of IBAs of the Tropical Andes hotspot into five priority levels for conservation action. Species threat status according to the 2003 IUCN Red List of Threatened Species™: CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near-Threatened. Endemism level, based on the percentage of the species' global range in the five countries of the Tropical Andes: ENDEMIC, 90 percent of global range in the Tropical Andes; HALF-ENDEMIC, 50–90 percent of global range in the Tropical Andes. Number of IBAs where present: UNIQUE, present in only one IBA; TWICE, present in only two IBAs.

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Appendix I: Frequently Asked Questions About 'Extinctions Avoided' Outcomes

1. We are concerned that setting explicit species conservation outcomes may not be politically correct. Does this open us to the criticism that we are "valuing species above people"?

Species conservation is beneficial to people in four ways: direct economic value (e.g., revenues from ecotourism); ecosystem service value (e.g., pest control by bats); maximizing future option value (e.g., the discovery of drugs from rainforest plants); and aesthetic and moral value (e.g., bird songs). Different people value these benefits in different ways, but very often demonstration of one or more of them will actually be enormously valuable politically, e.g., in motivating local pride in support of conserving a threatened endemic species. Overall, though, it is never a question of "valuing species above people" but rather, simply, of "valuing species," whether for people or in themselves.

2. We are worried that using data on a set of species—mainly vertebrate species—to plan conservation outcomes will miss large amounts of biodiversity. Maybe we would do better using environmental surrogates for biodiversity, rather than taxonomic ones?

Several recent studies have addressed the question of whether species-level surrogates or environmental-level surrogates best represent biodiversity as a whole, and the emerging pattern is that species-level surrogates perform considerably better, as long as large quantities of species data are available. Selection of species—the finest resolution of data that we have consistently available—to represent the environment is more effective than selection of environments to represent species (Araújo *et al.* 2001).

The fact that, at present, our species-level biodiversity information is largely restricted to vertebrates does of course mean that setting conservation outcomes at the species level will not represent all species, especially plants and invertebrates. As these data become available, we can increasingly incorporate them into the IUCN Red List (e.g., certain groups of plants are planned for Red List assessment in the near future). In the meantime, however, it is essential to plan outcomes at the corridor level in order to maximize the representation of remaining natural habitat, to ensure the survival of this unknown biodiversity.

3. If we are going to achieve 'Extinctions Avoided' outcomes, shouldn't we be trying to protect all species, not just threatened species?

Yes, we certainly do want to ensure that all species are represented in conservation systems. However, if we are to achieve this goal, we need a strategy: we need to prioritize the species that we will lose unless we protect them now. These are the species with a high probability of extinction in the medium-term future, and the IUCN Red List is the best tool available for identifying such species. Once all species on the Red List are conserved, we would want to ensure that all geographically concentrated species were safe—these are naturally more vulnerable to extinction than average. Once all of these priority species have been successfully conserved, then we can broaden the targets for definition of our 'Extinctions Avoided' outcomes to encompass all species; of course, most other species will have been successfully conserved through the actions taken for globally threatened and geographically concentrated species.

4. There is still scientific debate about what constitutes a "species." Maybe we should be using a "Phylogenetic Species Concept" to define our targets for 'Extinctions Avoided' outcomes?

We should always work at the finest level of resolution for which we have comprehensive data. Following standard taxonomies, we have comprehensive data at the species level for mammals, birds, and amphibians. Going to more finely resolved levels of taxonomy, for example, to the "Phylogenetic Species Concept" (which defines species as evolutionarily independent units) is tempting where such data exist (as with some large mammal species). However, this is dangerous for two reasons. First, it will mean that the units used to define 'Extinctions Avoided' outcomes will differ between taxa and between places, and hence not be comparable. Second, it will give relatively heavier weight to groups of species that hold many similar (and only marginally evolutionarily distinct) taxa, as opposed to the unique deep lineages that represent disproportionate amounts of biodiversity, such as New Caledonia's Kagu, (*Rhynochetus jubatus,* EN).

5. What is the minimum amount of data that we need to define species-based outcomes for our hotspot (or other area)?

The fundamental data necessary for defining species-based outcomes are the occurrences of globally threatened species in any particular region (e.g., hotspot). The total set of threatened species occurring in any one region gives an excellent first cut at defining the 'Extinctions Avoided' outcomes for that region.

6. There are 10,000 species on the Red List globally. How can we prioritize our actions among these?

The IUCN Red List has a prioritization built within it, in the form of threat categories. Thus Critically Endangered (CR) species have an estimated probability of extinction of at least 50 percent within ten years, the Endangered (EN) category at least 20 percent probability in 20 years, and the Vulnerable (VU) category at least 10 percent probability in 100 years. This therefore gives an automatic measure of prioritization: protect Critically Endangered species first, then Endangered species, and then Vulnerable species.

An additional parameter that could be incorporated in prioritization is phylogenetic distinctiveness. This is effectively a measure of irreplaceability at the species level: how many millions of years of unique evolutionary history does a species "hold." Again, New Caledonia's Kagu, (*Rhynochetus jubatus,* EN), is a very good example of an evolutionarily unique species.

7. Can we define 'Extinctions Avoided' outcomes at a local or a national level?

In general, we should concentrate on defining targets for achieving outcomes that are of global conservation concern, for three reasons. The most important of these is that we must give highest priority to species that are in danger of disappearing completely. A local extinction can always be reversed at the species level through recolonization or reintroduction, whereas a global extinction is forever. Second, most conservation is local (or provincial, or national); CI is in a rare and privileged position of being able to determine the directions in which precious global conservation resources flow, and so has the responsibility of ensuring that they achieve globally significant outcomes. The third reason to focus on outcomes of global conservation concern is that this ensures that outcomes are standardized (and therefore comparable) from place to place—which is essential if we are to be able to monitor them.

This said, defining 'Extinctions Avoided' outcomes at a national or finer level can serve a useful purpose, especially in reinforcing national legislation and pride in conservation. In addition, given that all the areas in which CI works are extremely rich in endemic species, the bulk of species listed on national red lists will also be listed on the global Red List. The key danger to avoid is targeting small peripheral populations on the boundary of one country for conservation outcomes when these species are common in other countries: this has been a persistent problem for conservation in Europe and the USA. In addition, it is clearly very important not to duplicate effort through national red list processes: where taxa have already been evaluated at the global level, these assessments can generally be incorporated wholesale at the national level. Specific guidelines exist for national red list assessments (Gärdenfors *et al.* 2001).

National red lists can also be extremely valuable in that many cases exist where nationally endemic species have been assessed nationally but not globally. In such cases, the species should be assessed for the global Red List as soon as possible.

8. Some of the species listed on the Red List are common in my country. Should we still set these species as conservation targets?

Yes! This will be a relatively rare situation, but it generally involves species with very wide ranges that are declining rapidly over most of these areas. Thus, their conservation in a country in which they are not yet declining is extremely important—it may be the only hope for the species overall. The Giant armadillo (*Priodontes maximus,* EN), Giant anteater (*Myrmecophaga tridactyla,* EN), and Giant otter (*Pteronura brasiliensis,* EN) in the Guianas are excellent examples of this situation. Conservation action is most successful when species are protected in places where they are most likely to persist.

9. Most marine species have not been evaluated for threatened status on the Red List. How should we define 'Extinctions Avoided' outcomes for marine species?

It is true that many groups of marine species have yet to be assessed for the IUCN Red List, especially coral reef species. However, most marine megafauna (e.g., whales and dolphins, seals and sea lions, seabirds, marine turtles, and sharks) have been comprehensively assessed, and so an initial effort at defining marine species outcomes can at least be made. Many more groups will be assessed in the near future.

10. How can we define outcomes for intact biotic assemblages?

The current thinking is that the conservation of intact biotic assemblages is an outcome that should be defined at the corridor level rather than at the species level. Species assemblages involve not individual species, but rather entire communities of species distributed across the landscape, and so can only be conserved through corridor-scale interventions. There may be particular species within these assemblages that are indicators of the intactness of the assemblage overall—the Wildlife Conservation Society calls these landscape species—but the interventions necessary for conserving these are still necessarily pitched at the landscape scale (e.g., ensuring connectivity between habitats). Finally, much of the justification for having intact biotic assemblages as conservation outcomes is their value in producing ecological processes (e.g., predation), which are certainly corridor-level outcomes. Research on these issues is ongoing in CABS and the scientific community.

11. My data show that species A, although listed on the Red List, is actually globally abundant, while species B, not listed on the Red List, is very rare. How can I adjust the Red List using these data?

The Red List categories (CR, EN, and VU) are based on quantitative criteria, and so the entire process of Red Listing is by definition one that requires data. The responsibility for keeping the Red List up to date is delegated to Red List Authorities, who generally focus on particular taxa (sometimes on particular taxa in particular regions). These Red List Authorities can do their job properly only if they receive new data showing that Red List assessments need to be changed. In the first instance, the global Red List Officer (*redlist@ssc-uk.org*), in Cambridge, UK, can provide contacts for the Red List Authority relevant for any particular species.

12. Once we have used the Red List to identify which globally threatened species occur in our region, how do we find out what conservation interventions are necessary to prevent the extinctions of these species?

Increasingly, information on threats and conservation actions is being provided with the Red List. For birds, full documentation is provided in BirdLife International's *Threatened Birds of the World*, most of which is online at *www.birdlife.net/species/species_search.cfm*. For many mammals, many of the IUCN-SSC Action Plans are online at *www.iucn.org/themes/ssc/actionplans/actionplanindex.htm*. For other taxa currently under assessment (e.g., amphibians), documentation is being compiled into a system called the Species Information Service, which will be available online soon.

13. How can we monitor 'Extinctions Avoided' outcomes?

The question of how we monitor outcomes—at species, site, and corridor levels—is an extremely important one. For 'Extinctions Avoided' outcomes, the key difficulty is that clear indications of success (e.g., moving species from the Endangered to the Vulnerable category on the Red List) at the outcome level are likely to be attainable only after a number of years—the response time is slow. Thus, a set of more sensitive indicators, including the direction of population trends, will be necessary. In all cases, assessing outcomes will necessarily involve direct biological monitoring of populations of threatened species. A wide range of techniques (depending on the species involved) is available for implementing such monitoring in the field. The Outcomes Monitoring Program in the Regional Programs Division is working on providing guidelines for monitoring.

Appendix II: Published Important Bird Area Directories

Africa

Fishpool, L.D.C. and Evans, M.I. 2001. *Important Bird Areas in Africa and Associated Islands*. BirdLife Conservation Series No. 11. Cambridge, UK: BirdLife International.

National

Baha El Din, S. 1999. *Directory of Important Bird Areas in Egypt*. Cairo: BirdLife International.

Baker, N. and Baker, E. 2002. *Important Bird Areas in Tanzania*. Dar es Salaam: Wildlife Conservation Society of Tanzania.

Barnes, K.N. 1998. *The Important Bird Areas of Southern Africa*. Johannesburg: BirdLife South Africa.

Bennun, L. and Njoroge, P. 1999. *Important Bird Areas in Kenya*. Nairobi: NatureKenya.

Byaruhanga, A., Kasoma, P., and Pomeroy, D. 2000. *Important Bird Areas in Uganda*. Kampala: NatureUganda.

EWNHS. 1996. *Important Bird Areas of Ethiopia*. Addis Abbaba, Ethiopia: Ethiopian Wildlife and Natural History Society.

Project ZICOMA. 1999. *Les Zones d'Importance pour la Conservation des Oiseaux à Madagascar*. Antananarivo, Madagascar.

Asia

Cambodia

Seng Kim Hout, Pech Bunnat, Poole, C.M, Tordoff, A.W., Davidson, P., and Delattre, E. 2003. *Directory of Important Bird Areas in Cambodia: Key Sites for Conservation*. Department of Forestry and Wildlife, Department of Nature Conservation and Protection, BirdLife International in Indochina, and the Wildlife Conservation Society Cambodia Program, Phnom Penh, Cambodia.

India

Jhunjhunwala, S. 2001. *Important Bird Areas in Maharashtra*. Maharashtra, India: RSPB, Bombay Natural History Society, and BirdLife International.

Zafar-ul Islam, M. 2001. *Important Bird Areas of the Western Ghats, Kerala*. Bombay: Bombay Natural History Society.

Indonesia

Holmes, D.A. and Rombang, W. 2001. *Important Bird Areas in Sumatra*. Bogor, Indonesia: BirdLife International Indonesia Programme.

Holmes, D.A., Rombang, W., and Oktaviani, D. 2001. *Important Bird Areas in Kalimantan*. Bogor, Indonesia: BirdLife International Indonesia Programme.

Rudyanto and Rombang, W. 1999. *Important Bird Areas in Java*. Bogor, Indonesia: BirdLife International Indonesia Programme.

Philippines

Mallari, N.A., Tabaranza, B.R., and Crosby, M. 2001. *Key Conservation Sites in the Philippines*. Manila: Bookmark.

Vietnam

Tordoff, A.W. 2002. *Directory of Important Bird Areas in Vietnam: Key Sites for Conservation*. Hanoi: BirdLife International.

Europe and the Middle East

Evans, M.I. 1994. *Important Bird Areas in the Middle East*. BirdLife Conservation Series No. 2. Cambridge, UK: BirdLife International.

Heath, M.F. and Evans, M.I. 2000. *Important Bird Areas in Europe. Priority Sites for Conservation. Volume 1: Northern Europe.* BirdLife Conservation Series No. 8. Cambridge, UK: BirdLife International.

Heath, M.F. and Evans, M.I. 2000. *Important Bird Areas in Europe. Priority Sites for Conservation. Volume 2: Southern Europe*. BirdLife Conservation Series No. 8. Cambridge, UK: BirdLife International.

Latin America

Wege, D.C. and Long, A.J. 1995. *Key Areas for Threatened Birds in the Neotropics.* BirdLife Conservation Series No. 5. Cambridge, UK: BirdLife International.

Mexico

Del Coro Arizmendi, M. and Marquez Vadelamar, L. 2000. *Areas de Importancia para la Conservación de las Aves en México*. Mexico City: CIPAMEX.

Panama

Angehr, G.R. 2003. *Directorio de Areas Importantes para Aves en Panamá*. Balboa, Panama: Sociedad Audubon de Panamá.

Appendix III: Searchable Online Species Databases

Mammals

American Society of Mammalogists. 2002. Mammalian Species. *www.science.smith.edu/departments/Biology/VHAYSSEN/msi/msiaccounts.html* (631 species)

Wieczorek, J. 2001. Mammal Networked Information System. *elib.cs.berkeley.edu/manis* (point specimen data)

Wilson, D.E. and Reeder, D.M. 1993. Mammal Species of the World. *nmnhwww.si.edu/msw* (all species)

Birds

BirdLife International. 2000. Threatened Birds of the World. *www.birdlife.net* (all threatened species)

BirdLife International. 2003. Threatened Birds of Asia. *www.rdb.or.id* (all threatened birds of Asia)

Reptiles

Iverson, J.B. 1992. A Revised Checklist with Distribution Maps of the Turtles of the World. *emys.geo.orst.edu/*(chelonians)

King, F.W. and Burke, R.L. 1997. Crocodilian, Tuatara, and Turtle Species of the World: An Online Taxonomic and Geographic Reference. *www.flmnh.ufl.edu/natsci/herpetology/turtcroclist/* (crocodilians and chelonians)

Uetz, P. and Etzold, T. 1996. The EMBL/EBI reptile database. *www.reptile-database.org* (all species)

Amphibians

Frost, D.R. 2002. Amphibian Species of the World: An Online Reference. *research.amnh.org/herpetology/amphibia/index.html* (all species)

AmphibiaWeb 2002. AmphibiaWeb: Information on Amphibian Biology and Conservation. *elib.cs.berkeley.edu/aw* (all species)

Fish

Froese, R. and Pauly, D. 2002. FishBase. *www.fishbase.org/home.htm* (all species)

Eschmeyer, W.N., Ferraris, C.J., Jr., Mysi Dang Hoang, & Long, D.J. 1996. A Catalog of the Species of Fishes. *www.calacademy.org/research/ichthyology/species* (all species)

NEODAT II. 2002. Inter-Institutional Database of Fish Biodiversity in the Neotropics. *www.neodat.org* (point specimen data: Neotropics)

Plants

MBG. 2002. W3tropicos. *mobot.mobot.org/W3T/search/vast.html* (point specimen data)

Orthoptera (Grasshoppers, Katydids, and Crickets)

Naskrecki, P. and Otte, D. 1997. Orthoptera Species File. *140.247.119.145/Orthoptera* (all species)

Spiders

Platnick, N.I. 2002. The World Spider Catalog. Version 3.0. *research.amnh.org/entomology/spiders/catalog81-87/index.html* (all species)

Multiple taxa

Species Analyst. 2002.: *tsadev.speciesanalyst.net* (all species)

Chinese Biodiversity Information System. 2002.: *www.chinabiodiversity.com/indexe.html* (all species)

DESIGNING STRATEGIES TO ACHIEVE CONSERVATION OUTCOMES

CHAPTER 2

In this chapter

- APPROACHES TO DESIGNING/REFINING INTEGRATED ACTION PLANS TO AVOID SPECIES EXTINCTIONS, PROTECT KEY BIODIVERSITY AREAS, AND CONSOLIDATE BIODIVERSITY CONSERVATION CORRIDORS, FOLLOWING THE PROCESS OF:
    - ASSESSING STATE OF BIODIVERSITY AND ESTABLISHING BIODIVERSITY CONSERVATION OBJECTIVES
    - ASSESSING PRESSURES ON AND CONTEXT SURROUNDING BIODIVERSITY TARGETS AND DEFINING MILESTONES
    - IDENTIFYING, EVALUATING, AND SELECTING CONSERVATION RESPONSES AND DEFINING OUTPUTS AND ACTIVITIES

Introduction

Application of the conservation outcomes definition methodology presented in Chapter 1 generates a set of species, areas, and corridors that represent global priorities for conservation action. Applying the prioritization criteria presented in Chapter 1 provides a subset that represents CI's specific conservation priorities. This chapter presents guidance for designing strategies and action plans that will have the greatest potential to conserve these species, areas, and corridors.

The chapter is broken into three separate modules—Avoiding Species Extinctions, Protecting key biodiversity areas, and Consolidating Biodiversity Conservation Corridors—but each is organized following the same basic three-element planning framework, beginning with the assessment of the state (or condition) of biodiversity, followed by an assessment of the pressures contributing to biodiversity decline as well as the context that surrounds and drives those pressures, and finally the analysis and selection of a suite of conservation responses. We derive this planning approach from a commonly applied basis for many existing monitoring frameworks—the Pressure-State-Response (PSR) framework. PSR was first applied by the Organisation for Economic Cooperation and Development (OECD) and has been adopted by the Convention on Biological Diversity (CBD). The framework is based on a concept of causality. Simply put, human activities exert pressure on the environment through a range of social, political, and economic activities. This pressure changes the quality and quantity, or state, of the environment. Society reacts to these changes through environmental, economic, and policy responses (OECD 1993). These human responses to the changes include any organized behavior that aims to reduce, prevent, or mitigate undesirable change or environmental results. PSR has been applied in many countries and is recognized as a useful framework for monitoring and reporting worldwide. In fact, many of the existing monitoring and planning systems presently used by other conservation organizations, such as The Nature Conservancy's "5-S" framework (TNC 2000), stem from the PSR framework. Because CI places great emphasis on conservation outcomes, we have adapted the PSR framework to follow the logic of a different order—State-Pressure-Response (SPR)—to place consideration of the condition of biodiversity as the first step in our planning process (Figure 2.1). It should be noted that, unlike Chapter 1, which articulates a specific and mandated methodology founded in strong science for defining conservation outcomes, this chapter presents guidelines for designing conservation strategies, while recognizing that the science behind conservation strategy design is quite nascent. Nonetheless, the processes presented are rigorous and follow a set logic that, if followed, will help to ensure that the design of conservation strategies is based upon the best available information and expertise, upon careful consideration of the social context affecting biodiversity, and upon a deliberate and thoughtful planning approach.

Overview of the State-Pressure-Response Planning Framework

Although each of the planning modules in this chapter adapts the State-Pressure-Response planning framework to the scale in question, each provides guidance to answer the same basic set of questions. In assessing the state of biodiversity—whether it be a species, or the biodiversity targeted for conservation within a key biodiversity area or biodiversity conservation corridor—we begin by revisiting the conservation outcomes to be attained at the given scale. This information can be derived from the results of the outcomes definition process articulated in Chapter 1. We then assess both the condition of the biodiversity elements targeted and that of the habitat, communities, and systems upon which they depend. Using this information, we then set specific, quantifiable, and measurable biodiversity targets that must be reached if our conservation outcomes are to be achieved.

To assess pressures on biodiversity, we first identify the current and anticipated pressures on our biodiversity targets and then qualify and quantify the severity and scope of these pressures. To assist us in assessing whether to tackle the pressures directly or their causes, we then identify the sources of the pressures and characterize each according to its significance in driving the pressure, recognizing that pressures on biodiversity can result from the combined effect of several sources. We also identify those individuals or groups of individuals driving the pressures and attempt to understand what factors may be driving their behavior. We then use this information to set specific, quantifiable, and measurable changes in current behaviors and conditions that must occur if our conservation objectives are to be achieved. In CI terminology, we label these changes ***milestones***.

Finally, we begin to devise a conservation action plan to reduce the pressures on the targeted biodiversity by asking, "What are the possible incentives and approaches that CI and its partners can use to bring about the desired changes in behaviors and existing conditions? Which of these incentives and approaches are most likely to have the greatest positive impact on the most influential stresses?" At CI, the conservation responses we choose through this process are termed ***outputs***. The specific steps that must be taken to achieve our outputs, we term ***activities***.

FIGURE 2.1: STATE-PRESSURE-RESPONSE FRAMEWORK

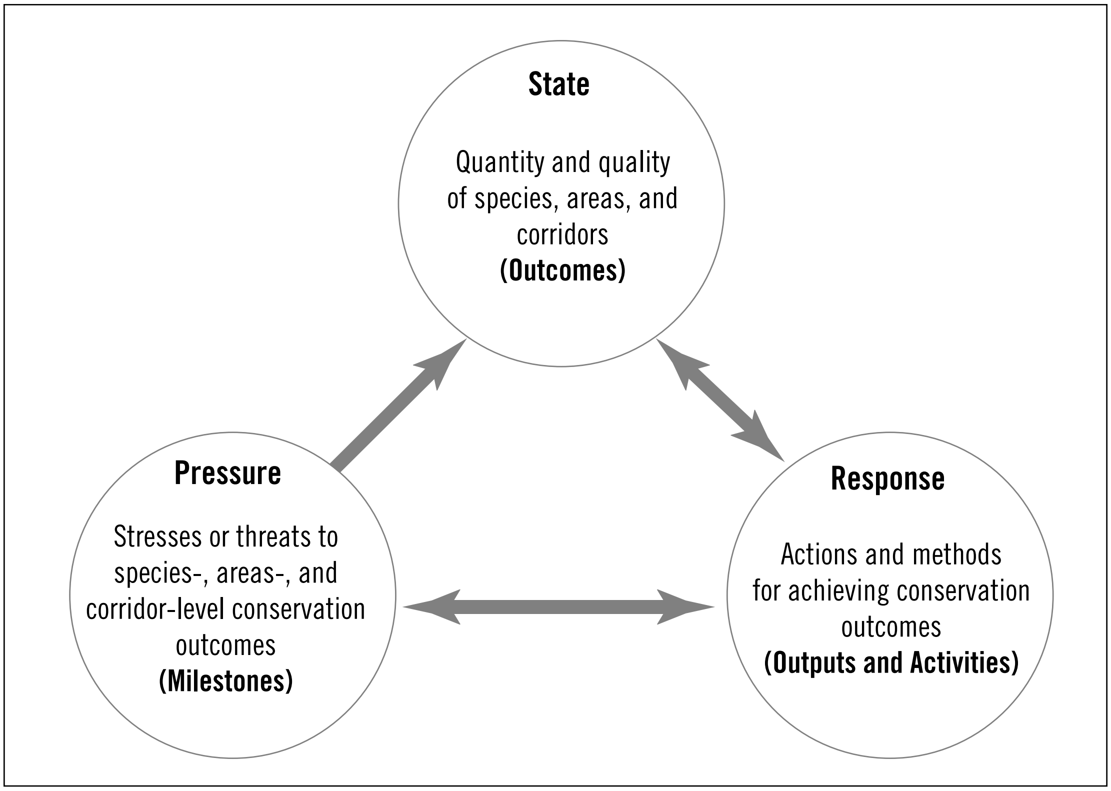


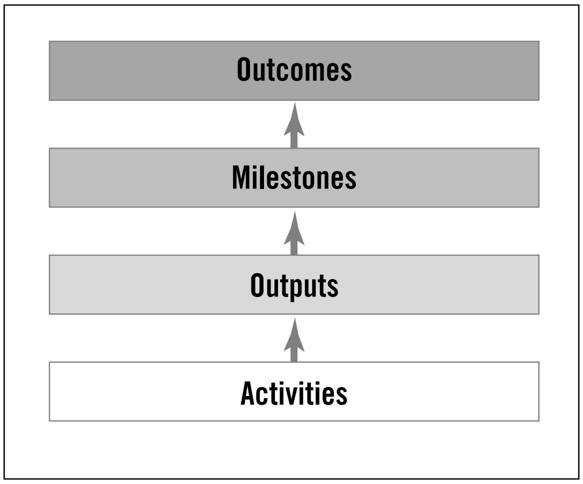
TABLE 2.1: THE RELATIONSHIP BETWEEN THE SPR PLANNING FRAMEWORK AND CI'S HIERARCHY OF OBJECTIVES

Step in Framework	Key Questions Asked	Resulting Decisions Regarding Strategy
Assess state	What are the targets/outcomes at the given scale? What is the condition of the targets and the habitat, communities, and systems upon which they depend (declining, stable, improving; viable or unviable; sufficient or insufficient)? What are the specific, quantifiable conservation objectives we hope to achieve?	Biodiversity Targets: Definition of quantifiable, measurable, and specific biodiversity targets within the site or corridor that must be attained in order to deliver our ***conservation outcomes***
Assess pressures	What are the current and anticipated pressures on the biodiversity targets? What is the severity and scope of each pressure? What are the sources of those pressures? How significant is each source in causing the pressure? To what extent will the pressure decline if the source driving that pressure is eliminated? Who has the ability to influence the source of pressure and to what extent? What is motivating or driving their behavior? What conditions are enabling their behavior? Which behaviors and conditions do we seek to change and in what way?	***Milestones***: Changes in current behaviors or existing conditions that are necessary to deliver our conservation outcomes
Select responses	What incentives and approaches can CI and partners use to catalyze the targeted changes in behavior and conditions? Which incentives and approaches are most likely to succeed and have greatest effect on conserving biodiversity?	Portfolio of ***Outputs and Activities:*** Actions that CI will take to reach the targeted milestones

TABLE 2.2: CI'S HIERARCHY OF OBJECTIVES: TERMS DEFINED AND EXAMPLES

Hierarchy of Objectives	Definition	Concrete Examples
Outcome	One of the quantifiable set of species, areas, and corridors that we must target to ensure that we attain our vision of the long-term persistence of all biodiversity globally	• No species with threatened status on the IUCN Red List • The most threatened species are downlisted • All key biodiversity areas have legal protection status, with biodiversity conservation as an official goal • All key biodiversity areas retain or increase baseline habitat coverage • Baseline corridor connectivity is retained or increased • Baseline suitable habitat coverage is retained or increased
Milestone	A measurable and/or verifiable change in a condition or the behavior of key stakeholders necessary for a conservation outcome to be delivered	• National parks legislation creating new protected areas enacted by the National government by December 2004 • $20-million trust fund for the creation and management of protected areas established by January 2005 • Legal responsibility for management of natural resources in forest reserves transferred from government to local communities by November 2005
Output	A major product or initiative under the primary responsibility and control of CI and its partners that alone or in combination with a portfolio of other outputs is intended to achieve a given milestone	• *Species Example:* Population viability analysis completed, specific recommendations for management and institutional responsibilities identified by February 2005 • *Protected Area Example:* Scientific survey of potential protected area highlighting value for conservation completed by May 2005 • *Corridor Example:* Corridor boundaries defined at multi-stakeholder workshop in January 2006
Activity	A specific action that needs to be undertaken for outputs to be produced or realized	• Regional outcomes monitoring trainings conducted in October 2004 • Sustainable resource use working groups established in January 2005 • Nursery established for reforestation activities by March 2005 • Map classifying vegetation in corridor produced by December 2004 • Map detailing forest change in hotspot produced by February 2005

FIGURE 2.2: CI'S HIERARCHY OF OBJECTIVES



The application of the state-pressure-response planning framework and how it results in an articulated strategy and action plan in terms of outcomes, milestones, outputs, and activities is summarized in Table 2.1.

In sum, by using a state-pressure-response analysis we derive our conservation strategies and action plans and are able to articulate them using a hierarchy of objectives: a tool for explicitly mapping out the causal chain that demonstrates how low-level tasks or activities contribute to higher-level objectives and how meeting these objectives in turn helps achieve the overall outcomes or goals of a project or program. CI uses a four-level hierarchy of objectives (Figure 2.2) and specific definitions of each of these terms along with examples of each are provided in Table 2.2.

References

OECD. 1993. *OECD Core Set of Indicators for Environmental Performance Reviews*. OECD Environmental Monographs, No. 83. OECD, Paris, France.

TNC. 2000. *The Five-S Framework for Site Conservation: A practitioner's handbook for site conservation planning and measuring conservation success*. The Nature Conservancy, Arlington, VA.

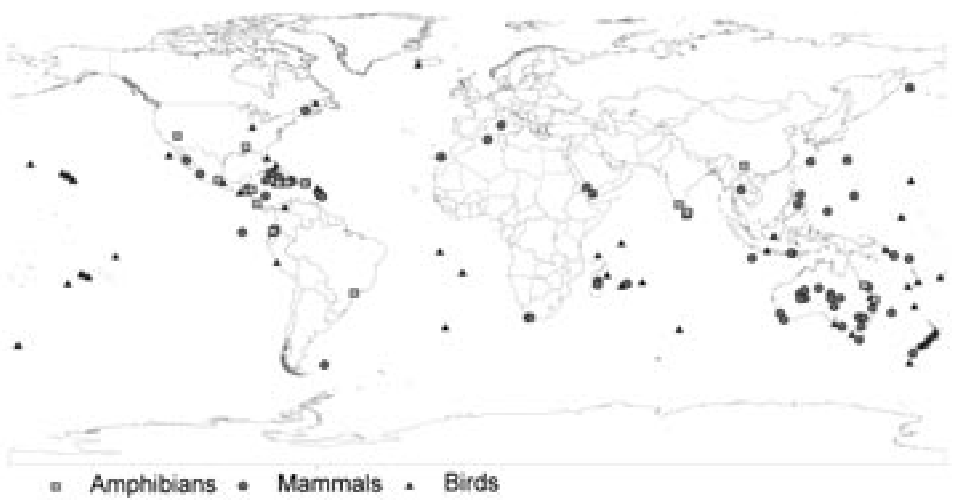
AVOIDING SPECIES EXTINCTIONS

Introduction

Species extinction is at the heart of the biodiversity crisis. Extinction is a natural process, but one that humans have accelerated to more than a thousand times the natural rate (Pimm *et al.* 1995). Since 1500, more than 1,000 species extinctions have been documented at the global level (IUCN 2003)—and there are certainly many others that remain undocumented—including the extinction of around 75 species of mammals and almost 130 species of birds (see Figure 2.3). As species are the fundamental unit around which CI defines its 'Extinctions Avoided' conservation outcomes, avoiding species extinctions is, therefore, at the heart of our mission.

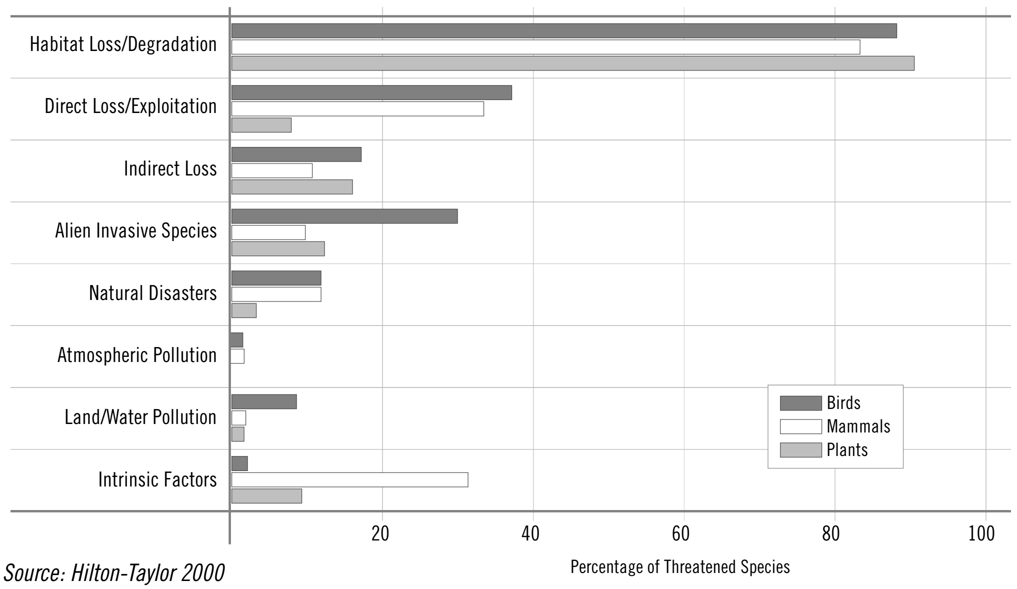
For the past few years, our knowledge of the most pervasive threats to species has been informed largely by the analysis of statistics released in conjunction with the 2000 IUCN Red List of Threatened Species. The IUCN's Species Survival Commission (SSC) conducted an analysis of 720 threatened mammal species (64 percent of those threatened), 1,173 threatened bird species (almost all of those threatened), and 2,274 threatened plant species (about 41 percent of threatened plants, mainly trees), and the results of this analysis revealed, quite conclusively, that the most pervasive threat to species is habitat loss and degradation, affecting some 89 percent of threatened birds, 83 percent of threatened mammals, and 91 percent of threatened plants sampled (Hilton-Taylor 2000; see Figure 2.4). It is not surprising then that current conservation efforts are focused primarily on establishing protected areas and linking these protected habitats by creating biodiversity conservation corridors. Protected areas, after all, remain the primary mechanism available for the long-term protection of species. The two other sections of this chapter—Protecting key biodiversity areas and Consolidating Biodiversity Conservation Corridors—provide guidance on implementing site and corridor conservation.

