Monitoring the Impact of Environmental Fund Projects on Biodiversity Conservation in Protected Area

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RedLAC Capacity Building Project for Environmental Funds

Second Edition – revised in July, 2014

Latin American and Caribbean
Network of Environmental Funds

Scaling up Conservation Finance

The Latin America and Caribbean Network of Environmental Funds – RedLAC – was created in 1999 and congregates currently 25 funds from 15 countries. Its mission is to set up an effective system of learning, strengthening, training, and cooperation through a Network of Environmental Funds (EFs) aimed at contributing to the conservation and sustainable use of natural resources in the region.

RedLAC, with the support of the Gordon & Betty Moore Foundation and the French Fund for the Global Environment (FFEM, for its name in French), implements a capacity building project with the objective of strengthening the capacity of EFs to develop innovative financial mechanisms for biodiversity conservation, reducing their dependence on donations, and also to support the establishment of new EFs, by systematizing and sharing proven best practices in funds day to day operation.

This project, coordinated by the Brazilian Biodiversity Fund – Funbio - on behalf of the RedLAC membership, has the goal of promoting the implementation of new revenue streams in the Funds' portfolios, creating financially sustainable sources of funding for these institutions to invest in conservation. Having knowledge management as its core, the project will systematize the existing information on different topics of interest for EFs and build new content based on the collective experience of the Funds' community.

This textbook was prepared to support the seventh workshop of the capacity building initiative, focusing on impact monitoring of Environmental Funds in Protected Areas biodiversity conservation. This textbook results from the work developed by the RedLAC Impact Monitoring Working Group, which debated the theme in 2012 with the support of experts and case study analysis. Funbio organized this workshop in collaboration with the Profonanpe, in the city of Lima, Peru on November 09 to 11, 2012.

This publication was revised in July 2014 to add adjustments to the monitoring system proposed by the RedLAC Working Group , which pilot-tested the implementation of the system in seven protected areas across seven different countries during 2013. On April 1st and 2nd 2014, the group met in a technical workshop organized by Funbio and supported by Profonanpe, once more in the city of Lima, to discuss the results of this test, the necessary adjustments and the main recommendations to other funds that decide to implement this monitoring system.

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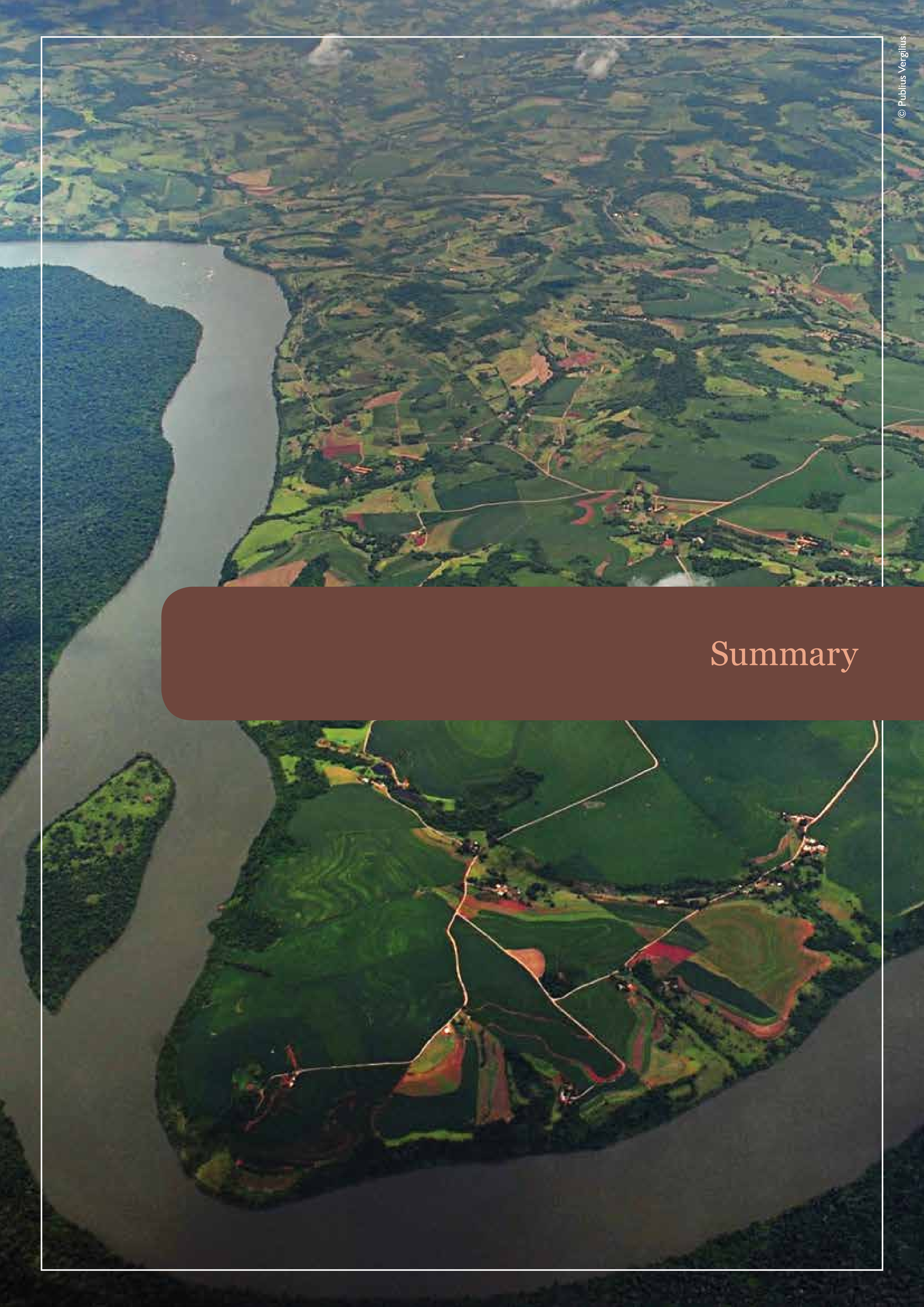


Summary

Monitoring the Impact of Environmental Fund Projects on Biodiversity Conservation in Protected Area

Over the years, the Environmental Funds (EFs) of the Latin American and Caribbean Network of Environmental Funds (*Red de Fondos Ambientales de Latinoamérica y el Caribe* – RedLAC) have demonstrated the ability to raise and manage funds under criteria related to performance and capital security . However, the impacts of EF funding for biodiversity conservation activities in Protected Areas (PAs) implemented by other organizations remain to be tested and measured. Therefore, the training sub-project "Developing and Validating a System of Impact Indicators for Environmental Fund projects related to Biodiversity Conservation in Terrestrial and Marine Protected Areas" seeks to align impact measurement systems of projects for biodiversity conservation financed by the RedLAC Environmental Funds. This would make it easier to integrate and compare data, improve communication among funds, donors and other stakeholders, and measure the impact of the RedLAC environmental funds as a group . In addition, at the project level, monitoring is key to decision-making for the adaptive management of protected areas. This impact indicator system for Environmental Funds, developed by RedLAC, will also serve as a reference point, both for funds from other regions and for new funds as they are created.

Biodiversity conservation interventions are primarily formulated as 'projects', which are managed through an ongoing process called the 'project cycle'. While the purpose for this RedLAC project is "to develop and validate an impact indicator system for environmental fund project related to biodiversity conservation in terrestrial and marine protected areas," it is worthwhile to highlight that the basic measurement units are conservation projects in protected areas financed by environmental funds.

Within the project cycle, monitoring and evaluation (M&E) systems for biodiversity conservation projects have similar components. The primary components are performance assessments and impact assessments. Performance assessments measure inputs, activity implementation and outcomes, while impact assessments measure effects and impacts.

In general, the most common approach for measuring impacts on biodiversity has been to identify biological indicators that directly measure the status of conservation targets such as ecosystem integrity, habitat quality, or environmental service preservation. However, there are other alternatives to asses a project's impact by measuring its effect on threat reduction.

RedLAC has adopted a multi-dimensional system to assess the impact of EFs on biodiversity conservation in Protected Areas that are supported with financing from those Funds. The system is based on measuring effect indicators (threat reduction) and impact indicators (status of conservation targets) for each PA that is funded by a RedLAC Environmental Fund. Raw data is converted into indices that can be averaged to obtain an impact measurement at the PA, EF and RedLAC levels.

We propose implementing participatory field measurements through PA staff, each PA's Management Committee, and local communities. Considering that Funds finance projects executed by other institutions, measurements can also be made by these entities. It is recomended that these entities be trained for the task and that their work be supervised regularly. Furthermore, it is proposed to establish a trust fund to provide long-term financing for periodic measurement of changes in PA habitat coverage and fragmentation using satellite inmagery.

The process of technological change is ongoing, and there are new technologies that can contribute to monitoring and evaluating biodiversity projects. A few examples include drones – miniature remote controlled aircraft that can be operated from the ground to take photos or transmit live images; and recording and analyzing the sounds of nature that indicate the presence and abundance of specific species. The EFs should be at the vanguard of studying and using new monitoring technologies.

1. Introduction

The goals of the Latin American and Caribbean Network of Environmental Funds (*Red de Fondos Ambientales de Latinoamérica y el Caribe* – RedLAC) are: (a) to help boost the effectiveness and efficiency of financial resources; and (b) to increase the impact on biodiversity conservation and environmental services in the region. To this end, RedLAC promotes learning, capacity building, and cooperation among its members.

Over the years, the RedLAC Environmental Funds (EFs) have shown their ability to raise funds and manage them under criteria regarding performance and capital security . However, the impacts of EF funding for biodiversity conservation activities in Protected Areas (PAs) that are implemented by other organizations remain to be tested and measured. Therefore, this sub-project seeks to align impact measurement systems for biodiversity conservation projects in protected areas that are financed by RedLAC EFs. This will make it easier to integrate and compare data; enhance communication among funds, with donors and other stakeholders; and measure the impact of RedLAC as a whole. Furthermore, monitoring serves to inform managerial decisions. For example, it can be used to compare the efficacy of different interventions for conservation, and to provide critical information for adapting projects to take advantage of lessons learned and improve management.

One of RedLAC members, Funbio – the Brazilian Biodiversity Fund, coordinates the RedLAC Capacity Building Project for Environmental Funds. The present initiative, called "Developing and Validating a System of Impact Indicators for Environmental Fund Projects related to Biodiversity Conservation in Terrestrial and Aquatic Protected Areas", is a sub-project of the larger Capacity Building Project. The sub-project is directed by a task force made up of representatives from selected RedLAC members, and is supported by an international

consultant, Allen D. Putney. This document is the fruit of their labors, which include the development of preliminary discussion papers and workshops.

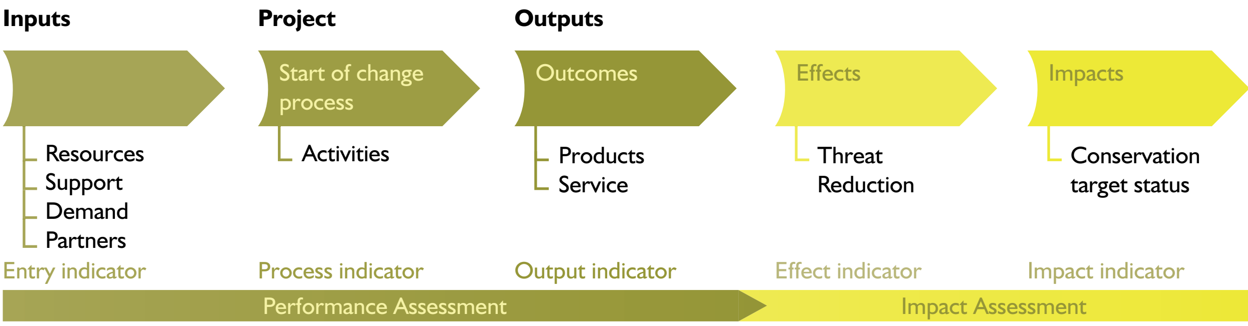
1.1 General Framework

Biodiversity conservation interventions are formulated primarily as 'projects' – a set of activities implemented by a defined group of implementers, including managers, researchers, community members, or other stakeholders – to meet certain goals and objectives. They are managed through an iterative process called the project cycle. While the purpose for this RedLAC project is "to develop and validate an impact indicator system for environmental fund projects related to biodiversity conservation in terrestrial and marine protected areas," it is worthwhile to highlight that basic measurement units are conservation projects in protected areas financed by the environmental funds.

In the project cycle, monitoring and evaluation (M&E) systems for biodiversity conservation projects have similar components. Figure 1 helps to visualize the hierarchy and relations of the M&E system and its indicators. The primary components are performance assessments and impact assessments. Performance assessments measure inputs, activity implementation and outcomes. Impact assessments measure effects and impacts.

The overall model presented in Figure 1 is for a given project, and is especially important for project designers.

Figure 1 – Hierarchy of Indicators



Adapted from RedLAC, 2008

The role of the EFs is to finance conservation projects that are implemented by other organizations. In this regard, they have a role as intermediaries between donors and conservation organizations implementing projects in the field. Therefore, RedLAC and its member EFs have regularly been asked to measure the impacts of their biodiversity conservation activities as individual funds, and as a group, in this case specifically in protected areas (PAs). For this purpose, all impact indicators used must allow for aggregation to give an indication of the impact of each EF's project portfolio and for the projects of all RedLAC EFs.

1.2 Definitions and Types of Monitoring

The terms that different conservation organizations use vary considerably. Therefore, for clarity's sake, Annex A defines the key technical terms used in this manual.

As indicated in Figure 1, a complete M&E system for an EF should include both performance assessments (with input, process and output indicators) and impact evaluations (with effect and impact indicators). However, it is important to emphasize that this document is limited specifically to:

- Impact assessment with effect and impact indicators (the last two columns in Figure 1)
- The Protected Area (AP) focus

1.3 Incentives

While there are several incentives for an EF to adopt a biodiversity impact assessment system, the primary one is to communicate effectively with key stakeholders regarding the level of success of a given project.

This information is also very important for an adaptive management process, because it makes it possible to assess project activities and identify any necessary adjustments as a regular part of the project cycle. Furthermore, a good monitoring system makes it possible to compare the success of different types of interventions, those of different PAs, and each EF's project portfolio. This is the basis for all adaptive management systems. It also helps report outcomes based on reliable figures for donors, the general public, and internationally to organizations such as RedLAC, and conventions such as the Convention on Biological Diversity and the World Heritage Convention.

> **"The role of the Environmental Funds is to finance conservation projects that are implemented by other organizations. In this regard, they have a role as intermediaries between donors and conservation organizations implementing projects in the field."**

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2. Overview of Impact Assessment Approaches

There have been many efforts to develop methods to measure the impact of conservation projects, but few have turned out to be practical, useful, and inexpensive. Historically, each institution designed its own monitoring and evaluation system without much reference to existing systems. These systems have various often overlapping purposes such as knowledge generation, program enhancement, accountability, transparency, resource distribution, promotion, and impact assessment. The outcome has been that, although the systems were conceptually similar, their terminology and methodologies varied, making it hard to compare systems and communicate among institutions.

