CERCARBONO
Certified Carbon Standard

Indicator Species Biodiversity Methodology

For conservation of intact regional biodiversity using indicator species

Methodology CBCP-01

For conservation of intact regional biodiversity using indicator species

Version 1.2

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Acronyms and abbreviations

BCP	Biodiversity Crediting Project
CBCP	Cercarbono Biodiversity Certification Programme
CBCPP	Cercarbono's Biodiversity Certification Programme Protocol
CBD	Convention on Biological Diversity
eDNA	Environmental deoxyribonucleic acid or environmental
IEP	Independent Experts Panel
ILO	International Labour Organizations
IP	Indigenous Peoples
ISBM	Indicator Species Biodiversity Methodology
IUCN	International Union for Conservation of Nature
iVBC	Innovative Voluntary Biodiversity Credit
KML	Keyhole markup language
LC	Local communities
MRV	Monitoring, reporting and verification
NBSAP	National Biodiversity Strategies and Action Plan
NGO	Non-governmental organization
PMP	Project Management plan
SDGs	Sustainable Development Goals
UNESCO	United Nations Educational Scientific and Cultural Organization
VBC	Voluntary Biodiversity Credit
WWF	World Wildlife Foundation

Terms and definitions

The following terms are relevant to this methodology. For definitions, refer to the ***Terms and Definitions of the Cercarbono's Biodiversity Certification Programme***, available at www.cercarbono.com.

Other terms related specifically to biodiversity science are described below:

Baseline: In the context of this conservation methodology, baseline refers specifically to the calculation of the Value layer of the biodiversity unit.

Biodiversity hotspots: A biogeographic region characterized by exceptionally high levels of species richness and a significant degree of habitat loss. These areas are recognized for their extraordinary concentration of endemic species, meaning species that are found nowhere else in the world.

Conservation: There is a technical argument that this methodology falls under the definition of 'preservation' in many environmental contexts. *"Conservation seeks the proper use of nature, while preservation seeks protection of nature from use"*. For simplicity, and readability with a non-technical IP and LC audience we have used the term conservation throughout (Becker & Ghimire, 2003).

Date-time stamp: Data indicating a specific date and time when an event occurred, or a particular record was created or modified.

Ecosystem connectivity: Connectivity (i.e., ecological connectivity) is the unimpeded movement of species and the flow of natural processes that sustain life on Earth. It may thus also refer to continuous ecosystems often connected through ecological corridors. There are two types of connectivity: structural (in which the continuity between ecosystems is identified) and functional (in which the movement of species or processes is verified).

Ecosystem integrity: An ecosystem is generally understood to have integrity when its dominant ecological characteristics (e.g., elements of composition, structure, function, and ecological processes) occur within their natural ranges of variation, and extinction, and can withstand and recover from most perturbations.

Ecosystem services: The benefits people derive from ecosystems.

Ecosystem value: The planet-wide value of an ecosystem in the context of global biodiversity loss. Often referred to as "significance" in other contexts.

Geographical location: Latitude and longitude values that uniquely identify a particular point or area on a map in decimal degrees format.

Home range: The specific geographic area or territory that an individual animal typically occupies and uses for its essential activities. It represents the spatial extent to which an individual carries out daily functions such as foraging, mating, seeking shelter, and defending resources.

Indicator species: In this methodology, this term is specifically defined as inclusive of the more precise academic terms for sentinel species (indicative of environmental disturbances or pollutants), umbrella species (representative of a larger ecosystem for conservation management), endangered, locally endangered, or threatened species (at risk of extinction in the near future), and rare species (not commonly found or with a limited population its natural habitat).

In situ conservation: The conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

Intact ecosystem: It refers to primary, undisturbed ecosystems with all healthy attributes in balance (composition, structure, and function) and where their natural ecological processes develop without interruption. These ecosystems have all the niches available to native species and are fully occupied accordingly.

Leakage: In this methodology, is defined as biodiversity outside of the project area that could be adversely affected by the implementation of the project.

Net gains in biodiversity: It corresponds to the difference in gains in biodiversity values from the baseline of the project compared to the ones obtained during the implementation of the conservation project. Note: not covered by this version of the methodology which is conservation-only (see Scope).

Risk of extinction: The probability that a species will go extinct in a given period of time.

Species: Group of individuals or natural populations that are actually or potentially interbreeding, reproductively isolated from other similar groups by their physiological properties (reducing incompatibility between parents or sterility of hybrids, or both).

Species distribution: The geographic area or range where a particular species is found and occurs naturally. It includes all the locations and habitats where individuals of a species are predicted to exist.

Species richness: The population of different species present in a particular area or ecosystem. It is a measure of biodiversity that quantifies the diversity of species within a given habitat or geographical region, but it does not speak to the abundance or distribution of the species.

Executive summary

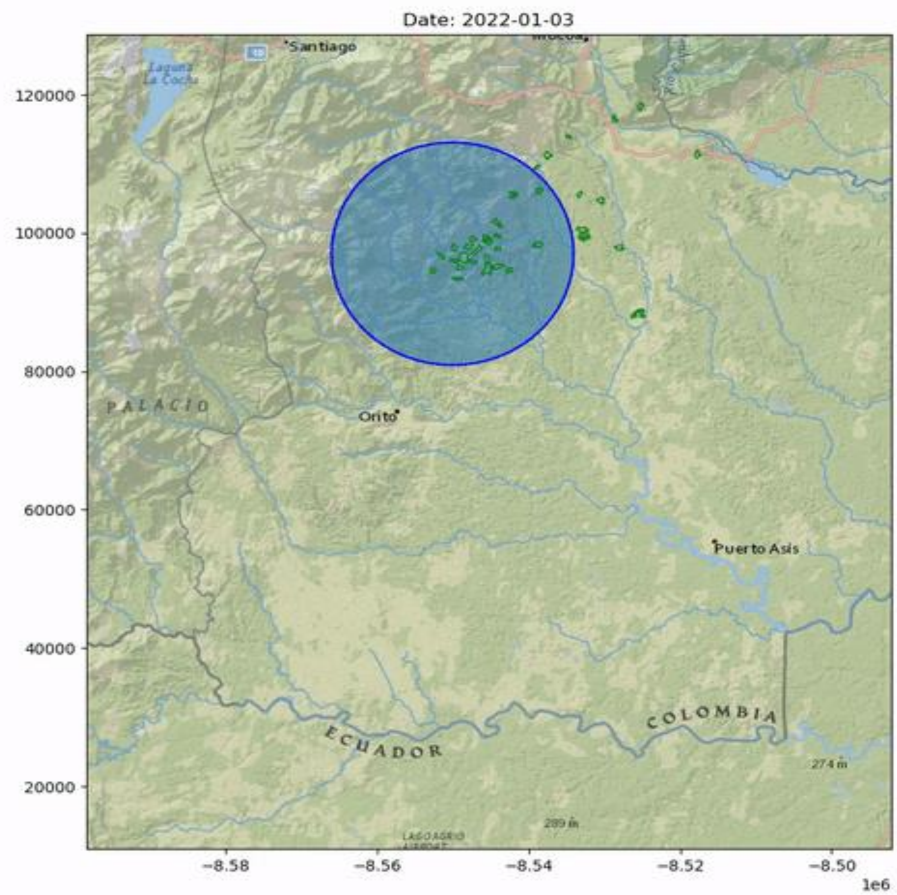
This methodology has been designed for simplicity and rapid deployment. It was co-developed with Indigenous Peoples (IP) and local communities (LC) involved in grassroots conservation in the Colombian Amazon *then* translated to global markets by a dedicated core of conservation scientists for the immediate use of like-groups.

Indigenous people steward an estimated 80% of the conserved biodiversity on earth (Stewart *et al*., 2021).

This methodology relies on indicator species. A simple but powerful concept: certain species of flora and fauna can survive only in functional ecosystems. A healthy specimen in the wild is a scientifically valid indicator that the ecosystem is functionally intact. Proving the existence of indicator species using non-invasive monitoring techniques (such as simple game cameras, photographs, or audio recordings), respects the wildlife and can be easily, and immediately implemented on the ground by IP and LC groups within traditional hunter-gatherer contexts. This is practical, useful, and valid given the difficulties of knowing or monitoring the fauna and flora of large ecosystems like the Amazon, and thanks to recent research, it is demonstrated that species diversity in one taxonomic group may be sufficient to represent other aspects of biodiversity (Cox *et al*., 2022; Rapacciuolo, 2024; Rapacciuolo *et al*., 2019).

This methodology issues voluntary biodiversity credits (VBCs). As such, it can never be used to provide “offsets” of any kind.

Figure 1. Data from ISBM biodiversity pilot site occurring over one year in the Colombian Amazon.



This methodology was co-developed with IP and LC. To date, leaders from eighteen Indigenous communities and hundreds of Indigenous smallfarmers in the Colombian Amazon have directly contributed to the design and piloting of this methodology. It is currently being considered for adoption by IP and LC groups in Ecuador, Peru, Brazil, Suriname, Mexico, Panama, Bolivia, Guatemala, Fiji, Papua New Guinea, Indonesia, the Philippines, Gabon, Kenya, South Africa, Uganda, Australia, New Zealand, the US, and Canada. It has been reviewed and refined privately and publicly by global experts using biological and anthropological considerations for biodiversity preservation, scientific understandings of complex adaptive systems, market needs for fungibility, and the urgency of minimizing further irreversible extinctions (for more information about authors please refer to www.savimbo.com).

This methodology was designed for behavior change. IP and LC can preserve or traffic rare species. They have unrestricted access to hunt or study the rarest and most valuable species on earth. They have traditional knowledge that far exceeds our best botanical and behavioral science. We have no choice but to fully respect their autonomy. This methodology is intentionally designed to economically incentivize positive role models within IP and LC and enables them to self-reinforce traditional ways of life which conserve and retain knowledge of biodiversity in its fullest expression.

We consider that this methodology will have the intended effect of strengthening the people with the biggest global impact on conserving biodiversity.

Getting started

The guidelines below provide the necessary steps for biodiversity crediting projects (BCPs) under Cercarbono Biodiversity Certification Programme (CBCP) to demonstrate ongoing conservation outcomes by monitoring indicator species. We detail the design and implementation of conservation-first ecosystem projects, projects that aim primarily to avoid the loss of intact regional functional biodiversity in biodiversity hotspots or equivalent ecosystems.

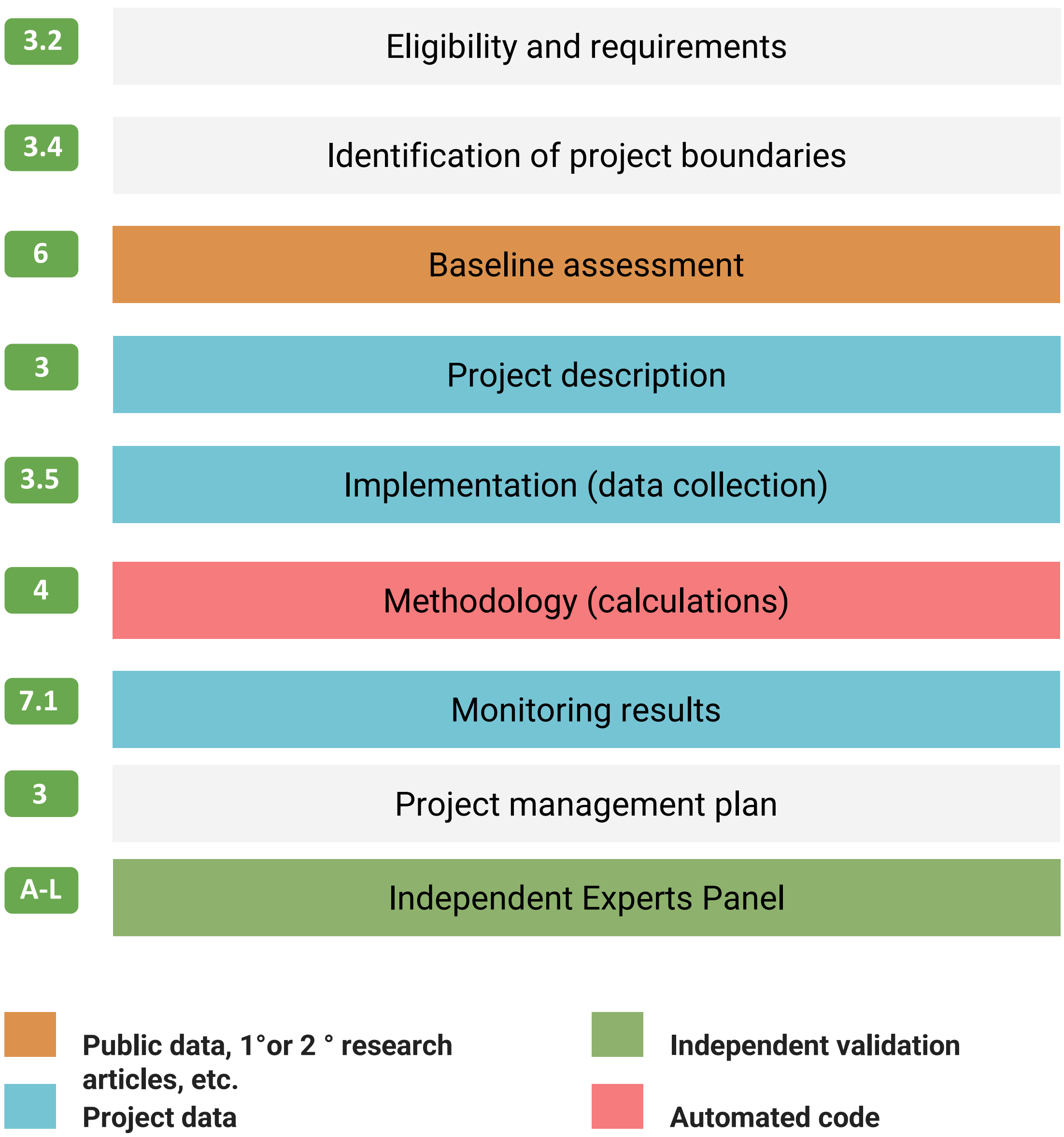
It contains clear incentives for IP and LC to participate in, and benefit from these projects, thus reducing human predation through hunting or trafficking activities. The methodology delivers specific requirements for outcome-based conservation crediting of biodiversity. Initiatives must:

- Design within the framework of the principles in CBCPP.
- Meet Eligibility and inclusion requirements.
- Complete the Safeguards checklist.
- Get Baseline assessment for their ecosystem(s) from public data:
  - Agents and drivers of biodiversity loss.
  - Baseline biodiversity (if available).
  - Ecosystem categorization (Value) and boundaries from a recognized source.
  - Indicator species that qualify for monitoring, justification, and characteristics.
  - Indicator species integrity score.
- Describe their Project in a Project Management Plan (PMP) with site-specific data including:
  - Project boundaries in time and space including jurisdiction(s), land rights, contracts, any ecosystem/jurisdictional segmentation, and potential leakage area.
  - Implementation plan and methods.
  - Monitoring plan and methods.

- Indicator species Observations in raw data (geocodes may be private).
- Alignment with Sustainable Development Goals (SDGs).

- Continuously Calculate credits using either open-source code or third-party-reviewed code.
- Continuously Monitor and report in accordance with CBCP requirements.

Figure 2. Steps in applying the indicator species biodiversity methodology.



1 Overall description

The Savimbo Indicator Species Biodiversity Methodology (ISBM) provides a simplified framework that protects resilient ecosystems while providing livelihoods for the human guardians of the land.

Simplicity is backed by current understandings of complexity theory, ecological science, and Indigenous and local knowledge. Most importantly, it offers an immediate and scalable response to the urgent problem of biodiversity loss, optimizing public data to leverage immediate action in the ecosystems most under threat.

The United Nations cites biodiversity as humanity's best defense against climate change, and according to Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), more than a million species are in danger of extinction within the next decade (World Wildlife Foundation, 2022). Furthermore, an estimated 80% of the conserved biodiversity on earth is stewarded by IP who are often excluded from accessing existing climate markets, whether philanthropic or commodities-driven, due to technical, economic, or socio-cultural factors (Bermúdez, 2023; Estrada *et al*., 2022; Gordon, 2022; National Geographic, n.d.; Stewart *et al*., 2021; World Wildlife Foundation WWF, 2020).

