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# Biodiversity Risk - Integrating Business and Biodiversity in the Tertiary Sector

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# Summary

Many businesses rely upon the services that ecosystems provide and the biodiversity that underpins them. However, these dependencies are often not realised and accounted for. This report aims to encourage greater integration of biodiversity into business decisions by clarifying the biodiversity associated risks and opportunities faced by the private sector. This report focuses predominantly on tertiary sector industries, particularly those operating in the UK and UK Overseas Territories, but the risks, opportunities and recommendations are applicable to a broad range of organisations. Tertiary sector businesses, made up predominantly of service industries, were focal in this study as biodiversity impacts and dependencies are often less visible to this sector. The aim of this study is to illustrate how businesses can sustain long-term value creation opportunities by extending considerations of biodiversity throughout the supply chain and implementing actions beyond regulatory compliance.

This report was carried out by Arcadis on behalf of, and in collaboration with, the Joint Nature Conservation Committee. The study draws on a literature review of tools, methods, frameworks and initiatives relevant to how businesses integrate ecosystems and biodiversity consideration into decision making. The report features case studies demonstrating impacts from biodiversity loss on business and highlights opportunities to be realised by better integration. Accompanying Appendices, A and B, present a compendium of case studies and examples of biodiversity integration measures adopted by companies respectively.

In addition, a survey was conducted by Arcadis of their relevant contacts and clients that work in the realm of corporate social responsibility across a variety of industries. This information is presented and provides first-hand insights into the understanding, motivations and barriers to greater considerations of biodiversity related factors within the business community.

The results showed that whilst some businesses deem biodiversity to be important, few report that operations have had been affected by biodiversity loss therefore it is not treated as a material issue. Many recognise that due to diffuse supply chains, biodiversity loss is perceived to be a systemic risk that the tertiary sector cannot manage in isolation. A current lack of metrics to measure impacts and report on progress hinders identification of tangible actions that businesses can take with regards to biodiversity risks.

Communicating how biodiversity affects day-to-day operations in tertiary sector industries is complex, yet the opportunities presented by correctly considering biodiversity in a corporate context, such as developing new products and entering new markets, has been a major factor in driving front-runner companies to take an informed strategic response to biodiversity issues. Recognising biodiversity as a material risk and acting proactively will give a comparative advantage over businesses that are forced to respond reactively.

The report concludes with a suite of recommendations as to how businesses can begin to decipher biodiversity in a corporate context, bring in new knowledge bases to help improve long-termism regarding biodiversity impact, risks and opportunities.

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# Glossary

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| Biodiversity | Biodiversity is defined by the UN Convention on Biological Diversity (CBD) as the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of their functions (i.e. ecosystem function). |
| Biodiversity loss | The reduction in the numbers of different plant and animal species, and also their abundance. This can occur at different geographical levels and can lead to extinction. |
| Bioprospecting | The systematic search for biochemical and genetic resources in nature to develop commercially-valuable products, such as in pharmaceutical, agricultural and cosmetic industries. |
| Dependencies | Refers to irreplaceable ecosystem services that are critical to enabling, enhancing or influencing successful business performance. |
| Ecosystem | A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. |
| Ecosystem services | The flow of benefits people derive from ecosystems, which includes timber, fibre, crop pollination, water regulation, climate regulation, recreation, and physical health. |
| Impacts | Arise when a company's operations significantly affect ecosystem function quantity or quality. |
| Kinase profiling | Kinase profiling is metabolic profiling which can expedite the drug discovery process. |
| Landscape approach | The landscape approach seeks to unify the complex and widespread environmental, social and political challenges that transcend traditional management boundaries by managing the landscape as a functional unit which can lead to conservation and societal benefits as well as functional efficiencies for business. |
| Material risk | A financial, operational, reputational or regulatory risk deemed to be significant enough to affect decision making. |
| Net gain | Following completion of a project the biodiversity associated with the project is greater than the previous baseline values. |
| Natural Capital | The stock of renewable and non-renewable natural resources on earth (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits or 'services' to people. These flows can be ecosystem services or goods and benefits, which provide value to business and wider society. |
| Ramsar site | A wetland site designated of international importance under the Ramsar Convention, the international Convention on Wetlands. |
| Systemic risk | The risk of collapse of entire financial systems or market, as opposed to risk associated with any individual entity, group or component of a system. Biodiversity loss can become a systemic risk when it has far reaching implications for the continuation or profitability of an entire sector. For example, loss of pollinator insects poses systemic risks to a range of sectors beyond agriculture. |

# Acronyms

| | |
|---|---|
| ACCA | Association of Chartered Certified Accountants |
| BCG | Boston Consulting Group |
| BIG | Biodiversity Interest Group |
| BITC | Business in the Community |
| BSI | British Standards Institution |
| CAFE | Coffee and Farmer Equity Practices |
| CBD | Convention on Biological Diversity |
| CDP | Carbon Disclosure Project (former) |
| CICES | Common International Classification of Ecosystem Services |
| CIEEM | Chartered Institute of Ecology and Environmental Management |
| CIRIA | Construction Industry Research and Information Association |
| CISL | Cambridge Institute for Sustainability Leadership |
| CSR | Corporate Social Responsibility |
| Defra | The Department for Environment, Food and Rural Affairs |
| eKPI | environmental Key Performance Indicators |
| EC | European Commission |
| ES | Ecosystem Services |
| EU | European Union |
| EUBS | EU Biodiversity Strategy |
| FAO | Food and Agriculture Organisation of the United Nations |
| FSC | Forest Stewardship Council |
| FTSE | The Financial Times Stock Exchange |
| GHG | Greenhouse Gas |
| GIS | Geographic Information Systems |
| GRI | The Global Reporting Initiative |
| HCV | High Conservation Value areas |
| HSE | Health, Safety and Environment |
| IEMA | Institute of Environmental Management and Assessment |
| IPENS | Improvement Programme for England's Natura 2000 Sites |
| JNCC | Joint Nature Conservation Committee |
| KPI | Key Performance Indicator |
| LCA | Life Cycle Assessment |
| MDG | Millennium Development Goal |
| MEA | Millennium Ecosystem Assessment |
| MSC | Marine Stewardship Council |
| NIA | Nature Improvement Areas |
| NC | Natural Capital |
| NCC | Natural Capital Coalition |
| NCAI | Natural Capital Asset Index |
| NCI | Natural Capital Initiative |
| NGO | Non-Governmental Organisation |
| ONS | The Office for National Statistics |
| PES | Payment for Ecosystem Services |
| PEFC | Programme for the Endorsement of Forest Certification |
| REDD | Reduced Emissions from Deforestation and Forest Degradation |
| RSPO | Round Table on Sustainable Palm Oil |
| SANG | Suitable Alternative Natural Greenspace |
| SDG | Sustainable Development Goal |
| SPA | Special Protection Area |
| SoNaRR | The State of Natural Resources Report (Wales) |
| SuDS | Sustainable Drainage Solutions |
| TEEB | The Economics of Ecosystems and Biodiversity |
| UNDP | United Nations Development Programme |
| WBCSD | World Business Council for Sustainable Development |
| WEF | World Economic Forum |

| | |
|---|---|
| WRAP | Waste & Resources Action Programme |
| WTO | World Trade Organisation |
| WWF | World Wide Fund for Nature |

# 1 Introduction

## 1.1 Biodiversity and business

Biodiversity underpins the planetary systems we rely upon, supporting natural processes that provide necessities for life, such as food, air, water and protection from extreme climate events. These ecosystem services are defined by the Common International Classification of Ecosystem Services (CICES 2017) as:

- **provisioning services:** food, fresh water, wood, medicinal products, *etc*;
- **regulatory and maintenance services:** purification of air and water, climate regulation, pollination, carbon sequestration, natural pest control *etc*; and
- **social and cultural services:** tourism and recreation, cultural heritage, educational opportunities and a sense of wellbeing.

We are all aware that the world is experiencing unprecedented rates of biodiversity loss. Sixty percent of ecosystem services (which are underpinned by biodiversity) are either degraded or in decline (Millennium Ecosystem Assessment 2005; WWF 2016; Newbold *et al* 2016) due to unsustainable levels of human activities. It is predicted that this trend will continue, giving rise to global economic implications (BITC 2014). Biodiversity directly and indirectly supports multiple global and local industries (see Figure 1). For example:

- 25 - 50% of the $640 billion global pharmaceutical market is derived from genetic material (Tholen *et al* 2011) with $43 billion of that value associated with drugs derived from plant materials (UNDP 2017);
- pollination services in the UK are valued at £430 million and contribute to 8% of the total market value of crop production (Vanbergen *et al* 2014);
- the global timber trade is worth more than $200 billion (Traffic 2017); and
- wildlife tourism contributes £127 million to Scottish economy annually (Bryden *et al* 2010).

Biodiversity loss is significant as it combines economic, social and environmental consequences yet is often overlooked as these consequences can be removed in time. The effects of biodiversity loss are often slow and incremental only becoming tangible once fundamental ecosystem processes have been disrupted.

Biodiversity loss can lead to resource scarcity and/or supply chain disruption, increased operational costs or permanent loss of a resource or service which can put future business operations at risk.

Historically, negative impacts of business operations have been the source of reputational risk, with NGO campaigns frequently targeting those organisations using commodities and raw materials, such as palm oil, fish, soy bean and timber unsustainably (Tholen *et al* 2011). More recently however, attention is focusing on how businesses, biodiversity and ecosystems provide critical benefits that sustain business operations.

The recognition of the importance of biodiversity, ecosystem services and natural capital has increased with the introduction of natural capital accounting and initiatives that attempt to make the benefits of biodiversity more visible. This has also increased the perception and understanding of the range of environmental risks that companies are exposed to, such as adverse impact on corporate brand value, increased operation costs, and increasing exposure to regulatory fines and compensations.

However, although a number of reports and articles stressed the underlying importance of businesses exposed to biodiversity risk (WEF 2010; McKinsey 2010; Harvey 2010; CISL 2016) biodiversity is not yet fully recognised as a material issue for many businesses (Dempsey 2013).

This report aims to highlight the biodiversity associated risks and opportunities faced by tertiary sector business and present evidenced case studies to support and encourage greater integration of biodiversity into business decisions.

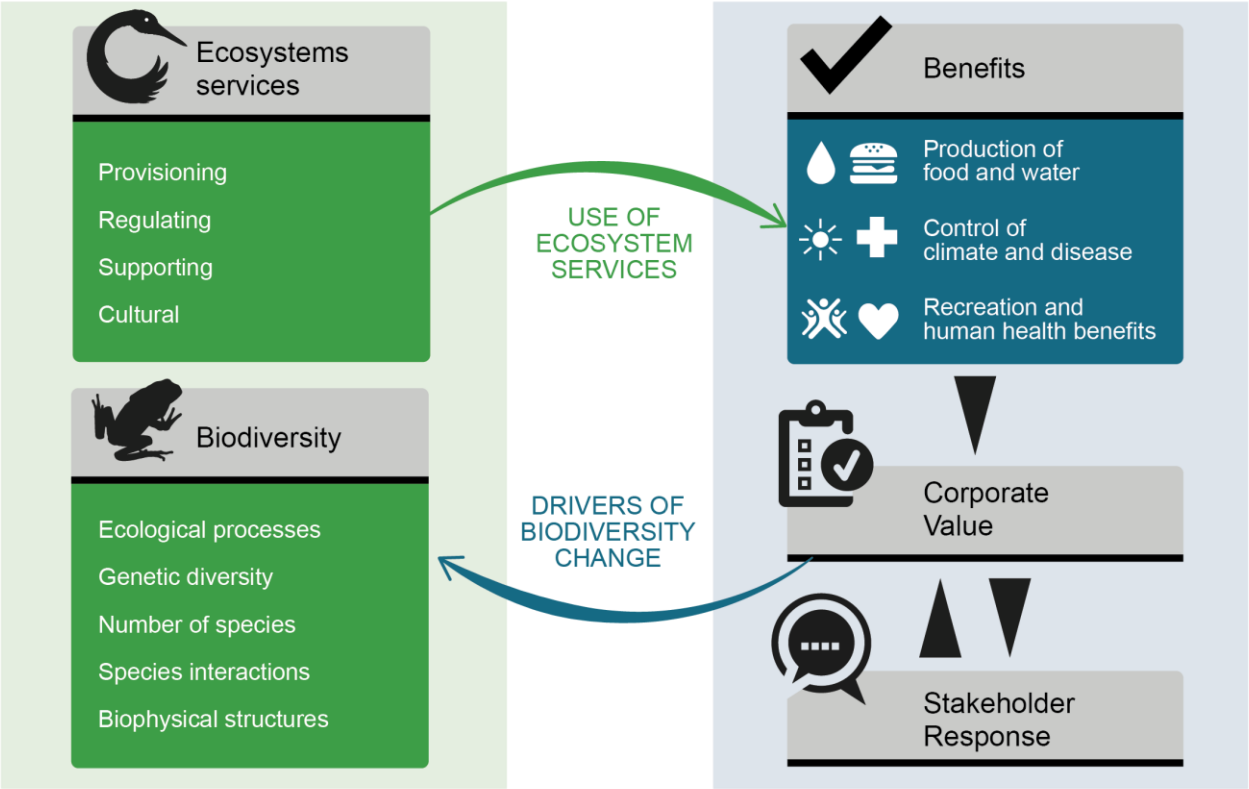


Figure 1: Relationship between biodiversity, its benefits and corporate value.
Source: Adapted from (Maes *et al* 2013).

## 1.2 The significance and importance of biodiversity loss

Despite the contribution biodiversity makes to human society and the economy, humans have significantly altered ecosystems in order to meet their growing demand for food, freshwater, timber, fibre, energy and other materials (Millennium Ecosystem Assessment 2005). In many cases the unintended consequence of these activities has been the degradation of ecosystems, resulting in the loss of biodiversity and reduction in the quality and quantity of ecosystem services (TEEB 2012; WWF 2016).

Biodiversity loss rarely manifests itself as a risk in the short term as there is often a lag period between biodiversity damage and tangible results of biodiversity decline and loss. In many cases the loss of biodiversity is deemed beyond a 'safe limit', after which an ecosystems ability to deliver key services is permanently reduced. As it is not easy to take rapid action to mitigate against biodiversity loss once it's been identified, biodiversity risks should be addressed as early as possible in order to influence long-term outcomes. Often cited examples of the significance of biodiversity loss include:

- 71 out of the 100 crops that account for 90% of the worldwide food consumed, rely on bee pollination (Strom 2017). In California, disruption of the honey bee supply raised prices for domestically grown nuts, fruits and vegetables. In 2003 beekeepers charged almond growers $51.99 per hive, which increased to $180-$200 a hive by 2016. Since 2011 the bee industry replaced 10 million hives at a cost of $2 billion, annual revenues stand at $500 million (Strom 2017);
- almost 60% of the world's megafauna species are threatened with extinction (Lindsey *et al* 2017). These species hold significant cultural and societal values, in terms of engendering interest and willingness to pay for conservation among the general public. These species also provide particularly important ecological roles (e.g. seed dispersal, pest control, nutrient cycling) and offer significant economic value if their use and conservation are managed appropriately and sustainably; and
- global demand for fish is leading to intensification of aquaculture and overfishing, it is estimated that 31% of global fish stocks are overfished (FAO 2016; WWF 2016). As a result of biodiversity loss, the fishing industry is resorting to harvesting species that were previously bycatch and intensifying fish farming, resulting in adverse environmental effects. BCG analysts predict that "to enable long-term sustainability, companies must also address mounting consumer concerns over the environmental impact of fish farming" (Terazono 2017).

Whist there are good estimates of society's willingness to pay for a number of non-marketed ecosystem services, we still know little about the marginal value of biodiversity in the production of those services (Cardinale *et al* 2012). A few studies attempted to estimate the total annual economic cost of biodiversity loss and ecosystem degradation. A landmark study estimated the value of nature to be equal to the global economy itself (Costanza *et al* 1997). RSPB (2002) estimated that more than $20 trillion a year is lost when nature is converted for unsustainable human use. A study by The Economics of Ecosystem Biology (TEEB) (2012) put the value of the total annual economic cost of biodiversity loss and ecosystem degradation at between US$2 and US$4.5 trillion (3.3 – 7.5% of global GDP), this includes losses attributed to several other risks (e.g. inland flooding and infectious diseases) to which biodiversity is connected.

The Office of National Statistics (ONS) and the Department of Agriculture, Environment and Rural Affairs (Defra) have estimated the value of the UK's natural capital (in 2014) to be £497 billion and ecosystem services supporting revenue in a number of sectors (e.g. 16% of profits from agricultural production; 37% for public water supply; and 87% for fish production) (ONS 2016). The UK's natural capital value has declined since 2007, where it was estimated to be £664.48 billion. The asset value in recreational services and oil and gas has decreased, whereas wind energy and carbon sequestration assets have increased.

Scotland's Natural Capital Asset Index (NCAI) (Scottish Government 2018; Albon *et al* 2014) monitors the quality and quantity of terrestrial habitats in Scotland, according to their potential to deliver ecosystem services now and into the future. According to the NCAI, Scotland's stock of natural capital has stabilised overall, with some habitats (e.g. uplands) continuing to deteriorate, whilst others (e.g. lochs and rivers) are showing improvement (Scottish Natural Hertiage 2017). The overall NCAI is coupled most closely with trends in regulation and maintenance services. Evidence and expert judgement suggest that this type of ecosystem service is of most importance to Scotland as it makes the greatest contribution to human wellbeing.

The State of Natural Resources Report (SoNaRR) (Natural Resources Wales 2016) provides information about the state of natural resources in Wales. It estimated, for example, that £385 million was contributed from agriculture, whilst £499.3 million was gained from the provisioning

services from the forestry sector and £18.2 million in health benefits to people from walking the Wales Coast Path.

Despite these compelling figures, loss of biodiversity is expected to continue at an increasing pace in the coming decades if the underlying drivers of environmental change are not addressed (Slingenberg *et al* 2009; UK Parliament 2011) Biodiversity loss is also not a single and independent issue. It is interconnected with other global issues, such as climate change (WEF 2017) which are further exacerbated by and contribute to biodiversity loss.

## 1.3 Project objectives

Many businesses rely upon the services that ecosystems provide and biodiversity loss can compromise the ability of nature to provide them (Newbold *et al* 2016). This can lead to declines in both societal well-being and economic stability. It is therefore imperative that biodiversity loss should be considered as an issue of vital importance for businesses.

This report aims to make the impacts from biodiversity loss to business productivity more visible and tangible for business managers by:

- identifying the risks and costs to business associated with impacts from biodiversity loss;
- highlighting the opportunities for integrating biodiversity into business decision making and outlining how business managers can identify and account for risks and dependencies on biodiversity;
- demonstrating how adopting a more interdisciplinary approach to identifying and accounting for biodiversity associated risks and dependencies can deliver a range of benefits to businesses and wider society; and
- communicating the *'value of considering biodiversity'* in business operations across a range of sectors.

The report hopes to contribute towards the transformation of organisational commitments by providing reasons to take meaningful action to halt biodiversity loss.

## 1.4 Research process

This report was prepared using different data sources and approaches. A number of reports and studies were reviewed using the "quick scoping review" method (Civil Service 2014).

Based on a literature review, the study assessed the types of risks stemming from the interaction between business activity and biodiversity, distinguishing between business dependency and impact on biodiversity. During the process, relevant case studies were identified to highlight the impact of biodiversity loss on business, how biodiversity is integrated into corporate decision making, how businesses collaborate with biodiversity experts, and the type of tools used to mainstream biodiversity considerations in business processes. As part of the review process, over 80 different tools, methods, frameworks and initiatives relevant to ecosystems and biodiversity were reviewed.

In order to provide a detailed understanding of what motivates businesses to take actions against current and potential biodiversity risks, and understand any barriers that prevent actions, the research was supplemented with a short non-randomised online survey. Results provided first-hand insights from industry representatives into current tertiary sector understanding of impacts and dependencies on biodiversity, including the perception of corporate risk stemming from biodiversity loss.

