Bridging the gap between science and business practice for biodiversity indicator development

Workshop summary report, October 2018

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Table of Contents

1. Introduction

The IUCN and University of Oxford hosted a workshop on the 7th of September 2018 in Oxford to convene a small group of conservation and environmental scientists to help communicate the science behind indicator development to the private sector. This workshop was part of the first phase of the IUCN and Oxford University project designed to provide guidance for businesses on how to identify or develop robust and relevant biodiversity indicators for different business applications.

This workshop brought together 12 scientists to discuss the wealth of academic research and practice that has been undertaken over many decades, and translate the science, tools and tips in order to support businesses in their development and use of biodiversity indicators.

The aim of this workshop was to develop a proof of concept: that the wealth of academic research and practice on biodiversity indicator development is directly relevant to businesses who are seeking to identify or develop biodiversity indicators.

In this workshop report we synthesise the key discussions between participants, and point to a wealth of scientific approaches that will be useful for businesses using and developing biodiversity indicators.

This report does not translate and interpret how these science-based approaches are relevant for business in detail. Full interpretation and synthesis of information from this workshop will be included in the final briefing note to be prepared by the IUCN and University of Oxford. This briefing note will present the spectrum of business applications for biodiversity indicators, which will be matched with the analysis of scientific approaches relevant to some/all of the business applications.

Participants and other interested colleagues will also have an opportunity to engage further on the topic of biodiversity indicators for business through the development of a joint-funding proposal to continue exploring and applying scientific approaches from conservation science to support businesses in developing and using fit-for-purpose biodiversity indicators. If you are interested to get involved, please contact the authors via biobiz@iucn.org.

2. The spectrum of business applications for biodiversity indicators

A draft spectrum of business applications for biodiversity indicators was used as a backdrop for discussion on approaches from conservation science relevant to business (Appendices 1 and 2). The spectrum was developed by the IUCN and the University of Oxford through consultation with NGO, academic and consultancy practitioners who work with business, and business representatives in the IUCN network (acknowledged in Appendix 1).

This spectrum demonstrates the breadth of contexts where biodiversity indicators are relevant to businesses: from assessment of risk, dependencies, impacts and gains; to internal decision-making (e.g., relating to risk management and accounting), and to meet a variety of external reporting requirements (e.g., certification, non-financial disclosure, and regulation).

Biodiversity may be assessed by companies for their current operations (e.g., environmental management of assets), but also often is assessed for future operations (e.g., forecasting to screen for risk and differentiate between alternative investments or operations). Finally, companies have a variety of spatial contexts in which they require biodiversity indicators – from their site-level operations, through their supply chains, and at aggregated levels such as business unit, product, or corporate-level.

The 8 identified business applications of biodiversity indicators are organized into 4 different levels at which typically business decisions are made using biodiversity indicators:

1. Biodiversity management and performance at individual site and landscape level.
2. Biodiversity management and performance at cluster, business unit, corporate or product levels.
3. Corporate level communication and external disclosure of biodiversity management and performance.
4. Third-party biodiversity performance assessment / rating of biodiversity management and performance.

While there may seem to be overlaps between each application, they are then further differentiated depending on the:

- Assessment scope (the spatial scale and temporal frequency of the decision)
- Current or planned (future) operations
- Primary audience of the indicator analysis & reporting (internal and external stakeholders)

Participant feedback on the spectrum was positive, with the following comments to help finalise the spectrum:

- Explore whether the different business contexts in the spectrum could be illustrated against the Natural Capital Protocol steps
- Could the biodiversity indicators that have been developed so far for business (e.g., those approaches reviewed by the EUB@B project, and the WCMC Biodiversity Indicators for the Extractives Sector) be aligned with the different business contexts in the spectrum. n.b., many of these are already mentioned in the spectrum (column B), but will be highlighted in the final briefing note.

3. Frameworks, approaches and tools from conservation science that support robust biodiversity indicator development

A key aim of this workshop was to help raise awareness of the approaches from conservation and environmental science that businesses are less likely to be aware of, but could help with the development and use of biodiversity indicator development for business. To address this aim, we asked participants to discuss and share good practice around indicator development, evaluation and reporting.

Participants identified and discussed 30 frameworks and approaches to indicator development that are available from conservation and environmental science that could help with the development and use of biodiversity indicator development for business (see Appendix 3, Sections A & B).

The conservation and environmental frameworks shared by participants, which have been applied across many countries, included Structured Decision-Making (#1), the Conservation Measures Partnership Open Standards (#3), and the Biodiversity Indicators Partnership framework (#6; Appendix 3 section A). There were also more specific frameworks which have been applied by organisations or countries, such as the UK Common Standards Monitoring (#17), US Vital Signs Monitoring Program (#18), and the WWF's Global portfolio monitoring and management system (#20; Appendix 3 section A).

Participants outlined a range of country or institutional level approaches to indicator development that are also useful for businesses to be aware of (Appendix 3, Section B). These include global indicator sets (e.g., Essential Biodiversity and Ocean Variables; #21), composite indicators (e.g., the Ocean Health Index; #22), and noteworthy monitoring programmes (e.g., Reef Life Survey (#24), Pressure monitoring in New Zealand, and Nation-wide monitoring of International Bird Areas in Kenya (#26).

Participants also raised an additional 20 approaches that are already applied and used by the private sector (see Appendix 3, Section C), which were noted but not discussed in detail as the intention of this workshop was to raise awareness of the approaches from conservation and environmental science that businesses are less likely to be aware of. These approaches included approaches and tools to support: scoping (e.g., Corporate Ecosystem Services Review), planning (e.g., Environmental and Social Impact Assessment, and Critical Habitat Assessment), management (e.g., Environmental Management standards (e.g., ISO14000) and Risk Management standards (e.g., ISO31000)), monitoring and reporting (e.g., Healthy Ecosystem Metric (CISL), and the Biodiversity Return on Investment Metric (IUCN)).

The tables in Appendix 3 outline the specific features of these frameworks and approaches, and their likely relevance to business applications of developing and using biodiversity indicators. We also list case study applications of these frameworks to help communicate these to business practitioners moving forward. Here we provide a brief outline of the frameworks, and some of the useful attributes of the approaches for development and use of biodiversity indicators by business.