ISBM is a streamlined methodology, to meet one need: immediate activation of LC and IP on the ground for conservation of primary and/or intact forests and intact biodiversity hotspots. Local drivers of deforestation, habitat degradation, and animal depredation are often driven by real-time economic pressures and limited direct access to conservation markets. To meet this market need, as well as provide an immediate stopgap to preserve the habitats that are in danger today, this methodology can be easily and immediately deployed, and used to appropriately remunerate IP and LC preserve biodiversity (Stewart *et al*., 2021).

The dramatic decline in biodiversity is a threat to entire ecosystems, as each living being in the ecosystem holds a key part of the full system functionality.

One of the most comprehensive reports on the economics of biodiversity notes: "*From a financial perspective, just as diversity within a portfolio of financial assets reduces risk and uncertainty, so biodiversity increases nature's resilience to shocks, and thereby reduces risks to the ecosystem services on which we rely (…) Reduce biodiversity, and the health of ecosystems generally suffers*" (Christianson & Center for American Progress, 2016). The review also notes that quantifying the biosphere in economic terms is misleading "...*if the ecosystem collapses, life on Earth ceases, at which point the entire financial system is useless*".

The biosphere isn't valuable because of its economic value. It's valuable because, without it, there is no life on Earth.

Further information on the theoretical framework of this methodology can be found in Section 2.1.

1.1 Objectives

- Promote the shift of the economy towards models based on biodiversity conservation.
- Enable vulnerable populations and minority groups to access financial incentives for conservation efforts.
- Contribute to international mitigation of biodiversity loss within the framework of voluntary projects through actions that preserve intact in situ biodiversity.
- Contribute to the national conservation goals of each country and their species inventories.

1.2 Scope

This methodology is specific and applicable to the CBCP. Within that framework, it describes Cercarbono's requirements and project-level guidance for biodiversity conservation projects, for the quantification, monitoring, and reporting of activities aimed at producing VBCs and enhancing planetary biodiversity.

This methodology can be applied by any natural or legal person, public or private, that intends to establish a BCP that relies on indicator species monitoring by communities, to qualify for payments for results or similar compensations, as well as to contribute to international mitigation in the framework of voluntary projects, because of actions that conserve intact biodiversity.

Biodiversity conservation from ISBM activities that a BCP undertakes, should be consistent with the national targets and may contribute to their accounting. Conservation outcomes from additional ISBM activities (as well as pools and sources of species richness not included in the NBSAPs), even if not accounted for at that scale, may also qualify for conservation outcomes in the scope of this methodology.

This methodology is applicable whether a project is in an overlapping situation with a National Biodiversity Strategies and Action Plan (NBSAP) or not. The overlap scenario allows for consistent monitoring between the ISBM baseline scenario, the project scenario, and the NBSAP. Under this situation, additionality needs to be evaluated with Cercarbono's additionality tool.

This methodology is consistent with the Convention on Biological Diversity (CBD) (UNEP, 2003) and is articulated with CBCP.

The ISBM centers on the conservation of biological diversity, an essential aspect of CBD activities identified by Norden *et al*. (2015). Conservation of biological diversity entails the protection of diverse ecosystems that may have been impacted by activities like hunting or habitat loss. The success of this conservation effort is evaluated by the extent of ecosystems that retain full Integrity throughout the assessment period, incorporating International Union for Conservation of Nature (IUCN) threatened species or habitats in alignment with national or international standards.

The scope of ISBM is designed for simplicity and rapid deployment. Thus, it only allows for conservation activities to be monitored. Future versions are likely to allow for the inclusion of restoration, habitat management, or climate change-related activities under the CBD.

1.3 Limitations

This methodology does not seek to fully quantify biodiversity in its crediting area. Instead, it seeks to provide a fair, transparent, and usable proxy metric for the local conservation of ecological zones which are known to be high-value targets for planetary health.

While this methodology can show the extension of conserved ecosystems as rare and endangered species extend their habitats and activity, it should not be used to show gains in ecosystem integrity (degraded ecosystem improvements). Which will fall under other methodologies in the CBCP.

This methodology is not designed for use for a particular species. Instead, it is encouraged for projects to collect data from as many qualifying species as possible to demonstrate an intact ecosystem in many taxonomic kingdoms.

As a standalone metric for conserved biodiversity, this methodology is designed to stack with other important ecological assets. Including soil, air, water and carbon. However, while it is possible for the presence of biodiversity to infer the presence of intact soil, water, and carbon fluxes, this methodology should not be used to quantify such inferences which would require specific ecological metrics that fall outside its bounds.

2 Justification

There are several reasons for the need for this methodology.

2.1 The urgency of targeted biodiversity conservation

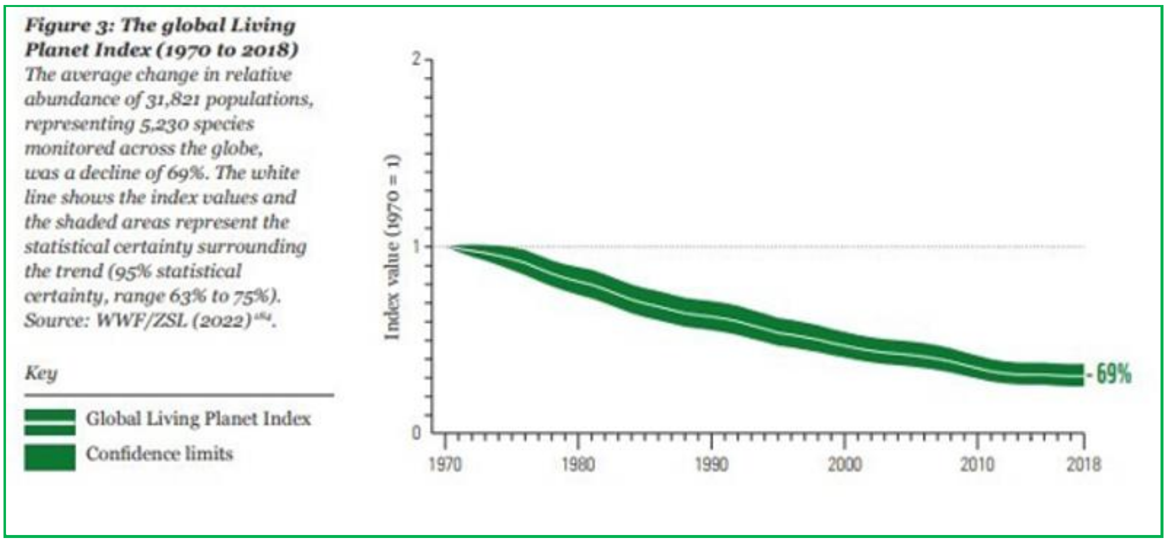
Given the current climate crisis, it is necessary to raise awareness about the benefits of wildlife conservation for humanity since human actions have modified their habitats, generated overexploitation of natural resources, and polluted ecosystems causing the extinction of many species, the Amazon has been strongly affected.

During the last 50 years, increasing its temperature by one degree and decreasing 20% of its primary forest cover, which represents a turning point of death of the Amazon (Bochow &

Boers, 2023; Nobre *et al*., 2016), without taking into account the fact that wild species are forms of life that evolve, and they are a fundamental part to maintaining the balance in each of the ecosystems that we have today and are sustaining the planet, added to the little recognition that IP and LC have for their long, and effective in situ conservation task, thus this proposal was born.

According to the World Wildlife Foundation (WWF), over the past 50 years, the planet has lost approximately 70% of the wild animal population (World Wildlife Foundation, 2023). Extinction of species has occurred throughout the history of the planet, but current extinction rates of species are 100-1,000 times the average extinction rate over the past tens of millions of years, and extinction rates are rising (Ritchie *et al*., 2022).

Figure 3. Global Living Planet Index.



Source: World Wildlife Foundation (WWF), 2022.

Fortunately, a large percentage of the world's biodiversity is preserved and protected today by a resource that is overwhelmingly untapped: IP and LC. Approximately 27% of the Amazon is occupied by Indigenous territories, which also contain the lowest rates of deforestation (Josse *et al*., 2021). Therefore, a more inclusive methodology that recognizes the wholeness of the system represents a tremendous opportunity both for the preservation of the planet and for the investors and technologists who can leverage this untapped resource (Fischer *et al*., 2023).

2.2 Simplicity, complexity theory, and biodiversity

This methodology is based on emerging multidisciplinary science and theory regarding complex adaptive systems (e.g., mathematics, physics, economics, and meteorology). Secondly, this biodiversity methodology does not attempt to classify and measure all of the species in an ecosystem, noting that an estimated 7 million of the world's species have not been characterized (Mora *et al*., 2011). The planet is in crisis and this methodology prioritizes clear and immediate action that provides measurable results. Today's best planetary science also supports this approach (Ruiz-García *et al*., 2023; Wilburn, 2023; Kimbrough, 2023).

Complex ability to self-heal. In such systems, small changes can have oversized effects. Disruption can irreversibly knock them out of balance, and small conservation efforts can have butterfly effects much adaptive ecosystems maintain their resilience, that is, the larger than the sum of their parts.

Competing biodiversity methodologies are highly complex and multifactorial. Multifactorial methods require the disruption of these ecosystems with invasive equipment and visitors, and they are often rejected by the LC and IP who live in these locations.

By tackling these measurement challenges head-on, ISBM's approach provides a nuanced perspective on biodiversity and ecological health. We strive to optimize our methodologies and remain receptive to ongoing scientific developments in the field.

ISBM is based on complexity theory and also respects and aligns with IP and LC knowledge systems. Central to our approach is the selection of multiple kingdoms of indicator species in each bioregion. These species, encompassing a diverse mix of trees, birds, mammals, reptiles, and amphibians, are chosen for their environmental sensitivity, serving as living barometers of ecosystem health.

This approach eliminates the need for invasive and exhaustive scientific surveys in high-value ecosystems which are under-researched.

Furthermore, in the ISBM, projects can access VBC crediting based on ex-post outcomes rather than comparisons with ex-ante baselines or ex-post projections (Wilburn, 2023). Outcomes are measured and reported on an ongoing annual basis. This logic is also consistent with complexity science as evidence shows that iteration for an outcome is more effective in designing changes for complex systems which often exhibit randomness, nonlinearity, and tipping points in systems-level change (Resnicow & Vaughan, 2006).

By rewarding outcomes, in the form of indicator species, we increase real-time incentives, and free BCPs to experiment and utilize all available means to achieve desired results. Further positive extensions of conserved habitat or indicator species are directly coupled to VBC crediting and thus promptly rewarded.

2.3 Inclusion of Indigenous Peoples and local communities by design

The ISBM has been co-developed over one year with an on-site collaboration of biologists, conservationists, and Indigenous small farmers who live in the Putumayo Amazon, technologists, and direct involvement of representatives from five Indigenous nations (Kamëntsá, Cofán, Pasto, Emberá Chami, and Inga). Each of these groups represents an essential contribution to its relevance (for more detailed description see www.savimbo.com) (Zanjani *et al*., 2023).

To truly preserve biodiversity hotspots and functional rainforests requires a tremendous amount of work with both IP and LC, respecting cultural differences in perspectives of time and trust. But these groups have been excluded both by design, and ignorance — inclusion requires more than invitation and extends to investment, tools and information (Cheikosman, 2023). Methodologies that are overly complex or structurally exclusive can be inadvertently harmful to IP and LC (Indigenous Environmental Network, n.d.).

2.4 Policy and regulatory framework

Under the CBCP, BCPs are required to report contributions to the SDGs using the Biodiversity's Tool to Report Contributions to the Sustainable Development Goals', which is available at www.cercarbono.com. The review of the application of this tool will be part of the verification process. The SDG Tool Rubric must be duly signed by the Independent Experts Panel (IEP) in charge of the verification.

2.5 Benefits and impact

We have laid out clear economic, social, and scientific reasons for the adoption of this methodology. The clearest benefit and impact of this methodology, versus historical options for preserving biodiversity (OECD, 2008), are:

- Reduced institutional intermediaries.
- Fluid outcome metrics.
- Increased opportunity for IP or LC-led, bottom-up, site-specific, innovation in *methods*, with a focus solely on outcomes (Doerr, 2018).
- Automation of complex calculations and simplified raw data requirements.

3 Project description

The project description defines site-specific, project-generated data that is unique to the ecosystem, and IP or LC implementing the project. This section defines specific information that needs to be in the PMP for an ISBM project.

The calculation of VBCs is closely tied to the presence of indicator species within project boundaries and by extension a conserved ecosystem, not only for habitat but for biodiversity.

Thus, projects are rewarded not for activities, or for projections, but for outcomes, on an ongoing annual basis.

The steps to follow for a successful BCP and PMP are outlined in the Getting started section.

3.1 Principles and their operability at project level

BCPs must be compliant with the principles outlined in CBCPP.

3.1.1 Principles of working with IP

Many of these principles are equally applicable to LC and we encourage a higher standard of accountability to these communities where appropriate. However it is worth noting that IP have specific rights at the international level that must be recognized as outlined in UN Declaration on the Rights of Indigenous Peoples (UN DRIP) (United Nations, 2007).

- **Land rights:** The rights of IP over the lands they occupy must be respected.
- **Free, prior, and informed consent (FPIC):** Any intervention in IP territories must undergo a process of free, prior, and informed consent.
- **Direct funding:** Direct access to biodiversity funding.
- **Protection of life:** IP conservation leaders must be protected. *Anonymization of individual participants may be necessary in the public version of some Indigenous project PMPs given that this is not public information.*
- **Traditional knowledge preservation:** Policies developed in IP and LC territories must consider traditional knowledge, which needs to be incorporated into climate change strategies. Data collection must credit Indigenous contributors.

3.2 Eligibility criteria

The ISBM is applicable to projects that meet the following eligibility criteria:

Table 1. Eligibility criteria for ISBM.

Criteria	Description
Project activities	Conservation initiatives aiming to maintain the in situ conditions of biodiversity, avoiding losses in biodiversity. The conservation activities prevent the partial or total loss of an ecosystem, population or species, or the extinction of an endemic and or threatened species.
Implementation entity	Entities implementing the projects can be any recognized legal entity, but they should have a clear mandate from local Indigenous people to represent the project in their area.
Land rights	Proof of land ownership or land-use rights must be legally valid and compliant with Cercarbono's programme requirements, and adhere to local and national regulations. BCPs must have documentation from all land-rights holders for project implementation.

Criteria	Description
Identification of stakeholders and beneficiaries	All IP and LCs must be identified, and their inclusion in remuneration from the project transparently disclosed.
Vulnerability	The project area is vulnerable to or on a trajectory towards biodiversity loss due to degradation and/or deforestation if no project is implemented.
Prior funding or stacking	As addressed in CBCP additionality section. Projects may only stack VBCs with carbon crediting if they can clearly demonstrate they are doing additional activities (over and above what they are doing for carbon).
Project Scale	The minimum project geography must encompass an area that is the size of the home range of an individual of the indicator species that qualify for validation of biodiversity. Projects can include adjacent or non-adjacent properties with a trajectory to create contiguous areas.
Geographical location	No limitations. This methodology was developed with tropical rainforests in mind but it can be adapted with appropriate evidence for other geographies.
Legal projects	Projects must comply with all relevant local, regional, national, and international laws and regulations.
Project duration	Duration should be compliant with Cercarbono's program requirements. Projects should be viable for the long-term future, preferably for a maximum of 30 years.
Governance	Governance of the project should be driven by a collaborative approach with IP and LC and transparency into all aspects of the project.

3.3 Additionality

General additionality of this methodology must be demonstrated by applying the decision tree that appears in the current version of the CBCPP and covers financial, normative, and regulatory surplus additionality scenarios, to demonstrate that the biodiversity conservation is directly related to the project activity(ies) and not an external source.

3.4 Project boundaries

Projects have spatial and temporal boundaries. But the use of grouped projects is encouraged under this methodology which was designed for lateral spread and viral behavior change among IP and LC.

The main input for identifying project boundaries is land enrolled in the BCP and thus eligible for crediting, and the dates of that enrollment. We will address each in turn.

3.4.1 Spatial limits of the BCP

BCPs do not need to provide complex spatial data, such as habitat mapping data to be eligible under this methodology (Space Intelligence, n.d.). Many ecosystem classification systems and the tools for that classification are incomplete, untested, or financially and technically exclusive. Thus, we have intentionally simplified technologies and tools for describing projects spatially.

However, the spatial limits of the BCP must be explicitly defined in the PMP for land rights, Indigenous rights, and crediting algorithms, based on Cercarbono's Guidelines for Mapping Presentation and Analysis, mentioned in Section 3.4.1.5 Mapping guidelines.

