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Business and Biodiversity: Dependencies, Responsibilities and Collaboration

Master's thesis in Management and Economics of Innovation
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SUMMARY

The aim of this study was to analyse the connection between business and biodiversity through the interests that companies might have in biodiversity and the needs that biodiversity might represent to them. In order to do this, we investigated how companies consider their dependence on and responsibility for biodiversity, how they translate them into initiatives (or lack thereof) to advance biodiversity conservation and the perceived challenges to their implementation. Furthermore, the thesis aimed to investigate what incentives companies might have, or how such could be created, to collaborate with a biodiversity hub such as the Gothenburg Global Biodiversity Centre.

The methods consisted of a literature search, a survey, and two rounds of interviews. In total, 15 companies participated in the study within the sample of the 100 largest Swedish companies by turnover in 2020.

The results show that the connection between business and biodiversity has received more attention in recent years. Even though there were tendencies of companies incorporating biodiversity into their strategies and values in an increasing way, the progress is quite uneven in knowledge and implementation, ranging from companies that actively attempt to reduce their impacts to companies that are unsure about which are their impacts. Generally, almost all companies considered themselves to be responsible for and dependent on biodiversity to different degrees. However, according to which inputs they take from nature and how they perceive their impacts, the companies are divided into four categories: companies with direct interaction, companies with direct use and indirect impact, companies with an indirect use and direct impact and companies with indirect interaction.

The incentives for companies to consider biodiversity stemmed from both external and internal forces and biodiversity hubs could have a role to play for companies battling biodiversity loss. Furthermore, in order to be appealing to companies, biodiversity hubs should clearly communicate what their targets are regarding biodiversity, and find companies that might be interested. In this sense, specific research topics that are currently in progress within the hub should be presented, but also what the biodiversity hub wants to achieve in a broader perspective, connecting to the business model of companies and taking advantage of network effects.

The field of business and biodiversity requires further research into medium and small companies from a wider set of industries, as well as possibilities for standardised frameworks to measure and monitor biodiversity in companies.

Keywords: biodiversity, business, value, biodiversity hub, GGBC.

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Verónica Romero
To my parents, who taught me how to sail in the ocean of life. To Jorge, my compass and strength, and Yobeida, my lighthouse. In memory of my aunt.

Jakob Streman
I would like to thank my family and Elvira for all their support and for always being there for me.

Abbreviations

CBD	Convention on Biological Diversity
COP15	15th Conference of the Parties
ES	Ecosystem services
FSC	Forest Stewardship Council
GDP	Gross Domestic Product
GGBC	Gothenburg Global Biodiversity Centre
GHG	Greenhouse gases
GRI	Global Reporting Initiative
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
MA	Millenium Ecosystem Assessment
NCP	Nature's contributions to people
NGO	Non-governmental organization
OECD	Organization for Economic Cooperation and Development
PEFC	Programme for the Endorsement of Forest Certification
PR	Public relations
SBT	Science-Based Targets
SDG	Sustainable Development Goal
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
TNFD	Taskforce for Nature-related Financial Disclosures
UN	United Nations
WEF	World Economic Forum
WWF	World Wildlife Fund

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1 Introduction

1.1 Background

1.1.1 The Anthropocene

The influence of mankind has become large enough to trigger global-scale changes to Earth's status over long time periods. As Crutzen (2006) points out, the consequences of anthropogenic greenhouse gases (GHG) emissions could last the next 50.000 years. These human-induced changes have grounded the basis for the proposition of a new epoch in the geologic time scale: the Anthropocene (Crutzen & Stoermer, 2000). Although there is scientific dispute about when and how we can pinpoint its starting date, the term has been increasingly adopted in both the academic and popular realms to emphasize the undesirable consequences of anthropogenic impacts on Earth's systems (Lewis & Maslin, 2015).

A central aspect of the Anthropocene is the rise of global temperatures due to GHG emissions, which has the potential of driving the Earth out of its current climatic conditions towards an uncontrollable and dangerous new state (Steffen et al, 2018). The threat of changing the climate of the Earth irreversibly rang the alarms and led the call for global action. However, the effects of human activities on the environment are far beyond an increasing atmospheric concentration of GHG (Lewis & Maslin, 2015).

1.1.2 Biodiversity loss: the next big crisis?

One notorious anthropogenic influence is driving changes within the evolutionary process at an unprecedented rate. Through artificial selection of the dominant species, controlled reproduction of a large array of animals and varying levels of harvest pressure, *Homo sapiens* is determining to a certain extent which species succeed and fail in their lands (Jørgensen, Søgaard, Folke & Carroll, 2019). In other words, humans have caused significant alterations to ecosystems in most of the terrestrial surface (Ellis et al., 2021). Although some could argue that not all of these interventions have been detrimental (Thomas, 2013), mostly it has led to the loss of species (Barnosky et al, 2011).

According to the Convention on Biological Diversity (CBD), biodiversity consists of the variability of genes, species and ecosystems (CBD, 2018). Furthermore, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019) describes biodiversity loss as the decline of ecosystems and the extinction of species. The current rate of biodiversity loss has never been higher in human history, and it can be derived from human activities (IPBES 2019; World Wildlife Fund [WWF], 2020). The fossil evidence shows that the normal or background extinction rate is between 0.1 and 1 per million species per year, calculated over the past 10 million years (Dasgupta, 2021). The current rate is tens to hundreds of times higher (IPBES, 2019).

However, it is fundamental to distinguish that the intervention of ecosystems and landscapes does not cause mass extinction per se, since humans have been modifying terrestrial nature for at least 12,000 years (Ellis et al., 2021). As Ellis et al. (2021, p.7) find, "the primary cause of declining biodiversity, at least in recent times, is the

appropriation, colonization, and intensifying use of lands already inhabited, used, and reshaped by current and prior societies".

For the past 50 years, the global population, consumption and production has outgrown nature's capacity to reproduce biological resources (WWF, 2020). In fact, the extinction of species is so accelerated, that experts declare the sixth mass extinction is already underway (Barnosky et al, 2011). Furthermore, the impacts have been unequally distributed: terrestrial natural habitats with a higher presence of endemic species experience a larger and faster ongoing decline than other terrestrial regions on average, and the slowing forest loss rates are due to net gains in temperate and high-latitude forests while tropical forests remain in decline (IPBES, 2019). Coastal marine ecosystems, among the most productive systems globally, have lost extent and condition, and face rapid decline (IPBES, 2019). Thus, humans are recently putting pressure on biological systems in such a way that the Earth's biosphere could undergo a state shift, causing a radical disruption of current evolutionary trends (Barnosky et al., 2012).

The effects of continued destruction of biodiversity can have profound and unpredictable consequences. We are currently facing some of those consequences. The current covid-19 pandemic has been linked to wildlife trade, but more importantly, biodiversity loss has created the conditions that made the pandemic possible by altering the composition of wildlife communities, increasing contact with disease hosts and diminishing the number of species that could negatively impact the transmission rates and act as a biological barrier (Ceballos, Ehrlich and Raven, 2020; Platto et al, 2021).

Additionally, there is a risk that after the pandemic, economic recovery will take the spotlight and further aggravate biodiversity loss in the short term (Otero et al., 2020; Sandbrook, Gómez-Baggethun & Adams, 2020). One of the critical moments for advancing more biodiversity conservation initiatives, the CBD 15th meeting of the Conference of the Parties (COP15), was already delayed because of the pandemic, pausing the implementation of a post-2020 framework for biodiversity (Ortiz, de Leon, Torres, Guiao & La Viña, 2021).

In the long term, a negative feedback loop could arise, where biodiversity loss causes events that disrupt global activities, and the measures taken to address those disruptions push biodiversity loss down in the agenda. These disruptive events go beyond health crises such as pandemics. As Steffen et al. (2015) state, biodiversity loss on a large scale could have effects on Earth as catastrophic as climate change. There is also feedback between the two: biodiversity loss means less carbon storage and possibilities to adapt to the rising temperatures, and climate change is the biggest rising driver of biodiversity loss (WWF, 2020). Furthermore, both biodiversity loss and climate change have a disproportionate impact on lower income countries, which could aggravate poverty (Fisher & Christopher, 2007; Mendelsohn, Dinar & Williams, 2006).

There are opportunities to address biodiversity and global issues such as pandemics, climate change, and poverty with cross-cutting actions in relevant areas such as food systems (Ortiz et al., 2021). However, often biodiversity is not considered a priority at the same level as economic growth (Otero et al., 2020) or climate change (Veríssimo, MacMillan, Smith, Crees & Davies, 2014). Thus, the relevance of biodiversity is often

overlooked by society at different levels: general public, international agendas, national governments and, as explored in the following section, companies.

Public awareness of biodiversity is one of the Aichi Biodiversity Targets, but the global progress towards the target is not going in a good direction. Buchanan, Butchart, Chandler and Gregory (2020) describe that only 2.5% of the countries are currently on a trajectory to fulfil this target. The importance of public awareness of the consequences of biodiversity loss is highlighted by Cooper et al. (2019) and Correia, Jepson, Malhado & Ladle (2017) who argue that if people were more aware of the consequences of biodiversity loss, more preventive action would be taken. The general knowledge and awareness are however difficult to measure according to Cooper et al. (2019), and Skogen, Helland & Kaltenborn (2018) describe that this is further complicated by the various understandings of what biodiversity means to civil society and to researchers, not only in terms of the concept, but also of the values that surround it. Additionally, biodiversity conservation remains far from the media coverage that climate change obtains (Legagneux et al, 2018; Veríssimo et al., 2014).

Biodiversity also seems less of a priority than climate change on international sustainability agendas. For example, while the SDG 13, Climate Action, addresses climate change directly, the halt of biodiversity loss is explicitly mentioned only in SDG 15, Life on Land, amongst other related ambitions such as combat desertification and halt land degradation (United Nations [UN], n.d.-a). SDG 14, Life below Water, is described as "Conserve and sustainably use the oceans, seas and marine resources", but the explicit mentions of biodiversity are limited to one target and the extended explanation of the goal (UN, n.d.-b). In the same way, the Aichi Biodiversity Targets, set to be achieved between 2010 and 2020, are much less known than SDGs. Furthermore, Veríssimo et al. (2014) evaluate the allocation of funding between biodiversity and climate change, and they find that the World Bank has dedicated on average 4.52% of their annual investment from 1985 to 2010 to climate change, as opposed to only 0,06% dedicated to biodiversity.

At the national level, environmental policies regarding tax incentives and other economic instruments only marginally cover biodiversity, while some governments financially support the destruction of nature (Organization for Economic Cooperation and Development [OECD], 2021). Moreover, no country has met any of the Aichi Biodiversity Targets, and some countries moved further from them in the past decade (Buchanan et al., 2020).

Thus, climate change and biodiversity loss both have the potential to cause irreparable damage to Earth's ecosystems, but the first one is more directly addressed than the second one at different levels, increasing the risks of potential consequences.

1.1.3 Business and biodiversity

Besides the fundamental importance of biodiversity for life on earth, it is also of major importance to business. In agriculture, pollination by insects is required to produce crops. Several ingredients that are used in the pharmaceutical industry are found in nature (World Economic Forum [WEF], 2020a). Degradation of land due to pollution or how the land is handled reduces the productivity of the land which has negative consequences to the economy (Sutton, Anderson, Costanza and Kubiszewski, 2016).

The true value of ecosystem services (ES), the range of benefits that nature provides to human health, livelihood, survival and overall well-being, is difficult to estimate due to the complexity of the exchanges (Costanza et al. 2014).

Despite the contribution that biodiversity has for business, it does not seem like biodiversity is a top priority for companies. In a study by Addison, Bull and Milner-Gulland (2018) of the 100 largest companies in the world in 2016, 49 of them mentioned biodiversity in their reporting on sustainability, but only a few had any concrete targets for biodiversity. Furthermore, SDG 13 and 14 are at the bottom of the sustainability agenda of businesses (KPMG, 2020), and a study made by S&P shows that of 3500 companies that represent 85% global market cap, less than 1% have a business model aligned with these SDGs (Cheung, n.d.). Lack of biodiversity targets in companies was also found by van den Burg and Boogardt (2014) and the reason for this could be insufficient understanding of how biodiversity relates to business or that the companies do not have proper incentives to adopt biodiversity targets. Furthermore, the complexity of connecting biodiversity to business is also highlighted by Dasgupta (2021), who argues that many ES are not visible and hence, difficult for companies to grasp. Finally, the OECD (2019) finds there is still a long way to go regarding current businesses' awareness and commitment to action to halt biodiversity loss.

There is however also progress towards including biodiversity in business, according to Wolff, Gondran and Brodhag (2018), explained by an increased stakeholder awareness. Furthermore, Seidel, Mulungu, Arlaud, van den Heuvel and Riva (2020) found that investments to prevent biodiversity loss have increased globally. There have also been developments in biodiversity knowledge in the recent decade, reported by IPBES (2019). Barna (2008) presents "business biodiversity" models with a level of success in the European economy related to sectors such as sustainable forestry and agriculture, carbon sequestration in biomass and ecotourism.

The decline of biodiversity globally has been reported by WWF (2020) since 1970, and the trajectory of biodiversity loss has not changed direction. Biodiversity has become an increasingly important topic in recent years for a wide array of stakeholders who pressure companies to take action (Houdet, Trommetter & Weber, 2012).

1.1.4 Biodiversity institutions and networks

The development of climate change and loss of biodiversity have given rise to organizations, networks and research institutes that are taking action to mitigate them at the global, national and regional levels. The landscape regarding such institutions is varied, and spans the public and private sectors. Two types of initiative are of particular interest in this thesis, biodiversity hubs and business networks.

A biodiversity hub refers to a group of independent institutions that form a partnership in order to find synergies and innovative approaches towards biodiversity conservation, research and education. On the other hand, business networks for biodiversity constitute formal networks among diverse companies, with the goal of reducing impacts on biodiversity and generating actions in this direction.

In Sweden, there are two relevant players for the purpose of this study: the Gothenburg Global Biodiversity Centre (GGBC) and the Business@Biodiversity Network.

The Gothenburg Global Biodiversity Centre (GGBC)

The GGBC is a biodiversity hub based in Gothenburg with a general aim to improve the research and public awareness of biodiversity (University of Gothenburg, 2021a). There are currently 16 organizations from western Sweden that are involved in the GGBC and these have different approaches towards biodiversity.

Two universities are part of the GGBC, The University of Gothenburg and Chalmers University of Technology. More specifically the members from the University of Gothenburg are the centre of Sea and Society and the Herbarium, as well as different departments; Biological and Environmental Sciences, Marine Sciences, Earth Sciences and Economy and Society. At Chalmers University of Technology, the Division of Environmental Systems Analysis is involved (University of Gothenburg, 2021a).

Furthermore, the other members of the GGBC are the Gothenburg Museum of Natural History, Gothenburg Botanical Garden, Gothenburg Maritime Museum and Aquarium, Havets Hus, Nordens Ark, Universeum, Slottsskogen Zoo, Västkuststiftelsen, and IVL - the Swedish Environmental Research Institute. Most of these organizations do research and provide education about biodiversity, but some are also more directly working with conservation of biodiversity. Visitors can see and learn more about animals at Nordens Ark, Universeum, Havets Hus and Slottsskogen Zoo. At the Gothenburg Museum of Natural History and Gothenburg Maritime Museum and Aquarium, there are exhibitions with information about biodiversity. Västkuststiftelsen manages nature reserves and in the Gothenburg Botanical Garden, visitors can see and experience a rich diversity of plants. IVL does research on sustainability, including biodiversity (University of Gothenburg, 2021b).

The GGBC is currently investigating how to interact with companies and the private sectors in order to foster the research on biodiversity and to create and reinforce connections for mitigating and adapting to biodiversity loss. The GGBC has contributed to this thesis as a co-supervisor.

Business@Biodiversity

Business@Biodiversity Sweden is a network of large Swedish companies that aim to work with biodiversity as part of their business model (Ecogain, n.d.). The network is an initiative from Ecogain, a Swedish consultancy firm dedicated to biodiversity, and involves 21 companies so far (Business@Biodiversity, n.d.a). The activities in the network consist of webinars, network events and a field trip (Business@Biodiversity, n.d.b). Ecogain has contributed to this study by giving advice.

1.2 Research gaps

In the Global Risks Report for 2011, the WEF recognised for the first time biodiversity loss as one of the top ten risks in terms of likelihood, one of the two parameters they use to categorize risks, the other one being potential impact (WEF, 2011). Biodiversity loss did not appear again until 2020, this time as one of the top five risks in both likelihood and potential impact (WEF, 2020a). The report also acknowledges that there

is still widespread lack of information and knowledge regarding what exactly biodiversity is, its importance to humans and how to tackle its loss (WEF, 2020a).

On the other hand, Green et al. (2017) explain the need to deepen the investment in the relations between the private sector and research community in order to reach a higher level of collaboration with environmental goals in mind. In general, the literature highlights the almost parallel roads of research and management of ES and biodiversity (Balian, Eggermont & Le Roux, 2014; Sitas, Prozesky, Esler & Reyers, 2014).

Furthermore, in an analysis of seven reports by the IPBES, Mastrángelo et al. (2019) find that the feedback between social and ecological systems is one of the key areas where knowledge must be improved in order to fulfil the Sustainable Development Goals, and that this research priority has prevailed during the time span of all the analysed reports, which amounts to fourteen years.

Additionally, one of the areas that Balian, Eggermont & Le Roux (2014) identify as a research priority comprises a better understanding of values and perspectives of biodiversity, and what motivates people in their decision-making in this topic, including perceived risks, benefits and trade-offs.

Thus, there are several knowledge gaps that comprise the study of the importance of biodiversity for people, the need to connect research and practice around biodiversity, as well as ecological and social systems.