3.1 Common steps to support monitoring and/or management of the natural environment, which include a specific step to develop indicators

While some frameworks outlined in Appendix 3 section A are designed to guide monitoring, or both monitoring and management, they all share common steps to support monitoring and/or management of the natural environment. All frameworks include the development of indicators to help assess whether management or monitoring objectives are being achieved. Indicators are often developed in association with setting management objectives and actions, but here we separate out indicator development to emphasise this as a step within a larger decision-making process, to ensure that indicators are fit-for-purpose:

1. **Define the decision context**: define the spatial and temporal context of the decision, the business need and intended audience, and the regulatory/financial/voluntary context driving the need for monitoring/management.

2. **Set management objectives**: set clear objectives that relate to what the organisation wants to achieve (in relation to management), and how that can be measured (set monitoring objectives that link to management objectives).

3. **Explore & set management actions**: explore management actions that could be implemented to help achieve management objectives.

4. **Develop indicators**: develop indicators that will help measure whether management or monitoring objectives are being achieved, which take into consideration an understanding of the natural system, and uncertainty in how the system will respond to management.

5. **Conduct monitoring, evaluation and reporting**: begin monitoring, evaluation and reporting, to meet the decision context requirements, and assess whether management and monitoring objectives are being achieved. This step also requires information management considerations to ensure the quality control and accessibility of data collected.

6. **Adapt and refine:** As new information is revealed about the system, adapt management and/or monitoring as required.

3.2 Useful attributes for development and use of biodiversity indicators by business

Participants were asked to describe the specific attributes of the frameworks and approaches, which they believed would be relevant to the development and use of biodiversity indicators by business. These attributes included pre-cursory steps (and supporting methods) required to develop indicators, specific methods for indicator development, ways to aggregate indicators, and useful formats for reporting indicators. These attributes and their relevance to different business applications are detailed in Appendix 3 (Sections A and B), and include:

1. **Ways to set the decision context and objectives**

- Structured decision-making (#1, Appendix 3) can support the development of clear objectives that relate to broader regulatory / political contexts and the decision context (using tools like objectives hierarchies and means-ends diagrams).

- The Biodiversity Indicators Partnership, indicator development framework (#6 Appendix 3) encourages a participatory process to define the decision context and set monitoring objectives *prior to* indicator development.
- Note this initial step of a process to develop indicators is emphasised in the common step 1 outlined above (section 3.1).

2. Methods to develop ecosystem understanding

- Conceptual models used within structured decision-making (#1 Appendix 3) can be used as a tool to help explore local and landscape scale ecosystems, how management actions could influence the system, and what indicators could help detect important changes in the system.
- Qualitative loop models used in a group modelling approach for Integrated Coastal Management (#11 Appendix 3), to work with participants and explore ecosystems, and develop fit-for-purpose indicators for monitoring.

3. Approaches to develop scalable Indicators (i.e., indicators are consistent from site to corporate level)

- The process to develop and select a 'core set of indicators' across the country-level Vital Signs monitoring program in America (#12 Appendix 3), that support both site level monitoring and management, and a national scale assessment of biodiversity information in a standardised format.
- The use of 2 sets of monitoring for International Bird Areas (IBAs; e.g., Kenya; #26 Appendix 3) to construct site and national indictors, where broad-scale monitoring involves remote sensing of pressures across all IBAs, and detailed on-ground monitoring is undertaken for species, threats and actions at selected IBAs.
- The use of Essential Biodiversity Variables (#21 Appendix 3), which include core indicators for biodiversity (from genes to species to ecosystems) that are consistent across countries and sectors and are designed to be used by multiple stakeholders).

4. Approaches to aggregate indicators (i.e., indicators can be combined to provide a high-level summary)

- A variety of approaches to develop composite indicators for national scales, which could be adapted for corporate application, such as the Ocean Health Index, Local Biodiversity Intactness Index, and the Biome Health Metric (#22, 23, 30 Appendix 3); but note the review by Burgass and colleagues that outlines how composite indicators can hide uncertainties, and mask important changes, and how these can be addressed during composite indicator construction (see discussion #22 Appendix 3).
- The JNCC Common Standards Monitoring approach (#17 Appendix 3) to developing a condition assessment for indicators, where baselines and targets to define favourable to unfavourable condition of species and habitats. This supports standardised assessments across species / ecosystems at site to national scales.

5. Ways to develop monitoring, evaluation & reporting systems

- The Protected Areas Management Effectiveness Evaluation framework (#13 Appendix 3) that includes the evaluation of full management cycle – from inputs, to outputs, and outcomes, and the measurement of State – Pressure – Response indicators.

- The approach used in French Marine Protected Areas to develop indicators (#5 Appendix 3), and evaluate these against selection criteria that relate to the power and accuracy of indicators to detect important changes, before selecting indicator and developing the final monitoring programme.
- The "report card" format used in the Conservation Measures Partnership Open Standards (#3 Appendix 3) and in the Vital Signs Monitoring programme (#18 Appendix 3) to present monitoring results for non-scientific audiences.

6. Ways to develop an information management system

- The UNEP- WCMC Guidance on Information Systems (#8 Appendix 3) promotes shared understanding of how a whole information system is needed to produce & process biodiversity information over time for user needs, & activities and roles required.

3.3 Communication of the frameworks and approaches from conservation science to the business world

In our discussions with participants we covered the following key points that should be followed up in future work on biodiversity indicators for business:

- ***Harmonize science-based approaches***: Rather than potentially confuse businesses with the variety of frameworks and approaches and types of indicators, how can we put forward a harmonised approach? If harmonisation is not practical, then at least convergence around key elements. The synthesis of key steps for indicator development and useful features for business are a first step at addressing this comment (as outlined in sections 3.1 & 3.2).

- ***Produce case studies, not guidance***: We cannot write another big framework guidance document. This is rarely useful to practitioners (based on experience with government agencies). Rather, we should synthesise key recommendations from all of the approaches, and illustrate with case studies and outline their relevance to business.

- ***Encourage measurement and management of biodiversity:*** We need businesses to not only measure but also manage biodiversity. We also need to encourage businesses to be aware of, and contribute to, international efforts to conserve and sustainably use biodiversity, thus helping drive for change and the achievement of positive outcomes for biodiversity.