3.4.1.1 Data layers

A BCP may contain three spatial data layers: areas, indicator species observations, and segments. These must be identified and delimited.

- **Observations** are comprised of the union of home ranges of indicator species generated during a BCP (Calculation).
- **Areas** allow for the macro division of the BCP, to separate surrounding areas from those where observations can be credited (Calculation).
- **Segments** can be used for projects that overlap two different ecosystems (i.e., ocean, coastline, and mangrove), or two different jurisdictional areas (i.e., different landowners).

3.4.1.2 Indicator species observations data layer

This data layer is generated by direct observations of the union of home ranges of indicator species during project implementation (see Area calculation).

3.4.1.3 Project area data layer

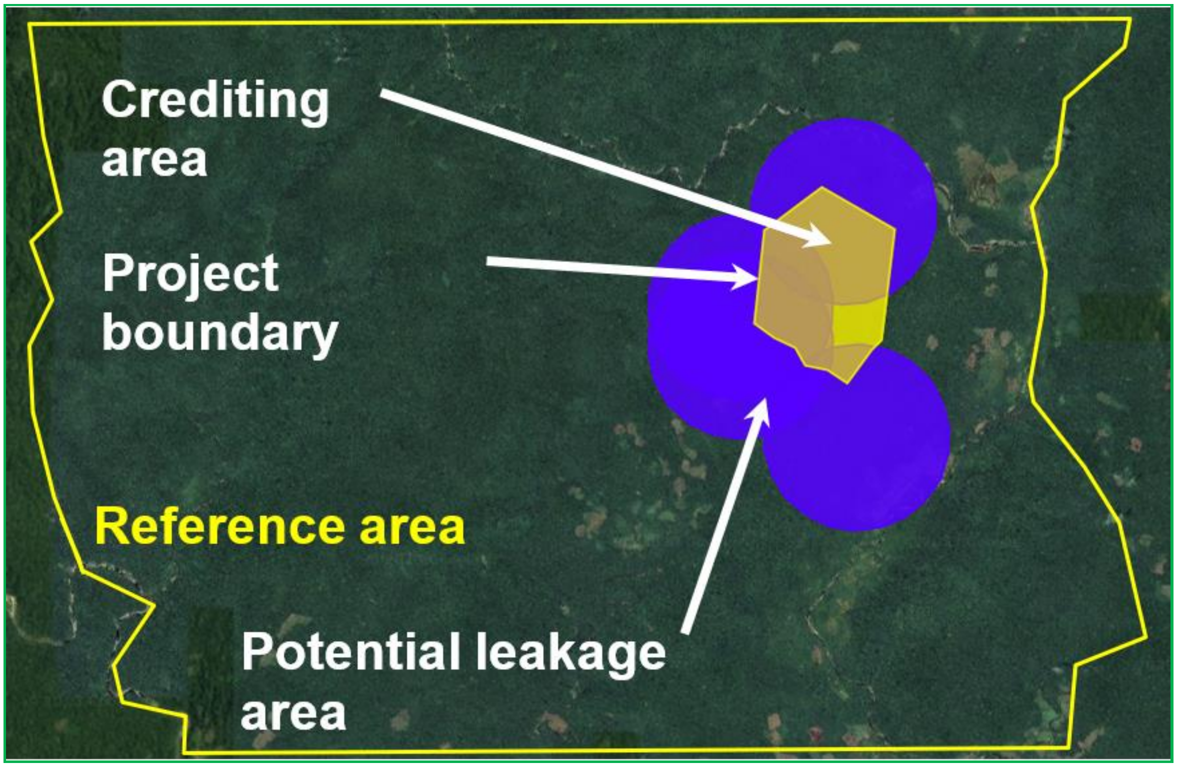
There are distinct project areas within a BCP, which may contain intact ecosystems as well as adjacent land, or ecosystems with some level of disruption.

Project areas are described below and depicted in Figure 4.

- **Reference area** is the geographical region or ecosystem(s) where the analysis of Agents and drivers of biodiversity loss is carried out, and Indicator species are defined. It should be bounded by micro-watersheds overlapping or adjacent to the BCP area. It is the broadest region of the BCP and includes all the other areas. The reference area must be defined in a geographic information system. It must include habitat areas and may or may not include non-habitat areas. The reference area is not subject to monitoring but must be re-evaluated in case of a reworking of the baseline scenario.

- **Project area** is the legally enrolled land within the BCP. This is the area where the BCP has permission or contract to issue biodiversity credits within (see Eligibility criteria). It is explicitly dedicated to biodiversity conservation, under contract with the BCP, and where the VBCs will be generated and rewards distributed. In grouped projects, land plots cannot overlap.
- **Crediting area** is the intersection of Indicator species observations and project area. Crediting areas may be segmented for ecosystems (different indicator species), value (different ecosystem threat classifications), or jurisdictional (crossing the border between two legal plots) reasons.
- **Potential leakage area** is radically simplified for IP and LC inclusion to the area home ranges of species observed within, but extending *beyond* the project area, animals likely ranging beyond crediting areas, this signal can be easily monitored from ongoing project data. If the analysis of agents and causes of biodiversity loss defines further drivers a BCP may decide to expand this area and describe and monitor a leakage management area for preventive action (see Additional monitoring requirements).
- **(Optional) Project activities area** this optional area can be described by BCPs but is not required. One aim of the methodology is to allow for a wide, and fluid range of locally-determined activities and reward for outcomes — thus stimulating experimentation from IP and LCs who know their ecosystems better than outside agents.

Figure 4. Diagram of spatial Areas of BCP with addition of the indicator species observations layer demonstrating creditable areas, buffer zone, total project area, and project boundary.



In developing your project, it's crucial to distinguish between the *reference area* and the *project area or crediting area*. The *reference area* refers to the entire geographical extent of the project, which might include both areas designated for conservation and other regions, such as infrastructure, human settlements, or areas that do not contribute to the project's biodiversity conservation objectives.

Some BCPs may obtain written permission from Cercarbono to use indicator-species observations generated outside the *project area*, where home ranges extend within the *project area* but all observations must fall within the *reference area* as described below.

As LCs frequently have small land plots, *project area* may not always be contiguous and could consist of multiple separate patches within the *reference area*. Each of these patches should contribute to the project's conservation goals, and their combined extent defines the *project area*.

IP projects may be grouped with neighboring LCs in grouped projects. This is encouraged when all parties agree as it contributes to conservation outcomes. This difference does not require segmentation as it is merely a difference in land ownership, but it will require different inclusion parameters and FPIC protocols.

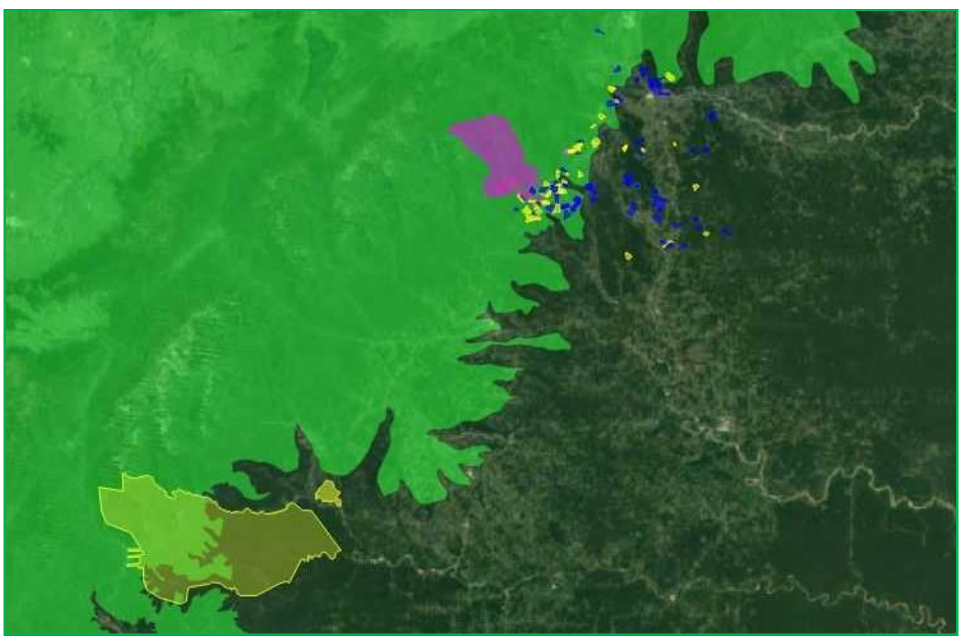
In summary, the crediting area is confined to the legally enrolled land, which is covered by a union of indicator species home ranges normalized to a circle (see Area calculations). Home ranges that overlap legally enrolled land compose an important metric, the potential leakage area (see Spatial limits).

3.4.1.4 Segments data layer

Projects that have substantial differences within the project area will need to be segmented for crediting. The most common reasons a project must be segmented are the following:

- **Ecosystems** may change within the project area. For instance, a large project that crosses ocean, to coastline, to mangrove swamps will have completely different ecosystem baseline classifications and indicator species.
- **Threat** many projects may protect the borders of ecosystems with different threat levels, and thus different crediting values (see Value calculations). Indicator species observations must be segmented for accurate crediting.
- **Jurisdiction** while projects that overlap countries borders must credit separately under Cercarbono's Standard, grouped projects may overlap regional boundaries with different governing parameters such as states.

Figure 5. Project area for a grouped project with satellite mapping showing segmentation by biodiversity hotspot boundaries.



3.4.1.5 Mapping guidelines

Project must comply with Cercarbono's Guidelines for Mapping Presentation and Analysis.

- **Ecosystems:** In line with the focus on maintaining and enhancing biodiversity within functional intact ecosystems, the boundary should primarily encompass regions that maintain their ecological processes. If the project contains more than one ecosystem, it needs to be segmented by ecosystem (see Baseline ecosystem characterization).
- **Geographic description:** It is required to provide a detailed geographic description of the project area in the PMP. This should include information about its physical characteristics (e.g., topography, climate), ecological features (e.g., ecosystem types, key species), and human aspects (e.g., land use, local communities). Describe any factors that might influence the project's implementation or outcomes.
- **Maps:** Include clear and detailed maps of the project and activity areas. Maps should include the project's geographic boundary and important features within it. Features could include habitat types, locations of key habitats, areas of particular conservation interest, ecosystem boundaries, and human settlements or infrastructure. Whenever possible, maps should be produced with GIS software or handheld GPS devices to ensure accuracy and clarity.
- **Boundary justification:** Provide a justification for the chosen boundary. Explain how the boundary aligns with the home range of the chosen indicator species and encompasses a functional intact ecosystem. Discuss any considerations or challenges encountered in defining the boundary, and how these were addressed.
- **Indigenous lands:** Include clear information about Indigenous lands included within or near the project area. Indigenous lands have different requirements for legal enrollment and must be clearly delineated.

3.4.2 Temporal limits of the BCP

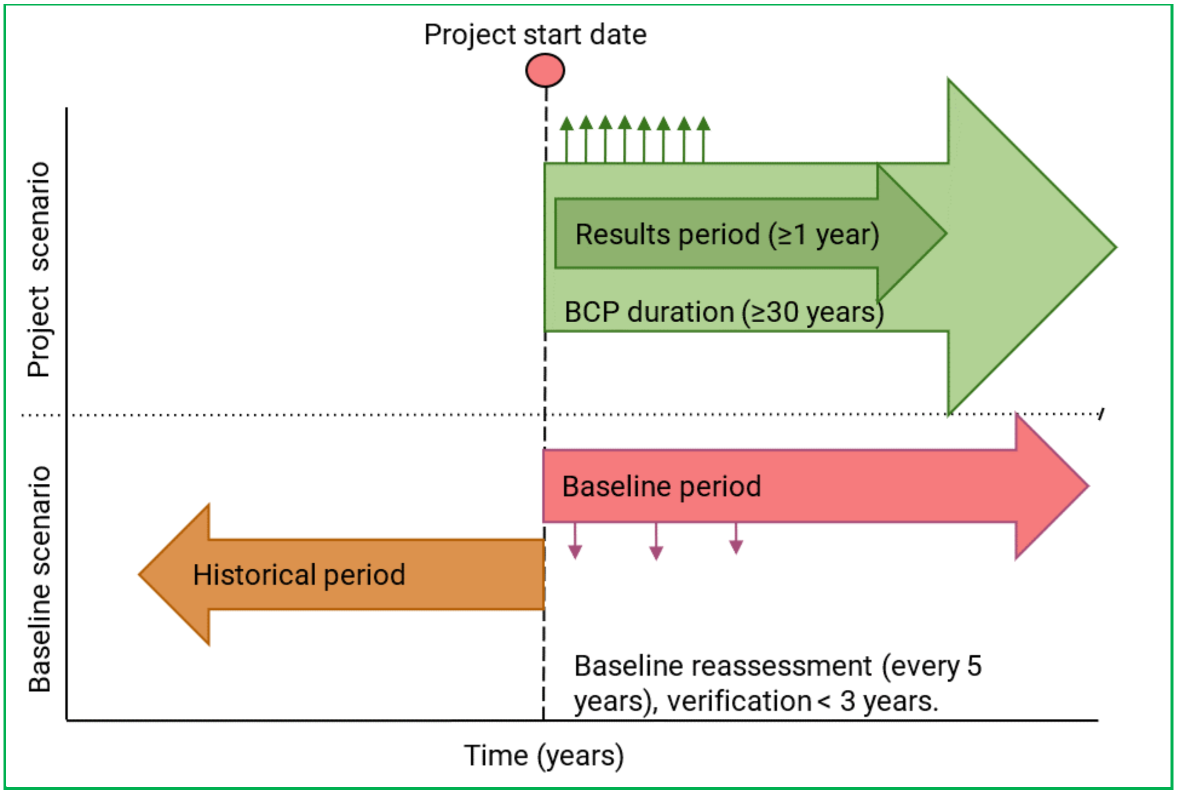
The temporal limits of the BCP must be explicitly defined in the PMP. VBCs may only be issued for conservation outcomes during the period determined by these limits. VBCs can be earned retroactively, see below.

The timing of crediting under the ISBM is the result of the long-term need for conservation against biodiversity loss, balanced against the contractual hesitance on the part of IP and LCs, the scientific limits of prediction in complex systems, acceptable market pricing, and the fundamental impermanence of biodiversity itself.

The methodology was written to allow for annual crediting based on evidence of continued presence of indicator species, rather than an assumed future state. For this methodology, temporal limits are defined by five different periods.

- **BCP start date:** The date on which the first on-the-ground actions were initiated, which led to conservation results. As per the Cercarbono program, the start date can be retroactive for up to 5 years prior to the validation of the PMP if project activities are well documented and have constituted *effective and proactive* conservation.
- **Historical period:** Period in which ecosystem function, native indicator species, and drivers of biodiversity loss have been characterized. This period should not be less than five years before the project start date and be justified for the stated CBD activities.
- **BCP duration:** Time range (in years) of active conservation projects. Projects can have a maximum duration of 30 years; these 30 years can span three consecutive crediting periods of 10 years each. Predicted biodiversity loss in the absence of intervention is optionally estimated during this period as data may be slim, and these projections are scientifically limited. The starting year of this period should coincide with the project start date where the first BCP interventions are carried out in the territory. Project registration can be canceled at any time, without the opportunity to re-register in the CBCP.
- **Results period:** Range of time (in years) over which BCP activities and the results of those actions are monitored in terms of observation of indicator species. The duration of this period may not be less than one year.
- **Verification times:** The periods of time within the results period in which the issuance of VBCs is certified by Cercarbono based on the indicator species observational data. BCP needs to have been verified at least once every three years during the crediting period.

Figure 6. Temporal delimitation of the BCP.



In summary, credits accrue monthly within the project's timeline and are issued annually for the duration of the project.

3.4.3 Grouped projects

This methodology was specifically designed for behavior change and lateral spread between IP and LC, whether adjacent smallfarmers, around the borders of game parks, and between Indigenous groups and their smallfarming neighbors. Thus grouped projects are encouraged, and the design of grouped projects is specifically addressed.

Grouped projects benefit biodiversity as animals range outside the borders of conserved areas, and ecosystem connectivity is a clear global conservation target (Vilar *et al.*, 2020).

Projects can begin as grouped projects. It is understood that IP and LCs desire shorter-term contracts specifically so they have the freedom to adjust to changing scientific standards or undesirable business relationships. Thus, projects are allowed to reduce crediting area as long as the 1-year minimum crediting period has been met. However, participants who have retired cannot be readmitted into the project.