FIGURE 2.3: LOCATIONS OF EXTINCT MAMMAL, BIRD, AND AMPHIBIAN SPECIES SINCE 1500



Sources: mammals: IUCN/SSC - CI/CABS Global Mammal Assessment; birds: BirdLife International; amphibians: IUCN/SSC - CI/CABS - NatureServe Global Amphibian Assessment.

FIGURE 2.4: MAJOR THREATS TO THREATENED BIRDS, MAMMALS, AND PLANTS



Source: Hilton-Taylor 2000

However, while establishing protected areas and consolidating biodiversity conservation corridors are necessary means to prevent species extinctions, the fact is that some threats, such as invasive species and disease, cannot be mitigated or rebuffed by these means alone. An example is the infamous extinction of the Golden toad (*Bufo periglenes*, EX) which suffered a disastrous decline in numbers within its small range in the Monteverde Cloud Forest Preserve in the Cordillera de Tilarán, near Monteverde, Costa Rica. Although the species' range was within a protected area, and one of pristine habitat at that, it has not been seen since 1989, and several hypotheses explaining its extinction, involving climate change, and perhaps other compounding factors, have been put forward (Pounds *et al.* 1999). Unfortunately, many such extinction occurrences have been noted around the world in protected or seemingly undisturbed habitats, to the extent that some areas have become nearly devoid of all wildlife. Redford (1992) has labeled this phenomenon "the empty forest syndrome." Clearly, the conclusion we must reach is that some species will require targeted action above and beyond (though always in conjunction with) habitat and landscape protection.

Returning to the IUCN list of the major threats to the survival of species, the second most significant threat is direct loss and exploitation, affecting some 37 percent of threatened birds, 34 percent of threatened mammals, and 8 percent of threatened plants. Threatened species are hunted and collected by humans for use as food, medicine, ornaments, clothing, timber, pets, garden specimens, and sport, both for local use and for commercial trade. Not far behind is the danger posed by invasive species which currently affects 30 percent of all threatened birds, 10 percent of threatened mammals, and 15 percent of threatened plant species. Although climate change and disease are not revealed as major threats, both are far more likely to threaten taxa not included in the analyses, such as amphibians and reptiles. Indeed, preliminary evidence suggests that both factors, and particularly infectious diseases, are having an important role in the recent global declines of amphibian populations (Daszak *et al.* 2003).

Species-specific conservation work at CI dates back to our inception more than 15 years ago. Our most notable efforts in this area include our plant conservation program (1989–1995) and species conservation and recovery programs in Brazil, West Africa, and Sumatra. In addition, CI is very closely allied with the IUCN/SSC, BirdLife International, and NatureServe through the Red List Partnership, a consortium of conservation organizations dedicated to establishing a functional and reliable mechanism for monitoring the status and trends of global biodiversity.

Building upon this foundation, CI's focus on species-specific conservation has grown in recent years, with several regional programs and departments in the Center for Applied Biodiversity Science (CABS) ramping up their species conservation programs and projects. For example, in collaboration with the IUCN/SSC, a Biodiversity Assessment Unit has been set up in CABS that merges the SSC's ability to collect biodiversity data with the analytical strengths of CABS, and which has allowed CABS to pioneer the use of the Red List in determining global conservation priorities and in conservation planning. This increase in activity has catalyzed the need for CI to solidify its agenda regarding species conservation, and discussions are ongoing regarding our best approach to preventing species extinctions. This initial thinking has resulted in a set of four key elements of CI's species conservation agenda and, as the development of this agenda is still in a fairly early stage, we discuss these agenda elements here rather than offering a set of specific guidelines for addressing species-level conservation.

In keeping with our State-Pressure-Response planning framework, the first two key elements of CI's recommended species-specific conservation agenda relate to supporting global, regional, and local efforts to better understand the state of species of global conservation concern, as well as the pressures that are contributing to their decline. Such efforts can themselves greatly contribute to species conservation, as efforts to combat the major threats described above have been significantly compromised both by the paucity of solid scientific data (which, in turn, has affected our ability to identify and prioritize among the most threatened taxa) and by our ignorance of how these threats (particularly climate change) affect species. To support state and pressure assessments for species, we recommend that CI programs:

- Actively support and participate in the IUCN Red Listing process; and
- Support and initiate studies targeting globally threatened species and threats.

The second two agenda elements propose specific conservation responses to mitigate the effects of threats that cannot be addressed by habitat conservation alone, namely unsustainable use, trade, and invasive species. We recommend that CI programs:

- Evaluate and promote broad-level conservation tactics that contribute to the conservation of species; and
- Partner with global programs aimed at addressing species-level issues.

Throughout the course of this chapter, we present examples of species conservation programs developed by CI regional programs and by CABS. As CI continues to gain experience in species-specific conservation, the lessons learned will be incorporated into the development of a standard CI planning framework for species conservation that can be applied in all regions.

Assessing the State of and Pressures on Species

As a global conservation organization, CI is committed to using and providing reliable global species data to ensure that informed decisions are made regarding species conservation. Because the

IUCN Red List of Threatened Species™ represents the best global source for this information (Lamoreux *et al.* 2003), CI's first agenda item regarding species conservation must be supporting and participating in the IUCN Red Listing process. To complement these efforts, CI must also support and promote local efforts to gather data on globally threatened and geographically concentrated species, and on the threats to them.

Actively Support and Participate in the IUCN Red Listing Process

The Species Survival Commission (SSC), the largest of the six commissions of the IUCN, is a global knowledge network of nearly 8,000 volunteer members, including wildlife researchers/managers, government officials, zoo employees, and taxon-specific experts, participating in more than 120 Specialist Groups. Besides serving as the main source of advice to the IUCN and its members on the technical aspects of species conservation, the SSC "provides technical and scientific advice to governments, international environmental treaties, and conservation organizations; publishes Action Plans, newsletters, policy guidelines; organizes workshops; implements on-the-ground conservation projects; and raises funds for and carries out research" (see *www.iucn.org/themes/ssc* for more information).

One of the major roles of the SSC, however, is to produce the IUCN Red List of Threatened Species™ (*www.redlist.org*), which lists globally threatened species that have been assessed according to strict criteria (see *www.iucn.org/themes/ssc/redlists/RLcats2001booklet.html*), major threats, and trends toward recovery or decline (updated on a yearly basis and falling under the remit of the Red List Programme based in Cambridge, UK). Despite these crucially important efforts, the SSC is seriously undervalued: its specialist groups continually face daunting funding shortfalls, while the structure of the network means that the Commission's success is wholly dependent on the volunteer service of its members. CI has played a major role in supporting the initiatives of the SSC, and particularly the IUCN Red List (being a partner of the aforementioned Red List partnership). Several CI staff members sit on the SSC Steering Committee, while many knowledgeable technical experts at CI participate in the activities of SSC's Specialist Groups (see Figure 2.5).

CI places such high value on the SSC, its member network, and the Specialist Groups for several reasons. Most important, Specialist Groups generally serve as Red List Authorities (RLAs), whose job it is to "ensure that all species within their jurisdiction are correctly evaluated against the IUCN Red List Categories at least once every ten years and, if possible, every five years" (*www.redlist.org*). Because CI's outcome definition and monitoring protocols are so closely linked with the IUCN Red List, it follows that our success in achieving these outcomes is wholly dependent on the accuracy, reliability, and scope of the species information contained therein. As such, it is the shared responsibility of our organization to ensure that the Red List does not become an unintentional bottleneck to conservation efforts. Considering that fewer than 15 percent of reptile species, 10 percent of fishes, and 5 percent of plants have been assessed, we must continue to support both global assessments and the work of specialist groups so that we can know as much about the conservation status of other vertebrate species as we do about birds (for which BirdLife International serves as the RLA).

CI, in partnership with the IUCN, is currently pioneering two such large-scale research projects. The Global Amphibian Assessment (GAA) and the Global Mammal Assessment (GMA), both supported by CABS, are providing important baseline data that populate and update the IUCN Red List database. Through the work of the GAA, some 5,500 amphibian species have been

FIGURE 2.5: CONSERVATION INTERNATIONAL AND THE IUCN/SSC

The IUCN/SSC Primate Specialist Group (PSG) is one of the largest of the Commission's specialist groups. Chaired by CI President Russell Mittermeier since 1977, and housed within CI for the past 15 years, the founding mission of the Primate Specialist Group is to maintain the current diversity of the order Primates, with dual emphasis on (1) ensuring the survival of threatened species wherever they occur, and (2) providing effective protection for large numbers of primates in areas of high primate diversity and/or abundance.

Among the various tasks and functions of the group has been the production of a number of regional primate conservation action plans. This began with A Global Strategy for Primate Conservation (1978), followed by the first-ever SSC Action Plan, the *Action Plan for African Primate Conservation: 1986–1990* (Oates 1986), which was quickly followed by the *Action Plan for Asian Primate Conservation: 1987-1991* (Eudey 1987), and several years later by *Lemurs of Madagascar, an Action Plan for their Conservation: 1993–1999* (Mittermeier *et al.* 1992). The last plan to appear was *African Primates: Status Survey and Conservation Action Plan* (Oates 1996). In addition, the PSG produces a variety of newsletters and journals, including *Primate Conservation* (initially launched as the *IUCN/SSC Primate Specialist Group Newsletter* in 1981), *Neotropical Primates, African Primates, Asian Primates,* and *Lemur News*. As with many other specialist groups, the PSG serves as the Red List Authority for primates.

Besides the PSG, the chairs or co-chairs of several other specialist groups are housed within CI, including Edentate (Chair Gustavo Fonseca), Marine Turtle (Co-Chair Rod Mast), Freshwater Turtle (Co-Chair Anders Rhodin), Caribbean Fish (Co-Chair Michael Smith), and Global Amphibian (Chair Claude Gascon). Furthermore, many CI staff serve as members of specialist groups, and CI also provides funding to help support the activities of many of these groups.

assessed and will be included on the 2004 IUCN Red List; fewer than 15 percent of amphibians—only 263 species—had been assessed and are listed on the 2003 Red List. Similarly, the conservation status of all the world's mammals will have been completely reassessed and updated from 1996 through the GMA (using Version 3.1 of the Red List Categories and Criteria; IUCN 2001), including the production of detailed, geospatial distribution maps for every species, enabling us to conduct detailed analyses of trends in species status and threats, something which now is only possible for birds. Similar assessments are planned for other taxa, including groups of invertebrates, plants, and freshwater and marine organisms.

In addition to supporting and participating in the activities of the SSC, other recommended actions to support Red Listing efforts include:

Support and promote the use of the global IUCN Red List as the global standard for the conservation status of species and the most important tool for prioritizing among species, sites, and regions. In many countries national red lists that have adopted IUCN's revised *Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0* (IUCN 2003b, available at: *www.iucn.org/themes/ssc/redlists/regionalguidelines.htm*) should also be used for the same purpose as tools for decision-making regarding country endemics. National red lists are also important in promoting conservation action at the national and regional levels.

Gather information on Red List candidate species. In the course of conducting outcome definition within any given region, CI programs can help to gather information on candidate species—those species that have not yet been assessed but are apparently highly threatened and, if assessed correctly using Version 3.1 of the IUCN Red List Categories and Criteria, would clearly be recognized as globally threatened. This will help to facilitate and expedite the Red List process for non-assessed taxonomic groups so that these species can become Red Listed, and, in turn, be formally incorporated into CI's definition of species and site outcomes (particularly in the case of geographically restricted species). For example, a list of almost 970 species of potentially threatened plants has been identified for the Eastern Arc Mountains and Coastal Forests in Kenya. Synthesizing these lists has leveraged financial resources for Red List assessment work in the Eastern Arc and other hotspots. It has also motivated specialists in these regions to work on Red List assessments because they are realizing that international conservation organizations and donors are making funding decisions based on targets derived from the Red List. An initial meeting in September 2003 of botanists from five countries in the Caucasus region to begin the Red List process for plants in the region is an excellent example of this process in action (only one plant species from the Caucasus is currently on the IUCN Red List).

Submit the results of small-scale research projects funded through CI programs, or any small grants funding mechanisms targeted at threatened species, to the relevant Specialist Group or Red List Authority. For example, a strict requirement of the Critically Endangered Neotropical Species Fund (CRNSF)—one of a number of CI's internal small grants funding mechanisms that specifically aim to contribute to global biodiversity conservation by providing strategically targeted, catalytic support for the conservation of threatened species (Figure 2.6)—is that at least one copy of any scientific or popular publication, newspaper or magazine article, report, or action plan resulting from the project must be made available to the relevant Red List Authority. Likewise, the results of CI-led or funded surveys, rapid ecological assessments, field studies, and other exercises should be made available to the relevant specialist groups or RLAs.

Support and promote efforts to effectively manage species data by the scientific and conservation community. Finally, although significant information on species and their distributions has been collected to date, it is rarely consolidated in a way that makes it useful to conservation efforts. Thus, part of the challenge we face is in organizing ourselves as a conservation and scientific community to use the reams of data that we do have to manage and conserve species more effectively. The Species Information Service (SIS) is being developed as SSC's data management initiative to address this problem (in partnership with CI), aiming to become a worldwide species information resource. It will be easily accessible to the conservation and development communities, including scientists, natural resource managers, educators, decision-makers, and donors, and will contribute to integrated biodiversity conservation products. See *www.iucn.org/themes/ssc/programs/sisindex.htm* for more information.

Support and Initiate Studies Targeting Globally Threatened Species

Although there is usually a multitude of species-specific conservation efforts underway in every region where CI works, and not necessarily by CI programs, many if not most of these efforts tend to focus on nationally threatened species or on large, charismatic animals that are often considered to be umbrella or flagship species. In some cases, umbrella or flagship species are also globally threatened and are, therefore, in critical need of conservation action. In addition, conservation of these species can play a major role in marketing biodiversity conservation to key stakeholders. All too often, however, efforts to conserve the "sexy" species benefit only local biodiversity and are insufficient to address the conservation needs of globally threatened species, many of which are difficult to conserve because of lack of information and/or donor interest. CI's tremendous capacity for fundraising, coupled with our strong scientific foundation and focus on preventing global extinctions, has placed us in a unique position to promote and support conservation efforts directed at globally threatened species. Often a minimal investment in a specific site or conservation program can make an enormous difference in the future prospects of a globally threatened species. For example, together with a number of other international, national, and regional conservation non-profit organizations, CI is a partner of the Alliance for Zero Extinction (AZE) (see *www.zeroextinction.org*), an initiative that aims to identify and protect the last remaining habitats for the world's most threatened species. It does so by identifying sites to which Critically Endangered (CR) or Endangered (EN) species are entirely or almost entirely restricted and promoting site- or species-specific action, thereby creating a front line of defense against imminent extinctions that will hold until broader-scale conservation efforts can enable populations to rebound.

Recognizing our need to more actively target globally threatened species, several of CI's CBCs and regional programs have initiated small grants programs that are used for anything from scientific investigation of the ecology or status of a species to small-scale conservation efforts directed at specific sites or populations that are key to the survival of a globally threatened species. This is in addition to the establishment of small grants funding mechanisms, such as the Primate Action Fund (PAF), Turtle Conservation Fund (TCF), and the aforementioned Critically Endangered Neotropical Species Fund (CRNSF), which provide financial support to projects on threatened species both within and outside of our priority regions (see Figure 2.6). As we shift to a more regional and partner-oriented approach, the development of similar funding mechanisms in other regions will become a priority. In light of this, the Outcomes Monitoring department has compiled Global Guidelines for Developing Species Research Grants (contact CI's Outcomes Monitoring Program). We must ensure that we use the species funds, with their limited, targeted resources, in a strategic manner by avoiding overlap in funding and other potential financial pitfalls. The development of a global species fund, targeted specifically at threatened species and including an emergency funding component for rapid dissemination of funds (as may be necessary, for example, in the case of a disease outbreak), is now a very high priority for donor support.

As discussed earlier in this module, there is a great need for information on the ecology and status of species and the impacts of threats on species. These elements should be considered as integral to any species-specific conservation study, either conducted or supported by CI programs. Projects that implement actual on-the-ground conservation measures, such as control of invasive species and education or public awareness campaigns, also require support, but are covered later in this chapter. In addition, when prioritizing among projects that target conservation of globally threatened species, CI programs should consult the SSC Action Plans (many of which are available online at *www.iucn.org/themes/ssc/pubs/sscaps.htm*), which outline a number of recommended immediate conservation actions and priorities for field research. Several of these Action Plans have been produced with moderate to significant CI input or participation (e.g., those for primates and turtles).

Ecology and Status of Species

Studies on distribution, population size and abundance, habitat preferences, and fundamental aspects of ecology (e.g., reproduction, life history) are important not only because they serve as a

FIGURE 2.6: SMALL GRANTS PROGRAMS PROMOTING THREATENED SPECIES RESEARCH

CI has built a variety of small grants programs to increase knowledge of and prevent extinction of threatened species, and to involve local communities, researchers, universities, and partners in outcome monitoring and conservation work. While the monetary value of the award is small, the funds are usually easily distributed and the dividends usually high. Experience from the Andean CBC suggests that for every $10,000 that a program can allocate, five to ten studies (depending on the amount allocated per study) can take place over the course of one year. The data and capacity building that come from the grants program are invaluable.

Presently, two types of small grants programs exist: the small grants programs of the regional programs and CBCs (such as the Andean, Brazil, and Madagascar CBCs), which are targeted at supporting research within CI's priority regions; and Washington, DC-based funding mechanisms, which typically fund research both within and outside of CI priority regions, but have other focal points, being either taxon- (e.g., PAF and TCF) or region-specific (e.g., CRNSF). Some of the funds have particular requirements according to which they prioritize funding. For example, the Madagascar CBC small grants program only considers studies on species in its priority sites (such as Corridor Zahamena-Mantadia, Parc de Zahamena, Corridor Ranomafana-Andringitra, Corridor Makira, Daraina, Menabe, and Ibity-Itremo). Similarly, the CRNSF only considers studies on Critically Endangered species in the Neotropics.

Common to all species-specific funding mechanisms within CI, however, are various conditions and criteria that are used in assessing proposals, such as conservation priority (globally threatened, especially CR and EN species), project feasibility, appropriate methodology, and community involvement. The ultimate aim is to fund research that will enhance scientific understanding of the target species and its habitat, and that contributes to improved protection of the species, increased public awareness, change of inappropriate policies or legislation, and so on.

form of monitoring program that improves our knowledge of the focal species, but also because the data gathered are essential to elucidating the status of a species.

Many species listed as threatened are very poorly known. In some cases, we do not even have sufficient information to make an assessment of the conservation status, and these species typically are listed as Data Deficient (DD). Given this, a clear priority is research into the status and ecology not only of threatened species, but also of Data Deficient and Not Evaluated (NE) species. While not an outcome in itself, clarifying the status of a poorly known species is an important step in preventing extinctions. If a species turns out to be rarer than thought (and under severe threat), then this research is, of course, crucial to its conservation and management; on the other hand, if a species turns out to be more common than previously thought, then this helps to focus attention on species more deserving of conservation investment.

We also recognize that the status of a species is not static, but dynamic. If we are to adapt our conservation strategies in a timely and effective manner, then we also must promote the development of species monitoring programs. For example, monitoring levels of harvesting of species and trends in the wildlife trade, coupled with baseline ecological monitoring, is essential. CI's outcome monitoring framework (described in Chapter 3) incorporates population-level studies for Critically Endangered (CR) species (as a first step toward addressing all threatened species) as one of the core methods for measuring success. Population-level studies can help us measure the incremental changes toward downlisting species within the IUCN Red List, one of CI's primary indicators of success toward our 'Extinctions Avoided' conservation outcomes.

Finally, the importance of basic taxonomic knowledge should never be underestimated, and initiatives to elucidate our understanding of species relationships (especially of lesser known groups of taxa) should be promoted (Collar 1997).

The Impact of Threats on Species

In recent years, research has increasingly been targeted at better understanding the nature and impact of threats on species. For example, a variety of studies in the tropics have analyzed data pertaining to amphibian population declines, and have found a direct relationship between these declines and climate change. In Brazil, researchers discovered that the incidence of severe frosts between 1979 and 1982 corresponded to the extinction of five frog species (Heyer *et al.* 1988), while Weygoldt (1989) found that other declines in the country were associated with dry winters. In Puerto Rico, Stewart (1995) noticed that the dramatic population declines of the Puerto Rican coquí (*Eleutherodactylus coqui*, NE) in 1983 corresponded to an increased number of extended dry periods (where the length of dry periods had increased rather than there being an overall decrease in the annual precipitation).

To a large extent, our understanding of the impact of threats on species has been facilitated by advances in research methodology and population modeling techniques; not only have these helped to shed light on the direct and indirect impacts of atypical threats to species, but they also allow us to predict what some of the short- and long-term consequences of these impacts on species may be in the future. Current advances in technology may enable us to make the greatest leaps in understanding and predicting threats to species, particularly through the use of geographic information systems and remote sensing technology. Remote sensing technology has been used for years to expose land cover changes and to monitor habitat loss and conversion (e.g., Skole and Tucker 1993), but it is now maturing as a tool that may enable us to improve greatly detection of species *per se* (Turner *et al.* 2003). An example where remote sensing technology is being applied to benefit species is in Madagascar, where CABS researchers are comparing satellite images of forest cover from the year 2000 with 1990 images to determine deforestation rates. Geographic data on species' extents of occurrence (EO) can be overlaid on maps of habitat and change. For forest-obligate species, such as the Golden-brown mouse lemur (*Microcebus ravelobensis*, EN) estimates of its area of occupancy (AO) can be produced by mapping the remaining forest within its EO. The most probable area of occupancy can then be recalculated and compared with the area thresholds for EOs and AOs used by the IUCN to assign risk levels reported in the Red List. Precise and timely updates of such data can provide a very powerful and consistent means for monitoring, and moreover, the scientific community can review all original and derived data.

Selecting Conservation Responses to Avoid Species Extinctions

Building our knowledge about species and threats will help us develop effective conservation strategies, but some of the most significant causes of species extinctions require immediate action. At the same time, we need innovative but scientifically sound methods to assist recovery of species that are on the brink of extinction and to prevent further species extinctions. Toward these ends our actions should focus on evaluating and promoting broad-level conservation tactics such as sustainable use, captive breeding, and species reintroductions. Specifically, we should expand programs to combat overexploitation due to bushmeat hunting and illegal trade in wildlife and to control the introduction and spread of invasive species.

Evaluate and Promote Broad-Level Conservation Tactics that Contribute to the Conservation of Species

CI is increasingly engaging with a suite of partners to tackle a variety of conservation issues. As many such possible collaborations are possible, it is important for us as an organization to assess existing conservation projects if these are to become models or templates for future conservation. We must also identify which initiatives best address the most serious drivers of species extinctions. CI could focus its attentions in a variety of areas, such as supporting initiatives to explore alternatives to wildlife products exploited in the traditional medicine, timber, pet, fur, and ornamental trade. Below, we highlight two conservation tactics that may, in some circumstances, pay particular dividends for species conservation, and that CI could support by partnering with IUCN. In addition, we discuss several issues at the top of our list of priorities: mitigating pressures caused by bushmeat hunting, illegal wildlife trade, and the introduction and spread of invasive alien species.

Sustainable Use

As indicated earlier, direct loss and exploitation represent the second greatest threat to species. In many cases, eliminating such harvesting altogether is impossible, for example, in cases where local communities depend on the harvest of species to meet their subsistence needs and no viable alternatives exist. In such cases, sustainable harvest of species is often promoted, and indeed, properly managed and controlled sustainable use programs can have considerable conservation benefits. Whether sustainable use strategies can work will depend on various factors, including the species (and its reproductive parameters), the availability of data, and the degree of regulation. For example, sustainable harvesting in the tropical timber industry has been hindered by a combination of illegal logging and biological parameters (for example, many trees, such as mahogany, are slow growing and consequently have limited potential to replace themselves) (Rice *et al.* 2002). Moreover, as previous attempts at developing sustainable forestry operations in the tropics have shown, if such operations are not managed and monitored extremely closely, they can be used as a cover-up for outright exploitation and unsustainable use.

Although very rare in the tropics, models for sustainable consumptive use do exist. For example, the game farming industry of southern Africa has blossomed largely because game farmers have demonstrated that they can reap bigger financial rewards from farming with wildlife (through tourism, safari hunting, photographic safaris, and sale of live animals and/or wildlife products such as meat) than from farming with domesticated livestock or crops. Additionally, game farming is less restricted by climate than crop production is, and in some cases it can be practiced in tandem with domesticated livestock ranching (Hanks 2001). As a result, the amount of land set aside for sustainable use of wildlife has soared, as have wildlife numbers (e.g., wildlife numbers on private land in Namibia has increased by 70 percent over a 20-year period).

In the future, we should look to work more closely with the IUCN Sustainable Use Specialist Group (*www.iucn.org/themes/ssc/susg/index.html*) to identify where sustainable use strategies can truly benefit conservation of exploited species, and how best to work with regional partners and local communities to implement them.

Captive Breeding and Reintroduction Programs

Zoological gardens and, in some cases, private collectors contribute to conservation through their preservation of genetic reservoirs, reintroduction efforts, research (e.g., reproductive physiology, and assisted reproduction techniques), and focus on animal health and nutrition. Moreover, many zoos are currently looking to reinvent themselves, to address conservation on the ground as well as in captivity, while at the same time appealing to the public. This presents a unique opportunity for CI to interact with the captive breeding community on several important levels.

First, the value of *ex situ* conservation programs for reintroduction initiatives, in particular, needs to be appreciated. We owe the survival of various species (e.g., Scimitar-horned oryx (*Oryx dammah*, EW)) to such efforts. However, some reintroduction programs have failed because of factors such as behavioral deficits in released animals, disease, climatic factors, and predation. Further, *ex situ* conservation is extremely expensive—many times more so than *in situ* solutions. Moreover, not all species reintroductions have a good probability of success (Balmford 2000). We should ask, "Are reintroduction sites available? Do they meet essential criteria, such as having suitable habitat and being free from relevant threats?"

In cases where *in situ* conservation or reintroduction is impossible currently or far into the future, we must accept that conserving a species only in captivity is preferable to its extinction. Species whose survival is threatened by invasive species (e.g., tree snails of Tahiti and Moorea of the genera *Partula spp.* and *Samoana spp.* threatened by the introduced carnivorous Rosy wolf snail (*Euglandina rosea*, NE)) may especially benefit from such captive breeding programs. Likewise, in order to ensure the continued conservation of toads of the genus *Atelopus spp.* currently being affected by the chytrid fungus in Latin America (e.g., Berger *et al.* 1998), captive breeding may be the only real immediate solution available. In this case, however, fungus eradication may allow restocking of some islands, and captive breeding programs are already underway and should be promoted.

Until now, with the exception of some work on primates and turtles (see Figure 2.7), captive breeding programs have tended to fall out of the purview of CI, and our involvement with

FIGURE 2.7: TORTOISES AND TURTLES

A comprehensive conservation plan for tortoises and freshwater turtles includes a diversity of actions. One such action involves establishing captive-bred "assurance colonies" for reintroduction to protected areas in formerly occupied portions of their range. But before these reintroduction efforts proceed, concerns and gaps in knowledge must be addressed. Possible transmission of disease, genetic mixing, and disruption of social structure must be considered if new individuals are to be added to existing populations; individual survival and site fidelity, as well as long-term population establishment and growth, are desired outcomes that must be ensured. CABS has been supporting research at the University of Georgia's Savannah River Ecology Laboratory where reintroduction is being tested as a conservation tool for tortoises. Using Gopher tortoises (*Gopherus polyphemus*, VU), several experiments are being conducted that will (1) reintroduce this threatened species to parts of it former range; (2) identify the methods most likely to ensure site fidelity and survivorship of individuals; (3) monitor population persistence and growth; and (4) serve as a model for future application to other appropriate tortoise species worldwide.

the captive breeding community has been restricted largely to occasional interaction with the American Zoo and Aquarium Association (AZA, *www.aza.org*). These programs are important to CI, but it should be noted that because of ethical and welfare complications in captive breeding programs, CI programs should seek evaluation by an independent authority, such as the IUCN Conservation Breeding Specialist Group (CBSG, *www.cbsg.org*), before becoming involved with these efforts; reintroduction programs should be undertaken in conjunction with the IUCN Reintroduction Specialist Group *(www.iucnsscrsg.org/pages/1/index.htm*) and adherence to the IUCN Guidelines for Reintroductions is essential (available at *www.iucn.org/themes/ssc/pubs/policy/reinte.htm*). A useful resource, *IUCN technical guidelines on the management of* ex situ *populations for conservation*, is available at *www.iucn.org/themes/ssc/pubs/policy/exsituen.htm*.

A second area for potential collaboration between CI and the captive breeding community is in the area of targeted funding. Zoos increasingly support *in situ* species conservation projects regardless of whether they hold the species in captivity, and a number of zoos have very effective and targeted funding mechanisms available for species work. Collaborating with the captive breeding community to determine which species take priority for funding is an important role that CI can play. Indeed, CI is already in the process of collaborating with the AZA to discuss where AZA priority species occur in biodiversity hotspots and high-biodiversity wilderness areas, and, in turn, where these are threatened and therefore in most urgent need of support.

Partner with Global Programs Aimed at Addressing Species-Level Issues

Throughout this chapter, active collaboration with IUCN specialist groups, both taxon-based and disciplinary, has been emphasized. Emphasis has also been placed on the need for increased collaboration with captive breeding organizations, which often have the ability to leverage funds for species conservation and the expertise available to do effective on-the-ground conservation work. However, in addition to these groups, CI is increasingly engaging with a suite of partners, including task forces and other programs that tackle specific species conservation issues. As there are many such possible collaborations, it is important for us as an organization to prioritize among these programs and to identify which global initiatives best address the most serious drivers of species extinctions. At the top of our list of priorities are mitigating pressures caused by bushmeat hunting, illegal wildlife trade, and the introduction and spread of invasive alien species.

Mitigating the Pressure of Bushmeat Hunting

Much has been made of the bushmeat problem as it pertains to Africa, where it is thought to be a greater threat to biodiversity even than that posed by habitat loss or degradation. However, bushmeat is not a problem restricted to Africa, but one that also affects wildlife communities in the Neotropics and much of Southeast Asia. Although bushmeat hunting in Central and West Africa has been most highly publicized, it is thought to be a primary cause of declines in wildlife populations occurring outside of protected areas in eastern and southern Africa. Bushmeat hunting is clearly unsustainable in these regions, but it is, nonetheless, the single most widespread form of resource extraction in the tropical forest environment. For this reason CI has long given due consideration to this issue, by supporting the goals of the BCTF (see Figure 2.8), by suggesting means and ways of dealing with the crisis (Bakarr *et al.* 2001), and by active on-the-ground work through its regional programs.

For example, over the past three years CI Ghana, in collaboration with International Communications, CABS, and CEPF, has carried out a project to build broad-based support to eliminate

FIGURE 2.8: BUSHMEAT CRISIS TASK FORCE

The Bushmeat Crisis Task Force (BCTF, *www.bushmeat.org*), currently housed at the headquarters of the American Zoo and Aquarium Association (AZA), was founded in 1999 as "a consortium of conservation organizations and scientists dedicated to the conservation of wildlife populations threatened by commercial hunting of wildlife for sale as meat." Its primary goal is "to facilitate the work of its members in identifying and implementing effective and appropriate controls over the commercial exploitation of endangered and threatened species in Africa." In addition, BCTF seeks to establish an information database and mechanisms for information sharing regarding the bushmeat issue, facilitate engagement of African partners and stakeholders in addressing the bushmeat issue, and promote collaborative decision-making. CI is a supporting member of BCTF, providing financial as well as technical and logistical resources necessary to achieve the goals and support the activities of the BCTF.

threats posed to Ghana's wildlife by the bushmeat trade. To achieve this objective, CI Ghana supported the creation of the National Stakeholders Task Force, a multidisciplinary group made up of policymakers, research institutions, NGOs, and traditional leaders. Together, the group launched a national awareness campaign focused on two main messages—the restoration of traditional protection practices once afforded to Ghana's wildlife, and the associated health issues surrounding bushmeat consumption. The project has been extremely successful in raising public awareness to the threats imposed by the bushmeat trade. The print, radio, and TV media have been instrumental in getting the message to a broad audience. The project has reawakened sociocultural and scientific concerns about the rapid extinction of wildlife species throughout the country. The major successes to date achieved through this project include a coordinated effort among all national partners through the creation of the National Stakeholder Task Force; consumer boycotts of bushmeat in Accra and Kumasi; development of alternative bushmeat supplies; increased investment by the international community including the FAO and other major donors; increased prosecution of illegal hunters; pledges from the traditional leaders from Ghana's ten major regions to uphold traditional laws and sanctions; the ban by Ghana's most influential traditional leader on all hunting of totem animals, use of toxic chemicals and automatic rifles, bush burning, and group-hunting practices; and the Accra Declaration on the Bushmeat Crisis (a set of recommendations to all members of society outlining possible contributions toward ending the crisis and halting further species extinctions within Ghana).