The survey was distributed to a list of Arcadis' contacts and clients who work across a range of industries and hold various corporate social responsibility (CSR) and health and safety (HSE) roles. These individuals were judged most likely to be familiar with the topic and most likely able to provide answers to questions posed. A survey of this nature and size does not provide statistically robust results but insight can be gained from the 52 responses obtained.

**Box S1:** Survey respondents' scope.

| |
|---|
| The biodiversity risk survey undertaken for this report highlighted the different levels of sector engagement. The survey comprised of 42 sector respondents and 10 environmental consulting professionals. From the 42 sector respondents, almost half were from the construction and transport infrastructure sector with few from the communications, business services, finance, retail and education sectors. Results should be treated as indicative, and not representative, of any sector or business community. |

## 1.5 Definitions and scope

The research focuses on the tertiary sector industries, particularly businesses operating in the UK and UK Overseas Territories, but are applicable to a range of businesses internationally. The core tertiary sectors covered in the report are described in Table 1. These sectors were based on the World Trade Organisation (WTO) definitions of the service sector (WTO 2017) and further refined by combining sector activities with similar characteristics.

The report is structured as follows:

- Chapter 1 introduces the key concepts around biodiversity loss and research methods used
- Chapter 2 covers interaction of the tertiary sector with biodiversity
- Chapter 3 introduces the concept of biodiversity risk and how tertiary sector companies are exposed to it, based on their impacts and dependencies
- Chapter 4 focuses on communication of risks due to biodiversity loss
- Chapter 5 outlines approaches to the quantification of biodiversity loss
- Chapter 6 discusses the benefits of and barriers to collaboration
- Chapter 7 discusses collaboration between sectors
- Chapter 8 presents examples of successful biodiversity integration
- Chapter 9 gives key thoughts and recommendations
- Chapter 10 provides concluding remarks

**Table 1:** Definitions of tertiary sectors covered in the study.

| Sector name | Sector description |
|---|---|
| Business services | Includes businesses that support other businesses but do not produce a tangible commodity. It includes services, such as professional services (accounting, consulting, *etc*), IT computer services, research and development, rental/leasing services that support other sectors. |
| Communication services | Includes telecommunications and audio-visual services that enable communication between different companies. |
| Educational services | Includes organisations responsible for delivery of educational services, such as primary, secondary, higher education and adult education. |
| Construction, engineering services | Includes sectors responsible for general residential construction, civil engineering, installations, building completion and finishing work. It also includes transport and energy infrastructure. |
| Retail services | Includes organizational involved in the process of selling consumer goods or services to customers through multiple channels of distribution. Includes businesses that such as retail outlets and wholesale. |
| Environmental waste management services | Includes services related to waste disposal including sewage services, refuse disposal and sanitation. |
| Financial services | The financial sector consists of commercial and investment banks, insurance, pension funds, mutual funds, and private equity. |
| Health related and social services | The sector provides goods and services to treat patients with curative, preventive, rehabilitative, and palliative care. It includes the generation and commercialization of goods and services to maintain and re-establish health. It includes hospitals, social services and other health services. |
| Tourism, travel, recreational, cultural and sporting services | Includes services related to attracting, accommodating, and entertaining tourists. It includes hotels and restaurants, travel agencies, tourist guide services, entertainment services, sport and recreation. |
| Transport and distribution services | Includes services that enable transportation of people or products and covers maritime transport, air transport, rail transport and road transport services. |

# 2 Tertiary sector interaction with biodiversity

Many businesses interact with biodiversity and for this reason it is crucial to understand how they are exposed to biodiversity and hence to risks that arise from biodiversity loss.

Businesses impact upon biodiversity with their operations, with primary sectors, such as mining, and agriculture having a high direct impact on biodiversity, while tertiary sectors (e.g. business services, education, tourism, *etc*) often have smaller direct impacts but larger indirect impacts. Direct impacts include the use and conversion of land and materials whilst indirect impacts arise through diffuse supply chains.

Companies also depend on biodiversity, the higher the dependency of the sector on biodiversity, the greater its exposure to risks linked to biodiversity loss. The primary sector depends on services such as pollination, organic and inorganic materials, water purification, protection from pests directly, while tertiary sectors depend on these services indirectly through their suppliers. Example of sector dependencies include:

- Tourism and biodiversity are closely linked as many types of tourism depend directly on biodiversity, which is frequently the main attraction. For example, dolphin watching on Scotland's east coast contributes £4 million annually to the local economy (Bryden *et al* 2010).
- The health sector depends upon products supplied by pharmacological companies who rely on biodiversity resources to develop new products. The global market for botanical and plant-derived medicines is valued at $32.9 billion with average annual growth rates of 11% (Villa Romero 2013). Kew's annual State of the World's Plants report records 28,187 species with a medicinal use (Willis 2017).
- The protection offered by ecosystem services, such as those delivered by wetlands, can reduce damages from storms and flooding and is monitored by insurance and reinsurance companies (Baumgärtner 2014). Swiss Re is also preparing an insurance policy for a stretch of reef providing policyholders (i.e. hotels) with a pay-out after a storm reducing the burden of repairs for the Mexican government (Flavelle 2017).
- The retail sector depends on the food products it sells. Food crop production is dependent on insect pollination and soil microbes. The potential loss of these elements of biodiversity would have profound impacts on supply chains. It is estimated that insect pollination contributes £430 million to the UK economy (Vanbergen *et al* 2014).
- There are also UK businesses that depend upon native plants and animals, for example UKs plant nurseries both depend on native stock and impact UK biodiversity by the introduction of (particularly), non-native aquatics (Dunnett *et al* 2007).

Companies from a range of primary sectors are voluntarily integrating biodiversity in their operations and channelling funds into environmental protection and biodiversity conservation. Conversely, many tertiary sector companies are doing this only via regulatory compliance and remain unaware of the role biodiversity plays in maintaining their corporate operations. This was touched upon by JNCC (McNab *et al* 2015), noting that businesses which directly impact and depend upon biodiversity (i.e. primary sectors) are starting to realise the implications of biodiversity loss and the risk this poses to their operations, while businesses with indirect impacts and dependencies are slower to respond.

The interrelationship between impacts and dependencies are presented in Figure 2 and vary among tertiary sector companies. These relationships have been identified through literature and case study review and are presented in Table 2 for individual tertiary sectors. All sectors depend on biodiversity to some extent either directly or indirectly, but construction, retail, finance, health

and tourism have the most significant dependencies on biodiversity, with education and waste services also benefiting directly. Of these, construction, retail, transport distribution and financial services are the more significantly impactful businesses in relation to biodiversity.

Table A1 in Appendix A provides cases study examples of tertiary sector dependencies.

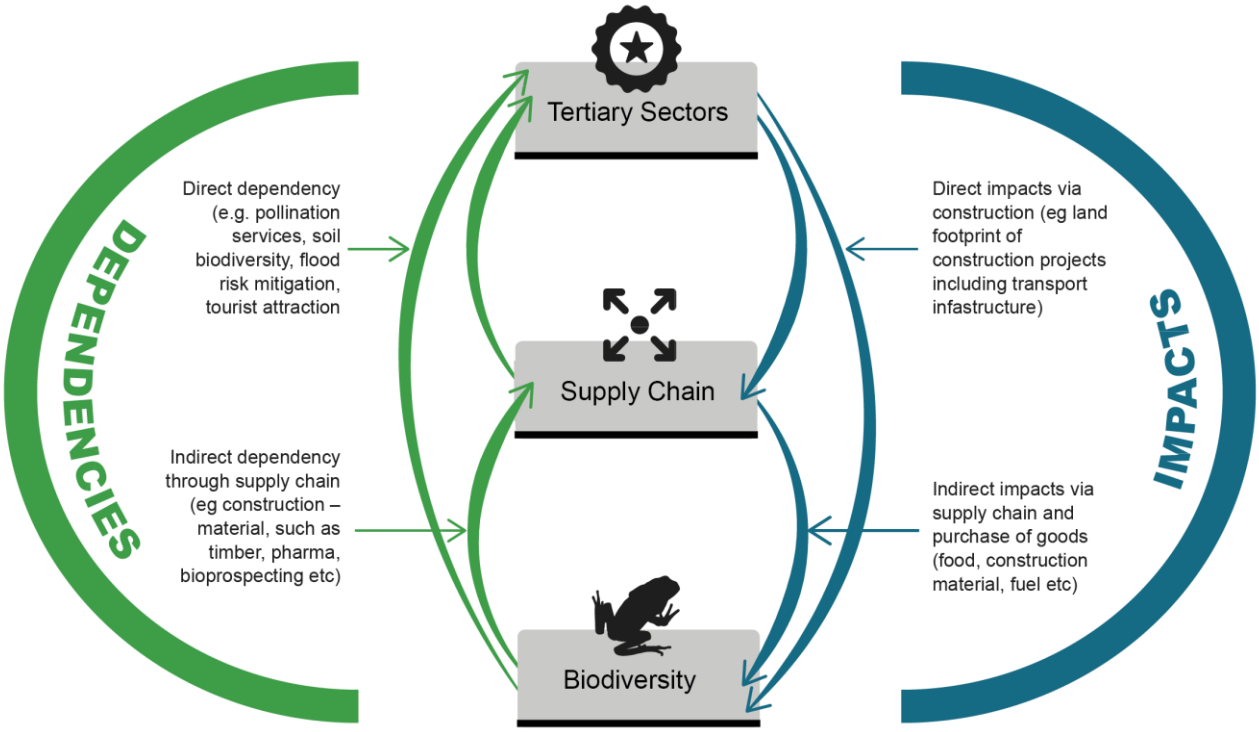


**Figure 2:** Biodiversity and the interplay between the tertiary sector and its supply chain.

**Table 2:** Summary of biodiversity related dependencies and impacts.

| Dependencies | | Sector | Impacts | |
|---|---|---|---|---|
| Direct | Indirect | | Direct | Indirect |
| Not significant | Supply chain (e.g. paper, food and other consumables) | Business services | Pollution and climate change from on-site operations (e.g. energy, water, waste *etc*) | Pollution and climate change through supply chain (energy, water, waste, and other procured services) |
| Not significant | Supply chain (e.g. paper, food and other consumables) | Communication services | Habitat loss and fragmentation required to build telecommunication infrastructure (base stations, telecom lines) | Overexploitation of resources (rare minerals and metals *etc*), pollution and climate change (energy, water, waste, and other procured services) |
| Biodiversity can add value to residential and large commercial complexes by providing amenity benefits | Supply chain (raw materials, timber, stone, water, *etc*.) | Construction and related engineering services | Habitat loss and degradation, fragmentation and pollution | Overexploitation of resources (minerals, wood, clay and metals), pollution and climate change (energy, water, waste, and other procured services) |
| Not significant | Supply chain (raw materials used in products) | Retail | Habitat loss from new site facility development, pollution & climate change from on-site operations (e.g. energy, water, waste) | Overexploitation of resources (biotic resources), pollution and climate change (energy, water, waste, and other procured services) |
| Biodiversity can enrich educational activities and prove beneficial to social development | Supply chain (e.g. paper, food and other consumables) | Educational services | Pollution and climate change from on-site operations (e.g. energy, water, waste) | Pollution and climate change through supply chain (energy, water, waste, and other procured services). |
| Biodiversity can provide cost-effective bio-remediation treatment (sewage, sludge) | Supply chain (e.g. paper, food and other consumables) | Waste services | Change of land use from new site facility, pollution and climate change during operational activities | Pollution and climate change through supply chain (energy, water, waste, and other procured services). |
| Not significant | Invest in products which rely on biodiversity for provision. System resilience and can reduce the impacts of climatic and other natural disasters, thus reducing the cost of compensation claims, investments that rely on biodiversity and lesser dependencies through supply chain | Financial services | Pollution and climate change from on-site operations (e.g. energy, water, waste) | Pollution, over-exploitation, habitat loss and degradation and climate change arising through provision of finance to unsustainable business activities |
| Access to nature is important for human physical and mental well-being. Biodiverse systems reduce the risk of pest and disease outbreaks | Reliance on biological components of drugs through the use of pharmaceutical products and through supply chain and procurement of goods and services | Health related and social services | Pollution and climate change from on-site operations (e.g. energy, water, waste) | Overexploitation of resources (biotic pharmaceutical resources), pollution and climate change (energy, water, waste, and other procured services) |
| Biodiversity as a natural asset | Through supply chain and procurement of goods and services (e.g. paper, food (e.g. coffee) and other consumables) | Tourism and recreation | Habitat loss and degradation, fragmentation and pollution | Pollution and climate change through supply chain (energy, water, waste, and other procured services). |
| Not significant | Through supply chain and procurement of goods and services (e.g. fossil fuels, biofuels *etc*) | Transport and distribution services | Pollution and climate change from operations (e.g. energy, water, waste *etc*) | Pollution and climate change through supply chain (energy, water, waste, and other procured services). |

Table 2 Key

| | | | |
|---|---|---|---|
| Does not depend or impact significantly on biodiversity directly | Low dependency or impact on biodiversity | Medium dependency or impact on biodiversity | High dependency or impact on biodiversity |

# 3 Business exposure to biodiversity risk

## 3.1 What is biodiversity risk?

The World Economic Forum (WEF) defines 'biodiversity risk' as business risks related to biodiversity in the broadest sense. Risks arise as a result of direct dependencies or impacts on biodiversity and ecosystem services, as well as regulatory, financing, reputational and supply chain risks that arise due to a business's relationships with biodiversity and ecosystems (WEF 2010).

Many international forums and organisations (TEEB 2012; WEF 2010; ACCA 2012) are trying to present biodiversity loss as a material risk to companies and they also expect biodiversity risk to grow in the future due to:

- Increased loss of global biodiversity further increasing pressure on companies that depend on it.
- Stricter legislation, such as wider definition of biodiversity under the EU liabilities regime and/or biodiversity 'levies', which may be introduced in order make companies pay for biodiversity impacts. Similar measures have been introduced in other fields, e.g. waste management and energy use (F&C Management 2004).
- Financial institutions potentially applying biodiversity criteria more rigorously within credit risk assessments or project finance. For example, the Equator Principles and Performance Standard 6 on biodiversity and sustainable management (IFC 2012) which sets a precedent for the consideration of environmental risks in project finance.
- Sourcing of commodities, such as soy, palm oil, and sugarcane, under increasing scrutiny of supply chain practices and impacts by governments, commercial customers, and pressure groups (Kissinger *et al* 2013).
- Growing pressure for companies to act in a more socially and environmentally responsible manner.

Despite this awareness around the importance of biodiversity risk, there is relatively low concern within the financial and corporate community about the risk biodiversity poses. For many it is not yet recognised as a material issue (Dempsey 2013). The perception of biodiversity risk has only slightly improved over the years. For example, in 2004 companies were not taking substantive action to manage their biodiversity risks effectively (F&C Management 2004). Similar conclusions were reached by Vigeo Eiris, an ethical investment research company (EIRIS 2010) which found that few FTSE companies have adopted policies on biodiversity, and that sectors with high biodiversity impacts in their supply-chain, have biodiversity policies yet their implementation was not comprehensive. Furthermore, they found 47% of companies that have a medium to high impact on biodiversity did not have any policies at all, with only 6% having what they considered 'good policies' (i.e. evidence of a biodiversity action plan at site levels or certified systems linked to certified sourcing).

In contrast McKinsey (2010) conducted a survey among 1500 managers and executives which revealed that 37% considered biodiversity 'somewhat important' and 27% 'very or extremely important' (UNEP 2014). Similarly, a WEF (2010) survey found that many CEOs surveyed were 'extremely' or 'somewhat' concerned about biodiversity loss being a threat to business growth prospects. This was reflected in an increased perception of biodiversity loss, indicated as an increase in both 'the severity of economic loss' and 'the likelihood that biodiversity has a business impact'. However, the issue was still perceived to be of lower material importance than many other environmental and non-environmental issues. In fact, a number of issues which are fundamentally affected by degradation of biodiversity and ecosystem services, such as coastal flooding or water

scarcity, were ranked higher. This indicates a lack of business perception as to how key issues interact with biodiversity loss.

One of the professional bodies for accountants, the Association of Chartered Certified Accountants (ACCAs) has stated that biodiversity is an important financial reporting consideration, yet their interest has not yet filtered down to a company level. Three of the eight CFOs interviewed stated that investors had shown no interest in biodiversity and ecosystem services issues to date (ACCA 2012).

In contrast to other issues, such as climate change, there is little up-to-date publicly available quantitative material around corporate risk and biodiversity. There are a number of reasons why biodiversity risk does not feature more prominently in tertiary sectors, these are explored further in the section highlighting barriers to biodiversity integration.

## 3.2 Types of biodiversity risk

The biodiversity risks presented in this report are summarised in Table 3 and follow established categorisation (ACCA 2012; TEEB 2012).

**Table 3:** Biodiversity related risk categories.

| Risk category | Type of risk |
|---|---|
| Operational | • Scarcity, or quality of raw materials (e.g. limited natural resources, such as timber, fish stocks, fresh water)<br>• Disruptions to business operations (e.g. heightened natural hazard frequency due to degraded ecosystems, such as flooding)<br>• Supply chain risks (e.g. disruption to supply or increased cost of essential materials procured from biodiversity sensitive areas) |
| Regulatory and legal | • Restrictions on access to land and resources (e.g. restricted operations in ecologically sensitive areas and restrictions on threatened biodiversity resources)<br>• Litigation (e.g. for environmental damage)<br>• Compensation i.e. where mitigation isn't possible, also termed offsetting (e.g. Section 106 compensation mechanisms under planning regulations)<br>• Procurement standards (e.g. restrictions on businesses not complying)<br>• Delay in obtaining permits (e.g. for construction projects) |
| Reputational | • Damage to brand or licence to operate (e.g. if products or operations negatively impact biodiversity) |
| Market and product | • Consumer preferences (e.g. trends and preferences for products with reduced biodiversity impacts)<br>• Purchaser requirements (e.g. supply chain requirements that include biodiversity safeguards) |
| Financial | • Cost of capital or lending requirements (e.g. financial blocks to companies negatively affecting biodiversity)<br>• Insurance risks (e.g. insurance premiums affected by how companies manage biodiversity issues) |

Source: Adapted from ACCA (2012), TEEB (2012).

Many individual risk categories overlap, addressing one may simultaneously reduce others. To reduce reputational risk, many companies may decide to change suppliers; as Tesco did with its beef supplier when it was exposed that sourcing was causing deforestation in Brazil (see the Tesco case study in Appendix A, Table A2). This approach may also be suitable when companies are faced with operational risk (i.e. loss of supply due to environmental factors) or because consumer preferences changed.

Biodiversity risk exposure is constantly evolving. New public policies and regulations are being developed in response to biodiversity loss and ecosystem degradation. This puts pressure on business managers to improve their understanding and manage their biodiversity and ecosystem impacts and dependence, while also developing new business solutions to meet these challenges (Tholen *et al* 2011) (see the Travis Perkins and Carillion case studies; Table A3). Sourcing raw materials that comply with certification schemes, such as the Programme for the Endorsement of Forest Certification (PEFC) and the Forest Stewardship Council (FSC) schemes for timber, are becoming increasingly important for end users (UK GBC 2017). For example, government suppliers have to comply with the Timber Procurement Policy to show that timber is legal and sustainable (GOV.UK 2013).

Some risks, such as financial and operational risk, may unfold over a longer time horizon when biodiversity loss becomes more visible and starts affecting corporate operations (Strom 2017). In contrast, reputational risk is more short-term in nature.

Biodiversity risk underpins and binds many business risks (see Table 3) together through a geographical lens. Many companies have supply chains or operations in developing countries and in areas with a high biodiversity value, where governments favour development activities and where regulation is often not effective or not enforced (Smith 2013). Furthermore, complex and opaque supply chains, with numerous intermediaries, spanning across geographies, make it difficult for companies to understand where their inputs are coming from. It is estimated that 30% of seafood across the world is mislabelled, which can deprive fishermen of livelihoods and threaten sustainable resourcing practices (Pardo *et al* 2016). Companies like Whitbread are working with NGOs and have developed a system to assess suppliers (Parker 2015) and ensure ten high risk commodities, such as meat, fish, soy, sugar, cocoa, tea, coffee, palm oil, timber and cotton, are sustainably sourced.