- ***Align science-based biodiversity indicator approaches with business approaches***: Can we translate the conservation and environmental science approaches with business management frameworks to illustrate how these approaches can be integrated within business (e.g., ESIA, Risk Assessment, ISO 14000 standard for environmental management). Can we use lessons from finance indicators and those used in the insurance & re-insurance sector, to help better integrate biodiversity indicators into business decisions?

- ***Encourage complete system-level understanding:*** There is so much other data (e.g. soil and water quality) that is relevant to biodiversity. We need to encourage getting a more complete system understanding, going beyond the measurement of biodiversity / the living environment.

4. Evaluating existing indicators against a checklist of principles

During the workshop participants were asked to discuss a proposed set of principles that could be used by businesses to help evaluate whether existing biodiversity indicators are fit-for-purpose and well aligned with the decision context. The proposed set of indicators (drawn from Beliaeff and Pelletier, 2011; Failing and Gregory, 2003; Jones et al., 2011; Keeney and Gregory, 2005), with additional implementation actions suggested by participants include:

Scientifically credible

- The indicator and/or its method for development has been independently tested / peer-reviewed by scientists
- There is an accepted & tested theory of the relationship of the indicator within the managed system (e.g., relationship between pressure and indicator state)
- The data informing the indicator are from a reliable and verifiable source (ensuring transparency)
- Any evaluation of the indicator is auditable by a third party

Responsive

- The indicator is sensitive to and respond predictably to business activities, by providing direct and unambiguous signals of change
- The indicator is representative of the management objectives
- Temporal scale of indicator data matches the temporal scale of the business need (e.g., annual evaluation & reporting will require data for a biodiversity indicator that is collected <12 months)
- Spatial scale of indicator data matches the spatial scale of the business need
- The indicator enables monitoring/measuring direct, indirect impacts and opportunities

Feasible

- The indicator is feasible to monitor and evaluate at the frequency required for business decision-making (i.e., is cost-effective)
- Baseline data for the indicator is available, and where it is not available can an alternative source of information be used (modelled data, or expert judgement)
- The indicator data source can be adapted to incorporate new types of data as they become available (e.g., remote sensing or modelled data)

Practical

- The indicator is informative at different spatial and temporal resolutions, or be able to be aggregated to the appropriate scale (including site – corporate or product level)
- Data to inform the indicator are reliably accessible (e.g., are likely to be updated in the future, and will remain available to businesses)

- The indicator does not double-count the same phenomenon as other indicators (particularly when used in an accounting balance sheet)
- The indicator is relevant across terrestrial, marine & freshwater realms

Meaningful

- The indicator and the reporting format is meaningful to the target audience (e.g., business decision-makers, shareholders, investors or the general public).
- The indicator focuses on important component of biodiversity / addresses priority biodiversity issues (as identified in the decision context and through setting management objectives)
- The indicator conveys information about the status of a species or ecosystem (i.e., state indicator)
- The evaluation of the indicator includes a measure of uncertainty (e.g., accounting for natural variability, monitoring bias)
- The indicator is precautionary, and helps provide an early warning of a change
- The indicator is non-emotive (e.g., CO_2 is a non-emotive indicator for climate, whereas species measures can often be very value-laden and emotive)

Participants saw value in refining the indicator selection principles above, and suggested a useful outcome from this group could be the development of a decision-support tool that could help businesses evaluate and prioritise indicators prior to their use (e.g. Table 1). This would be particularly useful when embedded within a broader process / framework for indicator development (as outlined in Section 3.1).

Table 1. Example of a decision-support tool that could include a series of prompting questions to help practitioners evaluate what biodiversity indicators match their decision context and adhere to good practice principles.

Criteria	Indicator 1	Indicator 2	Indicator 3	Indicator 4
1 Scientific				
1.1 …	●		●	●
1.2 …	●			●
2 Responsive				
2.1 …		●		
2.2 …		●		●
3 Feasible				
3.1 …		●	●	●
3.2 …		●	●	●
4 Practical				
4.1 …	●		●	●
4.2 …	●		●	
5 Meaningful				
5.1 …	●			●
5.2 …	●			●
TOTAL	60%	40%	50%	80%

5. Next Steps

During the workshop participants shared enthusiasm for communicating the wealth of science behind indicator development and the established conservation monitoring and management frameworks with the business world. However, we realise that many NGO's and consultants are working on biodiversity indicator development for business and our work needs to complement other efforts.

Moving forward we see added-value in bringing more science-based approaches from conservation and environmental science into the business sector. Taking the foundational work at this workshop, we believe that together we could generate an overarching framework to guide indicator development that draws on specific tools and lessons from conservation science for different business contexts. We would prioritise key business applications in the spectrum to focus our attention on, in order to address existing gaps where indicators are currently lacking to support specific business applications.

This framework could be used to provide brief guidance (noting that more guidance does not lead to greater application), and this could be tested with a variety of business case studies to refine the proposed approach and generate case study illustrations of new business applications or these approaches / tools.

The science-policy-practice network of the workshop participants covers universities in three continents (Europe, Oceania, North America), and NGOs and consultancies who work globally. Our network includes a range of businesses and governments who may be interested in collaborating in this future work.

Over the coming months, we will be preparing the following outputs from this project, which participants will be contacted about for further collaboration. These outputs include:

1. A final briefing note, which will present the spectrum of business applications for biodiversity indicators, which will be matched with the analysis of scientific approaches relevant to some/all of the business applications.

2. A blog post co-signed by workshop participants.

3. A short peer-review paper (e.g., policy piece or comment) that participants can opt-in to.

4. A project funding proposal to further mobilise knowledge within science and business networks more widely, and develop official guidance and case study illustration of business on indicator development, and encourage uptake.

If you are interested to get involved, please contact the authors via biobiz@iucn.org.

Appendix 1: Cover note to the spectrum of corporate biodiversity indicator applications for business

The spectrum of corporate biodiversity indicator applications for business

Background

Many businesses seek to develop biodiversity indicators to inform business decision-making. However, nature is complex, and serious challenges exist to develop indicators that can cut through this complexity and display clear and simple measures of biodiversity through space and time that are relevant to business needs.

Furthermore, from a business perspective, indicators are needed for many different reasons, and at very different levels, from site all the way to corporate, and for very diverse audiences. These differences clearly influence the development of the indicators.

