CAPITALS COALITION

Measuring and Valuing Guidance

Part of a series of Biodiversity Guidance to accompany the Natural Capital Protocol

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CambridgeConservationInitiative

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Key messages

- A number of measurement methods are available to help businesses quantify their impacts on biodiversity across the value chain.
- Methods to measure dependencies on biodiversity remain a gap.
- Progressing from measurement to valuation can help you understand the relevance and, to an extent, the magnitude of your impacts and dependencies on biodiversity in a defined context.
- Understanding the data available within your business and from external sources, and the strengths and limitations of different approaches, can help determine which biodiversity measurement and valuation approaches are feasible for your overall objective and scope.
- All measurement and valuation approaches have limitations which are important to understand. These limitations must be disclosed to ensure transparency with key stakeholders and sensitivity analysis should be conducted to determine their implications for decision-making.

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What is the Measure and Value Stage?

The Measure and Value Stage of the Natural Capital Protocol introduces guidance on how impacts and dependencies can be measured and valued, building on information provided in the **Scoping Guidance**. This guidance details how to **Measure** (Step 05 and 06) and **Value** (Step 07 of the Protocol) biodiversity impacts and dependencies as part of your natural capital assessment.

You may be incorporating biodiversity into your natural capital assessment for the first time, or you may be looking to strengthen the measurement and/or valuation of impacts and dependencies on biodiversity of previously completed assessments.

How does the Guidance map to the Protocol?

Table 1Table 1
The Measure and Value Stage: Mapping between the Protocol and the Biodiversity provides an overview of the questions and actions of the Measure and Value Stage in the Protocol and outlines the actions for which the Biodiversity Guidance provides additional information.

This Guidance has been developed to address the measuring and valuing questions asked in the Protocol. Note that they have been adapted slightly to specifically focus on biodiversity:

Step 05: How can your [biodiversity] impact drivers and/or dependencies be measured?

Step 06: What are the changes in the state and trends of natural capital [biodiversity] related to your business impacts and/or dependencies (and how can they be measured)?

Step 07: What is the value of your natural capital [biodiversity] impacts and/or dependencies?

Table 1
The Measure and Value Stage: Mapping between the Protocol and the Biodiversity Guidance

Protocol Step	Questions this Step will answer	Protocol Actions	Additional guidance included?
05 Measure impact drivers and/or dependencies	How can your [biodiversity] impact drivers and/or dependencies be measured?	5.2.1 Map your activities against impact drivers and/or dependencies	Yes See Action 5.2.1
		5.2.2 Define which impact drivers and/or dependencies you will measure	No Revert to Protocol page 60 for general guidance.
		5.2.3 Identify how you will measure impact drivers and/or dependencies	Yes See Action 5.2.3

Protocol Step	Questions this Step will answer	Protocol Actions	Additional guidance included?
		5.2.4 Collect data	No Revert to Protocol page 65 for general guidance.
06 Measure changes in the state of natural capital	What are the changes in the state and trends of natural capital [biodiversity] related to your business impacts and/or dependencies?	6.2.1 Identify changes in natural capital associated with your business activities and impact drivers	Yes See Action 6.2.1
		6.2.2 Identify changes in natural capital associated with external factors	Yes See Action 6.2.2
		6.2.3 Assess trends affecting the state of natural capital	Yes See Action 6.2.3
		6.2.4 Select methods for measuring change	Yes See Action 6.2.4
		6.2.5 Undertake or commission measurement	No Revert to Protocol page 78 for general guidance.
07 Value impacts and/or dependencies	What is the value of your natural capital [biodiversity] impacts and/or dependencies?	7.2.1 Define the consequences of impacts and/or dependencies	No Revert to the Protocol page 80 for general guidance.
		7.2.2 Determine the relative significance of associated costs and/or benefits	No Revert to the Protocol page 82 for general guidance.
		7.2.3 Select appropriate valuation technique(s)	Yes See Action 7.2.3
		7.2.4 Undertake or commission valuation	Yes See Action 7.2.4

Additional notes

You should address all of the actions associated with each Step in the Measure Stage of the Protocol. This Guidance provides additional information for some of the actions where biodiversity-specific considerations need to be taken into account. For a detailed appraisal of the suitability and potential accuracy of different methods of measurement and valuation please refer to the Protocol.

Valuation is the process of estimating the relative importance, worth or usefulness of natural capital to people (or to a business) in a particular context. Valuation may involve qualitative, quantitative or monetary approaches, or a combination of these. There are limitations to valuation of biodiversity, particularly monetary valuation, and so there are situations in which using qualitative and/or quantitative approaches will be more appropriate to inform your decisions.

Before you get started with the Measure and Value Stage

Before you get started with the Measure and Value Stage of your assessment, it is important to consider your planning requirements. The Protocol, for example, identifies some of the resource needs that should be considered for each component of the assessment. For measuring impacts on your business, fewer external resources are typically needed, as some data may be available in your company or in published literature. For measuring your impacts on society and your business dependencies, however, more resources are likely needed and may require specialist environmental /natural resource modelling expertise. Progression from measurement to valuation is helpful to understand the relevance and magnitude of your impacts and dependencies on biodiversity in your business context. However considerable training and applied experience are required to apply valuation techniques to biodiversity impacts and dependencies. You may need to commission external partners and consultants to assist your biodiversity valuation.

The availability of existing data and the ability to leverage existing biodiversity-specific published literature are important planning considerations not only for measurement and valuation but also when scoping your natural capital assessment. For biodiversity, there are a number of important resources including guidelines, frameworks and measurement tools. Table 2 provides a non-exhaustive list summarizing some of these and illustrates how they may be useful for your assessment.