**Box S2:** Survey respondent's perception of risk.

From the biodiversity risk survey respondents are concerned about the impacts of their operations on biodiversity and how this can be translated into business risk.

Biodiversity represented an important issue for survey respondents, but only 10% of respondents indicated that their business had been affected by biodiversity loss. The respondents stated that the main sources of risk are: reputation, relations with regulators and potential liabilities due to activities that adversely affect biodiversity. Generally, for some questions, response rates were very low. This could indicate respondents had issues responding to the question. See Figure 3 below for detailed breakdown of survey responses.

More specifically, many companies (e.g. construction and transport infrastructure, communications, finance) expressed that access to land is a source of risk. For example, a representative from the finance community stated that 'the risk of investing in infrastructure which adversely impacts biodiversity, can impact the primary principles of their investment approach'. Respondents also mentioned that a lack of early consideration of biodiversity risks often leads to delays in planning and project delivery with consequential costs and reputational risk. Respondents also indicated that the scarcity of resources can affect the availability of raw materials with a corresponding rise in costs. Another respondent pointed out that the loss of soil biodiversity can adversely affect retail grocery supplies.

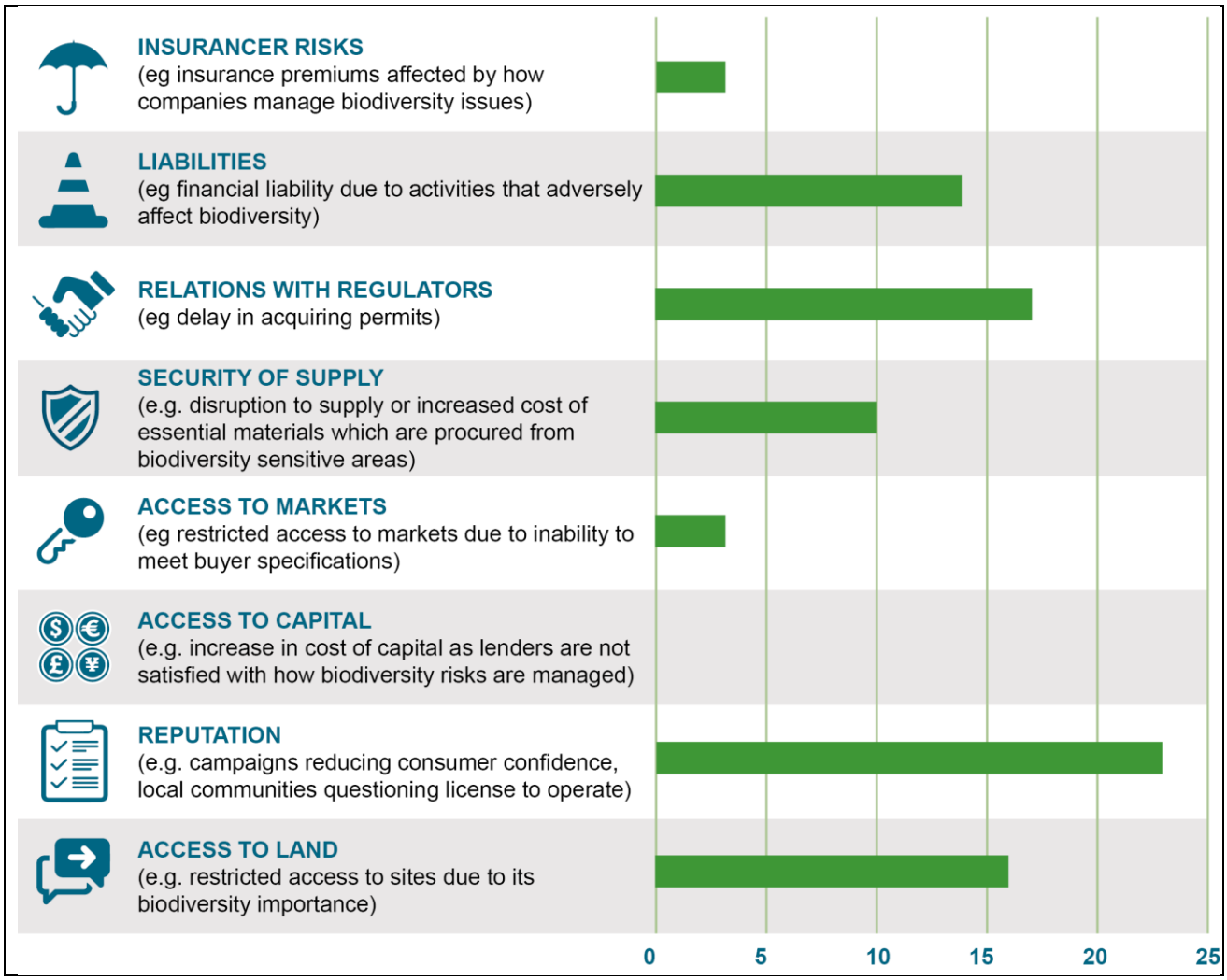


**Figure 3:** Survey responses to biodiversity risk.
N.B. *respondents were allowed to select more than one answer.*

## 3.3 Exposure of the tertiary sector to biodiversity risk

The tertiary sector is varied, with companies exposed to different types of biodiversity risks. Generally, tertiary sector companies depend on biodiversity more indirectly and their proximity to the end consumer makes them more exposed to reputational risk (Breeze *et al* 2011). Table 4 provides an indicative summary map of how different biodiversity risks are relevant to individual sector. Case studies are discussed in section 3.4 and further examples are presented in Table A3. In terms of risk, finance, construction, tourism and retail are showing the greatest commercial risk exposure.

**Table 4:** Summaries of tertiary sector risk exposure.

| Risk Description | Financial Institutions | Construction and Transport Infrastructure | Retail | Tourism & Travel | Business, Education & Communication | Health | Waste | Transport Operators |
|---|---|---|---|---|---|---|---|---|
| **Reputational** | | | | | | | | |
| Damage to brand or social licence to operate | Providing financial services to companies that adversely impact biodiversity (e.g. destruction of pristine habitats, such as rainforests) gives rise to stakeholder pressures. | Stakeholder and consumer pressures arising because of unsustainable sourcing of construction material, highly visible impacts of construction projects on landscape and the fact that contractors are highly visible to the public when operating. | High exposure to stakeholder and consumer pressures for the use of unsustainably sourced products. | Tourism operators have operational impact on biodiversity and can affect biodiversity also through new infrastructure requirements. | Potential reputational risk arising from the construction activities and sourcing of raw materials. | Small areas required for new facilities and reputational damage from the supply chain would fall to the supplier not the healthcare operator. | The disposal of waste is a significant environmental issue, but tends to focus on the waste item rather than the waste operator. Poorly managed sites can have adverse impact on the reputation of operators. | The use of biofuel is still relatively low compared to fossil fuels, and pollution of operators is more of a concern for public health than biodiversity loss. |
| **Operational** | | | | | | | | |
| Scarcity or quality of raw materials | Mainly through the supply chain (e.g. procurement of goods). | Reduced availability of raw materials that are the necessary production inputs (e.g. timber, sand *etc*) due to restrictions on resource extraction practices. | Reduced availability of vital inputs/finished products can lead to price volatility and increased prices of final products. | Mainly through the supply chain (e.g. procurement of goods, particularly food) | Mainly through the supply chain (e.g. procurement of goods). | Dependency on inputs (e.g. raw materials for pharma supply chain) due to increasing reliance on chemical synthesis rather than biotechnology. | Mainly through the supply chain (e.g. procurement of goods). | Mainly through the supply of biofuels which represent relatively small quantity of overall full consumption. |
| Disruption to business operations | Under estimation of risk and lack of understanding of the biodiversity interactions with natural hazards resulting in potential compensatory payments. | Impact through the supply chain (e.g. procurement of goods)., direct exposure is limited. | Affected security of supply can lead to price fluctuations, substitution of suppliers, absorption of the short-term costs or can lead to unavailability of products. | Damage to natural environment can affect the financial viability of business operations. | Impact through the supply chain (e.g. procurement of goods), direct exposure is limited. | Direct exposure is limited as is the impact through the supply chain (e.g. procurement of goods). | Pollution can have dramatic impact on the viability of waste operations. | Disruption associated with the damages to the transport infrastructure caused to an extent by biodiversity loss. |
| Supply chain risk | Mainly through the supply chain (e.g. procurement of goods). | Reduced availability of raw material forcing companies to find alternative suppliers with sustainable credentials. | Reduced availability of raw material forcing companies to find alternative suppliers or bear increased costs. | Reduced availability or higher cost of procured goods, particularly food. | Reduced availability or higher cost of procured goods. | Healthcare providers rely on the pharma industry for supplies of medicinal products. | Reduced availability or higher cost of procured goods | Low quantities of biofuel consumed; fossil fuels come from existing sites and pose low risk. |
| **Regulatory and legal** | | | | | | | | |
| Restriction on land access | Exposure arising through project finance due to project being postponed, delayed or cancelled. | Exposure due to project being postponed, delayed or cancelled. | Operations in urban areas have limited impact on habitats and the impact of new retail facilities is limited. | The sector depends on healthy and attractive environments. Introduction of fees or restriction of access to certain areas can affect their operations. | Operations in urban areas have limited impact on habitats. | New site developments have limited impact on habitats, while reduced access to new medicinal resources with potential medicinal properties can limit the development of new medicinal product. | Sector depends on land away from urban centres and demand for it will increase due to increasing quantities of waste arisings. | Low quantities of biofuel consumed; fossil fuels sourced from existing sites and pose low risk. |
| Litigation | Exposure to potential litigations as lenders can be held responsible for damages to habitats. | Exposure to litigation resulting from stricter regulation (e.g. EU Environmental Liability Directive). | Risk is born by suppliers. | Exploitation and destruction of pristine areas can trigger legal action. | All risks are born by suppliers. | Through activities of pharma companies not complying with regulatory frameworks for accessing biological resources. | Exposure through the adverse impacts on the environment (e.g. accidents and pollution offences). | Risks are often borne by suppliers. |
| Pricing and compen-sation | Mainly through supply chain (e.g. procurement of goods). | Fees and fines to compensate for the habitat loss but often enforcement and fine amounts are low when compared to the value of the project. | Mainly through supply chain (e.g. procurement of goods). | Exposure due to fees and fines to compensate for the damages. | Mainly through supply chain (e.g. procurement of goods). | Exposure through activities of pharma companies. | Mainly through supply chain (e.g. procurement of goods). | Mainly through supply chain (e.g. procurement of goods). |
| **Market and product** | | | | | | | | |
| Consumer preference | Exposure arising from investors seeking more sustainable investments and from pressures to divest from companies that are damaging the environment. | Consumers do not use biodiversity as a differentiating feature when it comes to purchasing real estate. | Consumers are willing to switch to a more sustainable products or preferring new products that do not have adverse impact on biodiversity or do not have sustainability accreditations. | Loss of revenues as a result of tourists switching to more sustainable tourism operators. | The sector has minimal impact and consumers do not use biodiversity as a differentiating feature. | Consumers of healthcare consumers do not use biodiversity as a differentiating feature. | While waste items generate high consumer interest at the point of sale, consumers do not have a choice regarding their waste provider (sector can be described natural monopoly where competition is economically impractical). | Currently climate change is a much more pressing issue than biodiversity. |
| **Financial** | | | | | | | | |
| Cost of capital or lending require-ments | Not reflected in the market, but unscrupulous lending practices can drive cost of borrowing from other FIs. | Not mitigating solutions in the design stage can lead to higher cost of borrowing as the businesses may be considered riskier. | Small impact of the sector as biodiversity does not significantly feature in credit rating assessments. | High insurance premiums can affect travel operators who are not mitigating for their adverse impacts on nature. | Small impact of the sector. | Small impact of the sector. | Small impact of the sector. | Small impact of the sector. |
| Insurance risk | Potentially high exposure if they miscalculate the exposure of their clients' operations to biodiversity risks. | Potentially high due to natural disaster that can arise. | Premiums for insuring supply can increase due to disruptions and higher cost of managing supply chains. | Potentially high due to natural disaster or loss of a key resource that attracts visitors. | Small impact of the sector. | Small impact of the sector. | Biodiversity is not dominant issue (fire is the top risk). | Small impact of the sector. |

Table 2 Key

| Low risk | Medium risk | High risk |
|---|---|---|

## 3.4 Biodiversity risks impacting on business success – case studies

Many tertiary sector companies struggle to understand the financial implications of biodiversity loss, due to reasons mentioned in the preceding sections. While sections 3.2 and 3.3 identified biodiversity risks faced by companies, this section presents a few examples that demonstrate the adverse effects of biodiversity loss and the responses to that risk.

Biodiversity loss may have as quantitatively significant an impact on ecosystem functions as other global change stressors (e.g. climate change) (Cardinale *et al* 2012) but the issue still needs to be more tangible to individual companies to facilitate action.

Most tertiary sector companies operate upstream and may not be directly exposed to the loss of biodiversity. However, any loss of biodiversity that affects the primary sector is likely to have implications for tertiary sector companies, through their supply chain but more often they have opportunities to readily mitigate against their risk without addressing the core issue (e.g. changing suppliers, adopting resource or product substitution, changing investment or loan portfolio). However, this is a short-term approach to risk management which is unlikely to address the material issue.

For example, the existing and potential value of bioprospecting to the pharmaceutical industry is undervalued and at risk with revenues falling. Currently collaboration with science for chemical solutions has been the industry response but there is yet more value to be gained through sustainable use of biodiversity (see Box CS1).

**Box CS1:** The existing and potential value and risks of bioprospecting for the pharmaceutical industry.

Biodiversity is the fundamental resource for bioprospecting that results in the production of numerous biochemical and biotechnical products. For example, the pharmacological sector is highly reliant on biological components. In 2002, 42% of sales of the world's 25 top-selling drugs were either biologicals, natural products, or entities derived from natural products (Newman & Cragg 2012). Although this figure is considerably less today, due to artificial synthesis, natural products still play a significant role in medicine. Examples include aspirin from willow bark (painkiller) and taxols and paclitaxel from yew trees (cancer treatment).

Although the market value of drugs derived from plants, often originally used by indigenous peoples, is estimated at US$43 billion, the lack of legislative provisions (and enforcement powers) for their exploitation have impeded the collection and distribution of royalties from this market. In recent years, only a low volume of bioprospecting transactions has been recorded. The values of bioprospecting contracts are estimated to be below US$100 million a year, while bioprospecting research contracts rarely surpass US$1 million.

The decline in bioprospecting revenues is a result of patent expiration, scarcity of new biodiverse material due to habitat degradation, and lack of a social license to operate (Aldridge 2006). The issues around social license to operate are due to difficulties regarding the process of exchange of genetic materials, which has become highly regulated, and the complex protocols of benefit sharing Covington (2016). The failure or reluctance in sharing the benefits of commercialization with the source country and communities of the genetic resource is termed 'biopiracy'. With greater scrutiny on biopiracy and the issue of intellectual property rights relating to compounds derived from natural products many companies have reduced natural drug discovery (Stenton 2003). However, there are still many untapped revenues from bioprospecting and by collaborating with governments and research institutes to ensure ethical profit sharing there are synergies to be realised, such as the University of Dundee's ongoing collaboration with the pharmacological sector on kinase (enzyme targeting) profiling methods (University of Dundee 2017). Since 2001, 27 new drugs that target kinases have been approved for clinical use with current sales of US$30 billion.

Financial services are indirectly affected by biodiversity loss through the direct effect on biodiversity from industries in their portfolio. However, the requirement to manage this risk has often been driven by reputational risk exposure which has then indirectly resulted in a financial impact. One example is the HSBC response to investing in companies responsible for deforestation (see HSBC case study Box CS2).

**Box CS2:** HSBC Deforestation Reputational Risk Response.

Campaigns, such as the Dirty Bankers report (Greenpeace 2017a) highlighted how HSBC, despite its policies that prohibit finance of deforestation, was providing financial services to companies in Indonesia associated with unsustainable palm oil exploitation. The report also assessed what policy requirements for palm oil sector customers other banks have in place. The campaign to change the bank's policies was joined by hundreds of thousands of people, including 30,000 HSBC customers. NGO campaigns targeting bank's customers on environmental issues can lead to those companies losing customer (IOI Group financed by HSBC lost contracts from Unilever after it was suspended from the RSPO in March 2016 (Burrows 2016). Some bank clients were also exposed to litigation for forest fires (Jacobson 2016). To halt the reputational damage that included their customers joining the campaign, HSBC adopted a new 'No Deforestation, No Peat, No Exploitation' policy (Greenpeace 2017b).

The retail sector has been particularly responsive to biodiversity risk due to their end consumer interface which can lead to high profile and rapid reputational risk exposure (see palm oil case study Box CS3).

**Box CS3:** Retail Reputational Risk and Security of Supply.

A number of UK companies, including Boots and Waitrose, were exposed to negative publicity as a result of not using sustainably sourced palm oil in their products (Hickman 2009). Waitrose adopted sustainability policies to address palm oil sourcing. In 2006 they became a member of the Roundtable on Sustainable Palm Oil (RSPO) and in 2012 they have achieved a target to use 100% RSPO certified palm oil (Waitrose 2017).

Further examples of differing risks responses for multiple sectors and their response are provided in Table A3.

## 3.5 Barriers to recognising biodiversity risk

Despite the examples discussed, there is currently relatively low concern within the financial and corporate community about biodiversity business risk (Dempsey 2013). This may be due to the fact it is classed as a systemic risk; although likely to have material consequences for the business, cannot be managed solely by the business. The challenge is to turn a globalised, systemic and diffuse risk of biodiversity loss into an individuated risk that can be measured, managed and mitigated by individual businesses so that they can act, invest, and operate differently. Business usually face the following barriers preventing incorporation of the issue into the decision making:

- **Lack of consistent 'currency' or metrics**: in contrast to greenhouse gas (GHG) emissions reporting, biodiversity encompasses a wide range of complex issues and there is no one indicator that can provide a reference point for assessing progress (Dempsey 2013). Many companies do not know how to measure and report effectively on biodiversity. Moreover, biodiversity issues are less easy to communicate compared to climate change, water, health and safety.

- **Perceived immateriality among decision makers**: the absence of a compelling business cases, lack of prices and linking biodiversity risk to tangible financial metrics. This leads to a perceived lack of importance of the issue amongst many company managers and investors as biodiversity cannot be translated into economic language and compared to conventional indicators (Mulder 2007).

- **Complexity and lack of scientific understanding**: there is limited understanding of the links between biodiversity losses and ecosystem functioning (Kremen 2005) making it more difficult to infer how biodiversity loss leads to an increase in corporate risks.

- **Biodiversity issues frequently lie beyond the scope of corporate influence**: biodiversity frequently goes beyond the boundaries of direct ownership and control, and therefore is both difficult to quantify and difficult to measure. In addition, indirect impacts that arise outside the boundary of influence are potentially much greater compared to direct impacts.

- **Lack of demand for biodiversity metrics**: investors and other stakeholders rarely demand data on biodiversity impacts and dependence which may reflect the relatively short-term focus of many people in the investment community.

- **Biodiversity risks are partly based on external factors not under the company's control**: reputational risk, for example, is created by the perception of trust and confidence of external stakeholders on how business operates. Regulatory and legal frameworks often result from societal pressures to prevent real or perceived negative impacts. However, benefits (e.g. influencing new regulation, understanding the value at risk) are difficult to quantify. Also, it is difficult to determine the percentage of value attributed to effective management of biodiversity and ecosystems (F&C Management 2004). Instead, companies tend to refer to 'doing the right thing' to account for their beyond-compliance investments in conservation.