The IUCN and the University of Oxford have a shared interest in bringing the latest thinking from the conservation community and science to business. We have come together to clarify the variety of applications where biodiversity indicators are currently used by businesses, and may be adopted in the future. Biodiversity indicators will not be developed in this project. Rather, this project seeks to define the spectrum of applications where businesses use or require biodiversity indicators.

This spectrum will be used as the foundation for discussion at the upcoming workshop at the University of Oxford with conservation and environmental scientists. In this workshop, we aim to begin to develop a set of science-based recommendations for the development and use of indicators for a variety of business applications. See workshop agenda for more details on the day's focus.

The Spectrum of corporate biodiversity indicator applications for business

To facilitate the reflection on which already existing frameworks and systems can be "adopted" by business to address their "needs for indicators", IUCN and the University of Oxford have developed the spectrum of business applications for biodiversity indicators through consultation with practitioners who work with business, and the IUCN business network[1]. This spectrum demonstrates the breadth of contexts where biodiversity indicators are relevant to businesses: from site-level to corporate-level assessment of risk, dependencies, impacts and gains; to internal decision-making (e.g., relating to risk management and accounting), and to meet a variety of external reporting requirements (e.g., certification, non-financial disclosure, and regulation). Biodiversity may be assessed as a one-off, or assessments may need to be repeated through time. Biodiversity may be assessed by companies for their current operations (e.g., environmental management of assets), but also often is assessed for future operations (e.g., forecasting to screen

[1] We would like to acknowledge the following practitioners for their valuable comments on an earlier draft of the spectrum: Annelisa Grigg (WCMC), Liam Walsh (CISL), Johan Lammerant (Arcadis), Neil Cousins (Blue Dot), Leon Benun (TBC), Joe Bull (University of Kent), EJ Milner-Gulland (University of Oxford), Pippa Hoard (FFI), Xavier Font (Surrey University), Doris Cellarius (IUCN CEESP), and Francis Vorheis (Earthmind).

for risk and differentiate between alternative investments or operations). Finally, companies have a variety of spatial contexts in which they require biodiversity indicators – from their site-level operations, through their supply chains, and at aggregated levels such as business unit, product, or corporate-level.

The 8 identified business applications of biodiversity indicators have been organized into 4 different levels at which typically business decisions are made using biodiversity indicators:

A. Biodiversity management and performance at individual site and landscape level
B. Biodiversity management and performance at cluster, business unit, corporate or product levels
C. Corporate level communication and external disclosure of biodiversity management and performance
D. Third-party biodiversity performance assessment / rating of biodiversity management and performance

While there may seem to be overlaps between each application, they are then further differentiated depending on the:

• context where the business question is relevant
• current and planned operations
• typical owners of the assessment
• primary audience (internal and external stakeholders)
• assessment scope (the spatial scale and temporal frequency of the decision)

How to use the Spectrum of corporate biodiversity indicator applications for business during the Workshop

During the workshop, the Spectrum will become handy when we discuss the various systems and frameworks used in conservation, as we will be able to check which specific applications the various frameworks could support specific business applications for biodiversity indicators. Furthermore, the break-down in the specific applications can also support the discussion on principles for the development and use of indicators.

Annex: What is a biodiversity indicator and other key terms

While we will not be developing indicators in this project, it is important to define what indicators are. Indicators should be a measure that conveys information about more than itself. Indicators should be relevant to a 'key question' or objective of an organisation, and be used to inform decision-making, and/or trigger action. There are a number of key terms that we use in this table to reduce misunderstanding (based on feedback that we've received already from conservation practitioners). See box below.

Biodiversity indicators are used to represent components of the environment that are relevant to decision-making - the **state** of biodiversity (e.g., a species or ecosystem), or the **pressures** (e.g., a threat) on biodiversity. Related indicators that are indirect measures of biodiversity, can also include business actions (e.g., the business **response** to mitigate biodiversity impacts), and the **benefits** that people derive from biodiversity (e.g., ecosystem services). Indicators can be a **single measure** (e.g., the abundance of a species of bird), or a **composite/constructed measure** (e.g., an aggregation the abundance of a threatened species of bird, forest condition and extent).

Indicators can draw on **raw data** (e.g., from biodiversity monitoring programmes), **modelled data** (e.g., from global models like the PREDICTS model) or **expert judgement** (e.g., experts estimates

of the likelihood and consequence of potential impacts in risk assessment). Indicators typically require information to be synthesized (e.g., through statistical analysis or assessment against a reference condition) to translate scientific evidence into a format that is relevant for decision-making. This process on analysis or synthesis is critical to ensure indicators are fit-for-purpose and are addressing the key question(s) or objective(s) of an organisation.

Box: Key definitions

Scale of business applications:

Site – a discrete area where there is a direct business footprint (and therefore potential impact on biodiversity) which can include upstream production sites and downstream offices, warehouses, stores, etc.
Landscape – an area surrounding a site, which is defined as an ecological unit (e.g., a catchment) or important area by stakeholders, where there is a potential for a business to contribute to indirect or cumulative impacts with other key operators in a landscape.
Business-unit – sub-group of overall corporate, typically grouping at regional or brand or subsidiary level
Corporate – accounts for the entire business operations (multiple sites, landscapes, supply chains, commodities, and products) and investment portfolio.
Supply Chain – a system of organisations from resource extraction/production through to product development and delivery to customers and eventual waste/recycling of materials.
Commodity - a raw material or primary agricultural product.
Product – a finished product made up of multiple commodities

Audiences of business applications:

Internal (teams/managers):
Operations – responsible for managing business operations
Finance– responsible for financial accounts and reporting
Procurement – responsible for sourcing products and raw materials
Sustainability/corporate social responsibility – responsible for directing and reporting on sustainability initiatives
Environment – responsible for managing environmental impacts of company operations, sometimes addressed under HSE (Health, Safety, and Environment)
Risk - responsible for risk management relating to environmental impacts and due diligence
Asset – responsible for management of investment portfolios
External:
Shareholders – shareholders of publicly listed companies
Stakeholders – the general public with an interest in the company (e.g., through Sustainability Reports) or interaction with company operations (e.g., within the landscape where a company operates)
Certification bodies – organisations like the Marine Stewardship Council and Forest Stewardship Council who provide independent certification of sustainably sourced natural resources
Regulators – government agencies that require reports from companies (e.g., through compliance & regulation)
Lenders – Financial institutions that invest in specific projects (i.e., banks)
Investors – Banks or firms that invest (e.g., purchase shares) in companies
Civil society groups – NGOs and charities that act as watchdogs to assess the environmental performance of companies
Tertiary sector – Businesses that provide services (e.g., transport, distribution, wholesale, and retail), which rely on the secondary sector (e.g., manufacturing), and the primary sector (e.g., mining).

