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Assessing Threats in Conservation Planning and Management: Synthesis

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Assessing Threats in Conservation Planning and Management

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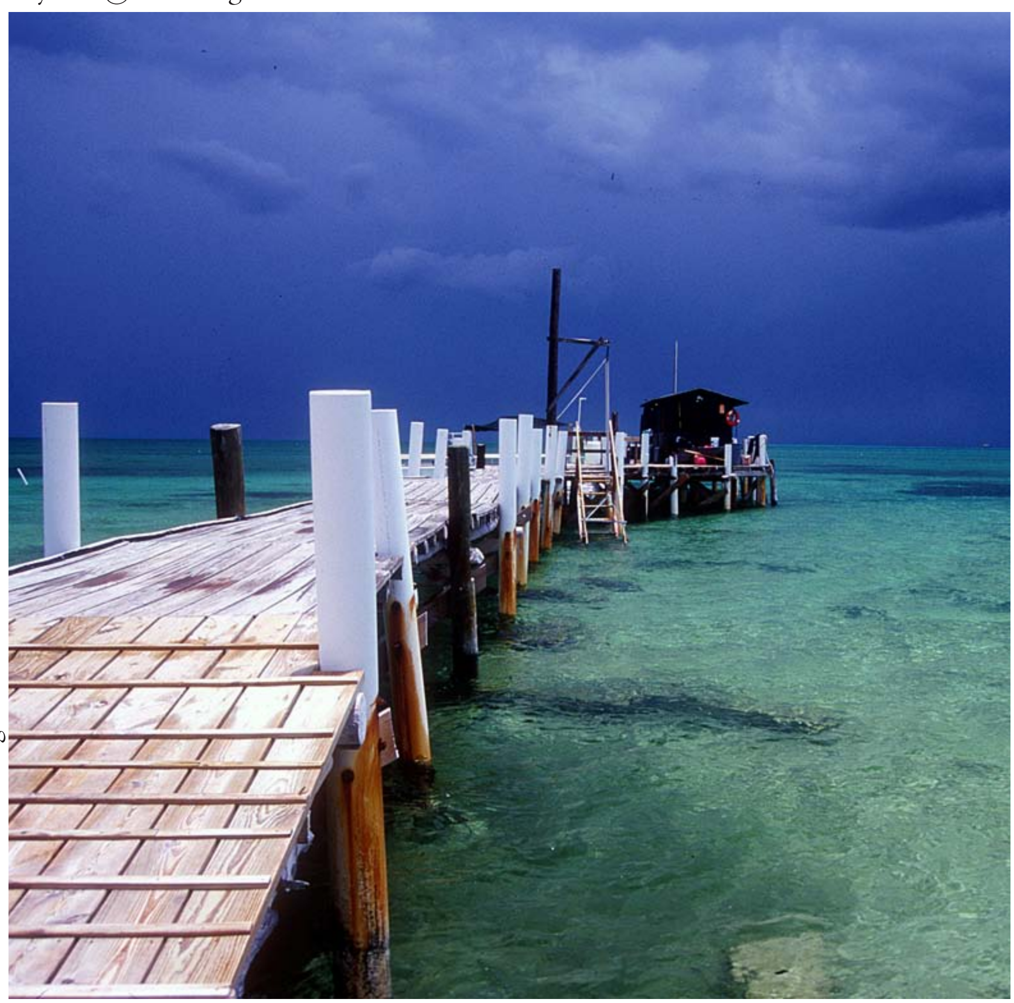

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Conceptual Roadmap of the Synthesis and Relationship to Other NCEP Modules

This synthesis reviews the role of threat assessment in conservation planning and management in setting conservation targets (what targets to conserve?), identifying priority strategies (how to conserve?), and determining their effectiveness (are strategies effective?).

The first part of the synthesis includes an overview of the use of threat assessment in **conservation planning** (what and how to conserve) by focusing on two broad aspects: (1) species-level, and (2) global-, regional-, and local(site)-level priority setting.

The section on species-level priority setting briefly discusses the IUCN Red List Programme, BirdLife International's Important Bird Areas (IBAs) Programme, Key Biodiversity Areas, and range-level priority setting for individual species (e.g., Jaguar Conservation Units, Tiger Conservation Units). The four approaches use threats as one of many criteria to prioritize species or their habitats.

The section on global-scale priority setting discusses the use of threat assessment in four approaches that identify the entire planet as the planning universe, and then attempt to identify places that require conservation attention: Hot Spots, Last Wild Places, Global 200, and Frontier Forests. Following this, the synthesis reviews the use of threat assessment in regional-scale priority-setting approaches such as The Nature Conservancy's seven-step planning framework and World Wildlife Fund's Ecoregion Based Conservation which involve selecting one or a cluster of ecologically defined regions as the planning universe and establishing a set of geographic priorities and strategies within them. In local-scale priority setting, the role of threat assessment is to identify and rank threats to conservation targets in order to select appropriate conservation strategies. The synthesis reviews two planning tools used in site conservation: conceptual models and The Nature Conservancy's Conservation Action Planning approach.

The second part of the synthesis reviews the role of threat assessment in measuring **management effectiveness** with reference to monitoring approaches that fall into two broad categories: (1) the assessment of the status and impacts of threats, and (2) the measurement of ecological integrity of conservation targets.

This section concludes with a comparison of threat monitoring methodologies focusing on two approaches: Threat Reduction Assessment and Rapid Assessment and Prioritization of Protected Area Management.

This overview is closely linked yet significantly different in focus from two other related modules, *An Overview of Threats to Biodiversity* and *Monitoring for Adaptive Management in Conservation Biology. An Overview of Threats* provides a discussion on the various direct threats to biodiversity such as habitat fragmentation, invasive species, pollution, overexploitation, and global climate change. There is a detailed description of each category of threat and ecological impacts on biodiversity and processes sustaining biodiversity.

Monitoring for Adaptive Management in Conservation Biology provides essential concepts for designing successful monitoring projects that directly serve conservation efforts through adaptive management. According to Margoluis and Salafsky (1998), all three parts of any conservation project can be monitored: the state of the target condition (species, ecosystems, protected areas, etc.), the success in mitigating threats to the target condition, and the process of implementing interventions. The module primarily focuses on monitoring the state of the target condition, which could be a particular species, a suite of species, a protected area, an ecosystem type, or a landscape comprising all of these components. Specifically, it describes (1) how to articulate clear management goals, (2) how to convert these into explicit monitoring goals, (3) how to estimate sampling necessary to meet those monitoring goals, (4) how to analyze monitoring data to determine if change has occurred, and (5) how to report results to stakeholders in a timely and effective fashion.

Introduction

Conservation strategies designed and implemented by practitioners to protect species, landscapes, and ecosystems are largely in response to *threats* to *biodiversity*. Hence, threat assessment involving the identification, evaluation, and ranking of threats to specific conservation targets is an integral part of conservation planning and management. Given the urgency for conservation action within the context of limited financial resources and a growing recognition of the deepening biodiversity crisis, the emphasis on systematic conservation planning and evaluation of management effectiveness has greatly increased in recent years. Government and non-government conservation organizations are under increasing pressure to pay more attention to three broad questions:

1. What targets should be conserved?
2. How should conservation strategies be designed?
3. Are conservation strategies effective in achieving conservation goals?

Threat assessment is critical to addressing all three questions.

What Targets Should be Conserved?

Threat assessment is a significant component of conservation priority setting processes for species and ecosystems (Dinerstein et al., 2000; Hilton-Taylor, 2000; Groves et al., 2002; IUCN, 2002). For example, regional conservation planning may identify several hundred potential conservation areas within a planning region on the basis of ecological criteria alone such as diversity, *endemism*, uniqueness, or the value of ecological services. Some areas, however, are in more urgent need of action than other areas. Therefore, a further step in the conservation planning process prior to implementation is to set priorities for action within the planning region. Threat assessment is an important criterion used to set such priorities.

How Should Conservation Strategies be Designed?

Once sites have been selected, threat assessment can help design strategies to conserve biodiversity targets (Margoluis and Salafsky, 1998). There is a growing trend among conservation practitioners to design conservation projects by identifying threats to conservation targets (such as species and ecosystems) at a site and then developing interventions or strategies that explicitly address these threats (e.g., Bryant et al., 1997; Salafsky and Margoluis, 1999; TNC, 2005).

Are Conservation Strategies Effective in Achieving Conservation Goals?

Conservation practitioners are increasingly asked to measure the effectiveness of their efforts to conserve biodiversity in ways that are scientifically sound, practical, and comparable across sites. One way to assess effectiveness of management action is to monitor threats to conservation targets; for example, are the most critical threats that affect biological diversity at a park changing in their severity or geographic extent as a result of conservation strategies (or lack thereof)? Or, has poaching declined as a result of efforts to develop and improve domestic livestock practices as a protein source for local communities? Threat assessment methodologies can be used in monitoring protocols to measure the effectiveness of management action (Salafsky and Margoluis, 1999; Hockings et al., 2000; Margoluis and Salafsky, 2001).

Threat assessment is also used to set priorities in conservation planning of marine areas (Salm et al., 2000); however, this module will emphasize the role of threat assessment in terrestrial conservation planning and management.

Assessing Threats in Conservation Planning

Priority Setting at the Species-level

The following section provides a brief overview of four approaches to assessing threats at the species level. These approaches use threats as one of several criteria to prioritize species or their habitats:

1. The IUCN Red List Programme evaluates the status of species relative to other species in terms of a species' *extinction* risk and allows for monitoring.
2. The Important Bird Areas Programme identifies critical sites for birds.
3. The Key Biodiversity Area approach identifies, documents, and protects networks of sites critical for the conservation of global biodiversity.
4. Range-wide priority setting approaches use threat assessment to set conservation priorities for individual species (for example, Tiger Conservation Units and Jaguar Conservation Units).