In order to face these issues, conservationist organizations collaborated in a joint effort, the Conservation Measures Partnership (CMP), to unify criteria and terminology. This is very important work for organizations such as RedLAC, which want to build conceptual bridges among their members, improve methodologies, and facilitate communications. The CMP efforts have also clarified the evolution of concepts and common denominators, so it is now easy to identify the most significant and potentially usable elements for RedLAC and its member EFs. In fact, the RedLAC initiative to measure the impacts of EFs on biodiversity could play a major role in promoting CMP's unified criteria and terminology among its members, in addition to the EFs promoting the same among their clients within their respective countries.

2.1 Most Common Methods

In general, the most common approach for measuring impacts on biodiversity has been to identify biological indicators that directly measure the status of conservation targets such as ecosystem integrity, habitat quality, or environmental service preservation. However, there are other alternatives to asses a project's impact by measuring its effect on threat reduction. For example, Margoluis and Salafsky (2001) have developed a method that they call the Threat Reduction Assessment (TRA). It was designed to be practical, low-cost, directly related to a given project's activities, change-sensitive over short periods, applicable over large extensions, and comparable among sites.

2.1.1 Biodiversity Status

In general, the most common methods for measuring biodiversity status are local ecological knowledge, sampling of transects or points, and/or satellite imagery analysis, combined with field reconnaissance (World Bank, 1998). Common biological indicators for Protected Area monitoring include:

- The area of specific habitat types (change over total area, in larger blocks, or in average sizes)
- Habitat fragmentation analysis (changes in distances between blocks or in average habitat block sizes)
- Land uses (changes in the area of uses that are incompatible with conservation; number, area, and location of land invasions)
- Vegetation structure (changes in canopy coverage)
- Habitat distribution (changes in the boundaries of specific habitats, changes in river-bank vegetation)
- Indicator or target species (changes in abundance or distribution, changes in limiting factors for key species, and changes in biomass)
- Invasive species (changes in presence, location, area, or population)
- Indicator events (changes in frequency or distribution)
- Biodiversity use (changes in different user group rates; changes in the number or percentage of individuals harvesting resources; changes in the percentage of sustainable uses)

Each method varies in terms of accuracy, cost, feasibility, and simplicity. The best indicators are easily measured, accurate, consistent, and sensitive. However, there is always a natural tension between what is scientifically ideal and practical realities. Data gathering protocols should take into account the probability of sampling bias, detection errors in sample design, minimal sample size and effort, and capacity of indicators to detect early warning signs. (Rao et. al, undated).

The specific indicators chosen for a given project will depend on its goals and objectives, and the activities proposed to reach them. For any project, it is important to select a minimum set, with a few indicators that are easy to measure, useful and pertinent to the project, and sustainable over time. For biological indicators, there needs to be a reliable baseline to which subsequent measurements can be compared (World Bank, 1998).

The beginning of a biodiversity conservation project frequently requires a comprehensive study to determine factors such as areas with high biodiversity value, threats and their locations, types and degrees of ecosystem degradation, ecological history of the area, etc. However, monitoring does not necessarily have to update all of this data, because in most cases trends are more important than absolute values, such as total number of species, exact densities, etc. (World Bank, 1998).

2.1.2 Threat Reduction

Using biological indicators is not the only way to assess the impacts of a project on biodiversity conservation. One alternative is to measure a project's threat-reducing effects. For example, Margoluis and Salafsky (2001) have developed a method they call the Threat Reduction Assessment (TRA). It was designed to be practical, low-cost, directly related to a given project's activities, change-sensitive over short periods, applicable over large extensions, and comparable among sites. So this index is of special value to the EFs and RedLAC, since indicators from different sources can be added together and compared, whether for an EF's Protected Area project portfolio, or for RedLAC as a group of EFs.The model it uses has four variables: the desired state for a conservation target, threats, intervention tools, and institutions.

In operational terms, biodiversity can be seen from the standpoint of a species, a habitat (area and status), or the functioning of an ecosystem (maintenance of focal systems and processes). Threats are current anthropic influences that negatively affect biodiversity and include direct threats from within PAs, direct threats from outside of PAs, and indirect threats (social, political and economic factors). There are also opportunities, which have a positive effect on biodiversity.

In general terms, the tools available to reduce or eliminate threats include direct protection, policy making and/or advocacy, education and awareness building, and changing incentives. The *Conservation Measures Partnership* (www.conservationmeasures.org) has developed a standardized Project Cycle model (Annex B), standardized threat lists (Annex C) and intervention tools (Annex D). By using these standardized elements, RedLAC members will promote a common language regarding M&E systems.

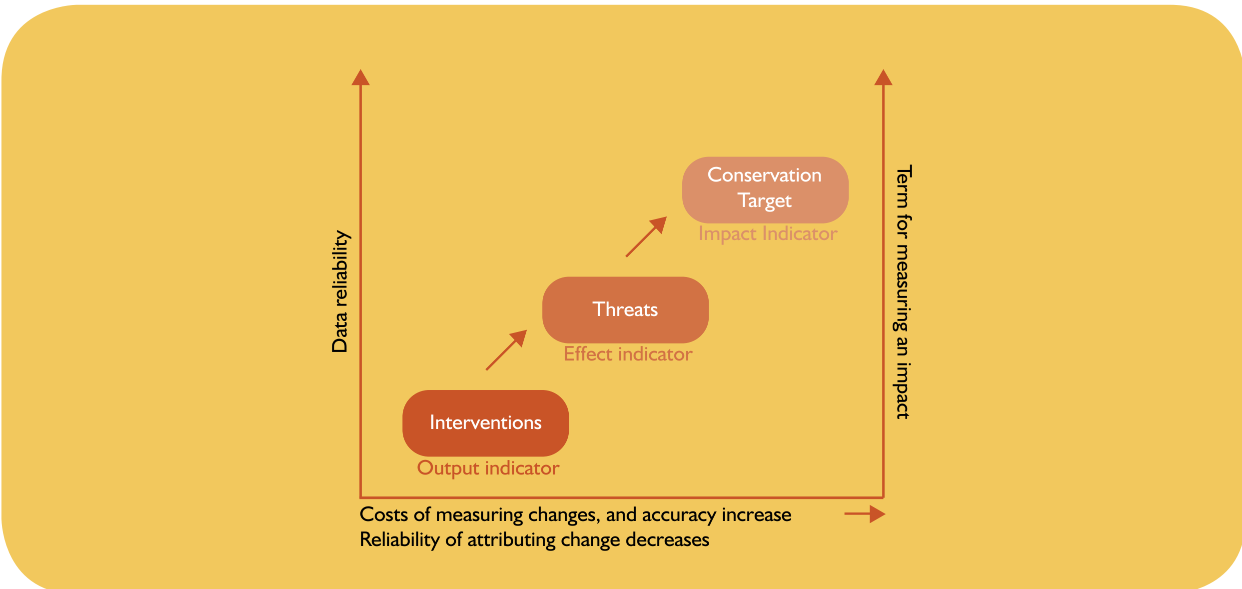
2.2 Comparisons

When an EF contemplates designing an M&E system, there are many factors to consider, such as the tradeoffs among costs, deadlines, accuracy, reliability, and attribution. Furthermore, each method responds differently to theoretical and practical considerations, and each is applied differently to marine or terrestrial protected areas.

2.2.1 Costs, Deadlines, Accuracy, Reliability, and Attribution

In order to know the level of biodiversity conservation in a PA with any degree of certainty, it is necessary to monitor changes in target status over time. Even without human pressures, there are natural variations in species populations and ecosystem integrity, and this makes it hard to detect changes that might be attributed to program or project interventions. Consequently, the way conservation targets change over time will determine the monitoring effort required to detect changes that are attributable to human threats. In many cases, measuring changes in a conservation object is a **long-term** effort.

Figure 2: Costs, Deadlines, Accuracy, Reliability, and Attribution



Given the supposed causal relation among conservation targets, specific threats, and actions designed to reduce threats, monitoring output indicators (third column of Figure 1) and effect indicators (fourth column of Figure 1) makes it possible to measure progress towards conservation on the **short and medium term**. There are pros and cons, however, and one should recognize when output and effect indicators are best used as evidence of progress towards conservation targets. The time needed to detect outcomes and the monitoring costs increase, and the reliability of attribution decreases, as one moves from monitoring intervention implementation (output indicator) to monitoring threat reduction (effect indicator) and target status (impact indicator). (See Figure 2.) Short and medium term assessments are less reliable in their ability to report on the true status of conservation targets.

A decisive factor in designing the whole M&E system is its cost. In general, obtaining accurate, reliable conclusions requires more data from more measuring points, which increases costs. The challenge, then, is to identify systems that provide the greatest accuracy at the least cost. For this purpose, these systems should involve key stakeholders in data collection, such as Park Rangers as they make their rounds, sports divers in marine PAs, hikers along official trails, organized bird watchers, PA administrative boards (such as in Costa Rica and Panama), and communities through participatory monitoring programs.

A good example of participatory monitoring is the system of Brazil's *Instituto Socioambiental* (ISA) (see Marinelli, 2011, for instance). Another advantage of using key stakeholders for data collection is that their involvement tends to raise their confidence in the legitimacy of the data collected and their interest in the findings. However, in many cases a good program is needed to train key stakeholders to carry out monitoring programs correctly.

2.2.2 Theoretical and Practical Aspects

Each system has its pros and cons. For example, Figure 3 compares threat reduction assessments and status of conservation targets. What this table shows is not only that these methods have different pros and cons, but that they also complement each other perfectly. Therefore, measuring effects and impacts together produces a fairly complete, and robust system.

Figure 3 – Comparing Effect and Impact Indicators

Criteria	Effect indicator (Threat Reduction)	Impact indicator (Status of Conservation Target)
Theoretical Aspects		
Directness of Measurement	− Indirect biodiversity indicator	+ Direct biodiversity indicator
Consistency and unambiguity	− uses qualitative indicators, which are more subjective	+ less subjective and thus less likely to be biased
Sensitivity to temporal changes	+ detects changes over relatively short periods (1-5 years)	− difficult to measure changes over short periods, especially considering natural variation
Sensitivity to spatial changes	+ sensitive to changes throughout the project area	− vulnerable to bias based on choice of sampling sites
Analytical uses	+ facilitates comparisons among different types of projects + can be added together to assess a project portfolio	+ difficult to create standardized indices acrosss different project types − can only be added together to show trends
Practical Aspects		
Ease and cost of data collection	+ based on data obtained using simple techniques + data can be collected as part of routine project activities	− based on data collected using complex biological techniques − data usually gathered separately from normal project activities
Ease of data interpretation	+ readily interpreted by project staff − results not directly related to biodiversity	− can be difficult to interpret + results related directly to biodiversity
Applicable retroactively	+ can be applied retroactively	− requires a prior baseline

Translated and adapted from Margoluis and Salafsky, 2001.

“Each method varies in terms of accuracy, cost, feasibility, and simplicity. The best indicators are easily measured, accurate, consistent, and sensitive.”

2.2.3 Terrestrial and Marine Protected Areas

In general, the methodologies used to monitor terrestrial and marine PAs are similar. However, there are exceptions, such as when using satellite imagery for monitoring.

Although satellite images may be useful for detecting changes in certain tropical marine ecosystems such as coral reefs, seagrass beds and mangroves, they are less useful for detecting changes in other ecosystems, such as in deeper waters or temperate zones.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3. EF Experiences

Technical workshops of the RedLAC Working Group on impact indicators, held in San Jose, Costa Rica (May 10, 2012), Lima, Peru (May 28, 2012) and Panama City, Panama (August 9-11, 2012) provided opportunities to share EF experiences using impact indicators. The information collected is summarized in Figure 4. The table includes a list of RedLAC EFs participating in the workshops, indicates that they all finance projects in protected areas and/or their buffer zones, and shows whether the monitoring system belongs to the EF and/or to the project implementors. The table also indicates whether the EF uses threat reduction indicators and/or indicators on the status of conservation targets.

3.1 Biodiversity Indicators often used for PAs

It is interesting to note in Figure 4 that all of these funds finance projects in Protected Areas and/or buffer zones, and that the indicators are measured by their clients, not by them directly. It is also noteworthy that only one fund uses indicators on the impact of its investments on threat reduction. Two of the bio-indicators are utilized the most: abundance of target species and changes in natural cover.

Figure 4: Biodiversity Impact Indicators used by Selected RedLAC EFs for Marine and Terrestrial Protected Areas

Fund	Fund Supports PAs	Monitoring System	Threat Reduction			Status of Conservation Targets				
	Projects in PAs and/or Buffer Zones	Carried out by the Fund or the Project implementor	Threat Reduction Index	GRILLA Method[1]	Incidence of Fires	Biodiversity Index	Changes in Natural Cover	Ecological Integrity	Abundance of Target Species[2]	Recovery of Natural systems
PACT, Belize	x	I[3]								
FUNBIO, Brazil	x	I					x		x	
FAAyN, Colombia	x	I					x		x	x
FPN, Colombia[4]	x	I					x	x	x	x
ACRxS, Costa Rica	x	F, I						x	x	
Natura, Panama[5]	x	I			x	x	x	x	x	
FCBTP, Paraguay	x						x		x	
Profonanpe, Perú[6]	x	I		x			x		x	

F – The Fund's own system;

I – The project implementor's system

[1] The GRILLA Method measures the presence of threats (loss of habitat, resources overuse, pollution, introduced species) within a grid established for each AP.
[2] Target species are indicator species, cynegetic species, or those of special importance to conservation.
[3] Pact, only assesses performance, not impact.
[4] Only for the Mosaicos Project
[5] Only for Chagres and Darién
[6] GRILLA is for all PAs of the national system; the other indicators are for administration contracts

3.2 Feasibility and Cost-Effectiveness of using Satellite Images

Satellite images are useful for monitoring the status of certain conservation targets in PAs. They provide a set of standardized, reliable indicators to measure changes in habitat coverage that are visible in satellite images, and their fragmentation. The downside is that they do not work in areas with almost permanent cloud cover or in the marine habitats of temperate zones, deep waters, or with rocky or sandy bottoms.