1.3 Aim and research questions

The aim of this study is to analyse the connection between business and biodiversity through the interests that companies might have in biodiversity and the needs that biodiversity might represent to them. This includes how the company understands biodiversity and what values the company has regarding biodiversity.

In order to do this, it is important to investigate how companies consider their dependence on and responsibility for biodiversity, how they translate them into initiatives (or lack thereof) to advance biodiversity conservation and the perceived challenges to their implementation. Furthermore, the thesis aims to investigate what incentives companies might have, or how such could be created, to collaborate with a biodiversity hub such as the GGBC.

This section presents two research questions, with their respective sub-questions, to address in order to fulfil the aim of the project.

1. How do Swedish companies consider their dependencies of and responsibilities for biodiversity?
   1.1. How do companies understand and value biodiversity?
   1.2. How do companies understand and value ecosystem services (ES)?
   1.3. How do companies perceive their impact on biodiversity?

2. What are the incentives that these companies have or could have to advance initiatives for biodiversity protection, in particular interactions with biodiversity hubs?
    2.1. Which initiatives are taken or planned to protect biodiversity?
    2.2. How do these initiatives fit the strategies of the companies' business models?
    2.3. What are the main drivers to implement initiatives to protect biodiversity?
    2.4. How companies address main challenges in implementing initiatives to protect biodiversity?
    2.5. Are companies aware of established biodiversity hubs?
    2.6. How could biodiversity hubs and companies interact to advance the implementation of initiatives to protect biodiversity?

1.4 Scope and limitations

The scope of the research is centred around Swedish companies. As for the limitations, in the first place, the thesis does not evaluate whether the company is good or not in terms of their impact on biodiversity, but addresses their willingness to promote biodiversity and measures for that. Secondly, this master's thesis does not elaborate on biodiversity indicators, only presenting those frameworks used by the participating companies when relevant for the research questions. Lastly, the research does not advise measures about biodiversity protection directly to the companies.

1.5 Expected contributions

This report builds on the available knowledge about the relation between business and biodiversity by considering how companies perceive that connection, focusing on the dependencies and responsibilities that companies consider. Additionally, the WEF (2020a) states the importance of including business and other stakeholders in the discussion of biodiversity loss. In doing so, this research aims to bridge the gap between academia, conservation institutions and companies, leading to a more effective prevention of biodiversity loss. Finally, through the design of possible interactions between conservation networks and businesses, this research proposes a set of ideas that said networks can use as a starting point of contact with companies.

1.6 Structure of the report

The next section of the report contains the theoretical framework that supports the thesis through the concepts of biodiversity and ES, as well as sources of value for biodiversity, drivers of biodiversity loss, and frameworks and measurements for biodiversity. In section three, the methods are presented, divided into a literature search and empirical methods consisting of a survey and interviews. Results of the thesis are presented in section four which is structured according to the research questions and subquestions described in section 1.3. Section five contains an analysis of the results, identifying patterns from the surveys and interviews and relating it to literature, and developing a classification for companies, as well as a framework for the interaction between companies and biodiversity hubs. The sixth and final section includes a discussion of the research questions, methodological aspects, and recommendations for academia, companies and biodiversity hubs.

2 Theoretical framework

This section explains the concept of biodiversity, followed by why biodiversity is important and what values that are associated with biodiversity. Thereafter, biodiversity loss and the drivers for biodiversity loss are addressed, as well as frameworks and measurements for biodiversity.

2.1 Concept of biodiversity

Biodiversity is defined by The CBD (2018, para.1) 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 part; this includes diversity within species, between species and of ecosystems."

2.2 Importance of biodiversity

The importance of biodiversity can be understood from many different angles. The broadest perspective is to evaluate its role in the support of all life systems in the long term. The planetary boundaries framework allows this analysis by the identification of nine boundaries within which humanity can safely operate (Rockström et al., 2009).

There are two boundaries that have an increasing risk of being surpassed, climate change and land-use change, and two others that have a very high risk, biogeochemical cycles and biosphere integrity (Rockström et al., 2009; Steffen et al., 2015). In the first version of the planetary boundaries, biosphere integrity was described as biodiversity loss, taking the extinction rate as an indicator (Rockström et al., 2009), while the most recent version has a two-component approach, genetic diversity and functional diversity (Steffen et al., 2015). The extinction rate is used as an indicator for genetic diversity, although the authors explain that a better indicator must be developed, while the change in population abundance due to human impacts is used as indicator for functional diversity. The trend on the former was explained in Section 1.1.2, and there is no global data on the latter.

Biosphere integrity and climate change are considered core boundaries, which means that pushing either of them beyond the limit would generate significant and to a certain extent unknown consequences in the configuration of Earth's systems, driving us out of the current Holocene stability which has made our life possible (Steffen et al, 2015). In other words, avoiding biodiversity loss is key to preserving the conditions that allow life on Earth.

A more practical way of considering the importance of biodiversity is by looking at the concrete contributions it makes to support human life and well-being, summarized by the concept of ES. The Millennium Ecosystems Assessment (MA) distinguishes four categories of ES: provisioning services such as food and wood; regulating services such as climate regulation and disease regulation; cultural services such as aesthetic and recreational services; and supporting services such as soil formation and nutrient cycling (MA, 2005). Figure 2.1 summarizes the categories of ES and their definitions.

Figure 2.1. Ecosystem services categories and their definitions, arranged by intensity of the linkages to human well-being from top (more intense) to bottom (less intense). Adapted from MA (2005).

The relation between biodiversity and ES has a diverse nature. Biodiversity can act as a regulator of ecosystems, as a final ecosystem service or as goods although on occasions both concepts are used interchangeably (Mace, Norris & Fitter, 2012). In any case, it is clear that the provision of ES is directly dependent on biodiversity.

ES are fundamental for human (individual and social) well-being on different levels (The Economics of Ecosystems and Biodiversity [TEEB], 2009). MA (2005) categorises well-being as a function of security, basic materials for good life, health, social relations and freedom of choice and action, the latter being both influenced by and a precondition for the previous four. In this sense, regulating services would have the highest link to well-being through their contributions to security, basic materials for good life and health; followed by provisioning services, essential mostly for the basic materials and health; cultural services would have less strong but still relevant links to health and social relations; and the support services which allow the rest (MA, 2005).

The importance of ES is larger for those with lower incomes, since they have less possibilities of substitution and are often directly dependent on ecosystems for their livelihoods (MA, 2005; TEEB, 2009). Additionally, they are also more vulnerable to climate shocks and biodiversity loss, not only because it happens more often in low-income countries, but also because of institutionalized social inequalities even in high-income countries (TEEB, 2009).

Thus, biodiversity and ES are an essential pillar of sustainability through their connection to economic, environmental and social dimensions. Wood et al. (2018) find that individual ES contribute to 41 out of the 169 SDG targets across 12 SDGs, while Yin, Zhao, Cherubini and Pereira (2021) state that ES are connected, directly or indirectly, to the achievement of all SDGs. There is also an opportunity to accelerate SDGs through the conservation and sustainable supply and demand of ES in the post-pandemic context (Yin et al., 2021). Furthermore, most ES contribute to more than three SDG targets, highlighting the importance of examining synergies and trade-offs (Wood et al., 2018).

The concept of nature's contributions to people (NCP), a framework developed by the IPBES (2019), builds on ES, including all contributions, positive and negative, that humanity receives from nature. Negative contributions would be, for example, plagues and predators that damage people or their assets (Díaz et al., 2018). The consideration of some NCP as positive or negative depends on the cultural, socioeconomic, temporal and spatial context (Díaz et al., 2018). In comparison with ES, the concept of NCP aims to encompass more world views and knowledge bases, namely, social sciences, humanities, and indigenous and local knowledge (IPBES, 2019). Furthermore, NCP acknowledges culture as a main element that shapes the link between nature and humans (Díaz et al., 2018). However, according to Kadykalo et al. (2019), the previous research about ES has already contributed to some of these novel conceptual claims (culture, social sciences and humanities, indigenous and local knowledge, negative contributions of nature, generalizing perspective, non-instrumental values and valuation).

As Costanza et al. (1997) explain, the importance of ES as a whole for life support makes them of infinite value for the economy, but it is still useful to estimate the impact of changes of the quality and quantity of a variety of ES and natural capital. The current annual value of services provided by biodiversity ranges between USD 33 and 140 trillion (OECD, 2019; WEF, 2020a). As a way of comparison, the global Gross Domestic Product (GDP) was USD 87.8 trillion in 2019 (World Bank, 2019), of which USD 44 trillion depends moderately or highly on nature (WEF, 2020b). Additionally, the costs of disrupting ecosystems are very high: an estimate of USD 10-31 trillion were lost per year in the period 1997-2011 due to land degradation and land-cover change, and the amount is predicted to increase (OECD, 2019).

The economic valuation of ES has received criticism for being too narrow, failing to engage multiple perspectives, and not halting biodiversity loss (Díaz et al., 2018). On the other hand, Costanza et al. (2014) argue that valuation is unavoidable, since every time a decision involves a trade-off within ES, there is a valuation, implicit or explicit. Thus, they insist on the transparency that economic valuation can bring to decision-making, as well as the notion that the economic system must consider all its assets, human and natural. The OECD (2019) insists on the importance of economic valuation to inform policy-makers and assist their decisions, since they are often informed through other interests such as economic growth or food security.

Finally, narrowing down the perspective to the relation with the productive system, biodiversity is an important pillar in most industries, either through inputs or the generation of liability, reputational and other kinds of risks (OECD, 2019). From food crops to key ingredients in medicines and cosmetics, the multiple roles of biodiversity in supply chains all around the world is essential (Dasgupta, 2021). Parr &

Simons (2007) explain there are key sectors when it comes to dependency from biodiversity: agribusiness, fisheries and aquaculture, forestry and paper, and tourism. In a discussion paper for the CBD, Duncan (2009) presents a wider list of dependent sectors, including construction, pharmaceuticals and cosmetics. The WEF (2020b) estimates that construction, agriculture, food and beverage sectors are the largest biodiversity-dependent industries. Furthermore, in 2013 the value of the natural capital consumed by primary production and some processing sectors was estimated at USD 7.3 trillion (OECD, 2019). It is also worth noticing that different industries can compete for the same resources, in particular those with high land use.

Thus, from any perspective, either short-term or long-term, either for humans or all life on Earth, either for business or society as a whole, biodiversity is key for the survival of natural and manmade systems.

2.3 Different values associated with biodiversity

Despite its undeniable relevance, explained in the previous section, valuing biodiversity may be one of the most controversial topics in the field. As Piccolo, Washington, Kopnina and Taylor (2018) argue, the debate about which is the best rationale to protect biodiversity is older than conservation science itself. There is consensus to some extent on two levels: biodiversity and ES are generally undervalued or unvalued by market prices and economic accounting, and some type of valuation is necessary to inform decision-making (TEEB, 2009; OECD, 2019).

The valuation of biodiversity can be done in relation to two complementary principles, resulting in the differentiation between instrumental and intrinsic value. Instrumental value is based on the perceived benefits of biodiversity to a particular subject, while intrinsic value is an objective value that biodiversity has in itself, independent of any possible benefits it can yield (Oksanen, 1997; Sandler, 2012). Instrumental value is therefore more related with ES, since it describes the links between nature and humans. Intrinsic value, on the other hand, is contrary to the concept of ES, since it cannot be conditional to the presence of benefits that impact humans.

A popular framework to address instrumental value is the Total Economic Value (TEV). The TEV attempts to capture all the different benefits that biodiversity and ES can bring to humans, in order to be able to assess trade-offs between different elements of biodiversity and society (TEEB, 2009). TEV is therefore related to instrumental values, and it considers the distinction between use and non-use values. Use values are further divided in direct and indirect use, and option value. The direct use is determined by the use of natural inputs of both consumptive goods, such as trees, or non-consumptive use, such as landscape appreciation (Kettunen, Bassi, Gantioler & ten Brink, 2009). Indirect use refers to support and regulatory services of the environment, while option refers to the availability for future uses. Non-use values refer to intergenerational justice (bequest value) or to the utilitarian satisfaction of knowing biodiversity exists (Fosci & West, 2016).

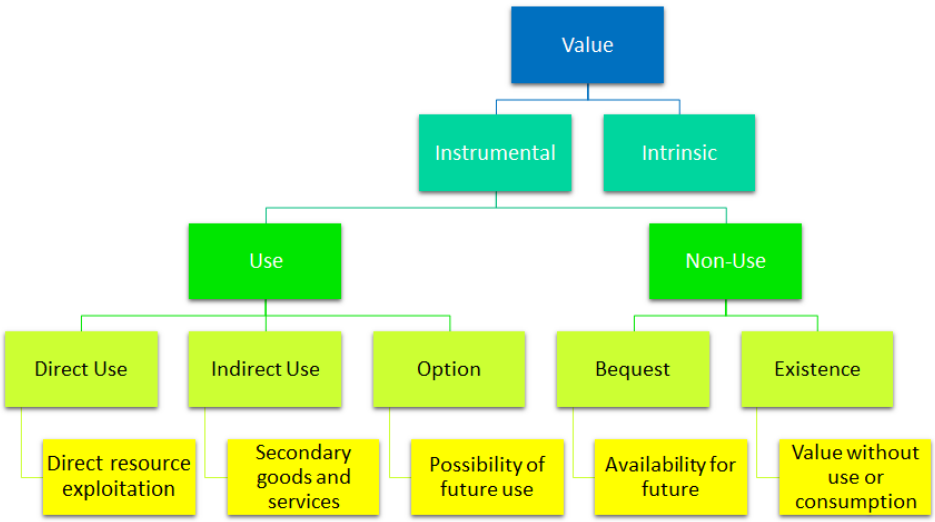

Figure 2.2. Different values of biodiversity. Modified from Kettunen et al. (2009).

The distinction between intrinsic and instrumental value is complicated. Existence value, for example, implies that we grant a level of consideration to the fact that biodiversity exists regardless of its uses, which is quite similar to intrinsic value (Dasgupta, 2021). On the other hand, an instrumental value that is not anthropocentric relies on an ethical consideration of non-human species and even ecosystems as subjects that have some capacity of receiving benefits or harms, which seems to de facto assign them intrinsic value (Fosci & West, 2016).

Some authors state instrumental value is based on an anthropocentric view of the world, where the relation with humans is the only criteria (Fosci & West, 2016). However, one can consider how biodiversity benefits other species through regulation and supporting services within instrumental value (Oksanen, 1997).

The role and importance of intrinsic value for conservation is contested in literature. Everard (2009) states that business might only marginally contemplate the intrinsic value of biodiversity, as well as its importance for future generations. Furthermore, intrinsic value is an absolute magnitude, either biodiversity has a value in itself or it has not, and because of that, it does not allow trade-offs (Justus, Colyvan, Regan & Maguire, 2009). This means that it cannot assist decision-making in the sense that it is not possible to use it to justify protecting one species or ecosystem over another (Fosci & West, 2016). Often, conservation problems consist of incompatible claims from diverse stakeholders over a natural resource, but intrinsic value is independent of stakeholders and there is no systematic way of comparison to instrumental values (Justus et al., 2009). Van Liempd and Bush (2013) argue that, even without considering intrinsic value, there are still ethical arguments towards biodiversity reporting. On the other hand, Scholtz (2021) argues that the CBD ignores intrinsic value and has an overly-anthropocentric focus that undermines the inclusion of animal welfare in the environmental dimension of sustainability, thus making a case for the necessity of intrinsic value. In a similar way, Taylor et al. (2020) affirm that the inclusion of moral arguments regarding the value that species and ecosystems have beyond human interests would enhance governmental biodiversity conservation. In any case, the indeterminate nature of an intrinsic value does not justify biodiversity loss nor it diminish the necessity for conservation measures (Oksanen, 1997).

2.4 Biodiversity loss

Biodiversity loss is according to the glossary provided by IPBES (n.d.) the death, destruction or manual removal of any aspect of biodiversity (genes, species or ecosystems). The current pace of biodiversity loss on Earth is unprecedented in history (WWF, 2020). On one hand, global indicators show that ecosystems have decreased on average a 47% from their natural baseline due to human influence (IPBES, 2019). Three quarters of the land surface has been significatively altered, there are accelerating cumulative impacts in up to 66% of the ocean area, and 85% of wetlands have disappeared (IPBES, 2019). Additionally, species, both discovered and undiscovered, are disappearing globally due to human activities to the point that some literature argues that the planet is currently experiencing a sixth mass extinction (Joaquín Torres-Romero, Giordano, Ceballos, & Vicente López-Bao, 2020; Cafaro, 2015). Measurements by WWF (2020) show that, between 1970 and 2016, populations of certain species of fish, mammals, amphibians, reptiles and birds have declined by an average of 68%. Furthermore, Joaquín Torres-Romero et al. (2020) show that large mammals are decreasing rapidly globally.

The loss of biodiversity is a global phenomenon, but some species are more exposed than others. The International Union for Conservation of Nature (IUCN, 2021) has created the IUCN Red List where species are evaluated by experts in order to keep track of biodiversity trends and biodiversity loss seem to be increasing. IUCN (2021) describes that roughly 28% of the species included on the list are threatened by extinction, and more specifically, this includes 41% of amphibians, 26% of mammals and 14% of birds. Tropical forests host a rich diversity of life and Dasgupta (2021) and Salete Capellesso et al. (2021) explains that rapid deforestation in order to use land for agriculture has severely reduced biodiversity. In fact, over half of all species that live on land have tropical forests as habitat (Gardner, Barlow, Sodhi & Peres, 2010; Dasgupta, 2021). Furthermore, tropical forests contain more than 96% of all species of trees on earth (Guo, Wang & Fan, 2021). The importance of tropical forests for biodiversity can also according to Gardner et al. (2010) be explained by endemism, meaning that certain species only exist in the tropical forests and nowhere else on earth.