1. The IUCN Red List Programme

The IUCN (International Union for the Conservation of Nature and Natural Resources and also known as the World Conservation Union) Red List is a tool to help assess and monitor the status of biodiversity at the species level (www.redlist.org). Threatened species lists such as the Red List provide a qualitative estimate of the risk of extinction.

The goals of the IUCN Red List Programme are to: (a) provide a global index of the state of degeneration of biodiversity, and (b) identify and document those species most in need of conservation attention if global extinction rates are to be reduced (Hilton-Taylor, 2000). The listing process utilizes a comprehensive system of threat classification and criteria to place species in one of seven broad categories: "extinct in the wild," "critically endangered," "endangered," "vulnerable," "lower risk," "data deficient," and "not evaluated" (Hilton-Taylor, 2000; IUCN, 2002; Baillie et al., 2004). For example, the 2004 IUCN Red List contains 15,589 species threatened with extinction. The assessment includes species from a broad range of taxonomic groups including vertebrates, invertebrates, plants, and fungi.

According to Possingham et al. (2002), there are four common ways threatened species lists are used: (1) to set priorities for resource allocation for species recovery, (2) to inform reserve system design, (3) to constrain development and exploitation, and (4) to report on the state of the environment. Possingham et al. (2002) acknowledge that such lists fulfill important political, social, and scientific needs, and are frequently the only tools based on sound ecological knowledge available for decision-making. However, they warn that the lists were not *designed* for any of the four purposes outlined above and provide a useful summary of their limitations.

BirdLife International, an international NGO (non-governmental organization), has been analyzing and documenting the status of the world's threatened bird species since the 1970s, and is the official Listing Authority for birds for the IUCN Red List. BirdLife collates information on threatened birds from a global network of experts and from published and unpublished sources. This information is used to assess each species' IUCN Red List category (and hence extinction risk) using standard quantitative criteria based on *population* size, population trends, and range size (Stattersfield and Capper, 2000).

2. The Important Bird Areas (IBA) Programme

The information generated by the Red List Programme outlined above is also used to focus global conservation efforts and to guide BirdLife's priorities for action. For example, BirdLife International's Important Bird Areas (IBA) Programme is a worldwide initiative aimed at identifying, documenting, and protecting a network of critical sites for birds. IBAs are key sites for conservation - small enough to be conserved in their entirety and often already part of a protected-area network. They fulfill one (or more) of the following criteria:

- Hold significant numbers of one or more globally threat-

ened species
- Are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species
- Have exceptionally large numbers of migratory or congregatory species

3. The Key Biodiversity Area Approach
The goal of the Key Biodiversity Area approach is to identify, document, and protect networks of sites that are critical for the conservation of global biodiversity (Eken et al., 2004). This methodology builds up from the identification of species conservation targets (through the IUCN Red List) and nests within larger-scale conservation approaches (such as IBAs). Sites are selected using standardized, globally applicable, threshold-based criteria, driven by the distribution and population of species that require site-level conservation. Such species fall into two main and non-exclusive classes: species that are threatened or species that are geographically concentrated. Thus, the criteria address the two key issues for setting site conservation priorities: vulnerability and irreplaceability.


Snakes sold for medicinal use in Vietnam (Source: K. Frey)

Key Biodiversity Area criteria cover:

- Globally threatened species that have been assessed following the IUCN Red List criteria as having a high risk of extinction
- Restricted-range species with small global distributions
- Assemblages of species confined to a particular broad habitat type, or biome
- Congregations of species that gather in large numbers at specific sites during some stage in their life cycle

4. Range-level priority setting for individual species
Threat assessment is also used to set conservation priorities over the entire *range* for individual species, such as tigers and jaguars (Dinerstein et al., 1997; Sanderson et al., 2002a). For example, a framework to identify high priority areas and actions to conserve tigers in the wild uses scoring indices for threats to tigers, such as habitat degradation and poaching, to prioritize Tiger Conservation Units, which are defined as "blocks of existing habitats that contain, or have the potential to contain, interacting populations of tigers" (Dinerstein et al., 1997). Similarly, the Wildlife Conservation Society's range-wide priority setting for jaguars identified and prioritized Jaguar Conservation Units (JCUs) as having high, medium, or low probability of long-term survival of the population using a weighted scoring system that included criteria such as JCU size, connectivity, habitat quality, hunting of jaguars, hunting of jaguar prey, and jaguar population status (Sanderson et al., 2002a). Such range-wide priority setting approaches can potentially be applied to other taxa as well.

Table 1 presents a comparison of these approaches. The three approaches share a common objective of using threats as one of many criteria to prioritize species (Red List, BirdLife's threatened species) or their habitats (Important Bird Areas, Key Biodiversity Areas, Tiger Conservation Units, Jaguar Conservation Units).

Priority Setting at Global, Regional, and Local (Site) Scales

Planning methods and conservation strategies of governmental and non-governmental organizations are increasingly focusing on large spatial areas or regions inhabited by many species and natural communities. Threat assessment forms

Table 1: Priority setting at the species-level

	Organization	Scale	Prioritized Categories	Criteria for classification	Method	Reference
IUCN Red List	IUCN Red List Programme	Species	Extinct Extinct in the wild Critically endangered Endangered Vulnerable Lower risk (Conservation Dependent, near threatened, least concern)	Several (see pages 54 and 55 in Hilton-Taylor, 2000)	Quantitative	Hilton-Taylor, 2000; www.redlist.org
BirdLife's Important Bird Areas (IBAs)	BirdLife International	Species and their habitats	Important Bird Areas	(i) Sites with significant numbers of one or more globally threatened species (ii) Sites with a suite of restricted-range species or biome-restricted species (iii) Sites with exceptionally large numbers of migratory or congregatory species	Semi-quantitative	www.birdlife.net
Key Biodiversity Areas	Birdlife International Conservation International Plantlife International	Networks of sites	Key biodiversity areas	Sites with (i) globally threatened species (ii) restricted-range species (iii) assemblages of species restricted to a particular broad habitat type or biome (iv) congregations of species that gather in large numbers at specific sites during some stage in their life cycle	Semi-quantitative	Eken et al., 2004
Tiger Conservation Units (TCUs)	World Wildlife Fund/Wildlife Conservation Society	Landscape	Level I	Habitat integrity	Qualitative (Weighted scoring)	Dinerstein et al., 1997
		[TCUs nested by tiger habitat types]	Level II	Poaching pressure		
			Level III	Population status		
			Immediate Surveys			
Jaguar Conservation Units (JCUs)	Wildlife Conservation Society	Landscape	High, medium, low probability of long-term survival	JCU size Connectivity	Qualitative (Weighted scoring)	Sanderson et al., 2002a
			Jaguars extirpated	Habitat quality Hunting of Jaguars		
			Status unknown	Hunting of prey Jaguar population status		

Table 2: Assessing threats in global, regional, and site-level conservation planning

Title	Organization	Scale	Role of threat assessment	Variables used to measure threat	Reference
Global 200 ecoregions	WWF	Global	What to conserve?	Total habitat loss	Dinerstein et al., 1995
				Degree of fragmentation	Olsen and Dinerstein, 1998
				Water quality	
				Estimates of future threat	
Hotspots	CI	Global	What to conserve?	Habitat loss (70% or more of primary vegetation lost)	Myers et al., 2000
WRI Frontier Forests	WRI	Global	What to conserve?	Commercial logging	Bryant et al., 1997
				Other biomass harvest (removal of fuelwood and construction materials, grazing)	
				Forest clearing (for agriculture, residential housing, etc.)	
				Road construction and other infrastructure development (e.g. powerlines, pipelines)	
WCS's Last Wild Places	WCS	Global	What to conserve?	Human Influence Index	Sanderson et al., 2002b
				Population density	
				Land transformation	
				Accessibility	
				Power infrastructure	
TNC's Ecoregional Planning Approach	TNC	Regional	How to conserve? (To set priorities for action)	Severity, Scope, Contribution, Irreversibility)	Groves et al. 2002
WWF's Ecoregional Planning Approach	WWF	Regional	How to conserve? (To set priorities for action)	Conversion	Olsen et al., 2001
				Degradation	
				Wildlife exploitation	
TNC Conservation Action Planning Process	TNC	Local	How to conserve? (To set priorities for action)	Severity of damage	TNC, 2005
				Scope of damage	
				Contribution	
				Irreversibility	
FOS TRA		Local	How to conserve? (To set priorities for action)	Area	Salafsky and Margoluis, 1999
				Intensity	
			Are actions working?	Urgency	
WWF (RAPPAM Framework)	WWF	Local	How to conserve? (To set priorities for action)	Extent	Ervin, 2003b
				Impact	
				Permanence	
			Are actions working?	Probability	
				Trend over time	

an important component of conservation planning methods helping to prioritize sites within large, terrestrial spatial areas (Groves et al., 2002). There are three "simplified" planning scales typically considered by conservation planners: global, regional, or local (Table 2).

1. Global-Scale Priority Setting

Global-scale conservation priority setting exercises are numerous and include World Wildlife Fund's Global 200 *Ecoregions* (Olson and Dinerstein, 1998), Conservation International's Biodiversity *Hotspots* (Myers et al., 2000), Birdlife International's Important Bird Areas (Grimmett and Jones, 1989), World Resources Institute's *Frontier Forests* (Bryant et al., 1997), and the Wildlife Conservation Society's *Last Wild Places* (Sanderson et al., 2002b). These analyses identify the entire planet as the planning universe, and then attempt to identify all the places (usually large regions or ecoregions) that require increased conservation attention. The priority areas identified in these global prioritization schemes are invariably large (e.g., the Caribbean, or the Tropical Andes) but sometimes include smaller areas (e.g., Important Bird Areas).