Table 2

Examples of biodiversity-specific resources relating to measurement and valuation

Author	Name	Type	Stage	Description
Capitals Coalition and CCI	Decision Tree	Online Tool	Measure	Designed to guide a user through a biodiversity-inclusive natural capital assessment by signposting to available guidance notes, frameworks and tools.
Convention on Biological Diversity (CBD)	An exploration of tools and methodologies for valuation of biodiversity and biodiversity resources and functions	Report	Value	Compilation of methodologies for valuation of biodiversity and biodiversity resources and functions, as well as other tools for prioritization in decision-making. It includes 13 valuation case studies.
Convention on Biological Diversity (CBD)	Voluntary guidelines on biodiversity-inclusive Environmental Impact Assessment	Guidelines	Measure	Structured to match the steps outlined in environmental impact assessments (EIA), guidelines are provided to better integrate biodiversity-related considerations in the EIA process.
Environment and Climate Change Canada and Department for Environment, Food & Rural Affairs (UK)	Environmental Valuation Reference Inventory	Database	Value	Searchable storehouse of empirical studies on the economic value of environmental assets and human health effects, which could be used in Value Transfer.

Author	Name	Type	Stage	Description
EU Business @ Biodiversity Platform	Assessment of biodiversity accounting approaches for businesses and financial institutions. Update Report 1.	Report	Measure	The first of a series of update reports assessing biodiversity measurement approaches for businesses and financial institutions. Methods using quantitative indicators are specifically assessed.
EU Business @ Biodiversity Platform & UNEP-WCMC	Assessment of biodiversity measurement approaches for business and financial institutions. Update Report 2.	Report	Measure	Second assessment report providing updates on measurement methodology developments with a focus on technical issues. Annex includes updates on each tool and explanatory notes on GLOBIO and ReCipe data tools.
EXIOBASE Consortium	EXIOBASE	Modelling Tool	Measure	Model utilizing a mean species abundance (MSA) indicator to calculate impacts on biodiversity due to human pressures.
Global Reporting Initiative	GRI 304: Biodiversity 2016 Standard	Framework	Measure	GRI's main and current standard on biodiversity impact measurement and reporting.
International Association for Impact Assessment	Biodiversity and Ecosystem Services in Impact Assessment	Framework	Measure	Provides best practice to improve development and capacity building within business to improve the EIA process.
IBAT Alliance (Birdlife International, Conservation International, IUCN, UNEP-WCMC)	Integrated Biodiversity Assessment Tool (IBAT)	Mapping Tool	Measure	IBAT offers a 'one-stop shop' data search service for those seeking authoritative global biodiversity information. Users can create reports, import raw data and map files.
Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)	Diverse Values and Valuation	Guidelines	Value	Methodological guidance based on the IPBES Preliminary guide on diverse conceptualization of multiple values of nature and its benefits. Covers topics including 'Contrasting Approaches to Values & Valuation' and a 'Six Step Approach to Valuation'.
International Union for Conservation of Nature (IUCN)	The development and use of biodiversity indicators in business: an overview	Report	Measure	Background information on the business need for biodiversity indicators related to their business application.
IUCN	Threats classification scheme	Database	Measure	Hierarchical breakdown detailing the drivers of species decline.

Author	Name	Type	Stage	Description
PRé Sustainability	ReCiPe	Modelling Tool	Measure	Developed for Life Cycle Assessment, the model expresses potential disappearance of species as an indicator of impacts on biodiversity.
TEEB	The Economics of Ecosystems & Biodiversity (TEEB) Ecological and Economic Foundations	Report	Value	Conceptual foundation linking economics and ecology, highlighting the relationship between biodiversity and ecosystem services and showing their importance for human well-being. Chapter 4 (The socio-cultural Context of Ecosystem and Biodiversity Valuation) and Chapter 5 (The Economics of Valuing Ecosystem Services and Biodiversity) are particularly relevant to Step 07 of the Protocol.
TEEB	Valuation Database	Database	Value	Estimates for monetary values of ecosystem services that could be used in Value Transfer.

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Step 05 Guidance: How can [biodiversity] impact drivers and/or dependencies be measured?

This section of the Guidance provides actions to answer the following question:

How can your [biodiversity] impact drivers and/or dependencies be measured?

In particular, it will help you to undertake the following actions:

5.2.1 Map your activities against impact drivers and/or dependencies

5.2.3 Identify how you will measure impact drivers and/or dependencies

When applicable, the Guidance provides further advice on how you can map impact drivers and dependencies against your business with a specific focus on biodiversity. The intention is to provide supplementary information to the Protocol as you complete a biodiversity-inclusive natural capital assessment.

5.2.1 Map your activities against [biodiversity] impact drivers and/or dependencies

Box 1: Glossary of relevant terms

Impact Driver: A measurable quantity of a natural resource that is used as an input to production or a measurable non-product output of business activity (Natural Capital Coalition 2016).

Pressure: Driving forces which lead to human activities such as transportation or food production that exert pressures on the environment (Kristensen 2004). For the purposes of this document pressures are synonymous with the term Impact Driver. To remain consistent with the Protocol, the term Impact Driver will be used throughout the document.

Natural Capital Impact: Negative or positive effect of business activity on natural capital (Natural Capital Coalition 2016).

Dependency: A business reliance on or use of natural capital (Natural Capital Coalition 2016).

Identifying Impact Drivers

Once the impact pathway is understood, it is important to consider how biodiversity impact drivers and dependencies can actually be **measured**. In a practical sense, you could determine how your business activities drive impacts on **species** and **habitats**, as these two metrics are the most easily quantifiable measures of biodiversity, particularly for site/project level assessments. However as noted in the **Framing Guidance** biodiversity is much more than species and habitats alone. For an overview of concepts related to impact drivers and impact pathways, refer to page 44 of the Protocol.

Biodiversity impact drivers can be **direct** (impacting biodiversity immediately) or **indirect** (leading to changes in biodiversity eventually). These are identifiable because they result in a measurable change to the environment. This can be through the **measurable** use of a natural resource (called an **input**, e.g. tons of sediment dredged from an estuary), or the creation of a non-product **output** (e.g. volume of pesticides sprayed in a given area). Examples of direct and indirect biodiversity **impact drivers** are presented in Table 3 below.

