WWF

THE BIODIVERSITY CONSULTANCY

ARTICULATING AND ASSESSING BIODIVERSITY IMPACT

A framework to support investment decisions

Methodology v1

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ARTICULATING AND ASSESSING BIODIVERSITY IMPACT

A framework to support investment decisions

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Shifting financial flows away from harmful practices and scaling up finance for nature recovery is a key lever in meeting the global goals of nature. At The Biodiversity Consultancy, we work to enable this transition by using science and our deep experience in biodiversity risk management to mainstream nature into business and finance decisions.

Collaborating closely with WWF Switzerland, we have developed a groundbreaking framework method, the Biodiversity Impact Assessment Framework (BIAF), aimed at assessing the potential biodiversity impact of investments or project interventions. The BIAF represents a significant milestone in making biodiversity central to decision-making processes. The BIAF achieves this by creating a globally applicable framework that considers both direct and indirect, net impacts of investments on biodiversity. The BIAF enables users to articulate the expected biodiversity gains from different investment alternatives ultimately guiding investments towards outcomes that benefit both nature and society. This has been made possible through an innovative systematic assessment of both the causes of nature loss and also the estimated benefits. These losses and gains are for the first time expressed in terms of biodiversity extent, condition, and significance.

We are proud to have contributed to this vital initiative and call on all stakeholders to join us in advancing biodiversity-conscious investment practices for a more sustainable future.

Jonathan Ekstrom

FOREWORD WWF

In light of the escalating biodiversity and climate crises threatening our planet's life-support systems, WWF Switzerland is honoured to present this landmark report, «Articulating and assessing biodiversity impact – a framework to support investment decisions».

The framework provides comprehensive guidance for integrating biodiversity considerations into decision-making processes. Recognising the need to significantly redirect financial investment, this will help to reverse the alarming loss of biodiversity worldwide. Together with The Biodiversity Consultancy (TBC) we present a robust framework for assessing the potential impacts of investments or project interventions on biodiversity. The Biodiversity Impact Assessment Framework not only addresses the urgent need for global applicability but also encompasses both positive and negative impacts on biodiversity across diverse ecosystems and business models. By integrating all key drivers of biodiversity loss, the BIAF empowers leaders to make informed decisions that prioritise biodiversity-friendly solutions. We invite investors, consultants, project developers and development banks to embrace this framework and join us in developing it into a widely used open-source tool in a collective effort to safeguard the future of our planet.

Thomas Vellacott

KEY TERMS AND ABBREVIATIONS

BAU, BUSINESS AS USUAL	The reference 'no project' scenario reflecting the status quo situation or reasonable expectation that current or predicted trends will continue.
BIAF	The Biodiversity Impact Assessment Framework described in this document.
BIN, BINNING	A statistical approach where data from a continuous variable are assigned to a set of discrete 'bins', each corresponding to a defined interval.
BIODIVERSITY-FRIENDLY	An investment or approach designed to deliver better outcomes for biodiversity than the reference scenario.
BIODIVERSITY BENEFIT/RETURN/GAIN	The positive outcomes for biodiversity from a biodiversity-friendly investment or approach compared to the reference scenario.
BIODIVERSITY IMPACTS	Biodiversity impacts may be positive or negative. Positive impacts reduce pressures on biodiversity and/or contribute to its conservation or restoration, leading to improved biodiversity condition. Negative impacts increase pressures on biodiversity and contribute to its further degradation and loss.
CEC, COUNTRY ECOREGION COMPONENTS	Country Ecoregion Components represent the portion of an ecoregion (Dinerstein et al. 2017) found within a national boundary.
DRIVERS OF BIODIVERSITY LOSS	The direct drivers of biodiversity loss identified by IPBES (2019). The five key drivers are changing use of sea and land, direct exploitation, climate change, pollution and invasive alien species.
IMPACTS (ON BIODIVERSITY)	Positive or negative changes in the state of biodiversity (quality and/or quantity) resulting from an entity's actions.
IMPACT INVESTMENT	Investments made with the intention to generate positive social and/or environmental impact alongside a financial return.
IMPACT PATHWAY	A simplified causal chain that connects (planned) activities with changes (positive or negative) to a direct driver of biodiversity loss.
MATERIAL IMPACT	A potential impact (positive or negative) that is significant enough to possibly affect an investment decision.
MSA, MEAN SPECIES ABUNDANCE	Indicator of ecosystem condition, based on the abundance of individual species in an ecosystem subject to a given pressure at a given intensity, compared to their abundance in an undisturbed reference situation (see page 17 condition for a full description of the term).
PLACE-BASED PROJECTS	Projects with spatially-focused activities that impact a well-defined geographic area.
POST-INVESTMENT ASSESSMENT	Assessment of the actual biodiversity impact of an investee or project, after an investment has been made.
PRE-INVESTMENT ASSESSMENT	Assessment of the predicted biodiversity impact of a potential investee or project, based on the business model and expected business outcomes.
PROJECT	A discrete set of planned activities (by a company or other organisation) for which investment is sought, with the aim to achieve defined business and/or conservation objectives.

REFERENCE SCENARIO	The reference scenario is either the BAU case (see definition above) or a reasonable expectation of a specific change, e.g., that an alternative use of the land will unfold if the project under consideration does not materialize.
REGION/REGIONAL	A contiguous area of land or water roughly between 1 million and 10 million km^2 in size.
QUALITATIVE ASSESSMENT	Use of assessment rules based on non-numerical categories or levels.
STAR, SPECIES THREAT ABATEMENT AND RESTORATION METRIC	Relative measure of a location's global conservation priority, based on the potential to reduce species extinction risk through threat abatement (STAR-t) or through restoration (STAR-r). See page 18 significance for a full description of the term.
STAR-T, THREAT ABATEMENT	Spatial assessment of relative opportunity for conservation gains through threat abatement activities. STAR-t scores can be broken down by type of threat to identify and prioritise actions to abate specific threats.
THEORY OF CHANGE	A description of the process of change towards a desired outcome that sets out the interventions required and their causal linkages, logical relationships, and sequence.

EXECUTIVE SUMMARY

The biodiversity crisis, along with the climate crisis, poses serious threats to the Earth's life-support systems and to human well-being. It is widely recognised that significantly increased financial investment is needed to halt and reverse the global loss of biodiversity. It is also crucial that available resources are applied where they can make the most effective contribution to conserving and restoring biodiversity. This report documents a biodiversity impact assessment framework as a response to this challenge.

Starting in March 2022, WWF Switzerland and The Biodiversity Consultancy (TBC) have worked together to develop a methodology to assess the potential biodiversity impact of investments or project interventions. The methodology was designed to meet three central requirements:

— Global applicability, across diverse business models and affected ecosystems

— Consideration of direct and indirect, positive and negative impacts on biodiversity

— Incorporation of all key drivers of biodiversity loss.

The biodiversity impact assessment framework (for convenience, termed BIAF in this report) is aimed at investments or interventions that intend to achieve positive biodiversity impacts, and for use by (among others) investors, consultants, project developers and development banks. It is not designed to assess risks or dependencies, nor for use by managers of large portfolios.

The BIAF is based on assessing three components of biodiversity: extent, condition, and significance. It involves identifying impact pathways that directly or indirectly link planned or actual activities to one of the five drivers of biodiversity loss (changing use of sea and land, direct exploitation, climate change, pollution, and invasive alien species). Each potentially material impact pathway is scored for the predicted extent of impact and associated condition change and significance, in relation to the most likely 'without project' scenario. A scoring framework supports estimation when limited information is available, and the assumptions and evidence behind scoring are documented. Overall scores can be used to compare the expected biodiversity gains from different investment or project alternatives.

The report explains in more detail the BIAF methodology and some of the challenges involved, and summarises four case studies to illustrate its application. In particular, the use cases illustrate how impact can be assessed for activities or projects that are not site-focused.

Pre-investment, the systematic and comprehensive assessment process not only enables evaluation of expected biodiversity impacts, but also shows where there is most leverage for realising further biodiversity gains post-investment. The business model or project interventions can be adapted based on these findings. The findings can also be used to formulate biodiversity action plans and to identify suitable performance indicators. Post-investment, measured biodiversity gains on project completion or investor exit can be compared with predicted values to demonstrate the biodiversity impact actually delivered.

Pilot application of the BIAF (including the four case studies outlined in this document) shows that the method provides plausible and interpretable results to support decision-making. Extension of the approach for planning or performance tracking has not yet been tested. Trialling the approach has also raised a number of issues requiring further work and review, such as the need for greater automation and better representation of uncertainty. These and other issues will be addressed in the next development phase.

BIODIVERSITY IMPACT ASSESSMENT FRAMEWORK (BIAF)

CONTEXT

The biodiversity crisis and the funding gap

We live in an age of rapid and unprecedented planetary change. Our economic growth and standard of living is impacting nature and people around the globe. According to the most recent **Living Planet Report** (WWF 2022), the populations of fish, birds, mammals, amphibians, and reptiles studied have declined by an average of 69 percent between 1970 and 2018 and humanity's demand on natural resources overshoots the Earth's biocapacity by at least 75%.

Current funding for biodiversity conservation is only around 17% of what is needed to halt biodiversity loss, with an estimated financing gap of c. USD 700 billion per year (Deutz et al. 2020). The biodiversity crisis and funding gap highlight both the urgent need for innovative and ambitious approaches, and the importance of directing available finance to investments with the greatest potential to bend the curve of biodiversity loss.

However, investors, consultants, project developers and planners in different sectors currently lack a consistent, broadly applicable impact assessment framework to rank investment opportunities or intervention options based on their potential to generate biodiversity benefits.

This document reports on WWF Switzerland and TBC work to develop a biodiversity impact assessment framework (for convenience, termed BIAF in this report) to meet this need. It briefly describes the work so far, the conceptual approach, the framework itself, its pilot application to a series of projects, and possible next steps.

Vision

In alignment with WWF's mission to stop the degradation of the earth's natural environment, and in view of the biodiversity finance gap, we aim to offer a solution that supports the channelling of financial flows towards the most impactful investment opportunities or project alternatives in terms of biodiversity.

Specifically, WWF aims to offer an accessible and standardized way to assess and compare potential biodiversity gains and track outcomes of investment opportunities as well as project alternatives to:

- Inform investors about the most promising investment opportunities in terms of impacts on biodiversity
- Support companies and project managers on strategic decisions regarding the planning and improvement of biodiversity performance
- Track the biodiversityperformance of companies, projects, and investment portfolios.

Key deliverables of the biodiversity impact assessment framework

WWF Switzerland aims to develop an assessment framework for investments in enterprises and projects that have potential to generate biodiversity benefits.

In its current state, the framework focuses on predicting the potential biodiversity benefits of investee companies' and projects' activities, through comparing the business model or planned project to a reference scenario. The aim is to enable users **pre-investment** to:

— Make consistent comparisons of the potential biodiversity benefits of investment opportunities in business models and projects

— Make informed investment decisions in relation to their defined biodiversity objectives.

The framework applies a generalized measurement framework to pathways specified for positive and negative impacts. This provides a foundation for future extension to support users **post-investment** to:

— Track the biodiversity performance of investee companies and projects

— Support strategic decisions and operational improvements at the investee/project level

— Help identify opportunities for further biodiversity gains

— Assess the biodiversity performance of investments at portfolio level.

Combined, the assessment of business models/project alternatives (pre-investment) and the assessment of their performance (post-investment) will help to maximise the efficient use of capital to create biodiversity gains. Figure 1 summarises the key steps and outputs of the BIAF in the pre- and the post-investment phase.

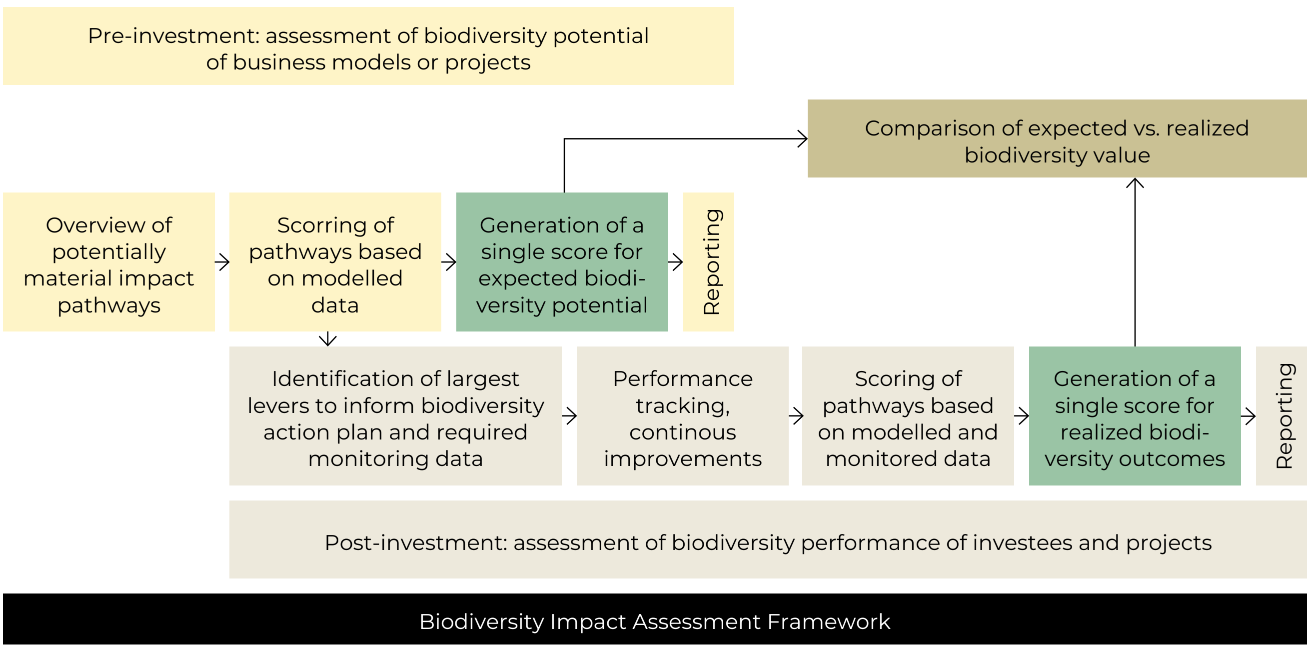

Figure 1. Outline of key steps and outputs in pre-investment and post-investment (to be developed) assessment. BECS stands for biodiversity extent, condition and significance.

Target users and suggested format

The BIAF is aimed at investments or interventions that intend to achieve positive biodiversity impacts, and for use by:

- (impact) investors
- consultants
- project developers
- development banks

It is not designed to assess risks or dependencies, nor for use by managers of large portfolios.