The criteria for determining priority areas for conservation are many and varied, but almost always include threat assessment at some point (Table 2). Two of the four approaches (Hotspots, Last Wild Places) use threats as the "primary factor" to define the priority regions, and two other approaches (Global 200, Frontier Forests) use threats secondarily to identify priority regions.

Conservation International's Hotspots are defined on the basis of habitat loss (>70% of primary vegetation lost) and endemism (Myers et al., 2000; Myers, 2003). The Wildlife Conservation Society's Last Wild Places are identified using threat proxies (population density, accessibility, power infrastructure, and land transformation) for human influence (Sanderson et al., 2002b).

The Global 200 initiative of the World Wildlife Fund (WWF) defines "ecoregions" as relatively large units of land containing a distinct assemblage of natural communities and species with boundaries that approximate the original extent of natural communities prior to major land-use change. The Global 200 Ecoregions are considered by WWF to be the richest, rarest, and most distinctive examples of all the Earth's diverse natural habitats.

The Global 200 uses threats at a secondary level to prioritize conservation actions within ecoregions that are identified on the basis of purely ecological and *biogeographical* criteria. Conservation assessments of the Global 200 Ecoregions are based on features such as total habitat loss, the degree of *fragmentation*, water quality, and estimates of future threat. The different ecoregions are classified into one of three broad categories: critical/endangered, vulnerable, or relatively stable/relatively intact (for a more detailed discussion of scoring ecoregions for conservation status, see Dinerstein et al., 1995; Ricketts et al.,1999; Wikramanayake et al., 2002).

Similar to the Global 200 approach, World Resources Institute's approach defines Frontier Forests as large, ecologically intact, and relatively undisturbed natural forests of the world and uses threat criteria to classify frontier forests secondarily as "threatened" or "low-threat" potentially vulnerable forests (Bryant et al., 1997).

2. Regional-Scale Priority Setting

Regional planning scales are intermediate between "coarse" global planning scales and the "fine" local scales typically associated with single site planning. Regional scale conservation planning often involves selecting one or a cluster of ecologically defined regions as the planning universe, and establishing a set of geographic priorities and strategies within them (Olson et al., 2001). Threat assessment is a useful tool for setting priorities for action among conservation areas within a region.

The Nature Conservancy's ecoregional planning process outlines a framework for developing regional plans to conserve biological diversity (TNC 2000a; 2003b; Groves et al., 2002). The ultimate objective in the planning framework is to set priorities for action among the portfolio of potential conservation areas. The framework uses five criteria for setting these priorities: degree of existing protection, conservation value, threat, feasibility, and leverage. The most important criterion among these is the degree of threat to conservation areas and to the targets contained in them. Evaluating threats is important for two reasons: (1) the severity and scope of threats help determine which conservation areas are in need of urgent conservation action, and (2) for threats that recur across many conservation areas, it may be possible to design multi-area strategies to abate these threats (Groves, 2003). Conservation areas that face critical threats are assigned a higher priority than those that are not imperiled - in other words, the greater the degree of threat, the higher the priority.

Logging in Vietnam (Source: C. Snyder)

In parallel, WWF's ecoregional planning process is a strategy for conservation planning and action at a scale that is determined by the patterns of biological diversity and the ecological processes that sustain them (Olson et al., 2001). The process focuses on maintaining these patterns and processes over the long term. A hypothesis of the Eco-Regional Based Conservation (ERBC) process is that addressing threats that occur over large spatial scales is a more cost-effective approach than addressing threats on a site-by-site basis. Hence the framework involves a threat assessment of priority areas, which is intended to gauge the urgency of conservation action and also to help determine the kinds of interventions that may be needed. Threats are categorized into three broad classes: conversion of ecosystems, degradation of ecosystems, and wildlife exploitation. Weighted scoring is used to identify high, medium, and low levels of threat.

The role of threat assessment in both regional planning exercises described above is similar: to identify conservation strategies and to gauge urgency of action.

3. Local (Site-Level) Priority Setting

In contrast to global and regional scales, conservation planning at local scales involves less of a focus on priority setting and more attention to specific site conservation strategies. At global and regional scales, the driving question is frequently where to work, and the process involves selecting candidate areas (where to conserve). At local scales, the decision has already been made to work at a particular site or area, and the driving question becomes how to protect the biodiversity contained in that site; site management issues replace site selection concerns. For conservation areas at typical, local site scales (e.g., protected areas, conservation reserves, etc.), it is extremely important to know the nature and status of biodiversity *plus* the distribution, severity, and intensity of threats impacting the sites.

In general, the role of threat assessment for site conservation planning is to identify and rank threats to conservation targets in order to select appropriate conservation strategies. There are a variety of different approaches to characterizing threats to conservation targets such as protected areas, conservation reserves, etc. The simplest and most common approach is a textual description of the threats to a particular conservation target. While this method identifies threats, it generally does not adequately characterize them for conservation planning purposes. In contrast, a formal assessment measures the relative importance of threats affecting a particular conservation target and thereby informs the most effective selection of conservation strategies (Sayre et al., 2000).

Site Conservation Planning Tools

Conceptual models

Margoluis and Salafsky (1998) have developed the conceptual model approach to designing, managing, and monitoring conservation projects. A conceptual model is a simple, graphic tool to help identify threats affecting biodiversity at a designated site and the conservation actions needed to address those threats. It is viewed as the foundation of all project design, management, and monitoring activities (Margoluis and Salafsky, 1998). The theoretical roots of the conceptual model approach are in diverse fields such as the social sciences, business management, professional practice, and ecosystem management, and are reviewed in Salafsky et al. (2000).

A conceptual model of a conservation project comprises three main components (Margoluis and Salafsky, 1998; see Figure 1):

1. The conservation target, i.e., target condition (such as biodiversity within a protected area) that the project ultimately would like to influence. In most projects, this biodiversity is defined spatially as the species and ecosystems at a specific site, the scale of which can range from a small area to an entire continent. For some projects, however, the targeted biodiversity cannot be tied to specific sites, but must be regarded as a stand-alone entity (e.g., populations of migratory birds or pelagic fish).
2. Causal chains of direct and indirect threats affecting the conservation target. Direct threats are factors that immediately affect the target condition or physically cause its destruction and include habitat fragmentation, *invasive species*, pollution, overexploitation, and global climate change. Indirect threats are defined as factors that underlie or lead to the direct threats. Often referred to as underlying causes of biodiversity loss, indirect threats are complex and stem from many interrelated factors, including population growth, migration, poverty and inequality,

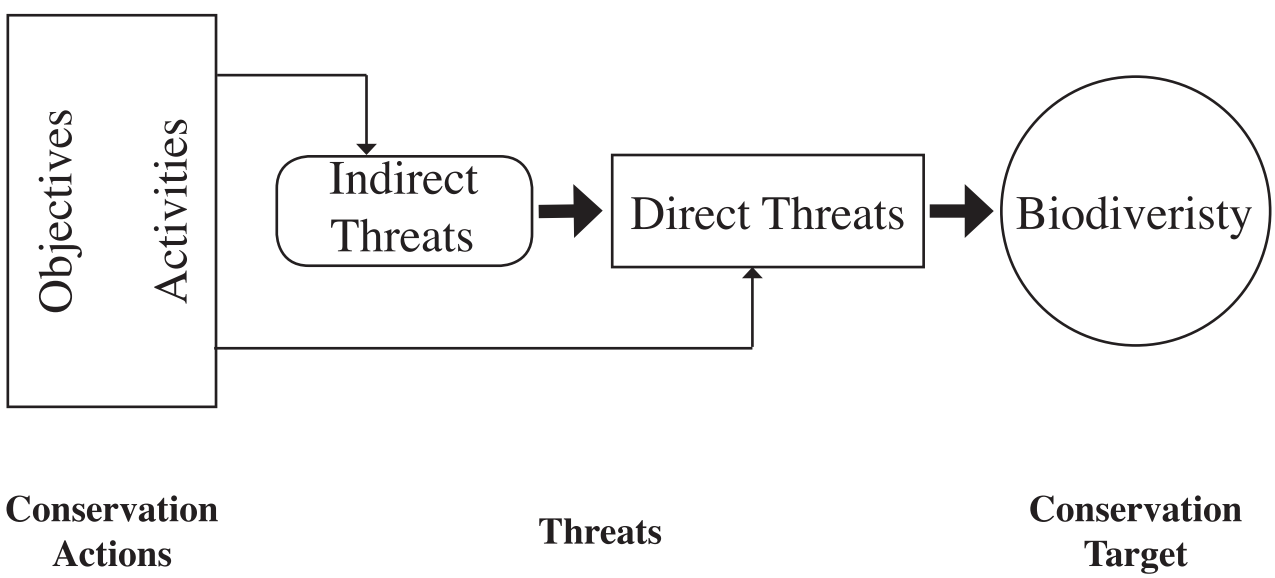

Figure 1: The three main components of a conceptual model of a conservation project include a conservation target, threats (direct and indirect), and conservation actions (Margoluis and Salafsky, 1998)

civil unrest, weak institutions and governance structures, weak legislation and lack of enforcement, and market forces and failures.

3. The third part of the model is a description of the conservation actions (objectives and activities) that project managers can use to counter the threats to their conservation target. A detailed description of the steps involved in building conceptual models of projects is provided in Margoluis and Salafsky (1998).