Reducing Illegal Wildlife Trade

Another priority of CI is illegal wildlife trade. The issue still requires careful consideration as to where and how CI can be most effective: as a catalyst, facilitator, or implementer. Wildlife trade is an issue that requires action at several levels: (1) International trade: The international trade in wildlife is a $20 billion/year business. CI could become more actively engaged in influencing international policy, particularly with CITES (see Figure 2.9). (2) Protecting wildlife at the source: This involves developing the mechanisms to cover the opportunity cost to those people responsible for harvesting—this can often be linked to the first, for example, through "poachers into rangers" schemes. It also includes strengthening direct enforcement of wildlife protection laws on the ground in protected areas. (3) Strengthening wildlife law enforcement beyond protected areas: This involves capacity building of government law enforcement agencies to disrupt domestic trade networks, including middlemen in major cities and towns. It also requires examining the law enforcement chain beyond suppression and detection, to include prosecution of wildlife crimes through strengthening legislation and the judiciary process. CI has developed an enforcement economics tool for identifying the weakest links in the overall law enforcement chain and determining how to strengthen the overall wildlife law enforcement system. (4) Addressing demand: The longest-term component necessary for a holistic approach to controlling wildlife trade is reducing demand through geographically broad but thematically targeted media campaigns.

Controlling the Introduction and Spread of Invasive Species

We already know that invasive species are a great threat to many species; indeed, most bird extinctions since 1600 can be directly linked to introduced predators (Ebenhard 1988, Atkinson 1996). Invasive species affect native species through predation, competition for food and other resources, hybridization, spread of disease, and alteration of the natural landscape. Invasive species have the potential not just to exterminate species, but also to destroy entire ecosystems. By reducing harvests and degrading catchment areas, among other problems, they have huge economic consequences for the global economy. Their effect on human health is also great, primarily through the spread of disease and human pathogens. In short, the invasive species problem emerges as one of the most pressing issues facing the conservation community today, and one that stands out as a real hurdle to any achievement of 'Extinctions Avoided' outcomes in a number of hotspots.

Article 8(h) of the Convention on Biological Diversity (CBD 1992, *www.biodiv.org*) places the onus on parties to the Convention to "prevent the introduction of, control, or eradicate those alien species which threaten ecosystems, habitats, or species." Two major global organizational

FIGURE 2.9: CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; *www.cites.org*) was instituted in 1975. Effectively, it is an agreement between governments that aims to ensure that international trade in wild animals and plants does not threaten their survival. Currently, CITES attempts to regulate the trade of some 30,000 species around the world, both plants (25,000) and animals (5,000), dead and alive. Membership to the Convention is entirely voluntary, and member countries, known as Parties, act jointly by agreeing to ban international commercial trade in a particular species that may be threatened with extinction. Currently, there are around 160 Parties to the Convention.

All forms of import and export are regulated by means of appendices, which have varying degrees of flexibility according to the required protection. Appendix I includes just over 800 species threatened with extinction, and trade in specimens of these species is permitted only in exceptional circumstances (e.g., scientific study). Appendix II includes some 29,000 species that are not necessarily threatened with extinction, but in which trade must be controlled in order to avoid levels of utilization that would be incompatible with their survival. Appendix III contains 200-odd species that are protected in at least one country, which has then asked other CITES Parties for assistance in controlling the trade. At the request of any Party, a species can be included on Appendix III. The Secretariat and Parties to the Convention meet every two years to revise the appendices, whereby species may be either downgraded or upgraded depending on their status (in order for an amendment to be made, there must be a two-thirds majority of Parties present), and to debate the benefits of opening trade.

networks exist to support these actions. The IUCN/SSC Invasive Species Specialist Group (ISSG, *www.issg.org*) exists to "reduce threats to natural ecosystems and the native species they contain by increasing awareness of invasive alien species, and of ways to prevent, control, or eradicate them." The Global Invasive Species Programme (GISP; *www.gisp.org*) has been established specifically to support implementation of Article 8(h) of the CBD by enabling "local, national, and multinational communities to draw on the best available tools to improve pest prevention and control systems immediately, and to identify priorities for the development of new tools needed to achieve longer-term success."

At an institutional level, CI can use a variety of strategies to engage in invasive species issues, in partnership with ISSG, GISP, and others. Numerous resources are available for developing projects where populations of invasive species are already established. Two particularly valuable publications are *IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species* (available at *www.iucn.org/themes/ssc/pubs/policy/invasivesEng.htm*), prepared by the ISSG, and the invasive species toolkit edited by Wittenberg and Cock (2001) (available at *www.gisp.org*).

A second major strategy must necessarily be prevention: development and enforcement of legislation and associated programs for controlling invasive species introductions. This would include (1) promoting preparedness among agencies charged with dealing with the invasive species problem; (2) eliminating economic incentives that encourage the introduction of alien invasive species; (3) creating programs to monitor the passageways by which alien species are spread (this could be implemented in conjunction with monitoring of the wildlife trade); (4) instituting punitive consequences to deter introductions through negligence and/or bad practice. Policy experts in CI regional programs, as well as the staff of the CCG, can work with government agencies to help develop and enact such legislation.

A third key strategy must be raising awareness and disseminating information. The fundamental principle here is that the threat of alien invasive species to ecosystems and native species must be made a priority issue. This can only be achieved when the large body of information that exists is made available in a variety of forms through the electronic and print media (scientific and popular publications, and television/radio awareness programs) to foster and improve awareness of this issue. CI's regional programs have an important role to play here in helping to disseminate the information on alien invasive species issues to within-country representatives, and, in turn, serving as consultants on alien invasive species issues. Finally, CI can help document invasive species. The ISSG maintains a database of alien invasive species, including a full datasheet report for each species with details of ecology, reproductive potential, distribution, description, general impacts, and methods and guidelines of control (*issg.appfa.auckland.ac.nz/database*). Allied to this is the establishment of what the IUCN Guidelines call "Black Lists," to draw attention to those species that should be policed at all costs because of the threat they pose to society.

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PROTECTING KEY BIODIVERSITY AREAS

Introduction

Chapter 1 provides guidance on the definition of conservation outcomes, including the identification of key biodiversity areas: sites that encompass habitat critical to the survival of globally threatened and geographically concentrated species. CI seeks to ensure that the biodiversity held by key biodiversity areas is formally protected, through either the creation of new protected areas or the expansion or improved management of existing protected areas. It should be noted that, in its usage here, the concept of "protected area" is intended to be somewhat expansive, to include not only government-designated strict protected areas, but also any area that has legal or binding contractual protection and is managed with conservation of biodiversity as an official goal (consistent with IUCN's definition of a protected area, see Figure 2.10). Thus, these areas could be a national park, wild river, marine reserve, or any other category of protected area. They could be declared by national or local governments or through the initiative of an indigenous or traditional community or private landholder desiring to conserve biodiversity within their lands.

FIGURE 2.10: IUCN DEFINITION OF PROTECTED AREA

A protected area is an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means (IUCN 1994).

CI believes that protected areas are the single most effective tactic in preventing species extinctions in the near term and in ensuring the persistence of biodiversity over the long term. Protected areas secure important blocks of natural habitats that are crucial not only for maintaining an adequate representation of native biodiversity within an ecosystem but also for maintaining functional landscapes and securing human well-being for the following reasons:

- They are the best options for protecting representative examples of globally threatened and geographically concentrated species and/or threatened and unique habitats, thereby preventing their extirpation or extinction.
- They help maintain ecosystem functioning (e.g., watersheds), biological productivity (source of biological resources), and ecological process (such as animal migration).
- They can contribute to sustaining livelihoods and indigenous cultures that are based wholly or partially on use of biological resources.
- They are a crucial part of a broader landscape that can help mitigate potential effects of large-scale changes in an ecosystem or region (e.g., floods, droughts, and erosion).
- They provide opportunities for long-term monitoring and research to help understand and mitigate the impacts of anthropogenic actions on the natural environment.

In promoting effective formal protection of biodiversity within key biodiversity areas, we must recognize the important difference between supporting effective conservation of sites and managing them directly. While CI may bring technical and financial resources to bear in promoting 'Areas Protected' outcomes, we very rarely have the management authority necessary to make decisions concerning protected area creation and management. Accordingly, CI's actions must be strategically defined to provide the resources, capacities, and incentives necessary to promote the achievement of conservation outcomes by countries, institutions, private and community landholders, and resource managers responsible for the protected areas that harbor the wealth of our planet's biodiversity.

In assisting managers, decision-makers, and landholders in creating and effectively managing protected areas, however, the support we provide must be consistent with our first priority for site-based management, which is the conservation of species of global conservation concern (as identified through the outcomes definition process outlined in Chapter 1). The cornerstone of our efforts will be in supporting site managers to incorporate conservation of these species into the management objectives of the site, recognizing that the global biodiversity targets that CI promotes may at times differ from those of site managers, who may also be concerned with meeting recreational, income, or natural resource needs. For example, a particular park may be globally significant for certain amphibians, but may attract tourists to see monkeys and birds. Park managers might manage the site to maximize ecotourism and revenues on orders from the Ministry; they may (or may not) be aware of the global significance of the site for amphibians. Our role would be to work with managers to ensure that the globally significant species are considered in management and protection actions, while capitalizing on ecotourism opportunities as important means of achieving both Ministry and biodiversity goals.

In other instances, private landowners may offer the best opportunity to achieve conservation goals. For instance, private landowners in Brazil are required to set aside a proportion of their lands as conservation easements, maintaining the forest to protect ecological services and biodiversity. CI provides the technical knowledge and policy leverage necessary to provide such landowners with incentives and greater options in creating set-asides so that these areas are located and configured in a manner most beneficial to achieving conservation goals.

Ultimately, CI recognizes that a protected area is a land use that must compete with other interests such as agriculture, settlements, and resource harvest (such as timber extraction). To catalyze the creation of new protected areas and the expansion or effective management of those that have already been created, we need sound strategies that are based on good science, an understanding of the social, economic, and political context surrounding the site—including the various objectives regarding the use of the site and the resources it contains—and the application of carefully selected tools and tactics. This chapter proposes a strategic planning process that incorporates these elements in a framework for conducting a preliminary situation assessment to determine the roles and interests of key actors with control or influence over the management of a particular site, analyzing the current status of biodiversity in a key biodiversity area, assessing the pressures on biodiversity and the threats and supporting conditions that drive them, and developing a portfolio of strategic responses that CI and its partners can implement.

Applying this framework to promote and support the creation of a new protected area versus to support the effective management of an existing protected area will take different forms, with the primary difference being that the former will initially require somewhat less in-depth assessments and analyses than the latter. For example, the methods presented below for assessing the state of and pressures on biodiversity are fairly data intensive and will require significant knowledge, expertise, and study. In cases where creation of a new protected area is sought, however, the state and pressure assessments may be preformed only to a depth necessary to gather the basic information needed to develop an initial protected area design (recognizing, of course, that more in-depth analyses eventually will be required to finalize a protected area design that meets the variety of objectives different stakeholders may have for a site). Finally, the section on selecting a portfolio of responses is divided into two discreet sets of guidelines, with the first providing an overview of a process for supporting the creation of a new protected area, and the second providing guidelines for selecting tools and tactics to alleviate pressures on a protected area and support effective management.

In the course of site-based planning and action, it is important to bear in mind that site conservation may require actions beyond the boundaries of sites and key biodiversity areas. It is for this reason that CI works to consolidate biodiversity conservation corridors, engaging policymakers, promoting awareness at broad scales, and influencing development trajectories in favor of biodiversity conservation. These issues are addressed in the following major section of this chapter, Consolidating Biodiversity Conservation Corridors. An overview of the site-based planning framework is provided in Figure 2.11.

Preliminary Situation Assessment

As discussed above, CI very rarely has management authority over specific sites. Rather, we must support and work alongside other actors and stakeholders to promote the creation and effective management of key biodiversity areas. In addition, because site and resource management planning tends to be very complex and political and cannot be entered into lightly, before initiating activities to promote the creation of a new protected area or the improved management of an existing protected area, it is advisable to conduct a preliminary situation assessment regarding the site in question. Such an assessment might include:

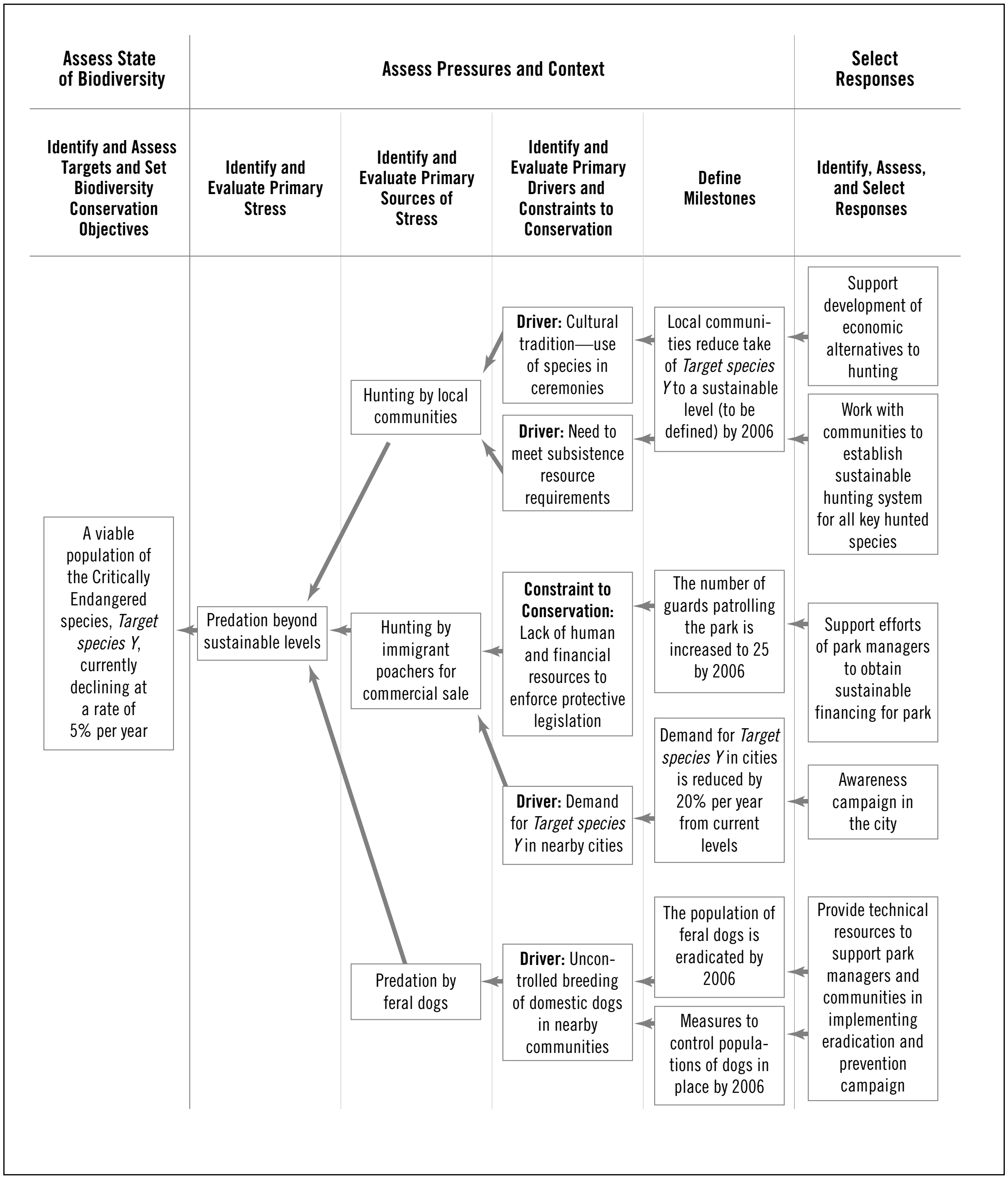
- Identification of actors with control over land and resource uses and characterization of their influence over and impacts on the site. Such actors might include tenured and untenured landowners, resource and land managers, resource users, managing government agencies, and concession holders;
- Identification of actors with influence over the conservation of the protected area and the broader landscape, and characterization of their influence and impact—such actors might include NGOs, community groups, industry, political actors, and government agencies;
- A description of resource uses, local and regional demands, and projected evolution of resource use trends; and/or
- Analyses of relevant land and resource use policies and development plans affecting the governance of the site.

Such information can assist us in identifying our own potential role in promoting conservation of a site, avoiding overstepping the management authority of key actors, understanding political and legislative constraints that may restrict possible options for managing the site, and anticipating major threats or interests that may impede the conservation of the area and its biodiversity resources.

Assessing the State of Biodiversity within a Key Biodiversity Area

Extensive literature exists on assessing and managing wildlife populations, and the assessment process described below is not intended to be a replacement for more thorough analyses and scientifically based assessments of biodiversity health and needs within a site. On the contrary, gaps in information and knowledge highlighted in the course of assessing the state of biodiversity should be added to a program's or site manager's research agenda (see the module Avoiding

FIGURE 2.11: OVERVIEW OF THE SITE-BASED PLANNING FRAMEWORK



Species Extinctions, presented earlier in this chapter). Even with limited data, however, the biodiversity state assessment should still be the starting point of any key biodiversity area conservation planning process, as it is necessary for establishing biodiversity conservation objectives for the area.

Three primary steps are involved in assessing the state of biodiversity within a key biodiversity area. First, data must be consolidated on the globally threatened and geographically concentrated species for which the site has been designated a key biodiversity area. Next, information on the status of the target species is needed. Finally, to support protected area design or effective management, measurable and, where appropriate, spatially explicit biodiversity conservation objectives must be defined. Details on these planning steps are provided below.

List and Consolidate Key Data on the Globally Threatened and Geographically Concentrated Species for which the Site Has Been Identified as a Key Biodiversity Area

Even though key biodiversity areas are defined by their importance for particular species, it will be useful to identify populations and areas of critical importance within key biodiversity areas to ensure that conservation efforts are focused on the right places. Consolidating such data also will be critical to justifying the need for conservation action to key stakeholders. Thus, the following questions should be answered:

- How many individuals or groups of individuals are known for each targeted endemic and/or threatened species, and how are they distributed?
- How do the targeted species use the site? What are their patterns of movement and use? What and where are the critical resources and processes occurring within the site needed to sustain the targeted species?
- How significant is the area for protecting populations of the targeted species relative to other areas across the landscape?
- What other ecological features make the area very special or unique? (Such features may include watersheds, an important breeding ground for some migrant species, presence of charismatic and/or keystone species, and unique habitat combinations.)

Many of the data needed to respond to these questions will have been compiled during the outcomes definition process (see Chapter 1), and, in some cases, this information may have been consolidated in the Conservation Outcomes Database. These data should be reviewed and, to the extent possible, placed on maps of the site.

Assess the Current Status of Target Species

It is important to understand whether the current population numbers, population density, and age/sex distribution within the key biodiversity area are adequate, with reference to analyses of population dynamics and minimum viable population analysis. It is also important to note trends in the populations of targeted species. Are they stable, declining, or increasing? In addition, status of supporting habitat and processes should be noted. Is there sufficient habitat (including access to shelter, forage or prey, and breeding sites) to maintain viable populations of the targeted species? Are important ecological processes being maintained effectively? As above, to the extent possible, these data should be consolidated and mapped.

Establish Measurable and Spatially Explicit Biodiversity Conservation Objectives for the Site

Although it is rare that sufficient data will be available to establish concrete, measurable biodiversity conservation objectives for a site, it is important to articulate these objectives to the extent possible, as all conservation planning for a site must ultimately be directed by them. At the very least, these objectives must include the maintenance of viable populations of the globally threatened and/or geographically concentrated species known for the site. How "viable" is then defined and quantified will depend greatly on the availability of information on each species. The conservation objectives for a site must also include the maintenance of the habitats and processes known to support these species.

Biodiversity State Assessment Summary

Upon completing a biodiversity state assessment, you should have the following:

- A list of the species for which the site was defined as a key biodiversity area
- Data on the habitat areas and other resources within the site that are key to the target species
- An assessment of the status of the target species within the site and of the resources upon which they depend
- Measurable and, where appropriate and feasible, spatially explicit biodiversity conservation objectives for the site

Assessing Pressures and Context within and around a Key Biodiversity Area

Regardless of whether you are focusing on creating or expanding a protected area or improving the management of an area that is already under protection, you will need to understand the pressures on biodiversity and the drivers and enabling conditions underlying those pressures in order to evaluate the design of the protected area and develop strategies for its long-term effective management. If your objective is to create or expand a protected area, you may elect to do a somewhat preliminary assessment of pressures at first in order to respond to initial questions of design, but this assessment eventually must be followed with a more thorough analysis.

An assessment of pressures on biodiversity has five primary elements. The first is identifying the stresses on biodiversity. Stress is an ecological explanation of how a threat affects the conservation target.

The second element is the source of stress. This is usually a human action, such as converting forest to agricultural land, petroleum exploration, hunting, or collection of species for trade. A source of stress also can be a change in the ecological system that initially resulted from human action but then continued unaided, such as the spread of invasive species.

The third element is the drivers and supporting conditions behind the sources of stress. Who specifically is taking the action that is causing the threat? What are the conditions that motivate this behavior? Since the stress is not only what affects the ecological target, but more precisely how it affects the target, identifying the source of stress and the drivers behind it should reveal several means of mitigating the impact on target species and ecological processes beyond simply eliminating the source entirely. An analysis of drivers also often leads to identification of a set of underlying or root causes that are indirect and subtle, but fundamental to effective behavioral change.

Fourth, particularly when the focus is on improving the management of a protected area, it is critical to understand what factors constrain effective conservation of a protected area, such as lack of financial or human resources, policies that are incompatible with protected area objectives, or lack of scientific information to support management decisions.

Finally, an assessment of pressures concludes with the articulation of specific, measurable changes in behavior or underlying conditions that are necessary to eliminate or reduce sources of stress. Together, these will represent the milestones that must be reached to ensure the effective conservation of the key biodiversity area.

This methodology for assessing pressures on biodiversity is adapted from The Nature Conservancy's *Five-S Framework for Site Conservation* (TNC 2000). The first two steps of the assessment process presented below align with the steps within the TNC framework entitled "Stresses" and "Sources."

Methods for identifying and describing stresses, sources of stress, drivers, and milestones are presented below.

Identify and Evaluate Stresses

For each biodiversity target within the key biodiversity area, identify the range of stresses and describe each in terms of severity and scope (see Figure 2.12 for an illustrative list of stresses). One way to evaluate severity is to predict the degree to which the target will be damaged by the stress over a ten-year period. For example, is the stress (1) destroying or eliminating the target, (2) seriously damaging it, (3) moderately degrading it, or (4) slightly impairing it? Damage includes direct effects—such as depleted population numbers, density, or distribution—and indirect effects, such as degradation of important habitats or ecological processes.
To evaluate the scope of the stress, we can estimate the extent to which the target is affected by the stress. For example is habitat degradation a stress throughout the target species' range, or only in a small proportion? It is often useful to map the area affected by each stress, starting with the most severe, and overlaying this information on areas of high-biodiversity importance. Alternatively, similar categories can be used to identify the geographic scope of impact on the conservation target under a business-as-usual scenario: (1) very widespread or pervasive, (2) widespread, (3) localized, and (4) very localized.

FIGURE 2.12: ILLUSTRATIVE LIST OF STRESSES

- Resource depletion
- Habitat destruction or conversion
- Habitat fragmentation
- Thermal alteration
- Alteration of natural fire regimes
- Sedimentation
- Modification of water levels; changes in natural flow patterns
- Extraordinary competition for resources
- Extraordinary predation/parasitism/disease
- Nutrient loading
- Toxins/contaminants
- Habitat disturbance
- Salinity alteration
- Groundwater depletion
- Altered composition/structure of biotic community
- Selective predation leading to imbalances in sex and/or age ratios
- Excessive herbivory

Source: Adapted from TNC 2000

Identify and Evaluate Sources of Stress

Sources of stress include those activities or changes around the site that are leading to the stresses. Sources of stress can be described in terms of their contribution to the stress—is the source the primary cause of the stress or is it only a contributing factor? It is also valuable to consider sources in terms of the reversibility of the stress if the source is eliminated or its impact mitigated. These two factors will help to determine which sources of stress are having the greatest effect on the biodiversity targets within the site. At this stage in the analysis, only the most direct and proximate sources are considered, even though most threats are shaped by actions and policies distant from sites. These are analyzed later in the pressure assessment.

This process should be repeated for all of the conservation targets, recognizing that there may be a number of different stresses for each target, and a number of different sources for each stress. Some sources may contribute to more than one stress, and some stresses may affect more than one target. At each stage, it is worth determining which sources of stress have the greatest current or anticipated impact on biodiversity, while not neglecting those less important sources and stresses.

Identify and Evaluate Drivers

Each source of stress will be driven by anthropogenic or biophysical forces. To select strategies with the greatest likelihood of mitigating a particular stress, we must understand what these forces are and how they are driving the sources of stress. This kind of understanding can often reveal contextual subtleties that otherwise would not be uncovered through a basic threats assessment. For example, bushmeat hunting may be identified as a critical source of stress for a given species, and it is often assumed that this hunting is driven by local people meeting their subsistence need for food. Further investigation has revealed, however, that in many cases bushmeat hunting is a commercial operation driven by the demand for bushmeat in urban areas. To successfully mitigate this threat, a resulting strategy then would need to consider not only the bushmeat hunters but also the urban residents creating the demand. And in such a case, using tactics to reduce bushmeat hunting by local communities alone would be a misguided strategy.

For each anthropogenic source of stress, we identify the various actors driving the threat, the incentives promoting their behavior, and also the key conditions that allow the behavior to occur. Incentives may be purely financial, for example, maximizing the profitability of land and resource use, or may be more intrinsic. Social incentives may drive land users to acquire greater area for power and prestige, cultural incentives may drive overexploitation of particular resources, and policy incentives may compel modest landowners to extend areas of land conversion for access to fiscal rewards or power. Who is the proximate actor (e.g., the bushmeat hunter)? What is driving their behavior? What is enabling their behavior? Do we expect this behavior to continue over the long term, or will this behavior be constrained to a certain time period or area?

Biophysical forces such as climate change or the spread of invasive species are significant drivers of ecological stress and ecosystem change. By identifying the magnitude of impact and trends in these drivers, we can promote mitigating and preventive actions, such as expansion of protected area corridors to accommodate climate-driven ecosystem change or campaigns for eradicating invasive species.

Identify and Evaluate Constraints to Protected Area Conservation

Our ability to achieve conservation outcomes may be constrained by protected area design or by deficient management processes and actions, including such issues as inadequate staffing and financial resources, insufficient planning and technical guidance, or unresolved border and tenure issues. Such issues may be identified in protected area assessments, which evaluate management according to a set of desired standards. Numerous methodologies have been developed to evaluate management actions and their effectiveness, ranging from complex scoring systems (e.g., Cifuentes *et al.* 2000) to simple tracking tools (e.g., Stolton *et al.* 2003), many of which are reviewed by Hockings (2000). References to this literature are provided in Appendix III. The World Commission on Protected Areas (WCPA) framework (Hockings *et al.* 2000) provides excellent guidance to developing and conducting protected area assessments. The framework recommends six elements of management assessment: context (e.g., legal status), inputs (e.g., financing), planning (e.g., management plans, and budgeting), process (e.g., management actions), outputs (e.g., visitor facilities), and outcomes (e.g., effectiveness). Detailed analyses of context are recommended as part of this site planning chapter, whereas outcomes and management effectiveness for protected areas are evaluated as part of CI's outcome monitoring protocol. We are presently developing and field-testing an adaptation of the protected area tracking tool piloted by the World Bank/WWF Forest Alliance (Stolton *et al.* 2003) as a means of efficiently assessing the status of protected area administration, planning, inputs, processes, and outputs. The methodology, which is easy to use, is based upon a subjective rating of basic elements of management. Given the subjective nature of the tool, it is most useful as a qualitative measure. As we develop the tool, the subjective elements will be complemented by empirical measures of management efficiency, evaluated relative to desired management standards. Technical guidance on the application of this methodology is forthcoming.

Articulate Specific, Measurable Changes in Behavior or Underlying Conditions That Are Necessary to Eliminate or Reduce Key Sources of Stress: Milestones

Milestones to achieving effective protected area management will usually fall into two major categories: (1) changes in behaviors or conditions external to the protected area that are necessary to reduce or eliminate sources of stress, and (2) changes in the resources or capacity available to protected area managers to assist them in effectively managing the site in question. An example of the first might be that private companies with concessions within the protected area reduce logging of a specific tree species to a certain quantity per season or year. An example of the second might be that the national government dedicates a certain level of annual financial support to the protected area each year or that a certain number of park guards be hired, trained, and employed by a certain date. By defining milestones for a protected area from these two perspectives, we clarify not only changes required in the drivers themselves but also those required to enhance the ability of the protected area manager to respond to pressures and effectively manage the area. To the extent possible, milestones should specify whose behavior needs to change (e.g., the logging company, or the government), how it needs to change (e.g., reducing logging of a particular species by a particular amount), and when it needs to change (e.g., by next year).

While all of the milestones you specify will be necessary to the effective management of a protected area, some may be more likely than others to affect the biodiversity targeted at the site. Consequently, it may be valuable to prioritize among the milestones identified, with the most important criterion being the potential contribution to reducing the most significant sources of stress on biodiversity and to alleviating the greatest deficiencies in resources and capacity necessary for the effective management of the site.

Pressures and Context Assessment Summary

Upon completing a pressures and context assessment, you should have the following:

- A list and description of the stresses causing the decline of biodiversity targets within the site, with each described in terms of its severity and scope;
- Sources of each stress identified, each source described in terms of its contribution to each stress, and the reversibility of the stress should the source be eliminated;
- An assessment of the actors linked to each source of stress, with each assessed in terms of their control or influence over the stress and the motivations driving their behavior;
- An assessment of the constraints to effective protected area management; and
- Milestones defined in terms of (1) changes in behavior or conditions necessary to reduce or eliminate pressures on biodiversity and (2) changes in the resources or capacity available to protected area managers to assist them in effectively managing the site in question.

Managing Information on Pressures and Context: Conceptual Modeling

Even if applied in a superficial manner, the methodology described above will produce a mountain of information describing what is usually a very complex situation. There are many approaches to managing and organizing this information, with the most common being the conceptual model. The conceptual model is a visual representation of the factors affecting the conservation target of interest. Conceptual models are extremely useful and provide the following benefits:

- They explicitly define what we want to influence or change as a result of project interventions;
- They characterize and prioritize the factors that directly or indirectly affect the species, areas, and corridors we want to conserve;
- They represent how these threats or opportunities, individually or in combination, cause a change in the species, areas, and corridors we want to conserve; and
- They demonstrate that the interventions we choose are clearly focused on addressing key threats and opportunities as a means of achieving our outcomes (discussed below).

Conceptual models take many forms, including tables of information, flow charts, or webs of notecards taped to a wall. Finding the right type of model to use will depend on the team of actors involved, the venue in which the model will be used, and the ways the team wants to use the information over time (e.g., notecards on a wall will likely have a shorter life than a database). Nonetheless, it is valuable to define the data management system you would like to use, as the exercises outlined here will generate reams of information that, if not well organized and easily accessible, will not be particularly useful to your planning efforts. Additional details on conceptual modeling are provided in Chapter 3.

Selecting Conservation Responses to Protect Key Biodiversity Areas

Once we have set our conservation targets and assessed the pressures, we need to determine how best to achieve our milestones. The actions we take will depend first on whether or not the key biodiversity area in question is already protected. If it is not, then we must take some initial steps to promote its formal protection. If the area is protected but requires support to reduce pressures and improve management, another suite of responses will be necessary. For this reason, this section is broken into two parts, with the first describing a process for promoting the creation of new protected areas and the second describing a process for selecting responses that will help eliminate pressures on biodiversity and enable managers to conserve a protected area more effectively.

Promote the Creation of New Protected Areas or the Expansion of Existing Protected Areas

Timing, social feasibility, and political support are the critical elements in creating or expanding protected areas. In an ideal situation, protected areas would happen through a process where the "top down" need to protect an area due to its global biodiversity significance was identified, and then a "bottom up" process driven by local planning and support would take place. In reality, few new sites are created this way. Park creation is a political action; and it is rarely viewed in a neutral manner. Even if an area has no local residents and the government owns the site, there are likely to be challenges to the protection of natural resource stocks or the transfer of management authority. Ultimately, the long-term sustainability of a protected area will require that the preparatory phase leading up to its creation consider both biodiversity conservation and human welfare objectives (see Figure 2.13).

Given the highly politicized nature of creating and expanding protected areas, the process must be flexible. Nonetheless, the following fundamental steps of this process should be undertaken:

- Receive initial interest in or approvals for pursuing creation or expansion of protected area from the relevant authorities or landholders;
- Compile scientific and socioeconomic justification and preliminary design for protected area (proposal);
- Prepare detailed design of protected area and zoning;
- Obtain formal declaration protecting the area; and
- Conduct site planning and prepare management plan.

The order and sequencing of these steps and the depth to which they are applied may vary from one case to the next. Occasionally, for example, protected areas are created or expanded for political reasons (e.g., a president chooses to leave a political legacy before leaving office), and the associated process includes almost none of the steps listed above. Conversely, in some cases, a more systematic approach closely resembling the process outlined above many be applied, as in the case of the Apurimac area of Peru, which was initially designated as a Reserved Zone and then went through a lengthy participatory design process before the area was broken into two community reserves and a national protected area.

Even when the steps presented above are not followed in order, each represents a critical step in ensuring that a protected area meets its conservation objectives over the long term. This is generally true regardless of the type of area being addressed—whether it is a publicly managed protected area or a private (e.g., NGO or indigenous community) site.