So as to maximize uptake of the BIAF, and thus its overall impact, WWF proposes an open-source code and method which can be easily incorporated into the user's existing environment, and/or developed into a web-based tool. An appropriate business case (to be developed) ensures maintenance and improvement of the code and the method in the long run.

Picture: Anne Nygard, unsplash.com

Place in the biodiversity assessment landscape

Numerous other approaches, frameworks and tools exist or are in development for business-related biodiversity assessments (see for example EU Business and Biodiversity Platform 2021, Finance for Biodiversity 2022, TNFD 2022[1]). Figure 2 illustrates a subset of these and their relationship to the BIAF.

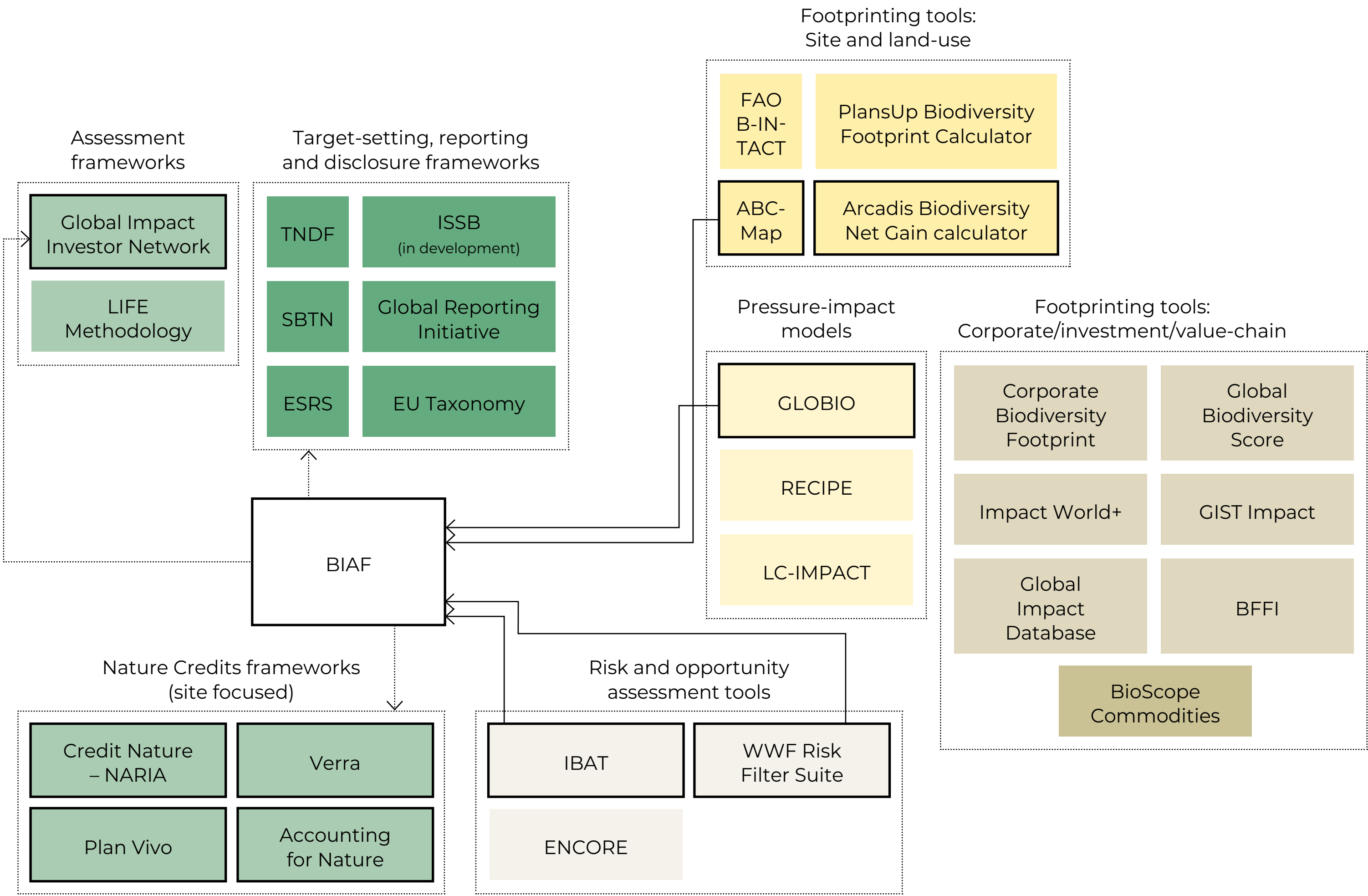

Figure 2. Landscape of selected tools, frameworks and models used for biodiversity impact assessments. Tools outlined with thick lines have at least a partial focus on positive impacts. No existing tool focuses on SME or projects. Solid arrows: current or potential information sources for the BIAF. Dotted arrows: potential information flow from the BIAF. Abbreviations: see footnote[2].

[1] Also TNFD's online tools catalogue

[2] *Abbreviations in Figure 2: BFFI, Biodiversity Footprint for Financial Institutions (BFFI); ENCORE, Exploring Natural Capital Opportunities, Risks and Exposure; ESRS, European Sustainability Reporting Standards; FAO B-INTACT, Food and Agriculture Organisation Biodiversity Integrated Assessment and Computation Tool; GLOBIO, Global Biodiversity model for policy support; IBAT, Integrated Biodiversity Assessment Tool; ISSB, International Sustainability Standards Board; NARIA, Natural Asset Recovery Investment Analytics; SBTN, Science-based Targets Network; TNFD, Task Force for Nature-related Financial Disclosures*

These approaches, frameworks and tools are very varied but can be broadly classified into different (though overlapping categories):

— Footprinting models, methods and tools, focused on a suite of pressures and/or land-use changes. Global footprinting tools rely on a set of pressure-impact models, based on empirically observed relationships that are generalised to estimate a quantitative impact for any measured or inferred level of pressure. These models and tools can inform the assessment of defined impact pathways in the BIAF (for example, use of the GLOBIO model for impacts related to pollution, or the ABC-Map tool for impacts related to land-use and management changes). At present, these footprinting approaches have gaps in coverage for some pressures and/or realms, limited spatial differentiation in the models applied, and no in-built significance component. Most are focused on assessing negative impacts, though in principle it is possible to assess positive impacts by comparing a with-project and counterfactual scenario. Currently, most footprinting tools are proprietary (can be run only by the organisations that developed them) and/or require specialist expertise to use. Open-access tools designed for non-specialist users, such as ABC-Map, BioScope and FAO B-Intact, currently cover only a subset of use cases and may be restricted to non-commercial use.

— General frameworks for target-setting, reporting and disclosure. These recently developed frameworks focus on both risks and opportunities. Major recent frameworks include the Task Force for Nature-related Financial Disclosures (TNFD), European Sustainability Reporting Standards (ESRS) and Science-based Targets Network (SBTN, with guidance issued for science-based targets for nature involving land and freshwater). In January 2024, the Global Reporting Initiative also launched its updated Biodiversity Standard. These frameworks have their own specific requirements, but also extensive alignment in their core elements. The BIAF can potentially inform assessment of opportunities and positive impacts, contributing to business target-setting and reporting using these and other frameworks.

— Risk and opportunity assessment tools. The BIAF provides a framework to apply the data from tools such as IBAT and the WWF Risk Filter Suite for comparison of investment opportunities.

— Other assessment frameworks. Among these, the Global Impact Investment Network (GIIN) IRIS+ framework provides broad guidance and core metrics for investments aimed at biodiversity improvements (among many other impact goals). However, it is not designed for quantitative comparison of potential gains from different investment opportunities. The BIAF can potentially contribute to informing investment decisions within the GIIN framework.

— Nature Credits frameworks. Several frameworks have recently been developed to assess biodiversity gains in the context of the emerging Nature Credits market. These take different measurement approaches, but focus on site-based conservation and/or restoration of nature. The BIAF provides a complementary framework that can predict and assess biodiversity gains for technology-based or other non-site focused crediting schemes. The BIAF is therefore well positioned to make the external costs and benefits of economic activities visible and accessible to decision-makers.

The BIAF is thus largely complementary to other frameworks and tools, but with potential to draw on or contribute to several of them. The BIAF has a distinctive combination of features that include:

— Applicability to all realms, and all potential business models or project types

— Assessment based on an explicit theory of change and defined impact pathways

— Inclusion of all key drivers of biodiversity loss

— A focus on positive change, but accounting for potential negative impacts

— Explicit consideration of timeframe

— Ability to use data across a broad range of precision, and to inform meaningful comparisons using limited information.

The assessment framework clearly focuses on biodiversity impacts. Other environmental and social issues will also need to be considered as part of the analysis of a potential investment or project. For example, investors might require that projects should have a positive or at worst neutral effect on greenhouse gas emissions and on local communities' well-being.

For pre-investment assessments, the focus of the BIAF is on overall business and project models, not on fine-tuning management practices. However, the overall assessment of business and project models can provide insight on potential operational refinements to maximise net biodiversity gains.

Key requirements

Key requirements (for the complete set of requirements see Annex B, page 58) for the impact assessment framework were identified as:

— Identifies and assesses how business models, or project interventions, relate to the five key drivers for biodiversity loss (i.e. changing use of sea and land, direct exploitation, climate change, pollution, and invasive alien species)

— Captures material direct and indirect, positive, and negative impacts on biodiversity

— Is responsive to user needs in terms of effort, costs, data, and technical expertise required for the analysis. Specifically, scores can be estimated (if necessary) with incomplete or imprecise input data

— Covers diverse business models, intervention approaches and geographic locations

— Is transparent and traceable with regards to assumptions, data inputs, caveats, and methods used

— Delivers replicable and consistent results

— Discriminates effectively between project alternatives or investment opportunities in order to inform decision-making

A suite of c. 40 potentially relevant tools and approaches for measuring biodiversity impacts was screened against the requirements. As none of the considered tools and approaches fully met them, a general biodiversity extent, condition and significance (BECS) framework was chosen to develop and pilot the BIAF.

The biodiversity extent, condition and significance (BECS) framework

A biodiversity extent, condition and significance (BECS) framework provides a flexible and robust approach for assessing and comparing likely biodiversity gains. As the name indicates, this measurement framework combines three components: extent, condition and significance of ecosystems/biodiversity.

Frameworks based on extent and condition of ecosystems are well established, for example in the UN System of Environmental Economic Accounting – Ecosystem Accounting (UNCEEA 2021) and in footprinting approaches such as the Global Biodiversity Score (CDC Biodiversité 2018). Adding a significance component recognizes that the conservation priority of biodiversity varies from place to place, and (according to the choice of significance metric) aligns the approach to a defined policy goal. Existing biodiversity extent, condition and significance metrics include the Biodiversity Impact Metric targeted at commodity supply chains (CISL 2020) and adapted for the ENCORE Biodiversity Module (UNEP-WCMC et al. 2021).

Extent

Extent refers to the extent of the ecosystems affected by the project or investment opportunity. Determining extent for fully place-based projects is relatively straightforward, i.e. the area of land for terrestrial projects or the length, surface area or volume of water in freshwater or marine biomes. For projects aiming to transform systems or processes, it can be more difficult to establish the ecosystem extent that they are affecting. These areas could be large for some projects with a regional or global scope. In either case, this assessment needs to be based on the project's stated business model and growth projections within the defined assessment timeframe.

Where available, the actual area impacted is used in scoring extent. Where this is not known, the assessment framework can also be applied with only an order-of-magnitude estimate for extent (page 25).

Condition

The **condition** component of the framework relates to the quality of the ecosystem at a location, measured by its characteristics compared to an undisturbed, reference state. Ecosystem condition is a useful and important way of assessing the state of nature at a location, as condition (together with extent: page 16) underpins the broader integrity of the ecosystem and its capacity to supply ecosystem services.

Ecosystem condition is a complex concept with a number of different components, that may include physical or vegetation structure, connectivity, species composition, function, physical and chemical state and threatening processes (e.g. UNCEEA 2021). There are therefore many potential condition measures, which may be more or less relevant for different ecosystem types (for example canopy cover, species richness, water chemistry or dispersal processes). Different condition measures are likely to be interlinked and correlated.

The pre-investment assessment framework assesses changes in condition via changes in pressures, defined for particular impact pathways (see page 21). Considering land-use change, for example, ecosystem condition changes when lightly-logged natural forest is converted into forest plantation, or an agricultural field is restored to native grassland. Models relating condition to the intensity of particular pressures have been developed based on empirical studies, e.g. through the GLOBIO global biodiversity model (Alkemade et al. 2009, Schipper et al. 2016). These generalised pressure-condition relationships can be used as a starting point to predict ecosystem condition changes.

GLOBIO uses Mean Species Abundance (MSA) as an indicator of ecosystem condition (Annex A, page 53). MSA is an ecosystem composition metric. It is calculated based on the abundance of individual species in an ecosystem subject to a given pressure at a given intensity, compared to their abundance in an undisturbed[3] reference situation. MSA includes only species present in the undisturbed situation, and ignores increases in individual species abundance above those in the reference situation (Alkemade et al. 2009). This prevents the indicator being inflated by generalist, opportunist species that may benefit from ecosystem disturbance. Like other condition metrics, MSA is a dimensionless number ranging from 1 (representing an undisturbed ecosystem where the species assemblage is fully intact) to 0 (representing a fully converted ecosystem where all the original species are locally extinct).

The pre-investment assessment framework uses change in MSA as a reference basis for scoring. Although ideally the actual expected condition change would be used, it is also possible for scores to be estimated using a rough approximation of the magnitude of change (page 26). For land-use, averaged condition metrics for different land-use types and intensities (with some interpolations) are shown in Annex A, page 53. For other pressures, the proportional change in pressure intensity predicted to occur through an impact pathway can be used to estimate change in condition.

As with extent, company or project forecasts for the scale of activities are used to estimate changes in pressures and subsequently MSA.

Assessing ecosystem condition 'on the ground' would usually require measurement and combination of several different metrics. For the purpose of predicting potential biodiversity gains pre-investment, only an approximate estimate is required, and it is possible to take a simpler approach using one indicative metric. Mean Species Abundance is a convenient metric to use in the current framework, for several reasons:

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[3] *As used in* GLOBIO, MSA *refers to the set of species and their abundance in an undisturbed ecosystem. In principle, any desired reference state for the species community may be used when calculating* MSA, *giving scope for reflecting future climate-adapted or (desired and defined) novel ecosystems.*

— It assesses the composition component of condition. Composition is dependent on ecosystem structure and function, but the reverse is not necessarily the case, so a composition metric is an appropriate choice if only one metric is being used. A composition metric that refers to the intact (or other defined) species community is also applicable to all ecosystems, whereas appropriate structure and function metrics may be different for different ecosystem types.