Once the conservation project has identified the direct and indirect threats influencing the focal conservation target, the next step is to assess the relative importance of these threats. An assessment of threats helps determine which threats need to be addressed or modified to have some impact on the status of the conservation target (Margoluis and Salafsky, 1998; Salafsky and Margoluis, 1999). Threats are ranked on the basis of three criteria: area, intensity, and urgency (see below).

TNC's Conservation Action Planning (CAP) (TNC, 2005)

The Nature Conservancy has developed a method known as the Conservation Action Planning process that includes developing *strategies*, taking action, and measuring success at any scale including at the site level. The system is based on the earlier 5-S Framework for site conservation. The five S's include:

- *Systems:* the biodiversity targets occurring at a site, and the natural processes that maintain them, that will be the focus of planning
- *Stresses:* the types of degradation and impairment afflicting key attributes of the system(s)
- *Sources:* the agents generating the stresses
- *Strategies:* the types of conservation actions deployed to abate sources of stress (threat abatement) and altered attributes of the systems (restoration)
- *Success:* measures of system viability and threat abatement

The conservation approach is based on the principle that stresses must be abated to ensure viable conservation targets. The approach develops and implements conservation strategies to (1) abate the critical sources of stress (i.e., threat abatement), and (2) directly reduce persistent stresses (i.e., restoration).

The Conservation Action Planning process involves the following 4 stages and a total of 10 steps:

A. Defining the project
B. Developing conservation strategies and measures
C. Implementing conservation strategies and measures
D. Using results to adapt and improve

The following is a brief description of the activities under each stage:

A. Defining the project.
Step 1. Identify people involved in the project with the selection of project leader, team members and assignment of roles.

Step 2. Define project scope and focal conservation targets with a brief text description and basic map of project area or scope, a statement of the overall vision of the project and a selection of no more than 8 focal conservation targets and explanations of why they were chosen.

B. Developing conservation strategies and measures.
Step 3. Assess *viability* of focal conservation targets including (i) the selection of at least one key ecological attribute and measurable *indicator* for each focal target, (ii) assumptions regarding acceptable range of variation for each attribute, (iii) determination of current and desired status of each attribute and (iv) brief documentation of viability assessments and any potential research needs.

Step 4. Identify critical threats including the identification and rating of stresses and sources of stress for each focal target.

Step 5. Conduct Situation Analysis. This includes indirect threats/opportunities and associated stakeholders behind all critical threats and degraded attributes and a picture in narrative form or a simple diagram of hypothesized linkages between indirect threats and opportunities, critical threats and focal targets.

Step 6. Develop strategies: objectives and actions. This includes identifying good *objectives* for all critical threats and degraded *key ecological attributes* that the project is taking action to address and one or more strategic actions for each conservation objective.

Step 7. Establish measures. This includes a list of indicators and methods to track the effectiveness of each conservation action.

C. Implementing conservation strategies and measures.
Step. 8. Develop work plans. This involves developing lists of major action steps and monitoring tasks, assignments of steps and tasks to specific individuals, timeline, brief summary of *project capacity* and a rough project budget.

Step 9. Implementation through actions and measures.

D. Using results to adapt and improve.
Step 10. Analyze, learn, adapt, and share. This step involves appropriate and scheduled analyses of data, updated viability and threat assessments, modification to objectives, strategic actions and work plans as warranted, updates of project documents and identification of key audiences and appropriate communication products.

In Step 4, the process identifies four variables used to measure threats:

- *Scope of Damage* is "the geographic scope of impact to the conservation target expected within 10 years under current circumstances."
- *Severity of Damage* is "the level of damage to the conservation target over at least some portion of the target occurrence that can reasonably be expected within 10 years under current circumstances."
- *Contribution* is "the contribution of a source, acting alone, to the full expression of a stress."
- *Irreversibility* is "the level of reversibility of the stress caused by a source of stress." Each threat is scored for each variable using a 1-4 ranking and the variables are combined through a series of rules to give an overall score for each threat (TNC, 2000b).

The TNC approach sometimes includes a comprehensive situation analysis of local economic, political, and social conditions and stakeholder interests as part of the 5-S planning approach. A situation analysis involves developing an understanding of the various factors that can affect the project's focal conservation targets. The process helps identify and prioritize direct threats; outlines underlying causes; and links targets, threats, and underlying factors in a chain-of-causation and/or conceptual model.

Box 1 provides an example of how TNC used this approach to develop conservation strategies for the Yunnan Great Rivers Project in China.

Evaluating Management Effectiveness Using Threat Assessment

Increasingly, donors and policy makers alike are questioning investment in biodiversity conservation with the overall concern: are conservation projects succeeding? Accordingly, measuring effectiveness of conservation strategies and actions has rapidly grown in importance over the past few years. Practitioners and donors are interested in determining whether conservation goals are being achieved and whether conservation strategies are effective in reducing threats to conservation targets. In response, several institutions have developed systems for measuring the effectiveness of management action (e.g., Hockings, 1998, 2003; Courrau, 1999; Dudley et al., 1999; Salafsky and Margoluis, 1999; TNC, 1999, 2003b; Ervin, 2003b).

Approaches in evaluating management effectiveness can be broadly classified into two categories:

Box 1. Local-Scale Conservation Planning: Developing Conservation Strategies for the Yunnan Great Rivers Project (The Nature Conservancy)

The Nature Conservancy uses conservation area planning to develop conservation strategies for the northwest of China's Yunnan Province, one of Earth's richest biodiversity hotspots. In 1998 the Yunnan provincial government invited The Nature Conservancy to help create a conservation and economic development plan for northwest Yunnan. Preparation of the plan, the first major task of the Yunnan Great Rivers Project, was a two-year endeavor involving surveys, research, and feasibility studies by 40 public and private agencies. The plan identifies the area's richest habitats and biggest threats and then proposes ways to abate those threats.

Yunnan Great Rivers Project facts:

Targets: Yunnan golden snub-nosed monkey, snow leopard, evergreen broadleaf forest, rhododendron shrub-lands, high-elevation spruce-fir forest

Stresses: Poverty, unsustainable agriculture, logging and fuel wood collection, unplanned tourism, unsustainable levels of harvesting and grazing, population growth

Strategies: Establish a system of durable protected areas, promote alternative energy sources, promote ecologically compatible land-use practices, influence land-use planning, build conservation alliances, promote eco-tourism

Results: Plan recommending the creation of 3.4 million acres of new nature reserves adopted by the Chinese Government

Source: Modified from http://nature.org

1. Assessment of the status of threats
2. Measurement of the ecological integrity or population status of conservation targets

In the first case, the question addressed is as follows: are the most critical threats that confront biological resources at a park changing in their severity or geographic scope as a result of conservation strategies (or lack thereof)? For example, has wildlife poaching declined as a result of efforts to develop and improve contained domestic animal husbandry as a protein source for local communities?

In the second case, the question becomes: do the ecological systems, communities, and species that are the focus of conservation efforts occur with sufficient size, with appropriately functioning ecological processes, and with sufficiently natural composition, structure, and function to persist over the long term? For example, are populations of mammals and birds declining at a slower rate, or growing, as a result of alternative protein production activities?

The following is a brief analysis of threat monitoring methodologies with greater emphasis on those that fall into the former category (threat status and impacts assessment) as compared to the latter (ecological integrity or target population assessment). A related module (*Monitoring for Adaptive Management in Conservation Biology*) provides a more comprehensive overview of monitoring target populations or ecological systems.

Most threats analyses have focused on the management effectiveness of protected areas (Ervin, 2003a). A number of organizations such as WWF, TNC, World Commission on Protected Areas (WCPA), and the World Bank have been prominent in addressing the issue of measuring management effectiveness through threat monitoring and have developed a number of methodologies. For a comprehensive review of these methodologies, see Hockings (2003), which analyzes 27 management effectiveness systems and documents the basis of each methodology.

Assessing the Status of Threats

Threat monitoring methodologies have been developed specifically to examine the status of threats within the context of assessing management strength and capacity. For example, TNC's Parks in Peril Scorecard (TNC, 1999) assesses the extent to which threats have been identified and/or are being addressed. In other cases, such as the WWF/CATIE methodology (Cifuentes et al., 2000), specific threats are identified and an assessment is made of how effectively management is addressing the threat. The Threat Reduction Assessment methodology developed by Salafsky and Margoluis (1999), described in detail in the Exercise that accompanies this module (page 115), monitors the threats themselves as a proxy measurement of conservation success. Assessing the degree to which threats have been reduced provides a framework for measuring conservation success. The WWF Rapid Assessment methodology (Ervin, 2003b), also described below (Box 2), uses a more detailed assessment of threats to assess vulnerability and assign priorities for intervention across a number of protected areas. Other methodologies allow the measurement and ranking of threats and pressures either at the protected area system level (Singh, 1999; Ervin, 2003c) or at the site level (Margoluis and Salafsky, 1998; TNC, 2000b).

In practice, threat assessments used to gauge protected area effectiveness are applied at varying scales. While some assessments study the prevalence of threats within a single protected area system (Parks Canada, 2000; Rao et al., 2002), others have been used for a regional sampling of protected areas (Brandon et al., 1998; Carey et al., 2000). The Nature Conservancy has developed a method to monitor threats at ecoregional scales and advocates that threat assessment at such scales is critically important as early warning measures for changes in biodiversity status (TNC, 2003c).