Insects are declining globally and consequently, ecosystem services that they provide such as pollination or soil nutrification (WWF, 2020). Pollinators have a fundamental role for biodiversity of plants and for food production globally (Blaydes, Potts, Whyatt & Armstrong, 2021) and putting a halt to the loss of pollinators will be important for future food security, according to WWF (2020).

The human impact on the oceans has damaged marine ecosystems globally and there are traces from human activities in basically every part of the oceans (WWF, 2020). Fishing is an important source of food to an increasing global population, however, as highlighted by O'Leary et al. (2020), it is currently the biggest threat to biodiversity in the oceans. Shipping has also a large impact on life in oceans due to noise pollution and dangerous substances, as well as emissions of GHG (O'Leary et al. 2020). Furthermore, the trade routes at sea enable invasive species to travel to new habitats to a larger extent (WWF, 2020).

2.4.1. Biodiversity loss in Sweden

Biodiversity loss also occurs in Sweden, reported by Statistics Sweden (2019). Sweden has committed to several biodiversity agreements, such as the CBD in 1993, which was later developed with the Cartagena protocol in 2003, the Nagoya protocol in 2014, and the Aichi targets which set goals for 2011-2020 (Naturvårdsverket, 2021). Furthermore, Sweden also agreed to the SDGs in 2015 (Statistics Sweden, 2019). However, as shown by Statistics Sweden (2019), the targets for biodiversity in Sweden have not been fulfilled. The total size of the Swedish forests is slowly decreasing and more area is being covered by sustainability certifications, but according to Statistics Sweden (2019) the pace of biodiversity loss is not hindered. According to Angelstam et al. (2020) about 16% of the Swedish forests are unmanaged, meaning that there are no harvesting operations in place. These areas tend to have more biodiversity compared to the production forests (Angelstam et al. 2020).

2.5 Drivers of biodiversity loss

The direct causes of the decline of biodiversity have been identified by IPBES (2019 p. 25) as "... land/sea-use change; direct exploitation of organisms; climate change; pollution; and invasive alien species". The direct drivers are derived from human behaviours and needs which embody indirect drivers for biodiversity loss (WWF, 2020). Examples of indirect drivers are global trade and consumption, how people are distributed on earth, and technology (IPBES, 2019; WWF, 2020).

2.5.1 Land use change

Change in land use is argued by IPBES (2019) and WWF (2020) to be the single largest driver of biodiversity loss on land. Activities that cause land use can according to WWF (2020) be derived to agriculture with crop production and animal husbandry, but also energy generation and forestry with harvesting of forests.

When habitats are transformed into productive grounds, species that used to live there are disturbed (WWF, 2020). Within food production, areas that previously were rich in biodiversity can be replaced by farms of a single crop and one example is deforestation of tropical forests to make space for palm oil cultivation (Azhar, Saadun, Prideaux, & Lindenmayer, 2017; Dasgupta, 2021).

Currently, the industries that are causing the largest impacts on biodiversity loss are food production (Crenna, Sinkko & Sala, 2019; Wilting & van Oorschot, 2017) and forestry, explained mainly by the massive use of land (Leclère et al. 2020). In a study by Chaudhary and Kastner (2016), it was found that since different food products require different amounts of space and depending on the previous state of biodiversity in the cultivated area, this causes different impacts on biodiversity. Chaudhary and Kastner (2016) exemplify that even though cultivation of wheat requires more land than palm oil, the latter is grown in areas that have a higher density of biodiversity. WWF (2020) describes that food production occupies one third of all land on earth and Dasgupta (2021) states that mining occupies about 1% of earth's land.

Gasparatos, Doll, Esteban, Ahmed and Olang (2017) argue that for local ecosystems, constructing wind, water or solar farms can be negative due to extensive land use. Besides direct land use, Gasparatos et al. (2017) point out that the blades of wind turbines can damage flying animals in case of interaction and that water turbines are in some cases blocking fish that seek to travel. Wind turbines are however, as stated by Shahzad Nazir et al. (2020), the source of renewable energy with the least impact on biodiversity and for instance birds are harmed to a larger extent by emissions of GHG. Solar parks can in fact be beneficial for biodiversity since it can become habitats for pollinators (Blaydes et al., 2021).

Forestry and mining companies are often forced to operate in areas of high biological values according to Boiral and Heras-Saizarbitoria (2017) and consequently impact biodiversity through disturbance and division of habitats. Regarding the mining industry, Murguía, Bringezu and Schaldach (2016) questions whether ore-rich sites located in areas of high natural values should be allowed for mining operations.

2.5.2 Resource exploitation

For the oceans, direct exploitation of organisms through unsustainable fishing is rapidly reducing the fish populations globally, and very few areas are left unharmed (IPBES, 2019). Bycatching of sea turtles, dolphins, and seabirds from industrial fishing have both direct consequences for the individuals that are caught, but also more unknown disturbances to ecosystems when animals that are on top of the food chain disappear (Lewison, Crowder, Read & Freeman, 2004). On land however, exploitation of animals is mostly related to extensive hunting (WWF, 2020). Poaching is causing population losses of certain species globally, for instance elephants in East Africa and India described by de Matos Dias, Colombo Ferreguetti & Henrique Guimarães Rodrigues (2020) but also redwood trees in USA, according to Kurland, Pires, and Marteache (2018). In the energy sector, generating energy by solar and wind does according to Gasparatos et al. (2017) not directly impact biodiversity negatively in terms of overexploitation of natural resources but for hydropower it could potentially do so indirectly.

2.5.3 Climate change

Climate change is not only affecting species directly by changing the conditions in different habitats, but also accelerating the other drivers of biodiversity loss according to WWF (2020). Impact on biodiversity due to change in climate is caused by an increased temperature on earth which in turn damages biodiversity through drought and forest fires (Dasgupta, 2021). Furthermore, Dasgupta (2021) explains that oceans capture carbon from emissions, leading to rising sea-levels and lower pH in the oceans, causing damage to coral reefs which is the habitat of a rich variety of marine species.

Targeting fossil emissions of GHG is fundamental for the transition towards a more sustainable future (Gasparatos et al., 2017). When comparing emissions from different renewable energy sources, Gasparatos et al. (2017) found that wind power did not have an impact on biodiversity due to emissions, as opposed to hydropower plants which could cause emissions of GHG from reservoirs. Food production is a large emitter of GHG and accounts for 29% of the GHG emissions globally (WWF, 2020). For the manufacturing sector, it was found in a study by Yang, Wang & Hou (2021) that it is

possible to reduce emissions and at the same time maintain, or even increase production levels.

2.5.4 Pollution

Release of harmful chemicals and pesticides can directly damage wildlife, but also food sources for the animals, leaving long lasting effects on habitats (WWF, 2020). Pesticides are widely used within agriculture and besides from the targeted pest, other animals or plants are impacted as well (Kumar, Nath Yadav, Saxena, Paul, & Singh Tomar, 2021). There are also dangers for sea life that consumes plastics in the oceans or that encounters abandoned fishing nets, according to Soto-Navarro et al. (2021). Within the mining industry, pollution is the single source that causes the largest impact on biodiversity (Murguía et al., 2016). According to Gasparatos, Ahmed, and Voigt (2021), renewable energy sources can generate pollution and one example is when chemicals are used to prevent plants from growing in areas of solar panels. Furthermore, Gasparatos et al. (2021) argue that the materials used in for instance solar cells could be gathered in an unsustainable way and hence have an impact on biodiversity.

2.5.5 Invasive species

Invasive species are spread more easily across the globe due to frequent transports by ships or air that are used for trade (IPBES, 2019). According to Fernandes Rodrigues Alves, de Paiva Barros-Alves, Santana Dolabella, Cristine de Almeida and Ariel Martinez (2021) marine invasive species travel in the ballast water of ships or attached to the ships. Species can also be introduced to new areas on purpose, for instance deer in British Columbia, Canada (Simberloff et al. 2013). Native species are challenged by invasive species, either because they compete for the same food source or because the invasive species feed on the native species directly (WWF, 2020). Besides the direct effects on local ecosystems, the estimated cost of managing invasive species is more than 5% of the world's GDP (McGeoch & Jetz, 2019). Methods used for tracking or gathering data on invasive species can also be expensive or highly time consuming (Kotowska, Pärt & Żmihorski, 2021).

2.6 Frameworks and measurements

Biodiversity is a complex subject and hence difficult to measure, highlighted by Marshall, Wintle, Southwell and Kujala (2020), Verburg and Osseweijer (2019), and Xu, Xie, Qi, Luo and Wang (2018). There is however a wide array of methods and frameworks that aim to give guidance to business on how to manage biodiversity, according to Verburg and Osseweijer (2019).

The mitigation hierarchy is a tool for managing biodiversity consisting of four successive steps: avoid, minimise, rehabilitate and offset. The decision process should proceed through each of them in order to reduce the impact on biodiversity. The first step, which is preferable, is to not have any impact to begin with, however, if it cannot be avoided, the impact should be as little as possible which is step two. Step three is to rehabilitate the biodiversity loss, and the final step is to do biodiversity offsets (Milner-Gulland et al. 2021).

Science Based Targets for Nature (SBTs for nature) is another framework that aims to provide guidance to companies' biodiversity work, according to The Science Based Targets Network (2020). One important aspect of SBTs for nature is that the targets should be actionable and possible to follow up on, to see whether they are fulfilled or not. SBTs for nature consists of five steps, with the first one being that companies should start to map out what potential impacts they have based on data. Thereafter, the company should focus on the most important and urgent impacts. The fourth step is related to monitoring and gathering of data related to the chosen focus area and then finally, follow up on the progress towards the focus area (The Science Based Targets Network, 2020).

Biodiversity net gain aims to go beyond restoring or compensating for negative impact, and to have a positive impact in absolute terms (McVittie & Faccioli, 2020). As one measure to achieve this, offsetting is increasingly being adopted by companies but there are uncertainties as to what to consider as being net positive regarding biodiversity. Since biodiversity includes living beings that are different from each other, it is not always clear how one can compensate for the impact that is done to one species according to McVittie & Faccioli (2020), as opposed to carbon offsetting, which may work to reduce overall emissions.

Global reporting initiative (GRI) is a framework that is being used globally by companies to report about sustainability (Szejnwald Brown, de Jong & Levy, 2009). GRI gives guidance to what companies should report regarding sustainability, divided into people, planet and profit, and using GRI can increase the quality and reliability of the information and increase transparency towards stakeholders (Marimon, del Mar Alonso-Almeida, del Pilar Rodríguez, & Aimer Cortez Alejandro, 2012).

3 Methods

Three methods have been used; literature search, a survey and interviews. Each method is described in detail in their respective section.

3.1 Literature search

In the initial phase, the literature search provided a foundation for the thesis, serving as input for how to design the survey and the interviews. The first search was performed during February 2021. In a second search, the terms “business value biodiversity”, “sustainability and business”, “business and ‘ecosystem services’” were used in Google Scholar to find papers serving as both framework and contrast to the answers obtained in the survey and interviews. Furthermore, the search words “business impact biodiversity” was used in the Chalmers library database. Search words such as “Sweden biodiversity” and “Sweden business biodiversity” were used to obtain a national context. This second search took place between 1/05/2021 and 23/05/2021.

3.2 Empirical methods

The empirical methods consisted of a survey and interviews. Both cover the same sample, the 100 largest Swedish companies by turnover in 2020. Only one employee per company was included in the study, using email, LinkedIn or phone-numbers available on the official website of each company as ways of contact. The selection of the employee was based on their position within the company, prioritizing those with a strategic role in sustainability or biodiversity, followed by the operation manager and finally the person responsible for communications.

Of the 100 companies in the sample, 89 were contacted in the period spanning from February to April of 2021. The remaining 11 were either a main subsidiary of an already contacted company or did not have updated contact information on their websites. Of the contacted companies, only 30 replied in some way to accept or decline participation. Finally, 15 companies participated in the study. The sustainability reports of those companies were used to obtain background information, as well as to analyse their environmental strategies.

3.2.1 **Survey**

The survey is focused on how the companies define and value the importance of biodiversity, their perceived role in adopting biodiversity protection initiatives, and to what extent they are willing to actively pursue improvements, including the interaction with research and conservation networks. The complete questionnaire is in Appendix A.

The design of the questionnaire was centred around the first research question and its respective subquestions. As stated in Appendix A, Question 1 aims to explore the degree of knowledge the company has about biodiversity through an open question design.

Questions 2-4 consider the different values that the company might assign to biodiversity, as well as the perceived interrelation with it in the form of needs and impacts, addressing RQ 1. Question 2 assesses the prioritisation of economic, social and environmental sustainability in a broad way. Question 3, about the importance of biodiversity, is based on the values presented in Figure 2.1 with a narrower focus on companies. Direct use is represented in the need for inputs and the absorption of outputs; indirect use through publicity, as well as any service for society as a whole; and intrinsic value through the statement "all living beings have value". Question 4 is structured according to the five major drivers of biodiversity loss described by IPBES (2019), also including if the company considers to not have an impact on biodiversity or to have one that is presented as an option.

Questions 5-7 explore the current initiatives to protect biodiversity, addressing RQ 2. Question 5 relates to if the companies are taking action to improve sustainability in general, but also specifically for biodiversity and what trade-offs between improving the environment and business targets the companies could consider. Question 6 presents possible challenges that companies are facing when it comes to the implementation of biodiversity initiatives, while Question 7 addresses some ways in which companies are trying to overcome these challenges. These respond to findings and recommendations of Ecogain (2020), TEEB (2009) and WEF (2020a).

Finally, Question 8, which is also connected to RQ 2, examines the interest of companies in engaging with research and conservation networks.

The data from the questionnaire is mostly analysed based on the answers on the Likert scale, from 1 (strongly disagree) to 5 (strongly agree). The first step in the analysis was to visualize the data through bar charts in Excel. Then, emerging patterns were identified. For the analysis of the open question, the focus was on the type of language the companies use, and which concepts appear most often.

One important topic to address is the anonymity of the answers and the treatment of the information. The questionnaire was preceded by a disclaimer stating the voluntary character of the participation, as well as information about the treatment of the data obtained. Furthermore, the disclaimer also informed of how the storage and handling of the data was conducted in a secure way. This involves who had access to the data and information about publication. All the participants remained anonymous. However, they could decide whether the report should include their position in the company and the name of the company. The full disclaimer is displayed at the beginning of the questionnaire as shown in Appendix A.

The survey was open from March 1st until April 25th. 19 companies started filling out the survey, but only 12 completed it, achieving a completion rate of 63%. The software registered that the respondents took from 7 minutes to over an hour to complete the survey. The first complete response was registered on March 6th, and the last on March 30th of 2021.

3.2.2 Interviews

The interviews were conducted with 10 of the sample companies in a semi-structured way. The interviews consisted of a few previously set general questions, but allowing the interviewees to elaborate on relevant topics that arise during each specific interaction. Due to the covid-19 pandemic, the choice for interactions was limited to online interviews. Zoom was the chosen software, since it is available for the general public and has been used for formal events and meetings around the world during the past year. The interviews are based on three themes: Values, understanding and knowledge; actions and incentives; and collaboration.

- **VALUES, UNDERSTANDING, AND KNOWLEDGE.** This area focuses on how much knowledge the company has about biodiversity, addressing mostly the first research question.
- **ACTIONS AND INCENTIVES.** This area addresses the company's current actions for biodiversity conservation, which covers mostly the second research question, but can also be useful for a better understanding of the values around biodiversity.
- **COLLABORATION.** This area explores the connection of the company with other companies in the supply chain or third parties that could collaborate with them to improve biodiversity conservation, such as the GGBC. This area therefore focuses on the second research question.

The full set of prepared questions can be found in Appendix B. The questions were modified for each interview according to the answers of each company to the survey or to the absence of reply. Some background information about the company, mainly regarding the sustainability strategies in place and the sustainability report, was also considered for input in the interviews.

The chosen software for transcription of the interview was the tool provided by Word Online under the license of Chalmers University. For further analysis, the data obtained through the transcriptions was coded. According to Easterby-Smith, Thorpe, Jackson and Jaspersen (2018), coding is an effective way to organize qualitative data in order to find patterns. This refinement of data allowed for comparison between the data from different interviews and facilitated the emergence of patterns. The research questions presented in section 1.3 served as a framework for the coding, resulting in 12 codes for the subquestions and 2 general codes for the two main questions. However, information that does not directly relate to any of the questions was considered to still be of relevance for the study and therefore, a particular category of code was used to capture this type of information. Finally, a last code was used to gather information about the background of the interviewee, which might give another insight to their answers. We coded the interviews separately at first, each of us in a different version of the document, and then discussed discrepancies to improve the consistency of the code.

Once the data was coded and analysed to achieve a preliminary answer to the research questions, a second round of interviews was conducted with the same companies in order to get feedback about the findings. In particular, this second interview was centred around the value proposition for the interaction between a biodiversity hub such as the GGBC and the private sector.

Regarding the interviews, in both rounds, the consent of participants was asked beforehand in order to be able to record with transcription purposes, and their replies to the survey regarding anonymity were verified. Finally, the interviewees were given the opportunity to read the transcribed interview and send comments for a period of two weeks. Two interviewees used this opportunity to correct a few facts.

4 Results

In this section the results from the survey, interviews and literature search are presented in accordance to the research questions, found in Section 1.3.

Seven companies replied to the survey and participated in the interviews. Five companies filled in the survey but did not agree to be interviewed. Finally, three companies participated in the interviews but did not complete the survey, for a total of fifteen companies that contributed to the study. The companies that agreed to disclose their involvement were Swerock, from the Peab Group, Boliden, OX2, PostNord, Sweco and NCC.

Table 4.1 displays industries for participating companies of the study.