- **Time element:** in planning and managing investments an option that minimises early costs is favoured at the expense of incurring higher costs later. Furthermore, the effects of biodiversity loss are not, in most cases, dramatic one-off events, but rather they accumulate gradually, and so are less visible to decision-makers (Dempsey 2013).

These barriers were also reflected in the survey responses (Box S3).

**Box S3:** Survey respondents perceived barriers.

From the biodiversity risk survey respondents have identified the following barriers to integrating biodiversity into their day-to-day operations:

- poor understanding of biodiversity and biodiversity risk;
- difficult to establish cause-effect between biodiversity and business activities (e.g. how biodiversity (loss) affects business operations);
- difficult to measure biodiversity (e.g. what metrics, tools to use);
- lack of standard response to biodiversity management (standards to not prescribe how biodiversity should be dealt with).

# 4 Communication around business risks due to biodiversity loss

From the research undertaken for this report, effective communication of the importance of biodiversity to business is essential to enable business to consider biodiversity in their day-to-day operations and therefore to halt biodiversity loss. Different sectors have very different exposures to biodiversity and often use different language to communicate. In this chapter the following methods for potentially communicating this message are explored:

4.1 Risk reduction and opportunities demonstrated via case studies
4.2 Introducing biodiversity risk and opportunity profiling
- Simple and consistent messaging from biodiversity professionals for each sector
- High level screening of individual company's biodiversity risk and opportunities
- High level screening of sector analyses with quantitative information about the supply chain, potential risks and impacts on sourcing decisions

4.3 Staff engagement surveys
4.4 Popularisation of awards and accreditations

## 4.1 Risk reduction and opportunities - case studies

While many of the dependencies and impacts with regards to biodiversity loss may not translate into material risk, opportunities presented by biodiversity can often encourage companies to take a more proactive and engaged response. Dow, for example, launched an ambitious 10 year agenda in 2015 to create $1 billion in value for the company either through cost savings or new cash flow by simply considering natural capital as part of major capital expenditures or investment decisions (Dow 2017). Opportunities available to companies can range from developing new products and entering new markets to developing new revenue streams from existing assets. Table 5 outlines some of the biodiversity opportunities that tertiary sectors may benefit from.

**Table 5:** Biodiversity related business opportunities.

| Opportunity | Description |
|---|---|
| Operational | • Monitoring biodiversity impacts across operations can reduce cost and increase security of supply<br>• Benefits from increasing biodiversity driven design such as water-use efficiency or building an on-site wetland to eliminate the need for new water treatment infrastructure |
| Regulatory | • Engaging governments to develop legislation, policies and incentives to protect or restore ecosystems that provide services a company needs<br>• Improve compliance by adapting policies and practices near protected areas |
| Reputational | • Benefits from implementing and communicating sustainable purchasing, operating, or investment practices that help product differentiation and improve corporate image as consumer become more aware of sustainability issues<br>• Investment in mechanisms that minimise biodiversity impacts<br>• Investment in nature conservation as a mean to preserve sustainable supplies but also engage with local suppliers |
| Market and product | • Developing new businesses, such as ecosystem restoration and environmental asset finance or brokerage<br>• Development of new technologies that will increase the efficiency of ecosystem service use, decrease degradation or even restore ecosystems<br>• Developing new products and services that reduce consumer impacts on ecosystems, including selling certified sustainable products |

| Opportunity | Description |
|---|---|
| | • Participating in emerging ecosystem service markets (e.g. water-quality trading, watershed protection wetland banking and threatened species banking, markets for carbon sequestration),<br>• Capturing new revenue streams from company-owned, yet unrealised natural assets, such as wetlands and forests, but for which new markets or payments for ecosystem services could emerge. |
| Financing | • Access to more favourable financing terms or improved access to capital for companies supplying products and services that improve resource efficiency or restore degraded ecosystems or have no negative impacts.<br>• Better financing terms for companies reporting biodiversity related information and which have developed action or mitigation plans. |

Source: TEEB (2012).

For example, Marks and Spencer's maximised the opportunities from building their new Cheshire Oaks store in 2012, they were the first UK retailer to be awarded the Wildlife's Trust Biodiversity Benchmark for the development (Cheshire Wildlife Trust 2014). By improving design and incorporating biodiversity overall costs can be reduced, the planning process expedited and reputation enhanced.

Ninewells Hospital in Dundee realised that the greening of their hospital grounds created a health promoting environment (Forestry Commission Scotland 2010a). They mapped improvements in greening to positive impacts such as relaxation and improved moods, improved social interaction and improved mobility and physical activity opportunities. Ninewells were chosen as a national pilot for the NHS for other hospital to aspire to. These positive impacts can result in real reduced health care costs as they can contribute to faster recovery times (Forestry Commission Scotland 2010a).

Gatwick Airport turned what were Section 106 planning requirements into an opportunity by maximising biodiversity value via a Biodiversity Action Plan which covers 75 hectares (including woodland, grassland and wetlands) adjacent to the airport (Gatwick Airport 2015). As well as enhancements to the habitats and targeted species habitat creation they have included multiple stakeholders and have taken the opportunity for community engagement and promotion of education. The project is managed as part of Gatwick's ISO14001 standard and has achieved certification to the Wildlife Trust Biodiversity Benchmark Award as well as winning the 2016 CIRIA BIG Biodiversity Client Award. Their achievements have enhanced their reputation and are also likely to expedite further development planning permissions having generated trust and goodwill with regulatory bodies, NGOs and the local community.

Table A4 provides further examples of business maximising the opportunity value of biodiversity.

## 4.2 Introducing biodiversity risk and opportunity profiling

Promoting engagement for sectors less obviously materially exposed to biodiversity risk may be undertaken via risk profiling to highlight which operations could be exposed to biodiversity risk and how. Some of the strategies that can help companies identify potential biodiversity related risks and opportunities are as follows:

- **Simple and consistent communication:** The first step could include consolidating sectoral information (e.g. through fact sheets) about the main impacts and dependencies and associated risks and opportunities. This can provide a valuable engagement tool for key decision makers. Key findings may be presented in person by biodiversity professionals or through recorded webinars/presentations that would be integrated into part of a company's training programme. This can help raising the profile of biodiversity.

- **High level screening assessments for exposure to biodiversity risk and opportunities:** In addition to qualitative descriptions provided by facts sheets, a high-level screening assessment for business could be undertaken. This would involve identification of the main corporate operations around biodiversity; and their main resources and their sourcing locations. This would help identify critical points in the supply chain and operations where key biodiversity risks arise, and where opportunities could be maximised.

- **Detailed business analyses with quantitative information about the supply chain, potential risks and impacts on sourcing decisions:** This could build on the high-level screening approach, but with quantitative information to enable assessment and visualisation of the magnitude of potential exposure across operations and the supply chain. BioScope is one recently launched scoping tool (BioScope 2017) which is free for all to use. A similar exercise was conducted for identifying the environmental impacts of grocery sector products as part of the Product Sustainability Forum initiative that was facilitated by WRAP (2017) and supported by major corporates. The outcome was the development of product profiles for individual grocery products and associated action plans to minimise impacts.

## 4.3 Staff engagement surveys

Following the dissemination of information such as training, presentations or bespoke initiatives, periodic staff surveys around the perception and awareness of biodiversity could be conducted to raise the profile of biodiversity issues and also present successful approaches to addressing biodiversity issues. The survey could be prepared by biodiversity professionals and deployed by industry bodies across sectors to identify key issues and how individual sectors are responding.

## 4.4 Biodiversity accreditations and awards

Brand accreditations have been very successful in terms of uptake and implementation of biodiversity integration in the retail and supply chain. Examples of accreditations include the Marine Stewardship Council (MSC), the Forest Stewardship Council (FSC) certification, and the Roundtable on Sustainable Palm Oil (RSPO).

A KPMG (2012) study identified some challenges around measuring the success of certification schemes in general. Only a small percentage of studies identified by KPMG have used evidence-based research methodologies. Although biodiversity criteria are being addressed in certification schemes few demonstrated a high level of maturity. Evaluating biodiversity criteria was challenging as it is difficult to separate the impact on biodiversity from other indicators.

A number of sectors and companies are looking to increase their profile with accreditations and awards with the CIRIA BIG Biodiversity Awards being an excellent example (see Box CS4). Awards are opportunities for showcasing best practices and benefits companies can achieve through implementing various initiatives.

**Box CS4:** CIRIA BIG Biodiversity Challenge Awards.

CIRIA (Construction Industry Research and Information Association) are the UK's main guidance and best practice body for the construction industry. They launched the BIG (Biodiversity Interest Group) Biodiversity Challenge commitments and awards in 2014, which rewards those businesses which go above compliance to enhance biodiversity. This awards profile has grown consistently to the point where there was a launch event for the opening of submissions in 2017.

An analysis of 443 case studies of award submissions over three years showed that the large majority of submissions are based in areas where the industry does not necessarily significantly impact biodiversity

but instead presents an opportunity for enhancement (almost 30% of submissions were from Greater London).

Non-tertiary sector construction presented the largest number of submissions, largely relating to energy and water construction and maintenance, followed by transportation, education and residential; reflecting the general profile of public capital expenditure and risk exposure.

When looking at the type of biodiversity enhancement provided, the top three enhancements were semi-natural habitat creation, artificial habitats, and biodiversity education. Community engagement is the most subscribed awards category, followed by permanent biodiversity enhancements.

This range of submissions show that while the 'easy' options, such as artificial habitat, are heavily subscribed; permanent habitat replacement, biodiversity education and community engagement are regarded by the construction industry as core differentiators and opportunities to promote brand value and engage with key stakeholders.

# 5 The use of quantification for the integration of biodiversity into decision making

## 5.1 Quantification of risks and opportunities

Following identification of general biodiversity risks, more quantitative methods and approaches are required to integrate biodiversity into decision making. Different approaches will be required depending on the sector and the type of decision making that needs to be supported. This can include employing external experts, undertaking bespoke assessments and using specialised methods and tools for scoping risks and opportunities.

There are many different tools, methods, frameworks and initiatives that can help organisations understand their exposure to biodiversity risk. They are managed and produced by a range of private and public-sector organisations, academic institutions, and non-profit organisations. An overview of the landscape that supports biodiversity decision making is presented in Figure . In this chapter, different approaches are outlined in further detail. Although the focus in this section is on tools, a full presentation of these integration measures is presented in Appendix B.

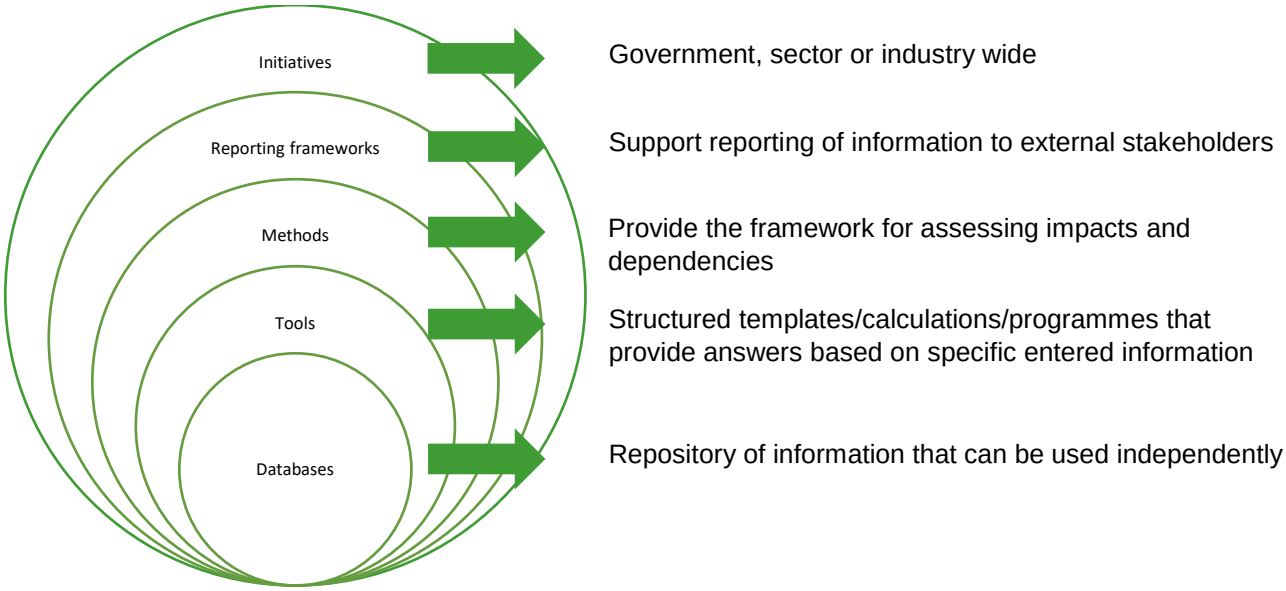


**Figure 4:** Hierarchy of biodiversity relevant approaches to scoping risk and opportunity.

### 5.1.1 Initiatives

One of the most potentially powerful initiatives was the agreement to establish Sustainable Development Goals (SDGs) (United Nations 2015). This was an outcome from the United Nations Conference on Sustainable Development held in Rio de Janeiro in June 2012 (Rio+20). The SDGs are intended to provide a transformative, integrated and universal approach that strives for a world that is just, equitable and inclusive, and promotes sustained and inclusive economic growth, social development, and environmental protection. They will build on the Millennium Development Goals (MDGs), which were to be achieved by 2015. While all 17 goals benefit from the integration of biodiversity, goal 15 in particular aims to "*Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss*".

The European Commission defined a strategy for the period 2011-2020 in a communication in May 2011 entitled, *"Biodiversity, our life insurance, our natural capital: an EU biodiversity strategy to 2020"* (EC 2011). Divided up into six objectives and 20 actions, it sets the goal of *"Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020.*

### 5.1.2 Framework reporting

The UK has a key academic framework reporting mechanism for biodiversity. The UK Post-2010 Biodiversity Framework covers the period from 2011 to 2020. It was developed in response to the Convention on Biological Diversity's (CBD's) Strategic Plan for Biodiversity 2011-2020 and its 5 strategic goals and 20 'Aichi Biodiversity Targets', published in October 2010; and the EU Biodiversity Strategy (EUBS), which was released in May 2011.

However, for business reporting, most of the commonly adopted standards fail to incorporate biodiversity. For example, the Climate Disclosure Standards Board (CDSB) and CDP (formerly the Carbon Disclosure Project) both focus on eliciting climate change-related information in corporate reports.

The Global Reporting Initiative (GRI initiated in 1997) is a widely used framework for sustainability corporate reporting. GRI G4 standards require companies to perform and report a materiality assessment and require companies to identify environmental Key Performance Indicators (eKPIs) to provide specific performance data. The G4 guidelines have four specific biodiversity indicators (EN11–14), for operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas.

The International Organisation for Standardisation (ISO) operate widely accepted standards implemented by the majority of big business, while ISO14001 for "*Environment Management Systems*" mentions biodiversity amongst its environmental requirements, the ISO 37101 2016 "*Sustainable development in communities -- Management system for sustainable development -- Requirements with guidance for use*" follows a more integrated approach having its own chapter on Biodiversity and Ecosystem Services and referencing the importance of resilience.

The UK has their own standards operated by the British Standards Institution (BSI) BS 42020 Biodiversity. "*Code of practice for planning and development.*" And BS 8583 Biodiversity. "*Guidance for businesses on managing the risks and opportunities*".

These are all voluntary standards centred largely around Corporate Social Responsibility requiring engagement with business to ensure the benefits of participation are understood. As previously discussed, with standards such as PS6, the financial community have seen the benefit of implementing compliance standards in addition to government regulatory compliance with regards to biodiversity to protect their investments (see Santander case study Box CS5).

**Box CS5:** Santander reacts to investors' environmental damage.

Lawsuits were filed against two banks for failing to comply with Brazilian environmental laws by financing cattle production in the Amazon Region. Prosecutors asserted that, without that credit, the farming and the consequent deforestation would not have occurred (Piazzon & Advogados 2012). Similarly, due to Amazonian deforestation, Banco Santander decided not to renew the funding to the paper and pulp company APRIL in 2015 and confirmed that any future loans would be conditional on APRIL implementing new sustainability measures to address its involvement with deforestation (WWF 2016).

This issue is strengthened following the adoption of the Environmental Liability Directive (EC 2004) which requires compensation payments from companies damaging natural habitats and is centred around the "precautionary principle", which requires companies to take preventative measures when their activities pose an "imminent threat of environmental damage;" and the concept of "polluter pays," which makes

businesses legally and financially accountable for environmental damage to biodiversity amongst other issues. By implementing their own compliance measures in advance of investment such as IFC PS6 investors hope to avoid such conflicts.

### 5.1.3 Methods

Numerous methods were developed for identifying and assessing corporate biodiversity impacts and dependencies and hence risks. The Natural Capital Protocol (NCP) was launched in 2016 by the Natural Capital Coalition (NCC) (Natural Capital Coalition 2016), who is currently working on a supplementary biodiversity guide to increase the biodiversity component of their framework. In 2016 CIEEM, CIRIA and IEMA also launched their *Biodiversity Net Gain: Good practice principles for development* which is currently being developed into guidance for the construction industry. The Corporate Biodiversity Management Handbook (Schaltegger & Beständig 2012) introduces and helps to create a business case for biodiversity, while offering specific tips on how to operationalize corporate biodiversity management. It is supported with tips, facts and information and backed up with best-practice examples from companies across the globe.

These methods present a starting point for tertiary sectors to identify and control how biodiversity features are integrated into development, operations and supply chain. Companies without resident biodiversity experts, may require external professional assistance to identify and prioritise biodiversity related issues.

### 5.1.4 Databases

There are numerous databases that provide necessary data which can be used to quantify biodiversity, many of which are open source although there is no systematic data collection process or data manager for biodiversity for the UK. The most commonly used public biodiversity database for the UK is the National Biodiversity Network (NBN) Atlas. Further databases are presented in Appendix B Table B3.

### 5.1.5 Tools

Ease of quantification is required for businesses to identify and manage biodiversity and ecosystems risks. Some tools are very complex and require users to enter quantitative ecological data into a format that can generate maps using Geographic Information Systems (GIS), while others require less specialist technical knowledge and are based on a set of questions that are organized in an Excel spreadsheet. Some enable landscape modelling, while others are more suitable for project site-level assessments. Tools can support product assessments, corporate performance evaluation, inform scenario modelling and support monetary valuation of ecosystem service.

Biodiversity is a complex issue which varies hugely depending on the sector and scenario. Tool selection depends upon the issue an organisation seeks to investigate, resource availability, assessment type (institutional, site, project, supply chain *etc*) and who is using the outputs. Table 6 presents a range of tools and their uses. Many tools however are ecosystem service centric and need to better understand the component that biodiversity adds to that value.

Based on the review of common tools, there is currently a shortage of tools that allow assessments of biodiversity impact and dependency at the product level (i.e. supply chain such as the previously mentioned BioScope). Eco-LCA (Life Cycle Assessment) (Center for Resilience 2017) is an on-line tool that provides accounting system software that quantifies the role of natural resources in LCA

taking into account a broad range of ecosystem services but it does not feature a biodiversity element.

All the tools assessed (with the exception of BioScope) would require additional expertise to use (i.e. procurement of additional professional services). In addition to the information presented in Appendix B, the Ecosystem Knowledge Network have developed an online resource called 'Tool Assessor', which provides a comprehensive assessment of environmental analysis tools (Ecosystem Knowledge Network 2017).