Measurement of Ecological Integrity

However important, measuring threat status is insufficient on its own for several reasons (Parrish et al., 2003). Most significantly, a focus on threat status alone must assume that there is a clear, often linear, relationship between a threat and the status of biodiversity. This runs counter to recent evidence of the nonlinear dynamics of ecosystems and threshold effects (e.g., Scheffer et al., 2001). Overall, measurement of threat status can be considered to be one tool to measure effectiveness, and needs to be accompanied by measurements of ecological integrity of conservation targets (see the *Monitoring for Adaptive Management in Conservation Biology* module). A variety of approaches have therefore been used to measure ecological integrity as an indicator of management effectiveness.

Tracking biodiversity in an area using species census data provides one potential avenue for measuring success; another lies in the use of indices of biotic integrity that incorporate information on both taxonomic and functional composition of sampled communities (e.g. Noss, 1990; Karr and Chu, 1999; Sayre et al., 2000). Such approaches face many challenges in protected areas, especially those that span large areas or incorporate combinations of terrestrial, freshwater, and coastal marine ecosystems (Parrish et al., 2003). The costs of repeated, comprehensive biological censuses can be unsustainable. In addition, biotic responses to threats may lag behind the pace of the threats or be difficult to detect with sparse monitoring data. Further, different biotic measures may be difficult to compare or standardize within the same protected area over time, let alone across multiple protected areas. Different biotic measures may be difficult to interpret for people who are not specialists in the particular taxa involved, and many conservation managers are, in fact, non-specialists (e.g., Salafsky and Margoluis, 1999; Dale and Beyeler, 2001). Finally, threats often change more rapidly and more measurably than systems and species, so measuring threat status provides an "early warning system" to detect changes more quickly than relying solely on measures of ecological integrity (TNC, 2003c).

Box 2. Threat Assessment in the Rapid Assessment and Prioritization of Protected Area Management (RAPPAM) Methodology

The RAPPAM methodology can:

- Identify management strengths and weaknesses
- Analyze the scope, severity, prevalence, and distribution of a variety of threats and pressures
- Identify areas of high ecological and social importance and vulnerability
- Indicate the urgency and conservation priority for individual protected areas
- Help to develop and prioritize appropriate policy interventions and follow-up steps to improve protected area management effectiveness

2 PRESSURES AND THREATS

Pressure:

❍ Has ❍ Has not been a pressure in the last 5 years

In the past 5 years this activity has:	The overall severity of this pressure over the past 5 years has been: Extent	Impact	Permanence
❍ Increased sharply	❍ Throughout (>50%)	❍ Severe	❍ Permanent (>100 years)
❍ Increased slightly	❍ Widespread (15–50%)	❍ High	❍ Long term (20–100 years)
❍ Remained constant	❍ Scattered (5–15%)	❍ Moderate	❍ Medium term (5–20 years)
❍ Decreased slightly	❍ Localized (<5%)	❍ Mild	❍ Short term (<5 years)
❍ Decreased sharply			

Threat:

❍ Will ❍ Will not be a threat in the next 5 years

The probability of the threat occurring is:	The overall severity of this threat over the next 5 years is likely to be: Extent	Impact	Permanence
❍ Very high	❍ Throughout (>50%)	❍ Severe	❍ Permanent (>100 years)
❍ High	❍ Widespread (15–50%)	❍ High	❍ Long term (20–100 years)
❍ Medium	❍ Scattered (5–15%)	❍ Moderate	❍ Medium term (5–20 years)
❍ Low	❍ Localized (<5%)	❍ Mild	❍ Short term (<5 years)
❍ Very low			

The methodology includes five steps:

1. Determining the scope of the assessment
2. Assessing existing information for each protected area
3. Administering a Rapid Assessment Questionnaire
4. Analyzing the findings
5. Identifying next steps and recommendations

For a complete description of the methodology, see Ervin, 2003b. Above is a description of the analysis of the scope, severity, prevalence, and distribution of a variety of threats and pressures (Questionnaire used in STEP 3 of the process).

Pressures are forces, activities, or events that have already had a detrimental impact on the integrity of the protected area (i.e. that have diminished biological diversity, inhibited regenerative capacity, and/or impoverished the area's natural resources). Pressures include both legal and illegal activities, and may result from direct and indirect impacts of an activity. Threats are potential or impending pressures in which a detrimental impact is likely to occur or continue to occur in the future.

Trends over Time

Increases and decreases may include changes in the extent, impact, and permanence of an activity.

Extent

Extent is the range across which the impact of the activity occurs. The extent of an activity should be assessed in relation to its possible occurrence. For example, the extent of fishing would be measured relative to the total fishable waterways. The extent of poaching would be measured relative to the possible occurrence of the species population.

Impact

Impact is the degree, either directly or indirectly, to which the pressure affects overall protected area resources. Possible effects from motorized vehicle recreation, for example, could include soil erosion and compaction, stream siltation, noise disturbance, plant damage, disruption of breeding and denning sites of key species, fragmentation of critical habitat, introduction of exotic species, and increased access for additional threats, such as poaching.

Permanence

Permanence is the length of time needed for the affected protected area resource to recover with or without human intervention. Recovery is defined as the restoration of ecological structures, functions, and processes to levels that existed prior to the activity's occurrence or existence as a threat.

Source: Modified from Ervin, 2003b

Box 3. Application of the RAPPAM Methodology to Evaluate Management Effectiveness of Four National Parks in Bhutan

Goal of the assessment: To analyze the strengths and weaknesses of the first decade of park management, identify areas for improvement, and establish baseline data for future assessments.

Protected Areas: Jigme Dorji National Park (JDNP), Jigme Singye Wanchuk National Park (JSWNP), Royal Manas National Park (RMNP), Thrumsihingla National Park (TNP).

Methodology:

- Rapid Assessment Questionnaires administered during one or more participatory workshop. Assessment focused more on comparative than on absolute threats and weaknesses.
- Various elements of management effectiveness (e.g., biological importance, planning, inputs, and processes) were scored by having respondents reply to statements such as "the siting of the protected area is consistent with the protected area objectives" with a "yes," "mostly yes," "mostly no," or "no" response.
- Respondents assessed past pressures and future threats within their protected areas.
- The questionnaire measured extent (the range in which the activity occurred), impact (the degree to which pressures affected overall protected area resources), and permanence (the length of time needed for the protected area resource to recover with or without management intervention).
- The degree of each pressure and threat was calculated by multiplying its extent, impact, and permanence, using the numerical values shown below.

	Value			
Indicator	**1**	**2**	**3**	**4**
Extent	Localized	Scattered	Widespread	Throughout
Impact	Mild	Moderate	High	Severe
Longevity	Short-term	Medium-term	Long-term	Permanent

Note: A separate value was assigned to each quality, and the three values were multiplied to calculate the degree of each pressure or threat. A degree of 1 to 3 was considered mild, 4 to 9 moderate, 12 to 24 high, and 27 to 64 severe.

Sources: Modified from Ervin, 2003b; Tsering, 2003

An alternative approach to measuring conservation success that is being pursued by a growing number of organizations involves the use of some form of ecological "scorecard." Such scorecards tabulate and synthesize diverse scientific information about the focal biodiversity of an area into a small number of measurement categories, which are standardized for use across multiple areas and conservation projects. Examples include the frameworks developed by The Nature Conservancy (1999), and Harwell et al. (1999). The Nature Conservancy's scorecard for assessing ecosystem integrity and species viability has four core components or steps: (1) selecting a limited suite of focal biodiversity targets, the conservation of which is intended to serve as a framework for protecting the whole; (2) identifying a limited suite of key ecological attributes for each target, along with specific indicators for each that provide the information for measuring target status; (3) identifying an acceptable range of variation for each key ecological attribute of the focal conservation targets, defining the limits of variation within which the key ecological attribute must lie for the target to be considered conserved; and (4) assessing the current status of each target, based on the status of its key ecological attributes with respect to their acceptable ranges of variation, and integrating the assessments of target status into a measure of the status of biodiversity overall (see Parrish et al., 2003). A further category of threat assessment focuses on measuring the impacts of threats on biodiversity targets and is more detailed and quantitative than the assessments described above. Studies have measured land-use changes as indicators of intactness of protected areas (Bruner et al., 2001; Jepson et al., 2002). It is also possible to measure the effects of specific threats such as pollutants affecting water quality (Whittier et al., 2002) or ecotourism visitor impacts in protected areas (Farrell and Marion, 2001). Another approach to monitoring threats is to monitor species persistence within individual protected areas (Revilla et al., 2001; Struhsaker, 2002). Table 3 provides a brief and non-exhaustive listing of the diversity of ecological monitoring approaches used in conservation practice.

Table 3: Threat impact monitoring

Variable monitored	Monitoring parameters	Reference
Land-use change as an indicator of protected area integrity	Land use pressure (land-clearing, logging, hunting, grazing, fire)	Bruner et al., 2001; Jepson et al., 2002
Ecotourism visitor impacts in protected areas	Trails and recreational site impacts	Farrell and Marion, 2001
Species persistence within individual protected areas	Mortality causes (including effects of poaching on mortality) and rates for Eurasian badgers in relation to edge effects	Revilla et al., 2001
Habitat fragmentation	Degree of fragmentation (distribution and intensity); loss of primary forest; structural classification based on radar data	Saatchi et al., 2001
Harvest of plant resources	Effects of harvesting on distribution, abundance, population structure, population dynamics of harvested NTFPs	Hall and Bawa, 1993; Godoy and Bawa, 1993
Impact of hunting and trade on a single species	Type and number of wildlife species captured and traded; offtake	Johnson et al., 2004
Ecological degradation in protected areas	Rate of change in forest cover and habitat (Giant Panda)	Liu et al., 2001

Threat Monitoring in Practice

The following is a brief description of two monitoring frameworks based on threat assessment that are currently being used by conservation practitioners.