FIGURE 2.13: BIODIVERSITY CONSERVATION AND HUMAN WELFARE

Supporting the connections between biodiversity conservation and human welfare has always been a central element of CI's mission. We have recently increased our efforts to identify and promote policies and actions that simultaneously increase human welfare, boost economic development, and support conservation. The reforms needed to achieve lasting conservation results are often the same as those necessary to alleviate poverty (e.g., good governance, engaged civil society, agricultural subsidies, and pricing policies). Macroeconomic planning tools, such as the Comparative Development Performance methodology developed by CI's Center for Conservation and Governance (CCG), demonstrate means of achieving economic development compatible with maintaining critical biodiversity habitat and ecological service benefits. Using such tools, we must compel institutions with a direct role in funding policy and institutional reforms (e.g., multilateral development banks and bilateral aid institutions) to chart development agendas that simultaneously meet biodiversity and poverty alleviation needs. In doing so, we will demonstrate that wise development, creating jobs, and economic welfare for developing countries are not only compatible with conservation, but are also enhanced by maintaining critical ecosystems and their environmental services.

Promising advances made by CABS's Conservation Economics program, the Conservation Enterprise and Ecotourism departments, and CI's Center for Environmental Leadership in Business (CELB) in providing direct incentives for biodiversity conservation to governments, communities, and private landowners are central to our efforts to demonstrate the tangible economic benefits of biodiversity conservation. Efforts to strengthen the knowledge and institutional capacities to promote sound socioeconomic development compatible with biodiversity conservation have been advanced by our Healthy Communities Initiative, Population and Environment program, and numerous initiatives led by our Regional Programs. By improving local knowledge and capacities for environmental stewardship and wise development, combined with economic planning and incentive mechanisms offering compensation for biodiversity conservation, we can provide win-win opportunities enabling local stakeholders to protect their own interests and those of the global community as effective agents of conservation.

Receive Initial Approvals for Pursuing Creation or Expansion of Protected Area

From the results of the context assessments described above, you will have been able to identify those actors with control or influence over the area being targeted for protection. The actors will likely include those with ultimate decision-making authority regarding the use of the area and those who will be influenced by the changed management of the area. Before embarking on an intensive design process, you should obtain from them initial approval for pursuing the creation or expansion of a protected area. Whether your forum for doing this is formal discussions with landowners, a government-run legislative process, or a consultative process in which you are supporting a community's efforts to protect some of its lands, a proposal will probably be necessary. At a minimum, the proposal should include a justification and preliminary assessment of feasibility for the protected area, an initial design (e.g., borders and zoning), and an indication of the type of protected area to be pursued (e.g., biosphere reserve, strict protected area, or community reserve).

Establish Scientific and Socioeconomic Justification and Preliminary Design for Protected Area

To prepare a **justification** for protecting the area:

- Consolidate the biodiversity significance and conservation objectives defined through the assessment of status of biodiversity;

- Consolidate basic data on social and cultural importance of the protected area (e.g., protection of indigenous lands or resources, and archaeological importance);
- Establish the role of the protected area within the larger landscape, including its contribution to preserving ecological services, its function as a biological corridor, its compatibility within the existing and projected land use mosaic, and its role in providing ecosystem services to human populations in the area; and
- Establish a rationale for designation of the protected area type relative to IUCN categories (Figure 2.14) and national legislation.

To conduct a **preliminary feasibility assessment**, consider the following issues:

- How will placing the area under protection affect socioeconomic needs and human livelihood practices within the region?
- To what extent are the local and regional economies dependent on resource extraction and use in the area?
- What is the tenure regime? Might resource or land-tenure issues influence the siting or creation of the protected area?
- Will major behavioral or livelihood changes be necessary to make the new protected area work?
- What is the cultural significance of the area to local people? To what extent do the habitat and species factor into cultural and traditional beliefs?
- Are the local people aware of and concerned about changes in the natural environments that may warrant the new protected area as a priority response?
- What are the initial attitudes of key actors regarding placing the area under protection?
- Are there competing interests (e.g., petroleum or logging) that have significant influence over the area?
- Does supportive legislation exist that would facilitate the creation and management of the area for biodiversity conservation?

FIGURE 2.14: IUCN CATEGORIES OF PROTECTED AREAS

The IUCN categorizes six types of protected areas by management objective:

I. Strict Nature Reserve/Wilderness Area: managed mainly for science or wilderness protection

II. National Park: managed mainly for ecosystem protection and recreation

III. Natural Monument: managed mainly for conservation of specific natural features

IV. Habitat/Species Management Area: managed mainly for conservation through management intervention

V. Protected Landscape/Seascape: managed mainly for landscape/seascape protection and recreation

VI. Managed Resource Protected Area: managed mainly for the sustainable use of natural ecosystems

These protected area categories are described in detail in *Guidelines for Protected Area Management Categories* (IUCN 1994), available online at *www.unep-wcmc.org/protected_areas/categories/eng*.

- What major legal, financial, and management hurdles will have to be overcome to protect and manage the area for biodiversity conservation?
- What opportunities exist to facilitate or provide incentives for creation and conservation of the protected area?

To prepare a **preliminary design** of the protected area:

- Define and map biological objectives;
- Identify and map areas of threat and vulnerability;
- Define and map human use objectives;
- Overlay spatial representations of biological, human use, and threat data;
- Draft a design compatible with long-term biodiversity conservation objectives and human use;
- Evaluate the preliminary design relative to protected area design principles (Figure 2.15); and
- Refine preliminary design for greater compatibility with principles.

A bibliography of resources on protected area design is provided in Appendix II.

FIGURE 2.15: PROTECTED AREA DESIGN PRINCIPLES

1. Minimize edge/area ratio: a larger protected area perimeter implies the need for more resources to effectively patrol and enforce boundaries; moreover, the higher the edge-to-area ratio, the greater the likelihood of edge effects on core protected zones.
2. Mitigate edge effects by avoiding abrupt breaks in land uses at protected area boundary and creating buffer zones around core area to prevent harmful anthropogenic effects.
3. Zone to accommodate and regulate extractive and non-extractive use areas and to appropriately buffer core area from user impacts.
4. Determine boundaries by natural features (e.g., topography and hydrology): this facilitates recognition, enforcement, and protection of ecological service flows (e.g., watersheds).
5. Establish sufficiently large core areas: larger core areas imply greater likelihood of maintaining the ecological conditions and services necessary to sustain healthy populations of endemic biodiversity.
6. Establish sufficiently comprehensive habitat coverage in core areas to maintain local climactic, hydrologic, soil, and geomorphologic factors, and biotic interactions that affect the ecological processes and the abundance and distribution of species at any one place.
7. Maintain integrity of areas providing ecological service flows (e.g., watersheds).
8. Maintain connectivity of habitats to accommodate animal movements and species distribution and to allow for long-term ecological processes, such as changes in vegetation and habitat with climate.
9. Create multiple protected areas of the same habitat type.
10. Zone to accommodate and regulate extractive and non-extractive uses.

Prepare Detailed Design of Protected Area

Negotiation with stakeholders should provide sufficient information on demands for protected area resource use and access to complement biological inventories and information on ecological service flows from the key biodiversity area. Overlaying these data in a spatial manner will permit an initial draft of protected area boundaries and zoning. The detailed protected area design should also designate areas for development of trails, interpretation, camping, and management infrastructure. Zoning should allow for rotation of extractive and non-extractive use areas to permit natural regeneration after periods of extended or intensive use. Habitat types, ecological service areas, and allowances for connectivity should be indicated in protected area design.

To obtain formal declaration protecting the area for protected areas that will become part of a national protected areas system, high-level political commitment in the appropriate national government agencies will be needed. Yet determining whether a country has a genuine political commitment to conservation and protected area management can be a difficult task. In many countries, political interest in protection may exist, but financial and human resources in park management agencies may be lacking or inadequate. In other countries, the political commitment may be high, but simply getting the legislative and administrative capacity developed and in place for serious natural resource management may be difficult.

Ultimately, to be considered a true protected area, it is fundamental that the site (a) must have been formally protected by national legislation, and in some cases, by communal agreement; and (b) must have biodiversity conservation as an official goal (although this can be one of several management objectives for the site). National legislation commonly permits formal declaration of protected area status for:

- Public lands (e.g., national, state and municipal parks);
- Private lands (e.g., easements, conservation set-asides, and private reserves);
- Community lands (e.g., community reserves, communal set-asides, and co-management areas of public parks); and
- Indigenous lands (e.g., indigenous reserves and semi-autonomous territories).

Note that for communal and indigenous lands, national legislation commonly designates that land as formally allocated to management by local populations, but it may not specify conservation areas within those lands. In such cases, negotiation of communal agreements is necessary to gain formal local recognition of the area and backing of a conservation agenda. Certainly, legislation controlling the creation of protected areas varies from country to country, and an understanding of national, state, and municipal legislation not only permits greater certainty in formalizing protected area status, but also will often reveal additional opportunities for and means of creating conservation areas.

Conduct Site Planning and Prepare Management Plan

The list of activities that a protected area manager must oversee is varied—trails must be maintained, personnel deployed, visitors educated, participatory planning implemented, budgets developed, and equipment maintained. Fundamental to the manager's capacity to implement this array of activities and to effectively ensure conservation of the protected area is the development of a site management plan. Site management plans should by nature be goal-oriented and proactive, and they should be developed so they can be adapted over time.

Goal-oriented. A management plan should respond to the purpose of the protected area and thus describe means by which management may fulfill the goals and vision underlying the creation of this area. The plan should be fundamentally oriented toward maximizing the conservation value of the protected area, whether this value be related solely to the conservation of species and advancement of scientific research or be tied also to generating public benefits through visitation, education, maintenance of critical ecological services, or, in special instances, extractive use. When conceived relative to the purpose and principal goals of the protected area, activities can be tailored to take advantage of particular attributes and values; to respond to opportunities for improved conservation, education, and revenue generation; and to more actively cultivate a supportive public.

Proactive. Dealing with threats to site and species integrity and capturing opportunities for improving site values and benefits cannot be merely reactive processes. Reacting to threats by confrontation alone rarely results in solutions; rather, repeated confrontation is likely to result. Proactive engagement of stakeholders for protected area creation and management is a more certain prescription for public acceptance and active contribution to conservation. Furthermore, while site management must necessarily be designed to respond to important threats, you will enhance public appreciation of the importance of site protection if you can take advantage of opportunities to demonstrate and improve site values in both financial and less tangible terms. Capitalizing upon opportunities to develop protected sites for public benefit in education and ecotourism, demonstrating tangible environmental and economic benefits of protecting soils and watersheds in set-asides within agricultural areas, and maintaining the productivity of multiple-use zones by more efficient, sustainable resource extraction are important means of increasing the perceived value of protected areas. If a site is developed for compatible economic and biodiversity benefits, the public is more likely to recognize the value of protected sites and thus to be more actively engaged in their conservation.

Adaptive. Identifying the threats and opportunities that guide the management of protected areas to achieve biodiversity conservation goals is an iterative process. Management is most appropriate when it can adapt to the changing conditions and needs for site conservation and development. Threat and opportunity analyses should accompany revisions of site management plans to reorient objectives and strategies according to evolving needs, improved information, innovations, and opportunities. Annual operational plans should also be guided by the principle of adaptive management, making appropriate adjustments to objectives and activities in order to better respond to evolving conservation needs.

The specific form and content required of protected area management plans varies according to national policies and prescriptions. More detailed guidance on management plans is currently being developed as a reference for all CI programs. This manual will be distributed widely and key elements may be integrated in future versions of this strategic planning handbook. Appendix I provides a bibliography of other useful resources for protected area management planning.

Supporting Effective Conservation of Biodiversity within Existing Protected Areas

Identify Possible Responses

CI's contributions to ensuring effective protected area management can be characterized as supporting local decision-makers in three complementary ways:

- **Enabling managers to manage better.** CI can assist protected area directors in managing their protected area by providing technical support, improved access to information and financial resources, support in refining management and monitoring plans, and training for park guards. The ultimate goal in providing these types of support is to ensure that, over the long term, protected area managers have sufficient information, capacity, and human and financial resources to be able to anticipate and avoid—or detect and respond to—management challenges that can arise.
- **Providing or eliminating options for using protected area resources.** CI can help to reduce pressures on biodiversity in two primary ways: (1) by providing alternative sustainable uses of the protected area's resources, such as conservation enterprise (Figure 2.17) and ecotourism (Figure 2.18); and (2) by helping managers or policy makers eliminate certain resource uses through the improvement of enforcement regimes and legislation, where appropriate and necessary.
- **Influencing how decisions are made.** CI and partners can also engage in activities that encourage positive and effective engagement by key stakeholders in protected area management. Tactics may include public relations campaigns, environmental education (Figure 2.19), and promoting protected area management networks.

Within each of these primary lines of strategic action, it is possible to identify tools, tactics, and interventions that might be used to support the effective management of a protected area. Options that are worth considering will be those that will most directly contribute to the attainment of the milestones identified through the assessment of pressures and context.

Assess and Select a Portfolio of Responses

For effective conservation, we often need to use strategies that incorporate elements of all of the approaches described above, focusing on mitigating external threats, improving internal management, and influencing decision-making by key stakeholders. The aim is to devise a portfolio of responses that create the conditions that are necessary and sufficient for the effective conservation of target species and the resources upon which they depend over the long term. The choice of protected area interventions should be evaluated individually and together as an integrated strategy, based on the following criteria:

- **Impact on conservation outcomes:** Interventions should be chosen that are necessary for conserving the biodiversity targets within the site. Interventions should be evaluated for their potential to reduce or eliminate sources of stress and increase management capacity and resources.
- **Impact on other objectives:** Interventions should be evaluated also for their potential to improve human welfare and economic development.

FIGURE 2.16: A NOTE ON ADDRESSING ROOT CAUSES OF BIODIVERSITY LOSS

It is often difficult to address root causes at the site scale—they are often better tackled at the corridor or policy level. For instance, a proposed road may be part of a national economic development policy favoring infrastructure development in forest areas. Modifying this policy would require consultation with politicians and agencies at a national level who may influence the designation of road development areas and revise standards for development to mitigate threats to biodiversity.

FIGURE 2.17: CONSERVATION ENTERPRISE

What is Conservation Enterprise?

Conservation enterprise is a strategy to provide economic alternatives for people who would otherwise engage in destructive land uses in order to make a living. The enterprise may be any of various type; its essential characteristic is that it enables people to earn a livelihood without destroying the biodiversity of the hotspots and wilderness areas.

How Does Conservation Enterprise Help Conserve Biodiversity?

- As a direct response to a threat: Members of an enterprise will be motivated to conserve biodiversity if the enterprise depends on maintenance of biodiversity for a product or service. For example, developing an enterprise based on forest products (e.g., fruits, nuts, or resins) as a long-term source of income is a direct way to respond to threats of logging, land clearing, and hunting.
- As a response to local interests for sustainable development: One part of CI's core principles is to ensure that the human welfare of local people is taken into account when seeking to achieve lasting conservation. Responding to development needs through an enterprise that does not deplete natural resources can draw people away from other economic activity that does. This approach can also help gain social and political acceptance of a conservation agenda.
- As a part of a corridor design for sustainable land use: agricultural systems that use shade trees from the forest provide both biological connectivity between protected areas and a diversified income for farmers. Although less intact than undisturbed forest, agroforestry systems harbor significant levels of biodiversity and provide food and habitat for many species, while at the same time increasing the human welfare of local farmers by generating income, maintaining soil fertility, and enhancing populations of beneficial insects. Conservation objectives may be achieved through agreements with farmers adjacent to parks and reserves to restrict destructive activities, such as encroachment on protected areas or intensive production methods, and to plan farm retirement programs and community concessions.

What are Some Basic Criteria that Should Be Met Before I Pursue a Conservation Enterprise Project?

A conservation enterprise should be adopted as a conservation strategy only if analysis confirms that it will contribute to conservation outcomes. An analysis of the economic, social, political, and biological context should be undertaken before designing a conservation enterprise. This analysis should be participatory and summarized in an enterprise concept paper that makes clear its purpose in contributing to conservation outcomes and its relationship to other components of the regional conservation strategy.

A conservation enterprise should not be considered appropriate if it does not provide protection for or harms local globally threatened and geographically concentrated species. It should also not be considered appropriate if it substantially alters the naturally occurring habitat, eliminates biological connectivity, or interrupts important ecological processes.

Further information is in *Business Planning for Environmental Enterprises: A Manual for Technical Staff*, available from the Conservation Enterprise Department.

- **Immediacy of threat and time sensitivity:** Interventions should be chosen that are certain to make a contribution toward securing the conservation outcome before it loses its biological significance.
- **Appropriate scale:** It is important to confirm that specific milestones are best addressed at the site scale rather than the species, corridor, national, or international scales.
- **Feasibility:** Interventions should be evaluated for their probability of success and for the risks in their implementation. This analysis should include assessments of opportunities to build on common interests with decision-makers and other stakeholders.
- **Cost and efficiency:** Assessments can be based on the cost of implementing the strategy, including the opportunity costs of changes in land and resource use. More efficient tactics (i.e., those that will have the desired effect using fewer resources) should be preferred over less efficient tactics.
- **Sustainability:** Interventions should be evaluated for their ability to bring about a lasting result. This analysis should include aspects of institutional sustainability (including institutional capacity and appropriate mechanisms for decision-making), sociopolitical sustainability (including the risk of political change or social instability), robustness in the face of economic change, and financial sustainability.
- **Leveraging opportunities:** Interventions should be evaluated for their ability to catalyze further action toward achieving conservation outcomes.
- **Appropriateness for CI:** Interventions selected should align well with our role and our experience in designing and implementing conservation strategies. The introduction to this handbook provides an overview of CI's comparative advantage and its usual roles in affecting conservation.

Selecting Conservation Responses Summary

Upon completing a review and assessment of possible responses, you should have the following:

- For areas where formal protection is sought, a plan for (a) receiving necessary buy-in and approvals from key stakeholders, (b) producing a protected area proposal with scientific and socioeconomic justification and preliminary design, (c) preparing a detailed design of the protected area, (d) obtaining formal declaration of the protected area, and (e) developing a protected area management plan.
- For areas where improved management of a protected area is sought, a list of possible responses (i.e., interventions or actions), an assessment of the potential costs and benefits of each, and a final portfolio of the responses that are believed to be the best options for achieving effective conservation of the site.

FIGURE 2.18: ECOTOURISM

Ecotourism is most succinctly defined as travel to natural areas that conserves the environment and sustains the well-being of local people. It should not be confused with “nature tourism,” which is defined as travel to unspoiled places to experience and enjoy nature (Christ *et al*. 2003).

How Does Ecotourism Help Conserve Biodiversity?

Ecotourism can be an important component of a successful corridor strategy by providing economic incentives that are directly linked to biodiversity conservation. Ecotourism projects can be designed to have both direct and indirect impacts:

Direct Impacts:

- Development of ecotourism products that provide revenue to the government, the protected area, and the local community through taxes, fees, and/or voluntary contributions.
- Placement of additional biologically important areas under protection as part of ecotourism development.
- Provision of alternative economic livelihoods to local stakeholders who may have formerly engaged in occupations detrimental to biodiversity conservation.
- Economic justification for creating and expanding protected areas and altering natural resource use patterns.

Indirect Impacts:

- Political support protecting biologically important areas.
- Creation of a critical constituency for nature conservation, including tourism industry associations and local communities.
- Education, training, and raising awareness that focus on biodiversity conservation.
- Policy and planning approaches such as incorporation of ecotourism into economic development plans and the creation of codes and principles within the tourism industry.
- Establishment of standards and certification that encourage stakeholders to act more responsibly, thus mitigating environmental impacts.

What are Some Basic Criteria that Should Be Met Before I Pursue an Ecotourism Project?

Above all, an ecotourism strategy must be clearly linked to conservation outcomes. Existing or potential market demand for ecotourism products must be demonstrated, including a competitive natural, cultural, or historical advantage over other sites in the region. The area should enjoy general political, social, and economic stability to ensure steady demand for the ecotourism product considered. The resources and infrastructure necessary to support an ecotourism project must be available. Private sector representatives, local government officials, community members, and other stakeholders need to be actively interested in pursuing the project.

Ecotourism should not be considered when there is little or no local interest, especially at the community level. Ecotourism should also not be an option if it has the potential to harm an extremely fragile natural environment or local globally threatened or geographically concentrated species.

Further information is in *Tourism and Biodiversity: Mapping Tourism’s Global Footprint*, available from the Ecotourism department.

FIGURE 2.19: ENVIRONMENTAL AWARENESS AND EDUCATION

What is Environmental Awareness and Education, and How Does it Contribute to the Conservation of Biodiversity?

CI recognizes that effective conservation requires an informed, supportive, and participatory public. Environmental awareness and education comprises our diverse activities designed to inform, disseminate ideas, promote debate, and inspire change. These are all essential steps to halting the threats to our planet's environment. The ultimate goal is to generate, through a combination of efforts, a lasting change of behavior in favor of conservation.

The goal of environmental awareness and education is to "develop a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, skills, attitudes, motivation, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones" (UNESCO-UNEP 1978). Although environmental education can have short-term results, it is fundamentally a long-term process. CI's International Environmental Education program focuses its efforts primarily on teachers, students, and the formal educational system.

What are the Characteristics of a Well-Designed Environmental Awareness and Education Program?

- All awareness projects are linked to CI's conservation outcomes and priorities.
- Key stakeholders and partners are involved in the planning of a communications strategy.
- Beyond imparting knowledge and changing the attitude of target audiences, the real results will be found after changing their behavior.
- Monitoring and evaluation components are included to ensure that efforts are effective.
- Clear goals and objectives are identified and checks and balances are incorporated to monitor quality and effectiveness.
- Target audiences' knowledge, attitudes, and concerns are assessed in order to design appropriate education programs strategies.
- Investments are made in long-term capacity building for multipliers within an existing organizational structure (e.g., teachers, park guards, partner organizations, and community leaders).
- Environmental education strategies support local education and curriculum objectives.
- Effective strategies are designed for the use of locally appropriate educational tools.

Further information is in the *Handbook for Communicators and Educators at Conservation International*, available from the International Communications department.

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CONSOLIDATING BIODIVERSITY CONSERVATION CORRIDORS

Introduction

Chapter 1 provides guidance on the definition of conservation outcomes, including the identification of biodiversity conservation corridors: landscapes and seascapes that encompass key biodiversity areas and other habitat and ecological processes critical to the survival of globally threatened and geographically concentrated species. CI seeks to ensure the conservation of biodiversity within these corridors through an integrated system of protected areas, a connectivity network, and compatible land and resource uses. Biodiversity conservation corridors also offer opportunities for CI and its partners to improve human welfare while ensuring that biodiversity is conserved, in keeping with our mission "to demonstrate that human societies are able to live harmoniously with nature." This section presents a process for reviewing corridor-scale biodiversity conservation targets, evaluating the pressures on those targets and the context surrounding their conservation, and identifying efficient, effective responses to achieve consolidation of biodiversity conservation corridors.

Biodiversity Conservation Corridors Defined

A biodiversity conservation corridor is a biologically and strategically defined sub-regional space, selected as a unit for large-scale conservation planning and implementation purposes (Sanderson *et al.* 2003). Biodiversity conservation corridors are integrated systems of protected areas, connecting linkages, and compatible land and resource uses. They are designed and managed to strengthen and complement species- and site-scale conservation actions, while at the same time advancing human welfare.

FIGURE 2.20: BIOLOGICAL VS. BIODIVERSITY CONSERVATION CORRIDORS

The broad-scale biodiversity conservation corridor is not to be confused with one of its elements—the finer-scale biological corridor, which is "usually an elongated and continuous patch of habitat that maintains connectivity allowing the flux of individuals and ecological processes between two or more areas" (Sanderson *et al.* 2003).

A system of protected areas provides the core upon which the biodiversity conservation corridor is designed and managed. Connectivity networks comprise a mix of biological corridors (linear strips of habitat) (Figure 2.20), stepping stones (small patches of habitat), and/or compatible land and resource uses. Compatible land and resource uses are those human activities that, to various degrees, aid the maintenance of regional biodiversity (Gemmill 2002).

The specific targets of conservation at the corridor scale are globally threatened and geographically concentrated species, key biodiversity areas, and ecological processes that cannot be effectively conserved at either the species or site scale alone. A biodiversity conservation corridor provides a planning framework at a strategic scale for addressing broad-scale threats and opportunities for biodiversity conservation.

The Need for a Biodiversity Conservation Corridor Approach

Individual protected areas are sometimes too small to support viable populations of threatened species and maintain ecological processes. Protected area and site-scale initiatives have proven to be effective at protecting habitat even when resources for effective management are lacking

(Bruner *et al.* 2001), but protected areas alone are often too small to sustain viable populations of the species they are designed to protect (e.g., Newmark 1995). Even where species targeted for conservation have more limited ranges, their long-term survival in the wild will depend on functioning communities, which may include wide-ranging species and other ecological processes that operate at a broad scale (such as hydrological processes and migration) (Sanderson *et al.* 2002; Soulé and Terborgh 1999). Even large core areas will not persist in the long term if the broad-scale ecological processes on which they depend are not also maintained (Pickett and Thompson 1978; Schwartz 1999; Noss 2002). Biodiversity conservation corridors are anchored on protected core areas but incorporate additional areas necessary for the long-term conservation of wide-ranging species and the maintenance of critical broad-scale ecological processes.

Connectivity is critical for maintaining the seasonal movement and dispersal patterns of species. For many species, individuals and populations must move from one core area to another, either in search of different resources within a large home range or to disperse to new territories; doing this will require some form of connectivity among core areas (Bennett 2003). Connectivity may also be critical for adaptive responses to long-term change, such as climate change (e.g., Hannah *et al.* 2002). In the absence of good predictions about how loss of connectivity will affect biodiversity, existing connectivity should be maintained where possible, as it is much more complex and costly to restore connectivity once it has been lost (see Simberloff *et al.* 1992 for a discussion of these issues).

The resilience of key biodiversity areas can be enhanced by designing buffers of compatible land and resource use. While protected areas and biological corridors form the backbone of the biodiversity conservation corridor, the matrix of land uses surrounding these patches has a significant impact on habitat and species viability (Wiens 1996). Buffers of compatible land and resource use can mitigate edge effects that might threaten species and habitat at the boundaries of core areas (e.g., Woodroffe and Ginsberg 1998, Gascon *et al.* 2000). Thus, by promoting compatible land and resource use in surrounding areas, biodiversity conservation corridors make key biodiversity areas more resilient.

Many threats to species originate outside key biodiversity areas and are better addressed at a broader scale. Working only in and around protected areas on the most immediate and proximate threats is usually insufficient to conserve biodiversity targets effectively. Even large areas set aside for conservation purposes will persist only if they are effectively managed and protected from existing and emerging threats beyond their boundaries. Broader areas of compatible land and resource use can provide a forward defensive line against the incursion of dynamic threats, such as human migration and colonization, or the expansion of timber harvesting, livestock operations, or agricultural plantations. Biodiversity conservation corridors provide a tactic for addressing these threats proactively (Sanderson *et al.* 2003).

Planning at the biodiversity conservation corridor scale provides more flexibility in designing conservation strategies that also meet development or other social goals. Planning at the corridor scale allows conservationists to recognize a variety of options to meet conservation goals that would not be apparent when focusing on individual sites. Once irreplaceable areas are identified within a biodiversity conservation corridor or region, there may be several corridor designs that will meet conservation targets. By incorporating assessments of the benefits and opportunity costs of biodiversity conservation and using participatory approaches to evaluate different scenarios, biodiversity conservation corridors can be designed to achieve biodiversity conservation targets while contributing to economic development and poverty reduction.

Biodiversity conservation corridors also provide an opportunity for integrating biodiversity conservation targets into conventional land-use planning activities, and the corridor design process should be designed to support that. Ideally, conservation planning will be officially proposed or led by the relevant land-use planning authority, even if CI and conservation partners take the lead in the actual corridor design. This relationship needs to be cultivated from the beginning, as it is unlikely that planning authorities will simply adopt a plan once completed. Other important land-use decision-makers and stakeholders also need to be identified and brought into the process from an early stage. At the very least, the corridor design and associated data should be made available to local land-use planning authorities and integrated into base maps used for land-use planning purposes (Sanderson *et al.* 2003).

Conservation Actions at the Biodiversity Conservation Corridor Scale

Conservation action at the corridor scale builds upon conservation action at species and site scales. Biodiversity conservation corridors are designed to strengthen and complement actions at these scales and are not a substitute for them. The targets of conservation action at the corridor scale are the globally threatened and geographically concentrated species, key biodiversity areas, and ecological processes that cannot be effectively conserved at either the species or site scale alone. The challenge of biodiversity conservation corridors is how to achieve adequate scale (area), connectivity, and resilience to address current and emerging threats to biodiversity and increase the benefits of conservation actions or limit opportunity costs. All conservation actions at the corridor scale should be evaluated against their effectiveness of meeting these criteria. Generally, conservation action at the biodiversity conservation corridor scale focuses on the following:

- Creating systems of protected areas with sufficient connectivity to meet the area requirements of wide-ranging threatened species and ecological processes by:
    - Establishing additional areas managed for conservation (see the section, Protecting Key Biodiversity Areas, earlier in this chapter); and
    - Ensuring that systems of protected areas are managed as a coordinated system for the effective conservation of wide-ranging species and ecological processes.
- Promoting compatible land and resource uses as buffers to core areas, additional linkages within connectivity networks, and a forward defense against emerging threats by:

FIGURE 2.21: WHY DO WE NEED A BIODIVERSITY CONSERVATION CORRIDOR APPROACH?

- Individual protected areas are sometimes too small to support viable populations of threatened species and maintain ecological processes.
- Connectivity is critical for maintaining the seasonal movement and dispersal patterns of species.
- The resilience of key biodiversity areas can be enhanced by designing buffers of compatible land and resource use.
- Many threats to species originate outside key biodiversity areas and are better addressed at a broader scale.
- Planning at the biodiversity conservation corridor scale provides more flexibility in designing conservation strategies that also meet development or other social goals.

- o Providing information to decision-makers and building support for biodiversity conservation;
- o Creating effective incentives for biodiversity conservation;
- o Establishing a supportive policy and legislative framework; and
- o Building capacity to manage biodiversity resources.

An overview of CI's approach to designing biodiversity conservation corridor strategies is showin in Figure 2.22.

Additional descriptions of CI's approach to biodiversity conservation corridors include Sanderson *et al.* (2003), Boyd (2004), CABS and IESB (2000), and Morrison *et al.* (in press). Descriptions of the landscape-scale conservation approaches of our partner organizations are listed in the reference section at the end of this chapter.

Assessing the State of Biodiversity Within a Biodiversity Conservation Corridor

Refine Conservation Targets at the Corridor Scale

The process for defining 'Corridors Consolidated' conservation outcomes is outlined in Chapter 1. The first step in biodiversity conservation corridor design is to review conservation targets at the corridor scale and get a better understanding of their current status. To refine the conservation targets within a biodiversity conservation corridor, we follow a two-step process. First, we review the species, key biodiversity areas, and ecological processes that triggered the need for the biodiversity conservation corridor in question. Second, we identify additional areas within the biodiversity conservation corridor that may be needed to ensure that (1) our 'Extinctions Avoided' species-level outcomes within the corridor, as well as wide-ranging species that support key ecological processes, have sufficient habitat and that this habitat is connected so as to support migration patterns, gene flow, and other ecological processes; (2) Our 'Areas Protected' site-level outcomes of key biodiversity areas are surrounded by adequate buffer zones; and 3) these key biodiversity areas are sufficiently connected through a matrix of compatible land and resource use so that targeted ecological processes will be maintained.

Review Species that Require Action at the Biodiversity Conservation Corridor Scale

Globally threatened and geographically concentrated species that cannot be effectively conserved at the site scale are indentified during the process for defining species outcomes. These include species with large home ranges (e.g., the African wild dog (*Lycaon pictus*, EN)), species that occur at low densities (e.g., the Philippine eagle (*Pithecophaga jefferyi*, CR)), species that need to move between key biodiversity areas (e.g., the Giant panda (*Ailuropoda melanoleuca*, EN)), and species that generally thrive outside core areas (e.g., the Cheetah (*Acinonyx jubatus*, VU)). We thus target these species for corridor-scale conservation actions.

For each of these targeted species, we need to have a solid understanding of the direct stresses or immediate causes of decline in numbers. Declines may not be straightforward in their cause and effect, but cumulative and interactive. For example, Sea otters (*Enhydra lutris*, EN) are declining in Alaska because of excessive predation by Killer whales (*Orcinus orca*, LC) whose usual prey, Steller sea lions (*Eumetopias jubatus*, EN) and Harbor seals (*Phoca vitulina*, LC), are declining because of overfishing and changes in fish migration patterns associated with global warming (Estes *et al.* 1998). For globally threatened species, this information should already be available, but further research may be required to support the design of appropriate interventions.

Review Key Biodiversity Areas

Biodiversity conservation corridors are also designed to strengthen the resilience of key biodiversity areas directly by providing buffers of compatible land and resource use to reduce edge effects and by addressing threats proactively (Sanderson *et al.* 1998). Key biodiversity areas within the biodiversity conservation corridor are therefore also conservation targets at the corridor scale.

The scale of hotspots and wilderness areas limits options for conducting rapid biodiversity assessments to fill data gaps and generate comprehensive analysis of spatial priorities. An important early step in corridor design is therefore to review the data used to identify key biodiversity areas, prioritize data gaps (e.g., areas within the biodiversity conservation corridor that have not been surveyed but which remote sensing and species modeling or expert knowledge indicate as probable sites for globally threatened and geographically concentrated species), and collect new data. These data can then be fed back into the key biodiversity area analysis process described in Chapter 1.

Analysis of the main stresses to key biodiversity areas, especially those associated with edge effects and habitat loss and degradation within the biodiversity conservation corridor, is critical for designing appropriate corridor-scale strategies. This type of analysis is discussed in more detail in the section, Protecting Key Biodiversity Areas, earlier in this chapter.

