Building Forest Carbon Projects

Biodiversity Impacts Guidance

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Key Assessment Issues for Forest Carbon Projects

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EcoDecision is a social enterprise dedicated to developing new ways to finance conservation. EcoDecision is a pioneer in the emerging ecosystem services markets of climate change mitigation, water source protection and biodiversity conservation.

Established in 1995 by Jacob Olander and Marta Echavarria, EcoDecision is based in Quito, Ecuador, and works throughout Latin America with a broad array of clients and partners, including international and national non-governmental organizations, businesses, and government institutions.

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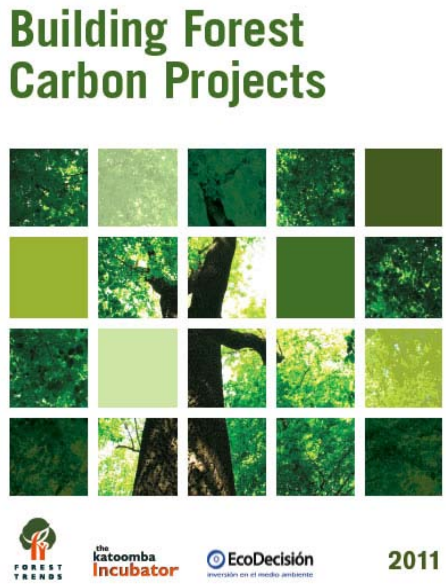

This guidance document is part of a Forest Trends series *Building Forest Carbon Projects*
Available at http://www.forest-trends.org/publications/building_forest_carbon_projects.

Other documents in this series, referred to throughout this document, include:

Step-by-Step Overview and Guide
Jacob Olander and Johannes Ebeling

REDD Guidance: Technical Project Design
Joerg Seifert-Granzin

AR Guidance: Technical Project Design
Johannes Ebeling and Alvaro Vallejo

Carbon Stock Assessment Guidance: Inventory and Monitoring Procedures
David Diaz and Matt Delaney

Community Engagement Guidance: Good Practice for Forest Carbon Projects
Tom Blomley and Michael Richards

Legal Guidance: Legal and Contractual Aspects of Forest Carbon Projects
Slayde Hawkins

Business Guidance: Forest Carbon Marketing and Finance
Phil Covell

Social Impacts Guidance: Key Assessment Issues for Forest Carbon Projects
Michael Richards

Acronyms

AR	Afforestation and reforestation
BACI	Before-After-Control-Intervention [Model]
CDM	Clean Development Mechanism
CCB	Climate, Community & Biodiversity [Alliance or Standards]
CSR	Corporate social responsibility
GHG	Greenhouse gas
IBA	Important Bird Areas
IFM	Improved Forest Management
IBAT	Integrated Biodiversity Assessment Tool
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	Reducing Emissions from Deforestation and Forest Degradation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks
VCS	Verified Carbon Standard

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1. Introduction

Biodiversity is increasingly recognized as a core benefit, rather than a co-benefit, in the voluntary carbon market. Carbon projects validated under the Climate, Community & Biodiversity (CCB) Standards, for example, may be able to command a price premium or have improved access to markets compared to those validated solely under the Verified Carbon Standard (VCS) or Clean Development Mechanism (CDM). Similarly, along with social benefits, the most attractive aspect of many forest carbon initiatives to donors and private investors (beyond carbon) appears to be high biodiversity value (see Business Guidance).

Buyers have several reasons for seeking carbon offsets with demonstrable biodiversity impacts. Most importantly, most corporate social responsibility (CSR) guidelines – and, increasingly, government procurement guidelines – require careful consideration of biodiversity (and social) impacts. Public and shareholder scrutiny of these may be higher than of carbon offsets themselves. Non-permanence and leakage concerns in forest carbon projects also cause investors and buyers to favor high-biodiversity projects. Protection and restoration of bio-diverse old-growth forests as well as planting with a mix of diverse native species can directly enhance permanence of carbon sequestration by making forests more resilient (Diaz, Hector and Wardle 2009; Thompson, et al. 2009). All other circumstances being equal, forest carbon projects that ignore either social or biodiversity impacts are arguably likely to have higher leakage and non-permanence risks. Ecosystem services beyond carbon sequestration and storage are increasingly being recognized in their economic and commercial value. Bio-diverse plantations and forests therefore have a higher potential to create multiple revenue streams, e.g., from monetizing hydrological services and non-timber forest products. Finally, demonstrable biodiversity and social benefits of a project increase the CSR value of buyers' investments beyond carbon benefits (see Business Guidance).

Despite an increasing need for project proponents[1] to understand, plan, and implement the assessment of biodiversity impacts, there has been almost no specific guidance developed to date. This chapter explains the principles of biodiversity impact assessment and then gives guidance on its incorporation into forest carbon project design in four key areas:

1. Identifying biodiversity starting conditions and targets;
2. Developing a reference scenario and establishing attribution;
3. Choosing indicators and methods for measurement and monitoring; and
4. Eliminating sources of error.

While these are logical groupings for issues and are loosely consecutive, it should be noted that these are not strictly sequential impact assessment steps. For example, it is necessary to consider potential sources of error early in the impact assessment design stage.

Numerous pitfalls await the unwary in the complex world of biodiversity impact assessment. Although a precise "how-to" manual is beyond the remit of this chapter, the tools, methods, and prior experience referenced herein should prepare forest carbon project developers to tackle such issues. Where there is already general best practice guidance on biodiversity impact assessment readily available, this chapter does not go over old ground. It instead focuses on providing explanation of key issues related to forest carbon projects and practical guidance on how to

[1] In this series, the term "project proponents" is used to refer to those individuals or organizations generally responsible for the overall organization, management, and legal representation of the forest carbon project. "Project developers," on the other hand, is used to refer specifically to entities tasked with the technical design aspects of the project as required by the carbon and/or co-benefit standard(s).

overcome these issues in order to develop a project that credibly demonstrates positive biodiversity impacts to auditors and offset buyers.

This guidance aims to be pragmatic by presenting best practice along with cost-effective alternatives, recognizing the project budgetary limitations and developing country constraints that many forest carbon project developers will face. Throughout, particular reference is made to requirements of the CCB Standards as the prevailing biodiversity standards, although these are paraphrased and introduced as concepts. Other standards, such as the Plan Vivo, CarbonFix, and Social Carbon Standards, also incorporate elements of biodiversity but are limited in their guidance in comparison to the CCB Standards. Even projects validated exclusively under the CDM or VCS – which do not explicitly contain net positive biodiversity requirements – may wish to incorporate at least some elements of the CCB Standards' guidance to enhance the attractiveness and sustainability of their projects (Box 2). This series' Social Impacts Guidance gives related advice on social impact assessment in forest carbon projects.

Throughout this chapter, key areas where further expert inputs will be necessary are highlighted. They are summarized as:

Level 3
Global standard ecologist, monitoring expert, or taxonomic expert

Level 2
Local ecologist or national taxonomic expert

Level 1
Project environmental staff

Often, Level 3 will need to train Level 2, which will work with Level 1.

Box 1. Rules of Thumb

PROJECT TYPE:

- REDD+ projects, and most Improved Forest Management (IFM) projects (those that reduce logging impacts and do not include enrichment planting or introduction of additional tree species), are likely to be positive for biodiversity owing to reductions in loss of forest area and condition. Therefore, causal models alone may be sufficient to show biodiversity benefits, without a quantitative biodiversity impact assessment. However, they require attention to leakage of deforestation, degradation, and other biodiversity pressures (e.g., hunting).
- Reforestation projects on degraded lands need to carefully assess whether lands are actually degraded since this term is often applied to natural grasslands and shrublands. Reforestation using indigenous species is likely to be positive for biodiversity, while reforestation with exotic species rarely is. In all cases, leakage risks need to be considered on agricultural or pastoral lands (even where these are considered marginal).
- Afforestation projects on areas of natural habitat are unlikely to be positive for biodiversity (and are not eligible under the VCS).
- IFM projects that include enrichment planting or introduction of additional tree species, and Afforestation and Reforestation (AR) projects in highly modified landscapes, may have complex impacts (including leakage risks) and will thus require the most sophisticated biodiversity impact assessment.

PROJECT STATUS:

- Projects that have already started can still obtain some data on starting conditions from remote sensing imagery and qualitative evaluation methods.
- Projects starting soon can quickly collect aerial photographs and conduct GIS ground-truthing of forest extent and High Conservation Values (HCVs) before project initiation.

INDICATORS AND MONITORING:

- Establishment of biodiversity starting conditions at the project site and control areas is relatively easy before project implementation but often difficult to assess retroactively.
- Carbon stock surveys are important surrogates for biodiversity state monitoring.
- Assessment should focus on HCVs but be wary of specialist biases towards certain species groups.
- Direct monitoring of species is rarely practical/useful, although it is desirable for HCV species.
- Indicators of pressures, or threats, (as opposed to state and response) are some of the most useful for forest carbon project participants, as they are relatively easy to measure and relatively well causally linked to the state of biodiversity.

2. What is Biodiversity Impact Assessment?

Put simply, biodiversity impact assessment is the process of measuring, monitoring, and evaluating effects of a given intervention or project on biodiversity in a given area. Good project implementation requires an ability to understand project outcomes as they occur and to adapt project interventions accordingly. Biodiversity impact assessment should thus not be an afterthought, but rather an integral component of the design and implementation of forest carbon projects. In most cases, ultimate long-term *impacts* of a project will not be seen during the short- or medium-term project implementation and monitoring period and thus intermediate *outcomes* are the focus of biodiversity impact assessment.[2]

The terms *measuring*, *monitoring* (repeated measuring), and *evaluating* are all used in this chapter to refer to elements of impact assessment. In addition, the Social Impacts Guidance of this series contains a more in-depth discussion on the definition of "impacts," albeit in a social context.