Threat Reduction Assessment (Salafsky and Margoluis, 1999)
The threat reduction assessment (TRA) approach described in Salafsky and Margoluis (1999) is used to measure project success and seeks to identify threats not only in order to design projects, but to monitor them as well. In effect, instead of merely monitoring the target condition, the TRA approach monitors the threats themselves as a proxy measurement of conservation success. Assessment of the progress in reducing threats provides a framework for measuring conservation success. Threats are ranked on the basis of three criteria: area, intensity, and urgency. Area refers to the percentage of the habitat(s) in the site that the threat will affect: will it affect all of the habitat(s) at the site or just a small part? Intensity refers to the impact of the threat on a smaller scale: within the overall area, will the threat completely destroy the habitat(s) or will it cause only minor changes? Urgency refers to the immediacy of the threat: will the threat occur tomorrow or in 25 years?

An index known as a "threat reduction index" is used to implement the TRA approach. The index is designed to identify threats, rank them according to their relative importance, assess progress in meeting each of them, and then pool the information to obtain an estimation of actual threat reduction so that meaningful comparisons can be made across different projects.

The TRA method has been used to monitor threats in the Crater Mountain Wildlife Management Area (CMWMA) in the highlands of Papua New Guinea (Box 1); for a butterfly and honey enterprise project in Sulawesi, Indonesia; and for a community-based logging project in the Masoala Peninsula, Madagascar (Biodiversity Conservation Network, 1996; Kremen et al., 1998).

Salafsky and Margoluis (1999) provide a comparison of the TRA method and biological approaches to measuring project success using various theoretical and practical criteria. Advantages of using the TRA approach include greater sensitivity to temporal and spatial changes, ease and cost of data collection, analytical benefits of direct comparisons between different types of projects, and ease in interpreting data. Furthermore, the TRA is viewed as a cost-effective tool for determining whether a given project is achieving its conservation goals or for comparing projects in different ecological and socioeconomic contexts.

Disadvantages of using the TRA approach are related to the fact that it is not a completely direct, precise, unbiased and objective measurement of the state of the biodiversity at a project site. Still, the TRA method has the potential to overcome many of the constraints in implementing biological and impact monitoring methods as described above (Salafsky and Margoluis, 1999).

The Rapid Assessment and Prioritization of Protected Area Management (RAPPAM)

Designed by the World Wildlife Fund, the RAPPAM offers policy makers a tool to develop and prioritize appropriate policy interventions to improve protected area management effectiveness (Ervin, 2003b). In general, the RAPPAM methodology is designed for broad-level comparisons among many protected areas. It can answer a number of important questions: What are the threats facing a number of protected areas and how serious are they? How do protected areas compare with one another in terms of infrastructure and management capacity? What is the urgency for taking action in each protected area? What is the overall level of integrity and degradation of each protected area? How well do national and local policies support the effective management of protected areas? What are the most strategic interventions to improve the entire system? Although it can be applied to a single protected area, the RAPPAM methodology is not designed to provide detailed, site-level adaptive management guidance to protected area managers (see Ervin, 2003b for the complete methodology and its applications).

The RAPPAM methodology helps identify management strengths and weaknesses, and analyzes the scope, severity, prevalence, and distribution of various threats and pressures. Pressures are defined as forces, activities, or events that have already had a detrimental impact on the integrity of the protected area (i.e. that have diminished biological diversity, inhibited regenerative capacity, and/or impoverished the area's natural resources). While pressures include both legal and illegal activities, and may result from direct and indirect impacts of an activity, threats are potential or impending pressures in which a detrimental impact is likely to occur or continue to occur in the future. For example, within a protected area such as the Thrumsingla National Park in Bhutan, ongoing poaching of wildlife for commercial trade constitutes a pressure, whereas road construction, in the form of road widening, constitutes a major future threat (Tsering, 2003).

The primary data collection tool of the RAPPAM methodology is the rapid assessment questionnaire. The questionnaire covers all aspects of the international evaluation framework developed by the World Commission on Protected Areas (WCPA) (Box 3; Hockings, 2003) but emphasizes two major areas: (1) contextual issues, including future threats, past pressures, vulnerability, and biological and socioeconomic importance; and (2) management effectiveness, including a variety

Table 4: Comparison of Threat Assessment Methods

Organizational approach	Threat categories	Variables used to measure threats	Measuring threats
TNC Conservation Action Planning Process (TNC, 2005)	**Stresses:** Types of degradation and impairment afflicting key attributes of the system(s). **Sources:** Agents generating the stresses.	**Scope:** Geographic scope of impact to the conservation target expected within 10 years under current circumstances. **Severity:** Level of damage to the conservation target over at least some portion of the target occurrence that can reasonably be expected within 10 years under current circumstances. **Contribution:** Contribution of a source, acting alone, to the full expression of a stress. **Irreversibility:** Reversibility of the stress caused by a source of stress.	Threat scored for each variable on 1-4 ranking: Very High, High, Medium, Low
WWF (RAPPAM Framework) (Ervin, 2003b)	**Pressures:** Forces, activities, or events that have already had a detrimental impact on the integrity of the protected area (i.e. that have diminished biological diversity, inhibited regenerative capacity, and/or impoverished the area's natural resources. **Threats:** Potential or impending pressures in which a detrimental impact is likely to occur or continue to occur in the future.	**Extent:** Range in which the activity occurs- in relation to its possible occurances. **Impact:** Degree. either directly or indirectly, to which the threat affects overall protected area resources. **Permanence:** Length of time needed for the affected protected area resource to recover with or without human intervention. **Probability:** Likelihood of the threat occuring in the future. **Trend over time:** Increases and decreases in the extent, impact, permanence of an activity.	Each threat is scored for each variable using a 1-4 ranking and then the scored are multiplied to give an overall score for each threat.
Foundation of Success Framework (Salafsky and Margoluis, 1999)	**Direct Threats:** Factors that immediately affect the target condition or physically cause its destruction, including habitat fragmentation, invasive species, pollution, overexploitation, and global climate change. **Indirect Threats:** Defined as factors that underlie or lead to the direct threats.	**Area:** Percentage of the habitat(s) in the site that the threat will affect: will it affect all of the habitat(s) at the site or just a small part? **Intensity:** Refers to the impact of the threat on a smaller scale: within the overall area, will the threat completely destroy the habitat(s) or will it cause only minor changes? **Urgency:** Refers to the immediacy of the threat: will the threat occur tomorrow or in 25 years?	Threats ranked from highest to lowest for each variable; scores are summed across the 3 variables to give an overall score for each threat.

Box 4. Protected Area Threats: Findings in Brifef

The major threats and pressures facing the four protected areas are grazing, road construction, extraction of non-timber forest products (NTFPs), and poaching, in decreasing order of degree of impact (average). For actual scores, see Ervin, 2003b.

Summary of strengths and weaknesses across the four protected areas:
PA, protected area; S, strength, where 60% or more respondents answered "yes" or "mostly yes"; W, weakness, where 60% or more respondents answered "no" or "mostly no." A dash (-) indicates that the element was neither a strength nor a weakness.

Elements of assessing management effectiveness	Strength (S)/ Weakness (W)
Objectives	
PA objectives provide for biodiversity protection.	S
Management plan includes specific biodiversity-related objectives.	-
Management policies are consistent with PA objectives.	S
Employees understand the PA objectives.	S
Local communities support the PA objectives.	-
Legal security	
The PA has long-term, legally binding protection.	S
There are no unsettled disputes regarding tenure or use rights.	-
The boundary demarcation is adequate to meet PA objectives.	-
Resources are adequate to conduct critical law enforcement activities.	W
Conflicts with local communities are resolved effectively.	S
Design	
The siting of the PA is consistent with the objectives.	S
The PA layout and configuration optimize biodiversity conservation.	S
The PA zoning system is adequate to achieve PA objectives.	W
The land use in surrounding areas enables effective PA management.	-
The PA is linked to other conserved or protected lands.	S
Staffing	
The level of staffing is sufficient to effectively manage the area.	W
Staff members have adequate skills to conduct critical management activities.	S
Staff members have adequate training and development opportunities.	S
Staff performance is adequately monitored.	-
Staff employment conditions are sufficient to retain staff.	S
Communication and information	
There are adequate means of communication between field and office.	W
Ecological and social data are adequate for management planning.	W
There are adequate means of collecting new data.	-
There are adequate systems for processing and analyzing data.	-
There is effective communication with local communities.	S
Infrastructure	
Transportation is adequate to perform critical management activities.	S
Field equipment is adequate to perform critical management activities.	-
Staff facilities are adequate to perform critical management activities.	-

Protected Area Threats: Findings in Brief (continued)

Maintenance and care of equipment is adequate for long-term use.	S
Visitor facilities are appropriate for the level of visitor use.	S
Finances	
Funding is adequate to conduct critical management activities.	S
Management planning	
There is a comprehensive, recent management plan.	S
There is an inventory of natural and cultural resources.	W
There is a strategy for addressing PA threats and pressures.	W
There is a detailed work plan with specific targets and objectives.	S
The results of research are routinely incorporated into planning.	-
Research and monitoring	
The impacts of PA uses are adequately monitored.	W
Research on key ecological issues is consistent with PA needs.	W
Research on key social issues is consistent with PA needs.	-

FIRST PRIORITY RECOMMENDATIONS (CONCERNS NEEDING IMMEDIATE ATTENTION)

- Strengthening anti-poaching and law enforcement measures
- Updating research activities
- Gaining local community support through creating opportunities and benefits
- Zoning
- Financial management practices
- Availability of equipment and facilities
- Strengthening the Nature Conservation Division

SECOND PRIORITY RECOMMENDATIONS (CONCERNS NEEDING TO BE ADDRESSED IN THE NEAR FUTURE)

- Sustainable harvesting of NTFPs
- Road construction
- Fire management
- Bio-prospecting
- Continued assessment of protected areas

of measures under planning, inputs, and processes. The questionnaire also includes a series of questions that look at system-level design issues, protected area policies, and the broad policy environment.