Appendix 2: Draft spectrum of biodiversity indicator applications for business

BUSINESS APPLICATION	CONTEXT WHERE BUSINESS QUESTION IS RELEVANT	PRIMARY AUDIENCE	ASSESSMENT SPATIAL SCOPE/ FREQUENCY
SCOPE A. BIODIVERSITY MANAGEMENT AND PERFORMANCE AT *INDIVIDUAL SITE AND LANDSCAPE LEVEL*			
1. What's the biodiversity performance of the management interventions at site level?	Monitoring and evaluation of the effectiveness of management interventions (i.e., action taken to mitigate impacts) for sites (managing direct impacts) and surrounding landscape (addressing indirect & cumulative impacts beyond the footprint of an operation). Assess performance against:		
	1.1 Site-level business commitments (e.g., based on corporate commitments such as committments to NNL or Net Gain). These may integrate the below external requirements: e.g., biodiversity tools used: commonly site-specific measures of biodiversity status, threats, and actions (e.g., outlined in the Good Practices for the Collection of Biodiversity Baseline Data Guidance and Accounting for Mitigation tool). Undertaken by: operations, or environment teams	Internal – operations, environment, corporate compliance, or sustainability teams	Scope: Site Frequency: repeated through time (e.g., monthly / annual)
	1.2 Environmental management system requirements (e.g., ISO 14001, BS 8583:2015). Undertaken by: operations, or environment teams	Internal – corporate compliance or sustainability teams	Scope: Site Frequency: repeated through time (e.g., monthly / annual)
	1.3 Regulatory and permitting requirements. Undertaken by: operations, or environment teams Reporting format: monitoring reports as required.	External – regulators	Scope: Site Frequency: repeated through time (e.g., monthly / annual)
	1.4 Lender requirements including the guarantees required by the lenders (e.g., International Finance Corporation Performance Standard 6). Undertaken by: operations, or environment teams Reporting format: monitoring reports as required.	External – lenders	Scope: Site Frequency: repeated through time (e.g., monthly / annual)
	1.5 Commitments made to local stakeholders (e.g., through stakeholder engagement programmes). Undertaken by: operations, or environment teams or by external stakeholders with contributions from the company	External – stakeholders, civil society groups	Scope: Site Frequency: repeated through time (e.g., monthly / annual)
	1.6 Landscape level collective impact program commitments, such as collectively mitigating impacts at ecologically and socially important scales (e.g. catchment, as defined by stakeholders and partners). Undertaken by: operations, or environment teams, or external entity operating at landscape level with contribution from company	External – regulators, lenders, stakeholders, civil society groups	Scope: Landscape Frequency: repeated through time (e.g., monthly / annual)
	1.7 Corporate-level biodiversity commitments (e.g., to avoid operating in high biodiversity value areas (e.g., World Heritage Areas), and to mitigate impacts on biodiversity; as detailed in corporate biodiversity policy/strategy)). Undertaken by: corporate operations, financial, procurement, sustainability, or environment teams	External – stakeholders, civil society groups	Scope: Site Frequency: repeated through time (e.g., monthly / annual)
2. What is the biodioversity return on investment of a project?	2.1. Ex-ante or ex-post impacts of investments at a range of scales and over a range of timeframe. A specific metric has been developed to enable tracking this specific dimension of a project ROI (e.g. Biodiversity Retunr on Investment Metric). Undertaken by: investment and finance teams	Internal - Finance and senior management	Scope: Site Frequency: one off (ex ante and/or ex post)
SCOPE B. BIODIVERSITY MANAGEMENT AND PERFORMANCE AT *CLUSTER, BUSINESS UNIT, CORPORATE OR PRODUCT LEVELS*			
3. How are the business unit /country operations performing overall on biodiversity?	Monitoring and evaluation of the effectiveness of management interventions (i.e., action taken to mitigate impacts) aggregated for a cluster of sites, business unit and corporate levels, against:		
	3.1 Corporate-level biodiversity commitments (e.g., to avoid operating in high biodiversity value areas (e.g., World Heritage Areas), and to mitigate impacts on biodiversity; as detailed in corporate biodiversity policy/strategy) or linked to national and/or internationally recognized biodiversity targets (e.g. CBD Aichi Targets, SDG 14 and 15) generating internal rpeorts and dashboards. Undertaken by: corporate operations, financial, procurement, sustainability, or environment teams	Internal – operations, environment, risk, sustainability, or finance teams	Scope: Corporate Frequency: repeated through time (e.g., to meet internal / external reporting requirements)
4. What is the biodiversity performance of current and future end-user products?	Evaluate current and future end user product impacts on biodiversity, to identify where greatest impacts are occurring and additional management is required (e.g., working with suppliers to increase management standards, or change suppliers). Performance assessed against:		
	4.1 Corporate-level business commitments (e.g., specified in a biodiversity strategy). e.g., biodiversity tools used: BioScope, Healthy Ecosystem Metric, Product Biodiversity Footprint, Life cycle Assessment and Natural Capital Protocol Undertaken by: corporate operations, financial, procurement, sustainability, or environment teams Reporting format: Internal reports / dashboards	Internal – operations, financial, procurement, sustainability, environment teams	Scope: product / commodity / supply chain Frequency: repeated through time (e.g., to meet internal / external reporting requirements)
	4.2 Product or commodity business commitments (e.g., specified by the business, and undertaken by suppliers) e.g., biodiversity tools used: the Sustainable Tobacco Programme, Cool Farm Biodiversity Tool Undertaken by: Suppliers	Internal – operations, environment, risk, sustainability, or finance teams	Scope: Site, Supply chain Frequency: repeated through time (e.g., to meet internal / external reporting requirements)
5. What are the biodiversity risks and opportunities associated with site level future projects and operations?	Screening and assessment of biodiversity risks and opportunities of future projects operations (e.g., an extractives company's interactions with critical areas for biodiversity) under future scenarios of change to ensure that the risks are within an acceptable level, as defined by.		
	5.1 Risk screening criteria developed based on corporate-level business commitments (e.g., avoid operating in World Heritage Areas). e.g., Integrated Biodiversity Assessment Tool Undertaken by: corporate operations, financial, procurement, risk, or environment teams	Internal: corporate operations, financial, procurement, risk, or environment teams	Scope: Site Frequency: one-off
	5.2 Assessment undertaken by investors to differentiate between investment options based on the biodiversity performance or return on investment of different companies. Or undertaken by lenders to assess biodiversity risk and inform pricing credit. e.g., biodiversity tool used: Biodiversity Return on Investment Metric Undertaken by: investment, procurement, finance teams	Internal – procurement, finance teams External – investors, lenders	Scope: Corporate Frequency: one-off
SCOPEC. CORPORATE LEVEL COMMUNICATION AND EXTERNAL DISCLOSURE OF BIODIVERSITY MANAGEMENT AND PERFORMANCE			