In the most fundamental terms, biodiversity impact assessment consists of:

- Defining project scope, vision, and targets (including *biodiversity targets*);
- Measuring the *starting conditions* for the targets before project initiation;
- Developing a *reference scenario* (baseline projection) of biodiversity trends in the project area and a project *causal model*, monitoring changes to the target starting conditions during project implementation; and
- Evaluating these monitoring findings in order to update project interventions -- monitoring in isolation is of little value.

It is intuitive that forest carbon projects which plan to reduce deforestation or degradation will have positive effects on biodiversity. However, implementation does not always follow planning, and negative effects can occur (such as loss of animals to hunting owing to human population in-migration because of the project).

[2] This chapter uses key terms in the specific context of biodiversity impact assessment. These terms will be introduced in italics; readers may refer to the glossary for their definitions.

Plentiful examples of project monitoring and evaluation exist, including some particularly relevant to site-based forest carbon projects (Box 4). Despite the existence of such literature, few biodiversity conservation projects have yet devoted sufficient attention to this – let alone advanced to the level of actual biodiversity impact assessment. Fortunately, there are many lessons to be learned for biodiversity impact assessment from a longer history of social impact assessment (see Social Impacts Guidance) and from emerging conservation initiatives such as the Conservation Measures Partnership, the Cambridge Conservation Forum Harmoniing Measures of Success Project, and the evidence-based conservation movement,[3] all of which aim to draw links between conservation actions and effects on biodiversity.

Summary of Expertise Required throughout BIA

Level 3
Trains Level 2, with iterative input throughout process

Level 2
Works with Level 1

Level 1
Implements BIA

2.1 What Do the CCB and Other Standards Require?

The **CCB Standards** require that forest carbon projects "generate net positive impacts on biodiversity within the project zone and within the project lifetime, measured against the baseline conditions [i.e. reference scenario]" (CCBA 2008, Concept B1). The core requirements of the CCB Standards are summarized in Box 2. It is, furthermore, crucial to demonstrate that a project's assumed biodiversity benefits are additional and clearly attributable to project activities.

The CCB Standards currently represent the most widely recognized framework for assessing biodiversity impacts of forest carbon projects and for certifying their benefits. This is evidenced also by the fact that projects using a variety of carbon standards, some of which already contain biodiversity requirements (e.g., the CarbonFix standard) opt for CCB validation. However, most carbon standards themselves also contain at least some guidance or requirements regarding the biodiversity impact of forest carbon projects. Although it is beyond the scope of this chapter to discuss these in detail, a few key points are highlighted below with regard to prominent forest carbon standards.

Box 2. Key CCB Requirements of Biodiversity Impact Assessment

- Each forest carbon project "must generate net positive impacts on biodiversity within the project zone and within the project lifetime" (Concept B1), measured by a monitoring plan to quantify and document the changes in biodiversity resulting from the project activities.
- Invasive species populations must not increase as a result of project activities, and no genetically modified organisms may be used to generate carbon benefits.
- Project proponents must develop a plan for assessing the effectiveness of measures used to maintain or enhance biodiversity.

[3] Two main efforts exist in the evidence-based conservation movement: Bangor University's Centre for Evidence-Based Conservation and Cambridge University's Conservation Evidence.

- Project proponents must provide a description of biodiversity within the project zone and threats to that biodiversity.
- Project proponents must evaluate whether the project zone includes any HCVs and, if so, must provide a plan for maintaining or enhancing these.
- Project proponents must describe how biodiversity in the project zone (e.g., habitat availability, landscape connectivity, and threatened species) would be affected in the reference scenario.
- Project proponents must evaluate and mitigate likely negative impacts on biodiversity outside the project zone resulting from project activities ("leakage").
- There must be a plan for selecting biodiversity variables to be monitored and the frequency of monitoring and reporting to ensure that monitoring variables are directly linked to the project's biodiversity objectives and to anticipated impacts (positive and negative).
- For all projects wishing to claim Gold Level Exceptional Biodiversity Benefits, sites must meet Key Biodiversity Area (KBA) criteria of vulnerability and irreplaceability.

The **Verified Carbon Standard** does not require net positive biodiversity impacts of forest carbon projects. It does, however, contain a fundamental no-harm principle and requires that project proponents "identify potential negative environmental and socio-economic impacts and…take steps to mitigate them" (VCS 2011, 5).

Furthermore, the standard contains a requirement that can be of critical importance for reforestation projects and which could bar a significant number of potential projects from being eligible under the standard:

Project activities that convert native ecosystems to generate GHG credits are not eligible under the VCS Program. Evidence shall be provided in the project description that any ARR, ALM or PRC project areas were not cleared of native ecosystems to create GHG credits…Such proof is not required where such clearing or conversion took place at least 10 years prior to the proposed project start date. The onus is upon the project proponent to demonstrate this, failing which the project shall not be eligible (VCS 2011, 5).

This obviously raises operational questions of what constitutes a "native ecosystem" in many places of long on-going and complex land-use changes; nevertheless, it constitutes an important safeguard.

Somewhat similar to the VCS, the **Clean Development Mechanism** merely requires the documentation of an effort to identify and remedy negative environmental impacts. CDM projects can only be validated if:

> Project participants have submitted….documentation on the analysis of the socio-economic and environmental impacts, including impacts on biodiversity and natural ecosystems, and impacts outside the project boundary…If any negative impact is considered significant by the project participants or the host Party, project participants have undertaken a social impact assessment and/or an environmental impact assessment in accordance with the procedures required by the host Party. Project participants shall…include a description of the planned monitoring and remedial measures to address them. (Decision 19/CP.9 2003)

The CDM does not, however, mandate any explicit evidence that no native ecosystems were converted for forest establishment.

At the heart of the **Plan Vivo Standard** is the requirement that projects "promote sustainable land-use practices that benefit communities in rural areas," whereby sustainable land-use is defined as "the planned use of land, consistent with meeting livelihood requirements, protecting soils, watercourses and biodiversity" (Plan Vivo 2008, 16).

In order to operationalize these requirements, the Plan Vivo Standard stipulates (43):

- All activities must be limited to the use of native or naturalized species and must promote the restoration or protection of native ecosystems;
- Wider ecological impacts, including impacts on local and regional biodiversity and impacts on watersheds, must be identified and considered expressly;
- Naturalized (i.e., non-native yet non-invasive) species may only be planted where they can be shown to have compelling livelihood benefits; and
- Areas where naturalized species are involved must not be in immediate proximity to conservation areas and must not be likely to have any significant negative effect on biodiversity.

A further standard for AR projects, the **CarbonFix Standard**, requires that projects have "net-positive ecological impacts." CarbonFix indicators (CarbonFix 2010, 9-10) require that:

- At least 10% of the project area is managed as a nature conservation area (including evidence given that the management of the nature conservation area enhances habitat connectivity);
- No genetically modified species are used; and
- Only native species are used in planting, unless the use of other species can be justified.

Box 3. Key References on Biodiversity Impact Assessment

Gardner, T. *Monitoring Forest Biodiversity: Improving Conservation through Ecologically-Responsible Management*. London: Earthscan, 2010.

> *Provides a good introduction to, and overview of, monitoring forest biodiversity.*

Tucker, G., et al. *Guidelines for Biodiversity Assessment and Monitoring for Protected Areas.* Kathmandu, Nepal: KMTNC and UNEP, 2005. Available at: http://www.unep.org/tools/default.asp?ct=assess2.

> *Offers an excellent explanation of monitoring protected areas, which has many similarities with monitoring forest carbon projects.*

BirdLife International. *Monitoring Important Bird Areas: A Global Framework.* Cambridge, UK.: BirdLife International, 2006. Available at: http://www.birdlife.org/regional/americas/apm_documents/Background%20paper%2011.2_IBA%20Monitoring%20Framework.pdf.

> *An especially thoughtful yet simple and practical monitoring framework developed for monitoring Important Bird Areas, with broad relevance. This framework facilitates quantification of qualitative data when only such data are available and is compatible with key existing monitoring tools such as the GEF Management Effectiveness Tracking Tool for protected areas.*

Jagger, A., S. Atmadia, S. K. Pattanayak, E. Sillis, and W. D. Sunderlin. "Learning while doing: Evaluating impacts of REDD+ projects." In *Realising REDD+ National Strategy and Policy Options*, edited by A. Angelsen, M. Brockhaus, M. Kanninen, E. Sills, W. D. Sunderlin and S. Wertz-Kanounnikoff, 281-292. Bogor, Indonesia: CIFOR, 2009. Available at: http://www.cifor.cgiar.org/nc/online-library/browse/view-publication/publication/2871.html.

> *Outlines issues specific to monitoring REDD+ projects.*

Conseration Measures Partnership. *Open Standards for the Practice of Conservation, Version 2.0.* Washington, DC: Conseration Measures Partnership, 2007. http://www.conservationmeasures.org/initiatives/standards-for-project-management.

> *Gives useful guidance on the integration of monitoring and evaluation into project design.*

3. Identifying Biodiversity Starting Conditions and Targets

3.1 Starting Conditions

Targets and net benefits of a project can only be usefully assessed if, inter alia, the project developer knows the starting conditions of the relevant aspects of biodiversity in the project zones as well as the evolution of these variables under the reference scenario (see Section 4). While starting conditions must be described as part of CCB compliance, it should be emphasized that net benefits over the project's lifetime refer to differences not between project outcomes and starting conditions, but rather between project outcomes and the reference (without-project) scenario.