Table 3

Direct and indirect biodiversity impact drivers (adapted from IPBES 2017) and affiliated biodiversity examples

Type of Impact Driver	Impact Driver Category	Input/ Output	Examples of specific, measurable impact drivers related to biodiversity
Direct	Land/sea use change	Output	Area of land converted from natural forest to agricultural land, area of seabed used to install a windfarm.
	Direct exploitation	Input	Number of animals displaced due to project installation, change in population size due to ongoing site operations.
	Climate change	Output	Emission of GHG's into the atmosphere.
	Pollution	Output	Wastewater entering the marine environment, agricultural runoff, operational noise.
	Invasive alien species	Output	Movement of invasive species through shipping and transportation of goods.
Indirect	Demographic and sociocultural	Output	Increase in human population near project site, change in consumption pattern of local resources (by humans).
	Economic and technological	Input	Trade of species.

The **IUCN Threats Classification Scheme** (IUCN n.d.) details the categories of threats arising from impact drivers in a hierarchical structure. It details current drivers of decline for specific species, including historical threats that are no longer active and future threats that are likely to occur within three generations or ten years. This can be used to help identify **impact drivers** posing a threat to, and consequently impacting on biodiversity. Activities highlighted as having a greater threat would be deemed as having a higher risk and should be prioritized for mitigation/adaptation.

Identifying Dependencies

As biodiversity is an integral asset of natural capital, businesses inherently depend on biodiversity. For example, a coffee plantation will be dependent on the pollination of its coffee plants (see

from Figure 4.2 in the Natural Capital Protocol) to yield coffee beans. A successful coffee yield is dependent on the habitat (a component of biodiversity) used to grow the coffee plants and the pollinators within the area.

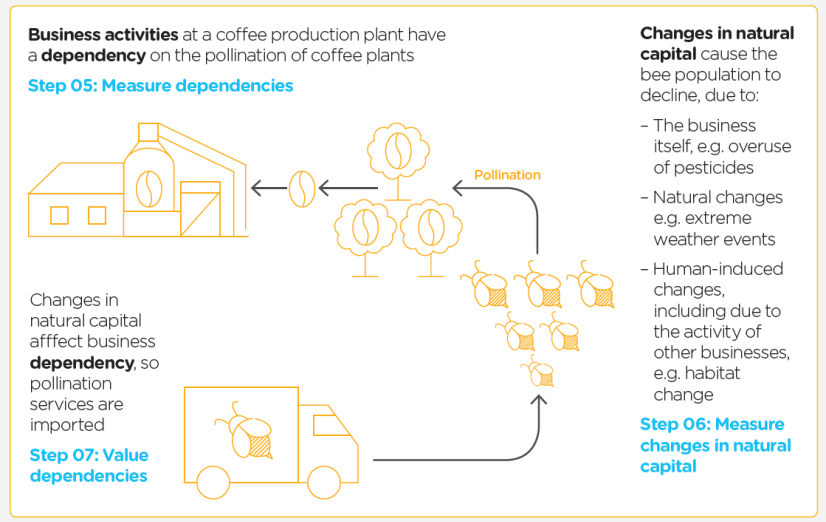

Figure 1
Image from the Natural Capital Protocol (2016) describing a coffee plantation's dependencies on insect pollinators for the success of its business – figure 4.2 in the Natural Capital Protocol

ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) is an online tool to help businesses identify the impact and dependency pathways related to their business activities. It is applicable to all business sectors and financial institutions and details how impacts and dependencies on natural capital may impose a business risk if environmental degradation occurs.

5.2.2 Define which impact drivers and/or dependencies you will measure

For this action, revert to the Protocol page 60, for general guidance.

5.2.3 Identify how you will measure [biodiversity] impact drivers and/or dependencies

To measure an impact driver and or dependency, you need to determine the type of data required. Many data sources exist and are described in detail within the Protocol (page 60). To measure biodiversity impact drivers and/or dependencies, there are generally two forms of data to consider acquiring and/or collecting. Each are described below with examples:

Primary data:

- Internal business data
- Site level data collected through field surveys
- Data collected from suppliers or customers

Secondary data:

- Published, peer-reviewed, and grey literature (for example, life-cycle impact assessment (LCIA) databases; industry, government, or internal reports)
- Estimates derived using modeling techniques, including:
    - Environmentally extended input-output (EEIO) models
    - Productivity models

    - Mass balance
- Past natural capital assessments

Data collection techniques can be highly variable and are often dependent on location, project and area of the value chain being assessed. For this reason, one technique may not be practical or well suited across multiple applications. For example, a site level project (e.g. an environmental assessment for a prospective mine) may involve large mammal aerial surveys (i.e. by helicopter or using a drone), whereas data collection for a wholesaler looking at impact drivers related to commodity sourcing may require information provided by individual farmers through a survey. Both techniques result in the collection of primary data.

Table 4 provides additional biodiversity specific considerations for the use of primary and secondary data. Once again, for a detailed appraisal of the suitability and potential accuracy of different techniques, please refer to the Protocol.

Table 4

Biodiversity-specific limitations for primary and secondary data approaches

Type of Data	Biodiversity-specific considerations
Primary data	Challenges faced when collecting primary data (to be aware of): • Timescales • Seasonal variations • Spatial variations • Remote sensing data (i.e. satellite data) requires clear weather conditions, is time-restricted and can be costly • Technical expertise required through the use of biology/ecology consultants • Land access • Cost
Secondary data	Challenges faced when utilizing secondary data: • Data required is often location-specific and complex • Data gaps result in the use of data assumptions, which are less accurate • Robust models for biodiversity are still not readily available • Underlying assumptions and limitations need careful consideration to ensure modelling scenario is appropriate for your situation

The Protocol provides more detail on the limitations and considerations needed when collecting and using primary or secondary data to measure impact drivers. This includes the use of intermediate indicators (see Table 5.6 in the Protocol).