Review Corridor-Scale Ecological Processes

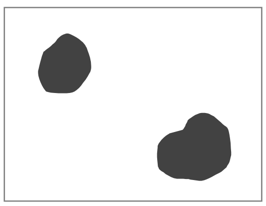
Ecological processes that are critical for the persistence of key biodiversity areas, such as water cycling, pollination, predation, fire, and flooding regimes, and that cannot be adequately conserved at the site scale are also conservation targets at the corridor scale. Chapter 1 provides some preliminary guidance on the identification of such ecological processes, but this will need to be refined once biodiversity conservation corridors have been identified and prioritized. The first step is to identify ecological processes that are critically important for the persistence of globally threatened and geographically concentrated species and of each of the key biodiversity areas within the corridor, focusing on those that occur at broad scales, and then pinpoint those that cannot be effectively conserved at the site scale. For example, hydrological processes are often critical for the persistence of key biodiversity areas and usually operate at scales broader than protected areas (Schwartz 1999). Conservation planners should also take into account the size of area necessary for target species and key biodiversity areas to recover from disturbances, such as fire and flooding (Pickett and Thompson 1978). In areas that have already been identified as priorities for biodiversity conservation corridors, there may also be wide-ranging species that are not themselves globally threatened but which are critical for the persistence of globally threatened and geographically concentrated species or of key biodiversity areas—for example top-level predators, megaherbivores, and pollinators. In most biodiversity conservation corridors, it will not be possible to systematically identify the wide-ranging species that play this type of keystone role, so candidate species will need to be evaluated on a case-by-case basis (see Simberloff 1998). It will be necessary to show why each species is critically important for globally threatened and geographically concentrated species or key biodiversity areas, and thus proving that these species merit specific intervention at the corridor scale.

FIGURE 2.22: OVERVIEW OF THE CORRIDOR STRATEGY DESIGN PROCESS

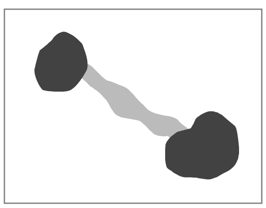
Assess State of Biodiversity

Review
- Species
- Key Biodiversity Areas
- Ecological processes

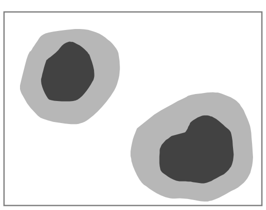
Establish Requirements
- Additional areas for species and ecological processes
- Additional connectivity for species
- Compatible land and resource use to provide resilience for key biodiversity areas



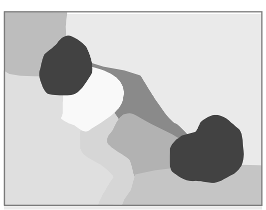
A - Traditional isolated parks



B - Links between protected areas

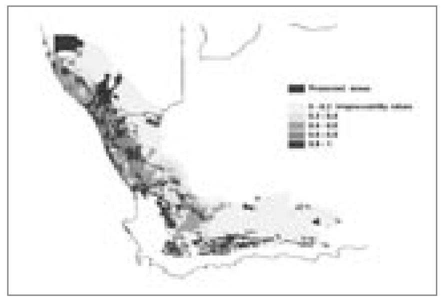


C - Parks and reserves with buffer zones



D - Land use mosaic constituting biodiversity conservation corridor

Design Basic Corridor Strategies
- Develop different spatial scenarios for meeting conservation targets (with irreplaceable areas 'locked in').



- Estimate economic benefits and costs

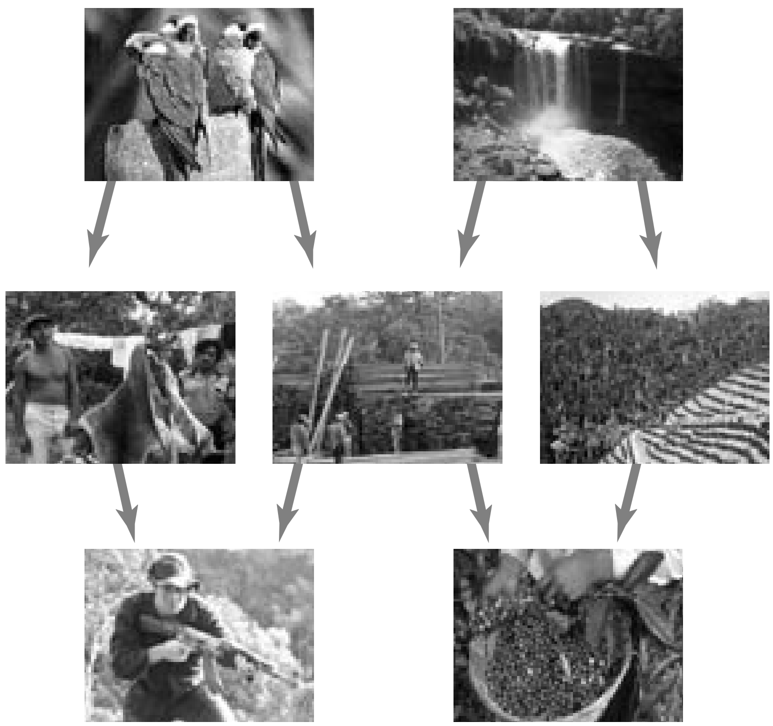
- Evaluate corridor scenarios
- Conduct a business-as-usual analysis, target areas for urgent action
- Integrate analyses

Note: This process is iterative with a number of feedback loops between steps.

Assess Pressures and Identify Milestones

Select Responses

Assess Pressures and Identify Milestones



Identify
- Sources of stress
- Land and resource use
- Stakeholders and other key decision-makers
- Necessary changes in behavior or existing conditions

Develop and Prioritize Interventions
- Establish additional protected areas
- Ensure coordinated management of protected areas
- Promote compatible land and resource use
- Adaptively manage in response to changing conditions

Monitoring and Evaluation

The next step is to develop a better understanding of the main stresses to these ecological processes—for example, whether fire regimes are being undermined by inappropriate fire management policies, fragmentation, or other factors; or hydrological processes are being undermined by changes in vegetation cover, pollution, or other factors (Richter *et al.* 1996).

Establish Requirements for Conservation Targets at the Corridor Scale

Review Additional Area Requirements for Species and Ecological Processes

The backbone of a biodiversity conservation corridor is a system of protected areas. The first steps in designing a system of protected areas are identifying and prioritizing key biodiversity areas at the hotspot or wilderness area scale (see Chapter 1). Once this process has been completed, the set of key biodiversity areas is reviewed to ensure that:

- The set encompasses all the sites required for the effective protection of globally threatened and geographically concentrated species;
- These sites are replicated where possible (to provide insurance against the risk of catastrophic destruction of any site);
- The set is complementary (i.e., that each key biodiversity area in the set provides clear added value to the set of areas in terms of species coverage or replication); and
- Each area is viable and resilient (i.e., sufficiently large and of appropriate design to persist in the long term).

For many species, individual protected areas will provide adequate habitat to support minimum viable populations, but there may be some globally threatened species that require access to larger habitat areas or connectivity over broader scales than can be accomplished within single protected areas (Figure 2.23). These species are conservation targets at the corridor scale. The conservation plan therefore needs to be expanded to include adequate habitat to support these species. Some species, such as the Spectacled bear (*Tremarctos ornatus*, VU), have large home ranges and require relatively intact habitat with limited disturbance. For these species, adequate habitat and connectivity to support viable populations should be included within the proposed system of protected areas but will require coordinated management. Other species, such as the Tiger (*Panthera tigris*, EN), are tolerant of a wider range of habitats, so additional areas may not need to be relatively intact but could include seminatural areas (even some types of grazing land or managed woodland) that meet the habitat or resource needs of the species in question (Sanderson *et al.* 2002).

Identification of additional areas is based on an assessment of the habitat requirements of minimum viable populations of species, and is clearly linked to the analysis of major stresses discussed above. This is used to determine whether requirements will be adequately met through the proposed system of protected areas. If not, then the next step is to describe, identify, and map the additional areas required to secure the persistence of these species (see e.g., Foreman *et al.* 2003). Remote sensing—the use of satellite imagery and aerial photography—provides important information on the biophysical aspects of the biodiversity conservation corridor and on the distribution of habitats of different species. These data enable predictions of species' ranges (area of occupancy, AO) and, when combined with a knowledge of habitat preference and resource needs, species richness. Considerable research may be required because different species have very different needs—for example, canopy bird species may be satisfied with intermittent patches of natural or seminatural canopy in an agroforestry landscape, whereas ground-dwelling species may need more continuous natural or semi-natural groundcover. However, the species targeted for intervention at the corridor scale are unlikely to be numerous.

The system of protected areas will be sufficient to protect many important ecological processes, such as water cycling, pollination, and predation. However, some critical ecological processes that operate at a broad scale may not be adequately maintained by the protected area system. Once these conservation targets have been identified, the next step is to determine what would be necessary for their maintenance, and then to map this where possible (e.g., Pressey *et al.* 2003). As with minimum habitat requirements for viable populations, the additional area requirements for ecological processes may by satisfied by semi-natural areas or compatible land and resource use areas rather than additional core areas.

Review Additional Connectivity Requirements for Species

While the movement and dispersal patterns of many target species will be fully captured within single protected areas, some species will require some form of connectivity between core areas. For different species, connectivity may be provided by biological corridors (linear strips of habitat) or stepping stones (small patches of habitat) or, for more tolerant species, by compatible land and resource use (Beier 1993; Bennett 1999). Biological corridors and stepping stones are likely to need some form of legal protection to ensure that they retain relatively intact habitat, whereas areas of compatible land and resource use may need less protection.

FIGURE 2.23: THE NEED FOR COORDINATED PROTECTED AREA MANAGEMENT

Species targeted for corridor-scale conservation efforts often require coordinated management of a system of protected areas. For example:

- The conservation of small populations of globally threatened species, such as the African wild dog (*Lycaon pictus*, EN), requires coordinated management of metapopulations across protected areas (Mills *et al.* 1998).
- Migratory species, such as the Whooping crane (*Grus americana*, EN), may require coordinated habitat management at breeding, wintering, and stopover sites (Meine *et al.* 1996).
- Ecological processes, such as fire regimes and grazing by large ungulates, may require coordinated management across protected areas (e.g., Noss 2002), (Harrington *et al.* 1999 and McLoughlin and Owen-Smith 2003).
- Coordinated management is also valuable for controlling threats such as invasive species and diseases (see, for example, TNC's Eastern Invasives Management Network and management of invasives in the Cape Floristic Region) (van Wilgen *et al.* 2001).

Coordinated management may be required because habitat loss has reduced natural patterns of variation in habitat quality, species populations have been reduced to levels at which populations are more vulnerable to natural variations in habitat quality, or local extirpations or reductions in some species populations have altered the functioning of natural communities.

Even in regions such as the Greater Yellowstone Ecosystem, where the scale of combined management units enables managers to promote natural regulation over active intervention, this approach must be coordinated across management units and adapted as new research becomes available (Committee on Ungulate Management in Yellowstone National Park 2002).

Connectivity networks are based on ecological studies and metapopulation analyses that indicate the connectivity needs of target species, including the need for gene flow to maintain population viability. These are then combined with studies of the actual movement patterns of these species and supplemented by modeling of migration or dispersal pathways when necessary (Walker and Craighead 1997). Again, these analyses should be tied in to the preliminary analysis of major stresses discussed above. Designing connectivity networks is particularly challenging when a variety of species is expected to use the connectivity network (Simberloff *et al.* 1992; Beier and Noss 1998). A useful first approximation may be gained by mapping current movement patterns for wide-ranging species, and combining this with maps of potential connecting features based on vegetation cover and land use.

When considering connectivity requirements and designing the connectivity network, it is important to recognize that not all areas need be connected. Where natural biogeographic barriers occur, creating connectivity that transcends these barriers may disturb and expose isolated communities of species to new threats that could lead to their decline or extinction (Sanderson *et al.* 2002). Efforts should be made to ensure that connectivity maintains natural biological transfer routes for the targeted species.

Review Additional Resilience Requirements for Key Biodiversity Areas

The analysis of additional areas required for resilience should build on the analysis of major stresses discussed above. By reducing edge effects, buffer zones contribute to the resilience of key biodiversity areas. However, resilience can be achieved only if these buffer areas are used to expand the area available for biodiversity conservation rather than to reduce the core area allocated to strict protection.

The delineation of edge effects has proved extremely challenging. The preferred approach is to identify the pressures on target species associated with edge effects, seek to understand the causes of these pressures (such as microclimatic changes that lead to increased vulnerability to fire, or increased competition from invasive species), then develop recommendations on the type and extent of compatible land and resource use required based on this analysis. In the interim, it may prove helpful to use vegetation cover and land use to identify potential buffer zones for core areas and to work to secure these until better information is available.

Analysis of remote sensing imagery can also indicate additional areas that should be added to corridor scenarios to provide a forward defense against oncoming threats. In terrestrial landscapes, analysis of aerial photographs and satellite images provides a clear geography of current human occupation and patterns of land and resource use. Comparison with previous images can indicate potential patterns of expansion and suggest areas where it would be useful to establish a bulwark against further encroachment.

Design Biodiversity Conservation Corridor Scenarios

Corridor scenarios are spatial designs for biodiversity conservation corridors, indicating the location and extent of protected areas and areas of compatible land and resource use. Corridor scenarios therefore integrate the analyses of additional area requirements, connectivity requirements, and resilience requirements that have been discussed above. In many land- and seascapes, there are multiple corridor scenarios that would conserve globally threatened and geographically concentrated species, key biodiversity areas, and corridor-scale ecological processes. The advantage of designing multiple corridor scenarios is that this provides much greater flexibility to explore different solutions that will meet conservation targets while generating socioeconomic benefits or limiting opportunity costs (see e.g., Airamé *et al.* 2003). Although this process is described below in step-by-step fashion, in practice it will be iterative, with a number of feedback loops between steps.

Corridor design and scenario development for biodiversity conservation corridors in hotspots have the same basic objectives as those in wilderness areas. Wilderness area corridors are intended to prevent fragmentation of communities, whereas hotspot corridors are intended to reconnect fragmented communities. However, different types of corridor strategies will need to be developed for hotspots and wilderness area corridors, because opportunity costs differ so greatly between them. These differences also mean that prioritization between the two in terms of the resources required would not be very useful. In general, for wilderness area corridors, the need for protected areas and connectivity is evaluated in terms of prospective fragmentation, and the extinction risks and loss of ecological processes that fragmentation would cause. For hotspot corridors, protected area and connectivity requirements are evaluated in terms of the cost of alternative spatial configurations that would reconnect or reinforce irreplaceable habitat for globally threatened and geographically concentrated species. The higher opportunity cost of land in hotspots (and rights within commercial fisheries in marine hotspots) usually requires higher spatial resolution to find cost-effective solutions than in wilderness areas. These factors should be considered carefully when designing an appropriate conservation strategy for a biodiversity conservation corridor.

Design Corridor Scenarios to Meet Conservation Target Requirements

The process of identifying key biodiversity areas described in Chapter 1 will identify some areas that are irreplaceable because they shelter species that cannot be protected elsewhere. These areas should be mapped and locked into all corridor scenarios as protected areas. The process will also identify flexible key biodiversity areas—those designated for globally threatened species that occur at multiple sites within the biodiversity conservation corridor, and therefore not all of which

FIGURE 2.24: COMPATIBLE LAND AND RESOURCE USE

From a biodiversity perspective, the ideal response to the need for broad-scale conservation and connectivity would be the expansion of existing protected areas. But in heavily affected regions, this is often no longer feasible, and conservationists must work with land and resource users outside protected areas to create new opportunities for biodiversity conservation. Compatible land and resource uses are identified on the basis of their contribution to the scale requirements of target species or critical ecological processes, the connectivity network, and/or the resilience of key biodiversity areas. Particular land and resource uses may, for instance, mimic the composition of the original habitat and help maintain populations of some target species. Shaded coffee, shaded cocoa, and other agroforestry systems may bear some degree of resemblance to the structure of natural forest and provide more benign alternatives to harsher modes of land and resource use such as monocultivation and cattle pasture. What constitutes compatible land and resource uses will also depend on species. For example, the resource uses compatible with ground-dwelling species may be very different from those compatible with canopy-based species. Considerable research is needed to determine whether different land and resource uses are likely to help achieve specific biodiversity conservation outcomes.

require protection. In biodiversity conservation corridors, it will be useful to add in information about additional area, connectivity, and resilience requirements before finalizing the identification of these flexible key biodiversity areas. From this combined analysis, different corridor scenarios can be developed that incorporate irreplaceable and flexible key biodiversity areas as well as additional areas required to meet corridor targets. This approach will be more efficient in terms of total area designated for protection than if key biodiversity area identification and corridor design are analyzed separately.

The final task at this stage is to provide recommendations on which areas may be designated for compatible land and resource use (Figure 2.24). The most straightforward way to do this is to identify the conservation target in each area that requires the highest level of protection and use this to guide the level of protection required. This guidance will need to be refined during the process of assessing socioeconomic benefits and cost and of specifying behavior changes.

It may be necessary to adjust the boundaries of the biodiversity conservation corridor as part of this process. The initial boundaries of the planning region will generally follow topographic or biogeographic boundaries (such as the limits of watersheds or ecoregions), but these may be adjusted to coincide with administrative or political boundaries, especially where the approach is led by government agencies or integrated into other land-use planning exercises (Figure 2.25).

To review the boundaries of a biodiversity conservation corridor when designing a conservation scenario, it is useful to answer the following questions about the proposed scale and corridor boundaries:

- Do they permit spatial integration of biodiversity goals and other stakeholder goals for the region (e.g., poverty reduction and ecosystem service maintenance)?
- Do they optimize opportunities to coordinate management of key biodiversity areas?
- Do they leverage opportunities to incorporate biodiversity conservation into regional planning?

In cases where the proposed biodiversity conservation corridor contains relatively few distinct areas with conservation potential, it will be possible to do this analysis by hand (see e.g., Pressey 2002). In more complex cases, with many areas to choose from and a range of different conservation targets, then conservation planning software may prove useful (Figure 2.26).

FIGURE 2.25: PRINCIPLES FOR DELINEATING BIODIVERSITY CONSERVATION CORRIDORS

Biodiversity conservation corridors should be based on the areas necessary to conserve threatened species not well conserved at the site scale alone (e.g., those that are wide-ranging or have low population densities); and

Biodiversity conservation corridors should be based on the areas necessary to conserve wide-ranging species and ecological processes on which the persistence of threatened species or key biodiversity areas depend.

As conservation tactics, biodiversity conservation corridors should be designed to address and proactively respond to existing and emerging threats to biodiversity, and incorporate benefits and opportunity costs into conservation planning.

FIGURE 2.26: THE USE OF MODELS IN CORRIDOR CONSERVATION

In our efforts to base conservation decisions on sound science, modeling is an iterative process of expressing what we know about regional ecology, its patterns and processes, and its response to threats. Note, however, that models do not create final corridor scenarios; but rather are useful as advocacy tools and powerful platforms for discussion with stakeholders in the biodiversity conservation corridor. These models are only as good as their inputs and parameters, and there are dangers associated with simplifying the complexity of these processes in a map. As part of that dialogue with stakeholders, it is therefore necessary to be transparent about the assumptions and data being used.

Some potential applications of models are too:

- Introduce the dynamics of land use and resource use over time into the planning process;
- Communicate to policymakers the risks associated with business-as-usual practices;
- Incorporate potential scenarios of biodiversity loss into monitoring systems, based on observed historical patterns and trends; and
- Compare the results of conservation action with business-as-usual scenarios as part of the monitoring and evaluation process.

Estimate the Economic Benefits and Costs of Different Corridor Scenarios

The broad scale of biodiversity conservation corridors compared with sites often enables conservationists to identify corridor conservation scenarios that will contribute to development objectives and conservation targets at the same time. Where there is flexibility in the choice of sites (i.e., there are different corridor scenarios that would each meet all biodiversity conservation targets), then an analysis of socioeconomic benefits and costs may help in the selection of scenarios.

The next step is therefore to evaluate the different corridor scenarios by integrating estimates of the socioeconomic benefits and opportunity costs of conserving different areas within each scenario. The methods for incorporating and mapping economics benefits and costs will vary based on the corridor context and resources available (see Figure 2.27 for an assessment in Brazil's Atlantic Forest). Results can then be fed into a participatory process that allows different stakeholder groups to provide additional contextual information to support the identification of corridor conservation scenarios that will generate socioeconomic benefits or limit opportunity costs and that are feasible from a sociocultural and political perspective. This participatory process is likely to involve modifications to the proposed scenarios, and should therefore be seen as part of an iterative process of proposing, reviewing, and modifying corridor scenarios until a solution has been found that achieves the conservation targets within the biodiversity conservation corridor. In practice, even this solution will need to be regularly updated as new opportunities arise and new information emerges.

Identify Areas Requiring Urgent Conservation Action

Analysis of current and future threats to biodiversity will help to determine which areas to target for urgent conservation action. One tool of such analysis is landscape mapping, which can reveal

FIGURE 2.27: ESTIMATING SPATIAL OPPORTUNITY COSTS OF CONSERVATION IN BRAZIL'S ATLANTIC FOREST

Biodiversity hotspots might be thought to present steep opportunity costs for maintaining forest cover against pressures of agricultural conversion. In Brazil's Atlantic Forest, CI and its partner IESB teamed with World Bank economist Ken Chomitz to discover the spatial distribution of this economic pressure. The methodology was to conduct a sample survey of rural properties sold in the previous two years, obtaining sales price and detailed characteristics data for 231 properties. Survey data were supplemented with geographic information on slope, soils, climate, and roads. The per-hectare sales price of the property was then regressed on geographic factors expected to explain the variation in land price. The regression results show that agricultural attractiveness strongly determines the value of land. Higher slopes are associated with lower land values. More favorable soils are associated with higher land values. Most importantly, primary forest cover was associated with a 70 percent reduction in land value, and secondary forest with a one-third reduction in land value, other things being equal.

Parameters from the regression results were then used to interpolate land values across the region, multiplying each parameter by each pixel's biophysical and other map data. By using this methodology, it was possible to identify the least expensive 10,000 hectares of land with high forest cover in each zone. The mean value of these lands was less than a modest US$90/hectare. Protecting these areas would pose little constraint on agriculture, as there remain ample quantities of non-forested land with good-quality soil not in current use for cacao or forest plantations. In addition, a participatory stakeholder workshop was held at which areas for strict protection and compatible land use were selected and evaluated according to economic costs and environmental benefits. The results suggest that even in the Atlantic Forest, opportunity costs for the region's unique biodiversity are relatively low. Despite the region's long settlement history and considerable population, conservation-development trade-offs may be modest (Chomitz *et al.* 2004).

the rate and patterns of environmental landscape change. Land-use change analyses provide information on the spatial and temporal changes in the patterns and structure of the different vegetation types in the biodiversity conservation corridor (be they natural or human-induced), and hence an improved understanding of the scale and geography of the threat to target species and their habitats. Such analyses can be conducted at various scales to highlight areas of particularly rapid change. The power of remote sensing lies in its ability to provide repeatable, unbiased information about the distribution and conversion of natural habitats. While satellite mapping has traditionally been costly, recent increases in computing power and large reductions in the price of satellite data have made this a very cost-effective means for comprehensive monitoring of habitat change for hotspots (see e.g., Steininger *et al.* 2001; Tucker and Townshend 2000; and Steininger *et al.* 2004).

Business-as-usual scenarios are projections and modeling of future vegetation cover and land use patterns in the absence of any conservation intervention, based on the best available data. These can include extrapolations from biophysical parameters, historical change, threats (such as roads), and socioeconomic information. Business-as-usual scenarios help indicate those areas where conservation action is most urgent or natural vegetation will be lost. Alternatively, different projections may be built to describe a possible landscape if conservation action is taken, thereby allowing comparisons with business-as-usual scenarios. A variety of methods have been tested in Madagascar, Brazil, and the Philippines (see Figure 2.28 for an example from the Philippines).

Integrate the Analyses

Each of the information layers described above—conservation targets, socioeconomic benefits and costs, and business-as-usual—is a useful tool for guiding conservation planning in its own right. A variety of methods can be used to generate each layer, and the most appropriate will depend on data availability, capacity, resources, and other contextual issues. Each layer needs to be based on the best available data combined with participatory approaches that ensure that the final results are accepted and used by partners and decision-makers. The simplest approach to integrating the analyses is to overlay the data layers and evaluate scenarios and areas for urgent action, by hand or using basic GIS. Alternatively, conservation planning software tools can support integration and analysis. Most of these tools are flexible, so it is important to design the layers and analysis to suit the specific context and then select and adapt the most appropriate tool or approach.

Assessing Pressures and Identifying Biodiversity Conservation Corridor Milestones

Once conservation targets have been set within the biodiversity conservation corridor, the preferred corridor scenario chosen, and areas for urgent action identified, the next step is to develop a better understanding of the pressures on targets within these areas and to specify the

FIGURE 2.28: BUSINESS-AS-USUAL ANALYSIS IN THE PHILIPPINES

The forests of Palawan in the Philippines are renowned for their high biodiversity but are being rapidly cleared for agriculture on both commercial farms and subsistence smallholdings. There are few alternatives to subsistence agriculture for local livelihoods. As the island's population soars—owing largely to transmigration from other areas of the Philippines—so does deforestation. Consequently, agriculture has expanded into upland areas, fallow periods have been shortened, and cultivation has invaded ecologically fragile areas, resulting in extensive resource degradation with adverse environmental consequences.

CI's approach to developing business-as-usual habitat loss analysis for South Palawan integrated economic theory with geographic information systems. Given the prevalent influence of population growth on land cover and resource use, spatial economic analysis was used to tease out the relationships between geophysical land features and socioeconomic and demographic trends. The economic analysis thus identified which factors were statistically significant in contributing to deforestation. Multicriteria evaluation was then used to integrate these factors across the landscape and to determine areas of potential deforestation. The result of this process is a map with a composite index of deforestation risk, which was reclassified into three categories of risk: low, medium, and high.

Results of our analysis indicate that over 24 percent of all forests in South Palawan are under some level of deforestation risk over the next five years, of which approximately 18,900 hectares (8 percent) are under high threat of conversion to agriculture, and 35,800 hectares (16 percent) under medium threat. The risk-of-habitat-loss map for South Palawan highlights the locations where forests are most vulnerable to conversion according to current trends. This map of forest vulnerability can then be overlaid on corridor scenarios to identify areas that are vulnerable to deforestation and should be targeted for urgent action.

behavior or condition changes required to secure the targets. By this stage, there will already have been some analysis of the immediate stresses on targets and the types of protection required. The corridor scenario serves to focus this analysis on specific areas, and so the analysis can now be refined and extended to include an assessment of the main sources of stress, the stakeholders and decision-makers, and the behavior and condition changes necessary to conserve corridor targets.

Identify Sources of Stress

The main stresses on corridor targets will have been identified as part of the process of designing corridor scenarios. For example, stresses to species targets will have been defined in terms human-induced habitat loss and degradation, invasive alien species, harvesting, accidental mortality, persecution, pollution, natural disasters, changes in native species dynamics, intrinsic factors, and human disturbance. We now need to understand the sources of stress and evaluate their relative importance. For example, human-induced habitat loss and degradation may be caused by agriculture, fire, management of non-agricultural land areas, extraction industries (e.g., mining, fisheries, and timber), infrastructure development, invasive alien species, changes in native species dynamics that directly affect habitat, or other causes (*www.redlist.org*). It is important to prioritize throughout this analytical process—focusing on areas for urgent action, the most significant stresses for each target, and the most important sources of stress. Once the process is complete for all targets, you will need to identify which sources of stress must be addressed in the corridor strategy. It may be useful to prepare a matrix to facilitate discussion and review of this information. The most important sources of stress will not necessarily be those that occur most often, but rather the ones that threaten irreplaceable areas and have irreversible impacts. Sometimes, as in the case of weak governance, it may be impossible to change the most significant stress during the planned strategy implementation period. In these circumstances, you will have to set priorities among the behavioral milestones that are feasible, and to lay the groundwork so that functioning institutions can address the currently unchangeable stress in the future.

Identify Land and Resource Users, Stakeholders, and Other Key Decision-Makers

The next step is to identify the key land and resource users whose behavior will need to be modified in order to secure conservation targets, focusing again on areas requiring urgent action and the most significant stresses and sources of stress. As before, keep prioritizing throughout this process, focusing your attention on land and resource users having the greatest impact on corridor targets.

It is important to understand the different socioeconomic groups directly involved in land and resource use and the motives, incentives, and constraints driving their behavior. Much of the stress on a biodiversity conservation corridor will be posed by agricultural, tourism, infrastructure, and mining activities and the policies that govern them. The assessment needs to include an analysis of (1) how the proposed behavior changes will affect different resource user groups, (2) whether resource users have the capacity and resources to respond to changes in incentives, and (3) whether supportive institutional and policy frameworks exist. This review will help you identify barriers and the barrier-removal strategies discussed below.

Successful conservation also involves influencing decision-makers who can effect needed changes in policy and institutional structures. Identification of appropriate conservation options will depend partly on an assessment of the motivation and the capacity, power, and influence of different decision-makers to effect changes in incentives and in the behavior of resource users. Decision-makers can range from individual community members to heads of state, ministries and government agencies, regional management committees, corporations, or donor agencies. For example, in the case of agricultural encroachment on protected areas, resource users (individual farmers) determine agricultural practices, but national-level decision-makers may determine subsidies for agricultural inputs, which influence land-use practices and the level of enforcement for protected areas. In some regions, various local and international NGOs and donor agencies also drive resource use within a landscape. Understanding the agendas, mandates, and capacities of these organizations can also help identify opportunities for influencing decision-making.

The following questions may be used to evaluate stresses on biodiversity conservation corridors posed by perverse policies or by the absence of policy mechanisms necessary for effective conservation incentives:

Protected Area Policies

- Does the government officially recognize that protected area management requires corridor-scale policies to effectively prevent species extinctions?
- Have inholders in protected areas been adequately compensated, including for reductions in logging and hunting?
- Does tourism in protected areas threaten the ability to protect biodiversity?
- Do government protected area officials allow partnerships with NGOs to complement management and monitoring capacity?
- Do protected area officials risk their jobs to enforce laws on logging, hunting, and extraction?

Infrastructure Policies

- Do regional economic development policies threaten to undermine the effectiveness of the protected area network?
- Does the building of roads and tourism facilities pose a threat to biologically important connectivity?
- Can the location of increased development pressure be anticipated so that conservation action can be taken before opportunity costs rise?

Economic Policies

- Do agricultural, fishing, mining, or coastal development policies leave key biodiversity areas vulnerable to unsustainable use?
- Do tax policies favor large land holdings, forcing small holders to areas with inadequate agricultural potential?
- Do logging and mining contribute to government hard currency earnings and other stakeholder income that undermine the integrity of an effective protected area network?

Land- and Coastal Marine-Use Policies

- Do legal norms recognize user rights that encourage occupation of forested lands or preemptive deforestation in order to secure use rights or land tenure?
- Are catch limits sustainable and enforceable?
- Have zoning policies been built on the underlying economic potential of land use, with a

system of positive inducements for conservation-compatible behavior, as well as penalties for violations?
- Are there areas in the biodiversity conservation corridor that both meet biodiversity conservation objectives and provide essential ecological services for which economic instruments could be structured to compensate stakeholders in these areas for their conservation?

The impact of political decisions will also depend on how effectively agency regulations are drawn up and implemented. A government institution's effectiveness is determined, at least in part, by the clarity and scope of its mandate, and by its position in the larger administrative framework, both of which are usually established by law. An institutional analysis of implementing agencies should ask:
- Does the institution have a clear mandate?
- What is the institution's position in the local/regional/national administrative framework, and how does that location affect its authority and effectiveness?
- What is the institution's technical and financial capacity to process information and to take action and implement projects?

Specify Behavior Changes

The final step in this stage is to specify the behavior changes required to reduce stresses on conservation targets. The process of designing and evaluating corridor scenarios will have already contributed to this analysis by specifying whether areas require full protection or could instead be designated for compatible land and resources use. For each area requiring urgent action, you will have to provide detailed recommendations on appropriate resource uses and practices in each area. For example, conservation of target species may be compatible with collection of non-timber forest products but not with harvesting of large trees for timber; certain fisheries and fishing practices may be compatible with the protection of particular marine resources.

These specific changes in behavior or patterns of land and resource use within the biodiversity conservation corridor are the corridor-scale milestones. In the process of identifying potential milestones, however, you must think about how the initial change will create subsequent feedback and reinforcement of behavior. It is not enough to create a matrix of protected areas, connectivity, and compatible land and resource use without ensuring sustainable financing for its management. Policies that move toward economically efficient land use for both biodiversity conservation and economic growth have the potential to improve human welfare and reinforce support for natural resource management. While expectations of economic benefits are in many cases reasonable, they often lack solid economic quantification or institutional grounding that could lead to a system of compensation for changes in behavior. The public perception of these links between biodiversity conservation and human welfare will depend on how strongly they are felt in their everyday lives. Evaluating how strongly and how soon the benefits to human welfare from biodiversity conservation should be felt can help avoid unrealistic expectations that might easily undermine behavior change.

Selecting Conservation Respones to Consolidate Biodiversity Conservation Corridors

At this stage of the corridor design and strategy process, corridor conservation targets ('Corridors Consolidated' outcomes), the areas where they will be achieved, and the areas requiring urgent action have all been identified, as have the milestones required to deliver the corridor design. The next stage is to develop, evaluate, and select interventions (corridor-scale responses) to achieve our 'Corridors Consolidated' conservation outcomes.

The key to developing effective strategies is to understand the barriers to change and then to identify the set of interventions that is necessary and sufficient to overcome these barriers and achieve the desired change in condition or behavior—our conservation milestone. Ask "Do resource users have the awareness and technical knowledge to respond to changes in incentives? Do they have access to the credit and labor necessary to change their resource-use practices? Do they have ready access to markets to sell new products or purchase substitutes for old? Do protected area agencies have the capacity to manage a suite of new protected areas?" Uncertain property rights and land and resource tenure can provide a major impediment to successful conservation of biodiversity conservation corridors. For example, the benefit from no-take marine reserves in increased stocks in surrounding fisheries may be too diluted unless use rights are restricted to current and traditional users and communities. Changes in land and resource tenure are often necessary but not sufficient to generate changes in resource use behavior. CI cannot engage in all these interventions, but it is important that each of these are tackled by CI, our partners, or others.