In order to define the starting conditions (or "original conditions"), the CCB Standards require:

1. A description of biodiversity within the project zone and threats to that biodiversity;
2. An evaluation of whether the project zone includes any HCVs;
3. For all projects wishing to claim Gold Level Exceptional Biodiversity Benefits, sites must meet KBA criteria of vulnerability and irreplaceability.

HCVs and KBAs are subsets of overall biodiversity. They are introduced in Box 4 and discussed in more detail below. Understanding that they are a subset helps to focus efforts to provide a description of biodiversity and threats in the project zone.

Summary of Expertise Required to Identify Starting Conditions

Level 3
Designs starting conditions survey(s); trains Level 2

Level 2
Implements

Level 1
Implements and works iteratively with Levels 2 and 3 to analyze results

A general description of the vegetation, habitats, and ecosystems in the project zone is essential and can be provided by any non-specialist botanist. If exhaustive species inventories exist they can be used in the vegetation description, but they are not required. This is an important point to note, as scientists often have a strong interest in one group of species and may push for comprehensive surveys of that group. A forest carbon project developer will be expected, rather, to provide more detailed information on all HCVs and their threats. So, for example, if the only likely HCVs in a project zone are snakes, the developer can focus on contracting surveys for snakes and any likely threats to them.

The importance of identifying threats to HCVs (discussed in the following section) cannot be overstated, as a project will have to manage or mitigate these in order to fulfill CCB requirements of net positive biodiversity impacts. Fortunately, the very deforestation and degradation that REDD+ projects aim to reduce are also the main threats to biodiversity on a global and, frequently, local level. Therefore, a REDD+ project is likely to be de facto positive for biodiversity, except in cases where pressures increase off-site as a result of project activities (activity-shifting leakage) or where other, unmitigated threats (such as hunting) happen to increase as a result of project impacts (such as human in-migration owing to project benefits). Other threats fall into a few common groups, such as invasive species (Box 5), but are site- or HCV-specific and best identified with the support of both local and taxon-specific ecologists.

Surveys for HCVs should be carefully planned as they will likely form part of the project's starting conditions and a key element of the reference scenario, to which future project outcomes will be compared during monitoring and evaluation. When evaluating HCVs in the project zone, it will thus be important to engage biologists specialized in particular species groups or in vegetation classification. In addition, experts in impact monitoring need to be involved to ensure that starting conditions are measured in a way that will be useful for later monitoring.

Box 4. The Six Types of High Conservation Values and Their Evaluation in the Noel Kempff

Biodiversity HCVs

HCV 1: Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g., endemism, threatened species, refugia).

HCV 2: Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.

HCV 3: Forest areas that are in or contain rare, threatened or endangered ecosystems.

Ecosystem Service HCVs

HCV 4: Forest areas that provide basic services of nature in critical situations (e.g., watershed protection, erosion control).

HCV 5: Forest areas fundamental to meeting basic needs of local communities (e.g., subsistence, health).

HCV 6: Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance - identified in cooperation with such local communities).

The Nature Conservancy has been implementing a REDD project at Noel Kempff Mercado, Bolivia, which has several HCVs. Among these are: It is a national park containing a number of species of global conservation concern, including Brazilian Tapir, Marsh Deer and Maned Wolf. Both the fact that it is a national park and the globally threatened species it contains qualify it under HCV 1. Further, it has sections identified as a part of the Amazonia Wilderness Area by Conservation International. Since this is one of the three largest landscape-level forests in the world, it qualifies under HCV 2. Noel Kempff also qualifies as a KBA, thus meeting the CCB Standards Gold Level of Exceptional Biodiversity Benefits, because it has populations of greater than 30 individuals of globally threatened (vulnerable) species such as Marsh Deer and Brazilian Tapir. To ensure the project maintains populations of threatened KBA/HCV species these populations are monitored by park guards and outside experts.

Box 5. Invasive Species

One kind of threat that the CCB Standards specifically request all projects to assess is that associated with invasive species. These are non-native species that threaten native ecosystems, habitats, or species--for example, by competing with native species for resources. Direct negative impacts from invasive species may occur with AR projects, as some popular plantation trees can be invasive species in many settings. On the other hand, indirect negative impacts from invasive species may occur in cases where forest management unintentionally facilitates the spread of invasive species through access roads, extraction practices, etc. (it should be noted that invasive species can likewise be an issue in REDD+ or IFM projects). Some invasive species can be easily identified by consulting existing databases and lists of invasive species (notably, Invasive Species Specialist Group 2011, Haysom and Murphy 2003), but many non-native species are only invasive under certain conditions. Thus, an assessment will be required of the potential of existing non-native species in the project zone to become invasive, using a protocol along the lines of that developed by NatureServe in the United States (Morse, et al. 2004). This will require guidance from an expert ecologist.

3.2 Identifying High Conservation Values

Biodiversity is valued by different people in different ways. For example, scientists and conservationists may value rare frogs whereas local communities may value the abundance of relatively common reeds or medicinal plants, which might be of little interest to the conservationist. The HCV system is a tool to encompass all of these different values.[4] It was originally designed by the Forest Stewardship Council for use in sustainable forestry certification but is now used more widely. For example, the principles underpinning HCV have increasingly been incorporated into mandatory performance standards of international development banks.[5] Three HCVs are related to intrinsic values of biodiversity such as threatened species or ecosystems, and three relate to ecosystem services such as water catchment value or essential foods or medicines for local communities (see Box 4).

Summary of Expertise Required to Identify High Conservation Values

Level 3
Works with project participants to identify HCVs

ProForest has developed a clear guide to HCVs, including a practical toolkit for their identification by forest managers (see Box 6 for this and other tools). However, the concepts dealt with are complex and require frequent consultations with relevant organizations and specialists. Project proponents will thus still need to engage expert support – ideally a non-governmental organization or specialist consultancy with expertise in conservation planning and priority-setting – to work through the toolkit.

The ProForest toolkit contains numerous links to necessary information sources. Since it was developed, a number of additional resources have emerged which developers will find useful in identifying HCVs. Many resources which are relevant to intrinsic biodiversity values are steadily being incorporated into a very useful web-based map tool, the Integrated Biodiversity Assessment Tool (IBAT). There is now also an at-a-glance guide to prioritizations in any particular region (HCV 1), many of which also now have searchable online maps or databases.[6] An online spatial database, albeit imperfect, now exists of protected areas globally (HCV 1.1), and many priority sites for establishment of new protected areas will be identified through gap analyses carried out by Parties to the Convention on Biological Diversity under the Programme of Work on Protected Areas. The International Union for Conservation of Nature (IUCN) Red List of threatened species is now easily searchable online and provides maps and information – including on threats – for many species, including all mammals, birds and amphibians (HCV 1.2). Taxon-specific priority sites have now been brought together under an overarching concept of KBAs (HCV 1.2, 1.3 & 1.4), with the most highly-threatened of these identified as Alliance for Zero Extinction sites (HCV 1.2).

In order to meet the CCB Standards requirements for Gold Level Exceptional Biodiversity Benefits, sites must meet KBA criteria. KBAs have been identified for multiple taxonomic groups in almost 120 countries but are almost by definition a work in progress. Forest carbon project developers will therefore often need to briefly engage a specialist in global biodiversity priorities to assess whether their site meets KBA criteria.

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[4] High Conservation Value criteria are defined by the High Conservation Value Resource Network (http://hcvnetwork.org).

[5] CCBA (2008, Appendix A, Section G1) lists performance standards from the European Bank for Reconstruction and Development, the Inter-American Development Bank, the International Finance Corporation, the World Bank, and the Asian Development Bank.

[6] The CCB Standards highlight several such resources from WWF, including Olson, et al. (2001), Spalding, et al. (2007), and Abell, et al. (2008).

Box 6. Key Resources and Tools for Identifying Biodiversity Starting Conditions and Targets

Jennings, S., R. Nussbaum, N. Judd, and T. Evans. *The High Conservation Value Forest Toolkit. Edition 1.* Oxford, UK: ProForest, 2003. Available at: www.proforest.net/publication/publication/pubcat.2007-01-19.4709481979.

Provided by ProForest, this toolkit helps to identify HCVs.

Integrated Biodiversity Assessment Tool. *IBAT For Business.* 2008. http://www.ibatforbusiness.org/.

Provides a very useful web-based map tool.

IUCN and UNEP. *The World Database on Protected Areas (WDPA).* 2010. http://www.protectedplanet.net.

Maps protected areas around the globe.

IUCN. *IUCN Red List of Threatened Species. Version 2010.1.* 2010. http://www.iucnredlist.org.

Contains the ICUN Red List of Threatened Species.

WWF. *Terrestrial Ecosystems GIS Database.* 2011. http://www.worldwildlife.org/science/data/item6373.html.

Contains a downloadable GIS database of terrestrial ecoregions.

Langhammer, P. F., M. I. Bakarr, L.A. Bennun, T. M. Brooks, R.P. Clay, and W. Darwall. *Identification and Gap Analysis of Key Biodiversity Areas: Targets for Comprehensive Protected Area Systems.* Gland, Switzerland: IUCN, 2007. Available at: http://data.iucn.org/dbtw-wpd/edocs/PAG-015.pdf.

Provides a good explanation of KBAs.

Alliance for Zero Extinction. *Pinpointing and Conserving Epicenters of Imminent Extinctions.* 2010. http://www.zeroextinction.org/index.htm.

Details Alliance for Zero Extinction sites.

4. Establishing Attribution and Developing a Reference Scenario

4.1 Causal Models and Control Sites

When trying to determine net biodiversity impacts of a project, project developers face a key challenge in assessing to what extent any changes (or lack thereof) observed in the project area are related to specific project activities. A related challenge is the question of how developments in the project zone compare to what would have happened in the absence of the project (Ferraro 2009). To assess net project biodiversity impacts, the CCB Standards require:

- A plan for assessing the effectiveness of measures used to maintain or enhance biodiversity; and
- A comparison of the measured project impacts to those of the biodiversity reference scenario (baseline – see Box 7).