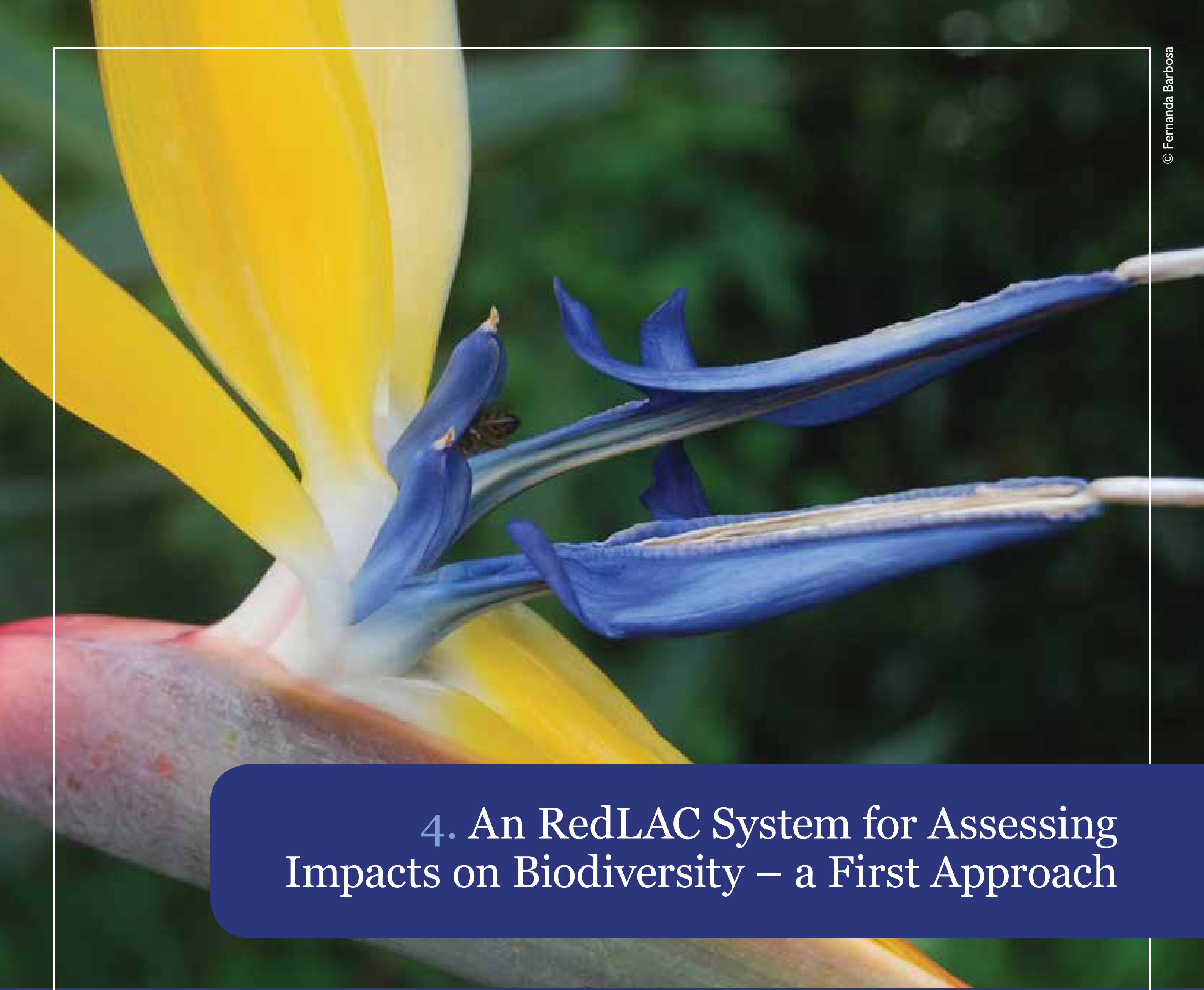
Indicators derived from satellite images can serve to supplement and cross-check other indicators, such as:

- Conservation targets derived from field measurements;
- Threat reduction assessments;
- Evaluations of management effectiveness; and/or,
- National systems of environmental indicators.

"Satellite images are useful for monitoring the status of certain conservation targets in PAs. They provide a set of standardized, reliable indicators to measure changes in habitat coverage that are visible in satellite images, and their fragmentation."

The *Global Conservation Fund* (GCF) of *Conservation International* (CI) uses satellite images as part of its monitoring system. However, it is only one component of the system, which also uses evaluations of management effectiveness systematically for the PAs that they finance. For the GCF, the value of the satellite imagery monitoring component is to have a methodology that uses common indicators interpreted by the same analysts for all of the PAs they finance in the world. The outcomes are quantifiable, comparable and can be added together or averaged, which is a plus when reporting on their investments. However, they need to present the information very carefully to avoid giving the impression that the outcomes are impacts that are produced by their investments alone.

In the experience of CI, the cost of acquiring, pre-processing, collecting field data, classifying, and validating each LandSat satellite image is approximately US$ 2,000. Each image covers 140 Km^2, so with an average of 2 images per PA, considering that they review each PA every 5 years, the **yearly cost** would therefore be about US$ 800 per PA per year. Note that the first year of work will be used to establish the baseline, and that only after 5 years can changes in habitat coverage and fragmentation be determined. Another factor to take into account is whether there is an interest in comparing the rate of vegetative cover change both within protected area and the area of influence. In this case, the cost rises significantly.



4. An RedLAC System for Assessing Impacts on Biodiversity – a First Approach

Given the complementarity of indicators for threat-reduction and for the status of conservation targets, RedLAC has chosen to use these two types of indicators together in a multi-dimensional impact monitoring system. The proposed impact assessment system is for protected areas that receive funding from RedLAC members. Processing of raw data makes it possible to develop indices for integrating data from different sources into general indicators for a Protected Area. Then, indicators can be converted into rankings to aggregate results of different PAs, achieving impact results for individual EFs and RedLAC, as shown graphically in Figure 5.

4.1 Overview

Figure 6 shows an overview of the overall RedLAC system. This system works for both terrestrial and marine protected areas, except for satellite imagery measurements of changes in the coverage and fragmentation of marine habitats in temperate zones, in deep waters, or even in cloud forests, where it is difficult to obtain cloud-free satellite images.

Figure 5: Relation of Indicators at the Project-Level, EF-level, and RedLAC-level

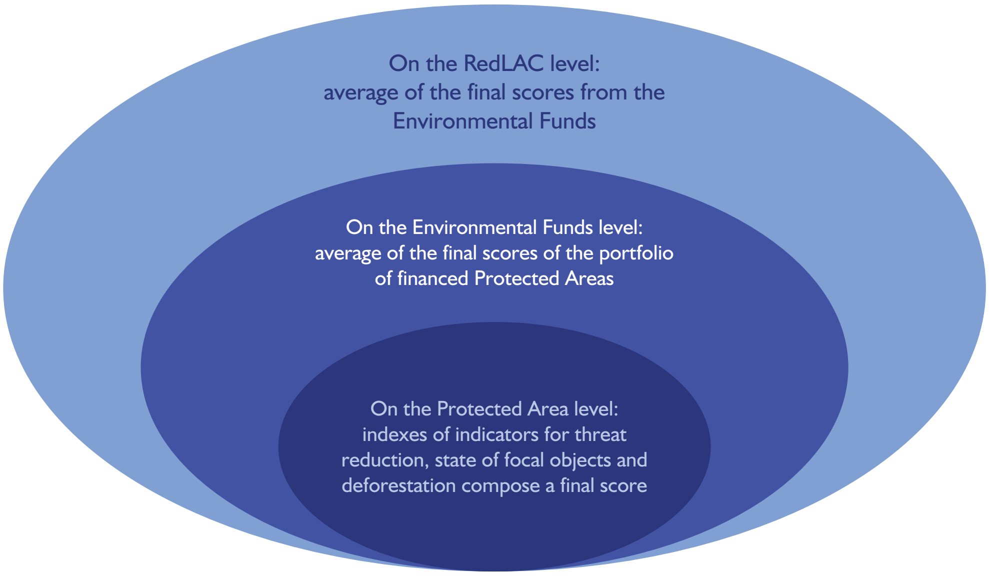


Figure 6 – Summary of the RedLAC–Recommended Multi–Dimensional System

Level	Effect Indicator	Effect Measurement	Impact Indicator	Impact Measurement
Project	Threat reduction rate for each PA funded by the EF.	Measurement of indicators t for each threat by staff of each PA. The PA index is the average for all threats.	1. Abundance index for two indicator species in each PA funded by the EF. 2. Habitat coverage and fragmentation change rate in funded PAs.	1. Measurement of two indicator species per park ranger, management committee and/or local community, using two transects for each indicator species (a total of 4 transects with 2 transects for each species) in 4 different sections for each PA. 2. Measured by a specialized entity every 5 years using satellite imagery.
Environ-mental Fund	Threat reduction index in PAs financed by the Fund.	Fund staff participate in a management committee meeting for each PA financed by the Fund, to review jointly the measurement of each threat and decide whether it coincides with the experience of committee members.	1. Abundance index for indicator species in PAs financed by the Fund. 2. Habitat area change index for PAs financed by the Fund.	1. The Fund index is the average of all indices for all PAs financed by the Fund. 2. Measured by a specialized entity every 5 years using satellite imaging and field verification.
RedLAC	Threat reduction index in PAs financed by member Funds.	The RedLAC index is the average of the indices for all member funds.	1. Abundance index for indicator species in PAs financed by RedLAC member funds. 2. Habitat area change index for PAs financed by RedLAC member funds.	1. The RedLAC index is the average of the indices for all member funds. 2. Measured by a specialized entity every 5 years using satellite imagery and field verification.

4.2 Field Measurement of Indicators

Threat reduction indicators and indicators of the status of conservation targets can be measured by protected area staff (biologists or rangers), management committees, local communities, or volunteers. Considering that Funds provide funding for executing agencies, measurements can also be made by these entities. As a principle, it is useful to include all these groups or persons in the monitoring programs, in order to increase participation in project and PA management, provided work quality can be maintained. Normally, PA staff require little training to measure indicators within an acceptable degree of variation, whereas management committees, local communities and volunteers require higher levels of training. However, this investment is often justified, because it is a way to involve communities in management and inform them directly of the threats to and status of their resources.

The abundance of indicator or target species is stated as a percentage of change in relation to an earlier figure. Measurement figures are initially compared to a baseline, and then in subsequent years to the measurement for the previous year. However, averaging these values to obtain one figure for each PA is not easy. It requires the intervention of a biologist to establish a process for integrating the figures obtained at different measurement sites and for different indicator or target species, using statistically valid methods. It depends on many factors, such as the area covered by each species within the PA, natural fluctuations in species populations, seasonal migrations, extreme climatic events, etc. There are also variants caused by unknown effects. The challenge is to establish a statistically valid change rate to enable comparisons among sites, and to average indices to obtain figures for one PA, for all PAs financed by an EF, and finally for RedLAC.

The data processing protocols are relatively simple. Annex E presents a work sheet and instructions to guide calculations of a Threat Reduction Index (TRI) for a PA. The variables used for this calculation are surface area, intensity, and permanence of the threat. Based on the qualitative values assigned to each variable, one calculates the relative position (ranking). Comparing the rankings in two separate periods determines the percentage of threat reduction, the raw score, and finally the Threat Reduction Index. This system is proposed to focus on threats of anthropic origin.

Annex F shows a hypothetical example of calculating an Indicator Species Conservation Index for a protected area. This calculation is based on the percentage of change observed in the indicator species from a previous measurement period, using the relative density and not the absolute number of individuals. For now, the system will not use Ecological Integrity as an indicator, because this would require more complex and costly measurements.

Data on changes in habitat coverage and fragmentation for a PA can be obtained using satellite imagery together with field checks. The measurement of the deforestation rate of each Protected Area can be compared to other PAs and integrated to establish an indicator for the PA, for the Environmental Fund and for RedLAC.

4.3 Measurements using Satellite Images

Although there are advantages to broad participation when measuring some indicators, there are also advantages to using a single supplier to interpret satellite images when detecting changes in habitat coverage and fragmentation[7]. Some EFs currently use satellite imagery to monitor their projects, but the types of images used and protocols for their interpretation vary among countries. Therefore, the ideal for RedLAC and its members would be to hire a single, highly-qualified supplier to centralize the purchasing, pre-processing, integrating of field data, classifying, and validating of satellite imagery for all funded Protected Areas. This will give RedLAC's EFs a standardized set of reliable, powerful indicators, which could complement and check the other indicators on threat reduction and status of conservation targets.

[7] This includes habitats that are visible to satellite imaging, such as forests, mangroves, paramo and puna grasslands, seagrass beds, reefs, and freshwater habitats. It does not include habitats that are not interpretable on satellite images, such as marine habitats in temperate areas, deep water, rocky or sandy beds, or tropical forests where it is nearly impossible to obtain cloud-free images.

Although a project of this magnitude would be quite costly, it would be a very important component of the monitoring system, as it could provide fully objective and comparable data to validate other, more subjective indicators and to compare with management effectiveness assessments. It is estimated that RedLAC members finance projects in around 500 PAs. If each PA requires an average of 2 satellite images (each image covers 140 km^2), the cost of analyzing some 500 PAs would be in the order of US$ 2 million. Considering that it is proposed that the analysis be done every 5 years, after the first analysis that would establish the baseline, the yearly cost would be in the order of US$ 400,000.

RedLAC would gain a number of comparative advantages in setting up such a system.

1. It is a partnership of EFs in many countries of the region. If the fund were established under the name of RedLAC, it would not be directly identified with any country, and this would give it certain independence from political considerations.
2. Furthermore, a RedLAC member EFs could manage a regional project on behalf of all RedLAC members without establishing a new administrative structure. In fact, this way of working has been used on several occasions, even in the Training Project. However, in this case the fund would be identified with the host country, which could have political implications.
3. EFs have lots of experience establishing, funding and managing trust funds. In this case, a trust fund would be practically indispensible for setting up a joint monitoring system using satellite imagery, and to ensure its long-term functioning. In fact, setting up the system for one or two measurements would make no sense, since it is historical trends that provide the most useful information.
4. RedLAC could achieve economies of scale. RedLAC's EFs currently finance some 500 PAs, and were RedLAC to work with other conservation organizations, this could lower the cost for all. (For example, CI's Global Conservation Fund presently monitors some 200 sites worldwide using satellite imagery). Several conservation organizations could potentially be interested in taking advantage of a standardized monitoring system of this type, in addition to national PA authorities, which in many cases have no images.
5. RedLAC's EFs have years of experience working with donor consortia, and it is likely that a donor consortium will be needed to set up a trust fund for the system being contemplated. This trust fund would be dedicated to monitoring the impact of RedLAC member funds, and would cover not only the cost of satellite image analysis, but also other activities needed to utilize the RedLAC impact monitoring system, such as training new funds in system use, conducting assessments, developing new phases, etc.

RedLAC's satellite imaging monitoring system would have to be implemented in phases. If one or more donors shows potential interest, it will be imperative to conduct a pre-investment study to determine the number, location and size of PAs funded by RedLAC, the specific products that would be needed, the degree of precision needed, the number of satellite images required, and the entity to administer the fund. With this information, it will be possible to calculate the yearly cost of the system and the size of the trust fund that will be required. It would also be useful to determine the economies of scale that could be achieved should other conservation organizations collaborate in developing and using the system. With all of this information, RedLAC would be in a position to work with a consortium of donors to set up the trust fund, invite tenders for acquiring and analyzing the satellite images, contract the winning bidder, and commence system implementation, perhaps in collaboration with other stakeholders. Until a single satellite image interpretation system for RedLAC is in place, the other components of the proposed monitoring system could be implemented independently. EFs that do have access to satellite imagery could seek to implement evaluations of habitat change and fragmentation on their own, and integrate them into their own monitoring system and reporting.