An important step is to identify the best entry point for initiating the strategy. For example, there may be an opportunity within national or local governments, with private industry, or among local populations. Building on the assessment of stakeholders and decisionmakers outlined above, we need to identify areas of shared interest and opportunities for collaboration.

The analysis required will cover socioeconomic, sociocultural, policy, institutional, and legal issues. It is essential that this analysis be tightly focused on the conservation targets, and the areas in which we seek to conserve them (and the most urgent areas in particular), and on designing ways to deliver the specific milestones identified through the pressures assessment. The Rapid Assessment of Conservation Economics (RACE) is designed to do exactly this—while the acronym refers only to economics, in practice the assessments cover the full range of socioeconomic, sociocultural, policy, institutional, and legal issues according to terms of reference designed specifically for each biodiversity conservation corridor (see Figure 2.29 for more details).

Promote the Creation of Systems of Protected Areas

Protected areas are the backbone of conservation at the corridor scale, and the management and technical capacity to support these is crucial if biodiversity targets at the corridor scales are to be achieved. Individual protected areas often suffer because staffing, technical know-how, infrastructure and equipment, and funding levels are insufficient for effective management. Therefore, creating or strengthening an effective and coordinated system of protected areas is essential for ensuring the sustainability of these protected areas.

FIGURE 2.29: THE RACE APPROACH TO ASSESSING CORRIDOR INTERVENTIONS

A Rapid Assessment of Conservation Economics (RACE) is specifically designed to identify the best strategies for achieving corridor milestones in an expert-based and participatory manner. Land- and resource-use activities that commonly provide significant sources of stress to biodiversity are fisheries, forestry, mining, large- and small-scale agriculture, and livestock. In each case, we need to understand the economic importance of the sector at local, regional, and national scales, the effect of different subsectors on conservation targets, the factors driving current patterns of resource use, and alternative development scenarios. In the case of fisheries, the assessment may include an analysis of the scope for creating and expanding reserves for fisheries management purposes; in the case of forestry, modeling may serve to identify different harvesting regimes. It is usually important to understand the actual and potential interactions between different sectors within a regional development framework.

For example, during 2001 and 2003, CI's Resource Economics Program worked with CI Indonesia and the Melanesia CBC to implement a RACE in Papua. The assessment started with identifying key macro-level issues affecting conservation in Papua, including forestry, mining, oil and gas extraction, spatial development trends and scenarios, district budget collection, and decision-making capacity and processes. CI engaged Papuan experts to conduct research on these issues and organized local technical and policy discussions on the results from the research. The purpose was to mobilize local stakeholders to specify major conflicts between development activities and biodiversity conservation and facilitate consensus building to resolve the conflicts. As a result of this participatory process, local stakeholders—including the provincial government and major civil society groups—proposed the establishment of a Papua Forum for Conservation and Development as a democratic platform to discuss innovative ways of achieving poverty reduction and economic development while enhancing biodiversity conservation in the province.

Typical outputs of a RACE are spatial analysis of current and future threats (business-as-usual analysis) based on integrated socioeconomic data and spatial analysis, analysis of the incentives and constraints driving the behavior of stakeholders and decisionmakers, recommendations on the suite of conservation interventions necessary to deliver corridor milestones, and assessments of likely social, cultural, and economic impacts. The key characteristic of a RACE is that it involves local experts throughout the process—in defining terms of reference, collecting and analyzing data, reviewing the assessment, and making recommendations.

Coordinated management of a system of protected areas carries additional demands. In the first place, high-quality science and technical capacity must guide coordinated management decisions (see Committee on Ungulate Management in Yellowstone National Park 2002 for an example). Institutional mechanisms and management capacity must be developed to support coordinated management, and policy and legislative changes may be required. Targeted incentive programs may be necessary to encourage and strengthen collaboration. Monitoring and evaluation, especially of the scientific underpinnings of coordinated management, is essential.

Promote Compatible Land and Resource Uses

Provide Information to Decision-Makers

Resource users and decision-makers who are aware of the value of biodiversity and ecological processes and their contribution to economic development are more likely to incorporate these values into resource use decisions. By combining information with appropriate incentives, capacity, and institutional frameworks, you can increase the likelihood of achieving your conservation targets. Providing information on the significance of conservation targets, and demonstrating the consequences of pursuing a business-as-usual approach on both conservation targets and development objectives will help build support for biodiversity conservation. Products such as forest-cover change maps and business-as-usual scenarios can be valuable communication tools for a wide range of stakeholders. Decision-makers can plan better for both biodiversity and development objectives, and can explain their choices to their constituents if they understand the economic implications of various land-use options (including biodiversity conservation).

Create Incentives

An incentive structure that supports biodiversity conservation is an important mechanism for achieving conservation outcomes in biodiversity conservation corridors. Examples of incentive mechanisms include direct incentives such as conservation service payments, conservation easements, agroecological schemes, and other tax concessions for landholders who maintain or support biodiversity on their land. Indirect incentives may be provided through ecotourism or conservation enterprise initiatives, such as Conservation Coffee™ and Conservation Cocoa™.

The need to expand area coverage of conservation often conflicts with urgent economic pressures. To minimize this conflict, zoning for agroecological uses can help regulate land use over large areas. Zoning aims to direct development to areas of high agricultural potential, while restricting land use in ecologically significant and sensitive areas. The experience with zoning has been disappointing, however, since zoning goals can be achieved only when zoning regulations are enforced. Zoning enforcement has typically relied on interdiction and penalties rather than on economic incentives. In practice, enforcement has been problematic where zoning imposes potentially large costs on private actors and where political support is lacking. The lack of success in using zoning tools suggests a need for a deeper economic analysis of the basis of zoning, and for the development of instruments and institutions that can reconcile zoning objectives and landholder incentives (Sanderson *et al.* 2003) (Figure 2.30).

Promote Policy that Supports Conservation

Local and national policy and legislative frameworks can both help and hinder conservation within a biodiversity conservation corridor. In many cases, the policy and legislative framework creates perverse incentives that lead to the overexploitation of biodiversity and other natural resources. For example, resettlement policies in the Atlantic Forest of Brazil direct new settle-

FIGURE 2.30: TARGETING INCENTIVES TO INDIVIDUALS AND COMMUNITIES

In many cases, incentives at the community level should be sufficient to induce behavior change, while incentives at the individual or household level will not be. For example, the community's best interest is to limit cattle numbers on communal lands to maximize total productivity, but individuals may still gain more by adding one more cow than they would lose in lost productivity for their share of the herd. It is therefore essential to assess incentives at the level of those actually making decisions about resource use.

ments to forested areas and conservation priority areas, threatening conservation outcomes. In the case of Madagascar's eastern rainforests, land and resource tenure can be secured by slash-and-burn agriculture within the forest reserves—*forêts classées*—thus attracting inhabitants of densely populated coastal regions into the *forêts classées* in search of new land. In such cases, the most efficient means to secure conservation targets may be to modify these perverse incentive systems through the policy or legislative framework.

Where the existing policy and legislative framework allows, special planning requirements (such as more rigorous requirements for environmental impact assessments or more stringent environmental quality standards) can be used to secure compatible land and resource uses in designated areas. These restrictions may be strengthened through linkages to positive incentives.

The policy and legislative framework can support biodiversity conservation only if there is real enforcement. Enforcement must provide sufficient disincentives to deter the illegal exploitation of resources. The opportunities for the enforcement chain (from detection to conviction) to be ineffective are numerous—because human and financial resources are inadequate, procedures are outdated or inappropriate, judicial authority is weak, or too many agencies are involved. Efforts to improve the policy and legislative framework need to be balanced with efforts to strengthen enforcement.

Build Capacity

Establishing compatible land and resource use areas requires that conservationists engage in regional-scale land and resource use planning and engage a wide variety of stakeholders. Capacity-building efforts should be part of participatory regional planning methodologies that incorporate both conservation targets and development objectives. Regional planning capacity needs to be complemented by capacity to coordinate and manage regional plans. Given that implementation of these plans is usually housed within government agencies and private industry responsible for forests, agriculture, livestock, fisheries, water, mineral resources, tourism, infrastructure development, and others, it may be necessary to work directly with these agencies to build their capacity to manage resources responsibly and build biodiversity conservation into decision-making (Figures 2.31 and 2.32).

Choose and Evaluate Conservation Actions

A successful biodiversity conservation corridor is one that conserves corridor targets and achieves corridor milestones. It is therefore based on successful design, the effectiveness of coordinated protected areas management, and the successful implementation of interventions designed to promote compatible land and resource use. The choice of corridor interventions should be evaluated both individually and as an integrated strategy, according to the following criteria:

- **Impact on conservation targets:** Choose interventions that have a direct link to the achievement of biodiversity corridor conservation targets and to the requirements of key biodiversity area protection, connectivity, and resilience. Interventions should be evaluated for the scope and intensity of their impact;
- **Impact on other objectives:** Where different interventions contribute equally to conservation outcomes, consider additional human welfare objectives such as poverty reduction and economic development;
- **Immediacy of threat:** Focus corridor interventions on changes that affect the most immediate threats, with particular attention to those that are most severe or with irreversible impacts—in other words, evaluate the relative costs of acting now or later;

FIGURE 2.31: ENGAGING WITH THE PRIVATE SECTOR: A CASE STUDY FROM BRAZIL

Leading global companies can significantly enhance biodiversity conservation by using their market leadership to encourage their suppliers to use environmental best practices. Within major commodity markets, such as soybeans, companies can link supply chain incentives for improved environmental performance to existing quality assurance programs.

CI-Brazil has worked with Bunge, Brazil's largest soybean processor, to build a foundation for the Aliança BioCerrado. This project involves working directly with Bunge supply chain managers and soybean farmers to integrate soybean farms into regional conservation strategies and create value for farmers and for Bunge. More than 50 percent of the Cerrado is used for agricultural purposes, primarily for animal husbandry and the growing of cotton, soybeans, and corn. This development has helped Brazil's economy in the short term, but at a major cost to the environment. To address this threat to the Cerrado, a pilot project was launched in 2003 aimed at farmers managing 150,000 hectares bordering Emas National Park. This pilot project has two primary components: creating private reserve networks and creating conservation incentives through supply-chain management.

Brazil's Forestry Code requires farmers to maintain buffer areas of natural vegetation along waterways and on steep slopes, in addition to protecting minimum amounts of natural habitat within the working landscape. However, only an estimated 20 percent of farmers in the region of Emas National Park have implemented the required reserves. The private reserve network component of the pilot project focuses on assisting farmers to create private reserves on their properties with an emphasis on identifying reserve areas that minimize the opportunity costs, while maximizing the corridor-scale biological value of these reserves. Farmers will profit from reduced legal liability and improved land values as a result of Forestry Code compliance, in addition to the ecosystem service benefits derived from maintaining the region's rich natural resources.

The conservation incentives component will result in the development of cost-effective and practical means for partner companies, through their supply-chain and purchasing operations, to provide suppliers and growers with meaningful non-cash incentives for implementing environmental best practices on their farms.

Some key actions for corridor planning involving industry partners:

- Analyze the most significant direct and indirect threats to protected areas and their buffer zones driven by commercial activity, along with the opportunities for engagement and conservation actions;
- Assess how failure to address these threats and opportunities will affect conservation outcomes;
- Assess the economics and the benefits to commercial stakeholders from the conservation activities;
- Design plans to approach business stakeholders with support from the Center for Environmental Leadership in Business (CELB);
- Develop and submit to corporate partners and other donors proposals for the planned incentive programs; and
- Implement pilot projects to build relationships, best assumptions, develop lessons learned, and further momentum for further collaboration.

FIGURE 2.32: ENGAGING WITH POLICY-MAKERS

Biodiversity conservation faces major constraints imposed by public policies and institutions. Reduced public spending on conservation, poor enforcement of conservation laws and regulations, and ineffective development policies that encourage forest destruction are examples of key roadblocks to conservation. We must address these if we want to make substantive progress toward sustainable conservation.

At the international level, CI's Center for Conservation and Government (CCG) is motivating the donor community to treat biodiversity conservation as a priority on their development assistance agendas. We are also developing international and regional mechanisms to enhance the enforcement of conservation laws and regulations, especially with respect to illegal logging, fishing, and harvesting of wildlife, which often have transboundary implications. In addition, we are promoting innovative approaches to poverty reduction and economic development to the World Bank, IDB, and government planners to compare alternative development options in different locations and sectors, support integrated planning for development and conservation objectives, and explore the potential of concentrated development to reduce poverty and conserve biodiversity.

At the national and local levels, we have been working with government and other stakeholders to identify and analyze major conflicts between development activities and biodiversity conservation, and to facilitate consensus building to find innovative ways to resolve these conflicts. Stakeholder participation is the key to the success of these efforts. Targeted external support is also important in providing incentives to local stakeholders to change the way policies are formulated and institutions are managed. In Indonesia's Papua Province, we are working with stakeholders to explore the potential for development and environmental conservation assistance to be linked to the willingness of local governments to consider siting large-scale development efforts away from priority conservation areas.

- **Appropriate scale:** Confirm that specific milestones are best addressed at the corridor scale rather than the site, species, national, or international scale;
- **Feasibility:** Evaluate interventions for their probability of success and for the risks in implementing them, including assessments of opportunities to build on shared objectives with decision-makers and other stakeholders;
- **Sustainability:** Evaluate interventions for their ability to bring about a lasting impact, including institutional sustainability (e.g., institutional capacity and appropriate mechanisms for decision-making), sociopolitical sustainability (e.g., the risk of political change or social instability), robustness in the face of economic change, and financial sustainability; and
- **Leverage opportunities:** Evaluate whether an intervention can catalyze further action toward achievement of conservation outcomes.

Keep in mind that if a pressure (e.g., the need for land reform) is one we cannot change, we may need to choose interventions that instead successfully address the consequences of the problems (e.g., by working with local populations to strengthen land tenure and resource-use rights within the existing legal framework).

Once the best suite of interventions to achieve our conservation milestones has been agreed, the next question is how to allocate responsibility for interventions among partners. The main issue here is comparative advantage—which organization has the most appropriate institutional and technical capacity for each intervention, and how are these responsibilities best shared among partners? While assessing the comparative strength of CI and partner organizations is important in selecting CI's organizational suite of conservation actions, we must not simply allocate ourselves the interventions for which CI has greatest capacity. Building capacity in our partners is essential for securing sustainable conservation.

Similarly, we must be careful not to give undue priority to the interventions for which CI and partners have the most capacity. Our technical capacity and long experience in areas such as ecotourism are valuable and may indicate good value for money, a high probability of technical success, and fundraising advantage. Nevertheless, the highest priority conservation needs must take precedence over the contextually less appropriate interventions. In some cases, this may involve adapting our own technical capacity to ensure that it provides a good match to the appropriate corridor strategy.

To allot conservation actions between CI and partners, we should first:

- Assess existing programs and activities of CI and partners. In many cases, partners are already working effectively toward achieving some conservation milestones, and reallocating our resources or duplicating these interventions is not appropriate. Moreover, if CI's own interventions are not contributing directly toward corridor milestones, we should reconsider the wisdom of these activities.
- Assess the institutional capacity, mission and mandate of CI and partners. Which organizations are best placed to engage with policymakers, the private sector, and local populations? Which organizations are best placed to raise funds in-country or internationally?
- Assess the technical expertise, existing programs, and knowledge of the biodiversity conservation corridors among partners.

In many cases, even specific interventions will require collaboration among partners. It is essential to clarify the roles of different partners and how each partner complements the others.

Adapt to Changing Conditions

Adaptive management is the process of testing the assumptions that underpin the selection and design of corridor conservation interventions and taking action to improve in light of this analysis or the results. In its purest sense, adaptive management involves systematically testing different options to achieve the desired milestone. This approach enables conservationists to develop a better understanding of why some interventions work better than others. In practice, most corridor strategies will involve testing a single set of interventions for each milestone. Therefore, the effectiveness of these interventions must be regularly monitored and evaluated, so that they can be modified if they are not proving successful. Evaluation should also involve a process to develop a better understanding of the corridor context and improve capacity for effective corridor strategy development and implementation. Adaptive management means that strategies are modified if they do not achieve the desired results or as conditions change (Salafsky *et al.* 2001).

As biodiversity conservation corridors are complex matrices of conservation targets affected by numerous dynamic and interactive pressures, adaptive management of our suite of conservation interventions is essential to ensure the persistence of our conservation outcomes.

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MONITORING AND EVALUATING CONSERVATION OUTCOMES AND STRATEGIES

CHAPTER 3

In this chapter

- MONITORING THE STATE OF CONSERVATION OUTCOMES AND MILESTONES
- MONITORING AND EVALUATING THE EFFECTIVENESS OF CONSERVATION ACTION (OUTPUTS AND ACTIVITIES)

Introduction

FIGURE 3.1: BENEFITS OF MONITORING AND EVALUATION

Among reasons to monitor and evaluate conservation targets and actions are to:

- Ensure planned results are achieved;
- Improve and support management decisions;
- Generate shared understanding;
- Generate new knowledge and support learning;
- Motivate stakeholders;
- Ensure accountability; and
- Foster public and political support.

In the most basic terms, monitoring and evaluation involves the periodic collection and interpretation of data about a specific organization, objective, or phenomenon. It involves setting explicit targets; establishing appropriate criteria for systematically gathering, analyzing, and interpreting evidence to determine how well performance matches or allows achievement of targets; and using the resulting information to document, explain, and improve performance. When it is embedded effectively within the larger conservation community, monitoring and evaluation can help us focus our collective attention, examine our assumptions, and create a shared culture dedicated to ensuring biodiversity conservation. The ultimate goal for monitoring and evaluation is to learn, and thus improve our ability to achieve conservation outcomes (Figure 3.1).

While monitoring and evaluation are often seen as one process, they actually are distinct processes with different purposes (see Table 3.1). Monitoring refers to the practice of collecting data and measuring trends over time, often to detect departures from a set target. Monitoring generally includes a set of defined indicators that can be measured regularly to track progress toward a result.[1] Project or strategy monitoring seeks to establish the extent to which activities are effectively and efficiently achieving desired goals and objectives and to provide early warning of problems that arise.

On the other hand, evaluation is done less frequently, and is a process in which program inputs, activities, and results are analyzed and judged explicitly against stated norms. It can include the more in-depth process of explaining what observed changes in trends mean or examining the reasons for a strategy's success or failure. A specific step in strategy evaluation is impact assessment, a process of predicting and evaluating the effects of an action or series of actions on a defined target. Ideally, impact assessment provides a systematic analysis of the enduring or significant changes in a system resulting from a given action or set of activities and then helps to determine if observed changes are positive or negative and intended or not.

This chapter explicitly addresses two classes of monitoring and evaluation: status monitoring, otherwise referred to as outcomes monitoring, and effectiveness monitoring. Although both are termed "monitoring," each includes evaluation as an important component. Outcomes monitoring is explicitly directed at assessing the status of the species, areas, and corridors that we target as our conservation outcomes. Effectiveness monitoring helps us to measure the usefulness of the strategies we are implementing as a means to achieve our conservation outcomes. Combined,

[1]Indicators can be described as a unit of information measured over time that documents changes in a specific condition. A given goal, objective, or additional information need can have multiple indicators. A good indicator meets the criteria of being measurable, precise, consistent, and sensitive (Margoluis and Salafsky 1998).

these two types of monitoring and evaluation provide the basic information we need to adaptively manage our conservation strategies. Implemented together, they help describe and measure the consequence of our on-the-ground actions, and determine if our assumptions and hypotheses underlying our strategies are valid and adequate.

For the purposes of this handbook we have made a concrete distinction between effectiveness and outcomes monitoring (Figure 3.2). Although they are obviously both necessary, CI has only developed specific institution-wide guidance for outcomes monitoring. Establishing the capacity and network to conduct outcomes monitoring is CI's monitoring priority for the near-term future. CI is working on developing frameworks to support field efforts in effectiveness monitoring, and we expect these frameworks to be available in the future. However, this chapter does provide general guidelines for effectiveness monitoring and establishing a comprehensive monitoring system. In addition, the basic research conducted through the CI's Tropical Ecology, Assessment, and Monitoring (TEAM) Initiative provides important information for conducting focused and cost-effective state and effectiveness monitoring (see Figure 3.3).

Outcomes Monitoring

Historically the conservation community has not used a systematic, consistent framework for measuring the status of conservation targets (species, areas, and corridors). This has impeded our ability to conclusively and quantitatively demonstrate that our actions are (1) the right ones, (2) in the right place, and (3) achieving the conservation impact we intend. CI has been working

TABLE 3.1: MONITORING AND EVALUATION

	Monitoring	Evaluation
What is it?	Monitoring is mainly consistent, rigorous, descriptive data collection. Monitoring reports usually consist of comparable data that are easily compiled into databases. Because of its focus on quantifiable indicators, monitoring is very specific and compares a particular plan to what was achieved.	Evaluation is an analysis of the why and how of project performance. It can use information that is more subjective and less easily comparable. Because it is more analytical, it compares a plan with results but also examines processes.
Who does it?	The same staff that are implementing a strategy or activity usually also monitor.	Evaluation is typically conducted by cross-disciplinary teams larger than those of monitoring and impact assessment and often includes external evaluators to provide further objectivity.
When do you do it?	Monitoring reports are done frequently (such as quarterly and are usually mandatory for large projects.	Evaluation occurs at less frequent intervals (e.g., annually); it is targeted to respond to specific questions.

closely with other conservation organizations to develop a systematic and objective approach for measuring conservation success. Drawing from prior efforts, CI's current outcomes monitoring protocols are an essential, institution-wide set of indicators that are our best proxies for reporting on the status of species, areas, and corridors defined as conservation outcomes. Outcomes monitoring provides the overarching framework from which to develop context-specific effectiveness monitoring systems. By implementing the consistent monitoring of species-, areas-, and corridor-scale indicators, we strengthen our ability to report on our progress and determine the effectiveness of our strategies over time.

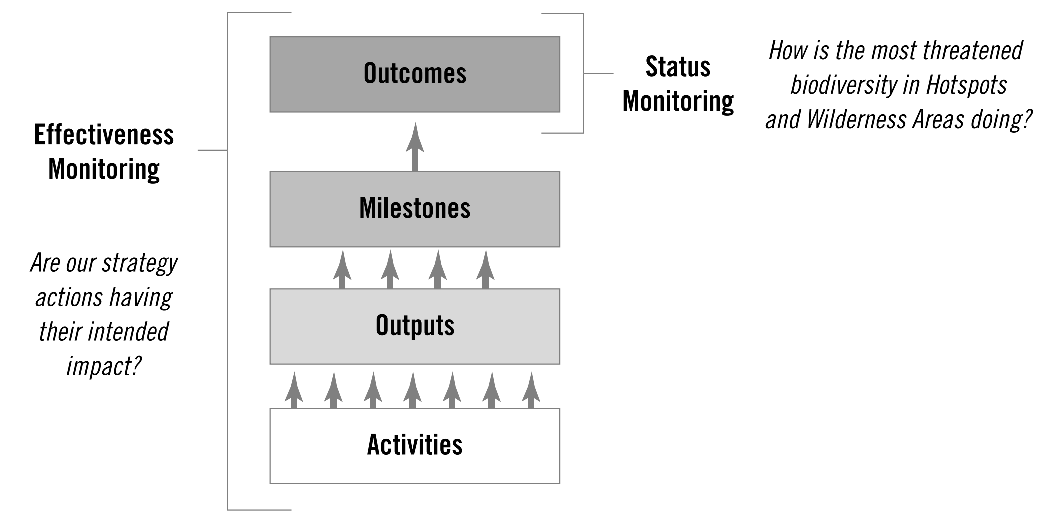
Outcomes monitoring is not intended as a complete monitoring system, but the indicators proposed herein for outcomes monitoring are considered to be practical, achievable, globally applicable, and strongly correlated to achievement of conservation outcomes. In many cases, CI's field programs, support programs, or potential partner institutions are already engaged in components of this monitoring work. The primary purpose of outcomes monitoring is to consistently measure progress toward avoiding extinctions, protecting key biodiversity areas, and consolidating biodiversity conservation corridors.

This section begins by providing a justification for the overall monitoring framework CI has selected to support its outcomes monitoring framework. The indicators to be measured in outcomes monitoring are then presented, followed by summary guidance to assist regional programs in implementing the outcomes monitoring protocol.

Basis of the Outcomes Monitoring Protocol

The most common basis for many existing monitoring frameworks is the Pressure-State-Response (PSR) framework, which is described in the introduction to Chapter 2. Simply put, human activities exert pressure on the environment through a range of social, political, and economic activities. This pressure changes the quality and quantity, or state, of the environment. Society reacts to these

FIGURE 3.2: RELATIONSHIP BETWEEN OUTCOME (OR STATUS) MONITORING AND EFFECTIVENESS MONITORING.



changes through environmental, economic, and policy responses (OECD 1993). These human responses to the changes include any organized behavior that aims to prevent or mitigate undesirable change or environmental results.

Although the PSR model provides a causal framework, it does have limitations. In particular, as a reporting framework it can oversimplify the complex dynamics within any ecosystem and misrepresent the causes of ecological change (Bossel 1999). Despite this limitation, the PSR model remains a useful way to organize our thinking when developing and reporting indicators. PSR fits well with CI's own way of working. Because CI places great emphasis on conservation outcomes, changing PSR to the State-Pressure-Response framework (SPR) better reflects the process by which CI monitors changes in state, identifies pressures, and then responds with conservation actions (see Figure 3.4).

Proposed Indicators for Outcomes Monitoring

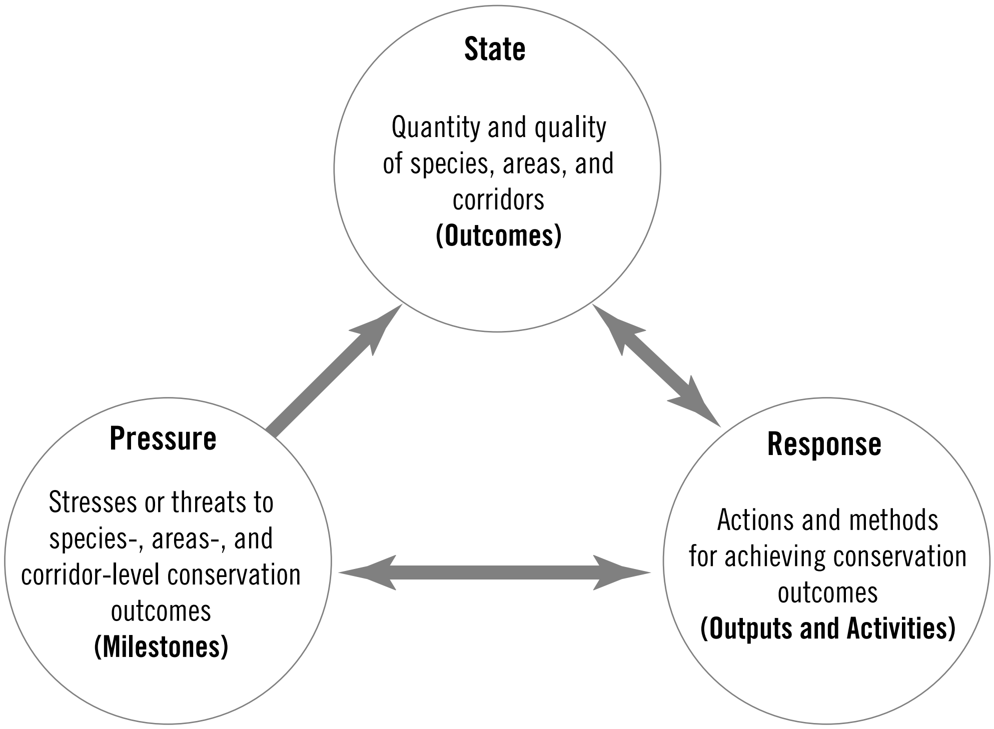
We arrived at a proposed set of indicators (Table 3.2) by collating indicators used by other efforts to monitor biodiversity conservation. These indicators were then organized into species, area, and corridor scales. While state indicators are the best measures of conservation outcome achievement because they measure the actual state of the targeted conservation outcome ('Extinctions Avoided,' 'Areas Protected,' and 'Corridors Consolidated'), they are also the more difficult to measure, requiring significant time, money, and skill. For CI's outcomes monitoring, pressure and response indicators have also been described. Pressure indicators are related to CI's milestones, since achievement of milestones (changes in behavior of the actors identified as exerting a particular pressure) is intended to result in a decrease in the pressures (e.g., hunting). The response indicators are related to CI's or a partner's outputs and activities (e.g., demarcation of protected area borders, increase in legislation and enforcement, and implementation of compatible land and resource use in a corridor).

It would be too complex to try to monitor every aspect of each environment where CI works. Regular measurement of indicators can quantify and simplify these complex realities by showing us trends or changes in the state of a system, population, or individual.

FIGURE 3.3: THE TEAM INITIATIVE

The Tropical Ecology, Assessment and Monitoring (TEAM) Initiative was established by CABS to monitor long-term trends in biodiversity through a network of tropical field stations, and provide an early warning system for large-scale threats by supplying timely, relevant, globally comparable information on changes in the status of biodiversity. The TEAM network will consist of a linked system of field stations that will conduct long-term monitoring of a select group of indicators of biodiversity. This long-term monitoring will take place in relatively "pristine" tropical forest and will serve as a baseline against which monitoring in disturbed areas can be compared. The monitoring data from the TEAM network will track the state of biodiversity in these forests throughout the tropics. TEAM field stations will also develop programs for training and capacity building; the emphasis in all cases will be working with local technicians, students, and scientists.

FIGURE 3.4: STATE-PRESSURE-RESPONSE FRAMEWORK



The SPR Framework, modified for the purpose of indicator definition. See Chapter 2 Introduction for more information on the SPR Framework.

Unit of Analysis

The outcomes monitoring protocol should be applied at the scale of the hotspot or wilderness area. While a lot of the actual work will be done at the area or site level, outcomes monitoring is most concerned with describing the state of conservation at the regional/CBC scale. Administration for outcomes monitoring will be through either the CBC or regional program. It should be understood that monitoring can be carried out by CBC or regional program staff or, more often, by partners.

Outcomes monitoring should be applicable across all the regions where CI works, both in wilderness areas and hotspots. In hotspots, our primary focus is to protect and restore populations of species classified as threatened on the IUCN Red List (see Chapter 1), while in wilderness areas, we are concerned with maintaining intact faunal assemblages and preventing species from being designated as globally threatened in the future. Thus, in hotspots our monitoring focus will be more heavily weighted toward species-scale measures, whereas in wilderness areas the same framework will be useful but the focus will tend toward corridor-scale measures. Please note that this chapter does not differentiate between freshwater, marine, and terrestrial ecosystems, and this approach is intended to apply in all three areas.

Indicators

Achievement of conservation outcomes will be assessed using the appropriate indicators in Table 3.2. Because CI works throughout the world, the indicators proposed in this document are designed to be useful in all regions. As we begin to measure these indicators, we will also work to develop additional pressure and response indicators in CI's regional programs that are regionally useful, but not necessarily globally applicable.

TABLE 3.2: PROPOSED INDICATORS FOR MONITORING THE STATUS AND TRENDS OF CONSERVATION OUTCOMES

Outcome Category	State, Pressure, and Response Indicators
Extinctions Avoided	• Percent change in number of threatened species in each IUCN Red List category, number of species downlisted, and number of species that have become extinct (state) • Percent improvement toward achieving downlisting of each threatened species, concentrating on rates of decline, starting with Critically Endangered species (state) • Progress in definition of targets (response) • Research on threatened species (response) • Legislative protection of species (response) • Exploitation of species (pressure)
Areas Protected	• Percentage and total number of all key biodiversity areas that are protected with (a) legal recognition and (b) biodiversity conservation as an official goal (e.g., national park, private protected area, easement, conservation concession, indigenous reserve, or land under corporate management) (response) • Percent change in habitat cover at key biodiversity areas (state) • Progress in definition of targets (response) • Species focus within management objectives (response) • Permitted uses of protected areas (response) • Implementation of management (response)
Corridors Created	• Change in fragmentation statistics (state) • Percent change in suitable habitat cover for corridor-level species (state) • Progress in definition of targets (response) • Infrastructure development (pressure) • National conservation legislation (response) • Invasive species presence (pressure) • Land-use zoning (response)
The indicators defined here assume that baseline outcome definition is complete and that all outcomes are biologically defined. Since outcomes definition, and refinement has not occurred in many regions, monitoring can be initiated on existing defined outcomes until more thorough analysis is completed.	

Implementing the Outcomes Monitoring Protocol: Seven Global Steps

Although each regional program will develop an outcomes monitoring program at different times and through different processes, we have identified seven steps as essential for implementing a global outcomes monitoring program. We believe that each of the steps can be applied across all the regions where we work, and also that each program must accomplish each of these steps for a successful (and globally consistent) system to be in place. Although the steps are identified in sequential order, some regions may complete the steps nonsequentially if an opportunity arises (e.g., there is funding and a chance to hold a workshop or do a partner assessment even though a coordinator has not yet been hired). In other words, just because a regional program cannot complete one step, they should not be restricted from achieving another step further down the list. Regions may have already completed some of the steps listed, and they should move forward in working on additional steps as they see appropriate given their needs and capacity. These steps are in no way meant to limit the activities taken by the regions, and in fact each region will also need to identify region-specific steps in addition to the necessary global steps.

Step 1: Identify an outcomes monitoring coordinator. The outcomes monitoring coordinator may be appointed or hired, and can be positioned either within CI or externally with a close partner.

Step 2: Identify information needs based on management questions identified by key stakeholders in the region. The objective here is to support and strengthen a shared scientific research and monitoring agenda for the hotspot in question.