At its most basic level, the objective of a project wishing to create net positive impacts on biodiversity is to enhance conditions or mitigate damages compared to a without-project reference scenario (baseline). In most cases this will mean aiming to maintain or enhance the original state of biodiversity.[7]

Thus, forest carbon project developers not only need to monitor changes in biodiversity over time but also need to conduct biodiversity impact assessments that can credibly estimate to what extent any changes can be attributed to project measures and to what extent these changes would have happened anyway. To do so requires incorporation of appropriate methods for assessing *attribution* into overall project design. An important element of this assessment, according to the CCB Standards, is the elaboration of a reference scenario that projects the development of biodiversity conditions in the absence of the carbon project and to which project outcomes can be compared.[8]

There are two main ways, which are not mutually exclusive, of assessing the extent to which any changes measured during a project can be attributed to project interventions: developing a project causal model (also described as a "theory of change") and measuring impacts in *control sites* to establish counterfactuals.

To establish attribution of biodiversity impacts to project activities, the CCB Standards require that project proponents lay out a logical and well-substantiated explanation of how biodiversity conditions will change for the project area in the absence of project activities, and how project activities are likely to improve on this future without-project scenario. In more technical terms, CCB Standards de facto require the construction of a causal model that sets out how short-term project activities and outputs will cause mid-term outcomes, and how these outcomes will lead to longer-term impacts. If such impacts are then observed, it can plausibly be claimed that these are owed to project interventions according to the causal model. The CCB Standards require project proponents to not only demonstrate that project activities are designed to achieve positive biodiversity and social outcomes but also explain *how* this is expected to happen (even if control sites, see below, are later used to verify these projections).

Such causal models will often exist anyway for a well-designed project through, for example, the project logical framework. They are essential for designing logical project interventions and choosing suitable project monitoring indicators, and they are an important supporting tool for biodiversity impact assessment. Further guidance can be found in the Social Impacts Guidance, the REDD Guidance, and the resources referenced in Box 8.

Causal models have traditionally been the only tool used to establish attribution in biodiversity conservation projects and are still commonly used in social science, where ethical issues and the difficulty of monitoring human subjects without influencing their behavior make experimental methods difficult (see Social Impacts Guidance). They are also generally acceptable as the sole basis for developing a reference scenario in REDD projects, as well as IFM projects that do not include enrichment planting or introduction of additional tree species. Both of these project types have intrinsic habitat conservation benefits.[9] However, care must be taken to monitor other threats that may be

[7] In principle, under CCB Standards, this could mean defining a target which accepts a deterioration of biodiversity aspects during project implementation, as long as it can be demonstrated that this decline is less severe than would have been the case under the reference scenario. For example, a REDD project could set a goal to slow baseline deforestation rates to a specific, realistic level while still accepting some on-going forest loss.

[8] Most REDD+ project developers will be familiar with the use of a deforestation/degradation reference scenario, a prediction of what will happen to land-use and forest condition in a given area without the project (the business-as-usual scenario, or baseline). Likewise, a biodiversity reference scenario is a model approximating what would happen without any carbon project intervention. Any reference scenario will necessarily be an estimated prediction as it is established before project initiation, but the validity of this projection can be monitored during project implementation if suitable controls can be established (and this should be attempted where finances are sufficient and/or biodiversity risks are high).

[9] In principle, the same could be argued for forest restoration projects (i.e., certain types of AR projects) that plant a mix of native species on genuinely degraded lands. However, throughout much of the world, ecologically important shrublands and grasslands are frequently considered "degraded land" (and classified as such by governments).

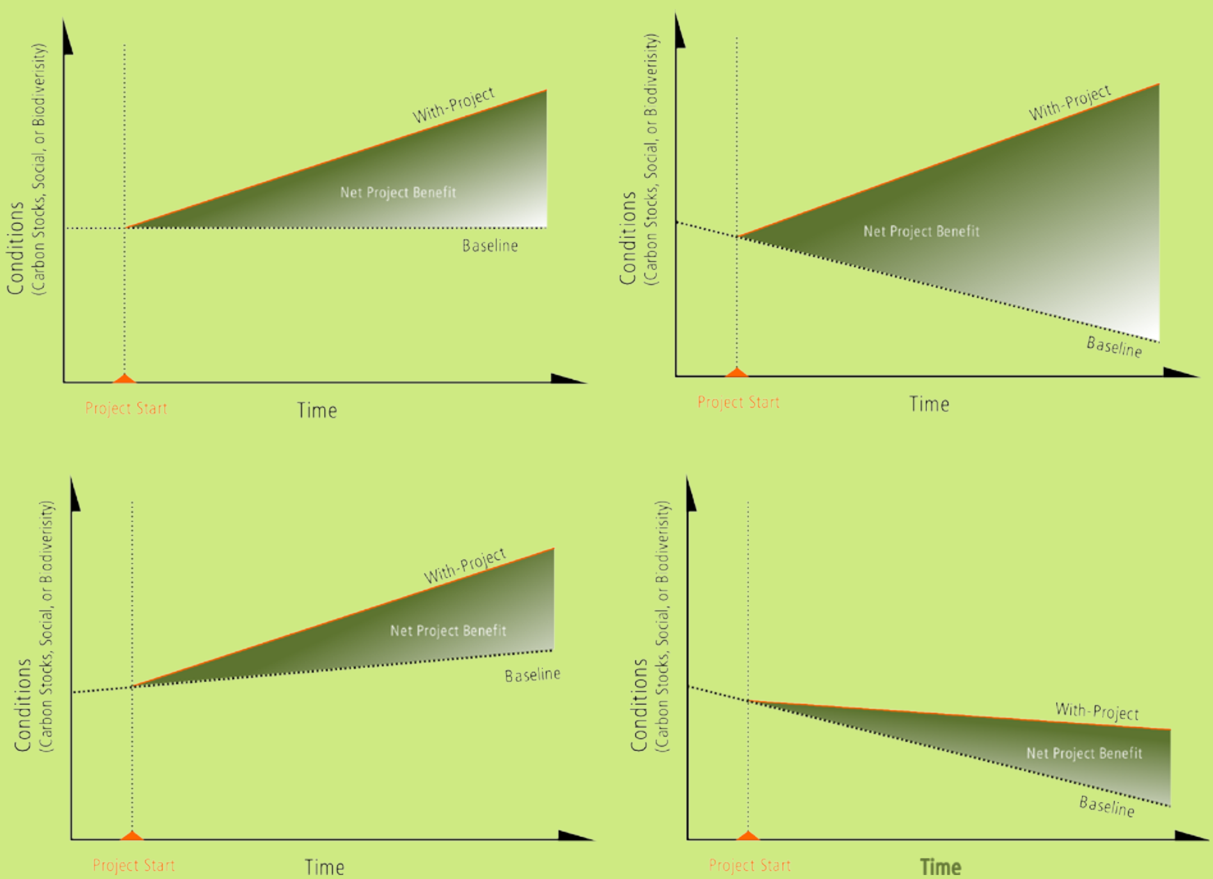
stimulated by the project (e.g., increased hunting owing to in-migration to receive project benefits) or leakage (e.g., where increased conservation protection displaces hunting or other activities outside project boundaries).

Box 7. Baseline Scenarios for Forest Carbon Projects

The concept of **baseline scenario** refers to a projection of what future conditions would be like in the absence of carbon project interventions. It is sometimes also referred to as the reference, or without-project, scenario. To generate offsets, forest carbon projects must capture or store more carbon than would have been the case under this future, projected baseline. Baselines are used for estimating and evaluating carbon benefits under all forest carbon standards (VCS, CDM, Plan Vivo, and others).

It is worth highlighting that baselines are not limited to quantification of carbon stocks or emissions, but are also used as the basis for determining social and biodiversity impacts under the CCB Standards: projects must demonstrate that communities and biodiversity are better off with the project than without it.

Baseline is used in this very specific sense in the carbon world, though in other types of assessment the term is commonly used to refer to starting or current conditions. To differentiate these concepts, the terms "original," "starting" or "time-zero" conditions are generally used in the carbon literature, and throughout this set of documents, to describe the conditions prior to the start of the project.



The figures above describe several possible combinations of baseline and project scenarios and are described in greater detail in the Step-by-Step Overview.

Unfortunately, experience shows that causal model predictions of the future can often be very inaccurate. Whereas the CCB Standards presently require the use of some sort of causal model, scientists recommend that a key feature of the biodiversity impact assessment process should ideally be the actual measurement of *counterfactual* outcomes through *control sites*, which allow for a quantitative comparison of with-and without-project scenarios and go beyond ex-ante projections. The factual outcomes of a project can, and should, be measured during implementation. The counterfactual outcomes that would have happened without the project obviously cannot be measured. These outcomes can be estimated, however, and net outcomes understood and quantified through monitoring and comparing project and control sites.

The best and most common method of measuring and quantifying project impacts in addition to a causal model is to monitor the future as it happens in a control, or comparison, site (Conservation Development Centre and the GEF Evaluation Office 2009). This monitoring does not necessarily have to take place with the same intensity as in the project zone. Changes observed in the control site represent a validation of the ex-ante reference scenario, and final outcomes comprise the counterfactual.