For examples of business activities and their associated impact drivers, indicators and data sources required, refer to Table 5 below. This also includes important considerations on data gaps and related uncertainties.

Table 5

Example of business activities that result in an impact driver, associated quantitative indicator and key data gaps or uncertainties to consider before undergoing measurement

Activity	Impact Driver	Quantitative indicator	Data source	Example data gaps and key issues to consider
Site level impact: Mining for ore	Land use change (i.e. habitat loss)	Hectares of habitat lost	**Primary** data: Direct collection	• Need to determine **boundaries** for site. • Determine if cumulative effects are being included.
Product level impact: Manufacturing leather shoes	Direct exploitation (i.e. species lost from sourcing materials)	Quantity of leather sourced per year (measured by weight or volume of materials purchased)	**Secondary** data**:** Global datasets	• Consider parts of the **value chain** being assessed (upstream, downstream and/or direct impacts). • Will rely on **proxy data** to understand impacts through the supply chain.
	Pollution (i.e. Wastewater from production plant)	Tons of deleterious chemicals released to surface water	**Primary** data	• Need to determine **physical boundary** of assessment, time period when field work will be completed, and number of **repeat measurements** necessary.
Portfolio/sector level impact: Food production	Land use change (i.e. biodiversity footprint of a food industry portfolio)	Hectares of land converted to monoculture	**Secondary** data**: Public** data (annual reports), **private** databases (fee required) and **internal** data collected (at global level).	• Data provided is likely from **multiple sources** and in multiple formats requiring heavy data pre-treatments. • **Transforming** multiple datasets into the same format is generally completed by **experts**. • Different levels of confidence may result for different aspects of the data.

In the case of business' dependencies on biodiversity, once they are identified, these will need to be measured in a standardized way. Currently, changes to the **stocks** (i.e. the impacts on biodiversity) and **flow** (impacts to ecosystem services) on biodiversity are relatively well understood. However, the relationship between the two is poorly understood and hard for businesses to quantify.

There are some tools such as ENCORE (focused on identifying impact and dependency pathways for financial institutions), LIFE (applicable at all organizational focuses), InVest and ARIES, which determine dependencies on **ecosystem services**. **Currently, there are no corporate biodiversity measurement tools and methodologies available for dependencies.** This is an area which will require innovation. Meanwhile, you can use the approach of the Natural Capital Protocol to incorporate dependencies on biodiversity as part of your assessment.

5.2.4 Collect data

For this action, revert to the Protocol page 65, for general guidance.

Step 06 Guidance: Measure changes in the state of biodiversity

This section of the Guidance provides actions to answer the following question:

What are the changes in the state and trends of [biodiversity] related to your business impacts and/or dependencies?

In particular, it will help you to undertake the following actions:

6.2.1 Identify changes in natural capital associated with your business activities and impact drivers

6.2.2 Identify changes in natural capital associated with external factors

6.2.3 Assess trends affecting the state of natural capital

6.2.4 Select methods for measuring change

As the existing methods currently available to quantify biodiversity are focused on measuring impacts (rather than dependencies), this Guidance provides further information on actions related to measurement of impacts on biodiversity. Some additional guidance for qualitative measurement of dependencies is also provided. For guidance on measuring dependencies, you should follow the general approach indicated in the Natural Capital Protocol

Refer to the Decision Tree to work through the actions presented below using the online tool. It is important to recognize that the Measurement Stage is an iterative process which may require you to go back and forth between different actions of the Protocol.

6.2.1 Identify changes in natural capital associated with your business activities and impact drivers

This action considers the changes in biodiversity resulting from the impact drivers measured or estimated in Step 05 above. Example impact drivers resulting in changes to the state of biodiversity, and potential challenges confronted when determining impacts on biodiversity are described in

Table 6 below. Refer to the Protocol (page 68) for further detail.

Table 6

Examples of impact drivers resulting in changes (i.e. impacts) to the state of biodiversity.

Impact driver	Change in biodiversity state	Natural process for why change is observed	Points to consider
Pollution (Kilograms of nitrates released to surface water)	Reduction in the number of species present in a given area.	Reduced oxygen levels within a waterway (river, lake or stream) due to the input of chemicals.	• Changes in biodiversity due to water pollution are location specific. • Depending on the type of pollution, quality of receiving water etc., this can present challenges for accurate measurement in large-scale assessments. • Water quality assessments are likely to be required on a monthly basis over a large period of time.
Land use (Hectares of natural land converted to agricultural land)	Decreased habitat availability and connectedness within a given area.	Land use transforms the amount of natural habitat available and fragments the landscape.	• Changes in biodiversity due to land use need to consider the amount of area lost, in combination with the loss in connectivity between available (natural) habitat. • Loss in connectivity (i.e. fragmentation) can also lead to a loss of habitat quality.

6.2.2 Identify changes in natural capital associated with external factors

a. Determining external factors – Related to impacts

You should identify external factors that could result in changes to the state of biodiversity within the bounds of your assessment. These may directly or indirectly affect the perceived significance of impacts resulting from your business. This becomes important when required to compensate for biodiversity losses relating to your activities.

For site level projects, this can be achieved through **on the ground data collection** within the assessment area *and* at a secondary location (i.e. a reference site) where your business activities are **not** occurring. Data should be collected at the same time, and in the same manner at both locations and the results compared.

If the impacts to biodiversity are greater in the project area compared to the reference site, then it is likely your business activities are contributing to **biodiversity loss**. If the impacts within the project area are lower than those at the reference location, it is possible a loss in biodiversity is occurring due to the cumulative effects of activities from multiple businesses, in addition to your own.

b. Determining external factors – Related to dependencies

You should consider identifying external factors affecting, or potentially affecting your business' dependencies on biodiversity. Considering the coffee plantation example, if a nearby river supplying water to the farm were dammed, there would be less water available to activities dependent upon the water supply. Or, if the forest surrounding the coffee plantation were to be degraded, this would reduce the protection from fire and flooding that is inherently provided by the surrounding, natural habitat.