The most thorough and effective approach to implementing this methodology is to hold an interactive workshop or series of workshops in which protected area managers, policy makers, and other stakeholders participate fully in evaluating the protected areas, analyzing the results, and identifying subsequent next steps and priorities.

The Importance of Assessing Threats in Biodiversity Conservation

As described in the various sections above, threat assessment plays a critical role in conservation planning and management. A significant issue that emerges is the diversity of approaches currently being used to conduct threat assessment by various organizations. To a large extent, methods developed and implemented by a particular organization reflect the organization's mission, and typically, conservation organizations vary enormously in their approach to conservation (Redford et al., 2003).

Table 4 attempts to contrast three current practices in threat assessment. Methods differ in definitions of threat categories, variables used to measure threats, and measurement methods. The lack of a standardized, consistent framework for threat assessment has significant drawbacks for effective conservation planning and management (TNC, 2003c). While they allow comparisons among sites using the same methodology (normally implemented by a single organization), the variety of threat definitions, measurement variables, and measurement methods across organizations often make it extremely difficult to make rigorous comparisons across sites using different methodologies.

Nonetheless, threat assessment methods provide managers with objective, repeatable ways to assess their effectiveness and allow much more efficient management at both the site and the system levels.

Terms of Use

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Literature Cited

Baillie, E.M., C. Hilton-Taylor, and S.N. Stuart. 2004. 2004 IUCN Red List of Threatened Species. A Global Species Assessment. IUCN, Gland, Switzerland.

Biodiversity Conservation Network. 1996. Annual report: stories from the field and lessons learned. Biodiversity Support Program, Washington D.C., USA.

Brandon, K., K.H. Redford, and S.E. Sanderson. 1998. Parks in Peril. Island Press, Washington D.C., USA.

Bruner, A.G., R.E. Gullison, R.E. Rice, and G.A.B. da Fonseca. 2001. Effectiveness of parks in protecting tropical biodiversity. Science 291:125–128.

Bryant, D., D. Nielsen and L. Tangley. 1997. Last frontier forests: ecosystems and economies on the edge. World Resources Institute, Washington D.C., USA.

Carey, C., N. Dudley, and S. Stolton. 2000. Squandering paradise? The importance and vulnerability of the world's protected areas. World Wide Fund for Nature, Gland, Switzerland.

Cifuentes, M.A., A.V. Izurieta, and H.H. de Faria. 2000. Measuring protected area management effectiveness.

World Wildlife Fund, Turrialba, Costa Rica.

Courrau, J. 1999. Strategy for monitoring the management of protected areas in Central America. Programa Ambiental Regional para Centroamérica, Central American Protected Areas System, Comisión Centroamericana de Ambiente y Desarrollo, US Agency for International Development. Available from: www.iucn.org/themes/wcpa/theme/effect/publications.htm. (accessed Sept. 12, 2003)

Dale, V.H. and S.C. Beyeler. 2001. Challenges in the development and use of ecological indicators. Ecological indicators 1:3-10.

Dinerstein, E., D.M. Olson, D.J. Graham, A.L. Webster, S.A. Primm, M.P. Bookbinder, and G. Ledec. 1995. A conservation assessment of the terrestrial eco-regions of Latin America and the Caribbean. World Wildlife Fund and The World Bank, Washington, D.C., USA.

Dinerstein, E., E. Wikramanayake, J. Robinson, U. Karanth, A. Rabinowitz, D. Olson, T. Mathew, P. Hedao, and M. Connor. 1997. A framework for identifying high priority areas and actions for the conservation of tigers in the wild. WWF-US and WCS.

Dinerstein, E., G. Powell, D. Olson, E. Wikramanayake, R. Abell, C. Loucks, E. Underwood, T. Allnutt, W. Wettengel, T. Ricketts, H. Strand, S. O'Connor, and N., Burgess. 2000. A workbook for conducting biological assessments and developing biodiversity visions for eco-region-based conservation. Conservation Science Program, World Wildlife Fund, Washington, D.C., USA.

Dudley, N., B. Gujja, B. Jackson, J.P. Jeanrenaud, G. Ovedia, A. Phillips, P. Rosabel, S. Stolton and S. Wells. 1999. Challenges for protected areas in the 21st century. Pages 3–12 in S. Stolton and N. Dudley, editors. Partners for Protection. Earthscan, London, UK.

Eken, G., L. Bennun, T. M. Brooks, W. Darwall, L. D. C. Fishpool, M. Foster, D. Knox, P. Langhammer, P. Matiku, E. Radford, P. Salaman, W. Sechrest, M. L. Wes, S. Spector, and A. Tordoff. 2004. Key Biodiversity Areas as Site Conservation Targets. BioScience 54: 1110-1118.

Ervin, J. 2003a. Protected area assessments in perspective. BioScience 53:819–822.

Ervin J. 2003b. Rapid assessment of protected area management effectiveness in four countries. BioScience 53:833–841.

Ervin, J. 2003c. Rapid Assessment and Prioritization of Protected Area Management (RAPPAM). World Wide Fund for Nature, Gland, Switzerland.

Farrell, T.A., and J.L. Marion. 2001. Identifying and assessing ecotourism visitor impacts at eight protected areas in Costa Rica and Belize. Environmental Conservation 28:215–225.

Godoy, R. and K. Bawa. 1993. The economic value and sustainable harvest of plants and animals from the tropical rain forest: Assumptions, hypotheses, and methods. Economic Botany 47: 215-219.

Grimmett, R.F.A. and T.A. Jones. 1989. Important bird areas of Europe. International Council for Bird Preservation, Cambridge, UK.

Groves, C.R. 2003. Foundations: ecoregions, guiding principles, and a planning process. Pages 24-40 in Drafting a conservation blueprint: A practitioner's guide to planning for biodiversity. Island Press, Covelo, California, USA.

Groves, C. R., D.B. Jensen, L. L. Valutis, K.H. Redford, M.L. Shaffer, J.M. Scott, J.V. Baumgartner, J.V. Higgins, M.W. Beck, and M.G. Anderson. 2002. Planning for biodiversity conservation: Putting conservation science into practice. BioScience 52:499-512.

Hall, P. and K. Bawa. 1993. Methods to assess the impact of extractions of non-timber tropical forest products on plant populations. Economic Botany 47: 234.47.

Harwell, M.A, V. Myers, T. Young, A. Bartuska, N. Gassman, J.H. Gentile, C.C. Harwell, S. Appelbaum, J. Barko, B. Causey, C. Johnson, A. McLean, R. Smola, P. Templet, and S. Tosini. 1999. A framework for an ecosystem integrity report card. BioScience 49(7):543-556.

Hilton-Taylor, C. 2000. The 2000 IUCN Red List of Threatened Species. World Conservation Union, Cambridge, UK.

Hockings, M. 1998. Evaluating management of protected areas: Integrating planning and evaluation. Environmental Management 22:337-348.

Hockings, M. 2003. Systems for assessing the effectiveness of management protected areas. BioScience 53:823–832.

Hockings, M., S. Stolton, and N. Dudley. 2000. Evaluating effectiveness: a framework for assessing the management of protected areas. In: Phillips, A., editor. Best practice protected area guidelines series, No. 6. IUCN, Gland, Switzerland.

IUCN 2002. 2002 IUCN Red List of Threatened Species. Available at: www.redlist.org. (accessed September 12, 2003)

Jepson, P., F. Momberg, and H. van Noord. 2002. A review of the efficacy of the protected area system of East Kalimantan Province, Indonesia. Natural Areas Journal 22:28–42.

Johnson, A., R. Bino, and P. Igag. 2004. A preliminary evaluation of the sustainability of cassowary (Aves: Casuariidae) capture and trade in Papua New Guinea. Animal Conservation 7: 129-137.

Karr, J.R. and E.W. Chu. 1999. Restoring life in running waters: better biological monitoring. Island Press, Washington D.C., USA.

Kremen, C., K. Lance, and I. Raymond. 1998. Interdisciplinary tools for monitoring conservation impacts in Madagascar. Conservation Biology 12:549-563.

Liu, J., M. Linderman, Z. Ouyang, L. An, J. Yang, and H. Zhang. 2001. Ecological degradation in protected areas: The case of the Wolong Nature Reserve for Giant Pandas. Science 292: 98-101.

Margoluis, R. and N. Salafsky. 1998. Measures of success: designing, managing and monitoring conservation and development projects. Island Press, Washington, D.C., USA.

Margoluis, R. and N. Salafsky. 2001. Is our project succeeding? A guide to the threat reduction assessment for conservation. Biodiversity Support Program, Washington D.C., USA.

Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca, and J. Kent. 2000. Biodiversity hotspots for conservation priorities. Nature 403:853-858.

Myers, N. 2003. Biodiversity hotspots revisited. BioScience 53:916-917.

Noss, R.F. 1990. Indicators for monitoring biodiversity: A hierarchical approach. Conservation Biology 4:355–364.

Olson, D.M. and E. Dinerstein. 1998. The Global 200: A representation approach to conserving the Earth's most biologically valuable eco-regions. Conservation Biology 12:502–515.