Summary Expertise Required to Assess Attribution

Level 3
Designs; trains Level 2

Level 2
Implements

Level 1
Implements and works iteratively with Levels 2 and 3 to analyze results

A simple way to conceptualize this is the commonly-used Before-After-Control-Intervention (BACI) model, which estimates impacts using data collected before and after project interventions, from both control sites and the project area. There is a need to measure the control both before and after because a control site will rarely have exactly the same starting value as an intervention site (both regarding ecological and socio-economic factors). Analytical methods to deal with this are called "double difference methods."

Control areas can be selected in a number of ways. Commonly, there may simply be judgment selection of subjectively similar areas. This is open to bias and poor representativeness of control areas. Control areas should be chosen in as objective and random a way as possible. Detailed guidance is available on methods to accomplish this in real-world situations. Matching methods should be involved to select control areas which have similar values to the project area for observable relevant criteria (e.g., forest type, population density). One powerful adjunct to the matching method, particularly when many criteria are relevant (as they usually are in the real world), is propensity score matching. This can also be used after project completion to select sub-sets of control data that are most relevant for comparison to project data.

An important consideration is that forest carbon projects, especially REDD+ projects, are almost always implemented in the context of land-use changes--in the case of REDD+ and many IFM projects, for example, the primary objective is to stop or reverse deforestation and/or forest degradation. As a result, there is often complex set of socio-economic variables that impact forest extent and forest condition – and, consequently, many key aspects of biodiversity – in the project area. Moreover, these land-use pressures usually evolve throughout the project lifetime. In order to establish suitable control areas, it is therefore necessary to also ensure that land-use change drivers are comparable to the project area regarding both their initial and evolving nature, as is the case for establishing reference areas under most current VCS methodologies.

It is obvious that some projects may struggle to identify suitable control areas in this light, and evolving socio-economic variables certainly introduce another source of error. However, where a reference area has been properly identified for developing and monitoring the baseline of a REDD project (see REDD Guidance), it should often be feasible to also determine suitable control areas for monitoring biodiversity reference conditions.

It is sometimes not possible to monitor controls – for example, in projects that have already started or in small projects where funds are really limited. In the absence of controls, reference scenarios can be constructed post-hoc using less quantitative and accurate methods. For example, the GEF has extensively used a qualitative method to assess completed projects.[10] Nonetheless, such post-hoc assessments are problematic, notably because the high variability of individual judgment and memory allows for a large subjective bias.[11] If planned well and with appropriate expertise, monitoring control areas and the project area need not be time-consuming or particularly expensive. Therefore, where risks of negative project impacts are significant, a sound argument exists for project developers to utilize causal models and, if possible, control areas. Careful design is necessary to ensure this is time- and cost-effective.

Box 8. Key References on Attribution and Reference Scenarios

Taylor-Powell, Ellen, and Ellen Henert. *Developing a logic model: Teaching and training guide*. Presentation, Madison, Wisconsin: University of Wisconsin, 2008. Available: www.uwex.edu/ces/pdande/evaluation/pdf/lmguidecomplete.pdf.

A thorough guide to causal or logic models.

Leeuw, Frans, and Jos Vaessen. *Impact Evaluations and Development.* NONIE Guidance on Impact Evaluation, Washington, DC: World Bank, 2009. Available at: www.uwex.edu/ces/pdande/evaluation/pdf/lmguidecomplete.pdf.

Perhaps the best overview of impact evaluation, including propensity scoring and double difference methods.

Ferraro, PJ, and SK Pattanayak. "Money for Nothing? A Call for Empirical Evaluation of Biodiversity Conservation Investments." *Public Library of Science Biology*, 2006: e105.

Ferraro, P. "Counterfactual thinking and impact evaluation in environmental policy." *New Directions for Evaluation*, 2009: 75-84.

Both articles do well to explain the need for quantified reference scenarios.

World Bank Independent Evaluation Group. Impact Evaluation -- The Experience of the Independent Evaluation Group of the World Bank. Washington, DC: World Bank, 2006. Available at: http://siteresources.worldbank.org/EXTEVACAPDEV/Resources/4585672-1251461875432/impact_evaluation.pdf.

Baker, J.L. *Evaluating the Impacts of Development Projects on Poverty: A Handbook for Practitioners*. Washington, DC: World Bank, 2000. Available at: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTISPMA/0,,contentMDK:20194198~pagePK:148956~piPK:216618~theSitePK:384329,00.html.

Both articles offer useful overviews of the use of controls, including double difference methods.

Tucker, G., et al. *Guidelines for Biodiversity Assessment and Monitoring for Protected Areas.* Kathmandu, Nepal: KMTNC and UNEP, 2005. Available at: http://www.unep.org/tools/default.asp?ct=assess2.

Explains protected area monitoring, which has many similarities with monitoring forest carbon projects.

[11] Projects aiming for CCB validation should note that the development of a reference scenario ("baseline projection") before project start is explicitly required.

Jagger, A., S. Atmadia, S. K. Pattanayak, E. Sillis, and W. D. Sunderlin. "Learning while doing: Evaluating impacts of REDD+ projects." In *Realising REDD+ National Strategy and Policy Options*, edited by A. Angelsen, M. Brockhaus, M. Kanninen, E. Sills, W. D. Sunderlin and S. Wertz-Kanounnikoff, 281-292. Bogor, Indonesia: CIFOR, 2009. Available at: http://www.cifor.cgiar.org/nc/online-library/browse/view-publication/publication/2914.html.

Gives particularly relevant guidance to the BACI model and matching methods.

5. Evaluating and Mitigating Leakage of Biodiversity Impacts

Similar to the risk of carbon leakage, forest carbon projects may face the risk of causing negative biodiversity impacts outside of the project zone by displacing threats through project interventions. As a result, the CCB Standards require that project proponents "evaluate and mitigate likely negative impacts on biodiversity outside the project zone resulting from project activities" (Concept B2).

Summary Expertise Required to Evaluate Leakage of Biodiversity Impacts

Level 3
Analyzes leakage risks

The implication here is that a project may be shown to have net positive biodiversity impacts in the project area, through careful integration of the methods described above, even while its overall net benefits may be reduced, or even negated, due to leakage. Displacement of deforestation pressures by a forest carbon project is a well-known form of leakage with negative impacts on biodiversity. However, other processes may not be linked to carbon leakage, such as displacement of unsustainable hunting or collection of non-timber forest products. Just as for forest carbon stocks, a project proponent cannot expect to claim biodiversity benefits for simply displacing threats elsewhere. Precisely quantifying such leakage would be extremely difficult. Therefore, the CCB Standards instead sensibly require the up-front evaluation of any such leakage risks and documentation of project activities focused on mitigating these. Project participants need to demonstrate that project biodiversity benefits outweigh any unmitigated negative offsite impacts on biodiversity.

If a causal model of likely biodiversity-related developments and pressures has been carefully developed as part of the reference scenario (see previous section), it should clearly indicate risks of biodiversity leakage. For example, if actors causing baseline pressures are highly mobile and are not engaged effectively by the project, or if demand for products that cause biodiversity threats is not tackled and/or met by the creation of an alternative supply, such risks should be evident in a causal model. This is not unlike the risks of carbon leakage, such as where baseline drivers of deforestation have not been effectively tackled (see Step-by-Step Overview). Where (residual) risks remain, appropriate indicators should be developed as part of the monitoring approach (see below) to recognize and react to negative offsite developments.

Box 9. Key References on Biodiversity Leakage

Ewers, R. M., and A.S. Rodrigues. "Estimates of reserve effectiveness are confounded by leakage." *Trends in Ecology and Evolution*, 113-116.

Gives an overview of non-carbon leakage.

TNC. Noel Kempff Mercado Climate Action Project: A Case Study in Reducing Emissions from Deforestation and Degradation. Arlington, VA: The Nature Conservancy, 2009. Available at: http://www.nature.org/ourinitiatives/urgentissues/climatechange/placesweprotect/noel_kempff_case_study_final-1.pdf.

Explains thoughtful project measures to combat the issue of leakage, albeit of deforestation.

6. Choosing Measurement Methods and Indicators

6.1 The Challenge of Measuring Biodiversity

Once biodiversity targets have been selected and a reference scenario has been developed, the obvious next step might seem to be to measure and monitor these targets. However, biodiversity is difficult to measure in simple, generic, and reliable ways – principally because it is not a single thing but all the diversity of nature and its human values. The carbon benefits of a project can be conveniently expressed in terms of a single currency: tonnes of carbon dioxide equivalent (tCO_2e). No such single currency exists for biodiversity – biodiversity is measured in currencies ranging from genes to populations to species to ecosystems to biomes. Therefore, *indicators* are frequently used to measure change, acting as surrogates of "real" biodiversity. The CCB Standards (B3, Indicators) require project proponents to develop a "plan for selecting biodiversity variables to be monitored and the frequency of monitoring and reporting to ensure that monitoring variables are directly linked to the project's biodiversity objectives and to anticipated impacts (positive and negative)," and they further state that such variables may include, but are not limited to, "species abundance; population size, range, trends and diversity; habitat area, quality and diversity; landscape connectivity; and forest fragmentation."

Summary Expertise Required to Identify Pressure, State, and Response Variables

Level 3
Designs; trains Level 2

Level 2
Implements

Ideally, these variables (indicators) would cover all biotic levels (genes to biomes) and the interactions between these. Realistically, they must at least cover the range of HCV levels identified in a project zone (as outlined in the previous section). The variables suggested by the CCB Standards are important indicators of the state of biodiversity, but to triangulate impacts and track change that may happen during project timescales, indicators of pressure and response should also be monitored, as discussed in the following sections.