— MSA integrates changes in both the presence and abundance of the original set of species, across a set of representative taxon groups. This provides a more sensitive and accurate indicator of condition change than metrics based only on species' presence and not abundance, or that do not use the original (or other defined) species set as a reference.

— Pressure-impact relationships in the GLOBIO model can be used to translate changes in pressures to estimated changes in MSA, and average MSA scores for broad land-use types and intensities have been tabulated and can be used for scoring in the current framework.

— MSA is a well-established metric that is already widely used in biodiversity footprinting and impact assessment for business and finance, in global biodiversity assessments and in scientific studies.

It is not essential to use MSA for assessing condition – in principle, any appropriate condition metric on a 0-1 scale could be used instead. In situations where MSA scores cannot easily be estimated, other approaches may be adopted to scale condition (see e.g. impacts on freshwater in the case study for Company C in page 37). It is important to document the rationale and supporting evidence in such cases.

Significance

The final component of the framework, the biodiversity **significance**, is a measure of conservation priority of the affected biodiversity.

There are many potential measures of significance. Significance measures should reflect overall conservation goals, which in turn reflect human value judgements. Ensuring the persistence of the world's species and ecosystems is generally considered an important goal, one that is central to previous and current global biodiversity targets. This goal implies that conservation should prioritise features with high irreplaceability (which constrains the available options in space) and high vulnerability (which constrains the available options in time) (Margules & Pressey 2000).

A convenient metric combining biodiversity vulnerability and irreplaceability is the **Species Threat Abatement and Restoration metric (STAR)**. STAR is based on information in the IUCN Red List of Threatened Species and maps range-rarity, a measure of the number of species and the proportion of their distributions overlapping at a site (Guerin 2015), weighted by species' threat of extinction risk (Mair et al. 2021). STAR is directly relevant to Goal A and Target 4 of the Kunming-Montreal Global Biodiversity Framework[4].

[4] **https://www.cbd.int/gbf/goals**
Goal A (2050)
«…Human induced extinction of known threatened species is halted, and, by 2050, the extinction rate and risk of all species are reduced tenfold and the abundance of native wild species is increased to healthy and resilient levels…»

Target 4 (2030)
«Ensure urgent management actions to halt human induced extinction of known threatened species and for the recovery and conservation of species, in particular threatened species, to significantly reduce extinction risk…»

Goal A and Targets 2–4 of the framework focus also on ecosystem integrity and genetic diversity. At present, there are no single convenient and globally-available significance metrics to apply for these aspects. An ecosystem equivalent to STAR is likely to be developed in coming years with expanding coverage of Red List of Ecosystem assessments.

STAR scores for a location show the potential to reduce species extinction risk through threat abatement (in species' current areas of habitat, STAR-t) or through restoration (in species' former areas of habitat, STAR-r). These scores also provide a relative measure of a location's global conservation priority.

STAR is accessible via the **Integrated Biodiversity Assessment Tool**, IBAT, as global data layers showing scores in 5 x 5km grid cells. The STAR global data layers include all threatened and near-threatened amphibians, birds and mammals – the major taxon groups that are comprehensively assessed and mapped. These data layers currently only cover terrestrial species, but work is underway to extend STAR to the marine and freshwater realms, and to expand the coverage to other well-assessed taxon groups.

The pre- and the post-investment assessment framework uses STAR as a basis for scoring, but other significance measures (reflecting different policy goals, for example increasing ecosystem integrity) could be substituted, and could be included as options in future iterations of the framework. While STAR grid-cell values for threat abatement (STAR-t) should be used for scoring where possible, it is also possible to use an order-of-magnitude estimate of the likely STAR value based on geographical context (page 27).

Picture: Anne Nygard, unsplash.com

APPLICATION

Overview

The overall aim for pre-investment assessment is to enable reliable comparison of investment opportunities or project alternatives in relation to expected net biodiversity gain and its efficiency (the expected gain/dollar invested).

At the pre-investment stage, typically information is incomplete, predictions are uncertain and time and resources for detailed research and analysis are also limited. The framework therefore does not require precise estimates for extent, condition and significance of impacts. Approximations may be used or, where necessary, estimates can be categorised within a set of broad ranges for values. To use the framework, it is thus only necessary to assign an estimate to the appropriate range.

It is suggested to do an initial commercial and environmental screening before starting the biodiversity impact assessment (see page 16) to filter out projects and investment opportunities that are clearly not viable or appropriate for generating biodiversity gains. The assessment process for anticipated biodiversity impacts is summarized in Figure 3 and detailed in sections below.

The first step is to review information from the potential investee or project on the business model, the location, expected project scale, and environmental aspects. Using this information, an overall theory of change and potential impact pathways are defined. After screening for materiality, potentially material impact pathways are assessed using a scoring framework. The process is very similar, and takes place in parallel, for both negative and positive impacts.

Assessment should be an iterative (repeated) process that involves identifying information gaps and points needing verification, seeking relevant information from the company or project and/or carrying out additional research, and then refining the overall theory of change, impact pathways, materiality screening and/or scoring for extent, condition and significance.

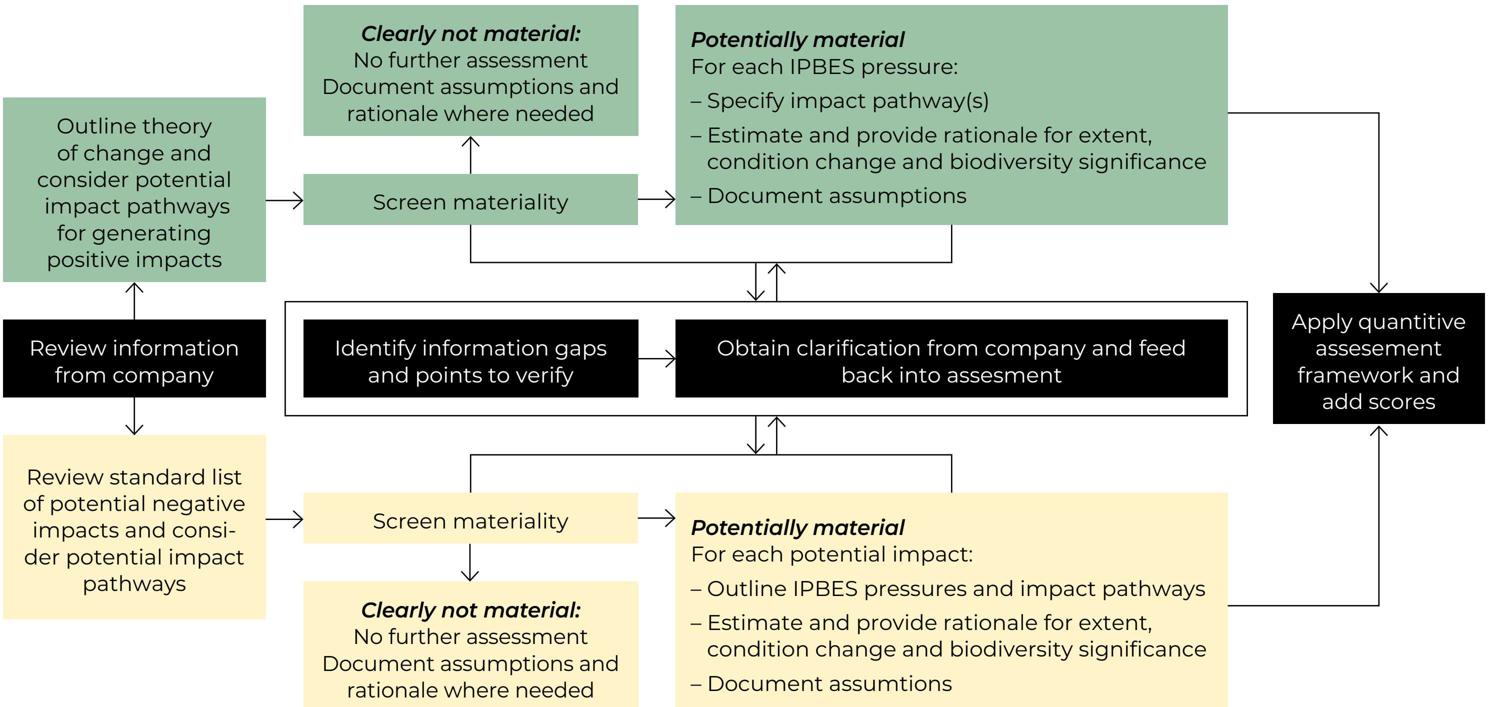

Figure 3. Summary description of the assessment process. Core assessment steps are summarized in black boxes, assessment of potentially positive impact pathways in green, and assessment of negative impact pathways in yellow.

Theory of change

Based on review of company/project documentation and answers to any initial questions, a theory of change should be outlined for the project. The theory of change should concisely explain how the investment or project will positively impact biodiversity, specifying the causal linkages and logical relationships between actions and outcomes, and documenting the underlying assumptions.

Impact pathways

Impact pathways should be defined for potentially material impacts, both positive or negative, and along the value chain as well as for own operations. However, impact pathways that are clearly not material need not be listed. Impact pathways are based on the theory of change[5]. Each pathway relates to one or more drivers of biodiversity loss, as defined by IPBES (2019). These drivers are changing use of land, freshwater or sea; direct exploitation; climate change; pollution and invasive alien species. More than one impact pathway may be specified for a single driver. However, specified pathways should be distinct and non-overlapping, so that their potential benefits are additive.

For each impact pathway, rough estimates are then needed for geographic scale, effectiveness in changing ecosystem condition, and location (in order to assess significance). Estimates are made for the situation at a standard fixed time after the start of the project (by default, five years; page 23), by comparing the situation anticipated with the project against the reference scenario (next paragraph) where the project does not take place. Available growth forecasts should be extrapolated if necessary (linearly, by default) to the standard timeframe (page 23).

These estimates are based on information from the company or project developer, further research and/or expert knowledge. The rationale and information sources behind each estimate should be clearly documented. Estimates are then converted into scores for extent, condition and significance, either directly or by assigning them to categories with associated midpoint scores (page 25ff).

Reference scenario

The assessment of impact pathways and materiality as well as the scoring itself are based on comparing the with-project scenario to the reference scenario without the project (the counterfactual). The reference scenario includes the business-as-usual (BAU) case which may involve reasonable expectation that current or predicted trends will continue, e.g. that land continues to be converted to supply growing demand for a particular commodity. In addition, the reference scenario also includes reasonable expectations of change, e.g. that an alternative use of the land will unfold if the project under consideration not materializes.

This means that negative and positive impacts are always evaluated in comparison to the reference scenario, not in absolute terms. This approach has advantages over an absolute assessment:

— Reduced evaluation effort: Impacts that deviate only slightly from the reference scenario do not have to be evaluated.

— Favours solutions that are significantly better than the reference scenario: These are likely to have the greatest positive impact on biodiversity when scaled up by the company and replicated more widely by industry.

[5] *Current and future regulations will influence the theory of change and impact pathways and need to be considered accordingly. In piloting the BIAF, the EU Regulation on Deforestation-Free Products (EUDR) entering into obligation on 30 December 2024 for medium and large-sized companies, was not considered as the EUDR may act to segment markets rather than reduce deforestation pressure overall until similar regulation comes into force in most major markets globally.*

The with-project scenario

The scale of potential positive and negative impacts on biodiversity depends greatly on the scale of relevant activity by the company or project at the five-year (or other fixed) time point. Appropriate forecasts for how individual business areas will develop are thus essential. Preferably these will come from forecasts in the company or project business plan that have been reviewed (and revised if necessary) as part of the commercial review process, before the biodiversity assessment takes place.

Materiality

There are many ways in which company/project activities could potentially impact biodiversity to create gains or losses. However, some pathways are likely to result in much larger impacts than others. Scoring pathways that are expected to have negligible impact is not a good application of effort. Impact pathways and their potential impacts are thus screened for materiality before application of the assessment framework, and only potentially material impacts are assessed.

In the context of pre-investment assessment, materiality relates to the change that the project is making from the without-project approach. For example, a project may require built infrastructure (scope 1) and energy (scope 2) to process a product that substitutes for fish harvested from the wild (the reference scenario). If the resulting biodiversity impacts (in this case, negative) from this processing facility are not expected to be significantly greater than the respective impacts from processing wild-caught fish, they would not be considered material and do not need to be scored.

This screening for now is based on expert assessment, using company information and contextual knowledge. When potential materiality is unclear, a more structured screening can be applied using the simple framework in Annex A, page 58, or the impact pathway can be included precautionarily for scoring.

For **negative impacts**, it is important to consider potential impacts, for all scopes of impact[6]. To simplify materiality screening for negative impacts, and to ensure that no material negative impacts are overlooked, a standardized checklist of project impact sources was developed (Annex A, page 53). This is not exhaustive but covers the likely potential impacts under each scope. Materiality is assessed for the with-project scenario against the reference scenario. Although it will often be clear if impacts are potentially material, the screening framework in Annex A, page 58 can be used where needed to identify whether impacts should be scored.

Material negative and positive impacts are both scored in the same way in the assessment framework, and added to produce a net score.

In some cases, material negative impacts might point to a no-investment decision, regardless of whether the net score is positive. This will depend on rules or principles established by the user, for example that all investments should be carbon-neutral or negative, or that material negative biodiversity impacts in one location, or as a result of one impact pathway cannot be traded for gains in another.

Transformative potential

Note that the framework only considers the change in impacts related to the project. For positive impacts, it does not consider whether projects improve biodiversity outcomes within an inherently unsustainable system or have potential to transform the system itself. Since transformative potential is not currently assessed with this framework, investment managers may need to consider this as a separate criterion when developing their overall investment strategy.

[6] *For consistency, the impact scopes for climate change defined by the Greenhouse Gas Protocol are also used here for biodiversity.*

Timeframe

A consistent timeframe is needed for fair comparisons across projects. However, commercial assessment of investment opportunities and projects may operate under varied timeframes. For piloting the assessment framework in the pre-investment phase we used a five-year timeframe, mainly because of the timeframes of forecast data in business models, and assumed linear growth over time in business activity to extrapolate predictions when needed.

Predictions of biodiversity gains over this timeframe may not necessarily reflect the actual change expected in biodiversity state, as changes in state are often slow and may lag changes in pressures resulting from interventions. With the simplifying assumption that business growth (and, where relevant, other processes such as ecosystem restoration) proceed linearly, comparisons across projects – the main focus of this framework – are not affected by the timeframe chosen. While a longer timeframe might be ecologically more appropriate, forecasts for business activity, and with-project vs business-as-usual comparisons, are likely to become increasingly uncertain beyond the five-year horizon.