Biodiversity is enhanced at the intersection of ecosystems, so it is possible a grouped project in the same geographic region may extend laterally to cover new ecosystems or indicator species. In this case, the project must provide segmentation and adjust the Project description and Baseline assessment if applicable. For instance, a wetland project extends into marine ecosystems, and when those projects are grouped, it enhances both environments. However, the indicator species may not be the same for those types of adjacent grouped projects. In such cases, projects must undergo a new validation process. Grouped projects must use the same methodology under Cercarbono's standard.

Once a BCP has implemented scalable infrastructure for the monitoring and reporting, scaling should be fairly straightforward. Updated Project boundaries can be provided during verification times if the Monitoring plan remains internally consistent.

As a note, given 5-year retroactivity of the CBCP, and clear monitoring data in the Leakage area, there is a strong financial incentive for neighboring lands to convert to conservation, and claim retroactive crediting.

In BCP projects using this methodology in de novo sites, it is strongly encouraged to start with a small area, prove the model sufficiently to IP and LCs first with tangible results then grow laterally year-over-year based on conservation successes and IP and LC earned trust.

3.5 Implementation plan

This methodology is applicable in resilient ecosystems with intact biodiversity that are under threat of a loss in biodiversity without intervention, or financial additionality. Projects must demonstrate a capacity to preserve local biodiversity by enabling IP and LC to become stewards of the ecosystem and deploying staff relying on traditional hunter-gatherer lifestyles to conserve the jungle and monitor for indicator species.

Each of the project activities must be under the responsibility of the project developers, and compliant with Cercarbono's certification standard.

Implementation plans have been intentionally simplified, as the primary data from a project is not a plan, but an outcome. Requirements are outlined in the CBCP PMP requirements.

3.5.1 Measurement approaches

The ISBM methodology requires primary data for an indicator species observation. Primary data that qualifies under this methodology must be able to identify an indicator species accurately, and have a geocode, and a date-time stamp.

Monitoring techniques that are not capable of delivering an accurate location for a species via triangulation or direct data capture (i.e., eDNA which could be generated anywhere along a watershed, untriangulated audio recordings in ocean) are excluded from this methodology. Identification techniques that are incomplete or inaccurate (i.e., uncharacterized DNA) are also excluded. However, some experimental approaches such as infrared drone may prove valid and useful and we do not preclude the use of techniques that meet the technical requirements.

Direct (video camera) and indirect (jaguar tracks or feces) observations are admissible in this methodology as long as the species being tracked can be geolocated by the indirect observation. For instance, feces from a spider monkey with a home range of 64 km could not geolocated a tree whose fruit is found in the feces to sufficient accuracy, unless the crediting area extended beyond 4 km in all directions of the observation, but it *could* accurately geolocate spider-monkey presence.

Raw data will require some post-processing with the identification of indicator species within the observation. And may require further processing such as auto-labelings of recordings, or triangulation of sonar.

Observations must include:

- **Verifiable unique, primary evidence** of the presence of the individual species using the appropriate equipment for the particular type of plant or animal. All evidence must be collected first-hand by the participants in the project or neighboring sites within the spatial and temporal project boundaries (see Project boundaries) and cannot be extrapolated from unaffiliated second- or third-party sources.
- **Geotagging and time-tagging of the evidence.** For areas where automated geotagging and time tagging are technically impossible, or financially unfeasible for the project, trusted participants/biodiversity guardians may provide written documentation of the observation time and location.
- **Species identification.** Ideally verified by a third-party such as iNaturalist.

The equipment chosen for the evidence is determined by the project itself who are best positioned to make decisions on the tradeoff between ensuring species detectability while avoiding wear and tear of equipment. For example, in jungle areas, game cams may be the only viable means to use without disrupting the environment, and high-humidity might limit the affordable use of audio recording equipment. However, in the ocean, sound recording devices may be the only practical option for detecting whales. In state-managed parks, animals may already be tagged. ISBM recommends each project choose the technology that is most effective, but least disruptive to the wildlife In their project areas.

It is important and relevant to note that this methodology has been democratized by a reliance on primary data. In this context, the raw data must be unique, of a high-quality, and accurately represent the BCP.

3.5.2 Indicator species observations and data

Indicator species observations require raw data (tagged, audio recording, video, or photo) date-time stamp, and geocode in decimal degrees format.

For rare, threatened, trafficked, or endangered indicator species projects are encouraged to mask geocodes for public PMPs through free sites like [iNaturalist](#) or [Earthranger](#), and arrange private review by IEP of Cercarbono.

Figure 7. Indicator species observations with geocode and date-time stamp.

DATA	DATE	LAT	LONG	SPECIES...	LATIN NAME/NOMB...	SIGN TYPE
	November 4, 2012	******	*********	Oso de anteojos	Tremarctos ornatus	Video
	May 17, 2013	******	*********	Tucan de real	Ramphastos ambiguus a...	Video
	March 5, 2014	******	*********	Danta o Tapir	Tapirus terrestris	Video
	April 22, 2014	******	*********	Oso de anteojos	Tremarctos ornatus	Video
	April 22, 2014	******	*********	Oso de anteojos	Tremarctos ornatus	Video
	September 26, 2014	******	*********	Pava azul	Aburria aburri	Video
	December 25, 2015	******	*********	Culebra 24	Bothrops atrox	Video
	January 29, 2016	******	*********	Danta o Tapir	Tapirus terrestris	Video
	January 29, 2016	******	*********	Danta o Tapir	Tapirus terrestris	Video
	October 28, 2016	******	*********	Jaguar	Panthera onca	Video
	October 28, 2016	******	*********	Jaguar	Panthera onca	Video
	October 28, 2016	******	*********	Jaguar	Panthera onca	Video
	October 28, 2016	******	*********	Jaguar	Panthera onca	Video
	January 6, 2019	******	*********	Jaguar	Panthera onca	Video
	January 6, 2019	******	*********	Jaguar	Panthera onca	Video
	January 28, 2019	******	*********	Jaguar	Panthera onca	Video
	January 30, 2019	******	*********	Jaguar	Panthera onca	Video
	January 30, 2019	******	*********	Jaguar	Panthera onca	Video
	December 29, 2021	******	*********	Guio	Boa constrictor	Video
	January 6, 2022	******	*********	Churuco	Lagothrix lagotricha	Video
		***	***			

It should be noted that automated data such as satellite telemetry for game cameras is prohibitively expensive for most IP and LC projects. Therefore, the vast majority of projects will require trusted human coders to add geocode and date-time stamp metadata to observations. However, this does not fundamentally differ from the trust requirements for carbon studies in quantifying carbon load and is controlled for by IEP analysis of project data and IEP site visits.

An example and template for this are provided in [Appendix D](#).

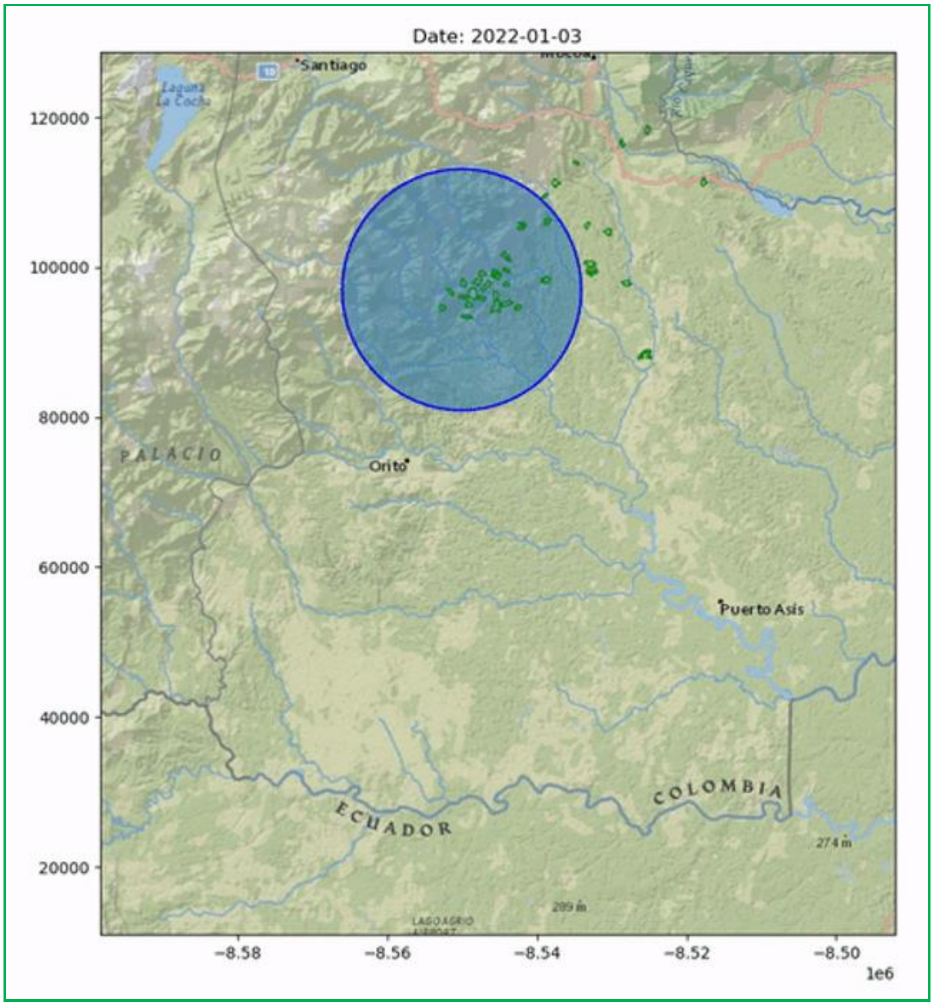
4 Methodology

The core of the methodology is this. We have a fungible, traceable, and culturally translatable metric for conserved biodiversity which is interoperable with other biodiversity metrics and methodologies.

A VBC under the ISBM represents 30 days of 1 hectare of a protected ecosystem with a value corresponding to the baseline ecosystem value (normalized to four levels). The protection of the ecosystem is determined by the presence of a qualified indicator species and its integrity score. Which if <1.0, may result in fractional crediting.

Here is an example site, with one year of data showing an interactive view of this methodology. Following, we will explain the sequential steps required to arrive at this view.

Figure 8. Biodiversity credits appearing and disappearing over time with different species observations.



It should be noted that calculations are simple in theory, and relatively complex in execution. The complexity has been offloaded to open-source computer code in order to make the observation points required at a project level simpler.

Here we explain the theory and the logic of the computer code but recommend BCPs use automated calculations from a vetted source.

However, all calculations can be easily automated, and open source code for this is available in Appendix E while manual calculations are demonstrated in Appendix G.

The calculations are devised to avoid double-crediting under a simplified methodology that does not identify individual species. Any specific hectare of land can only be counted only once at any given time, and cannot achieve a value greater than 1.0, and may receive partial crediting if the indicator species does not have sufficient scientific evidence for full crediting (see Integrity calculation).

4.1 Unit of a ISBM biodiversity credit

This methodology calculates biodiversity and issues VBC credits using an internationally interoperable biodiversity unit which has been negotiated with stakeholders cross-market and adopted by the CBCP.

These units are also used by other types of methodologies (e.g., restoration or impact assessments). This allows for international accounting under Kunming-Montreal and NBSAPs. A full description of the Indigenous-led unit can be found here unit.savimbo.com.

The area-based unit is **a fixed Area of one hectare, for a fixed Time of one month with measured Integrity reported on a scale from 0-1. Where full integrity is an ecosystem with every ecological niche available to, and filled by, native species**.

The unit is *independently* categorized by its location in the Baseline ecosystem categorization, then normalized in the publicly maintained Value calculations to Platinum, Gold, Silver, or Bronze representing the underlying biodiversity density and threat of the ecosystem. BCPs may issue credits of different values depending on their segmentation.

4.1.1 Calculation of an ISBM unit

This methodology issues conservation VBC, therefore it is concerned with demonstrating *no change* in the integrity of an ecosystem.

The calculation formula for this unit is:

$$VBCs = \sum_{a \in A} \sum_{t=1}^{T} Integrity_{a,t}$$

Variables:

- Where *a* is the unit area (one hectare).
- Where *A* is the project area.
- Where *t* is the unit time (one month), the starting point of a unit time is *t=0*, and the end of the first unit time is *t=1.*
- Where *T* is the monitoring period.

Methodology-specific notes:

- The one-month time period of the unit should *not* be confused with the two-month duration of an Indicator species observation as these frequently overlap in time.
- Projects will evaluate all data over a minimum monitoring period of one year, but credit in one-month intervals as per the unit.
- Integrity is the integrity of the ecosystem as demonstrated by indicator species observations found on the site (see Indicator species integrity score).

4.1.2 VBCs and iVBCs

According to the CBCP, in the first year of this methodology's adoption it will issue iVBCs, after which if accepted by the market it will automatically convert to VBCs if no substantial changes occur.

4.2 Value calculations from baseline ecosystem characterization

According to the CBCP, VBC under this methodology are categorized post-issuance using public data from the Baseline ecosystem categorization. They are then normalized into Platinum, Gold, Silver, and Bronze tiers as outlined in the CBCP Protocol.

To date, many of the accepted ecosystem classification schemas are incomplete, or periodically updated. And the public table is continually updated to ongoing multilateral feedback beyond the updates to the CBCP. Given this limitation, within two competing categories, projects can select the ecosystem category and segmentation that best describes their project but must provide justification for their selection in the project scenario when two competing ranks are available under Section 6.1. If the public unit table conflicts with the CBPC it must be resolved by the IEP on a per-case basis.

As an example, value calculation, a jaguar observation within the Tropical Andean biodiversity hotspot would have a platinum value because a biodiversity hotspot has a platinum value in the global categorization system above.

A value calculation template is provided in Appendix A.

4.3 Area calculations from indicator species

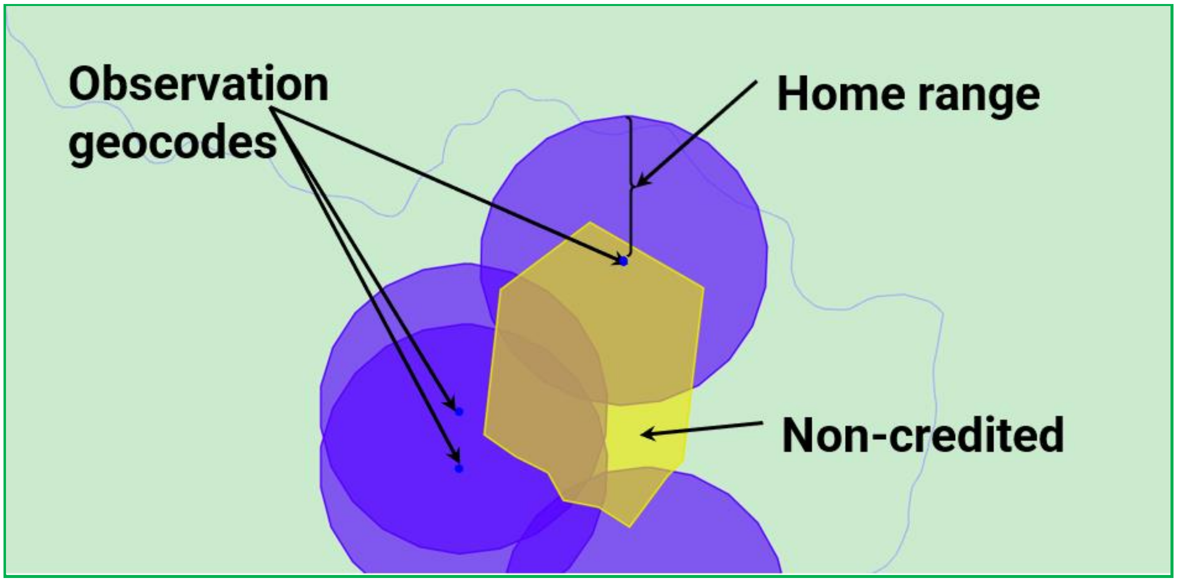
The full credited area for a BCP is dependent on the overlapping home ranges of the observed qualifying indicator species that lie within the crediting area — as determined by the union of individual observations within the same time frame.