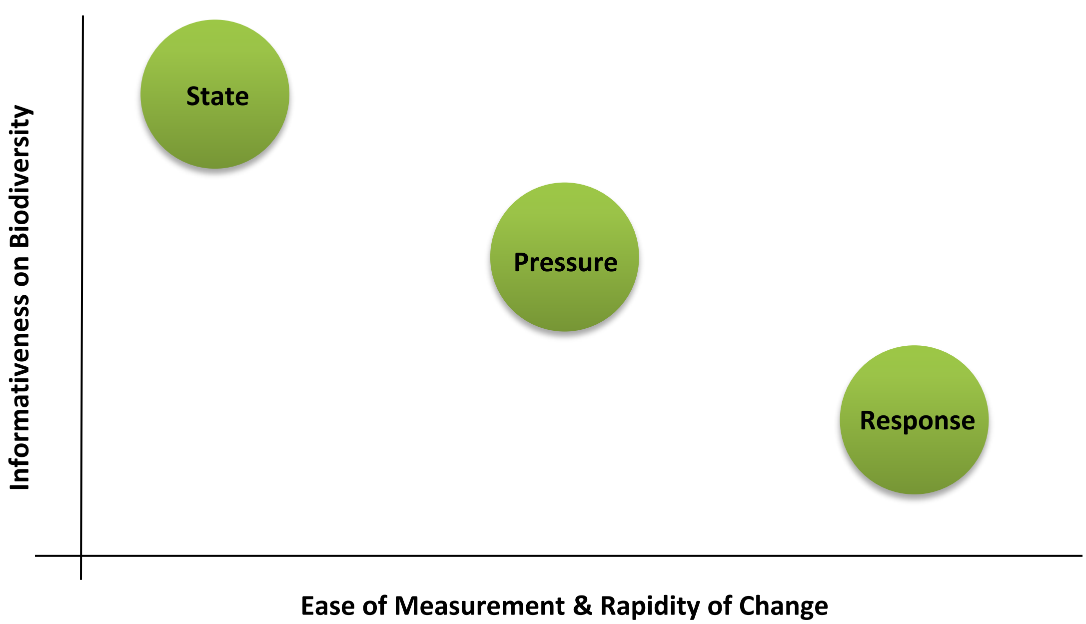
6.2 Pressure, State, and Response

The Pressure-State-Response framework is the most widely used biodiversity indicator framework, and plentiful guidance can be found on its use. Conceptually, it relies on a causal chain whereby *pressures* or threats (e.g., deforestation, pollution, or hunting) negatively impact the *state* or status/condition of biodiversity (e.g., species abundance or habitat area), but *responses* or project interventions are taken to reduce pressures/threats, which in turn are expected to improve the state of biodiversity.

Indicators of state are the holy grail of biodiversity impact assessment, as they most directly inform project managers of actual changes in biodiversity and, thus, enable measurement of project impacts. However, they are also often the hardest to measure and the slowest to change. Conversely, response indicators are very easy to measure and can change rapidly because they measure actual interventions that a project manager takes. However, they are the least informative about changes in biodiversity because it is not clear, when they are initially taken, whether they will actually reduce threats and – even if so – whether reduced threats will improve the state of biodiversity (Figure 1). Pressure (or threat) indicators are often the best compromise: they are relatively easy to measure and provide a reasonably accurate image of the status of biodiversity on the ground. It should be noted that the suggested variables for biodiversity impact monitoring under CCB (B3) refer primarily to state indicators (i.e., "species abundance; population size, range, trends and diversity; habitat area, quality and diversity; landscape connectivity; and forest fragmentation"), and validators may consider these as primary indicators.

A range of pressure, state, and response variables should be selected such that some indicators can measure and show change swiftly while others can more directly inform project managers of ultimate biodiversity impacts. Pressure indicators will often include a measure of the extent and abundance of invasive species in the project zone.

Figure 1. Strengths and Weaknesses of Pressure, State, and Response Indicators



Box 10. Choosing Monitoring Indicators and Methods in Brazil

The Juma Reserve REDD project, approved under the CCB Standards in 2008, is situated in an area of bio-diverse Amazonian forest in Brazil. Reducing deforestation in this area is expected to have significant positive biodiversity impacts. Nonetheless, the project is using a biodiversity impact monitoring model that ambitiously covers a range of pressure and state indicators. To do so expending without excessive time or monetary costs, the project combines existing land-use (pressure) and vegetation cover (state) monitoring, necessary in any case for carbon monitoring, with additional periodic sampled monitoring of boat and heavy vehicle traffic (pressure), timber and non-timber forest product extraction (pressure), and threatened species (state). The project intends to train local community members to collect this additional information. The project sees extensive monitoring of environmental pressures not as a burden, but as an opportunity to guide adaptive management. While community-based collection of monitoring data on rare and hard-to-see wild animals may prove challenging, monitoring of easy-to-find alligator nests may be more feasible.

6.3 Choosing Suitable Indicators

It is important to use a range of pressure, state, and response indicators, all of which relate to pre-identified biodiversity targets. As discussed above, pressure indicators can be the most valuable for forest carbon project proponents because they are moderately easy to measure and provide moderately accurate indications of change. However, there are no "correct," generic indicators, and indicators must be chosen for relevance to the particular setting of each individual project.

A detailed process for selecting indicators is summarized in Table 1. The final suite of indicators should be neither so small that it is uninformative nor so large that it is confusing or cumbersome. To select appropriate indicators for a particular project, forest carbon project proponents will likely need support from ecological experts with experience of monitoring and, preferably, direct experience of the project zone (or similar areas).

Table 1. Simple Process for Selecting Indicators

For each HCV, indicators should be selected that address the three questions.

		Example HCVs		
Project Proponent Questions	**Indicator Type**	*Water Quality*	*Threatened Species*	*Other*
What is the current condition of the HCV?	State	*Indicator 1*	*Indicator 4*	*Indicator 7*
What is the level of threat affecting the HCV?	Pressure	*Indicator 2*	*Indicator 5*	*Indicator 8*
What is the level of human activities to decrease the pressure?	Response	*Indicator 3*	*Indicator 6*	*Indicator 9*

Adapted from Whitman and Hagan (2003)

It is worth reiterating here the difficulty of measuring state variables, particularly those of "species abundance; population size, range, trends and diversity" suggested by the CCB Standards. Not only is the direct monitoring of species difficult, but the results are also hard to interpret. Many HCV species are, by their nature, rare. They may also be highly mobile or hard to observe. Even if such obstacles to monitoring can be overcome, it can be remarkably hard to detect species population trends amidst fluctuating and cyclical population change even in the best and most well-resourced studies. This is particularly the case during relatively short project time-scales and CCB verification cycles.

Sometimes certain species are themselves portrayed as "indicator species" of wider biodiversity. This "canary in the coal mine" idea has great value in theory, but the scientific underpinning of indicator species is often weak in practice. Monitoring relevant guilds of species, such as understorey birds, may have more value. The difficulty of species monitoring is belabored here not to discourage forest carbon project developers from attempting to monitor HCV species, but to urge pragmatism and to re-stress the great value of a supporting suite of pressure and response indicators related to the HCV (Table 1). Please note again that for CCB compliance a certain number of state indicators are likely to be required, and, if well chosen, these can be very valuable in assessing actual project impacts.

Summary of Expertise Required to Define Monitoring Approach

Level 3
Designs

7. Defining a Monitoring Approach

Methods for monitoring indicators range from externally-driven processes of exacting measurements by international scientists to locally-driven processes of approximate counts by communities after basic training.

Proponents of locally-based monitoring argue that while this method is often less precise, accurate, and objective, it has greater relevance, simplicity, cost-effectiveness, and sustainability. Additionally, engagement of local communities in monitoring forest carbon projects would certainly provide important opportunities for creating positive social impacts. Locally-based monitoring of indicators of pressure on biodiversity (often more relevant to – or even stemming from – local communities) is likely to be easier to achieve than locally-based monitoring of indicators of the state of biodiversity. Remote sensing techniques, already in use for carbon monitoring, are increasingly incorporating measures of biodiversity and have high potential for augmenting field-based monitoring methods, including the simple piggy-backing of monitoring forest extent (see Box 10).

Ultimately, a mix of methods across this continuum is likely to be optimal. Locally-based monitoring may be sufficient for some indicators and situations but not others. The BirdLife International Important Bird Areas (IBA) monitoring framework allows for incorporation of best available data, whatever the methods, and facilitates a balance across state, pressure and response indicators. Particular problems and methodological solutions exist regarding monitoring of illegal pressures, which may by their nature be hidden (Gavin, Solomon and Blank 2010).

Whether local- or expert-based monitoring is chosen, forest carbon project participants will need to engage ecological monitoring experts with experience of the project zone (or similar areas) to choose suitable methods. Care should be taken to ensure these methods are pragmatic and realistic within the project budget and timeframe. In particular, project proponents should resist the temptation to define an overly ambitious monitoring plan at project start that will be difficult to follow throughout the project lifetime, considering that the CCB Standards will demand that future monitoring follows what has been defined in the Project Design Document.

Summary of Expertise Required to Select Indicators

Level 3
Designs

Level 2
Implements

Box 11. Piggy-backing on Measurement and Monitoring of Forest Carbon Stocks

As discussed in the Carbon Stocks Assessment Guidance, forest carbon projects will require careful measuring and monitoring of carbon stocks. Carbon stock measures often represent highly valuable surrogate biodiversity indicators. Thoughtful design of forest carbon stock monitoring will enable powerful and low-cost or free piggy-backing of biodiversity monitoring, notably for key indicators suggested by the CCB Standards (B3): "habitat area, quality and diversity; landscape connectivity; and forest fragmentation."