Even using a fixed time period, comparisons across projects need to consider the different ways in which potential gains or losses accrue in different impact pathways. By default, the framework takes a 'snapshot' approach, comparing the predicted situation for extent, condition and significance at the end of year 5 between the with-project and reference scenarios. For simplicity, this does not take into account exactly when losses or gains occur during the five-year period. It also assumes that recurrent, annual pressures (such as pollution or water extraction continuing each year in the same location) do not have a cumulative effect on ecosystem condition. For most impact pathways, scores can simply be assigned based on the predicted scale of activities at the end of five years. However, for impact pathways that involve ecosystem restoration or conservation (avoided loss), it is necessary to consider and account for the accrued difference between the with- and without-project scenarios over the whole five years (Annex A, page 57).

Assessing potential net gains

Potential biodiversity gains are assessed using a simple scoring framework that covers each of the elements of extent, condition and significance, described below.

The current quantitative framework is a development of an earlier semi-quantitative approach. It uses the actual values for area, condition change and significance rather than dimensionless scores linked to value ranges ('bins') with quantitative lower and upper bounds. However, where actual values are not known, categorisation using 'bins' can still be applied to estimate a score for use in calculations. The categories and associated estimated scores are outlined in sections below and compiled in Annex A, page 54.

The scoring framework has been developed and refined through application to a range of different projects. The current framework has proved workable for a diversity of impact pathways, and with outputs that match biodiversity advisors' judgement (based on company information and expert knowledge) for whether investments are likely to yield low, moderate or high biodiversity benefits.

Design features and application

The framework needs to be suitable for application to a very diverse set of projects, both in scale and type of interventions. The overall approach is thus general and flexible, the aim being to produce an approximate estimate of potential net gains that can support fair comparison between projects, not necessarily a precise and accurate prediction.

— The best available spatial information on impacts should be used when scoring. The locations of supply chain impacts (whether positive or negative) are often not easy to determine, but further research, relevant datasets and reasonable assumptions can help to narrow these down. For example, if a company aims to scale-up production of algal protein as a substitute for beef, the assessment should focus on hotspots for expanding cattle and cattle-feed production, rather than all cattle-rearing areas or all agricultural land globally.

— Assessment involves a comparison between the 'business as usual' scenario or a likely alternative development (the counterfactual) and the investment scenario. It is this change – not the absolute value – that is assessed both for materiality and for scoring. A specific point is that a negative impact should not usually be considered material if the scale of impact (appropriately standardized per unit) is no greater than in the reference scenario.

— The defined impact pathways should be non-overlapping (overlapping pathways should be combined).

— Impacts are assessed by comparing start and end points. The start point is the pre-investment situation (BAU) or a likely alternative development, and the end point the projected with-investment situation after five years. 'Extent' is thus assessed as the area impacted at year five, and 'condition' as the positive or negative change in condition in that area, compared to the reference scenario. 'Significance' is a feature of geographic location that remains constant over the five-year investment period. Given its purpose and the need for simplicity, the framework does not attempt to annualize impact or to adjust for impact trajectories (e.g. related to linear or exponential growth of activities) within the five year period.

— The framework applies in the same way to (potentially material) positive and negative impacts. Negative impacts produce a negative score. Positive and negative scores can be added to produce a net overall score (see also last paragraph in page 22 «Materiality»).

— It is anticipated that the fully-fledged version of this framework will allow for some flexibility to adjust the scoring framework, including significance and condition metrics, in order to reflect each impact investor's focus/mission.

Scoring for extent

Projects may have impacts at a wide range of scales, from well-defined sites and landscapes to very large regions or the entire globe.

Generally, outcomes can be defined more clearly and are more certain to occur the smaller the geographical scale of impact. This is reflected in our scoring approach which is based on the log_{10} value of the actual area (Table 1). This approach means that projects affecting larger areas score higher, but do not completely overwhelm those with impacts at smaller geographic scale.

Some specific points to consider when scoring for extent:

— Where the actual area of impact is known, the score is the log_{10} value of the area in km^2.

— Where only the order of magnitude of the area of impact can be estimated, «bins» are used for scoring the extent. The 'bins' used for scoring extent have intervals defined on a logarithmic scale, with scores that are the log_{10} value of the mid-point.

— A minimum area threshold of 1.01 km^2 is applied to avoid handling zero or negative scores. Impacts on an area less than 1.01 km^2 will usually be regarded as non-material for scoring purposes. If there is a specific justification for including such impacts, extent may be scored as $log_{10}(1.01) = 4*10^{-3}$ log_{10} km^2 (Table 2).

— The Earth's surface area is c. 510 million km^2, comprising a total ocean area of about 360 million km^2 and a terrestrial area (including a relatively small area of non-frozen freshwater) of c. 150 million km^2. Scores for impacts covering these large areas are shown in Table 2.

Table 1. The framework to assign categories, when needed, and associated scores for extent from an order-of-magnitude estimate for the area affected by impacts (in km^2); M = million.

AREA OF IMPACT (KM^2)	1 – <10	10 – <100	100 – <1000	1000 – <10,000	10,000 – <100,000	100,000 – <1 M	1 – <10 M	10 – <100 M
Description	Very small	Small	Small – medium	Medium – large	Large	Very large	Regional	Supra-regional
Minimum area in category, km^2 (lower threshold)	1.01	10	100	1000	10 000	100 000	1 M	10 M
Maximum area in category, km^2 (upper threshold)	10	100	1000	10 000	100 000	1 M	10 M	100 M
Score based on log_{10} category midpoint	0.74	1.74	2.74	3.74	4.74	5.74	6.74	7.74

Table 2. Scoring for extent for extremely small or large areas of impact outside the categories in Table 1.
[þ] Where there is a justification for regarding impacts as material; M = million.

CATEGORY DESCRIPTION	TINY[þ]	GLOBAL TERRESTRIAL	GLOBAL MARINE	GLOBAL
Area, km^2	<1.01	150 M	360 M	510 M
Score applied	0.004	8.18	8.56	8.71

Scoring for condition change

Change is assessed on a 0-1 condition scale, where 1 represents the undisturbed reference condition and 0 complete loss of biodiversity.

The default reference basis for scoring condition is the Mean Species Abundance metric (page 17 condition, Annex A, page 54) but any appropriate 0-1 condition metric could be used (as for impacts on freshwater in the case studies, page 30). Only the change in condition needs to be estimated. This may require knowing the starting, baseline condition but that is not always necessary, for example, if assessing annual incremental condition gains from restoration.

When the actual condition change can be estimated, that value should be used for scoring. Otherwise, anticipated condition change can be assigned to a category based on the framework in Table 3. The category 'bins' for condition scores in Table 3 use unequal intervals, so as to accommodate likely scenarios in different kinds of projects, and to make it easier to assign impacts to the appropriate 'bin' when information is limited.

Annex A page 54 shows default (global average) values for change in MSA in the terrestrial realm from an intact condition to different land-use types and intensities. Annex A page 55 gives default annual increments in condition score for terrestrial biomes, based on a global review of restoration rates (Jones et al. 2018).

Table 3. The framework to assign categories, when necessary because of limited information and associated scores for change in condition within a 0-1 scale.

CONDITION CHANGE CATEGORY	0 – <0.01	0.01 – <0.1	0.1 – <0.3	0.3 – <0.5	0.5 – <0.7	>0.7 – 1
Description	Very small	Small	Small – medium	Medium – large	Large	Very large
Score based on category mid-point	0.005	0.055	0.2	0.4	0.6	0.85

Scoring for significance

For the **terrestrial realm**, significance is assessed using the STAR metric (see page 18), which is mapped globally at 5 x 5 km resolution. For pre-investment assessment, the STAR-t score is used only as a convenient indicator of the relative conservation priority of a location or larger area, not for estimating potential STAR gains (see The Biodiversity Consultancy 2021).

STAR grid-cell scores have a very large range of absolute values, across five orders of magnitude. This means that it is appropriate to use a logarithmic scale for STAR-based significance, as for the extent scoring framework.

Depending on how precisely the spatial location of the impacts can be defined, STAR values for scoring significance are determined at one of four levels. In descending order of preference, these are:

1. At a **particular location**: the mean STAR-t value for grid-cells overlapping the impact area[7], weighted by proportion of overlap.

2. Across one or **more Country Ecoregion Components[8]**: the area-weighted mean STAR-t 80th percentile value for the set of CECs.

3. Across **one or more countries**: the area-weighted STAR-t 80th percentile value across the set of countries.

4. Where there is limited information about the expected spatial location: based on the typical project cases and/or the categories for significance outlined in Table 4.

Significance score is the $\log_{10}$ value of the STAR-t value expressed in milliSTAR units[9]. Using milliSTAR units makes it easier to handle the numbers after logarithmic conversion.

For particular locations, the mean STAR-t value is used as this shows the potential for reducing global extinction risk in that actual location. At larger scale, the 80th percentile STAR-t score gives a better picture of the overall significance of the area than the mean or maximum STAR-t score (see Annex A, page 59). This is because (a) mean scores are substantially affected by the overall level of regional habitat loss, while (b) the distribution of STAR grid-cell scores is highly right-skewed, so maximum scores may reflect very high scores in one or a few grid cells, giving an unrealistic impression of overall significance.

If the STAR-t value is <10 milliSTAR, the significance score = 1. This is to ensure that no significance weightings are below 1. This approach is preferred so that scores for locations with relatively low significance are not down-weighted from the calculated extent x condition value.

[7] *For terrestrial place-based projects at a specific location, STAR scores for the relevant grid cells can be found through running an IBAT STAR report for the project polygon. There is a cost associated with this for commercial use.*

[8] *Country ecoregion components (CECs) represent the portion of an ecoregion (Dinerstein et al. 2017) located within a national boundary. The CEC is often a convenient unit to use for assessing significance where exact locations are not known, as CECs are relatively distinct from each other both in biogeography within a country (as they are components of distinct ecoregions, Smith et al. 2018) and in pressures on biodiversity within an ecoregion (as these reflect a country's particular socio-economic context).*

[9] 1 STAR *unit* = 1000 *milliSTAR*

Table 4. The framework to assign categories, when needed, and associated scores for biodiversity significance. Depending on impact scale, the reference metric for significance is the mean STAR-t (threat abatement) grid-cell score (in milliSTAR) for a location, or the area-weighted 80^{th} percentile grid-cell score across Country Ecoregion Components or countries.

SIGNIFICANCE	**<10**	**10-<100**	**100-<1,000**	**1,000-<10,000**	**>10,000**
Descriptor	Low	Moderate	High	Very high	Highest
Min (lower threshold)	0	10	100	1,000	10,000
Max (upper threshold)	10	100	1,000	10,000	100,000
Log$_{10}$ midpoint, used for scoring	1 [e]	1.74	2.74	3.74	4.74
Typical context for project impacts	Distributed across the entire globe (e.g. through reducing greenhouse gas emissions), including large areas of relatively very low species diversity, endemism and threat	Distributed at large scale, including areas of moderate species diversity, but not including large areas of very low species diversity, endemism and threat (e.g. where impacts are on cultivated land world-wide)	In a region of relatively high species diversity, with moderate endemism and threat, e.g. in widespread ecosystems of the tropics or subtropics	Focused in an area of known elevated species endemism and threat	Focused in an area of exceptionally high species endemism and threat
Example ecoregions [þ]	Arctic foothills tundra Eastern Canadian Shield taiga North Atlantic moist mixed forests Trans-Baikal conifer forests	Azerbaijan shrub desert and steppe Central Korean deciduous forests Alps conifer and mixed forests South Saharan steppe and woodlands Southwest Australia savanna	Caribbean shrublands Patagonian steppe Victoria Basin forest-savanna mosaic Northwest Iberian montane forests Zambezian flooded grasslands	East African montane moorlands Southeastern Indochina dry evergreen forests Western Guinean lowland forests	Eastern Arc forests Madagascar ericoid thickets Northern Andean páramo

[e] *For scoring with actual values, the minimum grid cell value taken is 10 milliSTAR, so that lowest weighting value = 1. Any grid cell with value < 10 milliSTAR scores 1.*

[þ] *With CEC STAR-t 80^{th} percentile scores in this category.*

STAR grid-cell values are currently available for the **terrestrial realm**. For the **marine realm**, STAR scores based on a suite of marine taxa have been assessed and mapped globally, but the methodology and scores are not yet published. A similar scoring approach applies as for the terrestrial realm, but with significance category thresholds adjusted because absolute STAR grid-cell scores are generally lower for the marine than terrestrial realm. Work is in progress to determine appropriate category thresholds. Marine ecoregions have been mapped for coastal and shelf areas (Spalding et al. 2007), but not for the open ocean. However, STAR values for pelagic ecosystems are generally low, so can be assigned a significance score of 1.

For the **freshwater realm**, a STAR assessment is in progress and will in due course be published. As freshwater STAR values are not currently available, significance scoring is for the time being based on two significance measures that have been assessed for the world's freshwater ecoregions (Abell et al. 2008): total number of freshwater fish species, and numbers of endemic freshwater fish species. In the WWF Biodiversity Risk Filter (WWF 2023), the ecoregion mapping has been converted to level 7 HydroBASINS (river catchments) and significance measures re-scored onto a 1-5 scale. WWF has combined the two measures in a biodiversity importance score available for countries and sub-national administrative units[10].

As the resulting importance scores range from 1-5, they are directly analogous to terrestrial significance (score 1 equals 'low', score 5 equals 'highest') based on STAR values and can be used without further transformation in calculating the extent x condition x significance score.

Combining scores

For each distinct impact pathway included in the scoring, scores for extent, condition change and significance are multiplied to give an overall score in units of weighted $\log_{10}$-km^2 equivalents. One weighted $\log_{10}$-km^2 equivalent can be thought of as representing a biodiversity loss or gain equivalent to an intact natural area of 1 $\log_{10}$-km^2 (10 km^2) that is in an undisturbed state (condition = 1) and has a significance score of 1.

Pathways representing biodiversity gains have positive scores, while those for pathways representing biodiversity losses are negative. Scores are added up across all impact pathways to give a total estimate for the biodiversity impact of the project at the end of five years.

Assessing realized net gains

The biodiversity assessment approach described in this document enables estimation of future net biodiversity gains compared to a reference scenario. These assessments allow ranking of project alternatives or investment opportunities in relation to expected biodiversity benefits. Assessments also lay the foundation for developing project biodiversity action and monitoring plans for the post-investment phase. Analysis of the individual impact pathways helps identify the most effective levers for increasing net biodiversity impacts. From this, suitable actions as well as indicators for monitoring purposes can be derived.