A simpler and cost-free way to use deforestation data to compose the monitoring system for biodiversity conservation is to take data from other systems such as the Global Forest Watch (www.globalforestwatch.org), an online collaborative platform that allows monitoring of deforestation in specific areas.

4.4 Data Integration

The overview of the RedLAC monitoring system shows general concepts for integrating data to develop project impact indices in individual PAs, in PA project portfolios for individual EFs, and in RedLAC as a whole. To integrate this data is not technically valid, since it is likely that each Environmental Fund adopts a different measurement protocol in order to address the demand for information within their own context. The system will allow a final score for each Protected Area, by classifying each variable - threats, species and coverage – in a ranking of 1 to 5. The final score of each PA can be averaged at the EF and RedLAC levels. At the same time, the data sheets are the same for all EFs and can be used to develop, report and archive monitoring system data. However, it is clear that not all funds have the information that is needed to fill in these work sheets. This sub-project has designed an ideal system, but implementing it will require a period of adaptation and learning. Meanwhile, the expectation is that EFs will fill out the summary sheets with the data that is available, and seek the other information to the extent possible in the future. One of the attributes of this system is the use of indices. Therefore, if an environmental fund only has data on indicator species, but not on changes in habitat coverage and fragmentation, or vice versa, this is not a problem; the EF can report the index with the available information.

RedLAC is in the process of developing an online conservation project/investment recording system called Ecofunds. In the future, this system may have a module where impact index sheets can be completed on line by each fund. This would make it easier for funds to have their sheets updated and available for query (even by stakeholders involved in each area), in addition to fuller reporting of the different aspects of each investment made by a fund in a PA.

4.5 Additional Recommendations for Best Practices

As part of the process of informing RedLAC with respect to the impacts of biodiversity conservation in PAs, it is recommended that, where possible, each fund also report on the following points:

- Use data available to the PA, especially on species and coverage. Data for threats can be gathered together with someone who knows the area (park staff, park board, NGOs working in the area, universities studying the area, surrounding communities, etc.)
- Determine the frequency of monitoring, according to the investment strategy and make comparable measurements (in dry / rainy season for example)
- Determine minimum protocols and respect them for all measurements. The more detailed the protocols for each threat are, the more accurate the measurement results will be.
- Adopt protocols that are possible to implement, considering the availability of data and the Fund's resources for this task.
- Select species that indicate results of the conservation strategy (conservation objects) financed by the fund.
- Use satellite images of the same satellite when hiring an analysis on forest cover change.
- Use coverage classification agreed on a national level (standards).
- Do not compare results of areas that did not follow the same monitoring protocols.
- Include, whenever possible, the percentage of the Fund's investments compared to the total budget of the Protected Area (from government or other sources)
- Include in the impact evaluation form of each Protected Area the investment made by each Fund and in which activities that relate to threat reduction
- Make suggestions as to how to improve the impact monitoring system

> **"Some EFs currently use satellite imagery to monitor their projects, but the types of images used and protocols for their interpretation vary among countries."**

4.6 Strengths and Weaknesses

Like any monitoring system, RedLAC's system has its strengths and weaknesses. On the positive side, this system is:

- **Sturdy** – being multidimensional and using indicators for both threat reduction and the status of conservation targets, especially if a single satellite imaging interpretation system can be developed.
- **Balanced** – it is the result of an intermediate solution between simplicity and reliability.
- **Standardized** – based on a single protocol for all RedLAC EFs and the protected areas they finance.
- **Reliable** – based on systems that have been tested by many conservation organizations.
- **Credible** – this is a collective proposal (developed from the bottom up) formulated by a group of EFs.
- **Comparable** – monitoring outcomes can be compared to evaluations of PA management effectiveness and with other data available in the country.
- **Reportable** – monitoring findings can be used to report to the Biodiversity Convention on EF contributions, both individually and as RedLAC, and towards meeting the Aichi goals.

However, this system has limitations that should be taken into account by those utilizing it. This system is:

- **Approximate** – it generates simple findings that are meant to serve as indicators for highly complex, little understood systems. Although threat reduction may be attributed to the project, changes in target status only show a correlation to the project but are not attributable to it.
- **Subjective** – it depends on the interpretations of those using it, since there is no single database, unless a single system for interpreting satellite images is achieved.
- **Insensitive to size** – it is generally more accurate for smaller protected areas, although this issue will be reduced by using satellite images.
- **Simplistic** – it only considers directly anthropic threats, although it is obvious that natural systems also respond to indirect anthropic threats, such as climate change, and natural, non-anthropic variations.
- **Ambitious** – it requires data that many EFs do not currently have and that they will have to develop in the future. The unified satellite image interpretation system is only a concept for now.

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5. Looking Forward

Looking towards the future, the first priority is to field test the recommended system to ensure that it works in a way that is easy to implement and useful to the stakeholders. The field test will provide experiences that will make it possible to fine-tune the system. Looking beyond the current system, it is useful to consider new technologies that in the future may provide important inputs for measuring the impacts of EFs on biodiversity conservation in PAs.

5.1 Field Testing the Initial RedLAC System

Some RedLAC EFs now have data available for immediate implementation of the system. Others will have to implement the system gradually. For all, implementing the proposed system represents an additional, unbudgeted cost. Some EFs will be able to cover the cost with currently available funding, while other EFs will have to raise additional funds for this purpose. Given this reality, the implementation period probably will be long.

5.2 Improving the Initial System

When the first EFs implement the system, this experience will probably supply inputs for improving the system. Another key aspect is setting up a trust fund to cover the cost of a centralized system that will use satellite images to determine changes in habitat coverage and fragmentation. The features of this system will also depend on the needs of potential partners in the initiative. Meanwhile, we should see this first approximation as just one step in the overall process of building a common system that is at once simple and effective.

Seven of the Environmental Funds of the RedLAC Impact monitoring Working Group tested this system in seven PAs during the year 2013. In order for everyone to test the system as close as possible to its ideal application, the Capacity Building Project of RedLAC hired the analysis of satellite images for the seven areas from a single source, generating comprehensive reports on coverage changes in one or two periods of five years, depending on the period of support from each fund to these areas.

The funds presented their impressions of the use of the system and discussed in depth how to calculate each index and how to use the proposed formats, creating tables in Excel and formats for measurement protocols.

The group concluded that in order to aggregate and compare results between Protected Areas, Funds and at the network level, all measurement protocols should be standardized, which is not easily achieved because each fund acts in its country in partnership with the national parks agency and uses available data that seldom follows common protocols between countries. In this context, a final score for each PA was created, a device that allows the methodology to add and compare outcomes between PAs and between Funds. The final score consists of the scores awarded to each index, from 1 to5, classifying each result against a ranking of what could have happened (see Annex G).

As a next step, some funds will start to implement the system, revised after this collective test, in their day to day work, using data available in each country. The group will continue to discuss the feasibility of implementing the system and may, over time, assess whether the results are relevant to answer the main question on the impact of investments managed by environmental funds.

[8] The book "The Great Animal Orchestra" by Bernie Krause contains many examples of biophony as an indicator of a protected area's ecological health.

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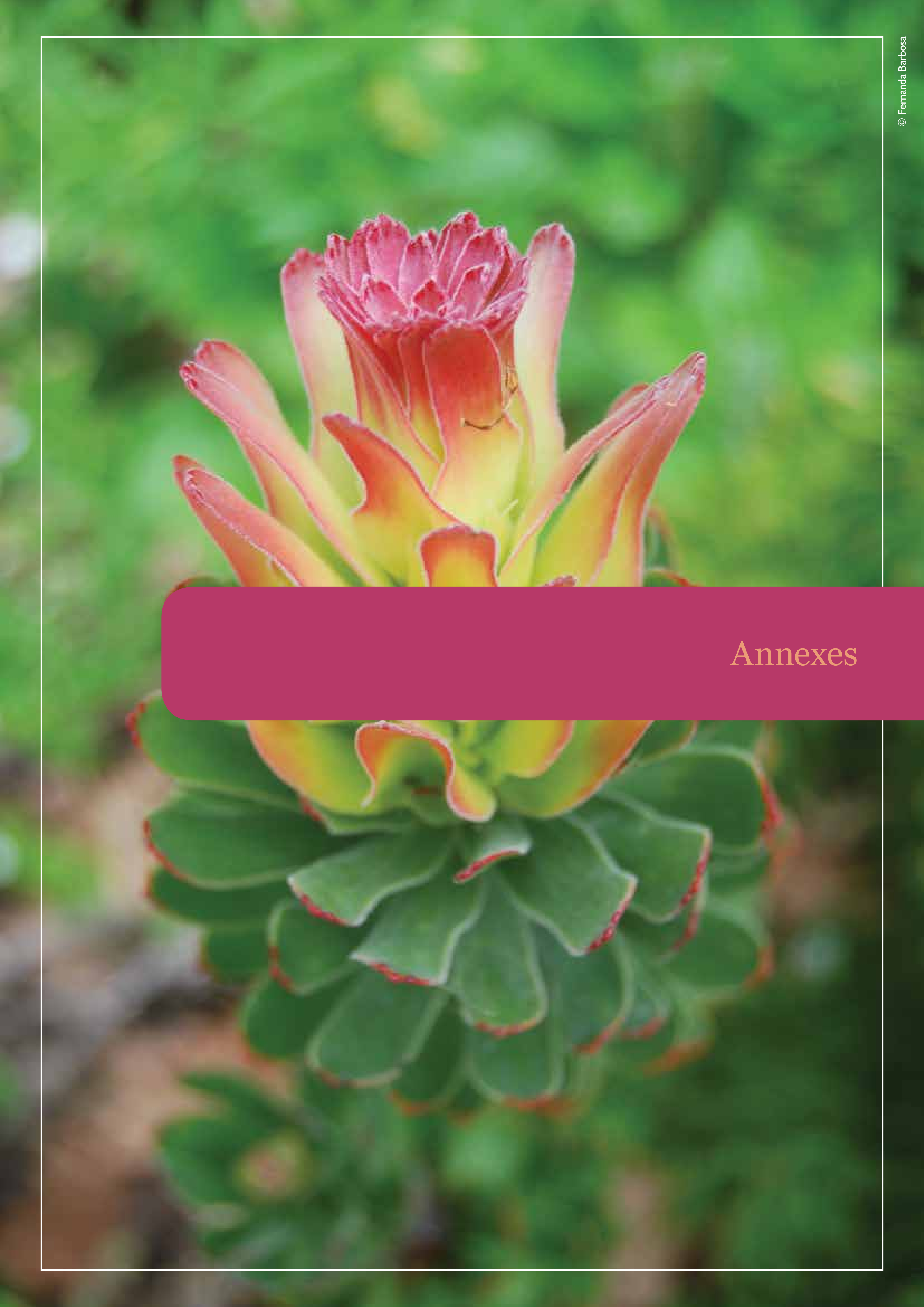

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Annexes

Annex A

Key Definitions

Threats – current influences that negatively affect biodiversity and include direct anthropic threats from within PAs, direct anthropic threats from outside of PAs, and indirect anthropic threats (social, political and economic factors) (RedLAC, 2008).

Effects – threat reductions that result in changes that are generated through efforts by the project, fund, etc. (RedLAC, 2008).

Evaluation – a project or program assessment measured against its own, previously selected goals and objectives (Biodiversity Indicators Partnership, 2011).

Impact – the quality of the conditions for sustaining of the abundance, viability, or distribution of conservation targets generated by EF interventions.

Indicator – a unit of measure based on verifiable data, which enables a quantitative comparison of an actual situation to a desired situation. For a project, it is a measurement of successfully achieving the proposed outcomes and conditions. (Biodiversity Indicators Partnership, 2011; RedLAC, 2008)

Index – a numerical scale used to compare variables, either with each other or against referential amounts (Biodiversity Indicators Partnership, 2011).

Measurement – a standard unit for expressing size, amount or degree. (CMP, 2007)

Monitoring – collecting and evaluating data on goals and objectives that are set.

(This process is often referred to as monitoring and evaluation or M&E) (CMP, 2007)

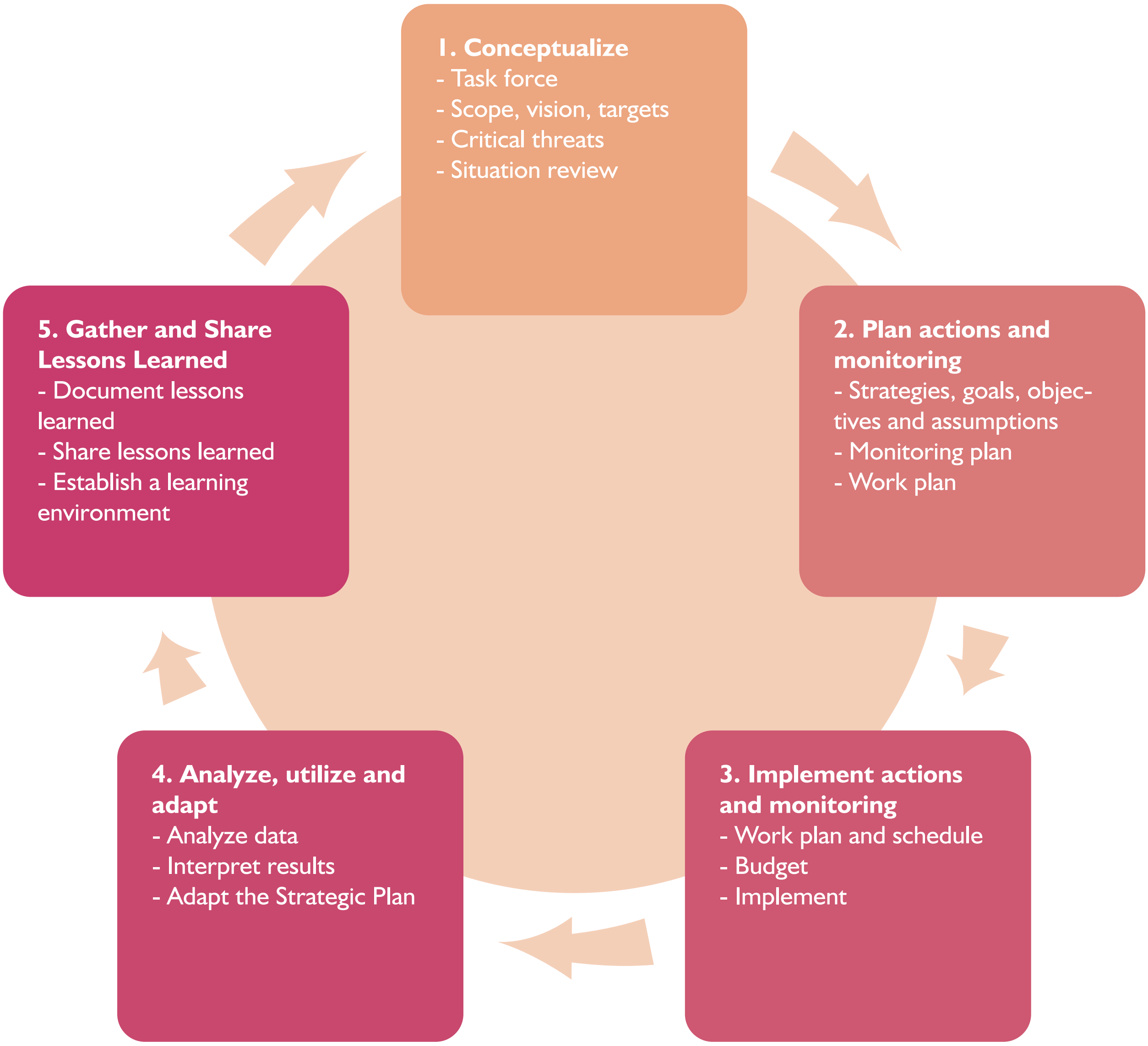
Multi dimensional – a system that includes more than one type of indicator.