Species are complex, dynamic, and diverse. Animals are typically observed at one geocode but have a far larger asymmetric habitat. For the purposes of simplification:

- **Each indicator species' publicly accepted home range area is normalized to a circle** around the central observation point where the species was verifiably observed. For details on this choice.
- **Identification of individuals of a species is NOT required by the ISBM.** While it may be relatively easy to accomplish for an indicator species such as a jaguar (based on markings, or more invasively with an implanted radio chip), it becomes prohibitively difficult when taking into account the wide array of species that may qualify for indicator species within an ecosystem. Further, many identification and population calculation techniques are invasive, and/or technically exclusive to IP and LC.
- **Observations are unioned.** Because individual observations could be one, *or many*, individuals of an indicator species — *if* the same area contains more than one observation within a 60-day period the area is NOT double-credited, it is equated through a union of the home-range areas (see Time calculations). Thus the ISBM methodology remains conservation-only, as population growth may be difficult to prove—although it is acknowledged that more sophisticated methodologies may emerge to define and credit these areas.

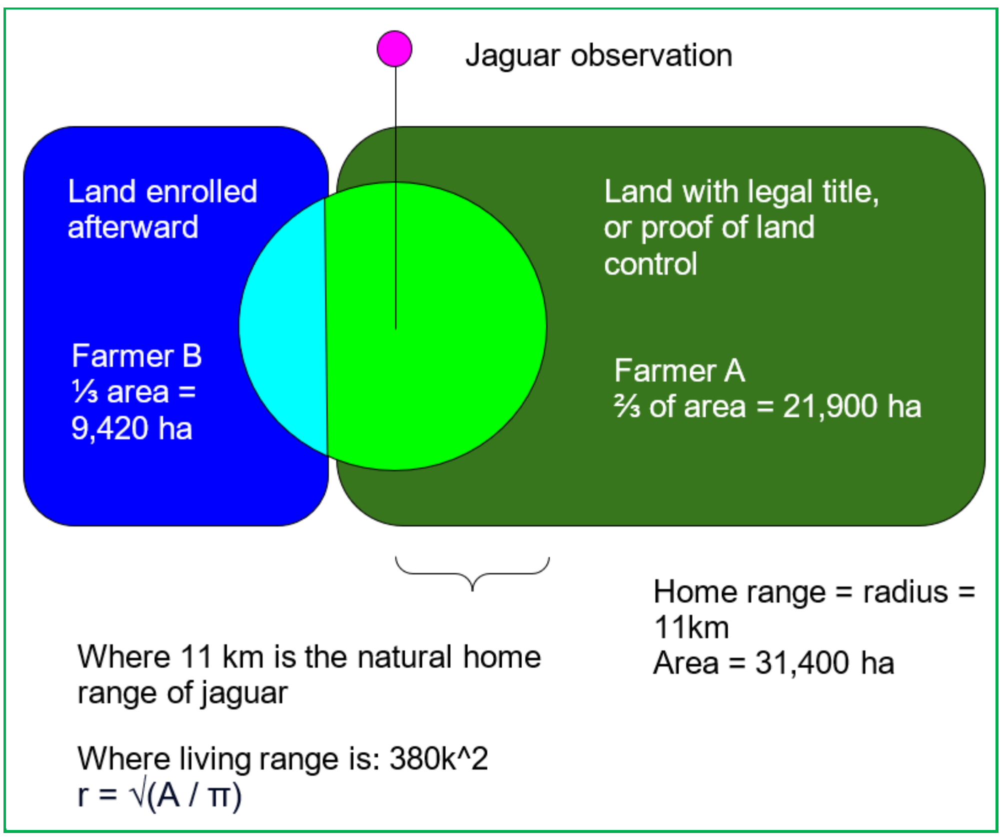
A sample list template of indicator species is provided in Appendix C.

Figure 9. Union of multiple jaguar observations to calculate crediting area from home range.



Please note that species observations involve one data layer. And for BCPs with project areas such as multiple adjoining land plots, grouped projects, or different segments, this layer might be split for calculations by another data layer.

Figure 10. Division of a crediting area by a grouped-project boundary.



4.4 Time calculations from indicator species

An observation from an indicator species has a base duration of 60 days. These days are defined as 30 days prior, and 30 days post the documented observation date-time stamp. The unit by contrast has a base duration of one month, or 30 days. So, one observation issues at most *two* credits, one before and one afterward.

This time period was chosen carefully based on the periodicity of subsistence lifestyles for IP and LC experts, the cost of monitoring devices for IP and LC, the incompletely characterized effects of electromagnetic fields from tracking devices on the full gamut of species within protected zones, and the potential for hunting or poaching to reduce animal populations during the crediting period (Appendix F).

Shorter time scales allowed for biodiversity fluctuations, and accounted for ongoing predation, and trafficking of rare species within the monitoring periods. IP and LC experts felt one year was too long to accurately reflect conservation outcomes in monitoring sites without tagging data as a jaguar could be killed for its teeth immediately after observation in the first month of a twelve-month crediting cycle.

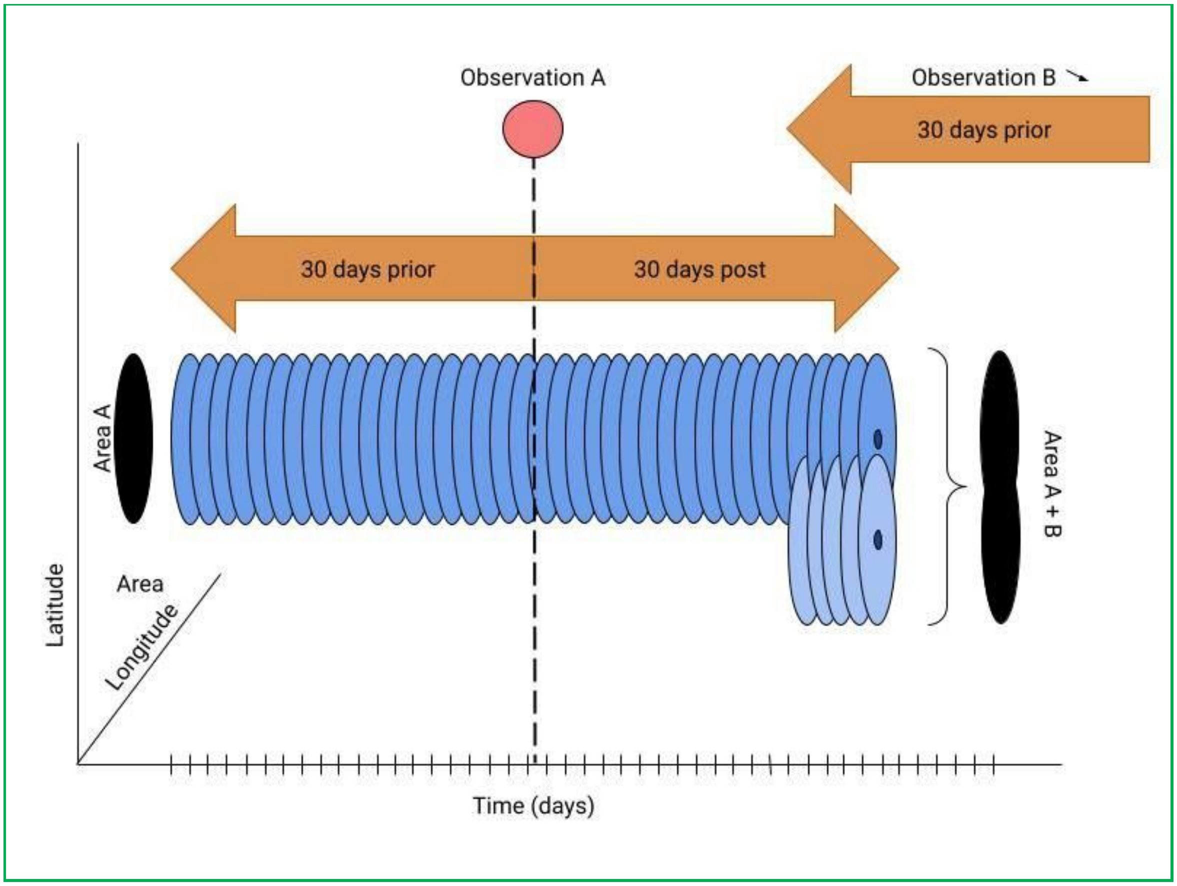
Two-month periods followed optimum hunter-gatherer tracking activities. Allowing for rest periods and scouting for indicator species yet delivering clear signals for species that had relocated or disappeared.

Observations occur fluidly throughout the crediting period. Monitoring groups exhibit hunter-gatherer periodicity in work activities. Furthermore, animals have diurnal and seasonal variation in observed behaviors. The methodology accounts for this, summing observations to standardize crediting in both space (Figure 9), and time (Figure 11).

1. The circle(s) representing the credited hectares for the observation points are first assigned a date range, which may overlap in area with another observation point during the same time period.
2. If observations overlap in time, the area of the observations are unioned for each date.
3. The resulting map is then clipped by the project boundaries to calculate the area to be credited.
4. The time period and map are then summed to present the total number of hectares that are available for crediting within that year.

Just as we credit only once for one hectare, even if more than one species is sighted, we credit only once per day for the hectare, even if there were multiple sightings that occurred with overlapping time periods. For example, if a sighting happened one day after a previous sighting, only one more day would be accounted for, not 30 days prior or after, because the delta is only that one extra day. This function in mathematics is known as the union of overlapping sets.

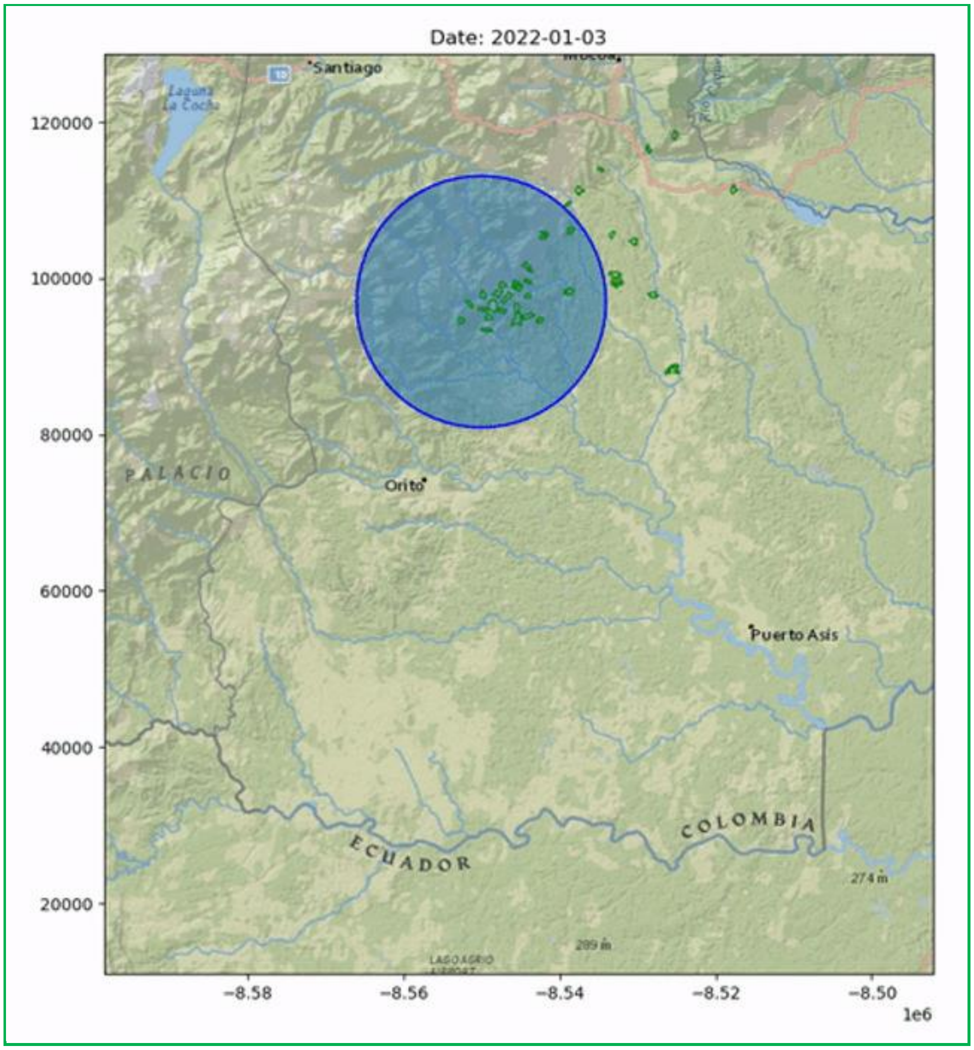
Figure 11. Union of observations which overlap in time-space to calculate crediting.



Just as we credit only once for one hectare, even if more than one species is sighted, we credit only once per day for the hectare, even if there were multiple sightings that occurred with overlapping time periods. For example, if a sighting happened one day after a previous sighting in the same area, only one more day would be accounted for, not 30 days prior or after, because the delta is only that one extra day. This function in mathematics is known as the union of overlapping sets.

Pilot data suggests that most projects will find periodic results and more experienced projects will find predictability resolves with practice (see Monitoring plan).

Figure 12. Biodiversity credits appearing and disappearing over time with different species observations.



4.5 Integrity calculations

As discussed in the Baseline assessment, indicator species and thus their observation area have an Integrity score based on their ability to represent the rest of their ecosystem.

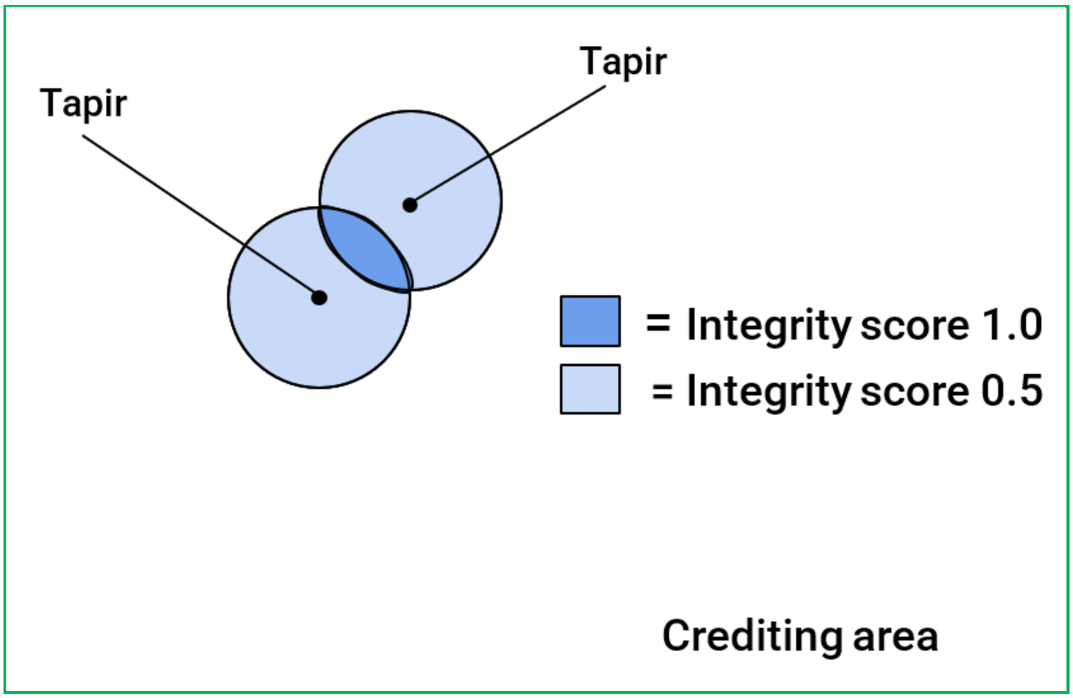
We have addressed the union of observations in space and time. While this is relatively uncomplicated for two observations from species that have an integrity score of +1 (fully representative of the ecosystem) it can become complicated in the presence of species that have partial integrity scores.

An integrity score is a number from 0 to 1, allowing for the crediting of areas that might be fully intact (e.g., score 1) or partially intact (e.g., score 0.5) based on the species sighted. Species that can live in contaminated systems will have a lower integrity score. Spotting one of those species gives only a partial credit because the species could occur in an ecosystem that is not fully intact.

This section explains the theory behind the summation of partial integrity scores and provides some visual examples.