On project completion or investor exit, monitoring data collected during the post-investment phase should support estimation of the realized net biodiversity impact, applying a similar scoring framework as in the pre-investment phase. Since some modelled or inferred values may now be replaced by groundtruthed data, the reliability of the assessment increases. Comparing post-investment measures with pre-investment estimates shows whether the intended impact target was achieved or even exceeded. Since units are standardised across all projects or investment opportunities, they can also be aggregated at portfolio level.

Future development of the BIAF will include elaboration of the post-investment methodology and linkages to existing monitoring, evaluation and reporting tools and initiatives.

[10] *Data available at* **https://riskfilter.org/water/explore/countryprofiles#**

CASE STUDIES

This section outlines the trial application of the assessment tool to four candidate investments. The projects have varied business models and each poses different assessment challenges.

For each case study, we have included a short outline of the business model, a summary of the theory of change, and a tabulated outline of impact pathways and their score. All impact pathways screened as potentially material are tabulated, although some of these are assessed with very low scores.

Detailed scoring worksheets for all case studies accompany this report as separate Excel files.

The assessment is focused on biodiversity, not on social issues. Where social issues are mentioned is in light of the potential resulting impacts on biodiversity. A separate due diligence/safeguards approach is required to ensure no harm or net positive outcomes from projects for vulnerable local communities.

Company A

Business Model

Company A works on rural development and inclusive agricultural value chains, by producing cashew nuts using organic farming and agroforestry practices in modified savanna soils in the Orinoco River Basin in South America. The company increases food security and creates income opportunities for local farmers with few resources.

The two main productive activities in the department are smallholder mega-extensive cattle ranching (i.e. 1 animal/10 ha), and exotic tree plantations (mainly eucalyptus and acacia) for corporate carbon compensation projects. Local farmers practice yearly burnings of the savannas to promote vegetation growth for cattle, which is a low-profit business; small scale, low-inputs subsistence agriculture is practiced along cattle ranching. Forestry businesses, on the other hand, arrived in the department in recent years attracted by the topography and the low costs of land, and the profitability of carbon compensation schemes.

Company A's proposition, on the other hand, improves habitat and soil condition, requires few agricultural inputs, and cultivates native species adapted to the local environment. Using the benefits of the cashew business, additional land is protected from savanna fires and other unsustainable practices. Over a five-year period, in association with local farmers, the company expects to:

- Increase the production area for cashew nuts from approx. 1,550 to 2,000 ha
- Protect an area of modified savanna and palm-forest habitats c. 50% larger than the one used for cashew production.

Theory of change

Company A will generate biodiversity gains by expanding cashew agroforestry and protecting savanna and palm-forest habitats from other uses (i.e. mega-extensive cattle ranching and exotic tree plantations) in the Llanos ecoregion. Land under cashew agroforestry systems is expected to have higher biodiversity value than land used for cattle ranching and (especially) plantations of exotic trees, because of its structural similarity to the original savanna ecosystem, maintenance of some savanna vegetation and regeneration of fragile soils.

Reference scenario: without the project, practices for mega-extensive cattle ranching and exotic tree plantations will continue and expand in the savanna habitats of the department.

Anticipated impact compared to reference scenario

Predicted impacts of Company A's business model on biodiversity are summarized and scored in Table 5. The main positive impact is on land-use change through improvement of habitat and soil condition, and by protecting savannas from burning for cattle-ranching and the establishment of exotic tree plantations for carbon compensation projects. Positive impacts on pollution (by preventing the establishment of exotic tree plantations) do not contribute to the score because they might be cancelled by potential negative impacts resulting from the use of biofertilizers and biopesticides in cashew agroforestry systems.

Table 5. Summary of positive (in green) and negative (in beige) impact pathways of Company A. Potentially material pathways were considered for scoring. In some cases, those proved to be non-material and were therefore not assigned a score.

DRIVER FOR BIODIVERSITY LOSS/SPECIFIC PRESSURES	IMPACT PATHWAYS	BECS COMPONENT	PARTIAL SCORE	TOTAL SCORE
LAND-/WATER-/SEA-USE CHANGE				**0.45**
Degradation and loss of savanna habitats through traditional practices for cattle-ranching and exotic tree plantations	Improving habitat and soil condition by implementing cashew agroforestry systems in modified savannas	E	0.65	0.32
		C	0.35	
		S	1.42	
	Protecting land beyond cashew plantations to allow for natural regeneration	E	1.46	0.12
		C	0.08	
		S	1.42	
Pressure on water sources for exotic tree plantations	Preventing the establishment (and irrigation) of exotic tree plantations in areas of cashew production	Given the low water scarcity index in the region, we consider this pathway non-material.		
No material negative pathways identified				
CLIMATE CHANGE				**0.04**
GHG emissions from traditional practices for cattle ranching	Sequestering carbon in agroforestry systems and improved soils; avoiding emissions from savanna burnings	E	8.71	0.04
		C	0.005	
		S	1.00	
No material negative pathways identified				
POLLUTION				**0**
Use and run-off of agricultural inputs from exotic tree plantations	Preventing the establishment of exotic tree plantations in areas of cashew production	Insufficient information for scoring. Assumed that these potentially positive and negative pathways cancel out (i.e. there is no improvement for the with-project versus the reference scenario).		
Use and run-off of agricultural inputs from cashew agroforestry systems	Applying biofertilizers and biopesticides in cashew agroforestry systems			
RESOURCE EXPLOITATION				**0**
No positive impact pathways identified				
No material negative pathways identified				
INVASIVE SPECIES				**0**
No positive impact pathways identified				
No material negative pathways identified				
COMPANY A TOTAL SCORE				**0.49**


Picture: Anton Shuvalov, unsplash.com

Company B

Business model

Company B develops novel recipes and commercializes processed foods made of mixtures of seaweed and other plant-based ingredients in Europe. The nutritional value, taste and other sensorial properties of Company B products (sandwiches, pizzas, spreads, wraps, salads, nuggets) are remarkably similar to fish- and shrimp-based foods, making them viable vegan and European-sourced alternatives to similar products made with tuna, white fish, salmon and shrimp. For the provision of seaweed and other main ingredients for their recipes, Company B has partnered with organic, regenerative seaweed farmers and harvesters, and recognized growers and producers of organic faba bean admixtures. Processing and transport of Company B products is performed by partner companies with experience in the industry and organic certifications. Commercialization to end-consumers is through recognized European supermarket chains or restaurants.

In five years, the company estimates the amounts of fresh seaweed and faba bean protein texturate, the main ingredients required for Company B products (next to water and rapeseed oil, which constitute 45% and 15% of the product's weight, respectively), at c. 841 and 737 tonnes, respectively, substituting approximately 2,500 tonnes of canned tuna, 16 tonnes of shrimp, 1,700 tonnes of salmon, and 800 tonnes of white fish per year, assuming Company B products in fact replace seafood-based products and are not consumed in addition to them.

Theory of change

Nutritious and tasty seaweed-based alternatives to seafood will reduce consumption of fish and shrimp, and increase the demand for seaweed cultivation. This generates potentially positive impacts for land and ocean's biodiversity by decreasing the demand for aquaculture and wild caught seafood, resulting in reduced pressures on natural habitats and wild fish and shrimp populations, and promoting benefits of regenerative seaweed cultivation.

Reference scenario: sandwiches, pizzas, spreads, wraps, salads, nuggets and other products made with tuna, salmon, white fish and shrimp.

Anticipated impact compared to reference scenario

Predicted impacts of Company B's business model on biodiversity are summarized and scored in Table 6. The main positive impact is on land-use change by reducing the demand for agricultural commodities (mainly soy) for aquaculture feed. Additional positive impact results from the reduced exploitation of wild tuna. Potential positive impacts on pollution in land and sea, marine habitats, and overexploitation of other wild fish and shrimp do not contribute to the scoring due to the small scale of the business and/or the lack of precise, local information and scientific research on the impact of sourcing farmed seaweed.

Table 6. Summary of positive (in green) and negative (in beige) impact pathways of Company B. Potentially material pathways were considered for scoring. In some cases, those proved to be non-material and were therefore not assigned a score.

DRIVER FOR BIODIVERSITY LOSS/SPECIFIC PRESSURES	IMPACT PATHWAYS	BECS COMPONENT	PARTIAL SCORE	TOTAL SCORE
LAND-/WATER-/SEA-USE CHANGE				**1.49**
Sea-use change for aquaculture of tuna, white fish, shrimp and salmon	Reducing demand for farmed tuna	Due to the insignificant contribution of aquaculture for tuna and white fish production, we consider these pathways non-material.		
	Reducing demand for farmed white fish			
	Reducing demand for farmed shrimp	As the area needed to farm the shrimp and salmon replaced is considerably smaller than the threshold of 1.01 km2, we do not score these pathways.		
	Reducing demand for farmed salmon (marine phase)			
Land-use change for aquaculture of salmon	Reducing demand for farmed salmon (freshwater phase)	As the area needed to farm the salmon replaced is considerably smaller than the threshold of 1.01 km2, we do not score this pathway.		
Land-use change for producing land-based ingredients for aquaculture feed	Reducing demand for land-based ingredients for aquaculture feed	E	0.44	1.49
		C	0.90	
		S	1.74	
Land-use change for producing faba beans	Increasing demand for faba beans, one of the main ingredients of Company B seaweed admixtures	As faba beans play an important role as a rotation and mixed crop that improves soil fertility, no additional land is expected to be converted for its cultivation.		
Loss of habitats for marine life	Creating suitable habitats for marine life in seaweed farms	Current findings on impacts of seaweed cultivation on biodiversity are mixed. As local data on sourcing seaweed farms are lacking, we conservatively treat these pathways as neutral.		
Loss of habitats for marine life	Modifying marine natural habitats with seaweed farms			
CLIMATE CHANGE				**0.04**
GHG emissions from aquaculture practices, aquaculture feed production, transport and cooling of fish and shrimp Ocean's carbon capture and storage capacity	Reducing demand for farmed and wild fish and shrimp Increasing ocean's carbon capture and storage in seaweed farms	E	8.71	0.04
		C	0.005	
		S	1.00	
No material negative pathways identified				
POLLUTION				**0**
Pollution from aquaculture of tuna, white fish, shrimp and salmon	Reducing demand (and the related pollution) for farmed tuna	Due to the insignificant contribution of aquaculture for tuna and white fish production, we consider these pathways non-material.		
	Reducing demand (and the related pollution) for farmed white fish			
	Reducing demand (and the related pollution) for farmed shrimp	As the area needed to farm the shrimp and salmon replaced is considerably smaller than the threshold of 1.01 km2, we do not score these pathways.		
	Reducing demand (and the related pollution) for farmed salmon			
Pollution from agricultural inputs for land-based ingredients for aquaculture feed	Reducing demand (and the related use and run-off of agricultural inputs) for soybean used in aquaculture feed	As the condition change from reduced agricultural inputs on c. 3 km2 of soybean fields is expected to be negligible, we do not score this pathway.		
Excess nutrients and lack of oxygen in marine ecosystems	Absorption of excess nutrients by farmed seaweed	As seaweed farms are not placed in areas with nutrient excess or unfavourable environmental conditions, we consider this pathway non-material.		
Pollution from the use of agricultural inputs for faba bean production	Increasing demand for faba beans, one of the main ingredients of Company B seaweed admixtures	As faba beans suppliers use organic practices, we consider this pathway non-material.		

Table 6 cont. Summary of positive (in green) and negative (in beige) impact pathways of Company B. Potentially material pathways were considered for scoring. In some cases, those proved to be non-material and were therefore not assigned a score.

DRIVER FOR BIODIVERSITY LOSS/SPECIFIC PRESSURES	IMPACT PATHWAYS	BECS COMPONENT	PARTIAL SCORE	TOTAL SCORE
RESOURCE EXPLOITATION				**0.06**
Fishing of wild tuna	Reducing demand for wild tuna	E	7.70	0.06
		C	0.01	
		S	0.74	
Fishing of wild white fish	Reducing demand for wild white fish	E	6.08	$2*10^{-3}$
		C	$4*10^{-4}$	
		S	0.74	
Harvesting of wild shrimp	Reducing demand for wild shrimp	As the expected condition change from the replacement of 8 tonnes of wild shrimp is expected to be negligible, we do not score this pathway.		
Fishing of wild salmon	Reducing demand for wild-caught salmon	As only 19% of consumed salmon in Europe is wild caught, we consider this pathway non-material.		
Exploitation of wild fish populations to produce fish meal for aquaculture feed	Reducing demand for raw ingredients (i.e. fishmeal) used in aquaculture feed	As the condition change from the reduction in fishmeal production is expected to be negligible, we do not score this pathway.		
No material negative pathways identified				
INVASIVE SPECIES				**0.04**
Escape of farmed fish and shrimp into natural areas	Reducing demand (and the related escapes) for farmed fish and shrimp	As the condition change from reducing escapes from salmon and shrimp farms is expected to be negligible, we do not score this pathway.		
No material negative pathways identified				
COMPANY B TOTAL SCORE				**1.59**

Company C

Business model

Company C is a B Corp certified company in central Europe that aims to make agriculture more sustainable by providing tools and technologies for detecting and interpreting plant bio-signals. Company C's technology helps indoor and outdoor farmers optimize their operations by detecting stress-related information directly from their plants, allowing them to take corrective action to prevent crop losses and adapt the input of water, fertilizers, and pesticides to actual needs.

Scaling up to a five-year time horizon, uptake of Company C's technology is estimated at c. 2,800 and 3,600 ha for production of outdoor and indoor tomatoes, respectively, in the Netherlands and Spain, and c. 500 ha for the production of almonds in California (USA).

Theory of change

By providing continuous, real-time data on plant health, Company C contributes to the improvement of agricultural practices that result in increased yields with reduced inputs (fertilizers, pesticides, water), thus benefitting biodiversity through the reduction of pressures and the demand for land.

Reference scenario: outdoor and indoor tomato farming in the Netherlands and Spain, and almond farming in California using current techniques without Company C's technology.

Anticipated impact compared to reference scenario

Predicted impacts of Company C's business model on biodiversity are summarized and scored in Table 7. The main positive impact is on land-use change, through increasing crop yields and freeing-up land for potential restoration (under the EU Nature Restoration Law) in Europe. The transformative potential of technologies that improve agricultural practices (enabling yields to be increased or maintained with fewer damaging inputs) appears high, but overall scores are not large because of the relatively small scale of the business. At this scale, potential positive impacts of Company C through reducing pollution and climate change are small, and may also be cancelled out by negative impacts relating to manufacture and maintenance of the sensors.

Table 7. Summary of positive (in green) and negative (in beige) impact pathways of Company C. Potentially material pathways were considered for scoring. In some cases, those proved to be non-material and were therefore not assigned a score.