The ENCORE tool can help identify impact and dependency pathways to determine external factors that may affect your business.

6.2.3 Assess trends affecting the state of natural capital

It is important to separate out changes in biodiversity driven by impact drivers over which a company has control from those which it does not. A number of tools and databases are available to assist in the assessment of background rates of change in biodiversity.

For this action, revert to the Protocol page 72, for general guidance.

6.2.4 Select methods for measuring change

Data requirements will change for different measurement methods and need to be reviewed in each instance. For example, measurement methods using primary data usually involve **on-the-ground** data collection. If budget, time restrictions or the objective of your assessment do not allow for the use of primary data, then secondary data can be used instead. By using secondary data, you are able to model biodiversity impacts, such as climate change, land use and pollution. However, the results are considered less granular.

Other specific limitations will exist for each method reviewed, and need to be considered in the greater context of your assessment. Refer to the EU Business @ Biodiversity Assessment Report and associated Annexes for further explanation of issues related to data and specific limitations/applicability for each method. Examples of various measurement and estimation methods are provided in **Error! Reference source not found.**.

Table 7

Examples of measurement and estimation methods for biodiversity

Measuring changes in biodiversity	Direct measurement	Proxies	Modelling methods
Species	Direct measurement of species richness and abundance. **Organizational Focus**: Product, Project, Site, Company	Integrated biodiversity Assessment Tool (IBAT) brings together 3 key global biodiversity datasets. **Organizational Focus**: Project, Company	The GLOBIO model uses mean species abundance to estimate the change in species as a result of a given impact driver. **Organizational Focus**: Sector/Portfolio
Habitat	Direct measurement of habitat area and assessment of quality. **Organizational Focus**: Site, Project	DEFRA Biodiversity Metric provides a method for estimating habitat quality and extent. **Organizational Focus**: Project, Company	Global Forest Watch provides data on deforestation and forest biodiversity intactness. **Organizational Focus**: Site, Project

There are several biodiversity measurement methods for businesses in development globally, with the majority currently in the piloting phase (see

and Box 2). They are currently classified by Business Application (see **Framing Guidance**) and organizational focus (see **Scoping Guidance**), but these are indicative and not restrictive.

Box 2: Aligning Biodiversity Measures for Business

The Aligning Biodiversity Measures for Business collaboration, in conjunction with the EU Business @ Biodiversity platform, is aiming to provide clarity on biodiversity measurement methods available, by developing a systematic approach to determining the most appropriate method for your biodiversity-inclusive natural capital assessment. Refer to the EU Business @ Biodiversity Assessment Report Update 2 (2019) for a description of the current methods available (as of December, 2019), the data required to utilize each approach and associated limitations. The Business Applications identified by the collaboration have been carried forward within this Guidance. See the Decision Tree and Framing Guidance for more information. A matrix (

, presented below) has been developed to visualize the methods available and their applicability across the value chain. The EU Business @ Biodiversity platform is assessing various case studies from piloting of these methods to determine the validity of these claims, as at present the information has been self-reported by the tool developers. For this reason, the matrix may quickly become outdated. It is suggested that you review all applicable methods, and choose the one most suited to your business needs.

It is recommended that you refer to this guidance in addition to the **Decision Tree**, to determine the measurement approaches appropriate for your business and assessment objectives. Once determined, the guidance presented here will assist you in data collection, measurement and valuation of your business' impacts on biodiversity. Choosing an appropriate measurement approach is also described in more detail below.

BUSINESS APPLICATIONS SUPPORTED	ORGANISATIONAL FOCUS					
	PRODUCT/ SERVICE	SITE/ PROJECT	SUPPLY CHAIN	CORPORATE	PORTFOLIO/ SECTOR	COUNTRY/ REGION
1.Current performance	ABD, PBF	ABD, LIFE, BIE, STAR, BD, BMS, BPT	ABD, LIFE, BD, PBF, BIM, BMS, EPL	BD, GBS, BIE, LIFE, BIM, BMS, EPL	BFFI, LIFE, GBS	ABD, LIFE
2.Future performance	PBF	LIFE, STAR, BPT	LIFE, PBF	GBS, LIFE	BFFI, LIFE, GBS	LIFE
3.Tracking target progress	ABD, PBF	ABD, BIE, BD, LIFE, STAR	ABD, STAR, BD, LIFE	ABD, BIE, BD, LIFE, GBS, STAR	ABD, LIFE, BFFI, STAR, GBS	ABD, STAR
4.Comparing options	ABD, PBF	ABD, STAR, BIE	ABD, LIFE, BIM, EPL	ABD, BIM, BIE, GBS, EPL	ABD, GBS, BFFI, LIFE	ABD, LIFE
5.Third party assessments/ ratings		LIFE		GBS, LIFE	GBS, LIFE, BFFI	LIFE
6.Third party certification		BD, LIFE, BMS	BD, LIFE, BMS	BD, LIFE, BMS	LIFE	LIFE
7.Risk & opportunity assessment	ABD	ABD, BIE, BPT	ABD, EPL	ABD, BIE, EPL	ABD	ABD
8. Biodiversity accounting		BD	BD	BD		

Key

ABD	Agrobiodiversity index	BIE	Biodiversity Indicators for extractives	LIFE	LIFE Impact Index
BFFI	Biodiversity Footprint Financials	BD	Biological Diversity Protocol	PBF	Product Biodiversity Footprint
BIM	Biodiversity Impact Metric	GBS	Global Biodiversity Score	STAR	Species Threat Abatement & Recovery
BMS	Biodiversity Monitoring System for the Food Sector	EPL	Environment Profit & Loss	BPT	Biodiversity Performance Tool
	Addresses biodiversity		Addresses ecosystem services		Biodiversity & ecosystem services

Figure 2
Examples of corporate biodiversity measurement methods

Source: EU Business @ Biodiversity Assessment Report Update 2 (2019).