Step 3: Survey ongoing monitoring for the region and complete the outcomes monitoring assessment workbooks. Many other organizations within a region, such as NGOs, biodiversity agencies, government ministries, research centers, and universities will have ongoing monitoring initiatives, and data on these efforts should be gathered to establish a baseline of current work. The outcomes monitoring framework supports the gathering of baseline information on the status of remote sensing, Critically Endangered species research, and protected area mapping currently ongoing in a region.

Step 4: Assess existing data and monitoring capacity of potential partners as they relate to the outcomes monitoring framework. These assessments will build on the baseline information collected (step 3) and help to establish a definite relationship with each partner to be engaged in the implementation of the outcomes monitoring framework.

Step 5: Field-based outcomes monitoring coordinators (or equivalent) define priority outcomes monitoring products, which will advance the biodiversity agenda in collaboration with key decision-makers. The coordinators will need to identify what products should come out of the data gathered from outcomes monitoring. A variety of decision-makers and management staff should discuss the priorities to ensure that the products can be used in decision-making processes around the region. These discussions should also help to shape the reporting system as well as the structure of the database (step 7).

Step 6: Identify capacity gaps and conduct workshops, both technical and conceptual, for building monitoring capacity. Field-based workshops that include partners (and potential partners) from other institutions, universities, government, and local communities, will support the ongoing process of applying the framework and ensuring that all involved have the appropriate capacity to fulfill their role in the process. Such workshops will also facilitate discussions regarding additional biodiversity status monitoring needs for the region. Such workshops should reflect a shared agenda and aim to strengthen the overall scientific capacity of a region, particularly in fields that support biodiversity monitoring, such as remote sensing and detection of changes in habitat cover.

Step 7: Develop an information system. The information system should be developed with the help of partners, as well as in conjunction with the outcomes database used for outcomes definition (see Chapter 1). A key capability of this database will be accessibility to all partners. Ultimately, the system should link to an outcomes monitoring reporting database that CI is planning to develop during 2004.

The final and most important step is obviously to work with partners and do the monitoring on the ground. While this eighth step is not included in the above, it is implicit in that these seven steps are intended to help regions prepare for implementing monitoring so that field programs and partner institutions can measure and evaluate the impact of biodiversity conservation investments for their region.

Effectiveness Monitoring

As the term implies, the specific focus of monitoring for effectiveness is to examine current practices and ensure that the strategy is, and continues to be, effective and relevant. Measuring strategy effectiveness allows us to assess our process and progress to date in reaching our defined milestones and conservation outcomes. It answers the question, "Is our strategy making a difference where we are working?" Monitoring and evaluation of current practice are fundamental parts of the process of strategy development and implementation. Assessing effectiveness offers CI managers, donors, stakeholders, and other decision-makers the following:

- Feedback on strategy performance, including the accomplishment of activities, outputs, and milestones; the decisionmaking and coordinating processes; the relevance of strategy interventions and objectives; and thus the information necessary to implement improvements for both existing and future strategy design and implementation;
- Incentives to achieve continuous improvement by encouraging the development of clear and measurable objectives, and providing information on what is attainable and why; and
- A means of establishing accountability both as an internal management tool within CI, and as a reporting tool for outside partners and donors.

Steps in Developing a Strategic Monitoring and Evaluation System

While there is more than one way to develop a monitoring and evaluation plan for conservation strategies, the framework presented below suggests a process that should prove useful. The development of a monitoring and evaluation system for a conservation strategy can be divided into eight steps, all of which are discussed in detail in this section. Key references used in the development of these steps include Finlayson *et al.* 2001; Lusthaus *et al.* 2002; Roche 1999; and Woodhill unpublished.

1. Determine outcomes, milestones, outputs, and activities (outlined in Chapters 1 and 2);
2. Determine the scope of the monitoring and evaluation system;

3. Select indicators at the outcome, milestone, output, and activity levels and reach agreement on monitoring system with key partners;
4. Develop an information management system and database;
5. Collect data (establish a baseline and repeat measurement);
6. Integrate evaluation and impact assessments to provide additional performance information not provided by selected indicators;
7. Analyze and report monitoring information; and
8. Integrate monitoring and evaluation information into strategy changes and management frameworks.

Keep in mind that incorporating monitoring and evaluation into your strategy requires additional activities and outputs, which in turn require additional resources. Although it is not actually a specific step in developing a monitoring and evaluation system, budget development is key to implementing monitoring and evaluation. Strategy managers will need to anticipate monitoring costs and include these costs as part of the fundraising strategy. It is important to budget for monitoring and evaluation within each proposal.

Step 1: Determine Outcomes, Milestones, Outputs, and Activities

The first step in monitoring and evaluation is determining your outcomes, milestones, outputs, and activities (see Chapters 1 and 2). This step is actually done at the strategy design and planning phase. This design and conceptualization phase includes evaluation of the context in which your conservation intervention will occur. As outlined in Chapters 1 and 2, political, legal, cultural, social, economic, and ecological factors all influence the "where" and "what" elements of your intervention strategy. Once you have a good understanding of context, you must develop your causal conceptual model, an explicit description of how your strategy is intended to achieves conservation outcomes: the conceptual model lays the groundwork for designing a useful monitoring and evaluation system and interpreting the results.

FIGURE 3.5: PRINCIPLES OF A SUCCESSFUL MONITORING AND EVALUATION SYSTEM

- Constructed and developed as a system that combines the functions of measuring analyzing, evaluating, and communicating results;
- Developed using best available science and standards;
- Delivers and communicates best practices and standards;
- Has strong written guidance;
- Incorporates staff and partner training;
- Includes objectives for networking among partners;
- Includes guidelines for consulting CI staff and partners;
- Driven by strategy objectives;
- Requires good baseline data; and
- Organized into a consistent framework.

Any strategy, program, or project is derived from a conceptual model (sometimes implicitly understood rather than explicitly described). The conceptual model is a visual representation of what factors are affecting the conservation target of interest and how the proposed strategic actions effect change in the identified factors to generate the desired change in status of the outcomes. The SPR framework used to develop the outcomes monitoring indicators and pressure and response indicators is a simplified conceptual model. Conceptual models are extremely useful and provide the following benefits:

1. They explicitly define what we want to influence or change as a result of project interventions. In the case of outcomes monitoring and the SPR framework, what we want to change is the status of the state variables (species, areas, and corridors);
2. They characterize and prioritize the factors that directly or indirectly result in impacts on the species, areas, and corridors we want to conserve. Using the SPR framework for outcomes monitoring, these factors are the pressure variables;
3. They represent how these threats or opportunities, individually or in combination, cause a change in the species, areas, and corridors we want to conserve; and
4. They demonstrate that the interventions we choose are clearly focused on addressing key threats and opportunities as a means of achieving our outcomes. The response variables in the SPR framework represent the interventions that are directed at addressing the pressures affecting species, area, and corridor status.

Another very simplistic conceptual model is a hierarchy of objectives. It is a pragmatic planning instrument and it offers a lot of advantages, but it includes one key limitation, which is that it reduces complex systems to a series of linear causal relationships, thereby isolating specific factors from each other. A hierarchy of objectives explicitly maps out the way low-level tasks or activities contribute to higher-level objectives, and how meeting these objectives lead to the achievement of the overall outcomes or goals of a project or program. Such a hierarchy of objectives shows the cause and effect, or means-ends relationships of an intervention. Higher-level objectives are, or should be, a consequence of achieving lower-level objectives. A well-developed hierarchy of objectives makes it clear what must be done to achieve results. In the end, planning needs to be expanded to sufficient detail to enable day-to-day workplans for activities and tasks.

Developing a clear logical conceptual model or hierarchy of objectives is fundamental to good strategy design and essential for monitoring and evaluation. There are multiple examples of conceptual models and hierarchies of objectives. However, as long as the concept of different aspects and purpose of a set of strategy actions are understood and the stakeholders within a particular context understand the meaning of different terms, it does not really matter what each level in the hierarchy is called. It is important to remember that a hierarchy of objectives or conceptual model is simply shorthand for describing your strategy to improve communication to various audiences. CI uses a four-level hierarchy of objectives as described in the Figure 3.6.

There will always be assumptions about the cause-effect (means-ends) relationships in an objective hierarchy and these assumptions should be made explicit in the design of a strategy, program, or project. You have identified many of these assumptions in your context analyses in Chapter 2. These assumptions must be incorporated into the monitoring system and managers should identify key assumptions about the context and the proposed strategy. Monitoring key assumptions in your strategy will allow you to revise your actions in a timely manner in the event your assumptions do not hold true. It is a good idea to distinguish the assumptions that will

FIGURE 3.6: CI'S HIERARCHY OF OBJECTIVES

Outcomes	Represent the quantifiable set of species, areas, and corridors that we must target to ensure that we attain our vision of the long-term persistence of all biodiversity globally
Milestones	Measurable and/or verifiable changes in a condition or the behavior of key stakeholders necessary for a conservation outcome to be delivered
Outputs	Major products or initiatives under the primary responsibility and control of CI and its partners that alone or in combination with a portfolio of other outputs are intended to achieve a given milestone
Activities	Specific actions that need to be undertaken for outputs to be produced or realized

make or break the success of your strategy, sometimes referred to as "killer assumptions," which will need to be monitored closely.

By clearly articulating the thinking behind your strategy, and achieving an agreed-upon understanding between all involved parties, you establish a basis for revising and updating it as new information becomes available through your monitoring and evaluation system. A concise model also provides an effective communication tool for the multiple audiences that you engage as you refine and implement your strategy.

Step 2: Determine the Scope of the Monitoring and Evaluation System

It is important to be clear about the overall purpose and scope of the monitoring and evaluation system. To determine the scope of monitoring and evaluation activities, you need to know what baseline and monitoring information will be required for effective management. As mentioned in step 1, the context assessments and analyses described in Chapter 2 should provide information on (a) the health of biodiversity, (b) the socioeconomic factors affecting biodiversity in the area, (c) the institutional, political, and legal environment affecting the conservation outcome(s), (d) conservation activities and capacity in the region, and (e) gaps in information. Understanding the information needs of key stakeholders (e.g., donors and partners) is also key. In particular, you want to be clear about who needs what sort of information for what reasons and when. It is a good idea to make a list of these key audiences and determine the following for each:

- Specific information needs;
- How they benefit from this information;
- What are the timeframes for key decisions;
- What information they are already collecting;
- Whether the information they are collecting can contribute to your monitoring and evaluation system;
- What additional activities are necessary to ensure that all information needs are met; and
- What resources are available (technical skill, capacity, and funding) to collect information.

The scope of the monitoring and evaluation system can generally be defined by answering these questions. To help sort out the information that is feasible to collect from the array of information that can be collected, consider the following suggestions:

- Prioritize your data needs. It will not be possible to answer all questions immediately.
- Develop your system to meet, not exceed your information needs.
- Use existing data whenever possible if it answers your explicit information needs.
- Be explicit about how information will be used. This will help you avoid collecting superfluous data.
- Focus on the most important management issues.
- Negotiate with donors and other audiences (e.g., governments) in order to align as much as possible the data needs or interests (to avoid collecting different data that are expressing similar things).
- Be cost-sensitive and do not forget the cost occurring with not only collection but also analysis.
- Be pragmatic and weigh the additional costs incurred for additional data collection versus the information gain.

An element of scope that needs to be considered in the design of an effective monitoring system is the scale—both spatial and temporal—at which to apply monitoring activities. The spatial and temporal scales are a function of the variability found in the systems of interest. All indicators considered for use in a monitoring system exhibit some degree of spatial and temporal variability. For example variability in natural systems occurs on a variety of temporal scales and may be affected by season, macroclimate, microclimate, natural succession, natural disturbance patterns, or other factors. Being clear about the objectives of the monitoring system will help determine the frequency of sampling and the permanency of sampling locations.

Step 3: Select Indicators at the Milestone, Output, and Activity Level and Reach Agreement on the Monitoring System with Key Partners

Indicators for monitoring outcomes are defined in the Outcomes Monitoring section above. The following section is general guidance for developing indicators for milestones, outputs, and activities (see also Table 3.3).

Instead of trying to monitor everything about the environments in which CI works, regular measurement of indicators can quantify and simplify these complex realities by showing us trends or changes in key elements of the system of interest. The use of such a reference point allows us to gauge, among other things, the extent to which an objective is being met. In addition, indicators are useful to a range of resource managers and users, including governments, the general public, other conservation NGOs, and scientists.

Well-designed indicators achieve the following:

- They help measure the extent to which goals and objectives are being achieved;
- They help focus attention on key conservation issues and actions, by means such as increasing awareness and engendering public support and participation;
- They provide a means for linking action to impact;
- They provide a tool for gathering consistent information; and
- They help to simplify the message portrayed through often complex datasets.

TABLE 3.3: CHARACTERISTICS OF GOOD INDICATORS

Specific	Each indicator should clearly and directly relate to the objective it is supposed to measure (and only that objective). Indicators should not be a summary of what has been achieved at the objective level below; rather they need to describe a consequence. Identifying the right indicators is a good way to proof the logic of the hierarchy of objectives.
Relevant	Indicators need to be relevant and provide a clear diagnostic value for measuring the achievement of the objective to which it relates.
Practical	Indicators must be chosen so that the collection and analysis of the necessary information can be done at an acceptable cost. It is useful to compare the cost of collection and analysis of an indicator to the benefit it generates (what information is gained?). Often it is necessary to establish more than one indicator to measure the achievement of an objective in a reliable way. However, use the minimum number of indicators to measure what is important (weighing the costs of collection and analysis).
Measurable	The indicators should be chosen in a way that they can be clearly and comprehensively formulated in terms of: • Quality (what level of change is expected and what is the spatial scale the project is targeting); • Quantity (numeric measure of how much change is to be observed); and • Time (when or over what timeframe qualitative or quantitative change is expected). The quantity and time are usually expressed through periodic (e.g., annual) targets.
Reliable	Indicators are only as good as the data from which they are derived. In choosing an indicator you need to be sure that the source of verification is reliable.

For indicators to be effective, they must include time and quantitative aspects, along with the qualitative descriptions. In developing indicators that will be most useful for the defined management questions, consider how your indicators will help you in identifying historical trends, in comparing across projects with similar goals, and in talking to project implementers.

A complete monitoring system is one that satisfies your key information needs and can help you track progress, identify efficiency, and determine impact. To make sure your system will do this, you will need to:

1. Identify the key evaluation questions for each level and result in the objective hierarchy; and
2. Identify what information or indicators will be required to answer each question.

The necessary information may come from a variety of resources such as specific quantitative or qualitative indicators, strategy and program records, generally available information, or specific research activities.

In many conservation interventions and strategies, quantitative indicators are considered the key component of developing monitoring and evaluation approaches. This reliance on quantitative indicators tends to restrict a monitoring and evaluation system by reducing its usefulness particularly in relation to supporting learning. There is no question that quantitative indicators are an important part of a monitoring and evaluation system, and that they should be used wherever practical. Nonetheless, it is the complement between strong indicators and good evaluation frameworks with some open-ended questions that provides the most robust construction for adaptive management and determining strategy impacts. A monitoring and evaluation system will be far more useful if it is designed around the broad evaluation questions rather than narrowly focused indicators. Such broad, open-ended activities are necessary for the following reasons:

- An evaluation that focuses solely on monitoring predetermined indicators will often miss unintended positive or negative results and impacts from an intervention.
- Monitoring indicators alone often does not provide an understanding of why objectives have or have not been met. This requires discussion and analysis with strategy actors.
- For multifaceted objectives, it may not be possible to develop an easily measurable indicator, and the achievement of the objective may have to be demonstrated through more descriptive information.
- Monitoring indicators provides only limited capacity for evaluating the success (or lack thereof) of the process of the strategy.

Define Indicators for Milestones

To formulate a milestone, we typically ask what condition or behavioral change in key stakeholders needs to occur in order for the conservation outcomes to be delivered. Accordingly, monitoring at the milestone level uses indicators that show changes in conditions or behaviors. The types of indicators most closely associated with milestones are those related to socioeconomics, policy, institutions, and participation. The purpose of monitoring at the milestone level is to determine whether our activities and outputs are having the desired effects on the underlying conditions and behavior affecting the health of biodiversity. It is important that monitoring at this level be able to indicate if and where adjustments in strategy should be made. To do this, to the extent possible, indicators should be designed to isolate the effect of outputs and activities on underlying conditions and behavior. Consequently, most milestones require the monitoring of several indicators.

Monitoring changes in socioeconomic behavior. A variety of indicators can be used to monitor changes in socioeconomic conditions or behavior. Indicators should relate directly to pressures or threats to biological or ecosystem resources. Because the relationship between socioeconomic changes in behavior and the state of biodiversity is not always clear, a combination of indicators is recommended to illustrate the impact of outputs and activities on socioeconomic conditions.

Monitoring changes in policy and regulatory framework. Monitoring changes in policy or the regulatory framework affecting natural resource use and biodiversity health can be achieved by tracking legislative and policy changes. However, such changes in and of themselves will not demonstrate an impact on conservation. A change in policy or a law accomplishes nothing if it does not change the behavior that threatens the health of biodiversity. A law introducing fines for illegal hunting will change behavior only if it is accompanied by enforcement or a credible threat of getting caught.

Monitoring changes in institutional capacity. The capacity of institutions to manage biodiversity effectively will be an important factor in the achievement of conservation outcomes. Indicators of capacity will help you choose strategic partners and identify institutions to target for capacity-building activities. Note, however, that the existence of the capacity to manage biodiversity does not necessarily translate into effective management. There are separate sets of indicators that reveal management effectiveness.

Monitoring community participation. There should be at least two aspects of community participation in the management of biodiversity that need to be monitored. Firstly, the degree and nature of participation that are desirable will vary from community to community and should be monitored. Second, the effect of community participation on biodiversity management should also be considered.

Define Indicators for Outputs and Activities

Our strategy outputs and activities are the things we actually explicitly generate or do as a conservation organization. They constitute our response to the identified pressures (threats and opportunities) that are influencing the state of conservation in the hotspots and wilderness areas. Monitoring for the completion and delivery of outputs and activities is relatively straightforward. Indicators to track the progress of operations include frequent recording of progress in strategy tasks and activities. These types of indicators serve as a tool to ensure that project resources are accounted for and being spent wisely, as well as delivering the intended outputs. Reporting on outputs and activities can also help describe accountability to domestic stakeholders, partners, and internal management.

Indicators at the output level should measure the deliverables of a project or intervention. They are the results of the intervention for which the managers can be held directly accountable. Indicators at the output level are often used as the terms of reference for a specific project or intervention.

Monitoring indicators at the activity level is also fairly straightforward, as it involves collecting information on inputs such as funds, person-hours, and the completion of activities. Monitoring systems may reveal that project activities are behind schedule or not achieving the desired outputs. It is important to catch these types of problems early and determine the cause, especially if the activity needs to be completed before another activity can begin. The Gantt chart—a tool that supports scheduling of the specific tasks in a project—is a useful tool in monitoring activity progress. Information can also be readily gathered from financial accounts and field activity records.

Review the Monitoring System with Potential Users

Be sure to review the overall monitoring and evaluation system both with those who will be implementing the methodologies for data collection and analysis and with those who will be using the resulting information. For each piece of required information or indicator established, it is necessary to define:

- The methods and frequency for gathering the information or monitoring the indicator;

- The baseline information required for comparison;
- What preparation and resources are required for the data to be collected, collated, and analyzed—for example, data collection and analysis forms, training of staff, database design, and external expertise; and
- Who is responsible for carrying out each of the above and by when.

Developing some form of chart or graph that shows when key monitoring activities will occur in relation to one another is a very useful tool. Representing the monitoring and evaluation system in a graphic format from the beginning will make everyone aware of the planned activities and of individual responsibilities toward the success of the monitoring system. Responsibilities for monitoring and evaluation must be very explicit in any terms of reference or job description, and such responsibilities should be incorporated as a core part of any staff performance monitoring and appraisal system. If staff are asked to undertake non-formalized monitoring and evaluation work as part of their core responsibilities, it will inevitably slip to the bottom of the work pile and never get done.

Once everyone is comfortable with the proposed system, be sure to test all the data gathering and analysis methods. Often what we propose on paper does not work the way it was planned.

Step 4: Develop Information Management System and Database

For monitoring outcomes, the Outcomes Database—being developed by the Conservation Synthesis and Conservation Knowledge teams in CABS in collaboration with a variety of organizations and donors—will function as the data management framework. The outcomes database is essentially a central warehouse for researchers and conservationists to track the data that have already been, and that need to be, collected. Once fully developed, the database will allow us to better assess the state of our species, area, and corridor outcomes. The database is populated during the outcome definition process (as described in Chapter 1) and is designed to store information on the described outcomes for all hotspots, wilderness areas, and countries. As of this printing, the database is still a prototype, but users are able to enter data for species and sites at this time. In the future, the capabilities of the database will be expanded to accommodate data for indicators included in the outcomes monitoring framework.

Step 5: Collect Data (Establish a Baseline and Repeat Measurements)

Once you have decided on your indicators and evaluation questions, you need a baseline to measure against. It is important to emphasize that for your outcome and several of your milestone-level indicators you will have generated a baseline as a result of activities described in Chapters 1 and 2. Additionally, it is not necessary to develop a baseline for outputs because outputs are by their very definition deliverables that are provided by the strategy intervention. However, for the additional indicators defined through consultation with key stakeholders or boundary partners you will need to develop a baseline. The baseline will help you decide the magnitude of change in your target necessary to claim success or achievement. For a specific time frame, it is important to define your criteria and standards for success explicitly.

Once a baseline is established, data collection should continue as outlined in the description of your monitoring and evaluation system. Data collection techniques are varied and should be adapted to the particular context of the conservation strategy (see step 3).

A well-designed sampling scheme allows the most information to be developed at the least cost, and the data quality is generally consistent if you adhere to systematic data collection techniques. In developing your sampling design there are four questions that will assist the strategy manager in selecting the appropriate sample design:

- What do you need to know?
- What will you do with the information you obtain?
- How much change is important to detect?
- How confident do you want to be in your conclusions?

Step 6: Integrate Evaluations and Impact Assessment to Provide Additional Performance Information Not Provided by Selected Indicators

An effective evaluation depends on a thorough understanding of the direct and indirect causes of biodiversity loss, as well as an understanding of indicators that accurately measure the impact of strategy outputs and activities. The outcomes monitoring and milestone indicators provide a foundation for assessing impact and for evaluating conservation strategies. Evaluation consists primarily of assessing the progress toward conservation outcomes and milestones, and secondly determining the reasons behind progress or lack of progress. Evaluation should also suggest ways of improving strategies to achieve conservation outcomes and milestones. It can provide insight into the nature of the problem or constraint that is slowing progress or stopping you from reaching your desired conservation outcomes. Formal evaluations should be programmed into the project workplan and these evaluations need to be supplemented with *ad hoc* studies where necessary.

Success is evaluated in terms of goal achievement and accountability for outcomes. Therefore if we want to evaluate both substance and process, we should ask questions such as the following:

- **Management of external environment.** Are the underlying assumptions of our strategy correct? How well are we managing our assumptions? Have there been any changes in the external environment? Have any new assumptions come up? Do changes in the environment present any serious risks for project success? Is it necessary to adjust our strategy? Many of these questions relate to the context in which the strategy is situated. The context assessments outlined in Chapter 2 frame the baseline for these questions. Generally the influence that context has on achieving results increases as we move up the hierarchy of objectives, from activity to output to milestone to outcome.
- **Achievement of objectives.** How well have we achieved the objectives (milestones, outcomes)? What are the reasons for success or failure?
- **Communication structure.** How is information shared among involved stakeholders? What are the frequency and quality of communication with regard to partners and audiences? How are communication and relations among key participants addressed?
- **Project staff.** What are the management skills of the program leader? How did they affect success or failure?
- **Decision-making process.** How have past decision processes worked? What is the decision-making procedure (e.g., consensus, majority vote, or mandate)? Does the chosen decision-making procedure work for the program? Is it effective or does it cause problems or conflicts?
- **Adaptive management.** How is the strategy being managed? Is it oriented by a specific process or standard (or structure of standards)? How effective is the chosen process?
- **Conflict management.** Are conflicts an issue? What is the status for formal and informal mechanisms for managing conflict?

- **Mobilization of resources.** What is the ability to develop a political strategy to mobilize financial, technical, and other resources?
- **Team-building.** How well have external partner organizations been engaged in the program? How clear is the definition of roles and responsibilities?
- **Sustainability.** Will there continue to be positive impacts as a result of the program or project? Why or why not?

Evaluation should include a mechanism for refining strategies and setting future direction; this should be associated with timetables and designation of responsibilities and accountability.

The evaluation or assessment of impact is a special type of evaluation. Assessing the impact of your strategy is the most essential evaluation question for establishing your credibility as a conservation institution. This is why CI has placed such an emphasis on establishing a systematic approach for monitoring conservation outcomes, and why it is so important to develop robust and consistent principles for measuring effectiveness of our strategies. Impact assessment is where the two classes of measurement overlap. Strategy impact assessments help to identify specific changes in behavior of key stakeholders and the status of species, areas, and corridors, and to correlate such changes with the strategy and its component outputs and activities. A distinguishing feature of impact assessment is that it involves before-and-after assessments or comparison between a treatment and control. In the practice of conservation, assessing impact usually involves before-and-after measurements. However, in a wilderness context, it is possible to compare undisturbed areas of a reserve with areas that allow restricted uses and make comparisons of selected parameters.

Here are the key questions for an impact assessment:

- Are our outcomes adequate to conserve biodiversity in the biodiversity hotspots and high-biodiversity wilderness areas?
- What is the long-term value of our strategy?
- Do our strategies generate the intended impact at the outcome and milestone level?

Strategy impact assessment is complicated by many other factors, such as markets, events, and macro-policies, which will have significant influences, although the strategy will try to identify, track, and intervene in these influences. Therefore, we also ask:

- How have strategies affected institutional conditions such as:
  - Values, habits, and practices;
  - Knowledge;
  - Technologies and infrastructure; and
  - Laws, incentive systems, organizations, and their relationships?

Step 7: Analyze and Report Monitoring Information

The purpose of collecting monitoring and evaluation data is to provide the basis for analyzing whether we are moving toward our desired outcomes and, if not, how to refine our strategies to be more effective in achieving our intended outcomes. Monitoring systems are often ineffective because they do not adequately formulate clear goals and objectives, develop the technical design of the monitoring system, and analyze and synthesize data that are relevant and accessible to decision-makers and the interested public.

Data analysis involves summarizing large volumes of data into meaningful statistics that can be interpreted by decision-makers. Analysis should be performed by individuals familiar with statistical analysis, in collaboration with the strategy planners. Analysis helps us interpret strategy outcomes or impacts, and allows us to draw conclusions regarding the monitoring objectives. Keep in mind that the results should be presented in tables and in graphs in such a manner that others can draw their own conclusions from the data.

Step 8: Integrate Monitoring and Evaluation Information into Strategy Changes and Management Frameworks

Monitoring and evaluation are useful only if they feed back into the project or strategy design. The final step in the cycle is then to make decisions about the future management of the strategy. If monitoring and evaluation reveal operational problems within a strategy, these may be addressed without altering your strategy, but instead by making adjustments of activity schedules, resources, and possibly a change in roles and responsibilities. If, however, your monitoring and evaluation activities point to problems with strategy or program design, you should engage the appropriate technical expertise to help assess the design of the program or the strategy. If the monitoring results are inconclusive, you have several choices as strategy manager. First, you can alter the monitoring design to provide more precise results. Second, you can modify the monitoring objectives to adjust precision or threshold levels. Third, the management of the strategy can continue in the absence of scientifically based conclusions, an alternative that will, however, result in increased risk.

It is important to design a learning feedback and communication process that informs all relevant stakeholders. And it is particularly important to design learning processes in which staff, beneficiaries, partners, and donors participate, such as an annual review meeting. What you glean from the monitoring and evaluation system should stimulate, inform, and support this learning process.

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ACRONYMS AND ABBREVIATIONS

AO Area of occupancy
AZA American Zoo and Aquarium Association
AZE Alliance for Zero Extinction
BAU business-as-usual scenario
BCTF Bushmeat Crisis Task Force
BSP Biodiversity Support Program, WWF
CABS Center for Applied Biodiversity Science, Conservation International
CAP Conservation Action Plan, IUCN/SSC
CBC Center for Biodiversity Conservation, Conservation International
CBD Convention on Biological Diversity
CBSG Conservation Breeding Specialist Group, IUCN/SSC
CCG Center for Conservation and Government, Conservation International
CED Conservation Enterprise Department, Conservation International/RCSG/PPA
CELB Center for Environmental Leadership in Business, Conservation International
CEPF Critical Environment Partnership Fund, Conservation International
CI Conservation International
CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora
C-Plan see glossary
CR Critically Endangered, species threat status, IUCN Red List
CRNSF Critically Endangered Neotropical Species Fund
DD Data Deficient, species threat status, IUCN Red List
EBA Endemic Bird Area, BirdLife International
EN Endangered, species threat status, IUCN Red List
EO Extent of occurrence
EW Extinct in the Wild, species threat status, IUCN Red List
EX Extinct, species threat status, IUCN Red List
FAO Food and Agriculture Organization of the United Nations
FOS Foundations of Success
GAA Global Amphibian Assessment, IUCN and Conservation International
GCF Global Conservation Fund, Conservation International
GEF Global Environment Fund, World Bank
GIS Geographic Information System
GISP Global Invasive Species Programme
GMA Global Mammal Assessment, IUCN
HCI Healthy Communities Initiative, Conservation International/RCSG/PPA
IBA Important Bird Area, BirdLife International
ICBP International Council for Bird Preservation
IDB Inter-American Development Bank
IESB Instituto de Estudios Sócio-Ambientais do Sul da Bahia
ISSG Invasive Species Specialist Group, IUCN/SSC
IUCN World Conservation Union, International Union for the Conservation of Nature
LC Least Concern, species threat status, IUCN Red List
M&E monitoring and evaluation
MARXAN see glossary
NE Not Evaluated, species threat status, IUCN Red List
NGO non-governmental organization
NT Near Threatened, species threat status, IUCN Red List
OECD Organisation for Economic Cooperation and Development
PAF Primate Action Fund
PPA People and Protected Areas Program, Conservation International/RCSG
PSR Pressure-State-Response framework, OECD
RACE Rapid Assessment of Conservation Economics, Conservation International

RAP™	Rapid Assessment Program™, Conservation International
RCS	Regional and Corridor Strategies Program, Conservation International/RCSG
RCSG	Regional Conservation Strategies Group, Conservation International/Regional Programs Division
RFF	Resources for the Future
RLA	Red List Authority, IUCN/SSC
SIS	Species Information Service, IUCN/SSC
SPR	State-Pressure-Response framework, Conservation International
SSC	Species Survival Commission, IUCN
TAMARIN	see glossary
TCF	Turtle Conservation Fund
TEAM	Tropical Ecology, Assessment, and Monitoring Initiative, Conservation International/CABS
TNC	The Nature Conservancy
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VU	Vulnerable, species threat status, IUCN Red List
WCMC	World Conservation Monitoring Centre
WCPA	World Commission on Protected Areas
WCS	Wildlife Conservation Society
WDPA	World Database on Protected Areas, WDPA Consortium
WRI	World Resources Institute
WWF	World Wildlife Fund (U.S.), World-Wide Fund for Nature (other countries)

GLOSSARY OF MAJOR TERMS USED BY CI AND PARTNER ORGANIZATIONS

Action Plan, Species – see species, Species Action Plan

activity, or conservation activity – Specific actions that need to be undertaken for conservation outputs to be produced or realized. Conservation activities are the fourth-highest level in CI's hierarchy of objectives (63, 65)

adaptive management – The process of testing the assumptions that underpin the selection and design of species, site, and corridor conservation interventions and taking action to improve these strategies and interventions in the light of this analysis. (135, 160)

amphibian assessment – see Global Amphibian Assessment

AquaRAP – A component of CI's Rapid Assessment Program™ dealing with freshwater systems. (25, 38)

'Areas Protected' conservation outcome – see outcome, 'Areas Protected'

assumptions – Conditions or situations considered to be existent or true in the development of a conservation strategy, and in building the cause-effect relationships between elements of a hierarchy of objectives. Assumptions should be made explicit in the design of a strategy, program, or project. Assumptions must be incorporated into a monitoring system, and key assumptions about the context and proposed strategy should be identified and monitored to allow timely revision of actions if the assumptions do not hold true. (151-152)

- **killer assumptions** – Assumptions that can "make or break" the success of a conservation strategy. Killer assumptions need to be monitored closely. (152)

Authority, Red List – see Red List Authority

biodiversity conservation corridor – see corridor, biodiversity conservation

biodiversity conservation corridor scenario – see scenario, biodiversity conservation corridor

biodiversity hotspot – see hotspot

biodiversity target – see target, conservation

biological corridor – see corridor, biological

biological species concept – A system of classifying flora and fauna species based on the concept of a set of populations reproductively isolated from other populations. They do not interbreed and cannot produce viable or fertile offspring with other populations (Mayr 1942, 1963). CI uses this concept when defining its conservation outcomes. (153)

biome-restricted species – see species, biome-restricted

breeding program – see captive breeding and reintroduction program

bushmeat – Wildlife or animal protein harvested from the wild for human consumption, from insects and reptiles to birds, rodents, ungulates (such as forest antelope and peccaries), and even elephants. Bushmeat is one of the most widespread forms of resource extraction in the tropical forest environment, and in Africa is thought to represent as great a threat to the loss of biodiversity as that posed by habitat loss or degradation (Hoffman 2002). (80-81)

business-as-usual scenario – see scenario, business-as-usual

captive breeding and reintroduction program, or *ex situ* conservation program – Conservation of a threatened species in locations outside of its natural range with a goal of eventual reintroduction, considered necessary when threats to a species' survival in its range are greater than we can adequately mitigate at the present time. (79-80)

Center for Biodiversity Conservation, or CBC – A regional center to stimulate, in biodiversity hotspots and wilderness areas, a joint effort among all conservationists to work toward outcomes at a much larger scale of action than has been possible previously. This includes regional and corridor-level conservation action through delivery of technical services, alliance building, regional training, conservation strategy development, and access to resources. Through the establishment and development of CBCs, CI will build in the regions the technical capacity that has previously been centralized in our Washington headquarters.