Most importantly, the extent of forest (or certain habitat areas within it) is a good indicator of the state of biodiversity (particularly HCVs 2 and 3). Remote-sensing images obtained and analyzed to calculate forest extent will typically be analyzed in full (rather than just for the project area), thus potentially providing data on the extent of forest in control areas (even if not, the additional costs of extra analysis once an automated methodology has been developed are minimal). They can also easily and cheaply be used to calculate other good indicators of the state of biodiversity, forest fragmentation, and landscape connectivity (particularly relevant to HCV 2).

Changes in carbon pools – particularly above-ground biomass, litter, and dead wood – will not only directly indicate habitat quality (particularly HCVs 2 and 3) but also indirectly indicate the extent to which forests are being disturbed or exploited – a good indicator of pressure on biodiversity (e.g., for HCVs 1.1-1.3). Monitoring of such changes is likely to involve a level of ground-truthing. In that case, simple modifications to ground-truthing methods – such as identifying HCV plant species in sample plots – may enable valuable data to be collected on the state of any HCVs that are plant species (HCVs 1.2 or 1.3). Such ground-truthing need not be expensive if it is community-based.

Note, however, that a carbon monitoring approach may well (conservatively) neglect items such as the deadwood or litter carbon pools for cost-effectiveness reasons. Where monitoring certain variables may not be justified or required for carbon stock assessments alone, their usefulness for biodiversity monitoring may justify incorporating them into an overall, holistic monitoring approach. It should also be noted that the CCB Standards require biodiversity monitoring in the entire project zone (i.e., including communities lands adjacent to the actual project area), whereas carbon monitoring may cover a different area (project area and/or reference area and/or leakage belt, as defined, e.g., by the VCS).

7.1 Timing Monitoring and Linking It to the Assessment of Starting Conditions

The CCB Standards require forest carbon project developers to "commit to developing a full monitoring plan within six months of the project start date." This should not be misunderstood to mean that monitoring itself need only start six months or more after the project commences. Although the frequency of monitoring through a project will depend on the biodiversity variables being monitored and the speed at which they are expected to show change in the project zone, it is crucial to design the initial assessment of starting conditions (as discussed in Section 3.1) with later monitoring objectives in mind. Project impacts can only be determined if observed (factual) outcomes of the project can be systematically compared to measured starting conditions. Measuring indicators only after a project has started will not lead to an accurate definition of starting conditions, and so full project impacts (positive or negative) will not be taken into account.

Box 12. Key References on Indicators, Methods, and Timing

Tucker, G., et al. *Guidelines for Biodiversity Assessment and Monitoring for Protected Areas.* Kathmandu, Nepal: KMTNC and UNEP, 2005. Available at: http://www.unep.org/tools/default.asp?ct=assess2.

> *Provides useful overall guidance on selecting project-/site-specific indicators, methods, and timing relevant to biodiversity targets and their threats.*

Layton, P.A., and S.T. Guynn. *Wildlife and Biodiversity Metrics in Forest Certification Systems.* Research Triangle Park, NC, USA: National Council for Air and Stream Improvement, 2003. Available at: www.ncasi.org/Publications/Detail.aspx?id=81.

Whitman, A. A., and J. M. Hagan. *Biodiversity Indicators for Sustainable Forestry.* Final Report to the National Commission on Science for Sustainable Forestry, Brunswick, Maine: Manomet Center for Conservation Sciences, 2003. Available: www.manometmaine.org/documents/HaganandWhitmanJForestry2006.pdf. See also their web-based tool at: www.manometmaine.org/indicators.

> *Two major reviews of sustainable forestry monitoring, which assess over 2,000 different biodiversity indicators and discuss important characteristics of good indicators.*

Danielsen, F., et al. "Local participation in natural resource monitoring: a characterization of approaches." *Conservation Biology*, 2009: 31-42.

Hockley, N.J., J.P. Jones, F.B. Andriahajaina, A. Manica, E.H. Ranambitsoa, and J.A. Randriamboahary. "When should communities and conservationists monitor exploited resources?" *Biodiversity and Conservation*, 2005: 2795-2806.

> *Both articles, and the references therein, discuss locally-based monitoring and its usefulness.*

BirdLife International. *Monitoring Important Bird Areas: A Global Framework.* Cambridge, UK.: BirdLife International, 2006. Available at: http://www.birdlife.org/regional/americas/apm_documents/Background%20paper%2011.2_IBA%20Monitoring%20Framework.pdf.

Bennun, L., G. Davies, K. Howell, H. Newing, and M. Linkie. *African Forest Biodiversity: A Field Survey Manual for Vertebrates.* Oxford, UK: Earthwatch Institute (Europe), 2002. Available at: http://www.earthwatch.org/europe/downloads/Publications/African_Forest_english.pdf.

Bibby, C., M. Jones, and S. Marsden, . *Expedition Field Techniques.* London: Royal Geographic Society, 1998. Available at: http://biology.kenyon.edu/courses/biol229/fieldmanual%20birds.pdf.

> *Key compendia of practical scientific methods for biodiversity survey and monitoring.*

Thomas, J.A. "Monitoring change in the abundance and distribution of insects using butterflies and other indicator groups." *Philosophical Transactions of the Royal Society B*, 2005: 339-357.

> *Provides a useful evaluation of insect monitoring.*

Pistorius, T., C.B. Schmitt, D. Benick, and S. Entenmann. *Greening REDD+: Challenges and opportunities for forest biodiversity conservation.* Unpublished policy paper, Germany: University of Freiburg, 2010. Available at: www.cbd.int/doc/meetings/for/ewredd-01/other/ewredd-01-oth-greening-redd-en.pdf.

> *Discusses the incorporation of biodiversity measures into remote sensing.*

8. Eliminating Sources of Error

There are many common pitfalls and sources of error in monitoring. The most relevant to biodiversity impact assessment are outlined below, with guidance to how such errors can be avoided or reduced. Although this section aims to provide an overview that may be useful orientation for project developers, readers should note that specific project monitoring needs will need to be addressed with the support of trained scientists.

8.1 Sampling Effort, Seasonality, and Standardization

These three Ss are perhaps the most common examples of pitfalls within biodiversity monitoring. Sampling, within both space and time, is necessary because monitoring cannot take place continuously everywhere. For example, specific small sample plots may be chosen within the project zone for monitoring twice each year. Insufficient sampling effort will yield meaningless results, but additional sampling effort raises costs. Likewise, there are trade-offs between increasing the number of sample areas or the number of surveys each year. For example, in Ghana, it was found that in order to reliably detect the population trends of four mammal species in two protected areas over five years, the project required a minimum of 26 monitoring sites (roughly one every 200 km^2) monitored nine times per year, with denser monitoring sites in the smaller protected area (Brashares and Sam 2005).

Decisions on how much sampling is enough for a particular project zone and suite of indicators can only be made by understanding the statistical methods that will be used to analyze collected data later in the project. Forest carbon project participants will, thus, need advice from experts who combine both biological and statistical knowledge.

Most forests across the world have some level of seasonality, whether in temperature, precipitation, or some other variable. Seasonality can affect such things as vegetation growth, fruiting, and related animal distributions. Monitoring should thus clearly take place in similar seasons each year, but this is often overlooked or poorly planned. Attempts to compare data from different seasons will struggle or fail.

Standardization is ideally required not just of seasonality, but also of surveyors and methods. Changing methods halfway through a project will yield results that are not comparable, and so greatly hinder attempts to assess project biodiversity impact. Changing even details of methods – such as the time of day or duration of surveys – may result in similar problems. Further, even the best, most consistent methods rely on the skill and judgment of those implementing them. Whenever possible, the same people should carry out each type of monitoring year after year throughout the project. When this is not possible, sufficient training should be given to ensure consistency among surveyors.

8.2 Sample Selection and Self-Selection Biases

Selection of sampling areas for monitoring within a project zone or within control areas can take place in a number of ways. Often, judgment selection is used whereby the project developer or external experts choose areas they judge to be representative of the project area. In reality, these are often not entirely objective choices – for example they may be biased by ease of accessibility – and, even when they are, experience shows that they frequently represent the overall project zone or control area sub-optimally. Ideally, sampling areas should be selected at random – although in reality common sense has to be used to ensure that randomly chosen areas are not too difficult or time-consuming to monitor regularly.

Ideally, in terms of scientific reliability of results, project implementers and local people should not be aware of the locations of the sampling areas, as this would likely cause unintended behavioral responses. For example, people may reduce – or be more secretive about – illegal activities if they know they are being monitored. However, such an approach may not always be practicable or appropriate, especially considering the aim of a transparent implementation of all project activities and broad community involvement.

In some cases, the whole project zone may be subject to self-selection bias. For example, forest carbon projects may be established in the first place in areas with conservation-minded communities, and thus biodiversity measures may perform better in the project area than nearby areas. Careful choice of control areas where communities have similar attitudes, to the extent that these can be measured, and use of a strong causal model will help to mitigate such effects of self-selection bias.

8.3 Contamination and Contagion

The value of monitoring control areas has been highlighted in this chapter. A major issue with trying to measure a reference scenario in a control area is contamination or contagion. These terms refer to changes in the control area that render it less valuable or representative as a control site, therefore requiring careful analysis of data in order to tease out the uncontrolled variables. Contamination and contagion may occur due to spillover effects of the projects or interventions by other agencies, similar to the concept of positive leakage.

Summary of Expertise Required to Assess Contamination and Contagion

Level 3
Designs, Trains Level 2

Level 2

Spillover effects generally refer to nearby communities noting positive effects of project interventions (for example, adoption of fuel-efficient stoves requiring less firewood) and spontaneously copying those interventions in areas near the project zone. In addition, a biological spillover effect may occur. For example, if hunting is stopped in the project zone, it may become a source area for species that spread into neighboring areas. Overall, selection of control areas must therefore ensure that they are close enough to the project intervention zone to be similar yet distant enough to have a low chance of contagion. Alternatively, spillover effects could also be conservatively neglected (similar to what is done with positive leakage regarding carbon benefits), as long as the project is still able to demonstrate net positive benefits.