Olson, D.M., E. Dinerstein, E.D. Wikramanayake, N.D. Burgess, G.V.N. Powell, E.C. Underwood, J.A. D'Amico, I. Itoua, H. Strand, J.C. Morrison, C.J. Loucks, T.F. Allnut, T.H. Ricketts, Y. Kura, J.F. Lamoreaux, W.W. Wettengel, P. Hedao, and K.R. Kassem. 2001. Terrestrial eco-regions of the world: A new map of life on earth. BioScience 51(11):933-938.

Parks Canada. 2000. Ecological Integrity of Canada's National Parks. Parks Canada, Ottawa, Canada.

Parrish, J.D., D.P. Braun, and R. S. Unnasch. 2003. Are we conserving what we say we are? Measuring ecological integrity within protected areas. BioScience 53:851–860.

Possingham, H.P., S. J. Andelman, M.A. Burgman, R.A. Medellin, L.L. Master, and D.A. Keith. 2002. Limits to the use of threatened species lists. Trends in Ecology and Evolution 17(11):503-507.

Rao, M., A. Rabinowitz, and S.T. Khaing. 2002. Status review of the protected area system in Myanmar, with recommendations for conservation planning. Conservation Biology 16:360–368.

Redford, K.H., P. Coppolillo, E.W. Sanderson, G.A.B. da Fonseca, E. Dinerstein, C. Groves, G. Mace, S. Maginnis, R.A. Mittermeier, R. Noss, D. Olson, J.G. Robinson, A. Vedder, and M. Wright. 2003. Mapping the conservation landscape. Conservation Biology 17(1):116-131.

Revilla, E., F. Palomares, and M. Delibes. 2001. Edge-core effects and the effectiveness of traditional reserves in conservation: Eurasian badgers in Doñana National Park. Conservation Biology 15:148–158.

Ricketts, T.H., E. Dinerstein, D.M. Olson, C.J. Loucks, W. Eichbaum, D. DellaSala, K. Kavanagh, P. Hedao, P.T. Hurley, K.M. Carney, R. Abell, and S. Walters. 1999. Terrestrial ecoregions of North America: a conservation assessment. Island Press, Washington, D.C., USA.

Saatchi, S., D. Agosti, K. Alger, J. Delabie, and J. Musinski. 2001. Examining fragmentation and loss of primary forest in the southern Bahian Atlantic forest of Brazil with radar imagery. Conservation Biology 15: 867-875.

Salafsky, N. and R. Margoluis. 1999. Threat reduction assessment: a practical and cost effective approach to evaluating conservation and development projects. Conservation Biology 13:1830-841.

Salafsky, N., R. Margoluis, and K.H. Redford. 2000. Adaptive management: a tool for conservation practitioners. Biodiversity Support Program, Washington, D.C., USA.

Salm, R.V., J.R. Clark, and E. Siirila. 2000. Marine and coastal protected areas. A guide for planners and managers. IUCN: Washington, D.C., USA.

Sanderson, E.W., K.H. Redford, C. Chetkiewicz, R.A. Medellin, A. Rabinowitz, J.G. Robinson, and A.B. Taber. 2002a. Planning to save a species: the jaguar as a model. Conservation Biology 16(1):58-72.

Sanderson, E.W., M. Jaiteh, M.A. Levy, K.H. Redford, A.V. Wannebo, and G. Woolmer. 2002b. The human footprint and the last of the wild. BioScience 52(10):891-904.

Sayre, R., E. Roca, G. Sedaghatkish, B. Young, S. Keel, R. Roca, and S. Sheppard. 2000. Nature in focus: rapid ecological assessment. Pages 1-31. The Nature Conservancy. Island Press, Washington, D.C., USA.

Scheffer, M., S. Carpenter, J.A. Foley, C. Folke, and B. Walker. 2001. Catastrophic shifts in ecosystem. Nature 413:591-596.

Singh, S. 1999. Assessing management effectiveness of wildlife protected areas in India. Parks 9(2):34–49.

Stattersfield, A.J. and D.R. Capper. 2000. Threatened birds of the world. BirdLife International. Lynx Edicions, Spain.

Struhsaker, T.T. 2002. Strategies for conserving forests in national parks in Africa with a case study from Uganda. Pages 97–111 in J. Terborgh, C. van Schaik, L. Davenport, M. Rao, editors. Making parks work: strategies for preserving tropical nature. Island Press, Washington D.C., USA.

The Nature Conservancy. 1999. Measuring success: the parks in peril consolidation scorecard manual. The Nature Conservancy, Latin America and Caribbean Region, Arlington, Virginia, USA.

The Nature Conservancy. 2000a Designing a geography of hope: A practitioner's handbook to eco-regional conservation planning, second edition. The Nature Conservancy, Arlington, Virginia, USA.

The Nature Conservancy. 2000b. The five-S framework for site conservation: a practitioner's handbook for site conservation planning and measuring conservation success. The Nature Conservancy, Arlington, Virginia, USA.

The Nature Conservancy. 2003a. Eco-regional planning standards. The Nature Conservancy, Arlington, Virginia, USA.

The Nature Conservancy. 2003b. The enhanced 5-S project management process. The Nature Conservancy, Arlington, Virginia, USA.

The Nature Conservancy. 2003c. Measuring the conservation status of eco-regions: A summary of proposed standards and recommendations for establishing an eco-regional measures program. July 2003 draft. Measures and Audit Team, The Nature Conservancy, Arlington, Virginia, USA.

The Nature Conservancy. 2005. Conservation Action Planning: Developing strategies, taking action and measuring success at any scale. Overview of Basic practices. The Nature Conservancy, Arlington, Virginia, USA.

Tsering K. 2003.Bhutan case study—evaluation of management effectiveness in four protected areas. World Wide Fund for Nature, Gland, Switzerland.

Whittier, T.R., S.G. Paulsen, D.P. Larsen, S.A. Peterson, A.T. Herlihy, and P.R. Kaufman. 2002. Indicators of ecological stress and their extent in the population of northeastern lakes: A regional-scale assessment. BioScience 52:235–247.

Wikramanayake, E. D., E. Dinerstein, C. J. Loucks, D. M. Olson, J. Morrison, J. Lamoreux, M. McKnight, and P. Hedao. 2002. The terrestrial ecoregions of the Indo-Pacific: A conservation assessment. Island Press, Washington, D.C., USA.

Glossary

Biodiversity: the variety of life on Earth at all its levels, from genes to ecosystems, and the ecological and evolutionary processes that sustain it.

Biogeography: the study of the distribution of organisms in space and through time.

Ecoregion: a relatively large unit of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions. The ecosystems within an ecoregion have certain distinct characteristics in common.

Endemism: refers to the degree to which species distributions are naturally restricted to a limited area.

Extinction: the complete disappearance of a species from Earth.

Fragmentation: the subdivision of a formerly contiguous landscape into smaller units.

Frontier Forests: they are the world's remaining large intact natural forest ecosystems - undisturbed and large enough to maintain all of their biodiversity and have been identified by the World Resources Institute (Bryant et al., 1997).

Hotspots: in general terms these are areas that have high levels of endemism (and hence diversity) but which are also experiencing a high rate of loss of ecosystems. A terrestrial biodiversity hotspot is an area that has at least 0.5%, or 1,500 of the world's ca. 300,000 species of green plants (Viridiplantae), and that has lost at least 70% of its primary vegetation (Myers et al., 2000).

Indicator: measurable entities related to a specific information need (for example, the status of a key ecological attribute, change in a threat, or progress towards an objective). A good indicator meets the criteria of being measurable, precise, consistent, and sensitive.

Invasive species: species whose populations have expanded dramatically, and out-compete, displace, or extirpate native species, potentially threatening the structure and function of intact ecosystems.

Key Ecological Attributes: aspects of a target's biology or ecology that, if missing or altered, would lead to the loss of that target over time. As such, key ecological attributes define the target's viability or integrity. More technically, the most critical components of biological composition, structure, interactions and processes, environmental regimes, and landscape configuration that sustain a target's viability or ecological integrity over space and time.

Last Wild Places: there are 568 Last Wild Places as identified by the Wildlife Conservation Society. These areas represent the largest and relatively wildest places in each of their biomes. Biomes are large, regional ecosystem types, defined within biogeographic realms, for example, the Afrotropical Tropical Moist Forests, or the Neotropical Flooded Grasslands. Last Wild Places represent the 10 largest, 10% wildest areas within each biome (Sanderson et al., 2002).

Objectives: specific statements detailing the desired accomplishments or outcomes of a particular set of activities within a project. A typical project will have multiple objectives. Objectives are typically set for abatement of critical threats and for restoration of degraded key ecological attributes. They can also be set, however, for the outcomes of specific conservation actions, or the acquisition of project resources. If the project is well conceptualized and designed, realization of all the project's objectives should lead to the fulfillment of the project's vision. A good objective meets the criteria of being: impact oriented, measurable, time limited, specific, practical, and credible.

Population: a group of individuals of the same species that share aspects of their demography or genetics more closely with each other than with other groups of individuals of that species. A population may also be defined as a group of individuals of the same species occupying a defined area at the same time.

Project Capacity: a project team's ability to accomplish its work. Elements include project leadership and staff availability, funding, community support, an enabling legal framework, and other resources.

Range: refers to the location of the smallest area within an imaginary boundary line that encloses all populations of a species.

Strategies: broad courses of action that include one or more objectives, the strategic actions required to accomplish each objective, and the specific action steps required to complete each strategic action.

Threats: factors that negatively alter the normal state of biodiversity including species, sites, ecosystems, landscapes etc.

Viability: the status or "health" of a population of a specific plant or animal species. More generally, viability indicates the ability of a conservation target to withstand or recover from most natural or anthropogenic disturbances and thus to persist for many generations or over long time periods.