Industry	Company	Survey	Interview 1	Interview 2
Mining	Boliden	No	Yes	Yes
	Mining 1	Yes	No	No
Manufacturing	Manufacturing 1	Yes	Yes	Yes
	Manufacturing 2	Yes	Yes	No
	Manufacturing 3	No	Yes	No
Forestry	Forestry 1	Yes	Yes	Yes
	Forestry 2	No	Yes	Yes
Food industry	Food industry 1	Yes	Yes	Yes
Energy	Energy 1	Yes	Yes	Yes
	OX2	Yes	Yes	Yes
Construction	Swerock (Peab Group)	Yes	Yes	Yes
	NCC	Yes	No	No

Transport	PostNord	Yes	No	No
Professional services	Sweco	Yes	No	No
Other	Company 1	Yes	No	No

4.1 RQ1. How do Swedish companies consider their dependencies of and responsibilities for biodiversity?

This section explores the general understanding of the concept of biodiversity and ES, the different values that companies assign to biodiversity and ES, and the positive and negative impacts on biodiversity that they consider.

4.1.1 How do companies understand and value biodiversity?

In order to answer this question, first we analyse how companies perceive social and environmental sustainability. Then, we focus on the concept of biodiversity, its functionality for businesses, comparisons with the concept of climate change and knowledge gaps around it. We continue by presenting why companies might consider biodiversity important by explaining the diverse values they assign to nature, as well as their relations to dependencies and responsibilities towards biodiversity. Finally, we look at the evolution of these findings.

Companies and sustainability

The literature search shows that the integration of sustainability within businesses is wide and varied. The traditional model of the firm, based on neoclassical economics, upholds the idea that companies must maximize profits for shareholders (Friedman, 1970; Key, 1999). Stubbs and Cocklin (2008) explain that, under this model, any social or environmental goal would be subordinated to this main goal, which implies the existence of significant trade-offs between them. Raworth (2017, p. 68) summarizes this idea as “the business of business is business”. Moreover, Porter and van der Linde (1995) argue that accepting this trade-off prevents environmental progress and raises costs by overestimating compliance costs.

The discussion has moved in the past decade towards the need for consideration of many other stakeholders, and the introduction of sustainable business models, where sustainability is at the core of decision-making (Stubbs & Cocklin, 2008; Bocken, Short & Evans, 2014; Raworth, 2017). Agudelo, Jóhannsdóttir and Davídsdóttir (2019) find through a literature review that the understanding of Corporate Social Responsibility (CSR) has evolved from profit generation to the creation of shared value.

In line with the trend presented above, most of the surveyed companies seem to move far from the idea of the traditional trade-off between delivering the maximum profit

and considering higher social benefits, as Figure 4.1. summarizes. Even though 90% of the companies participating in the survey think their main commitment is towards shareholders, they also acknowledge a role in society as a whole. Furthermore, all of the surveyed companies aim to make active efforts to reduce their environmental impact. In their sustainability reports, 14 of the 15 participating companies stated how they turn this goal into specific climate targets, and how they are effectively improving their environmental sustainability, mostly regarding GHG emissions and waste.

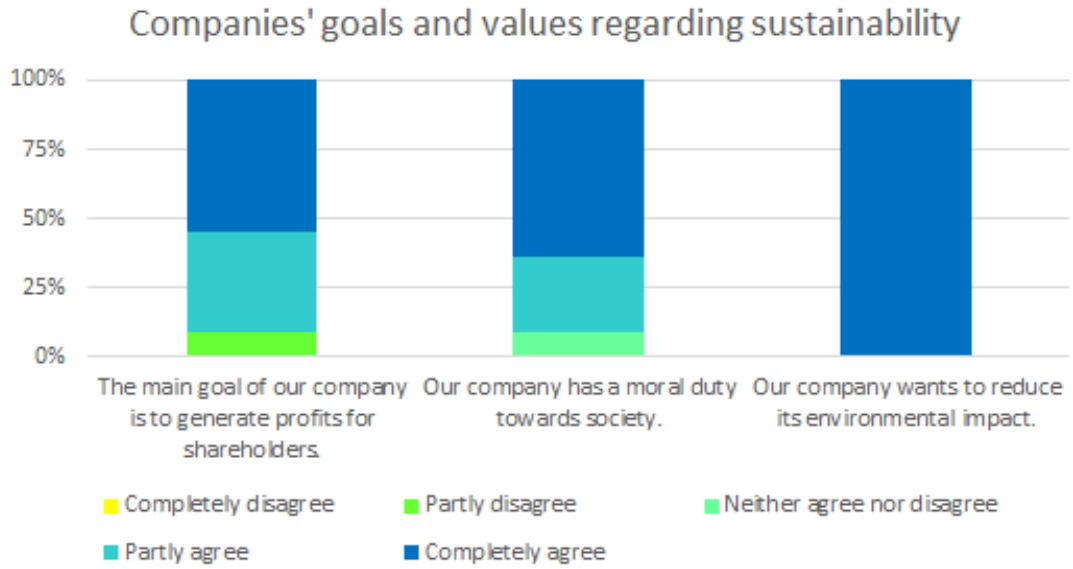

Figure 4.1 visualizes the answers to the survey question that relates to the goals and values of the companies. All respondents completely agreed that the companies wanted to reduce their environmental impact.

The concept of biodiversity from a business perspective

Regarding the understanding of biodiversity, 7 out of 11 responses to question 1 in the survey refer to the definition presented in section 2, in particular to "variability among living organisms" and/or "diversity within species, between species and of ecosystems". According to the European Commission (2018), awareness of the concept of biodiversity has grown from 2015, and Sweden is the country where comprehension of the term is higher.

Three companies mentioned the interaction between species and environment or ecosystems in their answers to the survey, defining biodiversity as "healthy balance between species and environment", "(...) combination of different species which are creating [a] well-functioning, broad ecosystem", and "the conditions for plant and animal life in different biotopes". Mining 1 gave a definition through contrast, stating that biodiversity is "the opposite of monoculture, whether it be natural or aided by man".

Furthermore, the concept that companies internalize can be even broader. Boliden highlighted the social aspect of biodiversity: "(...) maybe to me, biodiversity is a little bit wider than habitats and species. It's also about the social thing around that. What is suitable where and ES in different ways and doing the right thing at the right place". In

a similar way, Energy 1 stated “we're not so focused on the most scientific definition always, it's more like incorporating the green side of environment (...) into our activities”, after explaining they might perceive the concept as a synonym for nature protection.

Comparison with climate change

A common comparison that arose during over half of the interviews was that of biodiversity and climate change. While climate change is considered an established topic, with broad public understanding of the basic causes and consequences, biodiversity is more perceived as a lesser-known concept, by at least two companies. Manufacturing 2 stated that “when it comes to climate there are so many frameworks and laws and (...) guidance on how to prioritize and tools, and in [biodiversity] at least I am not aware of any such guidance”.

In a conceptual way, four interviewees pointed out that biodiversity was following the same trend that climate change had, and that it will become more present in the future, borrowing from indicators and frameworks developed for reducing GHG emissions. OX2 highlighted the role of mass media in disseminating knowledge and creating awareness.

The parallel was also used to compare how “simple” it was to know which measures to take to prevent climate change, and how it has an accessible indicator (CO_2 emissions) as opposed to biodiversity. Only Food Industry 1 stated that working with biodiversity was easier because of the big investments that represent reducing emissions for them.

The three manufacturing and two energy companies pointed towards the impact of climate change on biodiversity. There were also mentions by Forestry 1 of the importance of biodiversity in fighting climate change, as well as some trade-offs between halting biodiversity loss and reducing CO_2 emissions, described by Food industry 1. However, Boliden focuses more on the synergies than on potential conflicts.

Different type of values that companies assign to biodiversity

The value that companies assign to biodiversity is varied, as Figure 4.2. shows. Instrumental value, as discussed in section 2, is determined by direct use, indirect use (including the option of future use) and non-use values, while intrinsic value is not connected to any benefits. Direct and indirect use, and their relevance for the operations of the company, determine the degree of dependency that they have. All the different types of values determine the degree of responsibility that companies might have towards biodiversity.

Use values
In the survey, the sentences regarding provision of inputs and absorption of waste flows were used to estimate direct use values by companies, while those regarding public perception, environmental regulation, provision for society as a whole (not for the company activities) and human health addressed indirect use values.

Direct use by the companies depends on their activities. The importance of biodiversity as a provider of inputs is very high for companies in forestry and food industries,

according to their responses to the survey. The two participating service companies do not see themselves as highly connected to biodiversity through inputs and outputs, as nor do some companies related to construction or manufacture.

A different direct use comes from those companies that do not take inputs for biodiversity but design products or offer services that require healthy ecosystems. They depend on the existence of a healthy environment that their customers can enjoy, therefore they monetise the economic value of cultural ES. This was the case for Manufacturing 2.

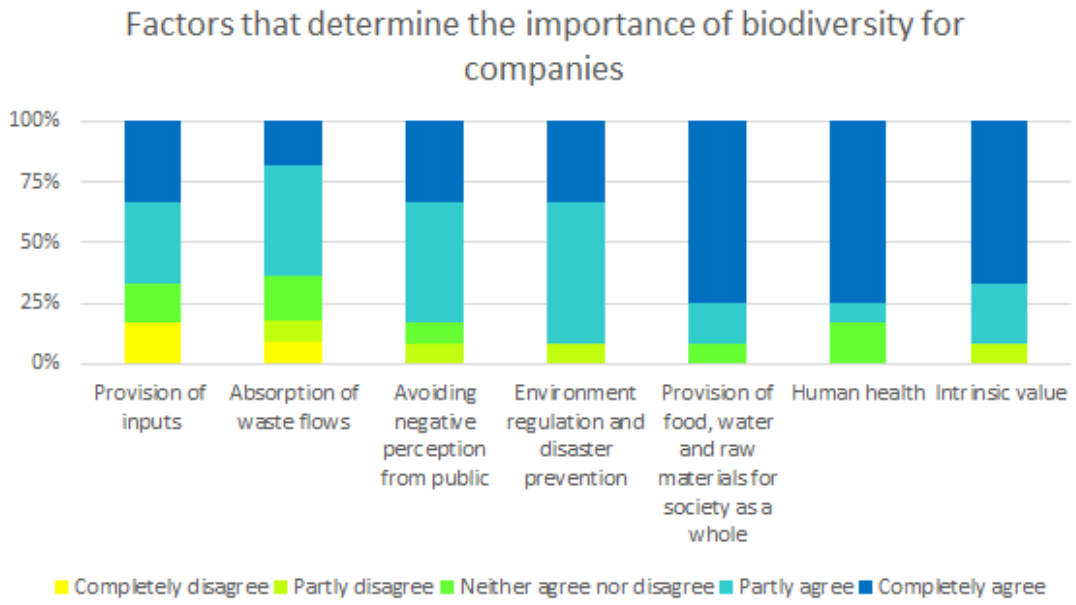

Figure 4.2 visualizes the answers of the survey question that relates to the importance of biodiversity for companies. The respondents agree to different degrees that biodiversity is important and particularly the provision of food, water and raw materials for society as a whole and human health.

Indirect use seems to be perceived as more relevant than direct use for most of the companies, which is connected to the fact that only 20% of the companies that participated in the study use animal or plant products directly. According to the results of the survey, the contribution (positive or negative) of biodiversity in the public perception of the company is an important source of value that could be classified as indirect use. In the interviews, two companies mentioned their interest in biodiversity in connection to public relations. Environmental regulation has an even higher regard according to Figure 4.2, but the most relevant factor for the importance of biodiversity is the provisioning services for society as a whole. The impact of biodiversity for mental and physical health follows.

Non-use values

As discussed in section 2.1.3, instrumental value can also refer to non-use values. Non-use values were not included in the survey, but four interviewees from different sectors highlighted the importance of preserving biodiversity for future generations (bequest value).

Intrinsic value
Intrinsic value is presented in the survey through the sentence "all living beings have value", implying that value is a non-conditional property of life, without exception, which agrees with the definition by Sandler (2012). As Figure 4.2 shows, 67% of the companies completely agreed, and another 25% partially agreed, which means that over 90% of the companies assigned some level of intrinsic value to biodiversity.

Different studies also show diverse rationales behind the interest of companies in biodiversity. Van den Burg and Bogaardt (2014) find in their interviews of five companies in the agro-food sector that they contemplate ethical arguments for biodiversity preservation, in line with intrinsic values. However, instrumental values appear more often in empirical studies about companies. Koellner, Sell and Navarro (2010) found through a survey of varied companies in Costa Rica that the main motivation to invest in ES came from non-financial benefits, such as personal values towards human welfare and ecological responsibility. Mulatu, van Oel and van der Veen (2015, p.475) obtain the same results for a case in Kenya, stating that "the altruistic preferences of decision makers do motivate investment decisions on ecosystem services improvement". Davies et al. (2018) find public image to be among the main rationales behind conservation initiatives, followed by CSR and employees' wellbeing.

Dependencies and responsibilities
Even if companies do not consider themselves directly connected to biodiversity through inputs and outputs, they can still perceive they are dependent on biodiversity due to all of the aforementioned indirect uses. In the interviews, all the companies stated they were dependent on biodiversity. Some companies base their business model on it. As a forestry company put it, "(...) it's important to recognize the fact that we're an industry based on a natural resource. (...) [Biodiversity] is not an add on or something complimentary, it's definitely at the very core of our whole business idea". Swerock and OX2, both companies with a large land use, appeal to permits as a type of dependency. On the other hand, manufacturing companies relied more on life-support functions, as illustrated by the answer of one of them: "I think the entire planet is dependent on biodiversity".

The considerations all types of value manifest in the sense of responsibility that companies have towards biodiversity. Nine of the ten companies interviewed stated they considered themselves as responsible for biodiversity. This responsibility in some cases encompasses the whole supply chain and might even go beyond the company's supply chain, expressed by Manufacturing 1 and Forestry 2. Moreover, this responsibility can be related with a sense of intergenerational justice referenced above as "bequest value". On the other hand, Manufacturing 2 stated that at the moment they did not have the awareness or the understanding of their impact to declare themselves responsible for biodiversity.

4.1.2 How do companies understand and value ecosystem services (ES)?

Even though many of the values associated with biodiversity can be connected to ES, these do not appear to be part of the growing discussion about biodiversity within companies.

Only 4 out of the 15 companies that participated in the survey and/or in the interviews include somehow the term “ecosystem services" in their publicly available information, although in very diverse contexts. Boliden briefly mentions them in their guidelines for biodiversity (Boliden, 2020). Two companies explain in their websites how their supply chains are related to ES. Sweco includes the term in their report about biodiversity in urban environments (Sweco, 2020). NCC states they believe in the importance of ES to achieve sustainable development (NCC, n.d.). For two other companies, the term appears marginally in news or reports older than a year. No further mention or explanation about ES appears in the sustainability reports or strategies.

ES only came up in the interviews with Boliden, Energy 1 and Forestry 1 when discussing the definition and importance of biodiversity, and Forestry 2 made a reference to services from nature. Some examples of the role of biodiversity for provision, regulation, support and cultural services were mentioned, without directly using those terms. Of these, provision services were addressed in half of the interviews, in particular in relation to companies with extensive land use. Regarding regulation services, the relevance of biodiversity for climate change adaptation and mitigation was highlighted in three interviews, while pollination was suggested as a working area by Food Industry 1. From supporting services, only soil formation is identified as an essential requisite by Food Industry 1. However, as mentioned in RQ 1.1, the general role of biodiversity in preserving the environment and supporting life on Earth is widely acknowledged. As for cultural services, they were only indirectly mentioned once due to their relation to the product of Manufacturing 2.

4.1.3 How do companies perceive their impact on biodiversity?

This section includes how companies perceive their impact on biodiversity. Direct and indirect impacts serve as the structure of the section, and these can be further categorised as positive, negative or neutral impacts. Positive impacts are actions that in some way improves biodiversity, for instance by recreating a wetland. On the contrary, negative impacts are actions that increase biodiversity loss such as deforestation. Neutral impacts do however neither increase or decrease biodiversity loss. Net impact on biodiversity was addressed by McVittie & Faccioli (2020), and it relates to the balance of impacts and to biodiversity offsets. It is therefore possible to have a net positive impact if the negative impacts are over compensated through positive impacts. Furthermore, actions can also be taken to reduce a negative impact, meaning that a single action can be positive in relative terms, but still negative in absolute terms.

Direct impacts

OECD (2019) defines a direct impact as a result of the direct interaction of an activity with biodiversity and ecosystems. This corresponds to the drivers of land-use, pollution, consumption of natural resources and invasive species. A company that uses land has a direct impact in the area. In a similar way, problems of pollution or resource overexploitation can be tracked down to the company or companies who have leaks or who are extracting resources. The case with invasive species might be more complicated, but the relation between a particular action of a company and the appearance of the driver is still possible. Although the connections between business activities and consequences for biodiversity are not always straightforward, these four

drivers of biodiversity loss have an immediate impact in a determined region out of the five explained in Section 2.5.

Land use

Half of the respondents to the survey disagreed that the companies had a significant negative impact on biodiversity through land use. Boliden expressed in the interview that the mining operations have to be in the areas where the resources are located and using land and water is necessary. Furthermore, the interviewee said that if the natural values are high in the site, it has to be managed. Swerock said that in their quarries, there were cases of having more biodiversity than in the surroundings, in particular pioneer species. Use of land was also mentioned by both the companies in the energy sector. Food industry 1 perceived that the company has a positive impact on biodiversity, with examples such as "But the way we see it is that we really affect biodiversity in a positive way (…)" and "(...) we're actually creating biodiversity, and that's something that we want to communicate more about in the future".