DRIVER FOR BIODIVERSITY LOSS/SPECIFIC PRESSURES	IMPACT PATHWAYS	BECS COMPONENT	PARTIAL SCORE	TOTAL SCORE
LAND-/WATER-/SEA-USE CHANGE				**0.14**
Large land footprint of agricultural production	Increasing crop yields, freeing-up land for restoration	E	1.05	0.14
		C	0.07	
		S	1.81	
Pressure of agriculture on water sources	Providing data to optimize water usage	E	5.99	$1*10^{-3}$
		C	$6*10^{-5}$	
		S	3.46	
Land-use change for raw material extraction	Increasing the demand of raw materials for sensors, servers, and computers	At the predicted scale of the business, this pathway is not expected to be material.		
CLIMATE CHANGE				**0.00**
High carbon footprint per kg of crop produced	Increasing crop yields and reducing agricultural waste at the farm level	At the predicted scale of the business, positive impacts are very small, and these opposite pathways are expected to cancel-out.		
GHG emissions from fertilizer production and application	Providing data to optimize (i.e. reduce) fertilizer application			
Sub-optimal carbon sequestration in perennial crop systems	Providing data to optimize the health state of perennial crops			
Operational GHG emissions from equipment manufacture and use	Increasing GHG emissions through the production, use and maintenance of sensors, servers, and computers			
POLLUTION				**0**
Use and run-off of fertilizers, causing aquatic pollution	Providing data to reduce the use of fertilizers	E	5.99	$5*10^{-3}$
		C	$2*10^{-4}$	
		S	3.50	
Use and run-off of pesticides, causing terrestrial pollution	Providing data to reduce the use of pesticides	E	2.01	$1*10^{-4}$
		C	$4*10^{-5}$	
		S	1.98	
Use and run-off of pesticides, causing aquatic pollution	Providing data to reduce the use of pesticides	E	5.99	$5*10^{-3}$
		C	$2*10^{-4}$	
		S	3.50	
Pollution caused by the manufacture of equipment	Increasing the demand of raw materials for sensors, servers, and computers	At the predicted scale of the business, this pathway is not expected to be material.		

Table 7 cont. Summary of positive (in green) and negative (in beige) impact pathways of Company C. Potentially material pathways were considered for scoring. In some cases, those proved to be non-material and were therefore not assigned a score.

DRIVER FOR BIODIVERSITY LOSS/SPECIFIC PRESSURES	IMPACT PATHWAYS	BECS COMPONENT	PARTIAL SCORE	TOTAL SCORE
RESOURCE EXPLOITATION				**0**
No positive impact pathways identified				
No material negative pathways identified				
INVASIVE SPECIES				**0**
No positive impact pathways identified				
No material negative pathways identified				
COMPANY C TOTAL SCORE				**0.15**

Picture: Markus Spiske, unsplash.com

Company D

Business model

Company D aims to scale up technology that allows the use of excavation material for building, reducing requirements for cement and aggregates and the need to dispose of construction waste. Company D's patented, cement-free admixture technology transforms excavation waste into environmentally friendly and cost-effective building materials. Admixture X is mixed with excavation materials and/or sludge in conventional concrete infrastructure to produce cement-free concrete, which claims c. 90% CO_2 emissions reductions and 29% lower cost compared to conventional concrete. The cement-free concrete does not completely replace the need for conventional concrete in buildings but can be used for structural features that are not load-supporting (e.g. floors). The additives used for the cement-free admixtures are mineral-based chemicals, non-toxic and non-hazardous.

Company D has not provided an economic forecast for scaling up. However, the company is included as a case study here to show how the assessment framework applies to its business model. In 2020, Company D stated plans to reach €28 million annual revenues in five years from commercialisation. This is about 0.01% of the current global cement market of c. USD 327 billion[11], and about 1% the revenue of the world's largest cement company, Holcim Group[12]. Global cement production is c. 4.1 billion tonnes annually[13], so after five years Company D's product could be substituting c. 410,000 tonnes of cement. Company D will target its products at emerging markets (e.g. India, Cameroon), and the DACH region.

Theory of change

Through commercial scaling up of its cement-free admixture technology, Company D will reduce the use of conventional cement in construction. This will reduce the need to extract limestone for cement manufacture and sand and gravel for making concrete, as well as greenhouse gas emissions, with benefits for biodiversity.

Reference scenario: continued use of concrete produced from cement and raw aggregates.

Anticipated impact compared to reference scenario

Predicted impacts of Company D's business model on biodiversity are summarized and scored in Table 8. The main positive impact is on land-use change, by reducing river-mining for the extraction of aggregates and sand for concrete production. Other predicted positive impacts on land-use change (e.g. by reducing limestone mining and landfilling) and climate change do not contribute to the score due to the relatively small scale of the business. However, these positive impacts have a high transformative potential if the business scales up substantially.

Table 8. Summary of positive (in green) and negative (in beige) impact pathways of Company D. Potentially material pathways were considered for scoring. In some cases, those proved to be non-material and were therefore not assigned a score.

[11] *Fortune Business Insights, 2022*

[12] *CHF 26.8 billion in 2021: Holcim Integrated Annual Report 2021*

[13] *https://gccassociation.org/key-facts*

DRIVER FOR BIODIVERSITY LOSS/SPECIFIC PRESSURES	IMPACT PATHWAYS	BECS COMPONENT	PARTIAL SCORE	TOTAL SCORE
LAND-/WATER-/SEA-USE CHANGE				**2.65**
Sourcing of raw materials for cement	Reducing the need to source raw limestone by replacing it with excavation and construction waste and an alternative mineral binder	E	$4*10^{-3}$	0.01
		C	1.0	
		S	2.74	
Sourcing of aggregates and sand for concrete	Reducing the need to source aggregates and sand by replacing them with local excavation and construction waste	E	1.18	2.64
		C	0.60	
		S	3.74	
Water use for aggregate washing	Reducing the need to wash raw aggregates	As the water use for aggregate production is only c. 0.3% of the total water used for concrete, we consider this pathway non-material.		
Land conversion for landfills	Reducing the amount of excavation and construction waste in landfills	As the area prevented to be landfilled is considerably smaller than the threshold of 1.01 km^2, we do not score this pathway.		
Sourcing of raw materials	Increasing demand of raw materials for Company D's admixtures	Information on the nature and sourcing of raw materials for admixtures is lacking, but pathway is not expected to be material.		
CLIMATE CHANGE				**0.04**
GHG emissions from cement production (including emissions from clinker calcination and from combustion of fossil fuels for the calcination process)	Reducing GHG emissions for cement production	E	8.71	0.04
		C	0.01	
		S	1.00	
No material negative pathways identified				
POLLUTION				**0**
No positive impact pathways identified				
No material negative pathways identified				
RESOURCE EXPLOITATION				**0**
No positive impact pathways identified				
No material negative pathways identified				
INVASIVE SPECIES				**0**
No positive impact pathways identified				
No material negative pathways identified				
COMPANY D TOTAL SCORE				**2.69**

Summary of overall scores

Overall biodiversity benefit scores for the four case studies are shown in Table 9. The scoring clearly separates out the four assessed projects, with highest scores for Company D and Company B, and relatively low scores for Company A and Company C.

Table 9. Summary of overall scores from the biodiversity impact assessment for the four case studies considered. Overall scores reflect both the particular impact pathways considered and the predicted scale of company activities after five years.

	SUMMARY THEORY OF CHANGE	OVERALL SCORE
Company D	Reduce the use of limestone-based cement and raw aggregates in construction through commercial scaling up of cement-free admixture technologies. Main biodiversity benefits arise by reducing land-use change pressure from sand and gravel extraction.	**2.69**
Company B	Offer nutritious and tasty seaweed-based alternatives to seafood. Reduced consumption of wild tuna and farmed salmon and shrimp generate positive impacts for ocean and land biodiversity by reducing pressures on land- and sea-use, and the overexploitation of wild populations.	**1.59**
Company A	Expand cashew agroforestry systems and protect land in the Llanos ecoregion in South America. Main biodiversity benefits arise from improving soil condition and protecting savannas from burning and the establishment of exotic tree plantations.	**0.49**
Company C	Improve agricultural practices and crop yields by providing in-situ data on plant health. Biodiversity benefits result mainly from increasing yields that free up agricultural land for potential restoration under the EU Nature Restoration Law in Europe.	**0.15**


Picture: Anne Nygard, unsplash.com

INSIGHTS AND ISSUES

Developing, discussing, and trialling the assessment framework has highlighted a number of questions, challenges and areas for further research and development. Some of the most significant are highlighted below.

Information needs

The scoring framework was successfully applied to a diversity of potential investments involving a range of business models at varying geographic scale. While the assessment framework itself is simple, it was not always straightforward or easy to develop estimates for impact on extent, condition and significance. This was due to a combination of project information gaps and inherent uncertainties in predicting the scale and location of impacts.

The information initially available from companies often did not address key aspects needed for biodiversity assessment. Further correspondence or discussion with companies was usually needed to clarify specific points, and some information gaps often remained. In most cases, it was necessary to make some plausible assumptions to develop estimates. This also often involved further research to develop the context for project impacts and allow a fair assessment. This work should be well within the capacity of a fund's biodiversity advisor, but does require ecological expertise and a good understanding of the drivers of biodiversity loss and how they relate to both local and global social and economic systems. Alongside development of a future tool, guidance documents and targeted training will help support users and reduce the level of expertise required.

Data accessibility

The datasets and models needed to apply the current framework are mainly public and freely accessible. However, calculating impact values (for instance, using the GLOBIO pressure-impact models) may require expert support or the use of proprietary tools (e.g., the Global Biodiversity Score tool).

The STAR global layer, proposed as the basis for assessing significance, is accessible for commercial use through IBAT, which involves a fee. Detailed IBAT data (by grid cell) for a particular location are needed when comparing or assessing the potential for site-focused interventions to reduce species extinction risk, and this may be relevant to some impact investment scenarios. For the case studies assessed here, detailed grid-cell data would not add significant value, as STAR scores are used only as an indicator of relative conservation priority in a broad region. STAR statistics at the ecoregion or country ecoregion component are thus adequate. These are not yet tabulated and publicly available, but may be in future.

Uncertainty

There are many sources of uncertainty in assessments made using the framework. Three such sources are discussed below: sensitivity to assumptions, potential for transformation, and unintended side effects.

Sensitivity to assumptions

Overall scores are sensitive to assumptions about project scale after five years, the reference scenario, and the location of impacts. They should therefore be interpreted with some caution. Nevertheless, scores based on reasonable assumptions differentiated between projects and appear to provide a good indication of the relative biodiversity gains that projects could deliver.

Aside from the actual scores, the assessment process requires impact pathways, potential negative impacts and key assumptions to be thought-through carefully, made explicit and documented. The structured framework and process for this are important for identifying potential uncertainties, flagging missing information, understanding whether gains are likely to be delivered, and comparing gains fairly overall. It is important to realize and make clear how assumptions impact the score. Also, as SMEs tend to be quite agile and projects are susceptible to changes, there is potential that actual impacts could differ from those predicted.

Uncertainty is already partly factored into the scoring through a logarithmic approach to assign scores to extent (the area impacted) and significance. This reflects the lower certainty of effects for large-scale and geographically less well-defined projects, respectively.

More explicit approaches to incorporate uncertainty could be to:

- Informed by impact pathways, provide the potential high to low range for scores, for a best case and worst case scenario (e.g. substitution of soybean from the tropics or soybean from the US; prevention of land conversion or further intensification).
- Include a score reflecting the overall level of certainty for each impact pathway.
- Follow the approach of carbon projects to apply a discount weighting for permanence and/or likelihood of success.

Transformative potential

Transformative change goes beyond addressing the direct drivers of nature decline to tackle its root causes: «the interconnected economic, sociocultural, demographic, political, institutional and technological indirect drivers behind the direct drivers» (Diaz et al. 2019).

In the current context, transformative potential thus relates to how far a project could change underlying systems versus making incremental improvements within existing ones. For example, a company aiming to produce lower-impact feed for livestock may reduce the negative impact on biodiversity per unit of product but not the level of meat consumption itself (in the worst case, it could even contribute to greater demand through a rebound effect). In contrast, a project that effectively substitutes plant or insect protein for meat arguably could reduce overall demand for meat, having a greater positive impact on biodiversity in the long-term.

At the moment, the BIAF does not explicitly consider transformative potential, and this aspect may be obscured in scoring because of the small scale of predicted activities (see, e.g. the case study for Company C, page 37). A structured approach to assess this could be added, either within the scoring framework or as a separate component.

Unintended side effects

Actions aiming to benefit biodiversity may have unintended negative consequences. For example, substituting a harmful land use (e.g., intensive cattle rearing) with one that is more biodiversity-friendly (e.g. agro-forestry) could lead to displacement of the impacts elsewhere, potentially to regions of higher biodiversity significance.

The checklist for identifying potential negative impacts includes a section for 'systemic' impacts that is aimed at capturing potential unintended side effects, in the following categories:

- Creating increased consumer demand – where more sustainable production of a commodity raises demand and thus overall impacts (rebound effect)
- Displacement of pressures– resulting in impact leakage, as outlined above
- Perverse incentives – where interventions create unanticipated incentives for harmful actions, for example a market for carbon credits leading to afforestation of natural grasslands
- Market splits – for instance, where the overall impacts of improving production sustainability (e.g. through certification) are limited because unsustainable production continues and targets a separate market with less stringent regulation or less discerning consumers.

The potential for unintended consequences can be difficult to quantify. Future versions of the BIAF could include a more structured framework for assessing the risks of unintended consequences and whether these are likely to be material.

Investment efficiency

For trial application, we did not use scores to assess investment efficiency, i.e. the potential biodiversity gains per dollar invested. This can be calculated directly from scores and compared across investment options, provided information on the scale of investment is standardised and comparable.

Low scores for large-scale impacts with very small condition change – climate change as example

The scoring framework will overall disfavour projects where potential impacts are delivered at large (regional or global) geographic scale, but create very small changes in condition. The logarithmic scoring of extent reflects the measurement challenges and high uncertainty of biodiversity impacts at very large scales. One specific implication is that projects focused primarily on greenhouse gas reductions will usually achieve low scores for biodiversity gains – unless the reductions are a significant proportion of global emissions[14]. Such projects might make useful if limited contributions to achieving climate goals, but are unlikely to be the most effective for achieving biodiversity gains *per se*.