Contamination can also occur because the project proponent is not able to control what happens in control areas. Other agencies could thus implement similar interventions. The only ways to cope with this are to have a strong project causal model and to measure as many relevant data as possible in project and control areas in order to be able to use statistical analyses to tease out values corresponding to an accurate reference scenario from the confounding variables.

Box 13. Key References on Eliminating Sources of Error

Tucker, G., et al. Guidelines for Biodiversity Assessment and Monitoring for Protected Areas. Kathmandu, Nepal: KMTNC and UNEP, 2005. Available at: http://www.unep.org/tools/default.asp?ct=assess2.

Introduces common pitfalls and sources of error in monitoring.

Brashares, J.S., and M.K. Sam. "How much is enough? Estimating the minimum sampling required for effective monitoring of African reserves." *Biodiversity and Conservation*, 2005: 2709-2722.

Provides a useful, real-world example of trade-offs between the number of sample areas and the number of surveys conducted annually.

Yuccoz, N.G., J.D. Nichols, and T. Boulinier. "Monitoring of biological diversity in space and time." *Trends in Ecology and Evolution*, 2001: 446-453

Discusses selection biases.

9. Allocating Resources Efficiently

This chapter has provided a range of options for conducting biodiversity impact assessment, from simple, cost-effective solutions through to ideal scenarios. Piggy-backing on monitoring of carbon stocks can go a long way towards cost-effectively supporting biodiversity impact assessment. In almost all cases, up-front design of project-specific biodiversity impact assessment requires engaging a global standard ecologist, monitoring expert, or taxonomic expert. During implementation, an off-the-shelf framework such as the BirdLife IBA monitoring framework may well prove sufficient to guide project staff and frame results within a causal model.

REDD+ projects, reforestation projects on genuinely degraded lands using indigenous species, and many IFM projects (especially those that do not involve enrichment planting or introduction of additional tree species) have a high likelihood of positive biodiversity impacts. Such projects will often be able to convincingly suggest biodiversity benefits through relatively simple causal models, supported by modest monitoring of biodiversity leakage and pressures unrelated to habitat loss and degradation (and therefore not directly linked to carbon monitoring). A local ecologist/national taxonomic expert in collaboration with project environmental staff will usually be able to implement such modest additional monitoring, although a global standard monitoring expert is likely to be required for analyzing monitoring results.

IFM projects that involve enrichment planting or introduction of additional tree species, and many types of AR projects, may have complex impacts and will thus require the most sophisticated biodiversity impact assessment. The quantitative assessment of biodiversity impacts they may require is not cheap. It is likely to depend on inputs from a global standard ecologist/monitoring expert/taxonomic expert throughout design, implementation and analysis. Projects with small budgets and potentially significant biodiversity impacts are unlikely to be able to either sufficiently measure changes in biodiversity or attribute these to project interventions, and they may therefore struggle to achieve CCB validation.

10. Conclusions

A wealth of relevant experience and guidance already exists in the fields of project design and management, and in biodiversity measurement, monitoring and evaluation. Existing frameworks, methods and indicators relevant to site-based forest conservation projects can be readily adapted to biodiversity impact assessment of forest carbon projects. Not only do suitable tools already exist for such assessment, but they can be implemented at relatively low cost by complementing limited expert monitoring of the state of key biodiversity targets with locally-based monitoring methods and existing forest carbon stock assessment measures. Realizing the additional market and revenue benefits associated with CCB-validated forest carbon projects should therefore be feasible, and need not be too costly, for most responsible forest carbon project interventions if the necessary assessments and responses are well planned and integrated well into the project development cycle.

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Glossary

For CDM projects, readers may wish to refer to the official definitions provided in the CDM Glossary of Terms, available at: http://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf.

VCS also provides standard Program Definitions, which are available at:
http://www.v-c-s.org/sites/v-c-s.org/files/Program%20Definitions%2C%20v3.0.pdf.

Additionality – The principle of carbon additionality is that a carbon project should only be able to earn credits if the GHG benefits would not have occurred without the revenue (or expected revenue) of carbon credits. The same principle of additionality can be applied to social and biodiversity benefits.

Attribution – The isolation and accurate estimation of the particular contribution of an intervention to an outcome, demonstrating that causality runs from the intervention to the outcome. That is, attribution demonstrates that benefits claimed by the project (usually *co-benefits*) have been caused by the project and not another phenomenon.

Baseline – See *reference scenario*.

Biodiversity target – Biodiversity features which the project will target in its efforts to achieve net positive impacts on biodiversity. These will usually comprise High Conservation Values.

Causal model – See *theory of change*.

Co-benefits – Benefits generated by a forest carbon project beyond GHG benefits, especially those relating to social, economic, and biodiversity impacts.

Control – In the context of impact assessment for forest carbon projects, an area that does not experience project interventions but is otherwise similar to the project area. Controls are used to monitor the reference scenario and to demonstrate the attribution of outcomes and impacts to the project.

Counterfactual – The outcome that would have happened had there been no intervention or project – i.e., the final outcome of the reference scenario.

Evaluation –The systematic and objective assessment of an on-going or completed project, program or policy, and its design, implementation, and results.

GHG benefits – Any emissions reductions from reducing carbon losses or emission removals from enhanced carbon sequestration due to the forest carbon project activities.

Impact – The positive and negative, primary and secondary, short- and long-term effects of a forest carbon project. Impacts may be direct or indirect, intended or unintended. Impacts result from a chain of inputs, outputs, and outcomes.

Indicator – A measurable variable that reflects, to some degree, a specific monitoring information need, such as the status of a target, change in a threat, or progress toward an objective.

Inputs – The financial, human, and material resources used for a forest carbon project. Most relevant in discussion of outputs, outcomes, and impacts.

Leakage – The geographical displacement of GHG emissions – or social, economic, or biodiversity impacts – that occurs as a result of a forest carbon project outside of the forest carbon area. Leakage assessments must consider adjacent areas as well as areas outside of the project zone.

Measurement, Reporting, and Verification System – A national, subnational, or project-level set of processes and institutions that ensure reliable assessment of GHG benefits associated with real and measurable emission reductions and enhancement of carbon stocks.

Methodology – An approved set of procedures for describing project activities and estimating and monitoring GHG emissions.

Monitoring – A continuing process that uses systematic collection of data on specified indicators to provide indications of the extent to which objectives are being achieved.

Multiple-benefit projects – Projects that generate sufficient environmental and social co-benefits, in addition to GHG benefits.

Outcomes – The likely or achieved short-term and medium-term effects of an intervention's *outputs*.

Outputs – The products, capital goods, and services that result from a forest carbon project.

Project area – The land within the carbon project boundary and under the control of the project proponent. (The CCB Standards use distinct language for *project area* and *project zone*.)

Project developer – The individual or organization responsible for the technical development of the project, including the development of the PDD, the assessment of social and biodiversity impacts, monitoring and evaluation, etc. Although the term does not necessarily describe a commercial entity, it often refers to an external company that is contracted to do work on the ground.

Project Design Document – A precise project description that serves as the basis of project evaluation by a carbon standard, commonly abbreviated to PDD. (Alternatively, VCS calls this the "project description," or PD)

Project participant – Under the CDM, a Party (national government) or an entity (public and/or private) authorized by a Party to participate in the CDM, with exclusive rights to determine the distribution of CERs – equivalent to *project proponent* under the VCS. In the voluntary market, project participant is used more loosely to describe any individual or organization directly involved in project implementation.

Project proponent – A legal entity under the VCS defined as the "individual or organization that has overall control and responsibility for the project." There may be more than one project proponent for a given project. Carbon aggregators and buyers cannot be project proponents unless they have the right to all credits to be generated from a project.

Project zone – The project area plus adjacent land, within the boundaries of adjacent communities, which may be affected by the project. (The CCB Standards use distinct language for *project area* and *project zone*.)

REDD – A system that creates incentives and allocates emissions reductions from reducing emissions from deforestation and forest degradation.

REDD+ – A system that creates incentives and allocates emissions reductions from the following activities: (a) reducing emissions from deforestation; (b) reducing emissions from forest degradation; (c) conservation of forest carbon stocks; (d) sustainable management of forests; and (e) enhancement of forest carbon stocks.

Reference scenario – An estimated prediction of what will happen in a given area without the project. Reference scenarios may cover land use patterns, forest conditions, social conditions, and/or biodiversity characteristics. Also called the "business-as-usual scenario" and the "baseline."

Starting conditions – The conditions at the beginning of a project intervention. Also called "original conditions" in the CCB Standards and sometimes referred to as the "baseline" in the field of impact assessment. This can, however, lead to confusion, considering that CCB Standards and carbon standards use the same term to describe the "reference scenario" of a forest carbon project.

Theory of change – The hypothesis, as developed by the project design team, of how the project aims to achieve its intended goals and objectives, including social and biodiversity objectives. This is sometimes referred to as the *causal model.*

FOREST TRENDS

The Family of Forest Trends Initiatives

Marine Ecosystem Services Program
MARES

Using innovative financing to promote the conservation of coastal and marine ecosystem services

Ecosystem Marketplace

A global platform for transparent information on ecosystem service payments and markets

Forest Trade & Finance

Bringing sustainability to trade and financial investments in the global market for forest products

the katoomba group

Building capacity for local communities and governments to engage in emerging environmental markets

BBOP

Business and Biodiversity Offsets Program, developing, testing and supporting best practice in biodiversity offsets

Chesapeake Fund

Building a market-based program to address water-quality (nitrogen) problems in the Chesapeake Bay and beyond

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