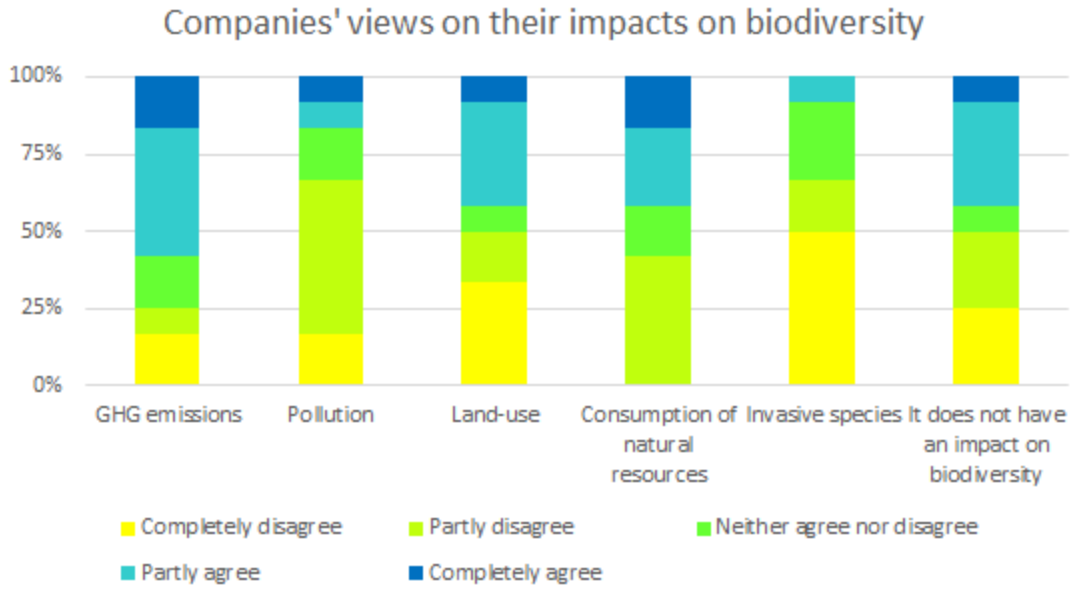

Figure 4.3 visualizes the answers to the survey question that relates to the companies' impacts on biodiversity. More than half of the companies disagreed that they had an impact on biodiversity through pollution and invasive species, but agreed that GHG emissions caused impacts.

Pollution

Pollution in different regards, for instance through the use of chemicals, was mentioned in the interviews by Manufacturing 1 and 3 but the pollution was considered to be nearly insignificant. In the survey, 67% of the respondents disagreed that pollution from the companies caused a significant impact on biodiversity.

Consumption of natural resources

Unlike the other categories of the survey, none of the respondents strongly disagreed that the company had a significant impact on biodiversity through consumption of natural resources, but about 42% of the respondents disagreed. In the interviews, the companies did not seem to relate taking inputs from nature as a negative impact that often, highlighting more emissions, pollutants and land-use.

Invasive species
Invasive species were not considered by the respondents to either the interviews or survey to be a significant source of impact on biodiversity caused by the companies. In the survey, half the respondents strongly disagreed that the company had a significant impact on biodiversity due to proliferation of invasive species, and invasive species was not mentioned once in any interview.

Indirect impact

The OECD (2019) explains that indirect impacts are those impacts that are not the result of a site or facility, and that are often produced away or through a complex pathway. From the interviews, impacts related to the supply chain and emissions of GHG emerged.

Supply chain
Several companies also mentioned in the interviews that other actors in the supply chain can have an impact on biodiversity. Manufacturing 1 and 3 mentioned that this could be from sourcing of material. Manufacturing 2 said that their impact could be related to how the customers use the product, the manufacturing process or from the suppliers. Energy 1 said that they are working to reduce the climate impact in the supply chain, and that climate impact is connected to biodiversity impact.

GHG Emissions
Reducing emissions of GHG in order to improve the impact on biodiversity was mentioned by four of the interviewed companies. Two of the companies are in the energy sector and by generating renewable energy and consequently, reducing emissions does according to the companies improve the impact on biodiversity.

Manufacturing 1 and Food industry 1 were instead considering lowering their own emissions. GHG Emissions was according to the survey the biggest source of biodiversity impact from the companies, with over half of the respondents agreeing to some extent.

4.2 RQ2. What are the incentives that these companies have or could have to advance initiatives for biodiversity protection, in particular interactions with biodiversity hubs?

This section starts with which initiatives companies have taken to protect biodiversity, followed by how these initiatives fit within the strategies of the business models. Then, we explore the motivation of companies to have an interest in biodiversity and associated challenges. Finally, we present companies´ knowledge of biodiversity hubs and the incentives to interactions between them.

4.2.1 Which initiatives are taken or planned to protect biodiversity?

Priorities within the sustainability strategy

In a similar fashion to RQ1, first the initiatives are examined from a general sustainability perspective. Figure 4.4. shows the current priority is reducing GHG emissions and, to a lesser extent reducing waste and achieving an efficient use of resources.

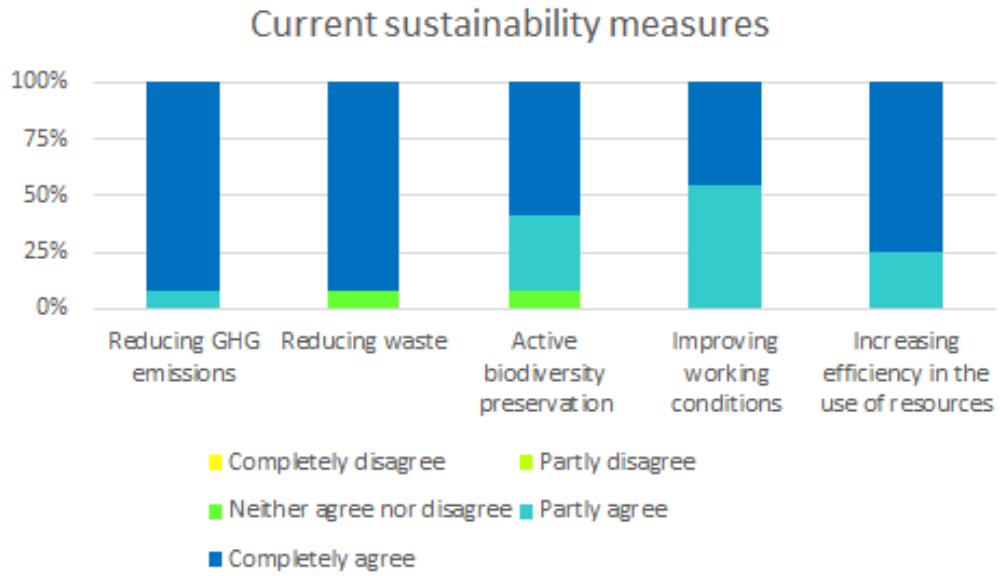

Figure 4.4 visualizes the answers to the survey question about the current sustainability initiatives used by companies. The companies agreed to a large extent to all sustainability measures but in particular to reducing GHG emissions and waste.

In the survey, the social dimension of sustainability is reduced to working conditions of the company's own employees. According to the answers to the survey, improving the workplace is less of a priority than other sustainability targets. However, in 73% of the interviews and websites of the companies, safety, health and well-being of employees are mentioned as an essential part of the sustainability strategy.

Sustainability and biodiversity frameworks

The frameworks that encompass sustainability strategies on a general level or that serve as a guide to establish targets and measure progress towards them are the SDGs, directly mentioned by 80% of the companies on their websites and reports, and the Science Based Targets (SBT), mentioned in two interviews. For sustainability reporting, the Global Reporting Initiative (GRI) is adopted by at least 66% of the companies as standard, according to the sustainability reports.

Focusing directly on biodiversity, it is almost as if every company has its own framework. In the interviews, the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC) are mentioned by the two forestry companies and for Manufacturing 1 as important for biodiversity. On the other hand, the two energy companies referred to the SBTN, which, as Energy 1 noted,

is an initiative that follows the SBT, in line with the idea explained in RQ 1.1 that biodiversity is following the developments in climate change. Boliden and OX2 appealed to the mitigation hierarchy for their biodiversity related initiatives.

Other relevant frameworks from the perspective of the companies are biodiversity net gain, mentioned by Boliden and Energy 1; the Aichi Targets and the Red List of Threatened Species for Sweden, both mentioned by Forestry 2; and company or industry's guidelines for biodiversity, mentioned by Boliden, Swerock and Forestry 1. Three companies do not have a specific framework to work with biodiversity, while at least two companies work with more than one framework simultaneously.

Approaches to biodiversity initiatives

Depending on their relation to biodiversity, mainly their impacts as described in RQ 1.3, companies take different approaches towards biodiversity. For example, Manufacturing 3 stated that they preferred to look at their biggest impact, which is GHG emissions, and focus their efforts on that. Construction, mining and forestry companies have a more direct approach towards it, with concrete plans for biodiversity management, although sometimes with a limited scale. They seem determined to undertake measures for biodiversity: Swerock stated they wanted to "make it simple, but make it happen" and Forestry 2 explained that they will work with biodiversity even when they cannot verify the magnitude and direction of the impact. Food Industry 1 referring to "small steps" or initiatives that didn't require big investments as a core part of their initiatives.

Biodiversity initiatives

In the same sense that there are different types of frameworks and approaches, the initiatives in place to halt biodiversity loss or create positive impacts are varied. The actions that companies consider depend on the activity of the company and the location of its operations. Large companies with different lines of business might consider biodiversity differently within each line. Energy 1 exemplified by comparing initiatives needed to operate a hydrological power plant and a wind farm. Table 4.2 summarizes the general type of initiatives that companies reported to be taking and some specific examples that were mentioned during the interviews.

Table 4.2. Examples of biodiversity initiatives in place or planned.

Initiative	Examples	Mentions
Avoid impacts	Set-asides Project design to find the best alternative.	Boliden, Forestry 1 and 2, OX2.
Minimise and rehabilitate	Protect old and unique trees in forests. Monitor and learn about Red Listed Species and their habitats, then maintain those habitats over time. Leave trees in buffer zones to wetlands.	Swerock, Food Industry 1, Forestry 1 and 2.

	Increase the natural value of quarries after operations. Biological pest control.	
Offsets		Boliden, Manufacturing 3 Forestry 1 and 2, OX2.
Independent positive actions	Help pollination.	Food Industry 1.
Pollution control in soil, water and waste.	Use of non-hazardous and/or organic materials. Site cleaning and remediation. Sustainable packaging and reducing plastic use.	Manufacturing 1 and 3, Food Industry 1.
Circular solutions	Use of manure as an energy source. Reduce food waste.	Food Industry 1.
Control of GHG emissions	Use of renewable energies. Carbon capture and sequestration.	Manufacturing 1 and 3, Boliden, Energy 1.
Upstream supply-chain management	Demand certifications from suppliers or aid them to obtain certifications.	Manufacturing 1 and 2, Energy 1 and Forestry 2.
Downstream supply-chain management	Consider the impacts during the use stage.	Food Industry 1, Manufacturing 2 and 3
Internal standards	Implement a code of conduct in all locations and acquisitions. Educate employees on biodiversity.	Manufacturing 1 and OX2
Research and development	Developing a system to measure impacts of land-use change on biodiversity.	Swerock, Boliden, Food Industry 1, Energy 1, Forestry 1.
Benchmarking	Follow indicators or methodologies used in other industries	Swerock, Manufacturing 2
Collaborations	Elaborate industry guidelines. Create or participate in networks like Svemin, Business@Biodiversity (Sweden), Skogsindustrierna. Enable external research in the location of operations. Stakeholder management and involvement.	Swerock, Boliden, Energy 1, Forestry 1 and 2.

4.2.2 How do these conservation initiatives fit the strategies of the companies' business models?

Regarding how willing the companies are to accept trade-offs in order to reduce their environmental impact, the respondents to the survey seemed to agree to a higher degree that public image was less important than the other topics, seen in figure 4.5. The respondents seemed to be more neutral regarding whether the production levels could be changed. The only category where respondents completely disagreed was increasing the final price of the product.

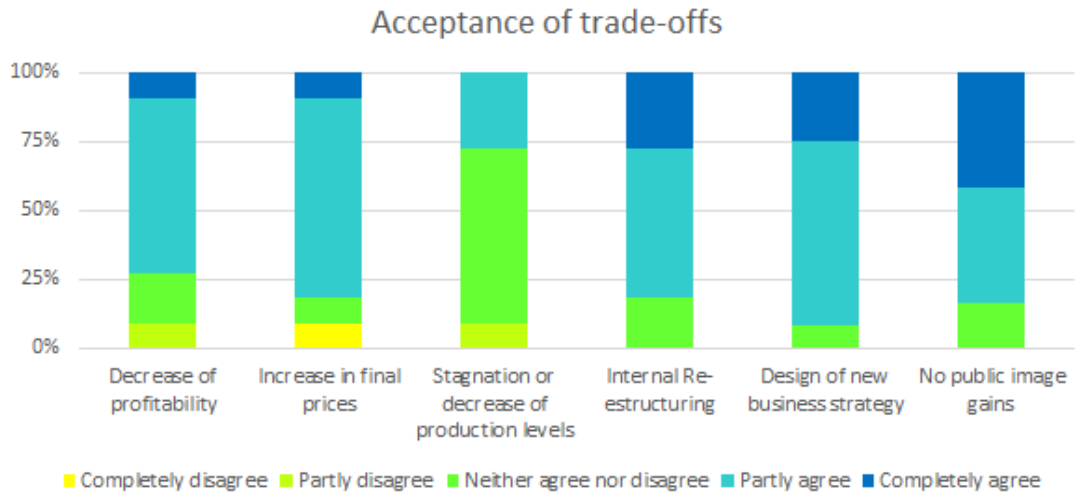

Figure 4.5 visualizes the answers to the survey question of what trade-offs companies could accept. Generally, the acceptance of designing a new business strategy or to not gain any publicity seemed to be stronger than to decrease the production output.

Biodiversity targets

For about half of the companies that participated in the interview, biodiversity seemed to be included within other sustainability goals rather than being a distinct target. Manufacturing 1 and Energy 1 did not have distinct strategies for sustainability and for business, rather it was intertwined in the business strategy. According to Manufacturing 1 the purpose was to make sustainability a more natural part of the everyday operations: "...we don't have a separate sustainability strategy. That sustainability is an organic and natural part of our company strategy and that way our company strategy is our sustainability strategy".

Businesses seem to be at a tipping point regarding the inclusion of biodiversity targets and strategies, with recent developments that aim to elevate biodiversity ambitions. Boliden and Energy 1 have specific sustainability targets for 2030 which includes having a net positive impact on biodiversity. Swerock has a specific plan for how to work with biodiversity in quarries, and is also currently developing how to incorporate biodiversity into the business plan. OX2 from the energy sector is also investigating how a biodiversity strategy could be incorporated in the same way for different projects. Food Industry 1 has developed a concept that describes the positive impacts they have on biodiversity. Forestry 1 has specific goals and visions for biodiversity preservation and they have goals to preserve all the species that are currently living in the forests. Forestry 2 had similar targets, to not reduce the current state of biodiversity in the

forests. Furthermore, the two forestry companies expressed that biodiversity has a fundamental role for the business. Notwithstanding, none of the manufacturing companies had any distinct biodiversity targets.

Biodiversity and sustainability priorities

Two manufacturing companies explained that they didn't have any concrete biodiversity targets because other sustainability targets were prioritised since the impact in these areas was considered to be more significant. Another manufacturing company expressed an uncertainty whether they should focus on biodiversity themselves or if this is an area where other companies should lead the way. However, the same company argued that they saw a need to incorporate biodiversity into their current sustainability efforts. Furthermore, OX2 is working with sustainability divided into people, profit and planet and in planet, biodiversity is top priority.

As for where biodiversity fits in project management, Boliden and Energy 1 mention the need to address biodiversity issues from the early stage of exploration all the way to long-term management, which supports the idea of a more integrated approach of biodiversity within both sustainability and business strategies.

Houdet (2008) also highlights the need for moving away from merely managing impacts and integrating biodiversity in shaping business strategies. In fact, this integration has been commonly labelled as "biodiversity mainstreaming" and even though the need for it has been recognized globally, the current progress is not well developed (Whitehorn et al., 2019). Comparatively, business and biodiversity seem to be more intertwined in developing countries, Whitehorn et al. (2019) argue that a possible explanation is an increased stakeholder involvement and connection to nature. Companies generally tend to regard biodiversity as an obstacle with focus on the costs of biodiversity, rather than as an opportunity (Houdet et al., 2012).

4.2.3 Which are the main drivers to implement initiatives to protect biodiversity?

Legislation

Manufacturing 1 and 3, both energy companies, and Swerock (50% of the interviewees) referred to current and expected legislation at several levels as an essential motivation behind biodiversity initiatives. In particular, the three latest mentioned the requirements of working with biodiversity in order to obtain permits to start or continue their activities. Boliden referred to Svemin's report, Mining with Nature, to convey their motivations. In the report, the access to permits is also stated as an incentive to develop biodiversity projects towards net gain (Svemin, 2020).

The European legislation was highlighted on three occasions. Swerock stated that the aggregate industry was waiting for the developments regarding directives and guidelines for biodiversity to initiate their next steps in the matter. They also mentioned they foresee new legislation will force companies to work with biodiversity. The manufacturing companies discussed more general sustainability legislation like the carbon pricing mechanism at the European level and pollution regulations.

Bishop, Kapila, Hicks, Mitchell and Vorhies (2009) argue that regulatory requirements are important drivers of investment in ecosystems, but appeal to the higher potential of market mechanisms (certification, trading permits and direct payment). However, these still do not exist as a main driver, considering the lack of mentions of them in the interviews. The only exception is the FSC and PEFC certifications in the forestry sector. Manufacturing 3 and Forestry 2 made reference to offset markets, but the first one was discussing carbon credits and the other stated they were trying to develop a trading scheme, but they were still in the early phases.