It is important to note that the categorization of the measurement approaches to various business applications has been self-reported by the developers of the methodologies. For this reason, the methods shown for each category (in Figure 2) may not be applicable for all assessment scenarios.

Once a method has been selected and reviewed (through the use of the Decision Tree and the Visual Matrix in Figure 2 above), it is important to consider the different datasets and associated metrics required. The method chosen will dictate what input data is needed, the level of granularity and the type of information determined once measurement is completed. This is described in detail below.

6.2.5 Undertake or commission measurement

Measurement methods (and associated models, if applicable) calculate different metrics, as a specific way of quantifying biodiversity. The most commonly used metrics within the biodiversity measurement approaches include; **mean species abundance** (MSA), **potentially disappeared fraction of species** (PDF) and the **risk of extinction** unit (see

Table 8). A particular metric may be more applicable to you depending on the activity or impact driver that you want to assess.

Metrics such as MSA and PDF do not capture changes to all aspects of biodiversity, such as **genetic** diversity, effects to **ecosystems** (i.e. species within a certain area and habitat) or changes to the **quality** of biodiversity. This is a current data gap within biodiversity measurement approaches requiring innovation (Santamaria and Mendez 2012).

Table 8

Selected examples of underlying metrics within corporate biodiversity measurement methods

Example Metric	Description	Data used	Level of applicability	Limitations
Mean Species Abundance	• Indicator of biodiversity intactness. • Considers mean abundance of species relative to their abundance in undisturbed ecosystems (i.e. reference site). • Relative abundance giving a value from 0 (completely destroyed ecosystem with no original species) to 1 (species abundance is unchanged).	• Based on the GLOBIO3 model, which aims at assessing scenarios of human-induced changes in biodiversity. • No weighting factors are applied to different taxonomic groups or to reflect gaps in biodiversity data.	• Product • Project • Company	• Does not weight areas by species richness.

Potentially disappeared fraction of species (PDF)	• Provides indicator of decline in species richness in an area over a time period.
	• Larger PDF values indicate a higher level of impact for the activity.
	• PDF impact factors focus on the species richness of plants.
	• Used by the ReCiPe methodology.
		• Three European data sources used.
		  ○ UK (Crawley & Harral 2001)
		  ○ Countryside Survey (2000)
		  ○ Switzerland (Koellner 2003).
			• Product
			• Project
			• Company
				• No distinction is made between species with potentially different conservation values (e.g. common vs. red listed).
				• Reliant on estimates based on species-area relationship.

Direct measurement	• On-the-ground monitoring / measurement of species and habitats determine species richness, abundance and trends over time.	• Direct measurement • Reliance on local datasets	• Product • Project	• Time bound • Costly • Use of consultants

It is noted that most impacts on biodiversity manifest over **time horizons** that do not match real-time decision-making. Companies need to select appropriate **measurement intervals** to best capture this gap. For example, yearly monitoring surveys are likely suited over monthly ones when assessing the impacts of noise from a power plant on a mammal population. Whereas, monthly surveys (likely for a year or more) are most appropriate when looking at changes to water quality in relation to a mine's effluent.

Click here to see an example of how a measurement approach is being applied across a company's cocoa supply chain.

In summary, all measurement methods have **limitations,** which are important to understand before selecting the most appropriate approach for your business.

For his action, revert to the Protocol page 78 for general guidance.

Case Studies

Case study of a biodiversity measurement approach to quantify impacts in the supply chain and compare raw material sourcing options.

The Biodiversity Impact Metric has been developed by CISL to help supply-chain companies better understand their impacts on biodiversity as a result of their raw material sourcing (CISL 2020). The metric is designed so that companies that do not have full traceability of their supply chains can use credible proxy data and assumptions to help fill in knowledge gaps. For a commodity sourced from a particular location, the metric assesses impact based on: 1. The land area needed for production of the commodity 2. The proportion of biodiversity lost through transforming land to produce the commodity, related to the type of land use and the intensity of the production practices 3. The relative global importance of that biodiversity.

The output allows a company to identify actions to reduce their impacts (e.g. by decreasing cropland expansion, reducing land use intensity or avoiding the use of commodities that are particularly damaging). Limitations for a metric like this, however, include the use of proxy and modelled data, which is less suitable for measuring actual impacts and changes to biodiversity through time.

Step 07 Guidance: Value impacts and/or dependencies

This section provides Guidance for answering the following question:

What is the value of your [biodiversity] impacts and/or dependencies?

In particular, the guidance will help you to undertake the following actions:

7.2.3 Select appropriate valuation technique(s)

7.2.4 Undertake or commission valuation

Valuation is the process of estimating the relative importance, worth or usefulness of natural capital to people (or to a business) in a particular context. Valuation may involve qualitative, quantitative or monetary approaches, or a combination of these. There are limitations to valuation of biodiversity, particularly monetary valuation, and so there are situations in which using qualitative and/or quantitative approaches will be more appropriate to inform your decisions.

7.2.1 Define the consequences of impacts and/or dependencies

For this action, revert to the Protocol page 80 for general guidance.

7.2.2 Determine the relative significance of associated costs and/or benefits

For this action, revert to the Protocol page 82 for general guidance.

7.2.3 Select appropriate valuation technique(s)

You can use valuation to understand the importance of biodiversity in a particular context. A variety of approaches are available. When selecting an approach, you must understand its applicability and limitations.

Your choice of valuation technique will depend on whether you want to estimate qualitative, quantitative or monetary values for biodiversity:

- **Qualitative** values inform the scale of costs and benefits in non-numerical terms.
- **Quantitative** values use numerical data as indicators of costs and benefits.
- **Monetary** values translate costs and benefits into a common currency.

For further information about qualitative, quantitative and monetary valuation approaches, see the scoping guidance action 3.2.5.

Different types of values offer different ways to examine the consequences of your impacts and dependencies on biodiversity. Hybrid approaches involve using different types of value (i.e. qualitative, quantitative and/or monetary) in combination to assist your decision-making. You may find hybrid approaches particularly helpful for ensuring that: 1) the value of final benefits provided by biodiversity; and 2) the value of biodiversity as part of a natural capital stock underlying continued provision of benefits, are captured.