Target – an element of biodiversity at a project site – which may be a species, habitat or environmental system, or ecological process – on which the project has chosen to focus (CMP, 2007).

Project – a set of activities implemented by a defined group of practitioners – including managers, researchers, community members, or other stakeholders – to meet certain goals and objectives (CMP, 2007).

Outcome – the products and services that are generated by a project, measured using an output indicator.

Appendix B
The Project Cycle



Appendix C

Standardized Classification – Threats

(adapted from Table 1 of Salafsky, et al, 2008)

Table 1. World Conservation Union–Conservation Measures Partnership (IUCN-CMP) classification of direct threats to biodiversity (version 1.1).

Threats	Definition
1. Residential and commercial development	Human settlements or other nonagricultural land uses with a substantial footprint
1.1 Housing and urban areas (urban areas, suburbs, villages, vacation homes, shopping areas, offices, schools, hospitals)	Human cities, towns, and settlements including non-housing development typically integrated with housing
1.2 Commercial and industrial areas (manufacturing plants, shopping centers, office parks, military bases, power plants, train and ship yards, airports)	Factories and other commercial centers
1.3 Tourism and recreation areas (ski areas, golf courses, beach resorts, cricket fields, county parks, campgrounds)	Tourism and recreation sites with a substantial footprint
2. Agriculture and aquaculture	Threats from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture, and aquaculture
2.1 Annual and perennial non-timber crops (farms, household swidden plots, plantations, orchards, vineyards, mixed agroforestry systems)	Crops planted for food, fodder, fiber, fuel, or other uses
2.2 Wood and pulp plantations (teak or eucalyptus plantations, silviculture, Christmas tree farms)	Stands of trees planted for timber or fiber outside of natural forests, often with non-native species
2.3 Livestock farming and ranching (cattle feed lots, dairy farms, cattle ranching ,chicken farms, goat, camel, or yak herding)	Domestic terrestrial animals raised in one location on farmed or nonlocal resources (farming); also domestic or semi-domesticated animals allowed to roam in the wild and supported by natural habitats (ranching)
2.4 Marine and freshwater aquaculture (shrimp or fin fish aquaculture, fish ponds on farms, hatchery salmon, seeded shellfish beds, artificial algal beds)	Aquatic animals raised in one location on farmed or nonlocal resources; also hatchery fish allowed to roam in the wild
3. Energy production and mining	Threats from production of non-biological resources
3.1 Oil and gas drilling (oil wells, deep sea natural gas drilling)	Exploring for, developing, and producing petroleum and other liquid hydrocarbons
3.2 Mining and quarrying (coal mines, alluvial gold panning, gold mines, rock quarries, coral mining, deep sea nodules, guano harvesting)	Exploring for, developing, and producing minerals and rocks
4. Transportation and service corridors	Threats from long, narrow transport corridors and the vehicles that use them including associated wildlife mortality
4.1 Roads and railroads (highways, secondary roads, logging roads, bridges and causeways, road kill, fencing associated with roads, railroads)	Surface transport on roadways and dedicated tracks
4.2 Utility and service lines (electrical and phone wires, aqueducts, oil and gas pipelines, electrocution of wildlife)	Transport of energy and resources

Threats	Definition
4.3 Shipping lanes (dredging, canals, shipping lanes, ships running into whales, wakes from cargo ships)	Transport on and in freshwater and ocean waterways
4.4 Flight paths (flight paths, jets impacting birds)	Air and space transport
5. Biological resource use	Threats from consumptive use of "wild" biological resources including deliberate and unintentional harvesting effects; also persecution or control of specific species
5.1 Hunting and collecting terrestrial animals (bushmeat hunting, trophy hunting, fur trapping, insect collecting, honey or bird nest hunting, predator control, pest control, persecution)	Killing or trapping terrestrial wild animals or animal products for commercial, recreation, subsistence, research or cultural purposes, or for control/persecution reasons; includes accidental mortality/bycatch
5.2 Gathering terrestrial plants (wild mushrooms, forage for stall fed animals, orchids, rattan, control of host plants to combat timber diseases)	Harvesting plants, fungi, and other non-timber/non-animal products for commercial, recreation, subsistence, research or cultural purposes, or for control reasons
5.3 Logging and wood harvesting (clear cutting of hardwoods, selective commercial logging of ironwood, pulp operations, fuel wood collection, charcoal production)	Harvesting trees and other woody vegetation for timber, fiber, or fuel
5.4 Fishing and harvesting aquatic resources (trawling, blast fishing, spear fishing, shellfish harvesting, whaling, seal hunting, turtle egg collection, live coral collection, seaweed collection)	Harvesting aquatic wild animals or plants for commercial, recreation, subsistence, research, or cultural purposes, or for control/persecution reasons; includes accidental mortality/by-catch
6. Human intrusions and disturbance	Threats from human activities that alter, destroy and disturb habitats and species associated with non-consumptive uses of biological resources
6.1 Recreational activities (off-road vehicles, motorboats, jet-skis, snowmobiles, ultralight planes, dive boats, whale watching, mountain bikes, hikers, birdwatchers, skiers, pets in rec areas, temporary campsites, caving, rock-climbing)	People spending time in nature or traveling in vehicles outside of established transport corridors, usually for recreational reasons
6.2 War, civil unrest and military exercises (armed conflict, mine fields, tanks and other military vehicles, training exercises and ranges, defoliation, munitions testing)	Actions by formal or paramilitary forces without a permanent footprint
6.3 Work and other activities (law enforcement, drug smugglers, illegal immigrants, species research, vandalism)	People spending time in or traveling in natural environments for reasons other than recreation or military activities
7. Natural system modifications	Threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare
7.1 Fire and fire suppression (fire suppression to protect homes, inappropriate fire management, escaped agricultural fires, arson, campfires, fires for hunting)	Suppression or increase in fire frequency and/or intensity outside of its natural range of variation
7.2 Dams and water management/uses (dam construction, dam operations, sediment control, change in salt regime, wetland filling for mosquito control, levees and dikes, surface water diversion, groundwater pumping, channelization, artificial lakes)	Changing water flow patterns from their natural range of variation either deliberately or as a result of other activities
7.3 Other ecosystem modifications (land reclamation projects, abandonment of managed lands, rip-rap along shoreline, mowing grass, tree thinning in parks, beach construction, removal of snags from streams)	Other actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare
8. Invasive and other problematic species and genes	Threats from non-native and native plants, animals, pathogens/microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance
8.1 Invasive non-native/alien species (feral cattle, household pets, zebra mussels, Dutchelm disease or chestnut blight, Miconia tree;) introduction of species for biocontrol, Chytrid fungus affecting amphibians outside of Africa)	Harmful plants, animals, pathogens and other microbes not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities
8.2 Problematic native species (overabundant native deer, overabundant algae due to loss of native grazing fish, native plants that hybridize with other plants, plague affecting rodents)	Harmful plants, animals, or pathogens and other microbes that are originally found within the ecosystem(s) in question, but havebecome "out of balance" or "released" directly or indirectly due to human activities

Threats	Definition
8.3 Introduced genetic material (pesticide resistant crops, hatchery salmon, restoration projects using nonlocal seed stock, genetically modified insects for biocontrol, genetically modified trees, genetically modified salmon)	Human-altered or transported organisms or genes
9. Pollution	Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources
9.1 Household sewage and urban waste water (discharge from municipal waste treatment plants, leaking septic systems, untreated sewage, outhouses, oil or sediment from roads, fertilizers and pesticides from lawns and golf-courses, road salt)	Water-borne sewage and nonpoint runoff from housing and urban areas that include nutrients, toxic chemicals and/or sediments
9.2 Industrial and military effluents (toxic chemicals from factories, illegal dumping of chemicals, mine tailings, arsenic from gold mining, leakage from fuel tanks, PCBs in river sediments)	Water-borne pollutants from industrial and military sources including mining, energy production, and other resource extraction industries that include nutrients, toxic chemicals and/or sediments
9.3 Agricultural and forestry effluents (nutrient loading from fertilizer runoff, herbicide runoff, manure from feedlots, nutrients from aquaculture, soil erosion)	Water-borne pollutants from agricultural, silivicultural, and aquaculture systems that include nutrients, toxic chemicals and/or sediments including the effects of these pollutants on the site where they are applied
9.4 Garbage and solid waste (municipal waste, litter from cars, flotsam and jetsam from recreational boats, waste that entangles wildlife, construction debris)	Rubbish and other solid materials including those that entangle wildlife
9.5 Air-borne pollutants (acid rain, smog from vehicle emissions, excess nitrogen deposition, radioactive fallout, wind dispersion of pollutants or sediments, smoke from forest fires or wood stoves)	Atmospheric pollutants from point and nonpoint source
9.6 Excess energy (noise from highways or airplanes, sonar from submarines that disturbs whales, heated water from power plants, lamps attracting insects, beach lights disorienting turtles, atmospheric radiation from ozone holes)	Inputs of heat, sound, or light that disturb wildlife or ecosystems
10. Geological events	Threats from catastrophic geological events
10.1 Volcanoes (eruptions, emissions of volcanic gasses)	Volcanic events
10.2 Earthquakes/tsunamis (earthquakes, tsunamis)	Earthquakes and associated events
10.3 Avalanches/landslides (avalanches, landslides, mudslides)	Avalanches or landslides
11. Climate change and severe weather	Long-term climatic changes that may be linked to global warming and other severe climatic or weather events outside the natural range of variation that could wipe out a vulnerable species or habitat
11.1 Habitat shifting and alteration (sea-level rise, desertification, tundra thawing, coral bleaching)	Major changes in habitat composition and location
11.2 Droughts (severe lack of rain, loss of surface water sources)	Periods in which rainfall falls below the normal range of variation
11.3 Temperature extremes (heat waves, cold spells, oceanic temperature changes, disappearance of glaciers/sea ice)	Periods in which temperatures exceed or go below the normal range of variation
11.4 Storms and flooding (thunderstorms, tropical storms, hurricanes, cyclones, tornados, hailstorms, ice storms or blizzards, dust storms, erosion of beaches	Extreme precipitation and/or wind events or major shifts in seasonality of storms

Appendix D

Standardized Classification – Conservation Interventions

(adapted from Table 2 of Salafsky, et al, 2008)

Table 2. World Conservation Union – Conservation Measures Partnership (IUCN-CMP) classification of conservation actions (version 1.1).

Conservation Actions	Definitions
1. Land/water protection	Actions to identify, establish or expand parks and other legally protected areas, and to protect resource rights
1.1 Site/area protection (national parks, town wildlife sanctuaries, private reserves, tribally owned hunting Grounds)	Establishing or expanding public or private parks, reserves, and other protected areas roughly equivalent to IUCN categories I-VI
1.2 Resource and habitat protection (easements, development rights, water rights, instream flow rights, wild and scenic river designation, securing resource rights)	Establishing protection or easements of some specific aspect of the resource on public or private lands outside of IUCN categories I-VI
2. Land/water management	Actions directed at conserving or restoring sites, habitats and the wider environment
2.1 Site/area management (site design, demarcating borders, putting up fences, training park staff, control of Poachers)	Management of protected areas and other resource lands for conservation
2.2 Invasive/problematic species control (cutting vines off trees, preventing ballast water discharge)	Eradicating, controlling and/or preventing invasive and/or other problematic plants, animals, and pathogens
2.3 Habitat and natural process restoration (creating forest corridors, prairie re-creation, riparian tree plantings, coral reef restoration, proscribed burns, breaching levees, dam removal, fish ladders, liming acid lakes, cleaning up oil spills)	Enhancing degraded or restoring missing habitats and ecosystem functions; dealing with pollution
3. Species management actions	Directed at managing or restoring species, focused on the species of concern itself
3.1 Species management (harvest management of wild mushrooms, culling buffalo to keep population size within park carrying capacity, controlling fishing effort)	Managing specific plant and animal populations of concern
3.2 Species recovery (manual pollination of trees, artificial nesting boxes, clutch manipulation, supplementary feeding, disease/parasite management)	Manipulating, enhancing or restoring specific plant and animal populations, vaccination programs
3.3 Species reintroduction (reintroduction of wolves)	Reintroducing species to places where they formally occurred or benign introductions
3.4 Ex situ conservation (captive breeding, artificial propagation, gene banking)	Protecting biodiversity out of its native habitats
4. Education and awareness	Actions directed at people to improve understanding and skills, and influence behavior
4.1 Formal education (public schools, colleges and universities, continuing education)	Enhancing knowledge and skills of students in a formal degree program

Conservation Actions	Definitions
4.2 Training (monitoring workshops or training courses in reserve design for park managers, learning networks or writing how-to manuals for project managers, stakeholder education on specific issues)	Enhancing knowledge, skills and information exchange for practitioners, stakeholders, and other relevant individuals in structured settings outside of degree programs
4.3 Awareness and communications (radio soap operas, environmental publishing, Web blogs, puppet shows, door-to-door canvassing, tree sitting, protest marches)	Raising environmental awareness and providing information through various media or through civil disobedience
5. Law and policy	Actions to develop, change, influence, and help implement formal legislation, regulations, and voluntary standards
5.1 Legislation (global: promoting conventions on (biodiversity, wildlife trade laws like CITES National: work for or against government laws such as the US Endangered Species Act, influencing legislative appropriations State/Provincial: state ballot initiatives, providing data to state policy makers, developing pollution permitting systems, dam relicensing Local: developing zoning regulations, countryside laws, species protection laws, hunting bans Tribal: creating tribal laws)	Making, implementing, changing, influencing, or providing input into formal government sector legislation or polices at all levels: international, national, state/provincial, local, tribal
5.2 Policies and regulations (input into agency plans regulating certain species or resources, working with local governments or communities to implement zoning regulations, promoting sustainable harvest on state forest lands)	Making, implementing, changing, influencing, or providing input into policies and regulations affecting the implementation of laws at all levels: international, national, state/provincial, local/community, tribal
5.3 Private sector standards and codes (Marine and Forest Stewardship Councils, Conservation Measures Partnership (CMP) Open Standards, corporate adoption of forestry best management practices, sustainable grazing by a rancher)	Setting, implementing, changing, influencing, or providing input into voluntary standards and professional codes that govern private sector practice
5.4 Compliance and enforcement (water quality standard monitoring, initiating criminal and civil litigation)	Monitoring and enforcing compliance with laws, policies and regulations, and standards and codes at all levels
6. Livelihood, economic and other Incentives	Actions to use economic and other incentives to influence behavior
6.1 Linked enterprises and livelihood Alternatives (ecotourism, non-timber forest product harvesting, harvesting wild salmon to create value for wild population)	Developing enterprises that directly depend on the maintenance of natural resources or provide substitute livelihoods as a means of changing behaviors and attitudes
6.2 Substitution (Viagra for rhino horn, farmed salmon as a replacement for pressure on wild populations, promoting recycling and use of recycled materials)	Promoting alternative products and services that substitute for environmentally damaging ones
6.3 Market forces (certification, positive incentives, boycotts, negative incentives, grass and forest banking, valuation of ecosystem services such as flood control)	Using market mechanisms to change behaviors and attitudes
6.4 Conservation payments (quid-pro-quo performance payments, resource tenure incentives)	Using direct or indirect payments to change behaviors and attitudes
6.5 Nonmonetary values (spiritual, cultural, links to human health)	Using intangible values to change behaviors and attitudes
7. External capacity building	Actions to build the infrastructure to do better conservation
7.1 Institutional and civil society development (creating new local land trusts, providing circuit riders to help develop organizational capacity)	Creating or providing nonfinancial support and capacity building for nonprofits, government agencies, communities, and for-profits
7.2 Alliance and partnership development (country networks, Conservation Measures Partnership (CMP)	Forming and facilitating partnerships, alliances, and networks of organizations
7.3 Conservation finance (private foundations, debt-for-nature swaps)	Raising and providing funds for conservation work

Annex E

Threat Reduction Index – TRI

The steps to complete the worksheet for calculating the Threat Reduction Index (TRI) are:

1. Develop a list of all direct threats. In the worksheet in the column entitled Threats, enter the names of the identified threats using the terminology of Annex C.