Stakeholder demands

Public relations (PR) involving diverse types of stakeholders were postulated as an important driver in 80% of the interviews, or, as Energy 1 put it, "make sure that we are in line with what our different stakeholders expect from us". In a similar way, Manufacturing 1 stated: "we welcome this pressure and that pressure comes multifaceted, whether it's through regulation, whether it's your customers, whether it's your shareholders or investors, most importantly, your employees. We have run pressure internally". Five out of the nine motives to work with biodiversity loss presented in Mining with Nature are related to PR involving, respectively, owners, clients, stakeholders, staff, and support from society (Svemin, 2020).

There are negative and positive aspects of the relations with stakeholders, i.e., the companies can face criticism and lose customers if they fail to address biodiversity loss, but there is also an opportunity to gain competitive advantage and strengthen the core strategy from leading successful initiatives (van den Burg & Bogaardt, 2014).

We identified seven types of stakeholders that companies consider at different stages for decision-making regarding biodiversity:

- **Authorities**. The connection with authorities is related to the previous driver, legislation. Swerock commented that more biodiversity initiatives bring easier cooperation and procedures for obtaining permits, which in turn generates motivation for biodiversity initiatives.
- **Customers**. Manufacturing 1 and Manufacturing 3 mentioned that creating extra-value and helping customers to reduce their own environmental impacts is a good incentive because it represents a way to expand the business.
- **Employees**. Three interviewees noted the relevance of the relation with the personal values of themselves and other employees, as well as the satisfaction employees might have from working in a place with a positive impact in an area that matters to them.
- **Investors and owners**. Half of the interviewees commented on the importance of sustainability and biodiversity risks for investors and owners, who are questioning the companies about their impact and strategies.
- **Local stakeholders.** Nearby residents were mentioned by Swerock due to their importance for the acceptability of quarries.
- **General public**. Energy 1 emphasized the growing interest of society in biodiversity.
- **Non-Governmental Organizations (NGOs).** Boliden and Food Industry 1 mentioned the need of contacting NGOs and receiving their approval regarding

metrics and trust building when dealing with biodiversity. However, they do not appear as a pressing main stakeholder.

Five companies point towards the fairly recent incorporation of biodiversity into the scope of their environmental considerations, indicating that it is gaining traction in their agendas in the last couple of years. The general interest in biodiversity is on the rise, as the companies also get more pressure from different stakeholders to take action, including through stricter regulation. OX2 and Manufacturing 2 stated that as a result of these pressures, the companies increased their awareness on the topic and have a desire to build-up knowledge.

Some studies did not find increasing demands from customers or NGOs regarding biodiversity conservation as an important factor behind decision making in that aspect (Davies et al., 2018; Koellner et al., 2010; Mulatu et al., 2015; van den Burg and Bogaardt, 2014), while others do (Bishop et al., 2009; Wolff et al., 2018). In Europe, a recent Eurobarometer survey finds that citizens' concern for halting biodiversity loss is stronger than in 2015 (European Commission, 2018). Furthermore, 2020 was the first year in which the KPMG Survey of Sustainability Reporting included biodiversity risk as a key factor in environmental reporting (KPMG, 2020). This year also led to developments such as the launch of the Dasgupta review and the creation of the Taskforce for Nature-related Financial Disclosures (TNFD) by the UN and WWF (Dasgupta, 2021; TNFD, n.d.).

Value of biodiversity and biodiversity risk

The companies are dependent on biodiversity for its contributions to business and societies, as explained in RQ 1.1. Food Industry 1 and Forestry 2 highlighted their interest in halting biodiversity loss for the survival of their business models. Three companies referenced the value for society to answer why they are implementing or would implement more initiatives to prevent biodiversity loss. Swerock commented that “It’s good for the environment as a whole. (...) Everyone is living on this Earth”, while Manufacturing 3 said “we live in this world” and OX2 stated “we want people and the planet to continue to thrive”. In general, the value that companies give to biodiversity, analysed in RQ 1.1, is one of the main drivers for initiatives.

4.2.4 How do companies address the main challenges to implement initiatives to protect biodiversity?

Regarding the perceived challenges to improving biodiversity, about half of the respondents to the survey answered that they agree to some extent that knowledge about impacts, knowledge about initiatives and economic resources were challenges, as seen in Figure 4.6. Furthermore, regarding different priorities in the company, 33% of the respondents disagreed completely, 25% partly disagreed and 33% neither agreed nor disagreed that the company had different priorities.

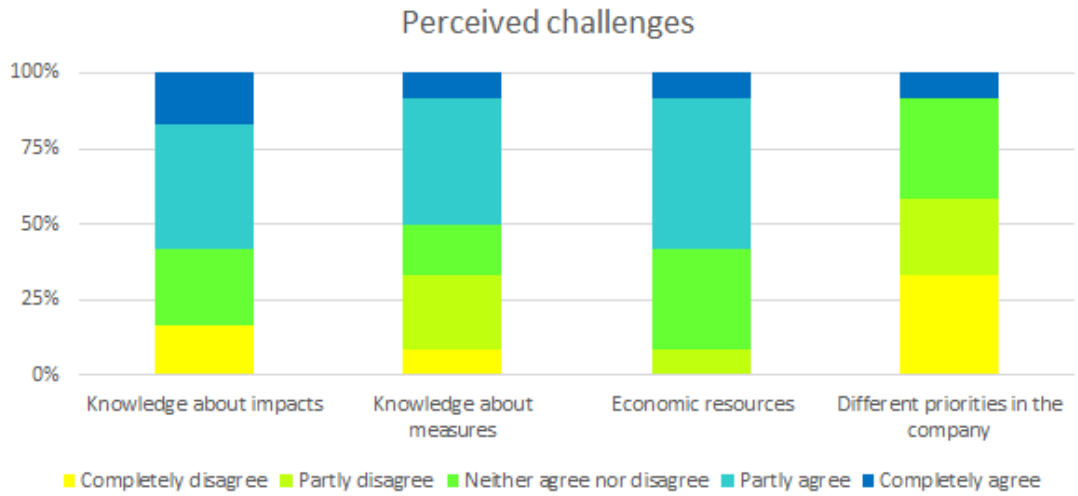

Figure 4.6 visualizes the answers to the survey question relating to if the companies have perceived challenges to implementing biodiversity initiatives. Knowledge of the company's impacts and economic resources seems to be perceived as the largest barriers, on the contrary, over half the respondents disagreed that other priorities hindered biodiversity.

Challenges

Knowledge gap

The interviews reveal difficulties of translating the definition of biodiversity into something that the companies can operationalize. Three companies from different industries referred to biodiversity as a complex or complicated topic. Forestry 1 explained that different stakeholders could interpret the same facts as either "good" or "bad" for biodiversity due to the many ways of understanding biodiversity.

Four interviewees noted the lack of knowledge within companies and of the general public around general causes and consequences of biodiversity loss, the links between them, and the implications this has on developing and implementing biodiversity protection initiatives. This also poses problems for a particular company to know if their efforts and the pace at which they are incorporating more initiatives are enough or adequate for their level of impact. As Swerock stated: "some things are really easy to do (...) but you have to think to do the right things and not do the wrong things".

This knowledge gap is not evenly distributed, neither between different sectors of society, nor between different companies, Manufacturing 2 appointed. As a result, some relevant stakeholders might have practical knowledge about working with biodiversity but lack the theoretical knowledge. An example from Food Industry 1 would be how small farmers do positive things for biodiversity without thinking about the concept of biodiversity per se. Forestry 2 pointed out how conservation organizations, which might be very knowledgeable regarding biodiversity, focus mostly on reducing the use of land, with a disconnection to the implications for businesses.

The mining companies lead the way in knowledge about biodiversity. Swerock, for example, stated that Mining with Nature, a roadmap for biodiversity created by the Swedish mining industry cluster Svemin, could serve as inspiration for the aggregate industry. They also affirmed they had a good level of knowledge about creating

biodiversity in quarries. Moreover, Boliden referenced industry initiatives to measure biodiversity. At a worldwide level, the mining industry is also the only sector "at risk" from biodiversity loss where a majority of the companies report said risk (KPMG, 2020).

On the other hand, manufacturing companies have many questions regarding implementation, as exemplified by statements they made: "I think we have a good understanding of the problem to be honest, we're looking at the solutions"; "For me, biodiversity is not clear. What is it I need to do?". Forestry and food companies have diverse initiatives in place, but they are hesitant about their level of impact. In a similar way, the two energy companies were concerned mainly about not knowing how to measure biodiversity.

Lack of methods to monitor biodiversity

From the interviews, the most frequently perceived challenge was the lack of methods to monitor and measure biodiversity which was mentioned by six companies involved in mining, manufacturing, forestry, construction and the food sector. For Boliden and Food Industry 1, the need of measurements was related to achieving and proving a net positive impact on biodiversity. Energy 1 described that since biodiversity is local it makes it more complex and resource intensive to measure on each site. OX2 expressed that they didn't want to measure things that weren't measured by other companies and that the comparability to other companies was important. Furthermore, the demand to measure biodiversity over time was mentioned by two companies, Energy 1 and Forestry 2. Lack of available data and methods to measure biodiversity is a generally known obstacle for biodiversity from the literature, acknowledged by for instance Stephenson (2019), Kuussaari et al. (2009), and Verburg and Osseweijer (2019). Another potential hindrance to implementing biodiversity measures is according to Verburg and Osseweijer (2019) that companies tend to prioritize other sustainability targets especially carbon emissions.

ten Kate, Bishop and Bayon (2004) explain that measuring the impact, the location and the timeline for voluntary offsets were major technical issues already at that time for companies to implement this type of initiative. In addition, Milner-Gulland et al. (2021) highlights that biodiversity mainstreaming, as explained in RQ 2.2, should include tangible actions and that lack of measures of biodiversity impact historically has been seen as a hindrance to companies.

Stakeholders

Another challenge to implementing biodiversity initiatives was related to different stakeholders. For companies that rent land, which is the case for Swerock, OX2 and Forestry 1, land owners were not always eager to adopt biodiversity initiatives. For Swerock, it was biodiversity initiatives after closing a quarry.

A challenge that was not directly mentioned in the interviews was the fear of criticism and the increase of scrutiny. According to ten Kate, Bishop and Bayon (2004), companies stated that they sometimes did not implement voluntary offsets because they did not want to face the risk of lacking stakeholder support and trust. The same applied for some governments. Manufacturing 1 stated they wanted to avoid greenwashing, but they did not relate it to a problem to establish new initiatives.

Regulations
From the interviews, there were also some perceived challenges regarding legislation or permits. For Swerock, it could be difficult to obtain permits in areas with high natural values, but also that if the biodiversity was improved by the company on site, they could eventually lose the permit to operate there. The permission to use land for compensation (offsets) was also considered by Boliden to be a challenge. For Manufacturing 2, the current regulation does not provide enough guidance about biodiversity.

Measures to overcome challenges and find information

Upon the question relating to what initiatives the companies had taken to overcome challenges which can be seen in figure 4.7, the most common answer in the survey was that 67% of the companies had joined biodiversity networks. The other answers, from the most popular to the least, were buying education (58%), hiring consultants (42%), following other companies (42%) and hiring experts in biodiversity (25%).

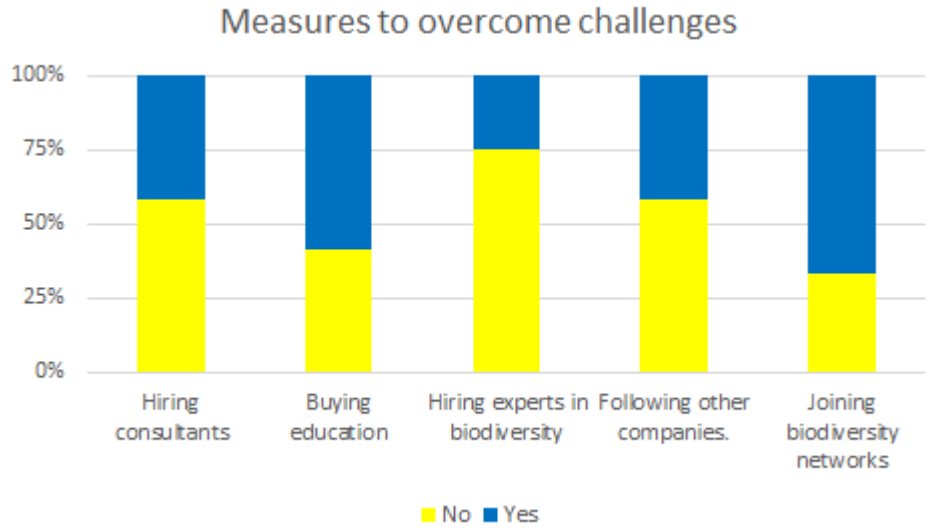

Figure 4.7 visualizes the answers to the survey question of what initiatives companies have taken to overcome challenges. Joining biodiversity networks was the most common measure to overcome barriers while the least common was to hire biodiversity experts.

Similar answers regarding where companies search for information about biodiversity appeared in the interviews.

Biodiversity experts
Using experts on biodiversity was considered to be a source of information for five companies. Manufacturing 3 and Forestry 1 mentioned that they have employees that are educated in biodiversity. For Boliden, experts on biodiversity are doing inventory on potential mining sites before the mine is established in order to obtain the permits. The inventory usually also describes how the sites will be handled upon termination of the mining activities. Experts on biodiversity were also mentioned by Food Industry 1 to develop measures for biodiversity. Swerock hired consultants to work with specific biodiversity issues.

The consultancy firm Ecogain and the Business@Biodiversity network appeared frequently in the interviews as a source of information.

Collaborations
Different collaborations around biodiversity were also mentioned with different compositions. Industry organizations were used by two companies, Forestry 1 said that the industry organization conducted research on biodiversity and Swerock said in the interview that the mining industry organization had developed a roadmap for biodiversity.

Two companies also mentioned collaboration with universities and other research institutes, Forestry 1 allowed researchers and students to conduct research in their forests and Boliden financed a PhD student and created a platform for research. Furthermore, Boliden collaborates closely with researchers.

The literature shows that industry organizations have developed ways for companies to manage biodiversity in the operations in the mining and forestry sectors (Boiral & Heras-Saizarbitoria, 2017). Furthermore, Boiral and Heras-Saizarbitoria (2017) present in their study, 35% and 55% of the participating mining and forestry companies respectively interacted with research institutions. Collaborations with NGOs to promote biodiversity is common within the energy sector and for this industry the EU level provides guidance with legislation according to Moreira (2019), for instance by regulating interaction with habitats of endangered species and birds.

Following other companies and benchmarking
Seeing how other companies are working with biodiversity, or benchmarking, was mentioned as a potential source of information to be used in the strategies by two companies. OX2 said that it could be good to know the biodiversity approaches by other companies, even if it is in other industries.

4.2.5 Are companies aware of established biodiversity hubs?

As Figure 4.8 shows, 83% of the companies have heard of research and/or conservation networks before. Five companies mentioned Ecogain and the network they created, Business@Biodiversity, during the interviews as an important player in the biodiversity landscape through their initiatives in developing and exchanging knowledge as mentioned in RQ 1.4. The mining and forestry industries stand out in their respective clusters and certification schemes mentioned in RQ 2.1 Regarding international networks, Boliden mentioned the International Council on Mining and Metals, despite not being a conservation network, but an industry cluster, due to their developments in guidelines for biodiversity. In this area, Forestry 1 mentioned BirdLife and the WWF. Forestry 2 highlighted the importance of networks with different types of stakeholders.

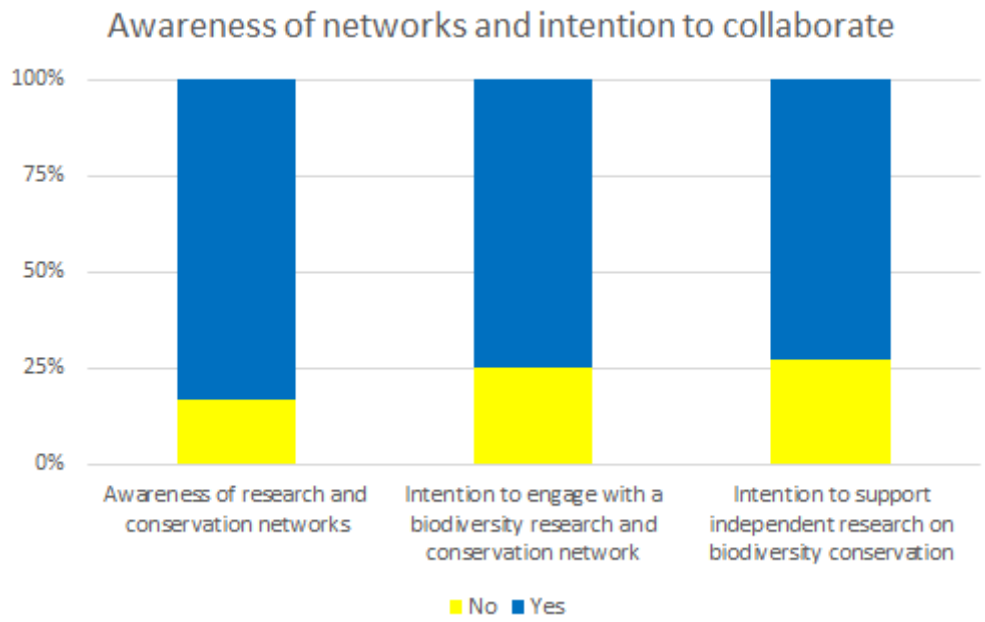

Figure 4.8 visualizes the answers to the survey question about the intention of companies to collaborate with research and conservation networks. Around three quarters of the companies are aware of such networks and have interest in engaging and/or supporting research.