6. How can I disclose my company's overall efforts in biodiversity management with external stakeholders and shareholders?	Share information on corporate performance, to demonstrate effective management of impacts and risks and opportunities (e.g. secure supply chains, improved accessed to financing, access to new markets, and improved social license), against:		
	6.1. Corporate-level biodiversity commitments (e.g., to achieve no net loss of biodiversity across all operations; as detailed in corporate biodiversity policy/strategy) and resulting in Dashboards; External sustainability reports Undertaken by: corporate operations, financial, procurement, sustainability, or environment teams	External – shareholders, stakeholders, civil society groups, national governments, lenders, investors, certification bodies	Scope: Corporate Frequency: repeated through time (e.g., to meet internal / external reporting requirements)
	6.2 Biodiversity regulations that require reporting on non-financial performance, including biodiversity performance (e.g., in France, and the EU)	As above	As above
	6.3 Environmental, Social, and Governance (ESG) reporting standards (e.g., <IR> Framework, ISO26000 on Corporate social and environmental responsibility, OECD Guidelines for multinational enterprises; the Global Reporting Initiative Sustainability Reporting Guidelines))	As above	As above
SCOPE- THIRD PARTY PERFORMANCE ASSESSMENT / RATING OF BIODIVERSITY MANAGEMENT AND PERFORMANCE			
7. What is a company's biodiversity performance rating?	7.1. Third party assessment of a company's environmental, social and governance disclosure and performance, which specifically includes biodiversity against an externally defined benchmark. Can be used to compare companies performance across a sector Undertaken by: Third party groups Biodiversity accounting approach used: Biodiversity Performance Assessment e.g., biodiversity tools used: Earth Dividend, Supply Change, SPOTT, Dow Jones Sustainability Index, Carbon Disclosure Project, Water Disclosure Project and FTSE4Good.	External – civil society groups, lenders, investors, stakeholders, tertiary sector	Corporate
8. Does a company meet certification requirements for acceptable biodiversity performance?	8.1. External certification requirements of product or commodity (e.g., FSC, MSC, or Wildlife Friendly certification). Generally this will require a third party assessment of biodiversity performance to meet certification requirements (e.g., FSC and MSC certification). Undertaken by: Certification bodies Biodiversity accounting approach used: Biodiversity Performance Assessment e.g., biodiversity tools used: e.g., FSC and MSC assessments.	External – certification bodies, tertiary sector, stakeholders	Corporate

Appendix 3: Tables of relevant frameworks and approaches to develop indicators from conservation science

A) Overarching frameworks / approaches to support indicator development, illustrating which are relevant to monitoring (●) and/or management (●)

Approach	Case study	Specific attributes	Business application
1: Structured decision-making & adaptive management ●●	Australian conservation management: managing recreational impacts in national parks, decision support for resource allocation, and management of socio-ecological systems by Parks Victoria (de Bie et al., 2013)	• Framework & steps to guide the entire decision-making process (objectives - monitoring - management) • Clarifying decision context & setting objectives, to ensure monitoring & management are fit-for-purpose (using objectives hierarchies and means-ends diagrams) • Uses conceptual models to help explore local – landscape scale systems & select indicators • Quantitative models to interpret indicator data, account for baselines, counterfactuals, etc • Uses methods to elicit expert judgement when monitoring data are unavailable • Deals with competing objectives, using methods like multi-criteria decision analysis • Helps with decision-making under uncertainty • Uses methods to evaluate the cost-effectiveness of different management interventions and monitoring programs • Encourages participatory process (i.e., stakeholder engagement)	• clarify the business context • set clear monitoring & management objectives (from local to corporate level) • support selection & testing of site – landscape level indicators • support the development of a monitoring, evaluation & reporting system • use models to explore scenarios & estimate consequences of possible management interventions
2: Management Strategy Evaluation ●●	Fisheries management around the world (e.g., particularly strong application in Australian and US fisheries management; CSIRO, 2013)	• Framework & steps to guide the entire decision-making process (setting objectives - monitoring - management). Shares many similar features as structured decision-making and adaptive management (the main difference being that MSE has been applied predominantly in fisheries management). • Encourages setting targets for indicators (e.g., defining acceptable vs unacceptable ecological condition) • Has predictive capabilities to explore the sensitivity of indicators to detecting future scenarios, and helps test the effectiveness of different management interventions • Encourages participatory process (i.e., stakeholder engagement)	As above