2. Define measurement protocols that determine the meaning of each score for each threat. Register your definition of each threat in a protocol sheet (below). Keep this information for use in step 7.

Values for the SURFACE of the threat: scores of 1-5 - determine what each score means as a percentage of area affected by the threat in relation to the total area of the PA. You can set ranges that can be used in all areas of an Environmental Fund or for each individual area.

5 - Very High

It is likely that the threat is very widely distributed or its scope is pervasive and affects all locations of the protected area.

4 - High

Threat is likely to have a wide reach and affect many of the locations of the protected area.

3 - Medium

Threat is likely to have a local scope and affect some of the locations in the protected area.

2 - Low

Threat is likely to have a limited local reach and affect a limited portion of the ecosystem locations in the protected area.

1 - Very low

Threat is likely to have a very limited local reach and affect a very small portion of the ecosystem locations in the protected area.

Determine for each area what the SURFACE scores mean:

Scores	Impact category or severity	Annual affected area (% of the total area)
1	Very low	
2	Low	
3	Medium	
4	High	
5	Very High	

<u>Values for the INTENSITY of the threat</u>: Scores of 1-5 - determine what each score means in terms of power of deterioration of the threat, directly related to the impact it has on the functioning of the ecosystem.

5 - Very High

Is likely that the threat will destroy or eliminate the ecosystem in a portion of its distribution within the protected area

4 - High

It is likely that the threat seriously deteriorates the ecosystem in a portion of its distribution within the protected area

3 - Medium

It is likely that the threat mildly deteriorates the ecosystem in a portion of its distribution within the protected area

2 - Low

It is likely that the threat will only slightly deteriorate the ecosystem in a portion of its distribution within the protected area

1 - Very low

It is likely that the threat will not exert significant deterioration to the ecosystem within the protected area

<u>Values for the PERMANENCE of the threat:</u> scores of 1-5 - select the estimated period of time in which the threat will persist

5 - Very High

The threat will remain for a relatively long time (> 5 years)

4 - High

The threat will remain for a relatively short time (<5 years)

3 - Medium

The threat will remain for a short period of time (<3 years)

2 - Low

The threat will remain for a very short time (<2 years)

1 - Very low

The threat will remain for a very short period of time (months)

3. Rank each threat to the protected area in terms of Surface. In the column **Surface**, indicate the score of 1-5 according to the protocol. Each threat gets its score independently of the other threats that affect the area.

4. Rank each threat in terms of Intensity. In the column **Intensity,** indicate the current score of 1-5 according to the protocol. Each threat gets its score independently of the other threats that affect the area.

5. Rank each threat in terms of Permanence. Similarly to the above, carry out the ranking in terms of **permanence**, indicating the score of 1-5 according to the protocol. Each threat gets its score independently of the other threats that affect the area.

6. MULTIPLY the scores to obtain the ranking. For each threat, multiply the numbers of the three columns: **Surface**, **Intensity** and **Permanence**. Enter the total in column **Ranking**. Add these numbers and enter the total at the bottom of the column.

7. CALCULATE the rate of reduction of each threat. In the column named % of Threat Reduction in the Period, calculate the percentage of reduction made for each of the threats by comparing the difference in scores in year 1 and year 2.

Keep in mind that there is no Total for this column, since each number stands on its own as a measure of the degree to which each threat, which has been individually assessed, has been reduced.

8. Calculate the Threat Reduction Index (TRI) of the protected area by dividing the total reduction scores by the total score in year 1.

Threats	Criteria (1 - 5)								% of Threat Reduction in the Period	Total Reduction
	Year 1				Year 2					
	Surface	Intensity	Permanence	Ranking	Surface	Intensity	Permanence	Ranking		
Threat 1	3	3	2	**18**	2	3	1	**6**	67%	**12**
Threat 2	4	5	4	**80**	4	5	4	**80**	0%	**0**
Threat 3	3	3	3	**27**	1	3	3	**9**	67%	**18**
Threat 4	4	5	1	**20**	2	5	1	**10**	50%	**10**
Threat x	5	5	5	**125**	5	5	5	**125**	0%	**0**
			Total	**270**				**230**		**40**
Threat Reduction Index (TRI) of the Protected Area										**14,81%**

The TRI in this example is calculated by dividing the total reduction that was 40 points (270 in year 1 and 240 in year 2 = 40) by the total ranking score in year 1 (baseline) - 40 / 270 = 0.1481 or 14.81% reduction for the protected area.

Annex F

Variation of Indicator Species

The steps to complete a worksheet to calculate the variation of Indicator Species are as follows (see example below):

1. Selecting indicator species to better indicate the status of conservation targets in PAs, in consultation with partners in the field (biologists, ecologists, etc). The best indicators are the following:

- Easily measured in quantitative or qualitative terms
- Precisely defined
- Consistent over time
- Sensitive to slight changes

2. Register a relative density of each species at the moment of each measurement according to the number of indicator species, always using the same counting method in all measurements (Year 1 and Year 2).

3. Calculate the % of change compared with the previous period (baseline) and write down the result in the specified column.

TABLE FOR THE CALCULATION OF SPECIES VARIATION

Indicator Species	Relative Density Observed*	% Difference between Year 1 and Year 2
Specie 1		
Year 1	15	-13,33%
Year 2	13	
Specie x		
Year 1	4	100,00%
Year 2	8	

* The absolute density gives the number of individuals per area unit, while the relative density measures the number of individuals for a sample unit not directly related to the area. When defining a unit to express density area, you are faced with a very important decision in both biological and statistical terms: variability. Because counting the entire population of a species is impractical for operational reasons and because of its high cost, it is necessary to use estimates of the average density and its variance. These are obtained through sampling, which is the counting of individuals in a subset of units in the distribution area of the population (the sample). The methodologies for the study of wildlife populations are not addressed in this document. It is assumed that EF's partners that work with species monitoring on the ground are familiar with sampling techniques and with the calculation of relative density.

Annex G - Summary Sheet

Monitoring Impact on Conservation - PROTECTED AREA

The steps to complete a Summary Sheet on Impact Monitoring in Conservation - PROTECTED AREA are as follows (see example below):

1. Complete the basic information about the Protected Area where you are working. It is recommended to include a brief narrative about the context of the area and any other relevant observations.

Suggested information:

- Name of Protected Area:
- Size (hectares):
- Annual investment made by the Environmental Fund:
- Investment of the EF as the % of the total annual budget of PA (if available):
- Threats observed (using terminology of Appendix C) that the investment seeks to mitigate or reduce:
- Date of report:
- Period covered: from xx / xx / xxxx to xx / xx / xxxx
- Final score of impact on biodiversity of the protected area during this period:
- Change in final score since the previous measurement period:
- The protected area covers ecosystems underrepresented in the national system?

2. Determine protocols for classifying changes in a final ranking of 1 to 5. For each of the three types of results – Threat Reduction, Species Variation and Coverage Change - classification criteria must be established.

Example of classification criteria for the final ranking:

Ranking for Threat Reduction	
1	Threats were not reduced
2	Reduced until 10%
3	Reduced from 10 to 20%
4	Reduced from 20 to 50%
5	Reduced more than 50%

Ranking of Species Variation	
1	Negative change (population reduction)
2	No change
3	Positive change (increase) of less than 10%
4	Positive change of more than 10%
5	Positive change of more than 100%

Ranking of Coverage Loss	
1	Loss over 50%
2	Loss from 25 to 50%
3	Loss from 10 to 25%
4	Loss up to 10%
5	No loss

3. Transfer the results of changes in Threats, Species and Coverage to the final table in the Changes column.

4. Determine a score of 1-5 for each change by evaluating the achieved change against the criteria defined in section 2.

5. Average the scores in order to achieve a Final Score for the PA.

FINAL TABLE - IMPACT MONITORING IN CONSERVATION - PROTECTED AREA

Indexes of the Protected Area			
Indexes	Change	Observations*	Ranking (1 to 5)
THREATS	15,93%		3
SPECIE 1	-13,33%		1
SPECIE x	100,00%		4
COVERAGE	0,00%		5
		Final Score PA	**3,25**

* Topics such as abnormal weather conditions, natural disasters, catalytic events, or reasons for not having the information, among others.

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Case Study

Monitoring Biodiversity In Alto Chagres

The FOUNDATION FOR THE CONSERVATION OF NATURAL RESOURCES, NATURA, is a non-profit organization legally incorporated on March 21, 1991, with broad experience in the administration of national and international funds geared for environmental programs, plans, and projects that develop civil society as well as governmental organizations, either independently or in coordination with other entities. Natura has equally worked on strengthening these organizations and institutions, both from the point of view of institutional development and for technical aspects of execution, and currently runs the Panama`s Ecological Trust Fund (FIDECO), the Chagres National Park Conservation Fund (Chagres Fund), and the Darien National Park Conservation Fund (Darien Fund).

The Chagres National Park Conservation Fund (Chagres Fund) is a national environmental fund created by virtue of the Park Conservation Agreement, subscribed in 2003 between the National Government of the Panama Republic, The Nature Conservancy (TNC), and the NATURA Foundation.

Chagres Fund resources come from the first Debt-for-Nature Swap formalized by the country on July 10, 2003, in a 10 million dollar amount for which the equivalent Panamanian foreign debt was bought off by the Government of the United States, with input from the TNC, in the framework of the Tropical Forest Conservation Act, established in the US on July 29, 1998, with Congress approved amendment N. 105-214.

The Chagres Fund contributes to the conservation, maintenance, and restoration of forest in Chagres National Park (PNCh) and its buffer zone, extending 5 kilometers into the Park's adjacent areas, by means of funding the National Park's management programs and environmental initiatives carried out by non-profit organizations in accordance with the Park's Management Plan.

For the Fund's Biodiversity Monitoring component, the eight (8) conservation objects defined in two (2) previous planning processes — the Alto Chagres Conservation Plan[1] and the Chagres National Park Management Plan[2] — were reviewed, and it was also based on the technical experience generated during the *Parque en Peligro* Project's conservation actions. Five (5) conservation objects were selected, and ecological attributes were defined under size, condition and landscape categories.

The objects of conservation include the jaguar, the harpy eagle, the semi-deciduous forest, the lotic ecosystem, and the cloud forest; and to assess the status of each object of conservation a total of eleven (11) biological indicators were identified.

The process of prioritizing indicators was based on the outcome of feasibility analyses, situational threats, and strategies where cost-benefit analyses were made. The monitoring period started in 2006 and is done for some indicators in the dry season and in the rainy season, and, for others, in one of the seasons, for instance, aquatic insects from the benthos show up in the early rainy season.

The biological indicators being monitored are the abundance of jaguar and harpy eagle prey, the number of hunted down jaguars, the density of jaguars, the number of amphibian species, the number of bat species, the number of aquatic insect families, the forest coverage, and the number of orchid bee species, as started in 2009.

Among the findings this far, the following ought to be mentioned:

- Cloud Forest:

These forests comprise the high biodiversity sectors of Cerro Brewster, Cerro Bruja, Cerro Jefe, and Cerro Azul, particularly with endemic species and as a protection area for headwaters, among others, and the *Number of Amphibian Species in Canyons* indicator is used to measure the condition of a cloud forest by means of the composition of amphibian species.

According to the 2006-2010 censuses, by means of approximately 200 x 1m transects along selected canyons in the cloud forests at heights ≥ 600 masl, the trend points at an increasing wealth of amphibian species in the monitored region.

The Ecologic Feasibility Analysis for the *Number of Amphibian Species in Canyons* indicator complies with the following considerations:

Indicator	Pondering the Indicator according to the Number of Species				Indicator current status	Desired qualification
	Poor	Regular	Good	Very Good		
Number of Amphibian Species in Canyons if	≤17 spp	18-22 spp	23-26 spp	≥27 spp	Good	Very Good

During the three monitoring periods (2006-2008, 2009 and 2010), results of the Ecologic Feasibility Analysis qualified the conservation status of Cerro Brewster site as Very Good-Good. The Cerro Jefe and Cerro Azul sites presented two the lowest values concerning their conservation status, whereas Cerro Jefe was qualified as Regular-Poor, and Cerro Azul was rated as the only site that presented Poor values throughout the monitoring periods.

[1] Candanedo, et al. 2003
[2] ANAM, 2005

- Relative density of the jaguar population (individuals per 100km^2)

Jaguar density represents the number of jaguars occupying a certain area and, in Alto Chagres, that has been estimated by employing the camera-trap method. The information thus obtained is then analyzed by a population size estimating program (CAPTURE).

The cameras enable an assessment of the minimum activity area for some individuals that have been photographed and the estimated density is obtained by **dividing the number of jaguars (abundance) within the effective sampling area** (Wilson y Anderson 1985).