**Table 6:** Description of selected tools.

| Name | Purpose/ Type of assessment | Description |
|---|---|---|
| Ecosystem Services Benchmark* | Screening / corporate level assessment | Designed for cross-sectoral investors to help them evaluate organisational risk management and opportunity identification relating to biodiversity and ecosystem services. |
| Business and Biodiversity checklist | Product, facility, company | Excel based tool incorporating a checklist with ratings resulting in a report providing areas of biodiversity strengths and weaknesses. |
| ARtificial Intelligence for Ecosystem Services (Aries) | Site level | A software tool that enables spatial mapping and quantification and economic valuation of ecosystem services. It enables detailed and dynamic assessment of how nature provides benefits to people. |
| Capital Asset Value for Amenity Trees (CAVAT)* | Site level | Used for managing trees in the UK as public assets rather than liabilities. A strategic tool to aid decision-making in relation to the tree stock in general, but can also be used to value a single tree in monetary terms. |
| Integrated Valuation of Ecosystem Services and Trade-offs (InVest) | Site level | An open-source software model using GIS that can map and value ecosystem services for assessment of impacts associated with management choices. |
| Spatial Decisions on Ecosystem Services (SPADES)* | Site level | Spatial analysis and assessment of ecosystem services (eCountability with the support of six partner organizations and advice from the UK construction industry). The GIS tool compares layout and design options for development. Outputs are quantitative, and monetized where appropriate. |
| i-Tree | Site level | A method for valuing the ecosystem service benefits (e.g. carbon sequestration and air pollutant removal) that trees provide. |
| Defra biodiversity offsetting metric | Site level | A calculation using biodiversity units as a proxy measure for biodiversity loss and the amount of mitigation and compensation required to achieve no net loss or net gain. Often that compensation needs to be undertaken off site. |
| Bio-scope | Supply chain | A fast and effective scoping tool demonstrating the impacts on biodiversity in the supply chain. |
| Ecologically-Based Life Cycle Assessment (Eco-LCA)* | Supply chain | Eco-LCA is a framework to account for the role of ecosystem goods and services in the life cycle of different products and materials and what impacts they have on nature. |

* Tools that, while useful, need to better acknowledge the contribution biodiversity makes to the delivery of the ecosystem services being assessed.

**Box S4:** Survey respondents regarding the use of tools, standards, frameworks.

Based on the survey responses, companies measure biodiversity impacts of their operations and dependencies and risk and opportunities to meet various business objectives. These include corporate strategy, addressing regulatory requirements, understanding the impact of biodiversity on business decisions, selecting suppliers and sourcing of materials.

In terms of frameworks, the majority of survey participants use the Natural Capital Protocol (21%) or Global Reporting Initiative (18%). Other frameworks used include: CIEEM guidelines for impact assessment; Business and Biodiversity Offsets Programme (BBOP); and Biodiversity Risk & Opportunity Assessment (BROA) (developed with British American Tobacco).

A third of respondents did not use methods or tools to quantify risks and opportunities associated with biodiversity. Another third was unaware whether they are being used for application in their sector. Defra's biodiversity offsetting metric (Defra 2012) was the method favoured by the remaining 40% of users

The range of tools reportedly used by survey respondents were:

- ARIES (Artificial Intelligence for Ecosystem Services) and integrated modelling tool;
- I-Tree (i-Tree is a recognised method of valuing the ecosystem service benefits such as carbon sequestration and air pollutant removal that trees provide (Treeconomics London 2015);
- Defra Biodiversity offsetting metric; and
- Various Geographic Information Systems (ESRI software).

A third of respondents have developed their own tools which are based on existing simple checklists and assessments but made specific for their business application reflecting the differences between sectors and projects. Representatives from financial institutions highlighted the development of a semi-quantitative scoring methodology which uses Environmental Impact Assessment terminology to describe biodiversity impacts on habitats and species and applies a score to the overall impact. This score is then provided to Investment Committee to aid in decision making.

## 5.2 Barriers to successful use of tools

From the research undertaken it is apparent that, despite the very wide range of initiatives, methods and tools available, there is still little consistency or implementation within or across sectors regarding the type of tools being employed. This reflects the main issues survey respondents had with the use of tools (see Box S5).

From the research for this report and the survey responses, the Defra biodiversity offsetting metric appeared to be the most consistently used or amended tool (Defra 2012). The most frequently used methods and reporting frameworks were the Natural Capital Protocol and the Global Reporting Initiative.

**Box S5:** Survey Respondents on barriers to using tools.

Barriers the survey respondents have highlighted are the lack of familiarity with the tools (e.g. which tools exist, for what purpose and the benefits they provide). Other issues with the tools include the perceived difficulty in using them, that they require support from experts, they are time and data intensive. Existing tools may also not be applicable for a particular project as they are either to specific or too general.

# 6 Collaboration with biodiversity experts to maximise opportunities

## 6.1 Why collaborate?

Quantification methods are complex and require expert advice. Many collaborative partnerships between biodiversity experts and businesses have emerged to navigate the complexities of identifying biodiversity risks and maximising associated opportunities. There are a number of benefits arising from collaboration with biodiversity experts including:

- enhancing corporate reputation;
- increasing access to land and license to operate;
- mitigating risk;
- obtaining access to specialist expertise;
- improving capacity to work with communities and access local information;
- building corporate values and capacity of staff;
- increasing credibility with key stakeholders and leverage with other NGOs;
- presenting new opportunities to engage with external stakeholders;
- support with project implementation,
- providing strategic advice; and
- regulatory compliance (i.e. planning and permitting).

## 6.2 Successful collaborations – case studies

For example, when Berkeley Homes required planning permission to build in close proximity to the protected Thames Basin Heath Special Protection Area (SPA), they collaborated with Natural England and the Local Planning Authority, Hart District Council, to develop a solution. They developed a partner based project that created Edenbrook Country Park (Natural England 2013) which converted agricultural land into high quality wildlife habitats in one of the first examples of Suitable Alternative Natural Greenspace (SANG). In addition to meeting regulatory requirements the park creation provided excellent stakeholder engagement opportunities and ensured that residents of the new development were provided with a high-quality living environment as well as a receptive local community.

Collaboration between industry and research institutions can result in faster uptake of ideas and sharing of knowledge that can facilitate innovation. The biopharmaceutical company, AstraZeneca, decided to co-locate with Cambridge University in 2016 resulting in a doubling of collaborations in one year (AstraZeneca 2014) and therefore increased potential for successful discoveries. Box S6 provides details of survey respondents' collaboration experience and Table A5 provides further examples of successful collaborations for business.

**Box S6:** Survey respondents' collaboration experience.

| |
|---|
| Based on the survey results 74% of businesses have successfully collaborated with biodiversity experts to identify how biodiversity could be included in operations or strategic decision making. The collaborations ranged across private consultancy, national NGOs (i.e. RSPB) Local NGOs (i.e. local wildlife groups), Government (i.e. local biodiversity officers) or University academics. |

## 6.3 Barriers to collaboration and suggestions for improvement

Despite some successful examples, there is scope for improving collaboration, especially by engaging biodiversity experts earlier in development of strategies and project plans. This could

help businesses mitigate risks and identify and realise opportunities. As concurred by survey respondents, current use of experts is often to fulfil regulatory requirements rather than business drivers to improve competitiveness and often at the end of the process rather than the beginning where it can have significant influence on making decisions. There are many reasons for this including the previously discussed barriers to understanding risk and there is the perceived lack of value in using experts from the business side and a lack of consistent messaging of the value of services provided by the experts (see Box S7).

**Box S7:** Survey respondents perceived collaboration barriers.

According to the survey, respondents' key barriers preventing collaboration include:

- Businesses seem to find biodiversity experts expensive, perhaps a lack of perception of value rather than direct cost (i.e. environmental consultants less expensive than many);
- There is a lack the understanding of the benefits experts can provide;
- Lack of clarity concerning links between biodiversity and dependencies; and
- Some biodiversity professionals lack the required understanding of critical business objectives to tailor professional services appropriately.

Reducing the complexity of biodiversity messaging and highlighting the benefits that can be delivered by biodiversity experts could help demonstrate how the value of collaboration outweighs the costs. The experts should address the link between biodiversity and corporate dependencies, how they matter for corporate sustainability and successful long-term operations and how integrating biodiversity will mitigate risk, improve opportunities or have direct impact on the corporate value. Furthermore, opportunities for developing mechanisms for transferring knowledge bases that could foster more strategic partnerships between different organisations, including research institutes and academia, to deliver knowledge in a more cost-effective manner.

Examples of how this could work and how experts could demonstrate their own value include:

- Promote the development of a common knowledge base to demonstrate the importance of biodiversity and the value its integration can bring. For example, a business focused version of the online Journal Conservation Evidence (https://www.conservationevidence.com/).

- Organize industry events that demonstrate successful case studies, facilitate networking between biodiversity experts and business people, encourage knowledge exchange around strategic requirements and opportunities for collaboration.

- Develop standard metrics that are verified and validated by accredited bodies to provide a more cohesive message.

These examples were also reflected by the survey respondents (see Box S8).

**Box S8:** Survey respondents perceived collaboration recommendations.

According to survey respondents, collaboration could be better facilitated by:

- More prominence and approachability of the experts;
- More resourcing of statutory bodies like Natural England and local council ecologists;
- Web based offers of skills to inform sectors of opportunities for collaboration;
- Integrating biodiversity at all levels from strategic to operational across all service areas;
- Involve experts at early stages of planning major projects, to recognize the financial implications of not doing so, ensuring biodiversity is not considered solely as an "after-thought";
- Further awareness of the benefits to business and projects;
- Calls from business for 'one voice' from biodiversity experts on what they need to do.

# 7 Collaboration between sectors

## 7.1 Methods of inter and intra sector collaboration

In addition to expert collaboration there is potential for inter and intra sector collaboration. As discussed in Chapters 3 and 4, various sectors interact through their supply chains and land use, with biodiversity being a factor linking different organisations who may be in conflict over resource access or management. Since biodiversity is often not explicitly valued, associated risks and opportunities are not considered in decision making, leading to over-exploitation of natural capital, and damage to biodiversity, which in turn can affect operations of other organisations operating in the same space. Sectors can minimise risks and maximise benefits by seeking to collaborate within and across sectors to address issues that impact multiple businesses.

The most obvious sector collaboration measures are via accreditation of suppliers to regulate supply and sustainable management at a landscape level generating efficiencies by maximising stakeholder collaboration.

## 7.2 Supply chain level collaboration

To manage risks, companies initially focus upon increasing efficiency of production (e.g. energy efficiency), but as the complexity of supply chains increases, companies focus on supply chain management, frequently with the use of certification to manage multiple suppliers.

The construction industry has embraced accreditation to demonstrate environmental compliance efficiently. Skanska joined accreditation scheme *Building Confidence* to streamline its approach to supplier accreditation as well as to reduce cost and save time (Skanska 2009), while Kier runs its own *Supply Chain Sustainability School* for its suppliers to capacity build in this area (Kier 2017).

This accreditation approach can help mitigate indirect risk but may not be effective enough to address risks to the supply in key sourcing areas beyond the influence of an individual company, such as water security or biodiversity protection, which require a landscape approach (Kissinger *et al* 2013).

One example of this is Starbucks' partnership with Conservation International, creating the Coffee and Farmer Equity (CAFE) Practices. Sustainable production is achieved by delivering producer support, addressing livelihood needs and income supplements through carbon payments, and providing incentives for farmers to not expand coffee growing areas into surrounding forests, reducing deforestation pressures driving biodiversity loss, and thus decreasing risk of negative publicity (SCS Global 2017). SCS Global Services (previously Scientific Certification Systems Inc.) are employed by Starbucks to ensure the quality and integrity of the third-party verification for suppliers.

The Rainforest Alliance is another example of a growing network of farmers, foresters, communities, scientists, governments, environmentalists, and businesses dedicated to conserving biodiversity and ensuring sustainable livelihoods. Costa is the only coffee chain in the UK that only uses sustainably grown beans sourced from Rainforest Alliance Certified farms.

## 7.3 Landscape level collaboration

Adopting a landscape approach has the potential to mitigate a number of risks and provide a framework for companies to identify the range of stakeholders it would be beneficial to work with,

beyond the project site or supply chain level. A landscape approach can help support corporate operations, ecosystem conservation, and livelihoods across an entire landscape in which multiple businesses may be working in, and thus reliant upon.

Companies adopting landscape approaches still harness the benefits associated with traditional sustainability initiatives, but have the additional benefit of understanding the complex nature of the areas in which they operate and identify opportunities for collaborative management of biodiversity related risks. This integrated systems approach can improve long-term viability of projects by bringing all relevant stakeholders to the table, enable businesses to act collaboratively on risk reduction (potentially leading to cost savings), access local knowledge to improve societal acceptability of planned projects, all of which can help secure strategic competitive advantages to business and the local community such as those delivered by the Mersey Gateway Project (see Box CS6).

The recognition and designation of high value biodiversity areas (i.e. designated sites) as a means of focussing goals and outcomes around the best collaborative use and management of the focal area can result in multiple benefits. For example, the Improvement Programme for England's Natura 2000 Sites (NE & IPENS 2012) and Nature Improvement Areas (NE & NIAs 2012) in the UK which aims to bring together numerous stakeholders to ensure appropriate management of the sites but also to tackle wider issues such as coastal management and pollution (Box CS6).

**Box CS6:** Mersey Gateway Project award winning inter sector landscape collaboration.

The Mersey Gateway Project (2017) which opened in October 2017, implemented by the Merseylink consortium (Kier, FCC Construcción SA and Samsung C & T Corporation), was designed by a joint venture between AECOM and Flint & Neill Ltd. The project constructed a new six lane toll road cable-stayed bridge over the River Mersey, designed to be the catalyst for the infrastructure investments required to deliver regeneration of Halton and the north-west. The bridge spans the Mersey Estuary Natura 2000 Special Protection Area (SPA) and a Ramsar site. The Manchester Mosses Special Area of Conservation (SAC) is in close proximity, as is Liverpool waterfront, a UNESCO World Heritage Site. The collaborative approach to the project has brought marked environmental benefits to the local area, which includes a new 28.5 hectare nature reserve parallel to the bridge. The long-term ecological management and monitoring will be undertaken by the newly created Mersey Gateway Environmental Trust. The project has inspired a new research partnership between AECOM and the University of Salford, to carry out research investigating the benefits the project has provided to the Mersey Gateway Area and how to reduce adverse impacts and improve outcomes of future projects. It won the CIEEM Best Practice Stakeholder Engagement Award 2017 and Kier's environmental manager won the CIRIA Biodiversity Champion Award 2017.

Multi-stakeholder collaboration can also lead to real biodiversity benefits for the supply chain at specific landscape level. Three corporate giants and an NGO formed the Carolinas Working Forest Conservation Collaborative to improve security of timber supply and to preserve biodiversity (see Box CS7).

**Box CS7:** Carolinas Working Forest Conservation Collaborative a multi-stakeholder collaboration to secure supply.

American Forest Foundation (AFF), International Paper, The Procter & Gamble Company (P&G) and 3M Company formed an initiative focused upon operations in the Coastal Carolinas Plain. The initiative aims to educate and engage family woodland owners in sustainable forestry, forest certification, the enhancement of habitat for at-risk species, and the conservation of bottomland hardwood. This initiative helps business deliver their sustainability commitments, provides land owners with sustainable livelihoods and benefits biodiversity (Kaye 2017).

Another landscape level approach involves Payments for Ecosystem Services (PES), such as carbon sequestration or watershed protection. With this approach, payment is made to providers of ecosystem services (e.g. the land owner or land manager) in return for management actions that

can increase the provision of ecosystem services (Smith 2013) such as the successful Pumlumon Project (see Box CS8).

**Box CS8:** The Pumlumon Project a multi-stakeholder collaboration to reinvigorate the upland economy using Payment for Ecosystem Services (PES).

The Pumlumon Project established in 2007, managed by the Montgomeryshire Wildlife Trust (MWT) is pioneering a rethink around the management of upland Britain. Across 40,000 hectares of the Cambrian Mountains, an upland economy is being established around wildlife, ecology and long-term sustainability. Local farmers, foresters and tourism businesses are being paid to manage the landscape differently. Within five years they have demonstrated, using good science and economic analysis, how large-scale ecological restoration can bring economic, social and environmental benefits. This information has been used to engage and inform policy makers and the private sector to influence future funding schemes (e.g. Glastir – Welsh Agri-environment scheme initiated in 2012) (Defra PES Pilot Evaluation of the Pumlumon Project 2014) (Wildlife Trusts 2014).

Other examples of successful landscape PES include Natural England's Uplands Ecosystem Service Pilots Bassenthwiate, South Penines and the South West Uplands which demonstrated that even with high management costs and only valuing a limited suite of benefits (water quality, carbon and biodiversity), investment in the catchment was worthwhile in economic terms (Waters *et al* 2012). A similar Defra pilot reported in "Slowing the Flow at Pickering" (Institute of Civil Engineers 2014) planted a total of 19 hectares of riparian woodland within the Pickering Beck catchment and 10 hectares in the River Severn and demonstrated that risk of flooding in the town of Pickering reduced from a 25% chance in any year to less than 4%. Further details on these landscape examples is provided in Table A6.

# 8 Demonstration of successful integration of biodiversity knowledge into corporate operations – case studies

Various companies have made public commitments to conserve biodiversity, including a number of multinational companies who have committed to achieving goals of 'no net loss' or a 'net positive impact' on biodiversity and ecosystems in all operations (Rainey *et al* 2014). Companies that are integrating biodiversity into decision making are doing this at different levels. Some are incorporating biodiversity at the corporate level, others at the project or supply level (see Box S9).

**Box S9:** Survey respondents' examples of successful integration of biodiversity.

The majority of respondents have integrated biodiversity into decision making (79%). These integrations were operating at the corporate level (44%), at the project level (32%) and at the facility level (3%). Respondents use biodiversity information for:

- Reducing regulatory and legal risk
- Reducing reputational risk
- Reducing operational risk
- Improving business decision-making

According to survey respondents, integrating biodiversity into decision making is used to

- Reduce corporate risk (e.g. reputational, operational, regulatory);
- Enhanced corporate performance (e.g. increased revenue streams, reduced costs),
- Develop new products and services (i.e. 'biodiversity business' opportunities)
- Develop new markets for biodiversity and ecosystem services (e.g. Payments for ecosystem services, biodiversity offsets

In terms of successful integration of implementations, the respondents have stated:

- A company standard on biodiversity and a company specification on how biodiversity is managed can be integrated into Environmental Management Systems, such as ISO14001;
- Corporate and Project specific Biodiversity Action Plans;
- Signing up to commitments such as CIRIAs BIG Challenge, Biodiversity Benchmark or Net Gain/Net Positive commitments; and
- Green Investment Strategies.

Hammerson PLC is a major British property development and investment company, switching to real estate investment trust status when they were introduced in the UK in 2007. They are an owner, manager and developer of retail destinations across Europe. They were one of the first companies to realise the value of biodiversity when they employed Arcadis (previously Hyder Consulting) to develop a Strategic Biodiversity Action Programme (BAP) to improve new development and existing maintenance with regards to biodiversity across their land holdings meeting their BAP targets by 2015. This delivered multiple benefits such as expedited regulatory processes, increased operator satisfaction, lower operational costs and increased footfall for retail outlets. This journey has led Hammerson to achieve two world sustainability firsts for Elliott's Field Retail Park in Rugby, an interim Outstanding BREEAM retail rating, a world leading sustainability assessment method, in addition to becoming the first shopping park globally designed to be carbon neutral. Creation of a canal bankside nature area for wildlife to enhance the site's ecological value was a key development feature (Hammerson 2017).

Haven Holidays, owned by Bourne Leisure, have benefited from their positive biodiversity management of Perran Sands Holiday Park in Cornwall, which lies within the Penhale Sands Special Area of Conservation (SAC) (http://www.businessandbiodiversity.org/cs_tourism.html). In addition to their biodiversity value, the Sands provide a coastal protection role by absorbing the impact of wave energy on the shore. The Holiday Park has been managing their section of SAC using the Countryside Stewardship scheme and in conjunction with the Ministry of Defence and the

Penhale Sands Management Committee, of which they are member. A Ranger, funded by the project, works with local schools and leads events for locals and visitors to increase public knowledge and appreciation of the dunes. They have benefited by being recipients of a gold David Bellamy Award (British Holiday and Home Parks Association 2017) which increases their reputation leading to potentially increased sales and a continued licence to operate on a protected site.