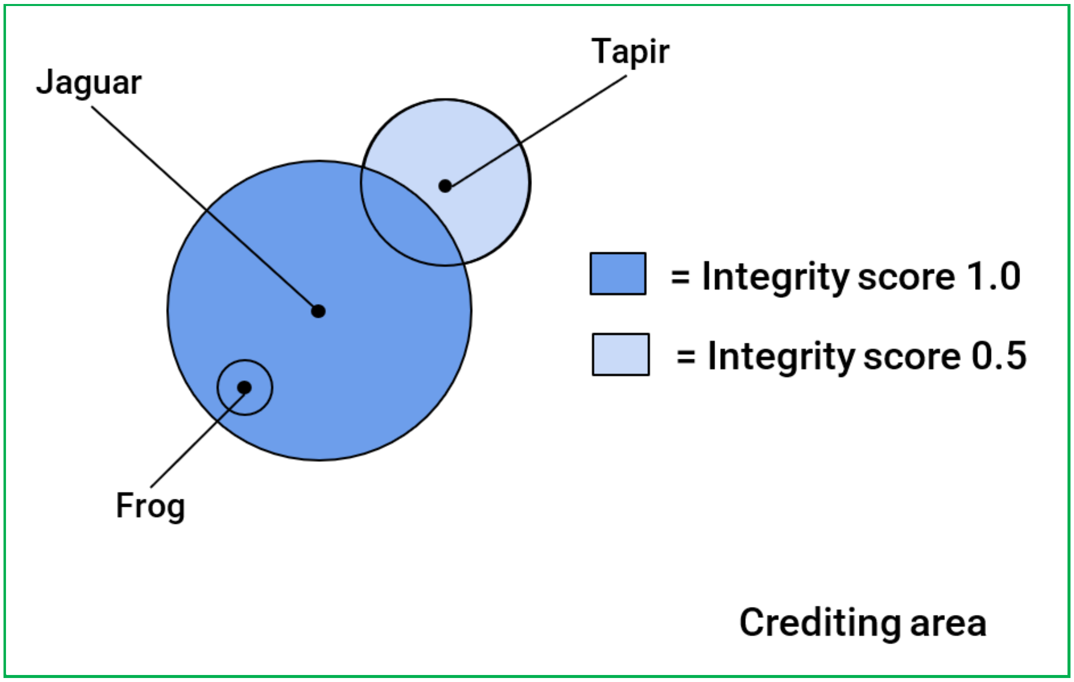
Partial scores can be summed. Where multiple sightings occur, the species indicator scores can be added together, to a maximum of +1. For example, if a tapir, with a score of 0.5 were sighted at the same area, as a frog with a score of 0.4 within a two-month range of each other, the combined score in the overlapping hectares could add to a 0.9 for the overlapping area.

Figure 13. Summing overlapping partial integrity scores.



Indicator species that offer full integrity, cannot be greater than +1 where they overlap, however a species like a Jaguar that has an integrity score of +1 will achieve the higher score on an overlapping area.

Figure 14. Summing overlapping full and partial integrity scores.



Depending on the variety of species observed, this data can become fairly complex.

While partial integrity scores may not offer additional crediting benefit, a full spectrum of data gives projects more validity in their claims to represent an intact ecosystem, and factors into qualitative assessments performed by IEP in their final evaluations.

5 Stakeholder engagement

The authors of this methodology feel that Cercarbono's protocol for the CBCP are both comprehensive, and informed, for documenting stakeholder engagement for IP and LC. Nevertheless, we reference other public requirements for documentation of stakeholder engagement. They include effective participation protocols for stakeholder maps, FPIC, conflict management, and documentation of agreements, public consultation, public-private partnerships, and transparency in project financing.

5.1 Methodology specific requirements

This methodology was designed by, and for IP and LC. It represents a market innovation and inclusion at the level of science and technical development, not only project implementation.

It is not within the purview of this methodology to enforce financial equity. As such, there are elements of market fairness that were of interest to its methodology authors but as yet nonstandardized, untraceable, and unenforceable by certifiers. We have opted to request a public commitment from developers using this methodology, to be published in the PMP which constitutes a voluntary pledge for fairness, in the hopes that it will spur the climate markets in general to make these elements traceable (Delacote *et al*., 2024).

5.1.1 Additional stakeholder requirements pledge

This information should be communicated in a clear and timely manner and allow for open discussions among the stakeholders such that there is no inequality of information access.

- **(Optional) Commitment to data fairness.** Projects commit to equity in access to, ownership of, and crediting for data from the project including promotional materials, project data about ecosystems and biodiversity, video and photographic data, and photographs of participants with IP and LC communities involved using FAIR and CARE guidelines (Carroll *et al*., 2021). This includes an IP or LC data steward from the community who takes responsibility for understanding and communicating all levels of data management.
- **(Optional) Transparency of costs and market price.** Projects commit to processes to ensure all costs associated with the project and the current market price of biodiversity credits, and agent fees, are made transparent to all stakeholders. This information should be communicated in a clear and timely manner and allow for open discussions among the stakeholders such that there is no inequality of information access. This includes how much of the expense of project implementation is assumed by IP or LC.
- **(Optional) Transparency of payouts.** Projects commit to fair, equitable, and transparent distribution of project funds to the actual individuals on the ground as validated by the IEP. With particular clarity for IP and LC if they are receiving revenue share, or profit share and in what format (pre- or post-crediting, net or gross). The technology for funds disbursement must have safeguards against corruption and eliminate middlemen and other potential diversions or dilutions of funds from the people who are actually preserving the ecosystem. All financial transactions should be traceable and auditable.
- **(Optional) Transparency of *ownership* and *control* and *staffing* in companies involved in BCP.** Projects commit to clear and transparent reporting to all stakeholders, publicly or privately, (including buyers), as to the true amount in percentages of IP *control*, and IP or LC *ownership* and *staffin*g, of companies involved in a BCP. It is not within the purview of this methodology, and incompletely enforceable with certifiers to require complete disclosure from projects as to ownership structures of companies in the biodiversity credit market. The authors of this methodology have seen multiple examples of companies with extractive share structures. This pledge is necessary for the market to become more equitable.

6 Baseline assessment

The baseline assessment in this methodology should be done with the public data available. It will not be used for a counter-factual so projections are not necessary.

It consists of:

- Categorizing the ecosystem with public data,
- Listing the available indicator species,
- Describing threats to biodiversity loss, and
- Where possible, providing estimates of Biodiversity.

Projects must update their Baseline assessment once every five years in the Monitoring plan, and credit Calculations may change as a result.

In the ISBM, unlike carbon projects, VBC calculations are not made from a projected baseline scenario, against a projected project scenario (Pollock *et al*., 2020). Rather, this methodology is simplified for direct market access to IP and LC. In other words, these are not areas that need restoration or improvement, but these areas are in threat of being disrupted or damaged. Maintaining these intact ecologies, rather than changing them, is the appropriate outcome of these projects. The ISBM Baseline assessment establishes the global value of, species within, and threat toward, the BCP's intact ecosystem from all publicly available sources. Only then does the BCP Project scenario establish the available area for crediting action in that intact ecosystem.

In this context, historical and projection data is useful, but not required as it may be very difficult to obtain, and prohibitively exclusive to IP or LC-led projects in biodiverse regions with a lack of access to research funding and in-situ researchers.

6.1 Baseline ecosystem categorization

ISBM crediting is for intact ecosystems through the proxy metric of indicator species. In order to fairly compare one project against another, we must characterize the ecosystem we are seeking to preserve. For market fairness, our baseline categorization relies on publicly available information. Unfortunately, public biodiversity research is often siloed under one classification schema or another. BCPs should identify and list their ecosystem classification in as many accepted categorization schemas as possible to extend the depth of public data that can be applied to their site (see CBCP Protocol).

A Baseline assessment template and sample project version can be found in Appendix A. Improvements to the baseline ecosystem categorization could be presented for evaluation to the expert panel.

6.2 Analysis of agents and drivers of biodiversity loss

The analysis of agents and causes of biodiversity loss builds on the project eligibility criteria (Eligibility criteria) and is supported by secondary information collected on socio-economic variables of historical processes of biodiversity loss and habitat degradation. The agents and causes included are those that are associated with unsustainable uses of habitat zones, but also those that show the potential for reversal by project activities in the form of sustainable management or leveraged conservation processes including ethnic factors, cultural conservation, and livelihoods.

The baseline risk of biodiversity loss can be extrapolated from public data at the level of the ecosystem (i.e., IUCN Red List ecosystem with a threat level of Critically Endangered) or it can be gathered from the list of threatened species native to the region (i.e., IUCN Red List of Threatened Species native to the ecosystem). Habitat loss data such as deforestation rates for the zone from Global Forest Watch (www.globalforestwatch.org/map) can be provided as supporting material.

The analysis of agents and causes should be an iterative process, updated every five years as information becomes available, to improve the effectiveness of BCP actions (Figure 6).

In its first iteration, the main results should be incorporated into:

- A first portfolio of BC activities. This methodology currently only includes conservation activities, but projects are encouraged to describe and define activities they used to achieve their outcomes (Section 3.4).
- The spatial delimitation of the BCP areas, including the final location of the segments of BC activities (Section 3.4.1).
- The temporal delimitation of the BCP (Section 3.4.2).

It is recommended that the remaining iterations be carried out on an annual basis according to the circumstances of the BCP. This means that the first diagnosis of causes and actors is done in the consolidation of the PMP. Once the first verification has been carried out, one calendar year should be counted. Thereafter, project findings and dialogues at the local level should be incorporated with new information on socio-economic factors and data reprocessed to analyze the new behaviors of the agents and causes.

The BCP should describe the drivers and causes of direct biodiversity loss, as well as the associated underlying causes that will determine the dynamics of drivers and causes of direct biodiversity activities (Table 2). It is recommended to use a variety of information (e.g., traditional knowledge, IP and LC experts, expert consultation, participatory social assessments, literature review, etc.).

Underlying causes are classified as those related to social, economic, demographic, technological, political, institutional, and cultural factors. The behavior of the underlying and direct causes should be described at the project level.

Clear knowledge of direct and underlying causes will aid BCP developers in designing targets for project activities that are effective, context-based, and IP and LC-informed.

Table 2. Drivers and causes of direct biodiversity loss.

Activity/driver of biodiversity loss	Mapping indicator	Common data sources	Common data sources for biodiversity loss (national level)	Examples of other indirect data
DIRECT CAUSES				
Commercial agriculture	Habitat destruction, large areas logged, post-harvest land use.	Historical satellite imagery.	Traditional biodiversity or habitat inventories/field measurements.	Commodity prices, agricultural censuses, share of gross domestic product, exports, among others.
Subsistence farming, smaller crops, and rotational crops	Small, logged areas, are usually associated with rotation cycles.	Historical satellite images with high temporal density or high resolution to determine rotation patterns.	Traditional biodiversity or habitat inventories/field measurements.	Population growth in rural and urban areas, agricultural imports and exports, and land use practices, among others.
Expansion of infrastructure	Road network, new mines, and built-up areas.	Historical satellite images.	Traditional biodiversity or habitat inventories/field measurements.	Growth in urban and rural population, infrastructure development programmes, import and export prices of raw materials.
Climate change	Coastline changes, desertification.	Historical satellite images with habitat mapping.	IPCC Reports, national reports, remote sensing, and satellite data.	Proxy indicators, comparison with historical records, paleontological data.

Extraction of habitat products for subsistence, local, and regional markets	Very small-scale canopy damage, understorey impacts, footpaths.	Land use/land cover maps, remote sensing and satellite imagery, ethnobotanical surveys.	Biodiversity on-the-ground surveys in areas where products are extracted, scientific research papers, national biodiversity databases, government reports, conservation organizations, etc.	Land use practices (e.g., agricultural burning), links to other activity data attributable to burning, fire prevention, and natural fires.
Subsistence hunting or biological trafficking	Very small-scale canopy damage, understorey impacts, footpaths.	Limited historical data. Information from local studies or national proxies. Only long-term cumulative changes can be observed by satellite imagery.	Limited historical data. Information from local scale studies. Community-based monitoring has a key role. Other indirect methods of measuring habitat changes can be employed.	Surveys and interviews with local communities, market surveys.
Other disturbances (e.g., uncontrolled fires)	Burn scars and associated impacts.	Historical fire-related satellite data, analyzed in conjunction with Landsat-type data.	Regular estimation of biodiversity loss can be measured consistently for different periods depending on data availability.	Vegetation sampling, monitoring indicator species.
INDIRECT OR UNDERLYING CAUSES				
		National statistical agencies, household surveys, and international organizations.	Biodiversity databases like IUCN, GBIF (Global Biodiversity Information Facility). Socioeconomic surveys that incorporate questions related to biodiversity interactions, Environmental Impact assessments (EIAs) Land use and land cover change.	Land use change and fragmentation, consumption patterns, socioeconomic surveys and household data.
Policy failures	Land	Land-use	National and regional	Conservation policy

	conversion and deforestation, habitat fragmentation, resource exploitation, illegal wildlife trafficking.	change analysis species inventories, habitat quality, and fragmentation assessment.	environmental agencies, research institutions, NGOs (non-governmental organization), biodiversity monitoring programs.	analysis evaluates the effectiveness of such policies, stakeholder interviews, and surveys, including local communities conservation organizations and policymakers.
Weak law enforcement	Illegal logging and timber trade, protected area invasion, agricultural expansion, mining, etc.	Land-use change analysis species inventories, habitat quality, and fragmentation assessment.	Government agencies, NGOs (non-governmental organization), Customs and borders control agencies, research and academic institutions, public reports.	illegal wildlife trade monitoring, satellite imagery, and remote sensing, expert surveys, and interviews.
Lack of local engagement	Habitat loss, loss of traditional ecological knowledge, illegal activities, fragmentation.	Land-use change analysis species inventories, habitat quality, and fragmentation assessment.	Biodiversity surveys and inventories, community-based monitoring programs, traditional ecological knowledge, community organizations, stakeholder interviews, and local surveys.	Community-based monitoring, local ecological knowledge, social surveys.
Global demand for resources	Land conversion and deforestation, resource and species exploitation.	Land-use change analysis species inventories, habitat quality, and fragmentation assessment.	Remote sensing and satellite data, Regional and national biodiversity inventories, Global Biodiversity Information Facility (GBIF), IUCN.	Land use and land cover change analysis, global trade data, supply chain analysis, economic indicators, and corporate sustainability reports.

6.3 Baseline biodiversity (optional)

Public data on biodiversity may not be available within threatened ecosystems. For this reason, the ISBM does not require full species richness data. However, an attempt to find this information should be made by BCPs, and where available it should be listed. If the data is believed to be incomplete, this should be noted.

Where possible, projects must draw on publicly available sources to characterize species richness and endemic species for the following taxonomic groups: All identified species of trees, vascular plants, amphibians, reptiles, birds, insects, mammals, fish, and fungi.

A sample template is provided in Appendix B.

6.4 Indicator species selection and characterization

This approach aligns with species-based biodiversity surrogate concepts such as indicator species, umbrella species, focal species, sentinel species, detector species, and bioassay organisms (Rodrigues & Brooks, 2007).

Indicator species must be selected using a scientific, data-driven approach that considers local ecology, IP and LC needs and traditional knowledge of totemic animals, threat factors, and conservation goals.

Species must have documented sensitivity to environmental changes and the ability to represent the integrity of the broader ecosystem, although this may be a partial score (see Integrity score).

Projects must characterize a full list of potential indicator species for their ecosystem meeting the criteria below. These lists are in the process of being normalized in public databases by independent experts. However, in the initial iteration of the methodology, projects are encouraged to review the list early, with external experts both IP and LC, and regional academic or conservation biologists prior to implementing a monitoring plan. BCPs should make an effort to collect observations from all qualifying species but are recommended to have 1-3 main species for consistency in tracking and monitoring (see Monitoring).

6.4.1 Qualifying categories of indicator species

Eight categories are available for consideration: Sentinel, Rare, Endangered, Umbrella, Trafficked, Keystone, Emblematic, and Endemic. BCPs must provide public research from a reputable source to identify the indicator species.

Indicator species will be reviewed by the IEP for each project.

- **Sentinel species:** Provide published research from a reputable source to identify sentinel species, their reaction to environmental changes, and their ability to serve as a proxy metric for the ecosystem being conserved.
- **Rare species:** Provide published research from a reputable source to identify rare species (i.e., bush dog) and their ability to serve as a proxy metric for the ecosystem being conserved.