There are often multiple impact pathways for a project that involve modest reductions in greenhouse gas emissions that will overall have very small biodiversity impacts. When scoring, these are not considered separately but combined into a single score based on global extent and the $\log_{10}$ midpoints for very small condition changes and low significance. If a specific pathway reduces a significant proportion of global emissions (suggested threshold: above 80 million tonnes CO_2 equivalent per year[14]), it can be scored separately with the expected condition change.

[14] *The threshold value for material ecosystem condition change from reduced GHG emission reductions is defined for consistency with the threshold value for material extent, i.e. 1.01 km², scoring 4*10⁻³. The maximum score for extent, for global impacts, is 8.71 and the ratio of minimum to maximum area scores is 0.004/8.71 = 4.6*10⁻⁴.*

Total annual global GHG emissions depend on the timeframe used for calculation but are approximately 54 bn tonnes CO_2 equivalents/y (UNEP Emissions Gap report, 2022). *Assuming condition change is directly proportional to the percentage of global GHG emissions reduced, an annual reduction of $4.6*10^{-4}$ of global emissions equates to c. 16 million t CO_2e. Climate change as a driver currently accounts for approximately 10% of the global decline in nature, though impacts vary by realm* (IPBES 2019). *The relative importance of climate change impacts is likely to increase in future. Assuming a 20% improvement in global ecosystem condition if all climate change impacts ceased, a threshold value for material emissions reductions in one impact pathway would thus be 16/0.2 = 80 million t CO_2 equivalents/y.*

Further consideration is needed whether climate change as a driver of biodiversity loss (rather than greenhouse gas emission reductions *per se*) should be incorporated in scoring at all or treated separately. Options could be to use a separate ranking for carbon impact, or include a statement on greenhouse gases, related to overall investment requirements for projects to be climate neutral or positive.

Time-frames, scaling

A consistent time-frame is important for comparing potential gains fairly across projects. The five-year timeframe used here requires assumptions about how projects will scale up. It may also not fully account for the longer-term transformative impacts of projects that do succeed in achieving very large scale. However, this may be an important additional aspect to consider alongside the score for potential biodiversity gains within the 5-year time horizon.

Condition and significance metrics

The current scoring framework bases condition scores on changes in Mean Species Abundance (as the default), and significance scores on STAR. It would be straightforward to substitute different condition and significance metrics, to reflect different contexts and/or overall policy aims.

For MSA, a constraint for assessment is that the global average values available apply to a limited and general set of land uses and intensities. MSA values related to specific management practices and for other drivers of biodiversity loss may be difficult to obtain. Condition scores showing the impact of management changes within these categories, e.g. of organic versus conventional agriculture, are not currently available. In some cases, condition changes may also differ depending on the undisturbed ecosystem, for example conversion to pasture will likely have greater impacts on the original biodiversity for forest than from grassland. This is not always reflected in available average MSA scores. Work is underway on this issue, which is a challenge for other assessment processes too. For the current framework, expert judgement is required to interpolate estimated MSA scores where necessary.

The STAR metric provides an indicator of conservation priority based on irreplaceability and vulnerability. STAR thus strongly steers priorities towards areas of high species endemism and threat, which are predominantly located in the tropics, and especially on tropical mountains and islands. This effect is tempered in the current framework through using a logarithmic scale for categorising significance. Currently, STAR is also available for the terrestrial biome only, and based on a fairly narrow taxonomic slice (amphibians, birds and mammals only). Work is underway to extend the taxonomic scope of terrestrial STAR, and also to extend the STAR global layer to cover freshwater and marine biomes, so these constraints will diminish in the near future. It should be borne in mind, though, that STAR may underestimate the conservation priority of certain ecoregions, notably areas with high plant endemism but lower vertebrate endemism, such as the southwest coastal regions of Australia and South Africa.

Impacts on freshwater

For the freshwater biome, especially for essentially linear systems such as rivers and streams, a catchment-based approach is appropriate for considering impacts. The WWF Water Risk Filter (WWF 2023) aggregates and maps risk data (for most risk factors) to HydroBasin Level 7 (Lehner & Grill 2013), which is an appropriate default assessment scale. However, in our case studies, relevant company data was only available at the national or sub-national administrative level, so these units were used for area estimates. Data from the WWF Water Risk Filter are useful for scaling both potential condition change and biodiversity significance (see case study for Company C, page 37) and are available summarised at country and provincial level[15].

Materiality

The current framework uses a simple materiality screening to determine whether negative impacts need to be scored in more detail. This relies largely on expert judgement, and does not take into account whether many small, non-material negative impacts could add up to a material effect. For the trial projects reported on here, this screening approach was easy to apply and the standardised list (Annex A, page 58) increased confidence that no potentially negative material impacts were being overlooked. Virtually no potentially material negative impacts were in fact identified, but this is the expectation if initial project screening is carried out effectively.

Gaming the framework

With any scoring framework, there is the possibility that the process could be gamed to increase scores on paper that would not reflect changes on the ground. Making impact pathways, assumptions, and the rationale for scoring explicit should reduce the likelihood of this happening. It may also be useful to consider bracketing low and high scores (to reflect the range given different plausible assumptions) and being explicit about the level of uncertainty (page 45).

Capacity

WWF Switzerland currently budgets eleven person-days for an assessment, including reviewing materials, collecting data, communicating with the company, the fund manager, or project owner, and compiling the actual impact assessment.

Some expertise is needed to apply the framework. In the future, it would be useful to automate some analyses and develop materials to guide users on the implementation of the method and its subsequent use, with the aim to enable any analyst, portfolio manager or consultant to apply it, perhaps after some initial training.

Other desired features

Some users are likely to be interested in a broader scope that includes dependencies, to help assess the viability of a project. Dependencies could limit how projects are able to scale, e.g. if they depend on limited biodiversity resources such as sustainably harvested wild plants. However, dependencies are not always obvious, such as an upstream forest preventing floodings downstream.

Similarly, other users might value a tool that allows assessment against social benefits alongside biodiversity. The scoring framework checklist for potential negative (Annex A, page 53) impacts includes a section for some social impacts that may also affect biodiversity, such as displacement, but a full integration of social aspects has not been yet considered.

[15] *https://riskfilter.org/water/explore/countryprofiles*

FUTURE DEVELOPMENT

Current status

The current version of the BIAF covers part of the vision for the approach (page 11), i.e. informing investors or other decision makers about the most promising investment opportunities or projects in terms of impacts on biodiversity. It partly covers support on strategic decisions for planning and improving biodiversity performance, but not yet the tracking of biodiversity performance. Assessment is currently done manually, and a number of issues need to be reviewed in more detail.

The current version is informed by:

— Workshop review of the BIAF with a group of biodiversity experts (September 2022), and implementation of some key recommendations

— An interview-based user-needs assessment with impact asset managers and advisors (April 2023)

— Continuous iterative improvements

— Trial assessment for eight potential investees, with development of four more detailed case studies applying the current version of the BIAF

— Interviews with biodiversity tool developers (June 2023).

Planned development steps

So as to maximize uptake of the approach, and its overall impact in improving where and how resources are targeted, WWF is proposing to develop an open-source code and method that can easily be incorporated into existing user environments, and/or developed into web-based tools.

WWF is seeking one or more partners to lead this further development of the BIAF into a widely applicable solution. This partner would work together with WWF, and potentially other collaborators, to further develop and test the framework[16]. To increase the solution's utility and acceptance, an advisory board consisting of potential users is envisaged to oversee the process.

Key development steps are envisaged to include:

— Definition of a minimum viable product and key deliverables, including priority sectors and/or industries

— Definition of alignment needs with various global initiatives for corporate action on biodiversity

— Development of overall technical scope for (semi-) automation of the framework, including workflow, background data sets, user data entry needs, and desired outputs (e.g. impact report, monitoring plans, biodiversity action plans, etc.)

— Development, standardization, and coding of the scoring approach and the impact pathways

— Addressing specific unresolved issues (see page 45)

— Identification and integration of data sources and data management

— Iterative testing/piloting and revision

— (Semi-)automated report generation (e.g. impact report, monitoring plans, biodiversity actions plans, etc.)

— Promotion/go-to-market strategy

If interested to contribute to the next phase of this project, please contact Sybille Borner at sybille.borner@wwf.ch.

16 *A preliminary list of roles includes the provision of IT services; provision of data for scoring; provision of test cases; data management; user support; development of a business model to ensure funding for maintenance and future improvements.*


Picture: Anne Nygard, unsplash.com

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ANNEX A
ASSESSMENT FRAMEWORK

Scoring framework

When values for extent, condition or significance cannot be estimated directly because information is inadequate, a quantitative scoring framework allows estimates to be made based on assignment to broad categories. This framework is outlined below in Table 10.

Table 10. Semi-quantitative categorical framework for estimating extent, condition and significance scores when information is inadequate to assess actual scores. Scores for extent and significance reflect log_{10} values of the category midpoints.

EXTENT – AREA AFFECTED (KM^2)								
	1<10	10 - <100	100 – <1,000	1,000 – <10,000	10,000 – <100,000	100,000 – < 1 million	1 million – <10 million	>10 million
Descriptor	Very small	Small	Small - Medium	Medium - Large	Large	Very Large	Regional	Supra-regional
Score	0.74	1.74	2.74	3.74	4.74	5.74	6.74	7.74

EXTENT – FOR EXTREMELY SMALL OR LARGE AREAS (KM^2)				
	<1.01	150 million	360 million	510 million
Descriptor	Tiny	Global terrestrial	Global marine	Global
Score	0.004	8.18	8.56	8.71

CONDITION – GAIN OR PREVENTED LOSS (CHANGE WITHIN 0-1 SCALE)						
	0<0.01	0.01 - <0.1	0.1 - <0.3	0.3 - <0.5	0.5 - <0.7	>0.7 - 1
Descriptor	Very small	Small	Small-medium	Medium-large	Large	Very large
Score	0.005	0.055	0.2	0.4	0.6	0.85

SIGNIFICANCE - STAR-T GRID-CELL SCORE, OR AREA-WEIGHTED 80TH PERCENTILE GRID-CELL SCORES ACROSS CEC OR COUNTRIES (MILLISTAR)					
	<10	10-<100	100-<1,000	1,000-<10,000	>10,000
Descriptor	Low	Moderate	High	Very high	Highest
Score	1	1.74	2.74	3.74	4.74

Checklist of potential sources of negative impacts

The standard checklist of impact sources for materiality screening is shown in Table 11. The checklist uses the Greenhouse Gas Protocol scopes, qualified as appropriate for biodiversity. It also prompts consideration of systemic impacts, outside the three scopes. These could result from unintended consequences of a project for wider systems, for example if pressures are displaced outside the project area (creating impact 'leakage', e.g. Wunder 2008) or if the project itself causes increased demand for commodities whose production damages biodiversity.

Impacts classed as potentially material should be linked to the five drivers of biodiversity loss and be scored using the quantitative assessment framework described in this document. This may not be possible for systemic impacts, which are better considered along with social and climate impacts as possible 'no go' findings for a project, or aspects needing further attention during the due diligence step.

Table 11. Checklist of origins of impact sources for materiality screening for potential negative project impacts. For consistency, the impact scopes for climate change defined by the Greenhouse Gas Protocol are also used here for biodiversity.

SCOPE	CATEGORY	SOURCE
1	**Direct**	Land for company facilities
		Pollution
		Water use
		Wildlife disturbance or displacement
		Wildlife mortality
		Operational GHG emissions
		Other
	Indirect	Displacement of local communities (creating increased pressures on biodiversity elsewhere)
		Induced access, in-migration and/or increased economic activity (creating increased pressures on biodiversity)
		Introduction or spread of pests, diseases or invasive species
		Other
2	**Energy inputs to operations**	GHG emissions
		Raw materials and manufacture of supplies for energy capture (e.g. solar panels)
		Other
3	**Upstream**	Production of raw materials for construction
		Production of raw materials for operations
		Processing of raw materials
		Transport of materials
		Other
	Downstream	Transport
		Waste disposal/pollution
		Other
x	**Systemic**	Overall consumer demand increased
		Displacement of pressures / impact leakage
		Other

Tabulated MSA change values for different land-uses and intensities

Table 12. Average values for condition change of terrestrial ecosystems based on Mean Species Abundance (MSA) when converting an intact ecosystem to different land-uses and management intensity classes. These are global average values, the actual impacts will depend on the context (including the type of intact ecosystem being converted) and management regime on the ground. Where more specific information is available, values should be adjusted accordingly. These averages values are taken from CISL 2020, based on global average estimates from the GLOBIO model (see Table 4 in Alkemade et al. 2009 and Table 2.2 in Schipper et al. 2016) with some interpolations according to expert judgement. MSA is a composition metric for ecosystem condition, ranging from 0 (entirely converted) to 1 (intact).

	INTENSITY		
LAND USE	MINIMAL	LIGHT	INTENSE
Managed forests	0.15	0.3	0.5
Plantations	0.7	0.75	0.8
Pasture	0.2	0.4	0.7
Cropland	0.6	0.7	0.9
Urban	0.9	0.92	0.95

Default biome restoration rates

Jones et al. (2018) reviewed studies of restoration rates across major biomes. They assessed recovery rates as the averaged annual improvement in ecosystem response variables over a time period, expressed as a percentage of the overall gap between the pre-recovery condition and an (intact) reference state. The recovery rate is similar to an annual condition increment through recovery, but not identical because it is calculated using a variable baseline starting level. Pre-recovery condition in the studies reviewed was typically at a low baseline (median value 0.1 of reference condition), so applying a 10% reduction to the recovery rate provides an approximation of the expected annual absolute proportional condition increment on a 0-1 scale.

Jones et al. (2018) found only small differences in mean recovery rates between active and passive restoration approaches. There was substantial variation in recovery rates within biomes, especially for certain biomes such as freshwater and tidal wetlands. Table 13 shows default annual condition change rates for recovering ecosystems in different biomes, based on adjusted mean values from Jones et al. (2018), and a review of the literature for shrubland and savanna ecosystems (TBC, unpublished).

Restoration rates for specific ecosystems may differ, and may change across different stages of the recovery process. Where more specific information on restoration rates is available for relevant ecosystems, these should be applied rather than the default value.