Table A7 presents additional examples of successful biodiversity integration. However, there are still perceived barriers to integration which require action (see Box S10).

**Box S10:** Survey respondents' examples of barriers to successful integration of biodiversity.

The main barriers faced by respondents include:

- poor understanding of biodiversity risk;
- difficult to establish cause-effect between biodiversity and business activities;
- difficult to measure biodiversity;
- biodiversity is difficult to understand; and
- lack of standard response to biodiversity management (standards not prescribed as to how biodiversity should be dealt with).

# 9 Key thoughts and recommendations

Although there are many compelling reasons to monitor and address biodiversity risk, it is still not as prominent a business topic as the risks and opportunities for business warrant. There is a lack of awareness about how important biodiversity loss is in relation to economic activities, and overall societal well-being. Corporate impacts on biodiversity dominate discussions, often resulting in reactive responses, whereas factors associated with dependencies and opportunities could facilitate a proactive response to managing biodiversity loss.

The reasons for this are as complex as biodiversity itself and range from the different sectoral technical and cultural requirements, to communicating with key decision makers, to collecting and using biodiversity data in a meaningful way to demonstrate risks and opportunities to the private sector.

Judging from the information reviewed and survey responses received, there is a clear need to improve private sector understanding of biodiversity and the role it plays in sustainable management of business-critical systems, and consider business requirements when developing the decision support tools required to integrate biodiversity into corporate decision making.

Only by embedding biodiversity into different sector cultures via knowledge sharing and targeted messaging, including the demonstration of success, will significant progress be made. The recommendations below outline the potential for future success.

## 9.1 Recommendations for measuring risk

- The tools available for quantification are very complex to use and users may not know what type of data they need to collect, so sharing information about what are minimum requirements for different applications may be helpful. JNCC could help develop a decision tree to help users understand what (minimum) information is needed for a particular application, which open source data are validated and verified to be used and some simple KPIs and financial metrics around biodiversity to measure per sector. This could also lead to the development of proxies to incorporate into risk and resilience modelling and financial investment packages.

- Rather than a bottom up technical approach, a top down approach could be used to assess business dependencies' and impacts and demonstrate performance efficiencies. This could take the form of a questionnaire specific to particular business operations focussing on key biodiversity interactions to generate risk and solution focus areas.

- A greater transparency in data provision via open access databases, public sector data, and private business knowledge sharing can minimise costs and ensure that results are sufficiently robust for decision making. For example, the National Biodiversity Network Atlas are seeking business partners to combine funds and data with local and regional data providers to validate, collate and manage the large amount of public and private data potentially available to deliver an exciting UK national biodiversity database which will reduce costs, result in better planning and a better outcome for biodiversity.

- Despite the number of often free tools available, the market users still are not familiar with them and the value they bring. Demonstrating benefits is crucial and there needs to be greater assessment and presentation of successful applications so that users can form an opinion what value tools can bring. Often tools are launched without support and without incorporating user feedback or success (TEEB 2012). Tools also need to be sector specific.

There is an opportunity for companies in the same sector to form partnerships with biodiversity experts to develop and monitor sector specific tools. This can result in efficiencies in terms of research and development but also with the identification of key biodiversity metrics and confidence in robust data.

## 9.2 Knowledge sharing recommendations

- Focussed sector specific training on the risks and opportunities around biodiversity would help enable the sectors to ask the right questions of their suppliers, partners and consultants. These could be tied in with sector specific workshops with JNCC, NGOs and biodiversity experts both researchers and practitioners. It is important to ensure that biodiversity is appropriately considered by organisations such as the Natural Capital Coalition (NCC) and the Natural Capital Initiative (NCI) and that its profile is raised within any sustainability measures.

- Lack of information is one of the key issues that arose through research and subsequent survey. A validated knowledge base could be developed where successful case studies and core metrics could be shared. Conservation Evidence is an online journal (https://www.conservationevidence.com/) that is potentially under used that would be an excellent forum for this information as would the currently unsupported Business and Biodiversity website (http://www.businessandbiodiversity.org/). The Ecosystem Knowledge Network and Valuing Nature Network are excellent resources but are not currently business focussed.

## 9.3 Improving collaboration

- JNCC could encourage and initiate collaboration between different sectors by showing the benefits and opportunities that could be realised using business case studies to demonstrate the point where hard data isn't available. This could be a case around a supply chain issue or across a landscape where many stakeholders can address common challenges that links them together (e.g. water quality, forest management). This may be best achieved by supply chain or landscape specific workshops involving major landowners and users, government, NGOs and other landscape managers. Collaboration was seen by survey respondents as one of the main opportunities for biodiversity integration (see Box S11). For example, business, local government and Universities could partner to develop citywide Sustainable Drainage Solutions (SuDS) and green infrastructure strategies in line with that funded by the Victoria Business Improvement Districts. This is a business-led and business funded body formed to support economic growth in Victoria (London) for which biodiversity led climate attenuation retrofitting and design is a key element.

**Box S11:** Survey respondent's collaboration suggestions.

Survey respondents the following approaches to collaboration:

- Early integration of biodiversity into design helps minimize biodiversity risk (a strategic and project level design based approach)
- Collaboration with the financial sector
- Synergies with suppliers to obtain common benefits (supplier accreditation approach)
- Collaboration between primary sectors such as agri-food, mining and forestry

- The UK is currently undergoing huge government and private capital expenditure to upgrade aging transport, water and energy utilities infrastructure, flood defence and new housing and associated social infrastructure (National Infrastructure Delivery Plan 2016–2021 (Infrastructure and Projects Authority 2016). This presents an enormous opportunity for multi-

sector collaboration and the potential to deliver an integrated approach that includes biodiversity at every stage and benefits every sector. Design and planning using the natural capital/green infrastructure design approach can maximise efficiencies, reduce costs, manage risk and deliver a better living and business operating environment. It would also achieve the benefit of sustainability, resilience and risk reduction associated with climate change, health improvements, wellbeing and societal improvement. There is also role for financial institutions and biodiversity experts to help demonstrate the financial viability of sustainable design and to provide a level of certainty that can be used for cost modelling and procurement to encourage sector implementation. Table 7 presents some potential cross sector collaboration opportunities which could help harness these opportunities.

**Table 7:** Potential collaboration opportunities between sectors to maximise biodiversity opportunities.

| Sectors benefiting | Opportunity | Actions required |
|---|---|---|
| **Construction**<br><br>**Finance**<br><br>**Health**<br><br>**Tourism**<br><br>**Retail** | **Multifunctional green infrastructure design and maintenance to reduce capital and operational costs, to increase resilience and provide greater amenity values.**<br><br>Sustainable Drainage Solutions (SuDS), biodiversity roofs, landscaping *etc*, deliver biodiversity benefits but can also deliver multiple benefits to business and society.<br><br>Benefits such as climate adaptation through passive cooling; natural flood protection, securing freshwater resources through sustainable catchment management (i.e. permeable surfaces); increased air quality through particulate filtering from natural barriers *etc*.<br><br>These benefits have associated health and recreational benefits, many of which will also help to retain staff and/or customers.<br><br>Companies can improve their reputations and lower overall construction and maintenance/operational costs.<br><br>There is greater resilience for natural systems adding security for financial investors. | The construction and finance sectors should not be averse to "novel" solutions.<br><br>Biodiversity experts need to standardise design and demonstrate benefits and finance professionals need to standardise costs to enable greater uptake of these solutions.<br><br>Demonstrate success on knowledge sharing web platforms such as the online journal of Conservation Evidence or the currently unsupported website Business and Biodiversity.org.<br><br>Collaborate with business targeted schemes, such as the University of Portsmouth ProSuDs scheme (University of Portsmouth 2017), which aims to standardise metrics to increase the business uptake of SuDS<br><br>Ensure the financial costs and benefits are incorporated into the financing models for construction and operation and hence scheme viability to prevent removal of design features prior to construction. |
| **Education**<br><br>**Construction**<br><br>**Health**<br><br>**Retail**<br><br>**Finance** | **Biodiversity Education for Increased Wellbeing and as a Mechanism for Stakeholder Engagement**<br><br>Involvement with nature can result in improved educational outcomes and societal wellbeing including social integration and health (Dillon *et al* 2005; Sandifer *et al* 2015).<br><br>Achieved by both local and global biodiversity education supplemented with practical experience via field visits, engaging with experts | Create positive actions harnessing the link between biodiversity and improvements in the health and educational and social development in children.<br><br>Funding models need to change to prevent a barrier to improvement. The biodiversity sector both NGOs, local government and professional practitioners could reach out to the education and health sector and |

| Sectors benefiting | Opportunity | Actions required |
|---|---|---|
| | both in and out of the classroom and by developing their own biodiversity rich spaces.<br><br>Children who are better engaged with biodiversity have been shown to experience physical and mental health benefits as well as educational benefits such as increased concentration levels and greater self-discipline (National Trust 2012). Business already realises how successful community engagement can be in delivering or developing new sites and products and could use biodiversity as a means to engage local stakeholders to operate more efficiently and enhance reputation. | provide *pro bono* expert support but also encourage future budgets to be incorporated around biodiversity education.<br><br>In addition to incorporating biodiversity into normal operating models to achieve net gain, business can use existing Corporate Social Responsibility budgets to maximise their investment and return in biodiversity via community engagement. |
| **Finance**<br><br>**Construction**<br><br>**Health** | **New Biodiversity Centric Financial Products**<br><br>Green bond investment reached $100 billion in 2017 (Climate Action 2017), with a focus on energy projects. The implementation of green bonds is relatively easy for energy projects as the costs (investment and operational costs are predictable and future energy prices can be modelled to determine the economic viability of these projects and how investment costs can be repaid).<br><br>With biodiversity, the benefits can be difficult to determine and what is worse they cannot be captured as a standard pricing mechanism does not exist. Therefore, there is an excellent opportunity to develop biodiversity centric services.<br><br>Instruments, such as green and performance bonds, could be adapted to take biodiversity benefits into account. In addition, impact investors may be willing to invest in these projects to diversify their portfolios with alternative investments and therefore spread risk. | Increase understanding of the risks and opportunities around investment in biodiversity driven solutions and services and limited information for standard pricing models.<br><br>Educate the finance sector and demonstrate potential financial benefits through the quantification of successful case studies, such as those supporting biodiversity for climate protection (Barbier *et al* 2013) in order to access additional financing sources. |

## 9.4 Cultural embedding

- Awards are an excellent way of embedding messages throughout sectors and within and between businesses. Many key decision makers are not aware of the awards and accreditations available or the impact rating/reach of these awards in the media such as the CIRIA BIG Biodiversity Challenge Awards or the Biodiversity Benchmarking accreditation. Signposting the awards and accreditations available and providing guidance on application could be a means of inspiring participation, success then further inspires engagement.

- Following the initiatives suggested it is vital to explore the level of engagement, success of uptake and demonstration and promotion of benefits. A sector specific survey could be designed around a set of biodiversity KPIs and/or positive behaviours and this could be valuable internal business tool to assess success but also may be used as a cost-efficient means to demonstrate CSR and accreditations/standards/initiatives compliance.

# 10 Concluding remarks

The biodiversity dependencies and impacts of tertiary sector businesses can be difficult to define and many companies are far removed in time and space from the actual impacts caused by their supply chains for biodiversity loss to be seen as a material issue. However, businesses that start managing their biodiversity risks will be at a competitive advantage to those that do not due to: securer resource supply; financial access; market space and; enhanced reputational profile, amongst others. Short-termism only delays addressing the problem of biodiversity loss and makes it more difficult to mitigate against due to the allowed continued biodiversity decline.

One barrier that prevents early action against biodiversity loss is that understanding and measuring biodiversity can be challenging. There is the opportunity for experts to collaborate with businesses to develop standardised simplified biodiversity metrics and proxies for different sectors. A top-down approach (e.g. risk and materiality assessment, risk profiling and identification of focus areas) could also complement the bottom-up technical approach while also facilitating engagement between experts and business.

Multi-sector collaboration can deliver wider societal benefits by managing biodiversity while increasing their own efficiency, reducing risk and increasing resilience. This approach can bring operational efficiencies and can be facilitated by supplier accreditations and a landscape led approach.

There is a role for finance sector to start integrating biodiversity risk into their investment profiles to reduce risk of investment and to mitigate potential impact on reputational risk. The construction sector can maximise benefits of biodiversity and green infrastructure to new developments. Retrofitting green infrastructure to existing developments when undertaken cumulatively will result in a wide range of benefits to industry, material improvements for business and also provide wider societal benefits including attenuating climate change.

Quality stakeholder engagement is also an important driver for positive biodiversity change. Biodiversity awards and accreditations are increasingly including educational and community engagement aspects around biodiversity reflecting the natural capital approach to driving change. The biodiversity elements showcased in the 25 Year Plan for the Environment (HM Government 2018) further supports the messages and opportunities presented in this report. Collaboration between government, NGO’s, business and experts can be driven by increased business performance and wider societal benefits to drive the positive direction of biodiversity change.

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# Appendix A: Case Studies

**Table A1:** Examples of dependencies.

| No. | Company | Sector | Description |
|---|---|---|---|
| 1 | Local community | Tourism | Visitors to the Scottish island of Mull to see Sea Eagles contribute around £2 million per annum to the local economy (Bryden *et al* 2010). |
| 2 | Asda | Retail | Asda are amongst those retailers working with WWF and the Roundtable on Sustainable Palm Oil (RSPO) to promote sustainable palm oil production. In 2016 13,233 tonnes of palm oil used in their products was sustainably sourced through the RSPO scheme. Annually Asda surveys suppliers to understand the progress they are making with regards to palm oil sourcing (Asda 2017). |
| 3 | Kingfisher | Retail | Kingfisher has worked on responsible timber sourcing for over 20 years, 96% of their timber is sustainably sourced. They adopt a restorative approach to forestry by seeking to attain positive impacts on forest ecosystems and society (Kingfisher 2016). |
| 4 | GlaxoSmith Kline, Novartis | Health | GlaxoSmith Kline had an arrangement to collect 30,000 samples for $3.2 million from Brazilian biotech company and was prepared to pay $4 million for 10,000 samples of micro-organisms. However, both transactions were terminated for political concerns about inappropriate commercialisation of Brazil's biodiversity (Harvey & Gericke 2011). |
| 5 | Skanska | Construction | Skanska gives preference to the use of timber and timber products which are assured as 'Grown in Britain' while their other construction products have to comply with a recognised responsible sourcing scheme (Skanska 2016). |
| 6 | Various | Health | Twenty-five to fifty percent of the pharmaceutical market valued at $640 billion is derived from nature's genetic diversity (Breeze *et al* 2011). Some molecules used in cancer treatment (e.g. paclitaxel) obtained from nature cannot be replicated in laboratories. The pharmaceutical industry has used only a fraction of the 53,000 species used medicinally worldwide in commercial development. As such the industry may miss out on new drugs given the current species extinction rates. It is estimated that the industry may be missing one important drug every two years (Grigg *et al* 2011). |

**Table A2:** Selected examples of companies exposed to biodiversity risk.

| No | Risk | Company | Sector | Risk/Issue |
|---|---|---|---|---|
| 1 | Reputational | Noble Caledonia | Tourism | In 2017 damage caused by travel and tourism providers can expose them to significant reputational risk. For example, a British cruise ship operated by Noble Caledonia accidentally ran aground during a bird-watching trip on Waigeo Island (West Papua) damaging coral reefs which could take up to 100 years to repair. The evaluation team demanded £1.58 million in compensation from the operator and local tour operators used Facebook to protest. This was reported in newspapers worldwide, including the Independent, damaging the company's reputation and adding to current and future financial risk (Meyjes 2017). |
| 2 | Operational | Aberdeen Roads Limited | Construction | The loss of habitats and land use change can contribute to flooding delaying construction operations and can also exacerbate pollution (Davidson 2016). Pollution fears for watercourses halted work on the Aberdeen Western Peripheral Route (AWPR) for 7 days in June 2016 resulting in hundreds of thousands of pounds in additional construction costs. |
| 3 | Operational | Entire sector | Construction | Many raw materials depend on biodiversity while some of the sourcing practices can have negative impact on biodiversity (e.g. mining, quarrying). The demand for tropical timber in the UK and Europe is very high. Some species are so popular that high quality timber can be difficult to find (FSC 2013), which can have operational implications for many companies, especially if the end buyer specifically requires sustainably sourced timber. |
| 4 | Regulatory | Essential Vivendi Construction Ltd | Construction | Essential Vivendi Construction Ltd pleaded guilty to intentionally and recklessly damaging or destroying the shelter of great crested newts on the site of the former Butlin's holiday camp, now called The Bay. Although the fine was relatively small and not financially material (£11,500 plus costs) the negative press was more damaging (Filey & Hunmanby Mercury 2009). |
| 5 | Reputational | Network Rail | Transport infrastructure operator | Network Rail faced protests over the impacts of vegetation clearance for maintenance operations during sensitive nesting periods for key bird species and a loss of mature trees (Channel 4 News 2012). This sparked television news coverage on Channel 4 and resulted in a cessation of vegetation clearance across the entire network. |
| 6 | Regulatory | Associated British Ports | Transport infrastructure operator | Regulatory risk affects the sector through construction of new infrastructure, on which the transport providers rely. Associated British Ports' share price dropped by 10% when they could not construct a port due to impacts on local biodiversity (Mulder 2007). |
| 7 | Liability | Network Rail | Transport infrastructure | Transport infrastructure during construction and operation may be liable for damages arising through the spreading of non-native invasive species which is leading to loss of biodiversity. For example, Network Rail is facing compensation claims that could total tens of millions of pounds after a landmark court ruling on damage caused to homes by Japanese knotweed growing on its land (Bedford 2017). |
| 8 | Regulatory | Isar Enterprises Keepmoat (Construction) | Construction | In addition to a £10,730 fine, plus costs, Isar Enterprises, a UK property developer, had their profits confiscated in an enforcement of the Proceeds of Crime Act for the first time in the context of biodiversity. This related to the destruction of a bat roost and was reported in the Guardian in 2016 (Barkham 2016). |