- **Endangered species:** Categorize all indicator species as per the IUCN Red List level (Appendix C). Note that in order to qualify as an indicator species under threat level alone, the species must be IUCN status *Critically endangered* or *Endangered* on the subnational, national, or international level.
- **Umbrella species:** Provide published research from a reputable source to identify umbrella species and their ability to serve as a proxy metric for the ecosystem being conserved.
- **Trafficked species:** Include only those trafficked species that appear on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) List.
- **Keystone species:** Provide published research from a reputable source to identify keystone species and their ability to serve as a proxy metric for the ecosystem being conserved.
- **Emblematic species:** Provide published research from a reputable source to identify culturally significant species, such as their historical or mythological significance, role in traditional ceremonies or rituals, use in arts and crafts, or their symbolic representation in cultural narratives. IP and LC will often have totemic animals for their ecosystem and this knowledge should not be ignored as it often represents ecological understanding not yet appreciated by Western science. IP and LC also often have early warning signals of species threat which justifies inclusion of species they put high-priority on monitoring (T. Fischer & Knuth, 2023).
- **Endemic species:** Identify species as restricted to a particular geographic region and not naturally found anywhere else. Endemic species are important indicators of the uniqueness and ecological significance of a particular region.

Many projects may end up identifying qualifying indicator species (e.g., harpy eagle for Colombia) which are rare, and may or may not generate observations. BCPs must take care to be inclusive of high-value species in their dataset of Observations, but realistic about the selection of species that can be reliably used for monitoring a large area (e.g., jaguar for Colombia).

Species must be fully characterized including latin name, common name, IP names where applicable, indicator type(s), national and international IUCN threat levels, CITES status, and home range (with scientific references).

Figure 15. Indicator species selection example for Colombia.

ESPECIES ID (ES)	INDICATOR TYPE/TIPO ...	LATIN NAME...	UICN GLOBAL	CITES	NACION...	HOME RANGE...
Aguila crestada	Rare/Raro, Endangered/En Pel	Morphnus guianen...	NT - Almost threatene...		NT - Almost ...	17.3
Aguila harpia	Rare/Raro, Endangered/En Pel	Harpia harpyja	VU - Vulnerable/Vulner...	Apendice 1		150.0
Anaconda verde	Rare/Raro	Eunectes murinus	Minor concern/Preocu...			0.4
Armadillo gigante	Rare/Raro	Priodontes maximus	VU - Vulnerable/Vulner...	Apendice 1	EN - Threate...	4.5
Caiman negro	Rare/Raro, Keystone/Clave	Melanosuchus niger		Apendice 1	VU - Vulnera...	1.0
Capibara	Rare/Raro	Hydrochoerus hyd...	Minor concern/Preocu...			0.2
Cerrillo barbi blanco	Endangered/En Peligro	Tayassu pecari	VU - Vulnerable/Vulner...			200.0
Churuco	Endangered/En Peligro	Lagothrix lagotricha	VU - Vulnerable/Vulner...		VU - Vulnera...	11.0
Culebra 24	Rare/Raro	Bothrops atrox	Minor concern/Preocu...			0.6
Culebra sapa	Rare/Raro	Bothrocophias hyo...	Minor concern/Preocu...			0.6
Danta o Tapir	Umbrella/Sombrilla	Tapirus terrestris	VU - Vulnerable/Vulner...	Apendice 2	CR - Criticall...	16.4
Guacamayos azul ama...	Rare/Raro	Ara ararauna	Minor concern/Preocu...			15.0
Guacamayos macao	Rare/Raro	Ara macao	Minor concern/Preocu...	Apendice 1		15.0
Guio	Rare/Raro	Boa constrictor	Minor concern/Preocu...	Apendice 1		790.0
Jaguar	Rare/Raro, Endangered/En Pel	Panthera onca	NT - Almost threatene...	Apendice 1	VU - Vulnera...	380.0

6.5 Indicator species integrity scores

An indicator species integrity score is intrinsic to the species, and its evolved niche in, sensitivity to, and fragility without, its natural ecosystem. It is generated from public data and/or traditional ecological knowledge.

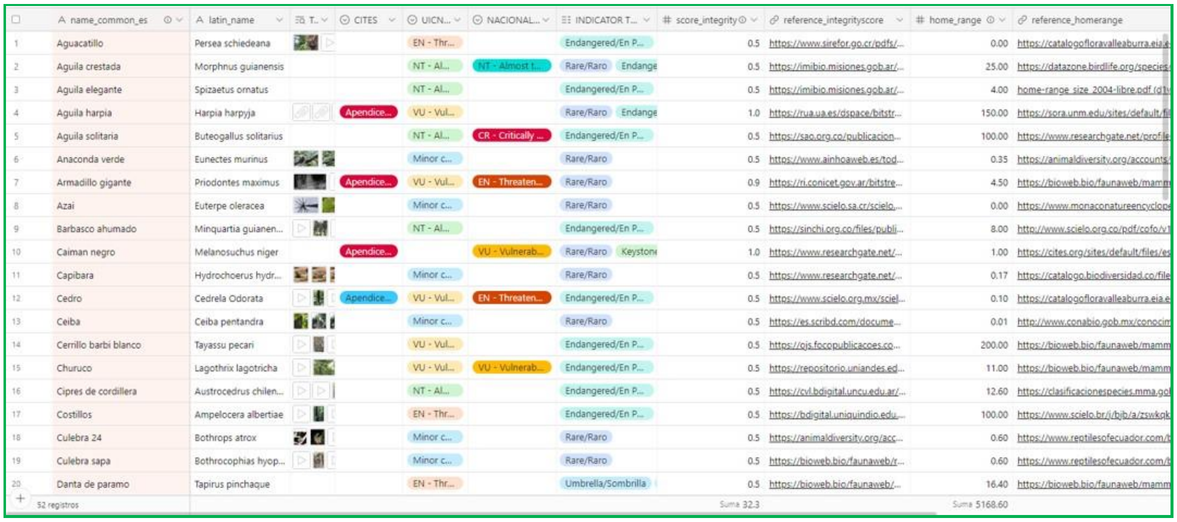
The ISBM is designed to represent intact ecosystems, however, some easily-monitored indicator species may fail to adequately represent the ecosystem they are found in. Species that can live in contaminated systems will have a lower integrity score. Spotting one of those species gives only partial credit because the species could occur in an ecosystem that is not fully intact. However, species that are more representative may be difficult to monitor. To democratize the methodology for IP and LC which may be inexpert, or under-resourced monitors we have introduced an indicator species integrity score which allows for non-idealized observations in lieu of perfected data.

For instance, many IP may find a tapir easier to find than a jaguar, and in many Indigenous nations across the Amazon, it is a totemic animal. However, it is not fully representative of an intact ecosystem, so it would have an integrity score of 0.5.

After generating a list of available Indicator species, they must also be ranked by their ability to represent the ecosystem with an integrity score between 0-1.0 where 1.0 indicates the full capability of representing the ecosystem. These scores will be used in Integrity calculation and must be supported by public data if available, and expert opinion when not, and will be reviewed by the IEP assigned to the project. Where a home range is not available in public data, a written expert opinion from an independent biologist who does fieldwork in the ecosystem or data from a comparable species will be accepted but must these exceptions be reviewed and approved by the IEP on a case-by-case basis.

A sample species list with external data for ratings is provided in Appendix C.

Figure 16. Indicator species integrity score example for Colombia.



	name_common_es	latin_name	T..	CITES	UICN...	NACIONAL...	INDICATOR T...	score_integrity	reference_integrityscore	home_range	reference_homerange
1	Aguacatillo	Persea schiedeana			EN - Thr...		Endangered/En P...	0.5	https://www.sirefor.go.cr/pdfs/...	0.00	https://catalogofloravalleaburra.eia.e
2	Aguila crestada	Morphnus guianensis			NT - Al...	NT - Almost t...	Rare/Raro Endange	0.5	https://imibio.misiones.gob.ar/...	25.00	https://datazone.birdlife.org/species
3	Aguila elegante	Spizaetus ornatus			NT - Al...		Endangered/En P...	0.5	https://imibio.misiones.gob.ar/...	4.00	home-range_size_2004-libre.pdf (d1
4	Aguila harpia	Harpia harpyja		Apendice...	VU - Vul...		Rare/Raro Endange	1.0	https://rua.ua.es/dspace/bitstr...	150.00	https://sora.unm.edu/sites/default/fi
5	Aguila solitaria	Buteogallus solitarius			NT - Al...	CR - Critically ...	Endangered/En P...	0.5	https://sao.org.co/publicacion...	100.00	https://www.researchgate.net/profile
6	Anaconda verde	Eunectes murinus			Minor c...		Rare/Raro	0.5	https://www.ainhoaweb.es/tod...	0.35	https://animaldiversity.org/accounts
7	Armadillo gigante	Priodontes maximus		Apendice...	VU - Vul...	EN - Threaten...	Rare/Raro	0.9	https://ri.conicet.gov.ar/bitstre...	4.50	https://bioweb.bio/faunaweb/mamm
8	Azai	Euterpe oleracea			Minor c...		Rare/Raro	0.5	https://www.scielo.sa.cr/scielo...	0.00	https://www.monaconatureencyclop
9	Barbasco ahumado	Minquartia guianen...			NT - Al...		Endangered/En P...	0.5	https://sinchi.org.co/files/publi...	8.00	http://www.scielo.org.co/pdf/cofo/v1
10	Caiman negro	Melanosuchus niger		Apendice...		VU - Vulnerab...	Rare/Raro Keystone	1.0	https://www.researchgate.net/...	1.00	https://cites.org/sites/default/files/e
11	Capibara	Hydrochoerus hydr...			Minor c...		Rare/Raro	0.5	https://www.researchgate.net/...	0.17	https://catalogo.biodiversidad.co/file
12	Cedro	Cedrela Odorata		Apendice...	VU - Vul...	EN - Threaten...	Endangered/En P...	0.5	https://www.scielo.org.mx/sciel...	0.10	https://catalogofloravalleaburra.eia.e
13	Ceiba	Ceiba pentandra			Minor c...		Rare/Raro	0.5	https://es.scribd.com/docume...	0.01	http://www.conabio.gob.mx/conocim
14	Cerrillo barbi blanco	Tayassu pecari			VU - Vul...		Endangered/En P...	0.5	https://ojs.focopublicacoes.co...	200.00	https://bioweb.bio/faunaweb/mamm
15	Churuco	Lagothrix lagotricha			VU - Vul...	VU - Vulnerab...	Endangered/En P...	0.5	https://repositorio.uniandes.ed...	11.00	https://bioweb.bio/faunaweb/mamm
16	Cipres de cordillera	Austrocedrus chilen...			NT - Al...		Endangered/En P...	0.5	https://cvl.bdigital.uncu.edu.ar/...	12.60	https://clasificacionespecies.mma.gol
17	Costillos	Ampelocera albertiae			EN - Thr...		Endangered/En P...	0.5	https://bdigital.uniquindio.edu...	100.00	https://www.scielo.br/j/bjb/a/zswkqk
18	Culebra 24	Bothrops atrox			Minor c...		Rare/Raro	0.5	https://animaldiversity.org/acc...	0.60	https://www.reptilesofecuador.com/
19	Culebra sapa	Bothrocophias hyop...			Minor c...		Rare/Raro	0.5	https://bioweb.bio/faunaweb/r...	0.60	https://www.reptilesofecuador.com/
20	Danta de paramo	Tapirus pinchaque			EN - Thr...		Umbrella/Sombrilla	0.5	https://bioweb.bio/faunaweb/...	16.40	https://bioweb.bio/faunaweb/mamm
	52 registros							Suma 32.3		Suma 5168.60	

7 Monitoring plan

The ISBM is unique in that project data for crediting are, in and of itself, proof of monitoring, reporting, and verification. In this context, annual crediting, and annual monitoring are the same activity.

It should be noted that the unpredictability of animal tracking frequently leads to lapses in data collection. Because this is a results-only methodology, IP and LC groups can work as frequently or infrequently as they wish to but they only achieve credits for documented outcomes. Although we caution that projects that begin with a large amount of observations, then taper off might be viewed with suspicion by an IEP.

It is recommended that projects plan a sustainable monitoring plan that can be consistently conducted throughout the year, with a budget that accounts for equipment failures. It is better to have consistent sightings in a small area, than lots of sightings that are not consistent throughout the year.

BCPs should collect data from as many qualifying indicator species as possible. To standardize and scale operations they must select a minimum of 3 species from 2 different kingdoms for ongoing monitoring.

We strongly suggest the use of pilot data in designing a monitoring plan as rapid iteration in the initial phases of a project are both desirable and encouraged. When selecting indicator species for ongoing monitoring please consider the following:

- **Clear link to biodiversity objectives.** Choose indicator species that have clear links to stated BCP activities (Section 6.4). This relationship between indicators and project objectives should be demonstrated ideally by documentation of scientific literature.
- **Multiple indicator species.** Natural systems are extremely complex, and even variables that are carefully chosen to reflect conservation may sometimes fluctuate for reasons unrelated to the project. Monitoring the abundance of only a few species may increase the risk of failing to document actual biodiversity. Although there is no single ideal number of indicator species to be monitored, it is necessary to manage a balance between choosing too few indicator species and too many.
- **Monitoring.** This methodology encourages BCPs to select some indicator species that are not too expensive to monitor, that can be easily monitored by members of IP and LCs, and that are not dependent on outside experts or equipment. However, the inclusion of rare species that are difficult to find provides a more comprehensive view of the ecosystem and should be considered.

Table 3. Example of simple monitoring plan.

	Indicator species	Data collection method	Monitoring frequency	Data storing method	Area monitored
Year 1-5	5	Cell phones	Two months	Airtable	10k
Year 6-10	20	Camera trap + cell phones	Two months	Earth ranger database	20k
Year 11-15	30	Camera trap, cell phones, audio recording	Two months	Private database connected to Earth ranger	50k
Year 15-30	50	Camera trap, cell phones, audio recording, and selectively tagged animals	Continuous	Private database connected to Earth ranger	16k

7.1 Monitoring report

The VBC calculation is automated and produces a report from observational data.

The monitoring period and reports can be as frequently as 1 year, and as infrequently as 5 years and must include:

- Changes in Baseline assessment if applicable.
- Adaptive changes in Implementation plan.
- Any changes in project boundaries (such as scaling from a Grouped project) with .kml format.
- Any changes in stakeholders, or project governance.
- Secure upload of raw project data for indicator species.
- Comparison report of Crediting area vs Leakage management area in hectares for current and prior years of project implementation (Project areas).
- Ideally publicly-validated indicators species observations (i.e., iNaturalist).

The BCP shall include, in the monitoring report, a short qualitative summary of the activities carried out during each verification period and their effectiveness in terms of biodiversity conservation.

7.2 Additional monitoring requirements

Where applicable, extended reporting may be necessary, including:

- **Leakage reporting.** Projects that identified a leakage management area in their baseline assessment will need to include additional data in their monitoring plan to support the management of these areas.
- **Habitat use and habitat change within the BCP area.** It is beneficial to monitor habitat loss, although the technology to do this well (i.e., satellite mapping) may be exclusionary to IP and LC. The ISBM is designed to allow indicator species themselves to provide a proxy metric for habitat changes that are difficult to prove otherwise (degradation, noise pollution, poaching, etc.). Observations for indicator species also represent proxy metrics for project activities. Thus project data itself is ex-post tables of activity data by stratum carried out throughout the duration of the BCP. If sites already have this data, we recommend inclusion in monitoring reports.
- **Impacts of natural disturbances and other catastrophic events.** Decreases in biodiversity from external forces over which the project proponent has no control including natural disturbances (e.g., forest fires, hurricanes, earthquakes, volcanic eruptions, floods, and droughts) or human-induced events (e.g., fires, acts of terrorism, and war) will be reflected

in observations and crediting directly. If this occurs BCPs should include a description in their monitoring report.

8 File Versioning

This document has been updated to consider its applicability worldwide for reporting the presence of intact biodiversity in endangered biozones in critical need of economic protection.

At the time of methodology development, there were no systems for tracking biodiversity measures that could be implemented in a straightforward way by IP or LC conservationists.

8.1 Authorship

This methodology is a scientific translation of the traditional ecological knowledge of the Pijao, Pasto, Embera chami, and Cofan communities in the Colombian/Ecuadorian Amazon.

Authors fall into four categories: Direct authors of the methodology, Indigenous leaders who have advised on its creation and piloting and independently informed its core tenets, advocates and scientists who endorse the methodology, and reviewers who have publically commented on or otherwise informed its development without direct endorsement.

Authors	**Role**
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Prach Sri	Biotechnology, Savimbo
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Leiner Jamauca	Computer science, Savimbo
Maria Paula Navas	Biodiversity, Savimbo
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Note: All contributing authors have been included according to ICMJE authorship/contributorship criteria.

8.2 File version

Cercarbono ISBM methodology file version history.