You may find it easier to measure the condition of biodiversity (as part of a natural capital stock) in biophysical units, such as the number of individuals of a species or the area of a habitat. Certain quantitative measurements can be converted into monetary values through the goods and services flowing from biodiversity, for example you could value the benefits provided by wild pollinators using market prices for crops.

Even where monetary valuation is your ultimate goal, you may only be able to monetise some aspects of biodiversity's value. Qualitative and/or quantitative approaches can be applied to aspects of biodiversity's value that cannot be assessed with monetary techniques. For example, you could apply qualitative approaches to spiritual values associated with biodiversity, and might use quantitative values to understand health benefits associated with biodiversity.

You may wish to apply a sequential approach where you first estimate values qualitatively and/or in quantitative units and then you could convert them into monetary values (TEEB 2010). You can develop biodiversity values over several iterations, for example in initial valuation analysis with limited scope you may estimate qualitative values, and then monetise progressively more values in subsequent assessments with increasing complexity and assumptions.

Qualitative and quantitative valuation techniques

The qualitative and quantitative valuation techniques described in the Protocol can be applied to estimating values for biodiversity (Box 3). The advantages and disadvantages of applying different techniques to biodiversity are the same as for other aspects of natural capital. Therefore, you are encouraged to look at the Protocol for information about valuing biodiversity using qualitative or quantitative techniques.

Revert to the Protocol page 84 for information on qualitative and quantitative valuation techniques.

Box 3: The UK National Ecosystem Assessment

The United Kingdom's National Ecosystem Assessment provides an example of how non-monetary techniques can be used to consider biodiversity's value alongside monetary values. In this assessment, impacts on farmland bird species and bird diversity were valued using multi-criteria analysis (MCA; refer to the Protocol Table 7.1 for more information on this and other valuation techniques). Monetary valuation techniques were applied to other impacts such as agricultural output, greenhouse gas emissions, recreation and urban greenspace under different scenarios (Bateman et al 2011). The different types of value could then be considered in parallel in decision-making – this is therefore also an example of a hybrid approach.

Monetary valuation techniques

Monetary valuation allows you to compare costs and benefits in a single tangible unit. It can simplify the assessment of trade-offs, not only incorporating biodiversity values, but also other environmental, social and economic imperatives.

The valuation techniques included in this Guidance are the same as those already included in the Protocol, but there are some additional considerations that you should take into account when selecting a technique to apply to biodiversity.

Table 9 outlines key biodiversity-specific considerations for each technique. Note that this table builds on Table 7.1 in the Protocol, which should be read alongside it. Table 7.1 in the Protocol provides a description of each technique, and an indication of the data requirements, duration, budget, skills required for application, and advantages and disadvantages in the general context of natural capital.

Revert to the Protocol page 84 for general information on the monetary valuation techniques in Table 10.

Table 9 provides you with information on the benefits and limitations of each technique in the context of biodiversity, indicates what type of biodiversity values it can capture, whether it captures impacts and/or dependencies on biodiversity, and gives examples of how each technique can be used to estimate biodiversity values.

Note: 'Use' values encompass the direct values (e.g. providing food), underpinning values (e.g. pollination, contributing to food chains), and insurance and options values of biodiversity. 'Non-use' refers to values such as biodiversity's intrinsic value, bequest value (i.e. knowing that future generations will continue to benefit from biodiversity) and existence values (i.e. connected to our desire to protect biodiversity irrespective of whether we derive any value from it other than associated with our knowledge of its existence).

Table 9

Biodiversity considerations relevant to different monetary valuation techniques.

Monetary valuation technique		Biodiversity considerations*
Market and financial prices		**Benefits:** Well-suited to identifying and valuing final benefits provided by biodiversity. **Limitations:** The extent to which the value of biodiversity is captured is heavily dependent on the degree to which variation in biodiversity influences demand for the market good. **Values:** Direct and indirect use. **Impacts or dependencies:** Both **Examples of use:** The market price of an agricultural output could be used to value an expected increase in crop yield associated with interventions to increase wild pollinator populations accessing a plantation.
Production function (change in production)		**Benefits:** Can be used to assess the value of complex and unclear business dependencies on biodiversity. **Limitations:** Requires complex modelling which may introduce a high level of uncertainty. **Values:** Indirect use **Impacts or dependencies:** Dependencies **Examples of use:** More diverse forests tend to absorb and store more carbon. The increase in the carbon value of a forest derived from biodiversity can be estimated using production function modelling.
Cost-based approaches	Replacement costs	**Benefits:** Reflects business costs that would be needed to maintain operations with changes in biodiversity. Can be used to look at the biodiversity underpinning flows of benefits. **Limitations:** Not consistent with underpinning economic theory – valuing biodiversity requires measurement of the demand for biodiversity, while cost-based
	Damage costs avoided	