- Rio Piedras: In 2009, a pilot sampling of this southeast sector of Alto Chagres reflected five photo-identified jaguars, and in 2010, they were down to four. The number of jaguars per 100 km^2, or jaguar density, was estimated in 2010 at 6.02 jaguars/100km^2. This number falls within the Regular range, according to the conservation status indicator, whereby the upper limit of that category is near the Good condition.
- La Llana: The survey was conducted in 2006 and 2008. In the pilot study conducted during the first year (2006-2007), two jaguars were photo-identified, and the same result was achieved in 2007 and 2008. The number of jaguars/100km^2 (density) was estimated at 3 for 2007 and 2008, considering the conservation status of the jaguar determined for both years as Poor. In this sector, jaguar condition is that of a severely threatened species.

- Relative abundance of jaguar prey

This is a jaguar conservation status indicator that informs on food availability for this cat and, indirectly, on poaching effects upon ecosystem ecological integrity as well as on deforestation effects upon jaguar. The availability of forest mammals is established by their abundance. The reduction or disappearance of these prey species, such as the white-lipped peccary (*Tayassu pecari*), collared peccary (*Pecari tajacu*), red brocket (*Mazama americana*), mountain paca (*Cuniculus paca*), and Central American agouti (*Dasyprocta punctata*), among others, is potentially the main reason of jaguar displacement to cattle raising areas in search for food.

- La Llana: the main jaguar prey species have been identified as collared peccary (*Pecari tajacu*), red brocket (*Mazama americana*), mountain paca (*Cuniculus paca*), and Central American agouti (*Dasyprocta punctata*), among other earthbound and tree-dwelling frugivores. The relative abundance index (indic/km) of these prey in this sector is obtained in 206, 2007, and 2008, except for the Central American agouti (*Dasyprocta punctata*).
    - From 2006 to 2008, the collared peccary shows a reduced relative abundance index (0.78-0.35) whereas it increased for the mountain paca (0.13-0.27).
    - The red brocket showed an increased relative abundance index in 2006-2007 and a reduced index in 2008.
- Río Piedra: jaguar prey indicator starts to be measured in this sector in 2009, whereby the Central American agouti (*Dasyprocta punctata*), the red brocket (*Mazama americana*), and the mountain paca (*Cuniculus paca*) present a Regular condition. The latter two fall within the lower range, close to Poor, whereas the Central American agouti is in the upper range, closer to Good.

The availability of jaguar prey species may be affected in the survey area, first because of the local deletion of important prey (*Tayassu pecari*) a couple of decades ago; then, because of poaching pressure on the prey species, which still persist in the area, and because of changes to their habitat. Importantly enough, the prey under analysis here are also available to other carnivores (*Puma concolor* and *Leopardus pardalis*).

- Relative abundance of harpy eagle prey:

This is an indicator of threat to and of status of the object of conservation, represented by the relative abundance parameter of primates such as the mantled howler monkey (*Alouatta palliata*) and the brown-throated two- and three-toed sloths (*Choloepus hoffmanni* and *Bradypus variegatus*, respectively), which stand among harpy eagle's main prey in Panama and in other sites of the Neotropic. This indicator reflects tree-dwelling prey availability for the harpy eagle, and the loss of forest coverage because of cattle raising or other activities would affect the prey because of their tree-borne nature.

These three harpy eagle preferred prey species were recorded in Alto Chagres (La Llana – Santo Domingo, Rio Piedra) in the 2006-2010 studies.

In la Llana (2007), it was established that the primate group is in Regular to Good condition, and, as a group, they offer good availability as prey species to the harpy eagle. Within the group, the bigger size species, such as the mantled howler monkey, the black-handed spider monkey (*A. geoffroyi*), the Panamanian night monkey (*Aotus zonalis*), the white-throated capuchin (*Cebus capucinus*), and the Geoffroy's marmoset (*Saguinus geoffroyi*) do not appear to be submitted to strong poaching pressure, and this is why their availability as prey is likely to remain in the mid run.

Other tree-dwelling species that have been observed are the squirrels (*Sciurus* and *Microsciurus*), the sloths (*Choloepus*), and anteaters (*tamandua*), which could eventually be incorporated in the eagle's diet, thereby increasing the availability of different types of prey.

In general, the primates appear to be in Regular-Good condition in the survey area, possibly due to the good status of the La Llana forest coverage and the low poaching pressure.

> **"The Chagres Fund contributes to the conservation, maintenance, and restoration of forest in Chagres National Park (PNCh) and its buffer zone"**

- Number and abundance of bat species in the Cerro Azul and Cerro Jefe cloud forest, Chagres National Park: This area is located towards the south of the Park and is a higher altitude zone within this protected area (1.077 masl). The area shown in Cerro Azul is composed of secondary forest located in the vicinities of natural El Patriarca and Romeo & Julieta trails. The purpose of this 2010 study is to learn the diversity status of bats, and also to determine the functionality of the ecosystem and the threats to biodiversity.

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Case Study

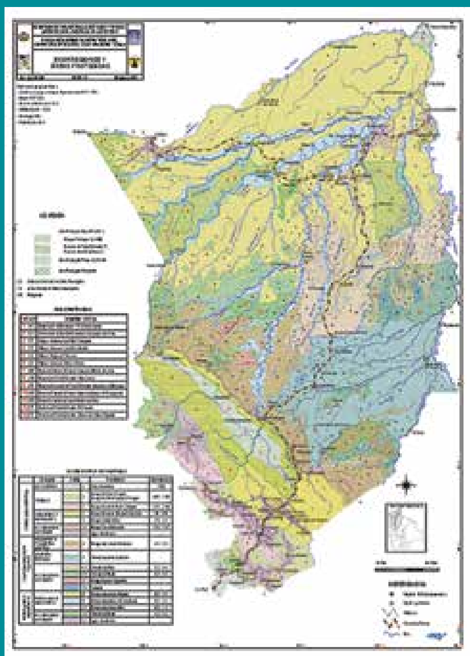
CLMA FUNDESNAP Monitoring

Brief description of FUNDESNAP

FUNDESNAP is the Bolivian Environmental Fund. It was established in 2000 to support the National System of Protected Areas (SNAP), which integrates protected areas and their buffer zones at the national, department, municipal, and community levels. Initially, FUNDESNAP was established with funds coming from the UK, Switzerland, the PL-480 and the GEF. At the same time, since the very beginning the Fund has been diversifying its financial basis with new sources of funding, through financial mechanisms, and developing extensive experience in capacity building for overall management of protected areas and their buffer zones.

Based on the general experience of supporting the Pilón Lajas (since 2002)and Madidi (since, 2005, including the Monito Lucachi Trust Fund) protected areas, FUNDESNAP has been developing a more concrete protected areas experience which geographically includes the National Protected Areas of Madidi, Pilón Lajas, and Manuripi in Northern

Chart 1: Ecoregions and Protected Areas



Source: ABC & DHV 2006: Strategic Environmental Evaluation of the North Corridor.

Bolivia, and thematically focuses on social environmental impact monitoring and mitigating mechanisms for highway construction and improvement works in the context of an initiative funded by CEPF, AVINA and other partners.

By means of a component implemented directly by FUNDESNAP to further the social, environmental, and financial management capacity of the different players involved in the three protected areas as well as by means of a set of four sub-donations to social organizations, social environmental monitoring tools have been designed and established and are currently being implemented in a joint effort by the local Environmental Monitoring Committees of two highways and their relevant protected areas: Pilón Lajas and Madidi.

Methodology to define indicators

Social environmental monitoring mechanisms have been conceived as a way to strengthen and complement institutionalized mechanisms for prevention, control, mitigation, and supervision available to Bolivian governmental authorities and in the context of safeguard policies established by the World Bank (WB), Inter-American Development Bank (IDB), and other entities funding the construction of highway infrastructure. Environmental Monitoring Committees were designed at a local level after a process of conceptual analysis of alternatives to social environmental monitoring mechanisms from the place developed by FUNDESNAP with the Deputy Minister for the Environment (VMA), the National Service of Protected Areas (SERNAP), the Bolivian Highway Administration (ABC), and other entities, and as a response to new challenges put forth by the Political Constitution of the State in 2009 about the implementation of social control mechanisms for infrastructure and development projects in the country.

Along these lines, in March 2011 two Environmental Monitoring Committees were formed locally with the participation of Madidi and Pilón Lajas residents, municipal governments, indigenous and intercultural organizations, in order to establish complementary monitoring mechanisms to generate up-to-date technical information on the social environmental situation of the protected areas under the influence of the North Corridor highway infrastructure works from the perspective of local players and thus be able to offer feedback for the prevention and mitigation measures raised for the works, as well as protection and monitoring measures offered by the protected areas.

Table 1: Composition of Environmental Monitoring Committees at the local level

Highway section	Composition of the local Environment Monitoring Committee
Yucumo – Rurrenabaque	Regional Council of Tsimane Mosetene (CRTM) Indigenous Peoples Center of La Paz (CPILAP) Federation of Yucumo Agroecological Producers (FEPAY) Federation of Yucumo Agroecological Women Producers (FEMAY) Federation of Rurrenabaque Agroecological Peasants (FECAR) Autonomous Municipal Government of Rurrenabaque Autonomous Municipal Government of San Borja Municipal District of Yucumo Protected Areas of Pilón Lajas
San Buenaventura – Ixiamas	Indigenous Council of the Takana People (CIPTA) Indigenous Council of the Takana Women (CIMTA) Federation of Indigenous Peoples of La Paz (CPILAP) Federation of Agroecological Producers of Abel Iturralde (FESPAI) Federation of Agroecological Women Producers of Abel Iturralde (FESMAI) Autonomous Municipal Government of San Buenaventura Autonomous Municipal Government of Ixiamas Protected Areas of Madidi

Source: CEPF FUNDESNAP, 2011.

Monitoring indicators have been identified in a knowledge exchange process between the local Environmental Monitoring Committee and the academy (Ecology Institute of the Universidad Mayor de San Andrés, La Paz). Technically speaking, we started from an analysis of documents such as Management Plans for the protected areas (particularly the Protection and Management Programs) and the environmental management tools for the highway infrastructure in the Pilón Lajas and Madidi area of influence (EEIA, EAE, PPM-PASA, and so on). In a series of knowledge exchange workshops, in combination with back office and field work support (reconnoitering, baseline assessment, and highway monitoring), the potential environmental, social, and economic impacts from the highway construction work were assessed. In response to those impacts, the most important aspects were prioritized, and indicators and tools for data collection, processing and analysis were identified.

Table 2: Monitoring Indicators for Highway construction and operation phases

Construction Phase	Indicators
Construction / Improvement until 2013	1. Families reporting changes to water quality. 2. Families reporting difficulties to access water sources for their daily activities (domestic and productive). 3. Families reporting difficulties with changes to the natural course of rivers and water streams. 4. Families reporting changes to their daily activities. 5. Families reporting changes to their customs, traditional activities and/or deep rooted beliefs. 6. Families reporting increasing timber and lumber activities along the highway. 7. Accidents. 8. Respiratory infections and cases of diarrhea.
Operation since 2013	1. Families reporting changes to their customs, traditional activities and/or deep rooted beliefs. 2. Families reporting changes to their traditional economic and/or productive activities. 3. Families reporting major difficulties to obtain species from the flora and faunda for use and/or consumption. 4. Families reporting increasing timber and lumber activities along the highway. 5. Families reporting cases o new community settlements and/or community centers in the vicinities of the highway. 6. A number of invasion or subdue cases in Original Community Land or protected areas. 7. Deforested areas per year and advancement of the agricultural frontier.

Source: Ecology Institute / UMSA & local Environmental Monitoring Committees, 2012.

This is the moment to make records of effects perceived at the onset of highway construction/improvement works by both protected area personnel and nearby communities. Patrols and rounds with protected area personnel and local Environmental Monitoring Committees enable the recording of visits to the protected areas (resource allocation activities, new settlements, pockets of heat, felled timber, water and air contamination, etc.).

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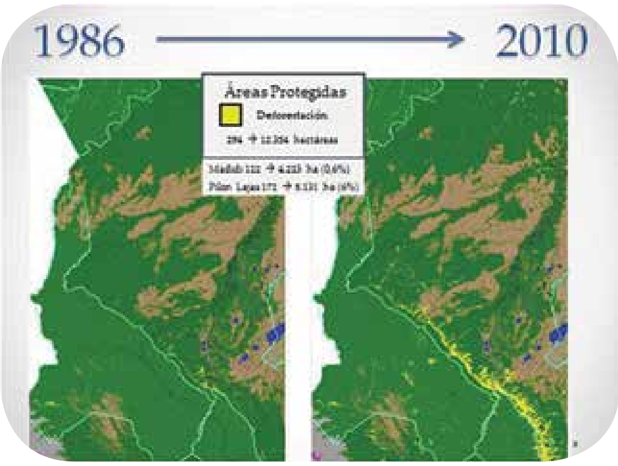
Biodiversity indicators are designed for the highway operation phase when construction work impacts will be felt. The focus of indicators, nevertheless, is still on monitoring the situation of threats or critical themes for biodiversity integrity, including issues such as deforestation. This monitoring will be complemented as protected areas protection and monitoring programs are put in place as the most concrete biodiversity control and surveillance tool for the protected areas and their buffer zones. In the framework of conservation monitoring programs handled by the National Service of Protected Areas (SERNAP), the main threats identified for the protected areas are: new human settlements; illegal exploitation of timber; poaching; agriculture (stock included); and fires ((Lilienfeld et al., 2004). Indicators managed for the protected areas are related with: crop surface, fallow land and secondary orchards (agricultural frontier); types of crops; production technologies; domestic species used; and stocking rate (Ibid.).

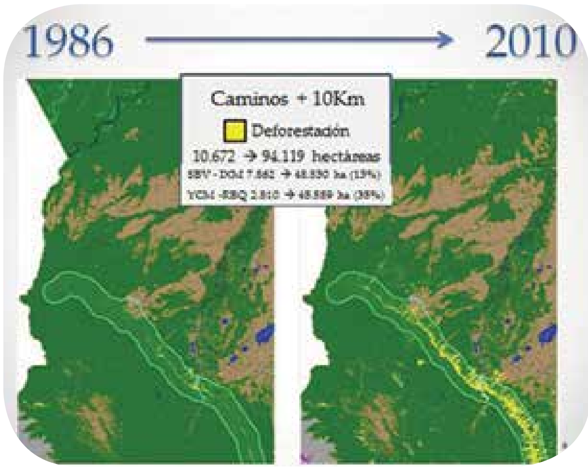
As a complement to the experience coordinated between protected area personnel and the local Environmental Monitoring Committees, through a partner in the portfolio of the Critical Ecosystem Partnership Fund (CEPF), annual information is being generated on deforestation until 2011.

Chart 2: Deforestation of Pilón Lajas and Madidi Protected Areas



Source: CI Bolivia 2011.

Chart 3: Deforestation in highway surroundings



Source: CI Bolivia 2011.

The way local Environmental Assessment Committees and protected area personnel work in our case is more focused on detecting immediate effects of highway construction works, in order to be able to intervene and suggest complementary prevention and mitigation measures to environmental authorities and reinforce park ranger protection activities in protected areas.

In that regard, local Environmental Assessment Committees have presented three complementary environmental follow-up reports to date concerning compliance with prevention and mitigation measures to the Deputy Minister of the Environment, SERNAP, the Bolivian Highway Administration, and the General Public Attorney.