Centre of Plant Diversity – A priority area for plant conservation, as assessed by WWF and IUCN (Davis *et al.* 1994-97). (24)

cocoa – see Conservation Cocoa™

coffee – see Conservation Coffee™

Comparative Development Performance methodology – A macroeconomic planning tool developed by CCG to demonstrate means of achieving economic development compatible with maintaining critical biodiversity habitat and ecological service benefits. (98)

compatible land and resource use – The designated use of land and resources that mimics the composition of the original habitat, and as such helps maintain populations of some target species, usually as an alternative to more destructive land and resource uses. As part of a connectivity network in biodiversity conservation corridors, compatible land and resource use must be areas that complement key biodiversity areas, as not all targeted species will be able to thrive in or move through a modified landscape or seascape. (121, 130-132)

congregatory species – see species, congregatory

connectivity – The condition required for species and ecological processes to move between key biodiversity areas within a larger landscape or seascape. (41-44, 121-122)

- **connectivity network** – A mix of biological corridors, stepping stones, and/or compatible land and resource use that provides connectivity between key biodiversity areas. A functional connectivity network is an important component of most biodiversity conservation corridors. (119-120)

conservation activity – see activity

Conservation Cocoa™ – CI's program to work with organized farmer groups supporting cultivation of cocoa grown under the shade of a forest canopy, which provides habitat for numerous plant and animal species and offers better financial returns while reducing the impact that intensive sun-grown cocoa farming has on the environment (*www.conservation.org* 2004). (104, 131)

Conservation Coffee™ – CI's program to work with organized farmer groups supporting cultivation of coffee grown under the shade of a forest canopy, which provides habitat for numerous plant and animal species and offers better financial returns while reducing the impact that intensive sun-grown coffee farming has on the environment (*www.conservation.org* 2004). (104, 131)

conservation corridor – see corridor, biodiversity conservation

conservation enterprise – A strategy to provide economic alternatives that cover opportunity costs for people who would otherwise engage in destructive land uses in order to make a living. The enterprise may be any of various types; its essential characteristic is that it enables people to earn a livelihood without destroying the biodiversity of the hotspots and wilderness areas. (104)

conservation milestone – see milestone

conservation outcome – see outcome, conservation

conservation output – see output

conservation tactic – see tactic, conservation

conservation target – see target, conservation

coral reef hotspot – see hotspot, coral reef

corridor

- **biodiversity conservation corridor**– A biologically and strategically defined sub-regional space, selected as a unit for large-scale conservation planning and implementation purposes (Sanderson *et al.* 2003). Biodiversity conservation corridors are integrated systems of key biodiversity areas, connecting linkages, and compatible land and resource uses, designed and managed to strengthen and complement species and site-scale conservation actions by maintaining the land- and seascape-scale ecological processes upon which these depend, while at the same time advancing human welfare. Biodiversity conservation corridors are CI's 'Corridors Consolidated' conservation outcomes. (41-44, 111-138)
- **biological corridor** – A continuous strip of land or water that differs from the adjacent landscape on both sides, and allows movement of individuals and ecological processes between two or more habitat areas (Sanderson *et al.* 2003). Biological corridors help establish connectivity within biodiversity conservation corridors. (111)

- **corridor scenario** – see scenario, biodiversity conservation corridor
- **'Corridors Consolidated' conservation outcome** – see outcome, 'Corridors Consolidated'

cost – A measure of the difficulty that must be overcome in order to conserve a given biodiversity element. Costs may be economic or sociopolitical. (45)

- **see also opportunity cost**

C-Plan, or Conservation Planning System – A system designed to support conservation planning decisions. C-Plan is a Windows™-based software package that when linked to a GIS can display the relative contribution of land areas toward a predefined conservation goal. C-Plan was developed by the New South Wales National Parks and Wildlife Service, Australia (*members.ozemail.com.au/~cplan* 2004).

Critically Endangered species – see species, Critically Endangered

Data Deficient species – see species, Data Deficient

database, outcomes – see outcomes database

direct incentives – see incentives, direct

ecological process – An environmental function that helps maintain ecosystem health. Examples of ecological processes are predation, pollination, nitrogen fixation, and seed dispersal. (43-44, 118-119)

ecoregion – "A relatively large unit of land or water containing a characteristic set of natural communities that share a large majority of their species, dynamics, and environmental conditions" (Olson and Dinerstein 1998). Ecoregions are used by WWF for prioritization of its conservation actions. (24, 30)

ecotourism – Travel to natural areas that conserves the environment and sustains the well-being of local people. (106, 131)

effectiveness monitoring – see monitoring, effectiveness

empty forest syndrome – Seemingly intact forests in which animal species have suffered severe declines through human activities, whether direct – such as bushmeat hunting – or indirect – such as collection of the foods upon which animal species depend (Redford 1992). (70)

Endangered species – see species, Endangered

Endemic Bird Area (EBA) – One of 218 discrete biogeographic regions holding at least two restricted-range bird species, as assessed by BirdLife International. (24)

endemic species – see species, endemic

engineer species – see species, engineer

enterprise – see conservation enterprise

environmental awareness and education – Activities designed to inform, disseminate ideas, promote debate, and inspire change to generate a lasting change of behavior in favor of conservation. (107)

evaluation – The process in which program inputs, activities, and results are analyzed and judged explicitly against stated norms. Evaluation can include the more in-depth process of explaining what observed changes in trends mean or examining the reasons for a strategy's success or failure. (142-143, 157-160)

***ex situ* conservation program** – see captive breeding and reintroduction program

Extinct in the Wild species – see species, Extinct in the Wild

Extinct species – see species, Extinct

'Extinctions Avoided' conservation outcome – see outcome, 'Extinctions Avoided'

5-S framework – see framework, 5-S Framework for Site Conservation

flagship species – see species, flagship

framework

- **5-S Framework for Site Conservation** – TNC's set of guiding principles for making strategic conservation decisions and measuring conservation success (TNC 2000). It is based upon OECD's Pressure-State-Response framework. (62)
- **Pressure-State-Response framework, or PSR framework** – A planning and monitoring framework developed by the OECD and used as a model by many organizations, based on a concept of causality: human activities exert *pressure* on the environment, this pressure changes the *state* of the environment, and society reacts to these changes through its *response* (OECD 1993). CI has adapted this framework to its own approach to conserva-

tion as the State-Pressure-Response framework. (62)

- **State-Pressure-Response framework, or SPR framework** – CI's conservation planning and monitoring framework, based on the OECD's Pressure-State-Response framework, which has been modified to place consideration of the condition of biodiversity as the first step in our planning process to more effectively achieve our conservation outcomes. (4-6, 62-66, 147)

freshwater hotspot – see hotspot, freshwater

frontier forest – Large, ecologically intact, and relatively undisturbed natural forests, which allow natural ecological and evolutionary processes to generate and maintain biodiversity, contribute ecological services such as watershed protection and climate stabilization, and are home to many of the world's remaining indigenous peoples, and used as a basis for prioritization of forest conservation and stewardship by WRI (Bryant *et al.* 1997). (24)

Future for Life, A – CI's 2005–2010 Strategic Plan.

geographically concentrated species – see species, geographically concentrated

Global 200 – 234 ecoregions that hold exceptional biodiversity, as assessed by WWF, and are used as a basis for representativeness in its biodiversity conservation strategy (Olson and Dinerstein 1998). (24)

Global Amphibian Assessment, GAA – An effort to assess all of the world's ~5,600 amphibian species against the IUCN Red List Categories and Criteria, led by IUCN/SSC, CI-CABS and Nature Serve. (33, 72-73)

Global Mammal Assessment, GMA – An effort to assess all of the world's ~5,000 mammal species against the IUCN Red List Categories and Criteria, led by IUCN/SSC and CI-CABS. (1:18)

globally threatened species – see species, globally threatened

Habitat/Species Management Area – see protected area, Habitat/Species Management Area

hierarchy of objectives – A tool for explicitly mapping out the causal chain that demonstrates how low-level tasks or activities contribute to higher-level objectives, and how meeting these objectives in turn helps achieve the overall outcomes or goals of a project or program. CI uses a four-level hierarchy of objectives: conservation outcomes, milestones, outputs, and activities. (65-66)

high-biodiversity wilderness area – see wilderness area, high-biodiversity

hotspot

- **coral reef hotspot** – Centers of multitaxa endemism based on distribution data for 3,235 species of reef fish, coral, molluscs, and lobster, which also received a high threats score under the Reefs at Risk analysis. (23-25)
- **freshwater hotspot** – Criteria for freshwater hotspots have not been finalized, and an analysis has not yet been completed. (25)
- **marine hotspot** – Criteria for marine hotspots other than coral reef hotspots have not been finalized, and analyses of these have not yet been completed. (23-24)
- **terrestrial biodiversity hotspot** – Regions that harbor a great diversity of endemic species and have been significantly impacted and altered by human activities. Plant diversity is the biological basis for hotspot designation; to qualify as a hotspot, a region must support 1,500 endemic plant species. Existing primary vegetation is the basis for assessing human impact in a region; to qualify as a hotspot, a region must have lost more than 70 percent of its original habitat. Plants have been used as qualifiers because they are the basis for diversity in other taxonomic groups and are well-known to researchers. Typically, the diversity of endemic vertebrates in hotspot regions is also extraordinarily high (*www.biodiversityhotspots.org* 2004). (20-22)

human welfare – One of CI's four strategic initiatives in its 2005-2010 Strategic Plan, *A Future for Life,* human welfare may be characterized by sufficiency of material goods, health, social stability, security, and freedom of choice/action (Brandon 2004). CI recognizes that biodiversity conservation is inherently a people-centered activity, and that the forces that pressure and threaten biodiversity are rooted in social, economic, and political issues. To ensure our conservation efforts are successful and sustainable, we must do our best to reconcile the needs and aspirations of indigenous and local communities with the conservation outcomes we seek. (98)

impact assessment – A process of predicting and evaluating the effects of an action or series of actions on a defined target. Ideally, impact assessment provides a systematic analysis of the enduring or significant changes in a system resulting from a given action or set of activities and then helps to determine if observed changes are positive or negative and intended or not. (142, 158-160)

Important Bird Area (IBA) – "Key sites for conservation – small enough to be conserved in their entirety and often already part of a protected-area network – that … have significant numbers of one or more globally threatened species, are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species, or have exceptionally large numbers of migratory or congregatory species" (*www.BirdLife.net* 2004). IBAs are a subset of key biodiversity areas. (28-30)

***in situ* conservation program** – Conservation of a threatened species in all or part of its natural range.

incentives

- **direct incentives** – Direct payment or other benefit for the protection of biodiversity. Examples of direct incentives are land purchase, leases, conservation easements, and conservation concessions (Sanderson *et al.* 2003). (131)
- **indirect incentives** – Economic activities that result in biodiversity protection as a by-product. An example of an indirect incentive is the creation of markets for products from sustainable biodiversity-compatible enterprises (e.g., ecotourism and agroforestry) (Sanderson *et al.* 2003). (131)
- **perverse incentives** – Incentives that encourage a particular set of behaviors, but result in unintended negative effects. Policies that permit destructive practices such as dam building or clear-cutting to be financially profitable in the short run, but which leave society as a whole and the environment worse off in the long run, are examples of perverse incentives.

indicator – A unit of information measured over time that documents changes in a specific condition. A given goal, objective, or additional information need can have multiple indicators. A good indicator meets the criteria of being measurable, precise, consistent, and sensitive (Margoluis and Salafsky 1998). (142, 145-147, 153-157)

- **indicator species** – see species, indicator
- **pressure indicator** – A measurement of the change in pressures on our targeted conservation outcomes. Pressure indicators are related to CI's conservation milestones (changes in behavior of the actors that are the source of the pressures). Achievement of our conservation milestones is intended to result in a decrease in the pressures affecting biodiversity. (147)
- **response indicator** – A measurement of the effectiveness of our response to pressures. Response indicators are related to CI's conservation outputs (major projects and initiatives). (147)
- **state indicator** – A measurement of the actual state of a targeted conservation outcome ('Extinctions Avoided', 'Areas Protected', or 'Corridors Consolidated'), often requiring significant time, money, and skill. (147)

indigenous peoples – CI's Principles for Partnership with Indigenous Peoples defines indigenous peoples as communities with "close attachment to ancestral and traditional or customary territories and the natural resources in them; [with] customary social and political institutions; [with] economic systems oriented to subsistence production; [with] an indigenous language, often different from the predominant language; and [with] self-identification and identification by others as members of a distinct cultural group." (9-11)

indirect incentives – see incentives, indirect

invasive species, or invasive alien species – see species, invasive

irreplaceability, or uniqueness – The degree to which options for conservation are lost if an element of biodiversity is lost (Pressey *et al.* 1994). Endemism is one measure of irreplaceability. (34-35, 45)

IUCN Red List of Threatened Species™ – see Red List, IUCN Red List of Threatened Species™

key biodiversity area – An area comprising critical habitat for the survival of globally threatened and geographically concentrated species, that can be managed for conservation. Protection of key biodiversity areas are CI's 'Areas Protected' conservation outcomes. (28-29, 35-40, 87-110)

keystone species – see species, keystone

killer assumptions – see assumptions, killer

landscape – A mosaic of habitat patches of different sizes, shapes, and patterns, whose biological character is the result of the action and interaction of natural and human factors (Sanderson *et al.* 2003; Council of Europe 2000). Biodiversity conservation corridors, our 'Corridors Consolidated' conservation outcomes, are CI's landscape-scale conservation targets. (111-138)

- **landscape species** – see species, landscape

Last of the Wild – One of 568 of the largest and relatively wildest places in each of the Earth's biomes, which indicate opportunities for effective conservation, representative of the biological diversity of the world, as identified by WCS. These are areas where we might conserve the widest range of biodiversity with a minimum of conflict (*wcs.org* 2004). (24)

Least Concern species – see species, Least Concern

mammal assessment – see Global Mammal Assessment

Managed Resource Protected Area – see protected area, Managed Resource Protected Area

map, outcome – see outcome map

marine hotspot – see hotspot, coral reef and hotspot, marine

MARXAN – A software that delivers decision support for reserve system design, finding efficient solutions to the problem of selecting a system of spatially cohesive sites that meet a suite of biodiversity targets. MARXAN is a modified version of SPEXAN that has been adapted to ArcView™, and was developed and enhanced in a collaboration between the University of Queensland, the University of California – Santa Barbara, TNC, Environment Australia, and the U.S. National Marine Fisheries Service (*www.ecology.uq.edu.au* 2004).

migratory species – see species, migratory

milestone, or conservation milestone – A specific, measurable, and/or verifiable change in a condition or in the behavior of key stakeholders necessary for a conservation outcome to be delivered. Conservation milestones are the second-highest level in CI's hierarchy of objectives. (63, 65)

monitoring – The practice of collecting data and measuring trends over time, often to detect departures from a set target. Monitoring generally includes a set of defined indicators that can be measured regularly to track progress toward a result. (142-143)

- **effectiveness monitoring** – Examination of current practices in order to ensure the strategies we are implementing as a means to achieve our targeted conservation outcomes are and will continue to be effective and relevant. Monitoring our conservation milestones, outputs, and activities is effectiveness monitoring. (149-161)
- **monitoring and evaluation, or M&E** – Together, the periodic collection and interpretation of data about a specific organization, objective, or phenomenon. Monitoring and evaluation involves setting explicit targets, establishing appropriate criteria for systematically gathering, analyzing, and interpreting evidence to determine how well performance matches or allows achievement of targets, and using the resulting information to document, explain, and improve performance. (142-161)
- **outcomes monitoring, or status monitoring** – Assessing the status of the globally threatened and geographically concentrated species, key biodiversity areas, and biodiversity conservation corridors that we target as our 'Extinctions Avoided', 'Areas Protected', and 'Corridors Consolidated' conservation outcomes. (143-149)
- **project monitoring, or strategy monitoring** – The process to establish the extent to which activities are effectively and efficiently achieving desired goals and objectives and to provide early warning signs of problems that arise. (143)
- **status monitoring** – see monitoring, outcomes
- **strategy monitoring** – see monitoring, project

National Park – see protected area, National Park

national Red List – see Red List, national

Natural Monument – see protected area, Natural Monument

nature tourism – Travel to unspoiled places to experience and enjoy nature (Christ *et al.* 2003). (106)

Near Threatened species – see species, Near Threatened

network, connectivity – see connectivity network

Not Evaluated species – see species, Not Evaluated

objectives, hierarchy of – see hierarchy of objectives

opportunity cost – The economic, social, political, and/or biological cost of choosing one set of conservation actions over alternative foregone opportunities. (123-125)

outcome

- **'Areas Protected' outcome** – The conservation of key biodiversity areas. (5, 35-40, 87-110)
- **conservation outcome** – One of the quantifiable set of globally threatened and geographically concentrated species, key biodiversity areas, and biodiversity conservation corridors that we must target to ensure that we attain our vision of the long-term persistence of all biodiversity globally. Conservation outcomes are the highest level in CI's hierarchy of objectives. (25, 28-29, 65)
- **'Corridors Consolidated' outcome** – The conservation of ecological functioning on which globally threatened and geographically concentrated species and key biodiversity areas depend, through the consolidation of biodiversity conservation corridors. (5-6, 41-44, 111-138)
- **'Extinctions Avoided' outcome** – The conservation of globally threatened species and geographically concentrated species that have a high probability of extinction. (4-5, 27-35, 69-85)
- **outcome map** – A mapping of globally threatened and geographically concentrated species distributions, key biodiversity areas as existing and potential protected areas, and the configuration of biodiversity conservation corridors. Cartographic standards for these maps are currently under discussion. (26)
- **outcomes database** – A database operating from a distributed platform, developed by CABS, and constructed around three modules—one for each scale of CI's conservation outcomes: 'Extinctions Avoided', 'Areas Protected', and 'Corridors Consolidated'—to ensure data standards, accessibility, transparency, clear documentation of targets, and the ability to revise targets as more information becomes available. The database will be accessible to the public through the Biodiversity Hotspots website (*www.biodiversityhotspots.org*) in the future. (26)
- **outcomes definition process** – The collaborative efforts of CI CBC's, Regional Programs, and partners, and supported by CABS Conservation Synthesis, to define the conservation outcomes we must achieve in the hotpots and wilderness areas. (25-44)
- **outcomes monitoring** – see monitoring, outcomes

output, or conservation output – A major product or initiative under the primary responsibility and control of CI and its partners that – alone or in combination with a portfolio of other outputs – is intended to achieve a given conservation milestone. Conservation outputs are the third-highest level in CI's hierarchy of objectives. (63, 65)

perverse incentives – see incentives, perverse

phylogenetic species concept – A system of classifying flora and fauna species as evolutionary independent units. CI uses the biological species concept rather than the phylogenetic species concept to define its conservation outcomes. (53)

Plan, Species Action – see Species Action Plan

pressure – The change in quality and quantity on targeted biodiversity elements caused by humans through a range of social, political, and economic activities. Pressure is one element of CI's State-Pressure-Response framework. (4, 146-147)

- **pressure indicator** – see indicator, pressure
- **Pressure-State-Response framework** – see framework, Pressure-State-Response

project monitoring – see monitoring, project

protected area – An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means" (IUCN 1994). The conservation of a protected area may—but not necessarily—be one of CI's 'Areas Protected' conservation outcomes, which are defined as the conservation of key biodiversity areas. (87, 95, 97-102)

- **Habitat/Species Management Area** – A protected area managed mainly for conservation through management intervention. IUCN Protected Area Category 4: "An area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species" (IUCN 1994). (99)
- **Managed Resource Protected Area** – A protected area managed mainly for the sustainable use of natural ecosystems. IUCN Protected Area Category 6: "An area containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs" (IUCN 1994). (99)
- **National Park** – A protected area managed mainly for ecosystem protection and recreation. IUCN Protected Area Category 2: "A natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area, and (c) provide a foundation for spiritual, scientific, educational, recreational, and visitor opportunities, all of which must be environmentally and culturally compatible" (IUCN 1994). (99)
- **Natural Monument** – A protected area managed mainly for conservation of specific natural features. IUCN Protected Area Category 3: "An area containing one or more specific natural or natural/cultural features which are of outstanding or unique value because of their inherent rarity, representative or æsthetic qualities, or cultural significance" (IUCN 1994). (99)
- **Protected Landscape/Seascape** – A protected area managed mainly for landscape/seascape conservation and recreation. IUCN Protected Area Category 5: "An area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant æsthetic, ecological, and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance, and evolution of such an area" (IUCN 1994). (99)
- **Strict Nature Reserve** – A protected area managed mainly for science. IUCN Protected Area Category 1a: "An area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features, and/or species, available primarily for scientific research and/or environmental monitoring" (IUCN 1994). (99)
- **Wilderness Area** – A protected area managed mainly for wilderness protection. IUCN Protected Area Category 1b: "A large area of unmodified or slightly modified land and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition" (IUCN 1994). (99)

Protected Landscape/Seascape – see protected area, Protected Landscape/Seascape

PSR framework – see framework, Pressure-State-Response

RACE, Rapid Assessment of Conservation Economics – A methodology to identify the best strategies for achieving corridor milestones in an expert-based and participatory manner. (130)

Rapid Assessment Program™, RAP™ – A biological inventory program that assembles teams of scientists to produce rapid assessments of the biological value of poorly known areas that are potentially important biodiversity conservation sites, and thus catalyze conservation action. (38)

Red List

- **IUCN Red List of Threatened Species™** – A system containing taxonomic, conservation status, and distribution information on taxa that have been evaluated using the IUCN Red List Categories and Criteria, which is designed to determine the relative risk of extinction, and which aims to catalogue and highlight those taxa that are facing a higher risk of global extinction (IUCN 2003). Species listed as threatened on the IUCN Red List are targets for CI's 'Extinctions Avoided' conservation outcomes. (27-35, 54-55, 69-77)
- **national red list** – A system containing information on the national threatened status of species

within a particular country. Species listed as threatened on a national red list are not necessarily threatened globally. Those that are globally threatened appear on the IUCN Red List of Threatened Species™; those that may be globally threatened but are not on the IUCN Red List should be assessed using the IUCN Red List Categories and Criteria to determine if they should be listed. (53-54)

- **Red List Authority** – A group, generally the respective specialist group, under the SSC to ensure that all species within their jurisdiction are correctly evaluated against the IUCN Red List Categories and Criteria at lease once every ten years, and, if possible, every five years. (72, 74)

Reefs at Risk – A map-based indicator of threats to the world's coral reefs, developed by WRI. This global analysis evaluated human pressure on coral reefs for 55,000 coral reef locations worldwide (Bryant *et al.* 1998). Coral reefs with a high Reefs at Risk score are our coral reef hotspots. (24-25)

reintroduction program – see captive breeding and reintroduction program

resilience – The ability of the environment or a component of the environment to reorganize and renew itself without loss of function or diversity. In biological terms, this is how fast an environmental component that has been displaced from equilibrium returns to it (Pimm 1991). The natural processes of evolution, competition, and succession in communities of diverse species form the foundation for ecosystem resilience, but human management must keep disturbance within certain bounds so that this foundation is not lost (Alcorn and Royo 2000). For key biodiversity areas in biodiversity conservation corridors, resilience is achieved through buffer zones, connectivity, and compatible land and resource uses to minimize edge effects (Boyd 2004). (120)

response – Human reaction to pressure through organized behavior to reduce, prevent, or mitigate undesirable change or environmental results. Response is one element of CI's State-Pressure-Response framework. (4, 146-147)

- **response indicator** – see indicator, response

restricted-range species – see species, restricted-range

scenario

- **biodiversity conservation corridor scenario** – A spatial design for a biodiversity conservation corridor, indicating the location and extent of protected areas and areas of compatible land and resource use, and integrating analyses of additional area requirements, connectivity requirements, and resilience requirements. Designing multiple corridor scenarios provides much greater flexibility to explore different solutions that meet conservation targets while generating socioeconomic benefits or limiting opportunity costs (Airamé *et al.* 2003). (120-125)
- **business-as-usual scenario, or BAU** – Projections and modeling of future vegetation cover and land use patterns in the absence of any additional intervention, based on the best available data. Business-as-usual scenarios help indicate those areas where conservation action is most urgent or natural vegetation will be lost. (124-125)

seascape – Marine conservation priority areas that are deliniated by biodiversity needs and ecological processes as well as by political and socioeconomic boundaries that enable policy development and outcome delivery across a broad scale. These large-scale conservation units encompass an array of key biodiversity areas and biodiversity conservation corridors established within the seascape to achieve specific species- and site-level conservation outcomes. Management regimes employed within a seascape will vary in levels of protection afforded from areas subject to general environmental protection and stewardship planning to fully protected reserves. Seascapes can include the Exclusive Economic Zones and territorial waters of one or more collaborating nations, and where international waters are included in seascapes, these nations can seek the cooperation of other countries in maintaining stewardship regimes. (23-25, 111-138)

Specialist Group – One of 120 groups and task forces established under the SSC to address conservation issues related to particular groups of plants or animals or to focus on topical issues such as reintroduction of species into former habitats or sustainable use of species. Specialist groups generally serve as Red List Authorities for their taxa (*www.iucn.org* 2004). (72-72)

species

- **Action Plan** – see species, Species Action Plan
- **biome-restricted species** – Species whose range is restricted to a particular biome. Biome-restriction has been assessed in birds by BirdLife International. Criteria have not been established to apply this to other taxa. (34, 36)
- **concentrated species** – see species, geographically concentrated
- **congregatory species** – Species of which a high proportion of individuals occur at a single site at a single time of the year. Criteria for birds have been established by BirdLife International. Criteria for other taxa are being assessed by CABS. (34-37)
- **Critically Endangered species, (CR)** – A species considered to be facing an extremely high risk of extinction in the wild, assessed using the IUCN Red List Categories and Criteria (IUCN 2001). These species are targets for CI's 'Extinctions Avoided' conservation outcomes. (31)
- **Data Deficient species, (DD)** – A species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status (IUCN 2001). Data deficient species are research priorities, but not necessarily conservation priorities. (31, 76)
- **Endangered species, (EN)** – A species considered to be facing a very high risk of extinction in the wild, assessed using the IUCN Red List Categories and Criteria (IUCN 2001). These species are targets for CI's 'Extinctions Avoided' conservation outcomes. (31)
- **endemic species** – A species that is restricted to a particular geographic area and thus are found nowhere else on Earth. Species that are endemic to small geographic ranges are known as restricted-range species. (34-36)
- **engineer species** – A keystone species that modifies its respective ecosystem(s). (32)
- **Extinct in the Wild species, (EW)** – A species that is known to survive only in cultivation, in captivity, or as a naturalized population (or populations) well outside its past range (IUCN 2001). Once reintroduced into its natural range, these species are targest for CI's 'Extinctions Avoided' conservation outcomes. (31, 79-80)
- **Extinct species, (EX)** – A species for which there is no reasonable doubt that the last individual has died, and for which exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual (IUCN 2001). (31, 70)
- **flagship species** – A popular, charismatic species that serves as a symbol and rallying point to stimulate conservation awareness and action. (32)
- **geographically concentrated species** – Species vulnerable to extinction due to their reliance for survival on small geographic areas. These include restricted-range species, biome-restricted species, and congregatory species. These species are targets for CI's 'Extinctions Avoided' conservation outcomes. (34-37)
- **globally threatened species** – Species with Vulnerable (VU), Endangered (EN), Critically Endangered (CR), or Extinct in the Wild (EW) status on the IUCN Red List of Threatened Species™; these species have a high probability of extinction in the short- or medium-term future. These species are targets for CI's 'Extinctions Avoided' conservation outcomes. (31-34)
- **indicator species** – A species whose health and abundance is assumed to reflect the health and abundance of other species sharing its habitat or overall ecosystem health. (32)
- **invasive species, or invasive alien species** – Non-native organisms that cause, or have the potential to cause, harm to the environment, economies, or human health. Invasive species affect native species through predation, competition for food and other resources, hybridization, spread of disease, and alteration of the natural landscape (*www.gisp.org* 2004). (82-83)
- **keystone species** – A species whose impact on other species in its habitat is greater than expected from its relative abundance. (32)
- **landscape species** – A species that "uses large, ecologically diverse areas and often has significant impacts on the structure and function of natural

ecosystems" (Sanderson *et al.* 2002). (32, 42-43, 118-120)

- **Least Concern species, (LC)** – A species that has been evaluated against the IUCN Red List Categories and Criteria, and that does not qualify for Critically Endangered, Endangered, Vulnerable, or Near Threatened status (IUCN 2001). Assessed widespread and abundant species have Least Concern status. (31)
- **migratory species** – A species that passes—usually periodically or seasonally—from one region or climate to another for feeding or breeding (Merriam-Webster 1995). (119)
- **Near Threatened species, (NT)** – A species that has been evaluated against the IUCN Red List Categories and Criteria, that does not qualify for Critically Endangered, Endangered, or Vulnerable status now, but that is close to qualifying for or is likely to qualify for a threatened category in the near future (IUCN 2001). (31)
- **Not Evaluated species, (NE)** – A species that has not yet been assessed using the IUCN Red List Categories and Criteria (IUCN 2001). (31, 76)
- **restricted-range species** – Species whose range is restricted to a small geographic area. Restricted-range birds have been defined by BirdLife International as those with a range of less than 50,000 km^2. Other taxa have not had criteria established, although any species with a range of less than 20 km^2 is defined as a globally threatened restricted-range species under the IUCN Red List of Threatened Species™. (34-36)
- **Species Action Plan** – Reports developed by SSC Specialist Groups to identify threats to groups of species and the activities required to reduce or eliminate those threats (IUCN undated). (75, 85)
- **Species Management Area** – see protected area, Habitat/Species Management Area
- **umbrella species** – A species with a large home range, but specific habitat requirements, so that its conservation is often assumed to save many other species at the same time. There is little empirical evidence that this tactic is effective for broad-scale biodiversity conservation. (32)
- **Vulnerable species, (VU)** – A species considered to be facing a high risk of extinction in the wild, assessed using the IUCN Red List Categories and Criteria (IUCN 2001). These species are targets for CI's 'Extinctions Avoided' conservation outcomes. (31)
- **wide-ranging globally threatened species** – A globally threatened species that migrates throughout or between landscapes or seascapes, and thus requires action at the biodiversity conservation corridor level to ensure its protection and survival. (42-43, 118-120)

SPR framework – see framework, State-Pressure-Response

stakeholder – A person, institution, government, company, or community with control of, rights to, or benefits from a particular area or resource. For any conservation strategy to be effective, key stakeholders must be engaged in the design, implementation, and monitoring and evaluation of conservation actions. (8-12, 98, 107, 126-128)

state – The condition of targeted biodiversity elements, and that of the habitat, communities, and systems upon which they depend. State is one element of CI's State-Pressure-Response framework. (4, 146-147)

- **state indicator** – see indicator, state
- **State-Pressure-Response framework** – see framework, State-Pressure-Response

status monitoring – see monitoring, outcomes

stepping stone – A small patch of habitat between key biodiversity areas that assists in establishing connectivity between these areas. (111, 119-120)

strategy monitoring – see monitoring, project

Strict Nature Reserve – see protected area, Strict Nature Reserve

sustainable use – Harvest of species in a properly managed and controlled program to meet local communities' subsistence needs when no viable alternative to the species exists, or in carefully managed and monitored consumptive industries that provide the economic benefits necessary to encourage maintenance of species habitats and stable populations. (78)

tactic, or conservation tactic – A tool or means to achieve our conservation outcomes. It is important to distinguish conservation tactics (e.g., environmental education, conservation enterprise development, and buffer zone management) from conservation targets (our 'Extinctions Avoided', 'Areas Protected', and 'Corridors Consolidated' conservation outcomes) to ensure we remain focused on our end-goal, the achievement of our conservation outcomes, which are the effective and sustainable protection of biodiversity.

TAMARIN, or Toolbox of Applied Metrics and Analysis of Regional Incentives – A planning support system developed to assist in regional conservation planning. A customized ArcView™ project that is being placed in the public domain as freeware for authorized users of ArcView™, it was initially developed by the University of California – Santa Cruz with funding by the World Bank, and has been further developed and enhanced by CI with contributions from IESB (Stoms *et al.* 2003).

target, conservation target, or biodiversity target – Our conservation outcomes. It is important to distinguish conservation tactics (e.g., environmental education, conservation enterprise development, and buffer zone management) from conservation targets (our 'Extinctions Avoided', 'Areas Protected', and 'Corridors Consolidated' conservation outcomes) to ensure we remain focused on our end-goal, the achievement of our conservation outcomes, which are the effective and sustainable protection of biodiversity.

terrestrial biodiversity hotspot – see hotspot, terrestrial biodiversity

threatened species – see species, globally threatened

Toolbox of Applied Metrics and Analysis of Regional Incentives – see TAMARIN

tourism – see ecotourism and nature tourism

umbrella species – see species, umbrella

uniqueness – see irreplaceability

use, compatible – see compatible land and resource use

use, sustainable – see sustainable use

vulnerability – The likelihood that an element of biodiversity will be lost or degraded in the near future (Pressey and Taffs 2001). Degree of threat is one measure of vulnerability. (36, 45)

Vulnerable species – see species, Vulnerable

wide-ranging species – see species, landscape and species, wide-ranging globally threatened

wilderness area

- **high-biodiversity wilderness area** – The largest remaining tracts of pristine habitat on the planet (each >750,000 km^2), are at least 70 percent intact, and are under much less pressure from human populations than areas like the hotspots, mostly having population densities of less than five people per km^2. Plant diversity is the biological basis for high-biodiversity wilderness area designation; to qualify, a region must support 1,500 endemic plant species (*www.biodiversityhotspots.org* 2004). (22-23)
- **IUCN category of protected area** – see protected area, Wilderness Area

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