Approach	Case study	Specific attributes	Business application
3: Conservation Measures Partnership Open Standards for the Practice of Conservation 	Conservation management around the world (e.g., applied to manage the US National Parks; CMP, 2013)	• Framework & steps to guide the entire decision-making process (setting objectives - monitoring - management). Shares many similar features as structured decision-making and adaptive management (however this focuses on monitoring and evaluating effectiveness of management) • Supports the development of Pressure – State – Response indicators • Supports implementation of management plans, and guides monitoring program development • Strong focus on the development of a monitoring, evaluation and reporting system for that encourages consideration of spatial & temporal monitoring frequency • Includes reporting approaches for non-science audiences, like condition assessment and report cards • Encourages participatory process (i.e., stakeholder engagement) • Adaptable – some NGOs (e.g. TNC, WWF) have developed their own versions.	• clarify the business context • set clear monitoring & management objectives (from local to landscape level) • support selection & testing of site – landscape level indicators • support the development of a monitoring, evaluation & reporting system • support the development of an information management system
4: Adaptive Surrogacy Framework 	Conceptual Adaptive Surrogacy Framework developed in Australia (Lindenmayer et al., 2015)	• Framework to guide indicator selection, by exploring trade-offs between measurement accuracy and practical constraints. • Uses conceptual models to help explore local systems & select indicators • Includes five key attributes of indicators that must be traded-off for indicators • Uses methods to evaluate the cost-effectiveness of different management interventions and monitoring programs	As above, plus: • Evaluating indicators against selection criteria
5: Marine Protected Area indicator development framework 	French Marine Protected Areas (Beliaeff and Pelletier, 2011)	• Framework properties like Common Measures Partnership Open Standards and the Adaptive Surrogacy Framework • Particularly useful in guiding the initial stages of setting objectives, and using conceptual models to help explore local systems and assess relevance of indicators • Encourages evaluating indicators against selection criteria relating to the power and accuracy of monitoring indicators to detect important changes	As above

Approach	Case study	Specific attributes	Business application
6: Biodiversity Indicators Partnership, indicator development framework ●	Used globally to help national governments develop biodiversity indicators (e.g., Brazil, Uganda, Botswana, Ethiopia, South Africa; Biodiversity Indicators Partnership, 2011)	• Framework properties like Common Measures Partnership Open Standards and the Adaptive Surrogacy Framework • Involves 10 steps to develop biodiversity indicators • Particularly useful in guiding the initial stages of setting objectives, and using conceptual models to help explore local systems and assess relevance of indicators • Encourages participatory process (i.e., stakeholder engagement)	• set clear monitoring & management objectives (from local to landscape level) • support selection & testing of site – landscape level indicators • support the development of a monitoring, evaluation & reporting system
7: Theory of change ●●	FFI and Conservation International conservation programs (e.g., Conservation International, 2013)	• Process used to support project planning and monitoring • Particularly useful in guiding the initial stages of setting objectives, identifying threats, exploring assumptions and estimating the indented outcomes to support the selection of management interventions • Supports the development of Pressure – State – Response indicators • Helps identify gaps in data / capacity / knowledge	• set clear monitoring & management objectives (from local to corporate level) • support selection of site – landscape level indicators • support the development of a monitoring, evaluation & reporting system • support the development of an information management system
8: UNEP- WCMC Guidance on Information Systems ●	National protected area indictor systems (e.g., Colombia, Fiji, Georgia; UNEP-WCMC, 2016)	• Promotes shared understanding of how a whole information system is needed to produce & process biodiversity information over time for user needs, & activities and roles required	• set clear monitoring & management objectives (from local to landscape level) • support selection of site – landscape level indicators • support the development of a monitoring, evaluation & reporting system • support the development of an information management system

Approach	Case study	Specific attributes	Business application
9: UNEP- WCMC Guidance on Biodiversity Assessment & Monitoring for Protected Areas ●	Nepal Protected Areas sites – 2006 (Tucker et al., 2005)	• Framework properties like Common Measures Partnership Open Standards and the Adaptive Surrogacy Framework • Includes detailed flowcharts for designing a site biodiversity monitoring programme • Supports the development of Pressure – State – Response indicators • Encourages participatory process (i.e., stakeholder engagement)	• set clear monitoring & management objectives (from local to landscape level) • support selection of site – landscape level indicators • support the development of a monitoring, evaluation & reporting system
10: ICIMOD and UNEP-WCMC Operations Manual on Planning Management for Ecosystem Services ●	ICIMOD projects in India (Bubb et al., 2017)	• Supports implementation of management plans, and guides monitoring program development • Supports the development of Ecosystem Services indicators • Encourages participatory process (i.e., stakeholder engagement)	• set clear monitoring & management objectives (from local to landscape level) • support selection of site – landscape level indicators (ecosystem services) • support the development of a monitoring, evaluation & reporting system • support the development of an information management system
11: Integrated Coastal Management (adaptive monitoring framework & group model building) ●●	Applications in the Wadden Sea (Vugteveen et al., 2015a; Vugteveen et al., 2015b)	• Framework & steps to guide adaptive monitoring and management (setting objectives - monitoring - management). Shares many similar features as structured decision-making, adaptive management and management strategy evaluation. • Encourages participatory process (i.e., group model building to select indicators) • Supports the development of Pressure – State – Response – Benefit indicators • Support the development of an information management system	• support selection of site – landscape level indicators (P-S-R-B) • support the development of a monitoring, evaluation & reporting system • support the development of an information management system

Approach	Case study	Specific attributes	Business application
12: International Bird Area Monitoring Framework ●	BirdLife IBAs (International, 2006)	• Framework & steps to guide adaptive monitoring • Supports the development of Pressure – State – Response indicators • Flexible, can be operated with very low amount of data • Designed by conservation NGOs. • Site level monitoring systems. Agreed process for collecting data and for aggregating at different temporal and scale levels	• support selection of site – landscape – corporate level indicators • support the development of a monitoring, evaluation & reporting system
13: Protected Areas Management Effectiveness Evaluation Framework ●●	Protected areas management effectiveness framework (Hockings et al., 2006), and tools like METT, RAPPAM)	• Framework & steps to guide adaptive monitoring and evaluation of protected areas • Standardised, and rapid to apply with tools like METT & RAPPAM • Encourages evaluation of full management cycle – from inputs, to outputs, and outcomes • Measurement of State – Pressure – Response indicators • Used already by some companies to demonstrate lack of impacts on protected areas near their operations	• support selection of site – landscape – corporate level indicators • support the development of a monitoring, evaluation & reporting system
14: Prioritization for species, ecosystems, or areas ●	Systematic conservation planning for marine and terrestrial protected areas (MARXAN), of species management prioritisation (Project Prioritisation Protocol; Brazill-Boast et al., 2018)	• Decision theoretic approach to prioritising species, ecosystems, or areas based on dealing with constrains (e.g., budget) and uncertainty	• Support management prioritisation (site – landscape scale)
15: Extinction Risk Assessment ●●	National Red List Index Assessment for species (e.g., Finland), also done for ecosystems	• Repeat assessments of extinction risk • Triggers government action when declines are registered • Directly relevant to international targets: Aichi 12, SDG 15 • Scalable across geography, taxon etc	• Useful transferable concept to development of local – corporate state indicators • Useful as a prioritisation approach, based on risk (to focus attention on higher risk species / ecosystems)