Regarding the intention of companies to interact, Figure 4.8 reveals that 75% of the companies would engage with a research and conservation network, while 73% would support independent research.

4.2.6 How could biodiversity hubs and companies interact to advance the implementation of initiatives to protect biodiversity?

There were several possible interactions between companies and biodiversity hubs mentioned in the first round of the interviews, such as focus groups, education, webinars and research. Three companies were especially interested in helping to develop initiatives for biodiversity. This was further elaborated by Forestry 2, that is searching for ways to measure biodiversity over time.

Engagement with different stakeholders was also mentioned in the interviews. Manufacturing 1 would value stakeholder education and awareness. Food Industry 1 wished to inform the customers about the positive impact on biodiversity from the products, and also to increase the public discussion around biodiversity.

Furthermore, the potential role for a biodiversity network as a source of information for companies occurred in the interviews. Manufacturing 2 mentioned that a biodiversity network could be a way to compare the company's impacts to biodiversity impacts by other companies. Furthermore, Manufacturing 2 explained that they were unsure about their impact on biodiversity and therefore whether biodiversity should be a focus area for them or if other companies should lead the way in this area.

Biodiversity offsets were mentioned in three interviews in relation to biodiversity networks. Forestry 1 argued that they had the potential to help other companies offset

biodiversity. However, Manufacturing 3 mentioned that collaborations with forests in order to offset biodiversity impacts are complex and that even though they were currently offsetting, it was only used as a last resort.

Manufacturing 1 mentioned that focus groups with other companies that have similar interests in sustainability could be one possible way of collaboration. The interviewee argued that the focus group should focus on possibilities regarding biodiversity. This type of network activity was also mentioned as useful for creating comparable standards and methodologies.

Value proposition of a biodiversity hub

In this section, a value proposition for how a biodiversity hub could engage with companies is presented. Value propositions have been recognized as an important tool to create understanding of what companies can provide of value (Payne, Frow, Steinhoff and Eggert, 2020). Payne et al. (2020) argue that a value proposition should address potential needs of actors and leverage the strengths that the provider has. Furthermore, exchange of knowledge is a strong motivation for the interaction between academia and business, according to Crespin-Mazet and Ingemansson-Havenvid (2021).

The value proposition means in this context the design of interaction and what activities the biodiversity hub could offer to companies in order to address their needs related to biodiversity and it is generally centralized around knowledge, but there are also some more tangible conservation measures. In total, there are 10 distinct suggestions.

The value proposition was modified based on inputs from the interviewees of the second interview. This means that the value proposition gradually changed and was developed with each interviewee and hence, the proposals were not identical when presented to all the companies. However, the main ideas persisted. The feedback from the companies is presented in accordance to each suggestion, although not all suggestions received feedback.

Lectures and educational material
Lectures and educational material could be provided by the biodiversity hub to the companies based on their previous knowledge about biodiversity. This would be used within the companies to increase the employees knowledge of biodiversity. With this offering, the companies wouldn't need to create their own presentations about biodiversity or develop their own material. This idea came from the first round of interviews, where Swerock mentioned that they would appreciate more information, Forestry 1 referenced the need for knowledge and OX2 explained they were already working on educating their employees. In a similar way, Manufacturing 2 expressed their need to start learning more about biodiversity.

Lectures and education material was considered to be interesting by three companies during the second round of interviews. Food industry 1 expressed that expertise on biodiversity could potentially be of interest since it was not currently something they had. Manufacturing 1 also expressed interest in lectures and suggested that the focus initially could be broad with an overview of how different industries impact biodiversity and then narrow down into industry specific aspects of

biodiversity. Furthermore, Manufacturing 1 highlighted that the information should be concise and actionable, meaning that companies should be able to act upon the obtained information. Another comment by Manufacturing 1 was that the lecture should initiate an interest in the companies to return for more information about biodiversity.

Sponsorships
Another way for the biodiversity hub to engage with companies could be through different sponsorships. For instance, if a biodiversity hub hosts public events such as lectures or workshops, these could be sponsored by companies. In return, the names of the companies could be displayed which gives publicity and employees could attend the events to learn more. Furthermore, the biodiversity hub could create a podcast to leverage their knowledge about biodiversity and potentially reach the public sector to a large extent. This podcast could be sponsored by companies in exchange for publicity. The idea of sponsorships of events originated from a member of the GGBC, while the podcast came from the need of generating public awareness that several companies expressed.

As for the second round of interviews, Swerock mentioned they liked the idea of the podcast.

Logotype or plant as symbol of membership
Companies could also in exchange of a fee receive a logo of the biodiversity hub to be used on either their website or the sustainability reports as a symbol that the companies support independent research on biodiversity. A more tangible version would be a plant that can be placed in the offices, but with the same purpose as the logo. Preferably, this plant would be durable and quite unique, allowing for easier recognition. Sponsoring a logotype was initially suggested by a member of the GGBC, but the option of a physical plant was inspired by a general request for tangibility related to biodiversity that appeared in some interviews.

From the second round of interviews, three companies showed interest in receiving a logo. Food industry 1 drew a parallel to how labelling works in other areas of sustainability and said that it would be good to have a symbol that consumers could recognise as that you fulfil certain criteria. Manufacturing 1 saw potential in sponsoring a logo, it should however be clear what the sponsoring money goes into and that it should not be biodiversity in general, but more specific topics related to biodiversity.

Networking event
A network event hosted by the biodiversity hub could also provide value to companies. Companies could interact and exchange experiences about biodiversity. It would also be an opportunity for companies to learn more about how other companies are handling biodiversity. At this event, companies could steer the direction of the topics that are discussed, but it would be managed and facilitated by the biodiversity hub. This proposed interaction is a result of the first round of interviews. Boliden mentioned they were interested in exchanging ideas and experiences in order to generate innovations for biodiversity initiatives, while Manufacturing 2 mentioned their desire to learn from other companies.

The importance of arranging network events was recognized by both forestry companies. Forestry 2 considered promotion of knowledge about biodiversity to be

important and Forestry 1 highlighted that a network event could contribute to get a broader perspective and to fulfil agenda 2030 targets. Food industry 1 suggested that it would be interesting to hear about best practices from other companies.

Adopt or sponsor animals, plants or a research project
Another possible way for the biodiversity hub to interact with companies is that companies could adopt, or sponsor specific animals that are being conserved by partner organizations of the biodiversity hub. Adoption includes that the companies pay for keeping the animals healthy in exchange for publicity, for instance by displaying the company names where the animals are kept. In a similar fashion, the biodiversity hub conducts multiple research projects which could also be sponsored by companies.

This interaction comes from different sources. First, Nordens Ark, one of the partners of the GGBC presented in Section 1.1.4, already works on a similar initiative (Nordens Ark, n.d.). Furthermore, one of the members of GGBC introduced this idea as a possibility. Finally, it is a common project in conservationist organizations such as WWF (WWF, n.d.).

In the second round of interviews, Forestry 1 stated it was currently considering adopting an animal from a biodiversity organization. However, the interviewee commented that the animals that were adoptable were very different compared to the animals, mostly insects, that the company interacted with daily in the forests. Sponsoring a potential research project was perceived by OX2 as an interesting option.

Displaying companies' biodiversity activities on the website of the biodiversity hub
Companies could gain publicity by displaying their current biodiversity conservation efforts on the site of the biodiversity hub. The website of the biodiversity hub could serve as a platform for research projects on biodiversity or conservation projects undertaken by companies and inspire and inform other companies and the public sector. This idea came as a response to the need of Food Industry 1 to collaborate in order to better communicate their progress regarding biodiversity initiatives.

Supervision of master theses
Furthermore, if the biodiversity hub supports master theses by supervising students, this could potentially be of value to companies. Companies that are interested in a specific topic regarding biodiversity could have the issue investigated by a master thesis under supervision by the biodiversity hub. This idea was inspired by those companies who favoured research projects in their locations. In the second round of interviews, supervision of master theses was considered to be interesting by one company.

Relocate and conserve species
Among the most tangible suggestions is that a biodiversity hub could help companies to relocate and conserve certain species that are either fragile or require special treatment. This is although probably more relevant for the companies that are directly using land for their operations. The source for this way of interaction came from the first round of interviews, where companies such as Swerock, Manufacturing 1 and 3, stated their preference for tangible measures and concrete solutions.

Workshop for stakeholders
The last suggestion for how the interaction could be designed is a specific workshop for relevant stakeholders. The role of stakeholders for initiating biodiversity conservation measures was prominent in the first round of interviews. For instance, land owners decided whether companies that operate on rented land could implement biodiversity protection measures upon termination of their activities. An industry specific workshop facilitated by a biodiversity hub directed to educate certain stakeholders about what role they could have in biodiversity protection could be an attempt to address this issue. In the first round of interviews, companies such as Swerock and Energy 1 mentioned their dependence on land-owners, which inspired this proposal.

In total, four companies showed interest in workshops during the second interviews. Food industry 1 emphasized that the workshops could be more interesting if they were industry specific with more of a local approach since it is not likely that every company is interested in the same topics.

Other insights
During the interviews, interesting feedback that does not relate directly to any of the ten suggestions was given. Manufacturing 1 stated that the biodiversity hub should focus and narrow down the scope, considering that biodiversity is a large topic and that one biodiversity hub can't address everything that biodiversity is. Forestry 2 was of a similar opinion, that the biodiversity hub should have a clear goal of what they want to achieve. The trademark of the biodiversity hub was seen as important by one company, stating that it would be more interesting if the biodiversity hub was well established and had a strong trademark. Forestry 2 would like the biodiversity hub to explore how biodiversity can drive value creation and focus on the possibilities connected to biodiversity. Furthermore, Forestry 2 said that it's important that the biodiversity hub engage both with NGOs and with the public sector. Finally, Energy 1 made reference to the established network, Business@Biodiversity, and how it could be beneficial for the biodiversity hub to contact an already existing web of companies in order to integrate these interactions with the private sector.

Benefits of the interaction with companies for a biodiversity hub

The proposed interactions have the potential to bring several advantages for biodiversity hubs. The most obvious ones are related to an increase in funds in order for the organization to expand its activities. However, there are more benefits than the economic ones. Interacting with companies can connect research and conservation institutions with the needs of companies, prompting activities that effectively advance biodiversity initiatives and halt biodiversity loss. Thus, knowing the specific challenges that companies have to face could inspire education, research and conservation in a way that helps them overcome those challenges. Furthermore, a stronger connection with the private sector could open the doors of companies in order to conduct research about impacts and appropriate responses. Forestry 1, for example, suggested that the biodiversity hub could use the forest to conduct research. In general, it could also advance public awareness by generating a link between the biodiversity hubs and customers of the companies.

5 Analysis

This section includes patterns or themes that emerged during the interviews which are presented accordingly to the two main research questions found in section 1.3. Firstly, the dependencies and responsibilities towards biodiversity as perceived by the companies are addressed through a categorization of companies. The needs that companies have related to biodiversity, strategic considerations and values associated with biodiversity is described and what initiatives companies take to protect biodiversity. Then, the incentives to further implement biodiversity measures and to potentially collaborate with biodiversity research networks are explained in terms of push and pull factors and also what activities that companies could be interested in from a biodiversity hub.

5.1 RQ1. How do Swedish companies consider their dependencies of and responsibilities for biodiversity?

As presented in RQ 1.1, all the companies consider themselves as dependent on biodiversity in one way or another, and most of them conclude they have responsibility towards biodiversity. We have used their values about biodiversity and ES, and their perception about impacts, to classify Swedish companies according to the degree of dependency and responsibility they have towards biodiversity.

5.1.1 **Dependency**

The type of dependency is determined according to the main use values that biodiversity represents for the company, and which ES are related to them.

A company is immediately dependent on biodiversity if its business model relies on inputs from determined species or ecosystems. In other words, biodiversity has a high direct use value for this type of company. The role of biodiversity in provision and cultural services is key in this case. In a general sense, companies from the agriculture, forestry, fishery and bioenergy sectors, as well as those that operate or design products to be used in natural landscapes (such as rural tourism companies) belong in this category.

On the other hand, if biodiversity is mainly addressed by the company from a systems perspective, and indirect uses, non-use values and/or intrinsic values are the main arguments for the importance of biodiversity, then the company is considered to be subordinately dependent on biodiversity. The role of biodiversity in regulation and support services is highlighted in this case. Most of the construction, manufacturing, mining, transport and service companies would be placed in this category.

The distinction between different types of dependency does not imply that only companies with subordinate dependency assign non-use or intrinsic value to biodiversity or that they are not affected by biodiversity loss.

5.1.2 **Responsibilities**

Regarding responsibilities, the same distinction between immediate and subordinate responsibilities can be applied. The type of responsibility that a company perceives towards biodiversity protection depends on how it perceives the effects of its operations on nature.

We define that a company has an immediate responsibility when it can directly link its business model with a significant impact on biodiversity, either positive or negative, i.e., when it has a direct impact. For example, a company that replaces a habitat with a production site is responsible for biodiversity loss that occurs in that site. Furthermore, a company who increases natural value in the places where it operates, reporting a positive impact, is responsible for that site. Agriculture, forestry, fishery, mining, construction and energy companies can be classified as companies with immediate responsibility.

In contrast, it is complicated to determine which species and ecosystems are affected by the GHG emissions of a particular company, even though climate change is perceived as a high risk for biodiversity. Therefore, we establish that a company has a subordinate responsibility if it has an indirect impact, i.e., if it relates their main impact on biodiversity to its contribution to climate change or through other companies upstream and downstream the supply chain. In general, manufacturing and service companies belong in this group.

The fact that the responsibility is subordinate does not constitute a qualitative judgement, i.e., this does not imply that they are “less responsible”, or that only companies with an immediate responsibility can and should protect biodiversity. However, it does mean that it is more complicated for the company to assess their effects on biodiversity as well as to reduce or neutralize negative impacts on their own.

Only companies with immediate responsibilities mentioned in interviews the concept of ES, which is interesting considering that those with immediate dependencies are the ones who would be more affected by their disruption.

Table 5.1. Classification of companies according to types of dependency and responsibility considering value and ES, and drivers of biodiversity loss.

			Immediate	**Subordinate**
Dependent	Value		Direct use in the business models.	Indirect uses, non-use values and/or intrinsic values.
	Ecosystem services		Provision and culture services.	Regulation and support services.
	Sectors		Agriculture, forestry, fishery, bioenergy, nature and outdoor activities.	Construction, manufacturing, mining, transport and service
Responsible	Drivers	Own operations	Land-use change, pollution, resource overexploitation and invasive species.	Climate change.
		Supply-chain operations	Any driver to a lesser extent than own operations.	Land-use change, pollution, resource overexploitation and invasive species.
	Sectors		Agriculture, forestry, fishery, mining, construction, transport and energy.	Manufacturing, services

5.1.3 Classification of companies according to their perceived main relations with biodiversity

As Table 5.2 shows, companies can be classified according to how they perceive their main relation to biodiversity as:

- **Companies with a direct interaction.** These companies need resources coming from genes, species, and ecosystems, but also consider they generate large impacts (positive or negative) on biodiversity because of their control and management of land or the other drivers on Table 5.1. Therefore, they have both immediate dependency and immediate responsibility. Companies in agriculture, forestry and fishery are part of this category. Other companies, such as fashion companies, could also be considered to have a direct interaction if they own the lands where the crops they use grow. From the companies in our study, Food Industry 1, Forestry 1 and 2 belong in this category.
- **Companies with direct use and indirect impact.** This category refers to companies that take inputs from nature at a marginal rate or that require healthy ecosystems for the use of their products and services, i.e., they have an immediate dependency. However, they do not have a high impact through their own operations regarding land use, pollution, resource use or invasive species, so they have subordinate responsibilities. Some examples of companies in this category would be those dedicated to outdoor activities, the manufacturing of products to use in nature, rural tourism and bioprospecting. In the case of our study, this category only includes Manufacturing 2.
- **Companies with an indirect use and direct impact.** These are companies that have a high land use, which means an immediate responsibility, but that do not need inputs from nature, nor their products are used only in healthy ecosystems, which means a subordinate dependency. The companies that could be generally placed in this category are mining, construction, most energy companies and international shipping companies. The participating companies in this category are Boliden, Mining 1, Swerock, NCC, Energy 1 and OX2.
- **Companies with indirect interactions.** Companies in this category depend on biodiversity mostly through their indirect uses due to support and regulation services, or provision way upstream their supply chain. They also generate mostly indirect impacts through GHG emissions and operations of other companies in their supply chain. Thus, they have both subordinate dependency and subordinate responsibilities. Companies in the manufacturing and services sectors belong generally to this category. From the participating companies, Manufacturing 1 and 3, PostNord, Sweco and Company 1 are in this category.

Even though we exemplified sectors that go into one or other category, it is important to note that the classification of each company will depend on its specific circumstances, perceptions, and values regarding biodiversity. Furthermore, this classification is not necessarily exclusive: a company can have different lines of business that fall under different categories, or they may have both a strong impact in their own operations and throughout its supply chain. It would also be possible for a company to change their operations over time, moving to a different category. However, as this study shows, each company has determined values and perceptions of biodiversity that would place it in one category over the other for a determined moment in time.

Table 5.2. Classification of companies according to their main relation to biodiversity.

		Responsibilities	
		Immediate	**Subordinate**
Dependencies	**Immediate**	Companies with direct interaction. Sectors: food, forestry.	Companies with direct use and indirect impact. Sectors: outdoor activities, manufacturing of products used in nature, rural tourism, bioprospecting.
	Subordinate	Companies with an indirect use and direct impact. Sectors: mining, construction, energy.	Companies with indirect interaction. Sectors: manufacturing, services.