Monetary valuation technique		Biodiversity considerations*
		methods report the costs that would be associated with a particular action; these have no relationship with demand. **Values:** Direct and indirect use **Impacts or dependencies:** Both **Examples of use:** Replacement cost has been used to highlight the costs of pollinator decline, especially where the next best alternative is hand pollination by humans. The costs of bringing in managed pollinator populations can also be used if it is a feasible alternative. Where habitats are deemed replaceable, biodiversity offsets are used to replace residual impacts on biodiversity that cannot otherwise be avoided. The market price of offsets can therefore be used to estimate the cost of meeting objectives such as no net loss.
Revealed preference (indirect)	Hedonic pricing Travel costs	**Benefits:** Can isolate the contribution of particular ecosystem services from biodiversity to human well-being. **Limitations:** A proxy-based method that may have context-dependent inaccuracies, for example hedonic pricing methods will struggle to distinguish a value of biodiversity if levels of biodiversity are not noticeably variable across the study area. Similarly, where there are many potential biodiversity sites in a given area travel costs may be low. To an extent both methods reveal what people have to pay to receive a benefit rather than the value they receive. **Values:** Direct and indirect use **Impacts or dependencies:** Both **Examples of use:** Research in England has shown substantial values (reflected in house prices) associated with proximity to high value biodiversity habitats and designations.
Stated preference	Contingent valuation (CV) Choice experiments (CE)	**Benefits:** Focus on estimating demand, therefore offer a theoretically justified method to estimate use and non-use values for biodiversity. Non-use values cannot otherwise be easily estimated. **Limitations:** Highly subjective, and there is often variation between what people claim they are willing to pay with regard to biodiversity (especially summed across a number of surveys) and what is revealed by their behaviour and affordable within their budget constraints. Results can be subject to numerous problems connected to participants lack of experience attributing monetary values to non-market goods (such as many of the benefits that biodiversity provides to society), and capacity to distinguish values across different levels of their provision (sensitivity to scope). **Values:** Use and non-use **Impacts or dependencies:** Both **Examples of use:** Stated preference methods have been applied in different contexts ranging from the value of specific species up to estimating the benefits of country-level biodiversity action plans.
Value (benefits) transfer		**Benefits:** Bypasses requirements for investment in new primary research. **Limitations:** Relationships between biodiversity and provision of benefits are often complex and context-specific. Therefore, value transfer requires a study of very similar nature as input and detailed knowledge of the ecological and economic context of the original study in order to transfer values in a justifiable way. Validity of results is likely to be questionable, especially if cultural/temporal/ecological context of the source study is not similar. **Values:** Use and non-use **Impacts or dependencies:** Both **Examples of use:** Context-specific values for different ecosystem services provided and/or supported by biodiversity (estimated using techniques outlined previously in this table) have been compiled in databases such as the TEEB valuation database[15]

Monetary valuation technique	Biodiversity considerations*
	and can be applied to estimate biodiversity values in similar contexts, or used in different contexts with suitable adjustments.

*The 'biodiversity considerations' column in Table 10 draws heavily from eftec (2015) and TEEB (2010). Annex B of the Protocol also provides more information about different monetary valuation techniques.

Selection of a valuation technique will often be aligned with the risks and opportunities you identified through your materiality assessment. For example, if your business is facing legal risks from its biodiversity impacts, the consequences could be understood through costs of non-compliance. Alternatively, to understand the business value of your dependency on biodiversity, you could estimate the costs of replacing biodiversity benefits.

7.2.4 Undertake or commission valuation

Applying these techniques to estimate values for biodiversity requires significant training and applied experience. You should consider whether you have the necessary skills and experience within your business to undertake valuation internally. If necessary, you should commission external partners to assist your biodiversity valuation.

Avoiding double-counting and considering the condition of biodiversity stocks

Double-counting can be a concern when you value biodiversity and ecosystem services. This is because biodiversity delivers benefits in multiple ways. For example, in production of agricultural crops, biodiversity supports nutrient cycling and pollination. These ecosystem services (and other benefits from biodiversity) combine to provide one final benefit to a business – increased crop yields. If you value each ecosystem service individually you may count the role of biodiversity several times.

To avoid double-counting, you can focus on final benefits, such as the crop yield, rather than intermediate or supporting services, such as nutrient cycling or pollination.

However, when you value final benefits (if they are flows resulting from values other than biodiversity's direct value) the connection between business benefits and the underlying condition of biodiversity stocks may be overlooked. For example, if you focus on valuing final crop yields the importance of pollinators may not be recognised. Where biodiversity is being degraded, it is particularly important that you consider this limitation, as the final benefit being valued may not remain in the long term.

You should try to identify where the condition of biodiversity stocks has been overlooked in estimated values, and consider the importance of biodiversity for continuing to provide benefits to your business in the future.

Further potential limitations and how to address them

Whether you are undertaking or commissioning valuation, there are several important limitations, particularly to monetary valuation, which you should consider and try to address when designing and implementing methodologies and interpreting valuation results (Sukhdev et al 2014):

- **Subjectivity** – values are a reflection of how a single group of people perceive their relationship with biodiversity at a single point in time. You should try to identify and engage with all relevant stakeholders to understand their perceptions of biodiversity and its importance. You should also be careful to avoid influencing these perceptions when designing your assessment.

- **Incommensurability** – the problem of incommensurability remains, even where some aspects of biodiversity's values have been monetised, as wider values which cannot be monetised remain difficult to take into account. For example, it is impossible to monetise intrinsic values associated with biodiversity, and very difficult to calculate accurate values associated with rights, responsibilities and care. Biodiversity provides multiple benefits to business and society, and even when all are expressed in monetary units it may be inappropriate to mix market values associated with biodiversity with values that biodiversity provides linked to the welfare of wider society. You can explore non-monetary techniques to look at the impact of weighting and scoring different values.
- **Economic uncertainty** – adding economic uncertainty in valuing ecologically uncertain relationships risks producing inaccurate values. You should try to use the best available information on forecasted market prices and revise them periodically to incorporate deviations on the state and values of your impacts and dependencies on biodiversity over time.
- **'Commoditisation'** – expressing biodiversity values in monetary units can be misinterpreted as pricing and marketing biodiversity. You should never interpret the results of your assessment as making biodiversity replaceable if a higher economic value can be found.

It is important that you recognise these limitations and try to address them where possible. You should interpret values estimated for biodiversity with caution, and use them alongside other information to assist (rather than replace) deliberation in your decision-making. You should always present the approach taken, and the assumptions made, clearly alongside your valuation results. Remember that values for biodiversity are likely to represent minimum estimates.

These issues notwithstanding, biodiversity valuation can provide a useful aid to your decision-making within a given context.

Having now measured and valued your biodiversity impacts and dependencies, please continue to the **Application Guidance** to explore how to interpret, apply and act on the results of a natural capital assessment to help set informed biodiversity targets.

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