Approach	Case study	Specific attributes	Business application
16: Convention on Biological Diversity Aichi Targets and Sustainable Development Goals & Targets ●	Applied at the national scale through NBSAPs (global application)	• Global, under umbrella of UN, it captures the PSR framework, most well developed indicators sit under these targets, associated to global database	• Good model for national scale indicators, which could translate to corporate scale
17: JNCC Common Standards Monitoring ●	UK monitoring of species and habitats in Protected Areas (JNCC, 2016)	• Framework & steps to guide adaptive monitoring and evaluation of protected areas. • Uses baselines and targets to define favourable – unfavourable condition of species and habitats. Which supports standardised assessments across species / ecosystems (meaning you can scale up across many sites) • Intended to provide an early warning system if a species or habitat is declining into 'unfavourable condition' • Framework is designed to incorporate flexibility, different level of data from difference sites.	• support selection / aggregation of site – landscape – corporate level indicators • support the development of a monitoring, evaluation & reporting system
18: Vital Signs Monitoring ●	US National Parks (Fancy et al., 2009; National Park Service, 2012)	• Framework & steps to guide adaptive monitoring • MER system for that encourages consideration of monitoring frequency, etc, • Reporting approaches include condition assessment and report cards • Supports the selection of a 'core set of indicators' that are assessed across all National Parks, in conjunction with Park specific indicators – potentially useful for site to corporate aggregation of biodiversity information	• support selection / aggregation of site – landscape – corporate level indicators • support the development of a monitoring, evaluation & reporting system
19. Global portfolio monitoring and management system (WWF) ●●	WWF International (Stephenson et al., 2015; Stephenson and Reidhead, 2018)	• Assesses programme performance using a conservation achievement KPI • Measures impacts and outcomes through a series of common indicators linked to Aichi Target indicators • Produces dashboards to facilitate data interpretation and adaptive management.	• Concept transferable to development and measurement of corporate indicators at site and global level
20: National Natural Capital Accounting ●	UN SSEEA, Dutch government, UK government	• 20 years of NCA and policy mainstreaming of Natural Capital in Holland	• Corporate level natural capital accounting for business

Approach	Case study	Specific attributes	Business application
		• incorporates natural capital environmental assets into natural accounts to capture the role of the environment in understanding the production and wealth of nations • Many publications with lessons learned, many of which will be relevant to corporate natural capital accounting	

B) Country / institutions approaches to indicator development and monitoring (●)

Approach	Case study	Specific attributes	Business application
21: Essential biodiversity variables & essential ocean variables ●	A framework to structure indicator development for biodiversity (Pereira et al., 2017; Pereira et al., 2013) and the oceans (Lindstrom et al., 2012)	• Designed to be comprehensive in terms of capturing biodiversity from genes to ecosystems. • Core indicators to cross countries and sectors (and core variables to be used by multiple stakeholders), to be used a building blocks. Thus are scalable.	• support selection / aggregation of site – landscape – corporate level indicators
22: Composite indices ●	The Ocean Health Index	• Links biodiversity with other factors, e.g. social & economic • Easy to communicate; but can hide uncertainties, and mask important changes (see discussion Burgass et al., 2017).	• Site – corporate level composite indicator development
23: Local Biodiversity Intactness Index (LBII) ●	Global database, which is the basis for PREDICTS	• Local Biodiversity Intactness Index (LBII) estimates how much of a terrestrial site's original biodiversity remains in the face of human land use and related pressures • Based on site-level biodiversity, it can be averaged and reported for any larger spatial scale • Good scientific basis (data from peer-review papers), but there are gaps in data.	• Useful transferable concept to development of local – corporate state indicators

Approach	Case study	Specific attributes	Business application
24: Citizen Science monitoring of rocky and coral reefs ●	Reef Life Survey (Global application)	• Monitoring undertaken by trained, skilled volunteers • Global subtidal rocky & coral reef monitoring • Species level (fish, macroinvertebrates) monitoring • Assessment of population trends (using advanced modelling approaches, which account for volunteer bias, and natural variability of indicators monitored) • Illustrates the integration of local information into regional/national information • Spatially explicit (e.g., assesses in and out of protected areas)	• Illustrates the principles to establish broad scale monitoring of state indicators • Useful transferable concept to development of local – corporate state indicators
25: Pressure monitoring ●	Predator Free New Zealand	• Monitoring the outcome of interventions (controlling invasive predators) & controls • Broad scale pressure monitoring • Assessment of effectiveness of management	• broad-scale pressure monitoring at corporate level
26: Nation-wide International Bird Areas monitoring ●	Nature Kenya, International Bird Areas	• Pressure State Response monitoring • Two levels of resolution: Broad-scale monitoring (involving remote sensing of pressures across all IBAs); Detailed on-ground monitoring of species, threats and actions at selected IBAs	• site & landscape indicators, and a broad-scale corporate indicators
27: Cockatoo monitoring ●	Katala Foundation, Philippine cockatoo monitoring on Rasa Island and Palawan	• Pressure State Response • Population monitoring (state), loss of nestling to harvesting (pressure), which leads to single species management	• selection of site & landscape indicators • broad-scale pressure monitoring relating to threatened species
28: Site monitoring using remote technology ●	Conservation International Wildlife Insights	• Camera trap information system for approx. 30 tropical forest protected areas • Very large data volumes generated • Not sustainable for long-term monitoring	• Useful technology and set up for monitoring mobile species
29: Species trade tracking tool ●	CITES trade database	• Example of international database that tracks species export, including for commercial purposes • Very useful monitoring system at multiple scales for illegal trade	• Useful transferable concept to development of local – corporate state indicators

Approach	Case study	Specific attributes	Business application
30: Biome Health Research Project ●	UCL and WWF UK (in development)	• Composite measure of biome health (beyond only species), combining habitat, species and ecosystem function. • It will be framework for the development of site level indicators that will link species, ecosystems and habitats.	• Site – landscape level composite indicator development

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