Version	Date	Name	Description
1.0	Jun 11, 2023	Savimbo	Draft finalized.
1.0	Jun 11, 2023 - Oct 11, 2023	Savimbo public consultation	Initial version of the June-September public consultation document.
1.1-C	Oct 19, 2023	Savimbo & Cercarbono co-edit	Methodology adjusted to the Cercarbono format for crediting.
1.2	Aug 27, 2024	Savimbo & Cercarbono co-edit	Methodology adjusted to the results of Cercarbono public consultation.

8.3 Methodology versions

As of this date this methodology is under consideration by several certification bodies who may adapt it within their unique biodiversity programs. These would constitute a fork of the original methodology with subsequent versioning. Currently, there are only two approved versions in use.

Version	Last updated	Current version	Description
Savimbo	Nov 5, 2023	1.1-S	Public IPLC version maintained with additional parameters for projects who will not seek certification but instead deliver MRV data directly to buyers or sponsors.
Cercarbono	Aug 27, 2024	1.2	Savimbo ISBM adapted for use within Cercarbono biodiversity crediting program after public review.

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Appendices

Appendix A: Sample baseline ecosystem categorization

This is a template and example table to show how a BCP can segment their project by value layers. Only one classification schema can be applied. The developer can choose the schema that is available for the project area and that best fits their site. As this is an example table, project developers should refer to Cercarbono's Protocol for completing the specific requirements.

Table 4. Template of baseline ecosystem categorization with value segmentation.

	Platinum	Gold	Silver	Bronze
IUCN Red List of Ecosystems	Critically endangered	Endangered	Vulnerable	Near threatened
Biodiversity hotspots	Biodiversity hotspot	Within 50 km from recognized hotspot	Within 100km (ha)	Not near a biodiversity hotspot
CBD National targets	Deforestation region 2020 - 2030	Deforestation region 2030 - 2050	Within 50km	Within 100km
IUCN Global Ecosystem Typology	50% probability of collapse within 50 years	20% probability of ecosystem collapse in within 50 years	10% probability of ecosystem collapse within 100 years	Threatened category in the near future

Here is an example of an executed version.

Figure 17. Example of baseline categorization for a project developed in Villagarzón, Colombia.

	Version	Platinum	Gold	Silver	Bronze
Biodiversity hotspots	version 2016.1	Priority target (ha)	Within 50 km from recognized hotspot	Within 100km (ha)	Not near a biodiversity hotspot
		1858.86	1656.28		
IUCN Red List of Ecosystems for Colombia	Version 2017	Critically endangered	Endangered	Vulnerable (ha)	Least Concern (ha)
		0	0	8031	9647.1
IUCN Global Ecosystem Typology	Version 2.0 (2017)	Major (ha)	Minor (ha)	Within 50km (ha)	Within 100km (ha)
		4070.7	1074.8	12532.6	
CBD National targets	Version 2021	Deforestation region 2020 - 2030 (ha)	Deforestation region 2030 - 2050 (ha)	Within 50km (ha)	Within 100km (ha)
		1532.2	0	16145.9	0
UNEP Forest Biodiversity Intactness Index	Version 2023	100% intact forest ecosystem with minimal human disturbance	75% intact forest ecosystem with moderate human disturbance	50% intact forest ecosystem with high human disturbance	25% intact forest ecosystem with very high human disturbance
		14681.2	2135.1	575.9	285.9

Appendix B: Sample categorization of species richness

Many of the most biodiverse regions on the planet have incomplete or inaccurate data on species richness. However, it is very important to seek out and report data on these regions or report the bias of such data to get an idea of the site's biodiversity, serving as a reference to highlight the ecological importance of the area and the specific BCP site. Below, we provide a sample table to report species richness for a BCP. The data itself and the data sources should be public, such as:

- iNaturalist.
- Global Biodiversity Information Facility (GBIF).
- eBird.

Table 5. Template of categorization of species richness.

Taxonomy	# Species	# Endemic	# Threatened	Zone
All species				
Trees				
Vascular plants				
Amphibians				
Reptiles				

Taxonomy	# Species	# Endemic	# Threatened	Zone
Birds				
Insects				
Mammals				
Fish				
Fungi				

An example table from Putumayo is shown here:

Figure 18. Example of species richness categorization for a project developed in Villagarzón, Colombia.

Taxonomy	# Species	# Endemic	# Threatened	Zone
All species	75,947	8,803	12,594	Colombia
Trees	2197	280	106	Putumayo
Vascular plants	1223	346	121	Putumayo
Amphibians	183	8	11	Wetlands, Putumayo/Caquetá/Amazonia
Reptiles	371	9	14	Amazon rainforest
Birds	598	23	141	Wetlands, Putumayo/Caquetá/Amazonia
Insects	190	12	49	Wetlands, Putumayo/Caquetá/Amazonia
Mammals	154	"No data available"	19	Putumayo
Fish	46	"No data available"	"No data available"	Wetlands, Putumayo/Caquetá/Amazonia
Fungi	95	"No data available"	"No data available"	Wetlands, Putumayo/Caquetá/Amazonia

Appendix C: Sample selection of indicator species

Projects must characterize a complete list of potential indicator species for their ecosystem that meet the criteria in Section 6.4. Below is an approach on how to organize the information for the characterization of indicator species.

Table 6. Template of sample selection of indicator species.

Name	IUCN category	National threat	CITES level	Home range	Indicator type	Integrity score

However, this only serves to present the information associated with the indicator species and is not functional for storing and managing their records.

That is why we recommend using Airtable, as it allows combining text fields with attached audiovisual files in rows in an organized and secure manner, as shown in the example here, see Figure 15. This example table is open-source and can be copied and reused for free.

Appendix D: Sample list of indicator species observations

Projects must characterize a complete list of indicator species observations that meet the criteria in Section 3.5.2. Below is an approach on how to organize the information.

Table 7. Template of sample indicator species observations.

Data	Date	Latitude	Longitude	Species	Latin name	Sign type

However, this only serves to present the information associated with the indicator species and is not functional for storing and managing their records.

That is why we recommend using Airtable, as it allows combining text fields with attached audiovisual files in rows in an organized and secure manner, as shown in the example here, see Figure 7. This example table is open-source and can be copied and reused for free.

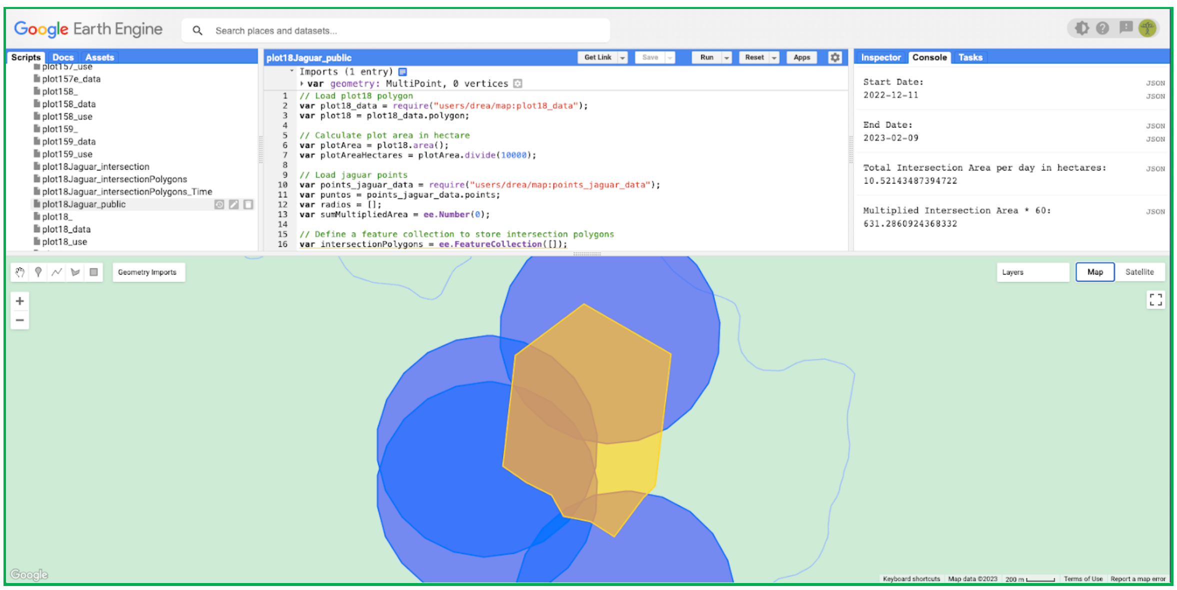
Appendix E: Sample open-source code and calculations

Google Earth Engine and Python open source code.

Open-source code for biodiversity credit calculations is available to the public at the Savimbo GitHub at this link.

To view an example calculation on Google Earth Engine, click on this link.

Figure 19. Google Earth Engine code sample.



Appendix F: Description of ISBM co-development with IP and LC

This methodology was developed over one year in a pilot site in the Colombian Amazon. the indicator-species biodiversity methodology was co-designed with Indigenous Peoples and local communities.

Like the Sherpas who climb Mt. Everest, jaguar tracking is a highly technical, and respected activity within Indigenous groups. It relies on years of knowledge of animal behavior, strong kinesthetic knowledge, traditional hunting skills, a supranormal degree of fitness, and technical woodsmanship.

But for over twenty years, the resources associated with this activity have been transacted through the charitable industry, with high overhead margins. Without judgment, this is not a good deal for the jaguar trackers. Organizations typically pay Indigenous and local trackers on a day wage, require them to supply their own equipment, and don't give ownership or credit for raw data (video and audio recordings) generated by tracking activities. Because it's a bad deal, these trackers have difficulty convincing their communities that these traditional conservation activities are sustainable in comparison to the modern alternatives; petroleum, mining, logging, urban work, or narco-trafficking.

This methodology was written to solve the economic problem of conserving biodiversity. To contribute an alternative, direct, climate market to Indigenous groups who conserve primary forests.

The ISBM is the translation of a successful 20-year IP and LC-led conservation program in an IUCN Red List ecosystem to financial markets. Translation occurred over the period of one year. Technology, biodiversity science, and market mechanisms were integrated to project activities with ongoing feedback. The intent was to scale activities, and fund associated livelihoods without disrupting IP or LC values or lifestyles.

The project began with unremunerated in-situ photo/video observations of jaguars and the endangered anteojos bear generated by Indigenous conservationist Jhony Lopez in the Columbian Amazo. The area was protected against narcotrafficking, petroleum, and mining interests by grassroots activism at the local, state, and national level by activism from Jhony, Fernando Lezama, and a committed group of local smallholders at a financial loss.

Figure 20. Jhony Lopez, conservationist and climate activist.

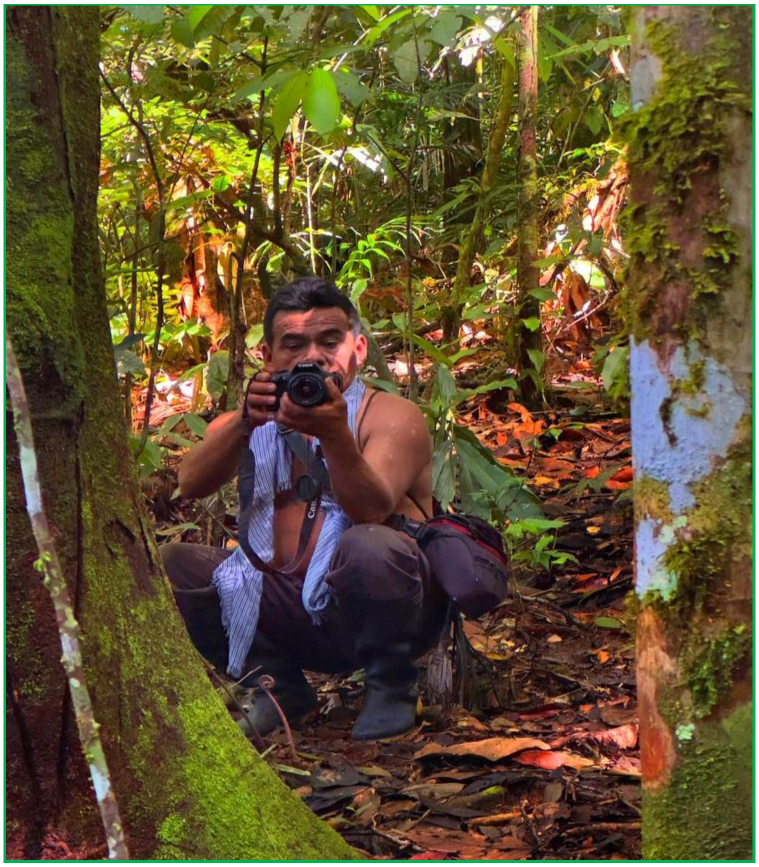


Figure 21. Pasto Indigenous heritage, Jhony Lopez and students tracking biodiversity indicator species in the Putumayo Amazon, jaguar sign and grassroots conserved areas.

They formed Savimbo with Drea Burbank, an MD-technologist in 2022 and began to extend and characterize their biodiversity work with satellite mapping, a program for local youth to learn jaguar tracking and game cameras, taxonomic classification, and geocoding.

In assessing the species for the region, the teams of scientists researching this methodology often spent as much as a week actively searching for one specimen of a rare species before finding one. After testing multiple video cameras, the team found that even the highest quality jungle cameras last up to three or four months before the rainforest destroys their functionality and they need to be replaced. The cost of this equipment and the physical labor required needs to be controlled in order to make biodiversity projects economically viable in these locations. Placing the cameras is highly technical work that can only be done only by those who frequent these locations and understand the lifecycles of these species. We discovered that most major biodiversity nonprofits in the region were hiring the same trackers—and that this was a highly technical skillset for IP and LC requiring years of training.

It is only by on-the-ground experience in functional ecosystems that the team was able to recognize and manage the challenges of creating a biodiversity methodology that is feasible given the physical challenges of working in these territories.

With one-year co-development and ongoing community feedback, the project was expanded to enroll neighboring farms, map the home range of Jhony's jaguars, and generate ever-fresh data.

In 2013 non-certified biodiversity crediting was initiated with Savimbo's payments system. Word-of-mouth spread among neighboring farms resulted in local control of hunting groups, and generated interest from several neighboring indigenous reserves, then IP and LC internationally in Suriname, Gabon, and the Ecuadorian Amazon.

The ISBM is unique because it is IP and LC-first, science and markets second, standard. We are also hopeful that this will give it an advantage in terms of scale, implementation, and outcomes.

Appendix G: How to calculate a biodiversity credit by hand

We don't recommend manual calculations, because with this methodology there is significant overlap in space and time, and most projects will make errors if they try to calculate credits outside of computer code. But if you *want* to do them, here's how.

Before starting, it is important to:

- Have the site cartography in a .kml format,
- Calculate the number of hectares, and

- Have a list of indicator species observations with an assigned integrity score and their established home range.
- Download Google Earth Pro desktop version and familiarize yourself with its use.

Calculating credits from a single observation

- Open the site .kml In Google Earth Pro.
- Use Tools > Ruler > Circle to create a circle which is centered at the geocode of the observation, with a radius equal to the home-range radius of the species in the observation.
- Calculate the area of the circle that falls within the project area, this is the area credited from this observation. If the entire circle is within the project area, this is the area of the circle. If some of the circle area falls outside of crediting area, then you must make a secondary polygon Add > Polygon, and trace the intersecting areas to calculate the area credited from this observation.
- Multiply the area credited by the integrity score of the species in the observation.

Calculating credits from observations overlapping in space

For multiple observations overlapping in space only, areas can be summed easily by hand.

- As above, create observation circles for each observation.
- For all circles with the same integrity score make a secondary polygon Add > Polygon, and trace the unioned areas to calculate the area credited from the observations multiplied by that integrity score.
- If two intersecting observation areas have different integrity scores, that area will use the higher value score.

Calculating credits from observations overlapping in space AND time

The most difficult credits to calculate by hand, are credits that result from observations which overlap in space and time, and for clarity this is the majority of observations on a BCP under this methodology.

- Make a spreadsheet of observations by date of validity (30 days before, and 30 days after an observation).
- Each date, sum all valid observations by space, as above.
- The credit value per day, is 1/30th of a credit and must be summed as such.

Manual credit calculations are easier to understand in an audiovisual demonstration. A public tutorial from Savimbo is available here. For more information, you can see sections 4.3, 4.4, and 4.5 .

Note: For more information on the development and application of this methodology, we recommend visiting isbm.savimbo.com.