**Table A3:** Examples of companies affected by biodiversity loss, scale of impact, and response.

| No | Company name (Sector) | Type of risk | How was the company affected? | Scale of the impact and response (if information is available) |
|---|---|---|---|---|
| 1 | HSBC (Financial) | Reputational | The Dirty Bankers report (Greenpeace 2017a) highlighted how HSBC, despite its policies that prohibit finance of deforestation, provided financial services to companies in Indonesia associated with unsustainable palm oil development. The report also assessed what policy requirements for palm oil sector customers other banks have in place. The campaign to change the bank's policies was joined by hundreds of thousands of people, including 30,000 HSBC customers. NGO campaigns targeting bank's customers on environmental issues can lead to those companies losing customers, IOI Group (financed by HSBC) lost contracts from Unilever after it was suspended from the RSPO in March 2016 (Burrows, 2016). Some banks' clients were also exposed to litigation for forest fires (Jacobson 2016). | To halt the reputational damage that included 30,000 HSBC customers joining the campaign, HSBC adopted a new 'No Deforestation, No Peat, No Exploitation' policy (Greenpeace 2017b). |
| 2 | Barclays group (Financial) | Reputational | An investigation by Friends of the Earth (FOE 2002) discovered that the Barclays Group financed Asia Pulp and Paper (APP) operations in Indonesia. APP was labelled as one of the most destructive paper companies in the world for clearing a large area of Indonesian rainforest and is involved in numerous land disputes with indigenous peoples. Barclays also came under scrutiny at the end of 2003 for providing a $400 million loan to the $1 billion project to build a series of dams in the east of Iceland (De Muth 2003). Friends of the Earth also organised nation-wide protests in the UK. | Barclay's now have an Environmental Risk Management Unit to assess the environmental risks of its lending.<br><br>APP has changed its operating practices and is now considering a number of activities that improve the sustainability of its operations and are even contributing to reforestation (Gunther 2015). |
| 3 | Asda, Marks & Spencer and John Lewis, Tesco, Floors-to-go and others (Retail) | Reputational, Operational | Investigations by Friends of the Earth (FOE 2004a) revealed that Tesco was selling garden furniture manufactured in Vietnam but made from illegally imported Indonesian timber. A study by Friends of the Earth (FOE 2004b) showed that Asda, Marks & Spencer and John Lewis were selling furniture products from unsustainable and possibly illegal sources. Merbau's Last Stand published by Greenpeace (Greenpeace 2007b) documented that a number of high street retailers were selling the Merbau (*Intsia* spp.) timber in the UK. This type of the tropical hardwood species is likely to become extinct within 35 years or less if action is not taken to stop the destructive logging and trade. | The procurement practices of many high street brands have improved and now sell FSC certified products (FSC 2017). |

| No | Company name (Sector) | Type of risk | How was the company affected? | Scale of the impact and response (if information is available) |
|---|---|---|---|---|
| 4 | Asda, M&S, Sainsbury, Tesco (Retail) | Reputational, Operational | Greenpeace uncovered that a number of UK retailers are contributing to the destruction of the Amazon rainforest by sourcing beef from suppliers linked to illegal deforestation (Adam 2009).<br><br>Britain is the second largest importer (50,000 tonnes in 2008) of processed Brazilian beef. Nearly 90% comes from Bertin, JBS or Marfrig, who supply main UK supermarkets (Greenpeace 2009b). Beef sourced from Brazil has a very high environmental impact, some is produced on areas of cleared rainforest.<br><br>Greenpeace wanted consumers to pressure supermarkets to stop purchasing from Brazilian suppliers who are not willing to improve the sustainability of their supply chain. They have used government records, company documents and trade data, satellite images, surveillance flights and site visits to assess deforestation and ascertain global movements of meat, leather and other ingredients made from Brazilian cattle. | To halt the reputational damage, a number of companies responded by reviewing their supply chain and their relationship with suppliers. In 2009, in response to increasing concerns about deforestation linked to cattle ranching, Greenpeace, in conjunction with the major beef producers in Brazil, developed the Brazilian Cattle Agreement.<br><br>Tesco has changed their beef supplier to avoid being associated with deforestation (Thornhill 2012). As part of the Consumer Goods Forum, they pledged to contribute to achieving zero net deforestation by 2020.<br><br>In 2016 Asda procured their meat suppliers outright to simplify their supply chain. |
| 5 | Boots and Waitrose (Retail) | Reputational, Operational | A number of UK companies, including Boots and Waitrose were exposed to negative publicity as a result of not using sustainably sourced palm oil in their products (Hickman 2009). | Waitrose adopted sustainability policies to address palm oil sourcing. In 2006 they became the member of the RSPO and in 2012 achieved their target to use 100% RSPO certified palm oil (Waitrose 2017). |
| 6 | Tourism | Operational | Wildlife tourism is one of the key attractions for much of the rural areas in the UK and is important in Scotland (Kelbie 2008). Wildlife tourism is an important source of revenue contributing £127 million annually to the Scottish economy alone (Bryden *et al* 2010). | A government study on the threats to Scottish wildlife tourism listed built developments as a cause of conflicts with wildlife tourism activities, through disturbance of wildlife itself and spoiling aesthetics making it less attractive for visitors (Bryden *et al* 2010).<br><br>In 2014, Ian Ross, the chairman of Scottish Natural Heritage warned that the recent spate of raptor poisonings in the Highlands is threatening the appeal of Scotland's nature-based tourism industry, which is worth an estimated £1.4 billion a year (Bryden *et al* 2010). |
| 7 | Fisheries and Tourism | Operational, Reputational | The use of antibiotics and commercial feed in fish farms is impacting upon wild Scottish salmon (McKenna 2014). This can pose operational risks for industries, such as retail, hospitality and tourism, and expose aquaculture and retail to reputational risk. Pollution from | Aquaculture is an important industry in rural Scotland, contributing £400 million in Gross Value Added (GVA); Scotland is the second largest producer of farmed Atlantic salmon in Europe. Tourism GVA is 12 times higher and, whilst visitor |

| No | Company name (Sector) | Type of risk | How was the company affected? | Scale of the impact and response (if information is available) |
|---|---|---|---|---|
| | | | aquaculture may affect other sectors reliant upon clean water resources, as well as financiers funding operations.<br><br>Examples from around the world show that aquaculture is threatening the viability of other industries operating in its sphere of influence. In British Columbia jeopardizing the province's sports fishery, commercial fishery, fish processing sector, and marine tourism. Furthermore, wild salmon support populations of other top predators, such as the bears, eagles, orcas which are crucial for ecosystem functioning (CARR 2017). | numbers are not presently diminished as a result of aquaculture (Nimmo *et al* 2009), potential for economic loss is considerable. As a result, opportunities are presented for cross-sectoral collaboration. |
| 8 | Hospitality | Operational, Reputational | Due to climate change a number of species may migrate to the northern parts of the planet, which may affect the composition of marine life in UK waters. For example, squid which prefer warm waters are set to replace some fish in the future (Topping 2016). | Decline in the availability of local resources will have implication for hospitality industry as restaurants will have to change menus or source fish from other countries which will increase their operational cost. As a result of biodiversity loss some companies are changing their operations. For example, Compass, the world's largest contract caterer banned 69 endangered fish species from its restaurants (Meikle 2009), such as Atlantic cod, bluefin tuna and swordfish. |

**Table A4:** Examples of potential opportunities.

| No. | Company (Sector) | Sector/company issue | Corrective intervention | Benefits |
|---|---|---|---|---|
| 1 | Travis Perkins (Retail) | The UK Government requires companies to source timber from sustainable sources. | Travis Perkins introduced a system for sourcing sustainable timber (Travis Perkins 2016) to increase its ability to track it through the supply chain in order to help the company minimise the risk of losing access to government contracts. | Protecting revenue streams<br>Risk management<br>Reputational enhancement |
| 2 | GSK (Health) | GlaxoSmithKline attempted to understand its impacts on biodiversity through sourcing of raw materials. | The company has reviewed its raw materials use and amongst others has identified the use of palm oil, fish oil and paper as areas of potential concern. As a response, the company intends to review its sourcing policy and source palm oil and paper packaging from sustainable sources. To achieve their responsible sourcing goals, GSK is collaborating with stakeholders in the supply chain, in particular working with groups such as the RSPO, the Consumer Goods Forum, Rainforest Alliance and CDP (RSPO 2018). | Security of supply<br>Risk management<br>Reputational enhancement |
| 3 | Vodafone/O2 (Communications) | Communication services have potential impact on land as a result of their infrastructure activities. Through careful planning of operations (e.g. sharing base stations) and procurement of products and services they can lower the impact on biodiversity and can simultaneously improve their bottom-line. | Companies such as Vodafone and O2 (Vodafone 2017) are sharing communication towers in the battle to gain territory over British Telecom. In 2012, both companies announced plans to form a grid of around 17,500 joint base stations by sharing sites to provide services to customers of both companies. This helps both companies reduce the number of sites they need and, in future, any new stations required will be built jointly. | Cost reduction (construction and operation)<br>Risk management |
| 4 | HSBC (Finance) | Financial sector companies have the potential to influence other companies to adopt more sustainable business models by providing financial products to their clients. At the same time, as a result of clients' operations, they themselves can be exposed to a range of biodiversity risks that can affect their financial performance. HSBC have had a number of high profile biodiversity investment issues. | Biodiversity was integrated into HSBC's ISO14001 accreditation and, in 2002, HSBC launched Investing in Nature - a $50-million, five-year partnership with several conservation organisations. As part of this initiative, HSBC sent 2,000 of its employees on Earthwatch Institute field research projects around the world and supported the training of 230 developing-country scientists. Participating HSBC employees also had a responsibility to undertake an environmental project in their workplace or local community, supported by a small grant from the company. This initiative supported conservation on the ground and also strengthened biodiversity awareness and commitment across the HSBC workforce (TEEB 2012). | Protecting revenue streams<br>Risk management<br>Reputational enhancement<br><br>An independent evaluation concluded that 80% of senior HSBC managers agreed that the programme contributes to embedding sustainability into the 'DNA' of the business, while 83% agreed it is worth the investment because the |

| No. | Company (Sector) | Sector/company issue | Corrective intervention | Benefits |
|---|---|---|---|---|
| | | | | programme gives HSBC a competitive advantage. Programmes also attract young talent (TEEB 2012). |
| 5 | Barclays (Finance) | Banks have recognised that the reputation of the bank and the borrower are inextricably linked. | Barclays uses environmental credit risk assessment policies and procedures as part of their loan evaluation and sanctioning process to assess how environmental risks can impact the financial status of the company or project. Factors relating to biodiversity include likelihood of change to budgeted number of operating days, likelihood and duration of delays or suspension of operating permits, potential for pollution and likely impact and mitigation costs of a pollution event. Barclays has also adopted Equator Principles and established a dedicated central environmental risk management team to advise on such assessments (F&C Management 2004; Barclays 2018). | Protecting revenue streams<br>Risk management<br>Reputational enhancement |
| 6 | Marks and Spencer (Retail) | Reputational risk for such a traditional and iconic British brand. | The Marks & Spencer store at Cheshire Oaks, was designed to be the “biggest and greenest” Marks and Spencer store ever built (18,000 sqm). Designed to be their most carbon efficient with a design strategy that also included sustainable use of water, energy, waste, biodiversity, community and materials. Biodiversity is integral part of M&S sustainability Plan A and the store was the first of its kind to be awarded The Wildlife Trusts’ Biodiversity Benchmark (Cheshire Wildlife Trust 2014). | Protecting revenue streams<br>Risk management<br>Cost reduction (operational)<br>Reputational enhancement |
| 7 | Retail general | The retail sector is under scrutiny from the public to source products sustainably. The sector also influences the purchasing choices consumers make and by specifying purchasing requirements can have a greater influence on their supply chain. | From 2017, 12% of global marine wild catch is certified to the MSC Fisheries Standard and the market for certified sustainable and labelled seafood is worth over US$5 billion (MSC 2017). In the UK the size of organic fish retail market exceeded £1.86bn in 2015 (Smithers 2015). | Security of supply<br>Risk management<br>Reputational enhancement |
| 8 | Network Rail (Transport Infrastructure) | The company wished to improve green corridors to support wildlife and reduce the risk of accidents caused by leaf and tree limb fall. | Network Rail need to maintain rail sides by vegetation management which involved clearance, however they have committed to a net gain biodiversity policy while undertaking these works. This is often achieved via habitat conversion from trees to more diverse grassland and/or wetland habitats thereby making infrastructure more resilient to flood and winter storms while also tackling leaf fall (Natural England, Department for Environment, Food & Rural Affairs and Highways Agency 2014). | Risk management<br>Cost reduction (operational)<br>Reputational enhancement |

Biodiversity Risk - Integrating Business and Biodiversity in the Tertiary Sector

| No. | Company (Sector) | Sector/company issue | Corrective intervention | Benefits |
|---|---|---|---|---|
| 9 | Ninewells Hospital (Health) | Ninewells Hospital in Dundee was selected as a national pilot site because it showcased joined up delivery between the environment and health sectors in Scotland. | The purpose of the pilot was to demonstrate that by greening hospital grounds you can connect built and natural environments to create a health promoting hospital site. The natural environment at Ninewells was an underused asset, which has now realised the potential to provide staff, patients and visitors with accessible outdoor space (Forestry Commission Scotland 2010a). | Cost reduction (operational)<br>Improved patient performance |
| 10 | Lawson Memorial Hospital (Health) | The Lawson Memorial Hospital was identified by the NHS as suitable for enhancing greenspace/patient interactions. | Following the Ninewells example space has been developed within the site which had the potential for greenspace development and which can provide potential health benefits to patients (Forestry Commission Scotland 2010b). | Cost reduction (operational)<br>Improved patient performance |
| 11 | Gartnavel Hospitals (Health) | Gartnavel General contains independent units such as Maggie's centre and the Homeopathic Hospital which have been designed to provide high quality surroundings and to offer links to the natural environment. | The Green Exercise Partnership project was introduced. This aimed to improve access to green spaces around Gartnavel Royal by clear signposting to outdoor spaces and walking routes (Forestry Commission Scotland 2010c). | Cost reduction (operational)<br>Improved patient performance |
| 12 | Gatwick Airport (Transport operation) | While the impetus for many of the initiatives on Gatwick Airport's Biodiversity Action Plan came from Section 106 requirements, they maximised the value of their BAP. | The airport has compiled a management plan which covers an area of 75 hectares including woodland, grassland and wetlands adjacent to Gatwick Airport. As well as enhancements to the habitats, they have included multiple stakeholders and have taken the opportunity for community engagement and promotion of education. The project is managed as part of Gatwick's ISO14001 standard has achieved certification to the Wildlife Trust Biodiversity Benchmark Award and won the 2016 CIRIA BIG Biodiversity Client Award (CIRIA 2018). | Risk management<br>Cost reduction (expedited planning and reduction in operational objections)<br>Reputational enhancement |

**Table A5:** Examples of successful collaboration between business, government, NGOs and biodiversity experts

| No | Lead | Partner organisation | Type of the problem | Solution | Benefits |
|---|---|---|---|---|---|
| 1 | AstraZeneca (2017) | Cambridge University | The pharmacological industry is facing pressures on their revenue due to multiple factors including expiring patents, complex regulatory requirements, siloed working practices separating Research and Development (R&D) from the commercial, production and supply chain (Pisani & Lee 2017). | By collaborating with governments and research institutes and complying with The Convention on Biological Diversity and The Nagoya Protocol on Access and Benefit-sharing, new products may be discovered more rapidly.<br><br>AstraZeneca's decision to move to Cambridge University in 2016 has already been hailed as a success with a doubling of collaborations in one year (Brackley 2016) even before physical co-location is complete enabling faster uptake of ideas and sharing of knowledge that can speed up discovery process in the pharma industry (AstraZeneca 2014, 2017). | Protecting revenue streams<br>Security of supply |
| 2 | Berkeley Homes (Natural England 2013) | Natural England and Hart District Council | Berkeley Homes sought planning permission for a housing development in close proximity to the Thames Basin Heath Special Protection Area (SPA), an interconnected and globally rare heathland habitat spanning Surrey, Berkshire and Hampshire, that is vulnerable to recreational disturbance. | Natural England worked with the local planning authority and the developers to find a solution which would meet the requirements of the Habitats Regulations and enable the housing development to proceed. The project partners created Edenbrook Country Park by converting agricultural land into a high-quality set of wildlife habitats. The local planning authority increased the area of land available for development, sped up consents and provided attractive amenity value while achieving stakeholder good will for future phasing and consents. | Risk management<br>Cost reduction (larger developable land area, expedited planning and reduction in operational objections)<br>Reputational enhancement<br>Increased product value |
| 3 | Wilmott Dixon (UK GBC 2017b) | The Wildlife Trusts | Wilmott Dixon had to mitigate the impacts of their activities on biodiversity and provide strategic mitigation plans in order to be allowed to continue with their activities. | The Wildlife Trusts' network of consultancies provided ecology advice and support on local habitats at Willmott Dixon projects ensuring that the developments received approval and left a positive legacy, and created good PR for the company. | Cost reduction (expedited planning and reduction in operational objections)<br>Reputational enhancement |
| 4 | Crest Nicholson (UK GBC 2015) | Wiltshire Wildlife Trust | Requirements for the development of Tadpole Garden Village in line with the original Garden Cities principles. | Crest Nicholson developed their own Garden Village Framework creating a Nature Park, which resulted in the conversion of more than 48 hectares of arable land to wildflower species rich meadows, and provided vital links in the green | Cost reduction (expedited planning and reduction in operational objections)<br>Reputational enhancement<br>Increased product value |

| No | Lead | Partner organisation | Type of the problem | Solution | Benefits |
|---|---|---|---|---|---|
| | | | | corridor which runs along the River Ray to the north Wiltshire countryside. | |
| 5 | Trumpington Meadows Land Company (UK GBC 2015) | Bedfordshire, Cambridge-shire Northamption-shire (BCN) Wildlife Trust | Trumpington Meadows Land Company needed to minimise objections to its planning application for a high-quality development. | The BCN Wildlife Trust was selected in advance as the land managing organisation and engaged with the landscape architect on design and creation of the development's green infrastructure to help secure better outcomes and limit future problems (e.g. flood alleviation). By overseeing the creation of new habitats, The BCN Wildlife Trust was able to work with trusted local suppliers and contractors resulting in significant financial savings. | Cost reduction (expedited planning and reduction in operational objections)<br>Reputational enhancement<br>Increased product value |
| 6 | c2c (National Express 2016) | Bumblebee Conservation Trust<br>Local community volunteers<br>Company employees | Poor local public perception of transport operator. | The wasteland brownfield site opposite Shoeburyness station was cleared of waste rubbish and litter by local volunteers to make it a more accessible and pleasant environment for both rail users and the local community. Focus was on areas that could be accessible to local children attending primary schools and members of Scout and Guide groups and would provide education opportunities for local children. | Protecting revenue streams (through continued licence to operate)<br>Reputational enhancement |
| 7 | Network Rail (Network Rail 2006) | Charity Butterfly Conservation<br>Centre for Ecology and Hydrology | Network Rail were responsible for line side management of habitat that supports the Large Blue, one of Britain's rarest butterfly species. | Two new habitats were created beside the railway with south facing slopes to provide the site with sunlight, allowing the butterfly to flourish. Consequently, Network Rail won a top conservation award. | Protecting revenue streams (through continued licence to operate)<br>Reputational enhancement |

**Table A6:** Examples of a landscape approach using Payments for Ecosystem Services (PES).

| Project | Area | Brief description | Beneficiaries |
|---|---|---|---|
| Slowing the flow at Pickering (Institute of Civil Engineers 2014) | North Yorkshire | Scheme led by Forest Research, closely supported by Forestry Commission England, The Environment Agency, The North York Moors National Park Authority, Durham University, Natural England, Local Authorities and the wider community. The project aimed to enhance flood protection against a 1-in-25-year flooding event for Pickering, whilst delivering co-benefits for water quality, wildlife and soil protection. This was achieved through a mixture of land management measures and woodland creation. Multiple funding sources supported the project on the behalf of beneficiaries such as local residents and businesses. | Local business<br>Landowners<br>Local residents<br>Wider society |
| Pumlumon Project (Millward 2014) | Wales | Led by Montgomeryshire Wildlife Trust funded by Defra and various partners, the scheme aimed to revive the ecology and economy of the Welsh uplands by taking an economic-based approach to ecosystem management with landowners in the Cambrian Mountain range. Funders included the landowners that received direct and indirect benefits. Indirect beneficiaries included residents downstream (water quality and supply), tourists and visitors, and wider society (carbon storage and sequestration). | Local business<br>Landowners<br>Local residents<br>Wider society |
| Natural England Uplands Ecosystem Service Pilots (Waters *et al* 2012) | Lake District National Park | One of three Natural England pilot studies with multiple funders and partnerships, the project in the catchment of Bassenthwaite Lake took an integrated approach to managing the catchment for multiple outcomes (e.g. water provision, water quality). This is a catchment-scale example of spatially prioritising land management actions for multiple ecosystem services through partnership working. The project combined public and private funding sources (Environmental Stewardship, English Woodland Grant Scheme, water utility company investment). | Tourism<br>Utilities<br>Local business<br>Wider society |

Source: (Smith 2013).