Chart 4: Yucumo – Rurrenabaque Highway Complementary Social Environmental Follow-up Report

Source: CLMA Yucumo – Rurrenabaque with support from the Ecology Institute / UMSA and FUNDESNAP, 2012.

As a complement, two observation flights were made during the course of the project, one in early October 2010 and another one in late September 2012. We are currently systematizing the data generated this far, but a brief review of some types of indicators is under way for which we have data and that have generated relevant information for more robust environmental management of the Pilón Lajas and Madidi protected areas.

Table 3: Comparing the results of observation flights over the RB TCO Pilón Lajas

First Flight (05.10.2010)	Second Flight (29.09.2012)
Results	
Activity between SERNAP and CRTM. A total of 17 active pockets of heat have been identified within the RB TCO, as a result of burning Gran Chaco areas for planting, 10 of which are in the East sector between Yucumo and Rurrenabaque, and 7, in the South zone (Cascada and Sillar). A new pathway has been identified, apparently for forestry extraction, stretching from the Michel buildings along the line of the Pelado Mountains towards the West, branching off into the RB TCO. There has been evidence that, in the East/Southeast sector of the RB TCO, the impacts of agricultural activities performed by intercultural peoples are bigger, with 15 pockets of heat against none in the Central zone of the reservation in indigenous communities of the Quiquibey River banks, apart from extensive deforested zones in the highway sector versus minimum surfaces in the indigenous communities of the Quiquibey River.	Activity between SERNAP and CRTM. The Michel buildings pathway has not been changed, nor has it been further extended, since the intervention in the protected area after the first observation flight. The telephone aerials pathway on the Pilón range, equally paralyzed to comply with the administrative process brought by the protected area against the Municipal Government of San Borja. Three pockets of heat in the South zone (Villa Tunari, Boquerón, and Michel buildings). In the Central and Western zones of the RB TCO, no problem has been identified. In the Yucumo – Rurrenabaque road, pockets of heat have been identified by the Río Hondo and San José communities.

Source: CEPF FUNDESNAP CRTM sub-project Final Report (prepared by Juan Carlos Miranda, 2012).

A specific theme for a more robust coordination of highway construction monitoring activities of the Pilón Lajas protected area that needs to be monitored is flow rate assessment, particularly considering the importance of conserving this protected area for the provision of water to the municipalities of San Borja, Rurrenabaque, and Reyes.

Table 4: Assessment and Monitoring RB TCO Pilón Lajas Flow Rates

			Coordinates		Date		Date	Date		
	Name of River	Time	X	Y	11/06/12	Time	08/08/12	09/08/12	DIFF Flow Rate	DIFF %
1	Arroyo la Herradura	11:45	675246	8394610	0.277	16:30	0.023		0.254	91.70
2	Arroyo la Asunta	12:15	679407	8393939	0.623	17:30	0.261		0.362	58.11
3	Rio Colorado	15:30	696512	8349666	0.632	08:00		0.417	0.215	34.02
4	Arroyo Siquili afluente Yacumita	17:25	704082	8334738	0.233	10:10		0.118	0.115	49.36
5	Rio Caripo	18:00	708355	8329591	0.407	10:45		0.201	0.206	50.61
6	Arroyo Aguas Claras	18:35	710944	8322828	0.665	11:25		0.623	0.042	6.32
7	Rio Yucumo	19:00	710987	8322892	0.606	11:40		0.343	0.263	43.40
8	Rio Piedras blancas	11:40				14:45		0.266		
9	Rio Cauchal	15:45				15:45		0.992		
					3.443		0.28	2.96		

Source: CEPF FUNDESNAP (prepared by Jaime Villanueva, 2012).

For activities like these, an exchange of knowledge has been established between the Ecology Institute / UMSA and the local Environmental Assessment Committees with more focused capacities, i.e., with the Hydraulics and Hydrology Institute of the same UMSA for the issue of assessing flow rates and the management of loan banks that, in one case, significantly affected one of the rivers in that zone. Based on this experience and on this constellation of players, we considered that a highly effective way to generate capacities, even more than workshops or other formal capacity building efforts, is hands-on practice together with monitoring visits with input from the different priority themes.

Finally, in the framework of the same project in early 2011, FUNDESNAP implemented the Management Effectiveness Tracking Tool (METT) in three national and two municipal protected areas. Designed by Stolton et al. (2007) for the WWF and the World Bank, this tool is part of the WB's monitoring kit to measure the Catalyzing of Protected Area System Sustainability and enables identification and valuation of themes such as threats to and management tools for protected areas. It is located along the lines of other macro tools, applied by the National Service of Protected Areas at different moments of their mandate, such as Measuring the Effectiveness of Managing the National System of Protected Areas (MEMS) being implemented until 2007/2008, and Measuring the Effectiveness of Performance (MED), which is under way now. In late 2012, the following measurement of the METT for the three national protected areas and the three municipal ones will be made.

In short, if we place the various components of this monitoring system between the local Environmental Assessment Committees and the protected area personnel among the effect (threat reduction) and impact (condition of focal conservation objects) indicators, FUNDESNAP is focusing and steering the task of monitoring the impacts of their contribution to the protected areas in Bolivia with effect indicators to enable development of new or complementary activities in an attempt to reduce the threats detected by the monitoring effort.

Monitoring periodicity and Investment Costs

The first visits of the local Environmental Assessment Committees in the highway sections, whenever in the area of influence of the protected areas, were carried out in mid 2011. Since then, various follow-up activities have taken place virtually every quarter, and the second measurement of all indicators offered through knowledge exchange in the highway construction/improvement phase is currently being prepared.

Chart 5: METT tool application for the RB TCO Pilón Lajas in 2011

RB TCO Pilón Lajas (16.03.2011)				
Protected Areas Threats: Data Sheet 2				
Please tick all relevant existing threats as either of high, medium or low significance. Threats ranked as of high significance are those which are seriously degrading values; medium are those threats having some negative impact and those characterised as low are threats which are present but not seriously impacting values or N/A where the threat is not present or not applicable in the protected area.				
1. Residential and commercial development within a protected area				
Threats from human settlements or other non-agricultural land uses with a substantial footprint				
High	Medium	Low	N/A	
		X		1.1 Housing and settlement
			X	1.2 Commercial and industrial areas
	X			1.3 Tourism and recreation infrastructure
2. Agriculture and aquaculture within a protected area				
Threats from farming and grazing as a result of agricultural expansion and intensification, including silviculture, mariculture and aquaculture				
High	Medium	Low	N/A	
	X			2.1 Annual and perennial non-timber crop cultivation
			X	2.1.1 Drug cultivation
			X	2.2 Wood and pulp plantations
			X	2.3 Livestock farming and grazing
			X	2.4 Marine and freshwater aquaculture
3. Energy production and mining within a protected area				
Threats from production of non-biological resources				
High	Medium	Low	N/A	
		X		3.1 Oil and gas drilling
		X		3.2 Mining and quarrying
			X	3.3 Energy generation, including from hydropower dams
4. Transportation and service corridors within a protected area				
Threats from long narrow transport corridors and the vehicles that use them including associated wildlife mortality				
High	Medium	Low	N/A	
X				4.1 Roads and railroads (include road-killed animals)
		X		4.2 Utility and service lines (e.g. electricity cables, telephone lines,)
		X		4.3 Shipping lanes and canals
			X	4.4 Flight paths
5. Biological resource use and harm within a protected area				
Threats from consumptive use of "wild" biological resources including both deliberate and unintentional harvesting effects; also persecution or control of specific species (note this includes hunting and killing of animals)				
High	Medium	Low	N/A	
	X			5.1 Hunting, killing and collecting terrestrial animals (including killing of animals as a result of human/wildlife conflict)
		X		5.2 Gathering terrestrial plants or plant products (non-timber)
	X			5.3 Logging and wood harvesting
	X			5.4 Fishing, killing and harvesting aquatic resources
6. Human intrusions and disturbance within a protected area				
Threats from human activities that alter, destroy or disturb habitats and species associated with non-consumptive uses of biological resources				
High	Medium	Low	N/A	
	X			6.1 Recreational activities and tourism
			X	6.2 War, civil unrest and military exercises
		X		6.3 Research, education and other work-related activities in protected areas
			X	6.4 Activities of protected area managers (e.g. construction or vehicle use, artificial watering points and dams)
			X	6.5 Deliberate vandalism, destructive activities or threats to protected area staff and visitors

Source: CRTM 2012.

The knowledge exchange process between the local Environmental Assessment Committees and the Ecology Institute of the Universidad Mayor de San Andrés has implied a 75,000 USD investment. Each monitoring visit or work meeting of the local Environmental Assessment Committee requires investments between 250 and 400 USD. These amounts are further increased by the coordination and follow-up expenditures from FUNDESNAP just like a complementary process of generating capacity of nearly 40,000 USD and the other sub-donations that have partly contributed to this process.

Results Achieved

To date, the local Committees for Environmental Monitoring have presented three complementary social environmental follow-up reports to the Deputy Minister for the Environment, SERNAP, and ABC. This information is enhanced by monitoring reports and personnel patrols of the protected areas, just as with specific reports about the different priority themes, p.e. assessment of flow rates, third parties loans bank for management.

Main challenges and success factors

The monitoring activities held this far keep up with the implementation phase of the highway construction works as they provide follow-up to the threats that have prompted the works (i.e., changes to water flow rates, loans bank management, etc.). Once the works have been finished and the highways start to operate, the impacts are soon to be felt upon biodiversity as well as upon the social, cultural and economic situation (i.e. deforestation, degradation of ecosystems, new settlements, new production patterns). In the same exchange of knowledge, the tools to proceed with the highway operation phase have already been developed.

Since both the environmental standard in Bolivia and the safeguard policies do not provide specific and concrete environmental management measures for the specific monitoring of effects, such as highways after construction/ improvement works are finished, the main challenge is to ensure the conditions for proper and effective social environmental management on the part of protected areas and municipal governments in coordination with local Environmental Assessment Committees.

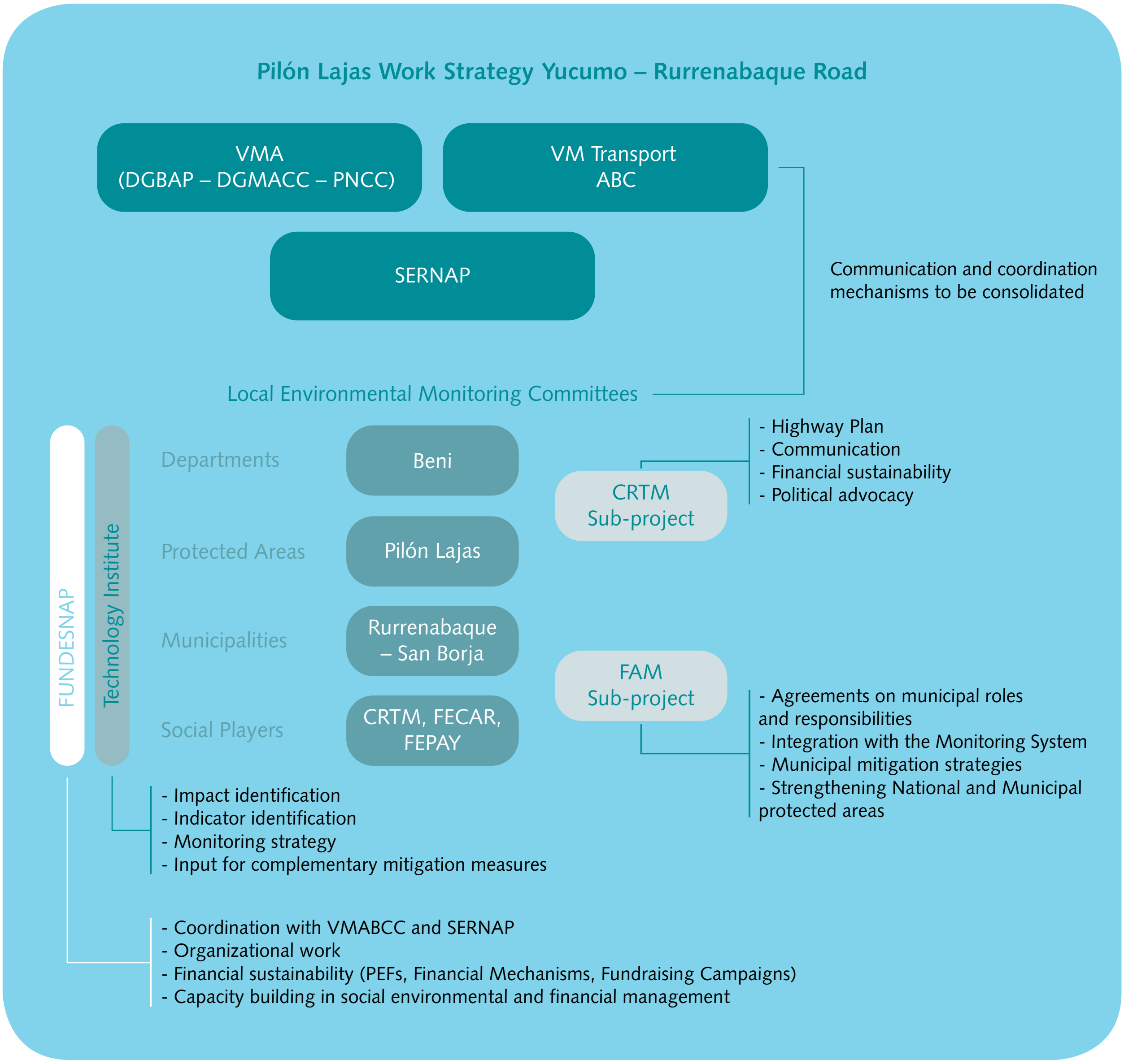
“The knowledge exchange process between the local Environmental Assessment Committees and the Ecology Institute of the Universidad Mayor de San Andrés has implied a 75,000 USD investment.”

Financial sustainability conditions ought to be generated in order to maintain the attention and response capacity with continuous monitoring of induced impacts. One opportunity to consolidate it is the recent re-instatement of Management Committees for the Pilón Lajas and Madidi protected areas. They include the participation of the same players as in the local Environmental Assessment Committees and this will facilitate the continuous integration of the information dealt with in issue of monitoring the very management of protected areas. Still, a most important challenge for the implementation of monitoring systems at the level both of individual protected areas and the Bolivian National System of Protected Areas has been to continuously generate relevant information for the management of protected areas and the focus of conservation actions and investments. The effort of generating information is often exhausted in the phase of learning about the initial situation. And though this information helps to better steer conservation actions and investments, this far there are few continuous series of information to ensure mid and long term trends that may require conservation actions and investments suggested in further detail and level of specificity.

Graphic representation of the system

The set of monitoring components in current implementation for the concrete case supported by FUNDESNAP is graphically presented below:

Chart 6: Working strategy for the monitoring effort in different instances for the RB TCO Pilón Lajas



Source: CEPF FUNDESNAP, 2011.

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