Table 13. Mean ecosystem recovery rates from Jones et al. 2018 (derived from mean values in Figure 3), and adjusted default annual condition increment for ecosystem restoration

BIOME	MEAN RECOVERY RATE (INCREMENTAL CONDITION IMPROVEMENT/YEAR)	ADJUSTED ANNUAL CONDITION INCREMENT
Forest, shrubland or savanna[a]	0.0165	0.015
Grassland	0.0184	0.017
Lake	0.0187	0.017
River	0.0229	0.021
Other freshwater wetland	0.0278	0.025
Marine	0.0288	0.026
Tidal wetland	0.0377	0.034

[a] Shrubland and savanna recovery rates were not included in Jones et al. 2018 but average rates are assumed to be similar to those for forest, based on further review of literature (TBC, unpublished)

Scoring impact pathways over time

Table 14. Assessment approach and scoring for extent and condition values, when considering the five-year assessment timeframe in different impact pathway contexts

NO.	CONTEXT FOR IMPACT PATHWAY	ASSESSMENT APPROACH	SCORING OF POTENTIAL IMPACTS	EXAMPLE IMPACT PATHWAYS	EXAMPLE CASE STUDY	ASSUMPTIONS
1	**Reducing recurrent impacts (through more sustainable processes or substi-tutions)**	Calculate total area, E_5, affected by reduced recurrent impacts **at end of year 5** Assess associated condition change, C, from counterfactual situation where impacts are not reduced	Extent = $\log_{10}E_5$ Condition change = C	**Reducing pollution (e.g. from pesticides or fertilisers, in terrestrial or aquatic ecosystems)** **Reducing water stress through reduced water demand** **Reducing direct extraction (e.g. through reduced fisheries pressure)**	**Company C** **Company B**	Impacts are not cumulative over years May be specific assumptions for deriving extent and condition estimates in particular pathways
2	**Prevention of new impacts – one-off transformation**	Calculate area, E_5, over which im-pacts have been prevented **during year 5** Assess condition change, C, resulting from new impacts in counterfactu-al situation where impacts are not prevented	Extent = $\log_{10}E_5$ Condition change = C	**Preventing conversion of natural ecosystems through reducing future demand for agricultural commodity**	**Company C**	Land transformation impact occurs only once, and agricultural commodities continue to be produced from that land once converted. The area saved from being impacted relates to the year 5 total of commo-dities produced in the counterfactual situation, and to annual yields.
3	**Prevention of new impacts – cumulative transformation**	Calculate area impacted to produce commodities in counterfactual situa-tion during year 5, DE_5 Assess condition change, C, resulting from new impacts in counterfactu-al situation where impacts are not prevented	Extent = $\log_{10}(3*DE_5)$ (Cumulative total years 1 to 5 = DE_5 $5/5*DE_5 + 4/5*DE_5 + 3/5*DE_5 + 2/5*DE_5 +$ $1/5*DE_5 = 15/5DE_5 = 3*DE_5$) Condition change = C	**Preventing conversion of natural ecosystems through reducing future demand for extractive products (e.g. limestone or aggregates)**	**Company D**	The amount of commodity that can be extracted per unit area is finite. Once the source is depleted, ad-ditional areas will be converted. The area impacted relates to the cumulative total of commodities produ-ced in the counterfactual situation, and to full-lifespan yields [17]. There is a fixed annual increment in the amount of commodities substituted, related to linear company growth to year 5.
4	**Restoration impacts, fixed area** **Conservation (averted loss at site) impacts, fixed area**	Calculate total area under restora-tion or conservation at end of year 5, E_5 (equivalent to starting area) Assess annual incremental condition improvement for restored area, or incremental condition loss averted for conserved area, C	Extent = $\log_{10}E_5$ Condition change = 5*C	**Ecosystem restoration or conservation (involving a fixed-size site)**	**Company A (company nature reserve)**	For conservation, condition changes are annualised as an incremental (absolute) change in ecological integrity, not a proportional change. This simplifies calculations and makes negligible difference to calcu-lated values over a 5-year timespan.
5	**Restoration, fixed annual area incre-ment** **Conservation (aver-ted loss at site), fixed annual area incre-ment**	Calculate annual area added for restoration or conservation, DE (equiv-alent to the area at end of year 1, E_1), OR the total area under restoration or conservation at end of year 5, E_5 Assess annual incremental condition improvement for restored area, or incremental condition loss averted for conserved area, C	Extent = $\log_{10}(5*DE)$ OR Extent = $\log_{10}(E_5)$ Condition change = 3*C This represents the mean condition change over the total area restored/conserved area over five years $=((5+4+3+2+1)*C)/5)$	**Reduced demand for agricultural commodity releases agricultural land for ecosystem restoration** **Restoration of area equivalent to the area brought under agricultural production**	**Company C** **Company A**	Area spared for restoration scales up each year, linearly, with land for restoration available at the start of each year. For conservation, condition changes are annualised as an incremental (absolute) change in ecological integrity, not a proportional change. This simplifies calculations and makes negligible difference to calcu-lated values over a 5-year timespan.
6	**Restoration, in-creasing annual area increment** **Conservation (averted loss at site), increasing annual area increment**	Calculate annual area added for rest-oration or conservation in year five, DE_5 Assess annual incremental condition improvement for restored area, or incremental condition loss averted for conserved area, C	Extent = $\log_{10}(3*DE_5)$ If E_1 is the area of land brought under restoration in year 1, and $t*E_1$ the additional area put under restoration in year t, then cumulative area under restoration over five years = $15E_1$ since $DE_5 = 5*E_1$, the cumulative area = $3*DE_5$. Condition change = (7/3)*C. The mean condition score increase across all land under restoration = the area-weighted mean across all five years = (7/3)*C[18].	**Restoration of area equivalent to the area impacted for extraction**	**None at present**	For conservation, condition changes are annualised as an incremental (absolute) change in ecological integrity, not a proportional change. This simplifies calculations and makes negligible difference to calcu-lated values over a 5-year timespan.

[17] *Potentially, restoration could begin as the resource in one area is exhausted and extraction moves elsewhere. Over the short time-frames considered in the BIAF, this does not significantly influence scores and so this aspect is not considered.*

[18] *Since* $((5*.2*E_5)+(4*.4*E_5)+(3*.6*E_5)+(2*.8*E_5)+(1*E_5))/3*E_5 = 7/3$

Materiality screening framework

To support materiality screening for impacts, the framework shown in Table 15 was developed. This uses a scope, severity and sensitivity of impact approach that is aligned to the extent, condition and significance framework used for overall assessment. This framework was successfully trialled in early assessments for impact sources. In further trials with the quantitative framework, it proved largely unnecessary as most materiality assessments could be made rapidly through expert judgement, with any doubtful cases classed as material and scored. The framework is documented here in case it may be useful for some projects/impact sources in future assessments.

The overall score is the scope score multiplied by the severity score multiplied by the sensitivity score. The thresholds reflect a more precautionary approach appropriate for screening. Different thresholds apply for temporary vs permanent impacts. Any impact source scoring 100 or more requires further assessment using the BECS qualitative scoring framework.

Table 15. Screening framework for materiality of impact sources. Any impact source scoring 100 or more requires further assessment using the quantitative assessment framework.

SCOPE – AREA AFFECTED	VERY SMALL	SMALL	MODERATE	LARGE
equivalent area km^2	<0.1	<1	<10	>10
Score	0	1	10	100

SEVERITY – BIODIVERSITY CONDITION IMPACTS		NEGLIGIBLE	MINOR	MODERATE	MAJOR
equivalent condition reduction (0–1 scale)	**Temporary**	<0.1	0.1-<0.2	0.2-<0.5	>0.5
	Permanent	<0.01	0.01- <0.1	0.1 -< 0.2	> 0.2
Score		0	1	10	100

SENSITIVITY – SIGNIFICANCE OF BIODIVERSITY AFFECTED	LOW-MODERATE	HIGH	VERY HIGH
milliSTAR scores (location or median 80^{th} percentile of CECs/ countries)	<100	<1,000	>1,000
Score	1	10	100

Distribution of STAR scores

Figure 4 shows the distribution of STAR-t scores for CECs and for countries, for the 80th percentile score and the maximum score. The distribution of maximum scores is heavily right-skewed, so maximum scores may reflect very high scores in one or a few grid cells, giving an unrealistic impression of overall significance.

a

b

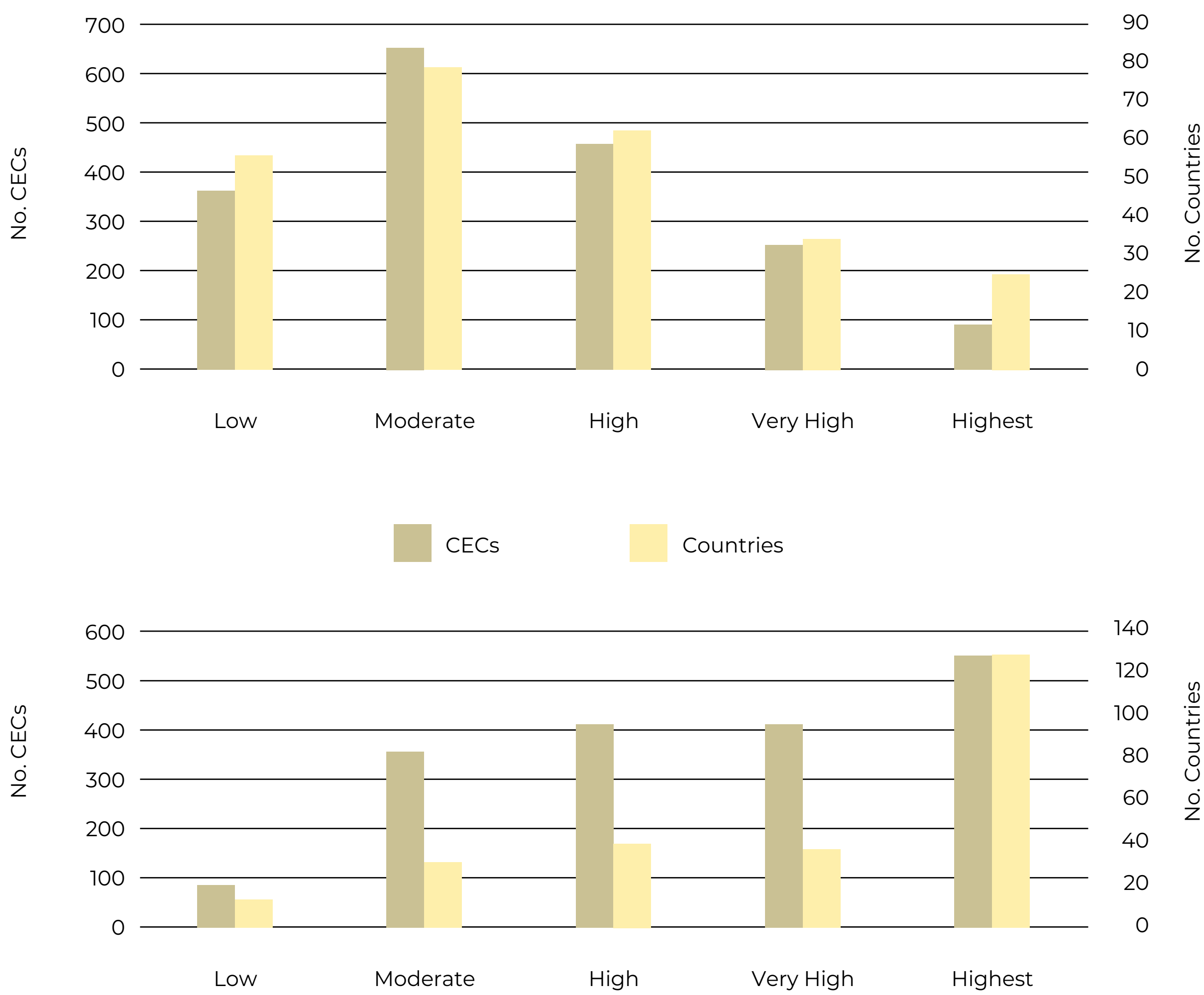

Figure 4. The number of Country Ecoregion Components (total = 1803) and countries/territories (256) in each significance category, based on (a) the 80th percentile and (b) the maximum values of 5x5 km grid-cell values for terrestrial STAR-t (threat abatement). See Table 4 for category intervals.

ANNEX B

REQUIREMENTS FOR THE DEVELOPMENT OF THE BIODIVERSITY IMPACT ASSESSMENT APPROACH

Table 16. Full list of criteria specified for biodiversity-related tools/measurement approaches to inform pre-investment decisions and post-investment assessment of projects and investments.

REQUIREMENT	CATEGORY
Allows for comparison over time	1 - Scope
Can deal with both reduction of negative impacts and creation of positive impact	1 - Scope
Can deal with various frames of reference/baselines (as a minimum: baseline before the intervention starts and counterfactuals)	1 - Scope
Covers diverse business models, intervention approaches and geographic locations	1 - Scope
Covers full value chains and product life cycles	1 - Scope
Covers material direct and indirect, positive and negative impacts on biodiversity	1 - Scope
Provides a solid basis for developing biodiversity monitoring and action plans	1 - Scope
Aligned with current global initiatives for biodiversity impact accounting (e.g. GBF, SBTN, TNFD, One Planet Business Framework)	2 - Design principles
Allows for (external) verification of the result	2 - Design principles
Allows for comparison of areas which are by nature very different in biodiversity	2 - Design principles
Allows for inclusion of new data and new scientific insights, as well as for changes of weightings and "value judgments"	2 - Design principles
Builds on existing approaches and tools	2 - Design principles
Incorporates data from databases that are regularly updated and widely recognized	2 - Design principles

Annex B: Requirements for the development of the biodiversity impact assessment approach

REQUIREMENT	CATEGORY
Integrates incentives generated to maintain existing biodiversity (e.g. revenues from wild harvesting, eco-tourism)	2 - Design principles
Provides a standardized but adaptable framework	2 - Design principles
Responsive to user needs in terms of effort, costs, data, and technical expertise required. Specifically, scores can be estimated (if necessary) with incomplete or imprecise input data.	2 - Design principles
Robust and rigorous in terms of the methods and data used	2 - Design principles
Transparent and traceable with regards to assumptions, data inputs, caveats, and methods used	2 - Design principles
Delivers replicable and consistent results	3 - Performance
Responds, in a timely way, to changes in company activities (e.g. changes in the intensity of pressures must be translated into impact changes)	3 - Performance
Supports decision-making (for investors and investees)	3 - Performance
Addresses all components of biodiversity, but at minimum species, their habitats and ecosystems	4 - Technical requirements
Allows for inclusion of alternative metrics and data sets	4 - Technical requirements
Allows for inclusion of site-specific data	4 - Technical requirements
Delivers a starting point (reference value for biodiversity) to compare future performance with	4 - Technical requirements
Generates a single but decomposable metric representing the net biodiversity impact linked to a business model or a project compared to the reference scenario	4 - Technical requirements
Identifies and assesses how company and project activities relate to the five key drivers for biodiversity loss	4 - Technical requirements
Takes into account common species that maintain ecological functions as well as charismatic or threatened species	4 - Technical requirements
Takes into account site-specific characteristics e.g. an ecosystem's scarcity and vulnerability	4 - Technical requirements