**Table A7:** Examples of successful integration of biodiversity knowledge.

| No. | Company | Sector | Activity/Objective | Type of benefits realised | Scale of benefits | Beneficiary |
|---|---|---|---|---|---|---|
| 1 | Hammerson (Hammerson 2017) | Construction and Business services | Arcadis (previously Hyder) developed a Strategic Biodiversity Action Programme for Hammerson to improve development and maintenance across their land holdings. Biodiversity implementation targets for all sites were achieved by 2015. | Improved brand/ reputation<br>Corporate social responsibility<br>Operational efficiencies<br>Lower development costs<br>Evaluation of current biodiversity assets and operations | Company benefited from marketing and publicity but also maximised efficiencies around development planning and management. | Company<br>Property buyers<br>Occupiers (wellbeing and footfall increase in retail areas)<br>Consumers<br>Local communities |
| 2 | The Body Shop (Edie 2017; Sustainable Brands 2016) | Retail | As part of Enrich Not Exploit™, the Bio-Bridges programme aims to regenerate 75 million square metres of forest by 2020. The brand will invest in sustaining biodiversity in locations which possess some of the world's most endangered animals. | Improved brand/ reputation<br>Corporate Social Responsibility<br>Ethical and sustainable product sourcing | The company aims to make its business the most sustainable global business in the world and the positive publicity continues to support its brand. | Company<br>Consumers<br>Local communities |
| 3 | Berkeley Group | Construction | Developed a Sustainability Living Tool that provides an interactive diagram and further facts about sustainable lifestyle (Berkeley Group 2018).<br>The company implemented a number of award-winning biodiversity enhancements at developments including a new nature reserve at Woodbury Down (Berkeley Group, undated) and beehives on top of One Tower Bridge. | Improved brand/ reputation<br>Lower development costs<br>Operational efficiencies<br>Corporate social responsibility | CIRIA BIG Biodiversity Challenge Award 2016 Pollinator category for beehives at One Tower Bridge.<br>90% of residents say they are satisfied with their lives at Woodberry Down, compared to the national average of 60%.<br>Woodberry Down CIEEM 2017 Best Practice Finalist for the NGO Impact Award along with the Wildlife Trust.<br>The UK Customer Satisfaction Award 2016. | Company<br>Property buyers<br>Local community |
| 4 | Land securities (Land Securities 2018) | Construction and Business services | Land securities' The Sustainability Report 2017 includes targets to maximise the biodiversity potential of all development and operational sites. The company plans to achieve a 25% biodiversity net gain across the five | Improved brand/ reputation<br>Corporate social responsibility | Developed a methodology with The Wildlife Trusts to measure biodiversity on all sites.<br>Developing net gain plans at several sites. | Company<br>Property buyers<br>Employees<br>Local community |

| No. | Company | Sector | Activity/Objective | Type of benefits realised | Scale of benefits | Beneficiary |
|---|---|---|---|---|---|---|
| | | | sites offering the greatest potential by 2030. The company has partnered with The Wildlife Trusts to develop a strategic action plan and launched the Sustainability Matters training programme. | | | |
| 5 | Skanska (Skanska 2017) | Construction | Skanska adopted an environmental management approach to biodiversity. Through charity partner Groundwork, their employees have contributed to enhancing biodiversity in the local communities in which they work through 'lend a hand' volunteer programme.<br><br>They supported the development on the Natural Capital Protocol. | Improved brand/ reputation | 2010: Skanska UK ranked second overall in Sunday Times Best Green Companies Award.<br>2011: Received the Sunday Times Greenest Company Award.<br>2014: Received the Construction News Sustainable Company of the Year Award.<br>CIRIA BIG Award shortlist for Pollinators and Temporary award 2015. | Company<br>Employees<br>Local community |
| 6 | Kingfisher Group (Kingfisher 2015, 2016) | Retail | Prepared Net Positive Report 2014/15 Delivering strategy sustainably to support sustainable sourcing.<br>Developed partnership to assess the impact of certification on forests and biodiversity.<br>B&Q became a founding member of the Forestry Stewardship Council (FSC) in 1991, and in 1993 was one of the first retailers to develop a responsible timber policy.<br>Developed B&Q One Planet One Home Sustainability Strategy.<br>Working towards 100% responsibly sourced timber in all operations by 2020 and elimination of peat use. | Improved brand/ reputation<br>Corporate social responsibility<br>Ethical and sustainable product sourcing | Reached an overall 92% responsibly sourced timber in products with B&Q UK achieved 100% in 2015.<br>Has won multiple awards including:<br>Sustainable Business of the Year - Energy and Environment Awards 2015<br>Britain's Greenest Garden Centre - Garden Retail & Garden Industry Awards in 2016 and 2017<br>Unsung Hero Award – The Guardian's Sustainable Business Awards 2016. | Company<br>Consumers<br>Society |
| 7 | British Land (UK GBC 2009) | Construction and Business Services | Biodiversity is integrated into British Land's business practices, through site specific management plans, and the | Improved brand/ reputation<br>Corporate Social Responsibility | All new London office buildings incorporate green roofs or walls. Won numerous awards including the following: | Company<br>Buyers<br>Employees<br>Local communities |

| No. | Company | Sector | Activity/Objective | Type of benefits realised | Scale of benefits | Beneficiary |
|---|---|---|---|---|---|---|
| | | | Sustainability Brief for new developments.<br>Promote green roofs and green walls in their new buildings to encourage biodiversity and improve building insulation, as well as providing aesthetics for occupiers.<br>Review opportunities to retro-fit green roofs to existing properties. | Providing occupier amenity | Guardian Sustainable Business Award 2011 for their green roof programme.<br>World Green Business Council Business leadership in Sustainability Awards 2013.<br>ENDS Green Economy Awards 2013 Highly commended 2013<br>EPRA Sustainability Reporting Awards 2015 gold for 4th year. | |
| 8 | A2 Dominion (NW Bicester 2018) | Construction | The development of the NW Bicester Eco town using a landscape-led master planning approach designed by Arcadis (formally Hyder) and Farrell's architects delivered an award-winning development that brought benefits to the developers, occupiers and surrounding communities.<br>Used extensive SuDS treatment drains to attenuate the water flow from site to pre-development levels while designing a landscape for healthy living.<br>The biodiversity value of the green infrastructure was maximised throughout the planning and development. | Improved brand value, reduced development and operational costs expedited planning consents, provided occupier amenity.<br>Human health.<br>Increased sales | Planned delivery of biodiversity net gain.<br>Properties in the development have sold incredibly well due to positive perceptions.<br>NW Bicester was named one of only 10 towns in England to be part of the NHS Healthy Towns initiative.<br>Green Apple Award 2015.<br>Winner of the Sustainability category of the Constructing Excellence awards 2016.<br>Estimated annual value of SuDS over £300,000 per year for the exemplar site. | Company<br>Buyers<br>Local community<br>Investors<br>Society |
| 9 | Ambitious about Autism / TreeHouse School (Treehouse School 2018) | Education<br>Business Services<br>Communication Services<br>Water Utilities | TreeHouse School has long recognised the importance of biodiversity for education with their award winning edible garden for secondary school children. In addition to creating the existing garden Arcadis was one of the pro-bono supporters of the new Sapling Project to create a wildlife and edible garden for young children while maximising the biodiversity potential of the site by providing ecology and arboriculture design and planning advice. With volunteers from Treehouse | Increasing educational performance.<br>Increasing staff knowledge.<br>Engaging the business community. | Second place in the 'Best secondary school edible garden' category of the Capital Growth gardening competition 2015. | Local community<br>Staff<br>Society |

| No. | Company | Sector | Activity/Objective | Type of benefits realised | Scale of benefits | Beneficiary |
|---|---|---|---|---|---|---|
| | | | School, DLA Piper, AECOM and British Telecom, Arcadis worked on design and implementation of the site which was gifted to the school by Thames Water. | | | |
| 10 | Haven Holidays part of Bourne Leisure (British Holiday and Home Parks Association 2017) | Tourism | The Perran Sands Holiday Park lies within the Penhale Sands Special Area of Conservation (SAC). The challenge was to run a successful business while protecting the SAC. The Holiday Park has been managing their section of the Penhale Sands SAC through the Countryside Stewardship Scheme but also the Ministry of Defence steered by the Penhale Sands Management Committee of which they are also members. | Improved brand value.<br>Expedited planning consents, provided occupier amenity.<br>Human health.<br>Increased sales.<br>Climate resilience.<br>Education. | Cited as an example of good practice in David Bellamy's new book "Conflicts in the Countryside, the New Battle for Britain" and won the David Bellamy Conservation Award<br>Green Tourism Business Scheme Award.<br>Doubling of the skylark population since 1995. | Local community<br>Company<br>Tourists<br>Wider society |

# Appendix B: Quantification and Measurement

**Table B1:** Methods for measuring biodiversity impacts and dependencies.

| Name | Brief description | Who is it for? | Authors |
|---|---|---|---|
| Corporate Ecosystem Services Review (ESR)* | ESR helps business managers develop strategies to address the risks and opportunities arising from a company's impact and dependence on ecosystem services. | Biodiversity practitioners and business managers at all levels. | WRI WBCSD (Hanson *et al* 2012) |
| Guide to Corporate Ecosystem Valuation (CEV)* | A framework for improving corporate decision making through valuation of ecosystem services. The guide provides a screening process to help businesses decide whether valuation is likely to be useful. It provides a step-by-step process on undertaking ecosystem valuation to inform corporate decisions. | Biodiversity practitioners and business managers at all levels. Helps users new to ecosystem service valuation understand concepts and interpret results. | WBCSD (2011) |
| The Corporate Biodiversity Management Handbook | The handbook for a business case for biodiversity and offers guidance on how to implement corporate biodiversity management. | Biodiversity practitioners and business managers to help them strengthen the implementation of biodiversity management systems. | Centre for Sustainability Management (Schaltegger & Beständig 2012) |
| Natural Capital Protocol* | A framework designed and created by a coalition of businesses, NGOs and biodiversity experts. Its purpose it to help companies qualify, quantify and monetize their interactions with natural capital assets to make better informed decisions. This includes biodiversity, but it is acknowledged that biodiversity is underrepresented in terms of valuation processes. | Can be used by biodiversity practitioners and tertiary sector users to help them inform decisions around the natural capital impacts and dependencies. | Natural Capital Coalition (2016) |
| Natural Capital Workbook version 1.0* | Frames the natural capital approach in a UK context to align with Government visions for net improvement in England's natural capital in its 25 Year Environment Plan. It is a practical model to help decision makers measure natural capital and its benefits in particular to identify threats and opportunities and to develop practical plans for implementation. | Intended to support decision makers, including planners, communities and landowners. It is relevant for decision makers that make place based decisions. | Natural Capital Committee (2017) |
| Key Biodiversity Area (KBA) Principles and Recommendations for Responsible Business Operations | In early 2016 the KBA Partners, under the coordination of IUCN, developed a suite of principles and recommendations to guide responsible business operations in and around KBAs. It is applicable to large multinationals, as well as small and medium-sized enterprises in any economic sector. It helps to identify risks and opportunities and form stakeholder relationships to responsibly operate in KBAs. | Biodiversity practitioners and business managers at all levels. | IUCN (2018) |
| Biodiversity Net Gain: Good practice principles for development | A best practice principle guidance document for the UK construction industry to help deliver net gain within infrastructure development projects. | For biodiversity practitioners, design professionals and construction managers to direct them towards the benefits of and methods of achieving net gain. | CIEEM, CIRIA, IEMA (2016) |

* Whilst useful, methods need to better acknowledge the contribution of biodiversity to ecosystem services.

**Table B2:** Description of selected tools.

| Name | Purpose/ Type of assessment | Description |
|---|---|---|
| Ecosystem Services Benchmark* | Screening / corporate level assessment | Designed for cross-sectoral investors to help them evaluate organisational risk management and opportunity identification relating to biodiversity and ecosystem services. |
| Business and Biodiversity checklist | Product, facility, company | Excel based tool incorporating a checklist with ratings resulting in a report providing areas of biodiversity strengths and weaknesses. |
| ARtificial Intelligence for Ecosystem Services (Aries) | Site level | A software tool that enables spatial mapping and quantification and economic valuation of ecosystem services. It enables detailed and dynamic assessment of how nature provides benefits to people. |
| Capital Asset Value for Amenity Trees (CAVAT)* | Site level | Used for managing trees in the UK as public assets rather than liabilities. A strategic tool to aid decision-making in relation to the tree stock in general, but can also be used to value a single tree in monetary terms. |
| Integrated Valuation of Ecosystem Services and Trade-offs (InVest) | Site level | An open-source software model using GIS that can map and value ecosystem services for assessment of impacts associated with management choices. |
| SPAtial Decisions on Ecosystem Services (SPADES)* | Site level | Spatial analysis and assessment of ecosystem services (eCountability with the support of six partner organizations and advice from the UK construction industry). The GIS tool compares layout and design options for development. Outputs are quantitative, and monetized where appropriate. |
| i-Tree | Site level | A method for valuing the ecosystem service benefits (e.g. carbon sequestration and air pollutant removal) that trees provide. |
| Defra biodiversity offsetting metric | Site level | A calculation for measuring biodiversity loss and the amount of mitigation and compensation required to achieve no net loss or net gain. Often that compensation needs to be undertaken off site. |
| Bio-scope | Supply chain | A fast and effective scoping tool demonstrating the impacts on biodiversity in the supply chain. |
| Ecologically-Based Life Cycle Assessment (Eco-LCA)* | Supply chain | Eco-LCA is a framework to account for the role of ecosystem goods and services in the life cycle of different products and materials and what impacts they have on nature. |

* Tools that while useful need to better acknowledge the contribution biodiversity makes to the delivery of the ecosystem services being assessed.

**Table B3:** Description of selected databases.

| Name | Description/ type of data available |
|---|---|
| Integrated Biodiversity Assessment Tool (IBAT) | Provides access to critical information on biodiversity priority sites to address any potential biodiversity impacts. It is a central database for globally recognised biodiversity information including protected areas, Key Biodiversity Areas, species and regionally important conservation areas.<br><br>Datasets within IBAT are updated several times per year and developed through a partnership of global conservation leaders including BirdLife International, Conservation International (CI), the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) and the International Union for Conservation of Nature (IUCN).<br><br>The IBAT alliance is also developing a set of web-based decision support systems that provide easy access to site-scale and national-level conservation priorities to support project screening/planning by providing the best scientific information.<br><br>The tool does not require any specific skills to use. |
| IUCN Knowledge products | The IUCN knowledge products include tools for the conservation of biodiversity, mechanisms, processes, datasets, analytical methods and applications, web-portals and publications. They are open access are underpinned by science, used to build capacity, support decision-making by policy-makers.<br><br>IUCN knowledge products which inform and underpin area-based conservation of biodiversity, restoration, and land use and marine spatial planning include:<br>• The IUCN Red List of Threatened Species™<br>• Protected Planet (including World Database on Protected Areas - WDPA)<br>• IUCN Standard for identification of areas of global significance for biodiversity (“key biodiversity areas”)<br>• IUCN Red List of Ecosystems<br>• Global Invasive Species Database (GISD) |
| Group on Earth Observations (GEO)<br>Global Earth Observation System of Systems (GEOSS)<br>Biodiversity Observation Network (GEO BON) | GEO BON aims to improve the acquisition, coordination and delivery of biodiversity observations and related services to users including decision makers and the scientific community. It is a global biodiversity observation network that contributes to effective management policies for the world’s biodiversity and ecosystem services. Monitoring systems consisting of satellite, air, land and ocean-based instruments that are interlinked through the Group on Earth Observations (GEO) to form the Global Earth Observation System of Systems (GEOSS).<br><br>The biodiversity element GEO BON combines stand-alone observation instruments with systems tracking trends in the world’s genetic resources, species and ecosystems (e.g. global change detection maps of forest cover). GEO BON is creating a global platform for integrating biodiversity data, with data on climate and other environmental factors.<br><br>Systems link to the Global Biodiversity Information Facility (GBIF) that provides open access to data gathered by thousands of recorders globally, and to the World Data Base on Protected Areas (WDPA), that contains information intended for ecological gap analysis*, environmental impact analysis and private sector decision making and can contribute to regional and global biodiversity assessments and scenarios. |

| Name | Description/ type of data available |
|---|---|
| UNEP World Conservation Monitoring Centre (WCMC) | WCMC provides databases on the status of biodiversity and ecosystem services relevant to business operations and policy applications. The WCMC Business, Biodiversity and Ecosystem Services (BBES) programme was created in 2009. It includes datasets, such as World dryland areas, World Database on Protected Areas (WDPA), Mountains and Tree Cover in Mountain Regions. It also includes species datasets, tools on key conservation areas including mangroves, wetlands, tropical forests and coral reefs. |
| GBIF Global Biodiversity Information Facility | An international open data infrastructure allowing access to information about all types of life on Earth. It is publicly funded and provides institutions that hold data with common standards and open-source tools to enable them to share information about where and when species have been recorded. |
| NBN National Biodiversity Network Atlas | The NBN Atlas is a new initiative emerging from the NBN gateway that intends to collate the UKs biodiversity data in one user friendly interface. It is a free online tool that provides a platform to engage, educate and inform people about the natural world. The NBN Atlas is innovative because the combination of the multiple sources of information about UK species and habitats, and the ability to interrogate, combine, and analyse these data – in a single location. |

* A tool used in wildlife conservation to identify gaps in conservation lands (e.g. protected areas) or other wildlands where significant plant and animal species and their habitat occur.

**Table B4:** Overview of guidance, standards, initiatives and reporting frameworks.

| Type | Description | Examples |
|---|---|---|
| Initiatives | Facilitate cross-sectoral collaboration among different organisations to develop the evidence base. | • The Sustainable Development Goals (2015) has 17 goals that can benefit from the integration of biodiversity. Goal 15 in particular aims to "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss".<br>• Convention on Biological Diversity (1992) unified nations around three main goals: the conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of benefits arising from genetic resources<br>• NERC's six-year BESS (Biodiversity and Ecosystem Service Sustainability) programme, completed in 2017, centred on the functional role of biodiversity in key ecosystem processes and the delivery of ecosystem processes at the landscape scale<br>• The EU Business and Biodiversity platform (B@B) is focussed at the EU level to help integrate natural capital and biodiversity considerations into business practices.<br>• The Natural Capital Initiative, the Natural Capital Committee and the Natural Capital Coalition report on different aspects of natural capital with NCI being the most biodiversity driven (NC Committee is an advisory to UK government policy and NC Coalition focusses on the corporate sectors)<br>• Cambridge Institute for Sustainability Leadership Natural Capital Leaders platform<br>• UK Green Business Council unites members in sustainable building<br>• IUCN Business and Biodiversity programme focussed globally on valuing biodiversity, promoting biodiversity net gain and investing in nature |
| Reporting frameworks | Enables corporate disclosure on biodiversity impacts and dependencies, and operational impacts. | • Integrated reporting (IR)<br>Provides a framework for a strategic evaluation and reporting of material sustainability risks and opportunities and their pertinence to a company's business planning and financial results. It features natural capital as one of six capitals that can be used in reporting.<br>• Global Reporting Initiative (GRI)<br>GRI is widely used guidance for corporate sustainability reporting. GRI G4 guidelines require companies to perform materiality assessments, identify environmental KPIs, and provide performance data related to these KPIs. The G4 guidelines have four specific biodiversity indicators (EN11–14), including operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas.<br>• UNEP World Conservation Monitoring Centre (WCMC) – An Approach for Reporting on Ecosystem Services<br>Published the guide which proposes indicators that organisations could use to assess and report their impacts on biodiversity and ecosystem services. |
| Standards | Enables investors to minimise risks associated with investing in projects that may have adverse effects on biodiversity. | • Equator Principles (http://www.equator-principles.com/)<br>It is a risk management framework, adopted by 91 financial institutions to help them determine, assess and manage environmental and social risk of financial products and services (e.g. project finance, loans, advisory) and provides a minimum standard for due diligence to help financial institutions support responsible risk decision-making.<br>• IFC Performance Standards 6 (IFC PS6) (2012) |

| Type | Description | Examples |
|---|---|---|
| | | The objective of PS6 is to protect and conserve habitats, encourage implementation of the mitigation hierarchy and promote sustainable management of living resources. It is directed towards IFC's clients and their projects that are located in natural and critical habitats and impact on or depend on biodiversity and ecosystem services. PS6 provide guidance on how to identify risks and impacts and how to avoid, mitigate, and manage them. |