5.2 RQ2. What are the incentives that these companies have or could have to advance initiatives for biodiversity protection, in particular interactions with biodiversity hubs?

The results show that the companies act under a diverse combination of external and internal motivations. First, there are factors that urge them to integrate biodiversity in their values and strategies. Companies face challenges to respond to these pressures, which in turn generates needs. Both external pressures and internal needs constitute incentives to implement a wide array of initiatives for halting biodiversity loss. Finally, biodiversity hubs must have certain characteristics in order to attract companies by helping them fulfil their needs and respond to the external pressures, leading to a determined set of interactions.

To understand the possible motivation for companies to engage with biodiversity hubs in pursuit of halting biodiversity loss, first we analyse the external pressures, then the companies' needs the pressures generate, followed by the initiatives designed to respond to those pressures and needs. Finally, the characteristics of biodiversity hubs and the respective possible interactions are explained.

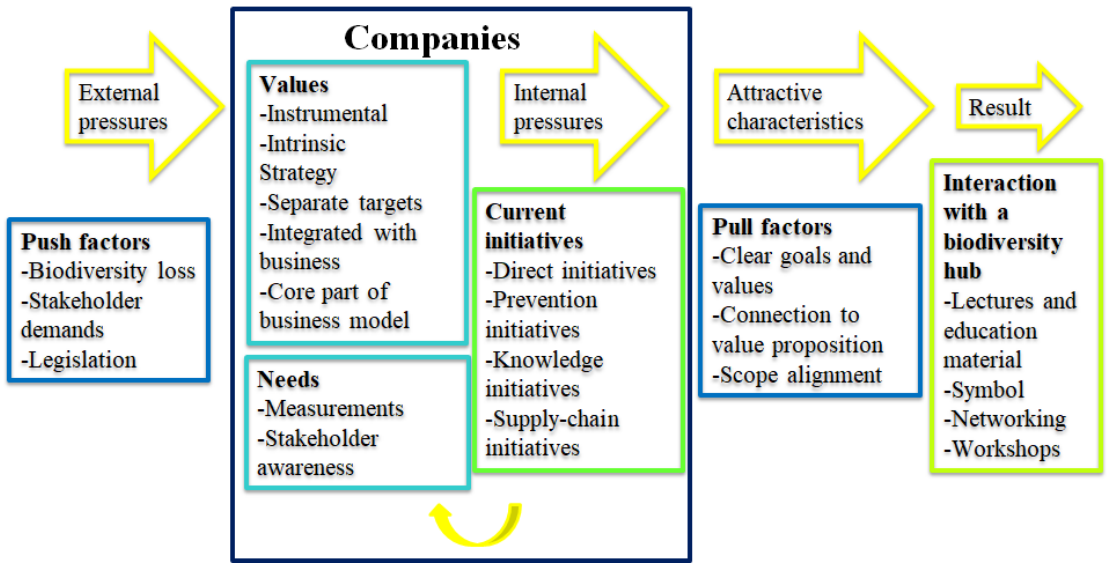

Figure 5.1 shows how companies get incentives to protect biodiversity from external and internal pressure. Characteristics of the biodiversity hub and ultimately what activities that are offered also influence the companies' incentives to interact with the biodiversity hub.

In general, it could be said that the companies are looking for the tangible side of biodiversity, something that could be translated from academia to concrete steps and roadmaps they could follow, in combination with a measurement system that would allow them to be accountable to relevant stakeholders and to determine the best way to manage biodiversity.

5.2.1 **Push factors**

There are factors that prompt the companies to consider biodiversity within their values and strategy, i.e., reasons why businesses are interested in reducing biodiversity loss. In this study, these are regulations, demands from stakeholders and the implications of biodiversity loss, hence viewed as push factors. The external pressure generated by push factors is not necessarily something negative, it can also reference the opportunities that companies see in each of them.

The push factors are diverse. First, there is the increasing importance of biodiversity for companies and stakeholders as explored under RQ 1.1 and RQ 2.3.

The risk that biodiversity loss represents for companies is therefore on the rise, even more so because biodiversity loss in itself has worsened. This also generates a further incentive for companies with immediate dependence to increase the number and scale of measures for biodiversity conservation.

Although it is possible that companies where biodiversity has a main role in the business model show interest in lobbying or demanding more initiatives from governments and other companies, in most cases it seems that the government is the one that takes the lead in demanding conservation measures through laws and regulations, a strong incentive according to the interviews as well as the literature. However, regulations did not seem to give incentives to promote biodiversity beyond a certain extent, i.e., there is no reward for being superior in biodiversity. For instance, if

a mining site initially had low natural values, but due to extensive protective measures increased in natural values, the permit could in fact be withdrawn.

Due to the effects that biodiversity loss could have on the companies, besides the requirements of stakeholders and legislation, companies value biodiversity, as explained in RQ 1.1, including ethical aspects that derive in internal incentives to implement biodiversity conservation measures. In other words, how companies understand and value biodiversity is related to how stakeholders (employees, customers, shareholders) do it.

In a similar way, the external pressures lead to the incorporation of biodiversity within the strategy of the company, either as a separate strategy within the environmental targets, as an integrated part of a sustainable business strategy, or at the very core of the business model. Thus, the push factors generate internal pressures in the form of the values and strategies of the company regarding biodiversity, as well as the needs it may have for successful implementation.

5.2.2 Needs of companies

There are a number of needs that the private sector has in order to succeed at the implementation of initiatives to mitigate biodiversity loss, which constitutes incentives themselves. Methods to measure biodiversity were demanded by several companies regardless of how developed or mature the company was in biodiversity. Similarly, there was a demand for more knowledge on biodiversity, both in general in the companies and specifically to solve certain issues. Besides measurement and knowledge, some companies also wanted to communicate more about their biodiversity work, revealing a demand for increased public awareness.

Measurements

Lack of an established method to actually measure and monitor biodiversity, which according to ten Kate, Bishop and Bayon (2004) is a barrier that has been around for more than 15 years, was mentioned in nearly every interview, spanning several industries. There were different approaches to address this problem, some companies took initiatives to develop such measurements themselves, while others collaborated with networks and industry organizations or waited for other companies to develop it. The applicability of the biodiversity measures developed by an industry organization are however limited for other industries, since it is likely that it will be too specific.

Stakeholder awareness

There is a wish by companies to increase the level of knowledge about biodiversity in relevant stakeholders. The awareness about biodiversity loss in the general public according to some of the companies is enough to generate pressure, as stated above, and it is on the rise. Nevertheless, said awareness is not established enough within society for all customers to be willing to pay more or to know exactly which initiatives companies have in place. The incentives to join a biodiversity hub could therefore also be related to either communicating more about how the company contributes to biodiversity, for instance by Food Industry 1. Furthermore, for companies that rent land, present in the mining, forestry and energy industry, the land owners are in a position to

determine whether biodiversity measures should be implemented or not upon termination of the companies' activities. In some cases, it could also be difficult to help suppliers improve their biodiversity efforts, or explain to the employees within the company why biodiversity should be considered.

5.2.3 Current initiatives of companies

This section groups in four categories the different actions, discussed under RQ 2.1, that companies take in order to prevent biodiversity loss. Each category is related to the push factors and/or needs explained above.

There are different approaches regarding which initiatives to take, depending on how close the company is to biodiversity, either because the business model directly needs biodiversity or because it directly affects biodiversity. Those companies with immediate responsibilities take actions related to conservation and invest more in acquiring and spreading knowledge. Those with subordinate responsibilities focus more on other types of impacts on the environment and then appeal to a spillover effect on biodiversity. They also emphasise supply-chain management as an important tool to reduce their environmental impacts. The use of these types of initiatives could also be related to the lack of knowledge on links between causes and impacts on biodiversity in manufacturing and service companies.

Direct initiatives

Immediate or direct initiatives work with determinate species or ecosystems within a particular geographical boundary. They are taken by companies mostly with immediate responsibilities. Regarding push factors, they are related to legislation and permits regarding land-use, but also to the particular use values of biodiversity. The initiatives of this type are partly covered by the mitigation hierarchy (avoid, minimise, rehabilitate and offset), but they also include some actions aiming to have a general positive impact such as helping pollination. From the companies in our study, they are used by the forestry and energy companies, but also by Swerock, Boliden and Food Industry 1.

Prevention initiatives

Prevention or indirect initiatives address potential risks to biodiversity, i.e., they target pollution and climate change, with or without making a connection with concrete impacts on biodiversity. Every company addresses these because of the importance of preventing climate change and pollution hazards, but the companies that related them with biodiversity were mostly companies with subordinate responsibilities. A probable explanation is that, since these companies do not have an elevated land use or use of natural inputs within their installations, these types of prevention measures are the closest to their operations. The motivations are linked to regulations of pollution and climate, but also to ethical standards within the code of conduct of companies (no-harm principles). Some examples are the reduction of GHG emissions, pollution control, leakage prevention, use of non-hazardous materials and organic solvents, reduced plastic use, implementing circular waste flows, and implementing high environmental standards in the internal and external code of conduct. In this category, initiatives to tackle climate change stand out.

Knowledge and biodiversity initiatives

The initiatives related to knowledge and biodiversity expertise are designed to the needs of measurements and increased awareness, both within the company and among important stakeholders. Mostly, it is companies with immediate responsibilities that undertake this type of initiative. From elaborating industry guidelines for the management of biodiversity to developing a system to monitor and measure biodiversity, this category includes many different types of projects. There is a relevant distinction between some initiatives that are more short-term oriented and rely on external knowledge and others which aim to build the knowledge within the company, in what seems a long-term strategy. More examples would be stakeholder involvement, educating employees about biodiversity, benchmarking, and funding research on topics such as the impact of land-use and site habitats.

Supply chain initiatives

Supply chain initiatives create or increase incentives for companies upstream the supply chain to develop and implement their own biodiversity conservation initiatives. Different types of companies reported to work with their supply chain to implement sustainability and/or biodiversity initiatives. Some examples are working with suppliers to help them achieve a certain standard or certification, directly demanding certifications from them, considering the impacts downstream, in particular the use stage of the life-cycle, and even raising customers' awareness. It could also be related to contributing to decarbonizing other industries through provision of renewable energy.

5.2.4 Pull factors

Different aspects of how the biodiversity hub engages with companies and the public sector have the potential to make interactions attractive for companies. These incentives can be classified as pull factors. The results show that companies require that the biodiversity hub clearly communicate about their mission and goals, that the hub is consistent with research and actions and that the scope of impact is aligned with the goals and size of the hub.

Clear goals and values

There was feedback from companies related to that the goals and mission of the biodiversity hub was unclear to them; therefore this seems significant to clarify. This includes what the biodiversity hub wants to achieve in the long run, but also what the current research topics are and here it seems that the more specific, the better.

Connection to value proposition

Any organization or network of organizations that wishes to establish a link with companies must speak their language. Companies are interested in initiatives that can directly relate to their needs as well as their own value proposition. Furthermore, the willingness of companies to do trade-offs in favour of biodiversity seems to be large considering figure 4.7. However, Food industry 1 and Manufacturing 3 said that their activities for biodiversity must fit their business.

The companies must be targeted according to the network that shapes the biodiversity hub. Not every company will be interested, which is why the type of company that most likely will have affinity must be identified. Depending on the offer of interaction that the biodiversity hub aims to make, it could be interesting to focus on companies with immediate responsibilities, who tend to invest more in knowledge and research, or on those with subordinate responsibilities, who have a higher need of knowledge regarding biodiversity. The first type would be more likely to engage in specific workshops or sponsorships that generate public awareness, while the second would appreciate lectures or educational materials, for example. Other things to keep in mind when targeting companies would be the location, size, level of knowledge about biodiversity, position in the supply chain and industry.

Scope of impact aligned

In order to attract companies, a biodiversity hub must have concrete and achievable goals and ambitions. There must be coherence between the reach of the network and its proposed impact.

Network effects

The interviewees mentioned on several occasions the importance of gathering a critical amount of collaborating companies, as well as the benefits of interacting with different stakeholders like universities and museums, but also representatives of civil society. The interest in networking spikes when multiple bonds can be formed within a single platform. Therefore, a biodiversity hub that includes partners from a diverse background is more attractive to companies. Moreover, engaging companies that are interested in each other, either because they are in similar industries or because they have similar supply chains, increases the value that the biodiversity hub can provide. In order to do this, the first step is to evaluate which business networks already exist and establishing an intention of collaboration, not competition.

6 Discussion and conclusion

The first part of this section presents our answers to the research questions. This is followed by a discussion of the limitations of the study and how it contributes to different actors of society despite said limitations. Finally, we give some suggestions to relevant groups in this research: academy, companies and biodiversity hubs.

6.1 Conclusion

The aim of this study, as presented in Section 1.3, was to analyse the connection between business and biodiversity through the interests that companies might have in biodiversity and the needs that biodiversity might represent to them. Two main RQ were presented in relation to this aim:

RQ1. How do Swedish companies consider their dependencies of and responsibilities for biodiversity?

RQ2. What are the incentives that these companies have or could have to advance initiatives for biodiversity protection, in particular interactions with biodiversity hubs?

Regarding RQ1, we found companies have different values associated with biodiversity, but nearly all companies consider themselves to be dependent and responsible for biodiversity. The results point towards companies being willing to make trade-offs to reduce their environmental impacts, but also that companies identify business opportunities in biodiversity.

The climate crisis has determined the relation between companies and the environment in more than one area. Besides bringing environmental issues to the centre of the stage, it has also set procedures and expectations for how companies address their environmental impacts. The biodiversity crisis is therefore following in many aspects: media coverage and framing, frameworks (SBT for Nature, offsets, permit trading), initiatives and general importance for society. However, the initiatives in place to halt biodiversity loss or create positive impacts are varied and context dependent, in comparison with the global mandate of reducing GHG emissions. Furthermore, reducing GHG emissions is a high priority at the moment, but not as many companies are undertaking initiatives to actively preserve biodiversity, confirming the bias towards addressing the climate crisis. Because of the perception of the climate crisis as more urgent and the reduction of GHG emissions as positive for biodiversity, often there is no independent biodiversity strategy within the sustainability targets.

Companies with subordinate responsibilities seemed to prioritise other areas of sustainability over biodiversity. This was based on prioritisation of impacts, but no distinct method for measuring biodiversity was prominent from the interviews. This shows some of the difficulties that arise from lack of measurements and that it perhaps also shifts focus to sustainability issues that are easier to measure.

We have established that the way companies value direct and indirect inputs and perceive impacts determine respectively the type of dependencies and responsibilities the companies have towards biodiversity. Companies with immediate responsibilities and dependencies are categorized by us as having a direct interaction with biodiversity. Companies that have subordinate responsibilities and dependencies are instead considered to have indirect interaction with biodiversity. Companies that have immediate responsibility but subordinate dependencies are indirect users with a direct impact and crosswise, companies with subordinate responsibility but immediate dependencies are direct users with an indirect impact.

Regarding RQ2, there were different incentives for why companies were interested in preserving biodiversity, visualized in Figure 5.1. External factors generate incentives through demands from stakeholders (mentioned by 80% of interviewees), legislation and biodiversity loss (both mentioned by 50% of interviewees). Internally, companies have the need to measure and monitor biodiversity and to increase stakeholder awareness of biodiversity. There are also incentives related to values and the strategy of the companies, including ethical considerations and business opportunities for biodiversity. As a response to the needs, values and strategies, companies launch initiatives which are categorized as direct initiatives, knowledge initiatives, prevention initiatives and supply-chain initiatives. The initiatives in turn create new needs for companies, creating a circular relationship between needs and initiatives.

Furthermore, pull factors that adhere to characteristics of a biodiversity hub seemed to spark incentives for companies to launch biodiversity initiatives. For instance, the purpose of a biodiversity hub should be easily understandable and accessible to companies. The initiatives offered should also be aligned, or related, with the business of the companies and there should be coherence in the biodiversity hubs research and activities. Finally, the incentives for companies to interact with a biodiversity hub was related to specific activities from which lectures and educational material, a symbol of supporting independent research, networking events and workshops received the most attention from the interviews. In addition, companies appealed to industry specific initiatives to make the information relevant for them.

To summarize our findings, the connection between business and biodiversity seems to have received more attention in recent years. Even though there were tendencies of companies incorporating biodiversity into their strategies and values in an increasing way, the progress seems to be quite uneven in knowledge and implementation. The incentives for companies to consider biodiversity stems from both external and internal forces and biodiversity hubs could have a role to play for companies battling biodiversity loss.

6.2 Present and future of business and biodiversity

Regarding the current context around the coronavirus pandemic, in the interviews there were no mentions of the role of biodiversity loss in advancing the conditions for a pandemic to develop, or how the reshaping of economies and societies after the pandemic will affect biodiversity conservation strategies.

The progress in incorporating biodiversity seems to be too slow, despite the mentions of increased awareness and initiatives in the last couple of years. Due to the increase of conservation initiatives and awareness, the classification we presented will look different in the future, once those companies with immediate dependencies and responsibilities (and maybe even the rest) integrate biodiversity conservation as a core part of their business models, and companies with positive impacts are more common. However, this paradigm change seems to be only in the first stages of development.

6.3 Limitations

The limitations of this thesis are the narrow focus on large companies, the lack of representation of relevant industries, a flaw in the design of the survey regarding length, the risk of self-selection bias and a classification of the companies based on self-perception.

Only large companies were included in the study and, considering Houdet (2008) findings that large companies tend to be more pressured by stakeholders to work with sustainability, the results do not necessarily apply to smaller companies. Furthermore, large companies have more resources to dedicate to large-scale initiatives and research, as well as more possibilities to control the supply chain either through vertical integration or through its market power. Thus, the supply chain initiatives described above could be more of an incentive for smaller companies, instead of something they apply themselves.

Even though several industries were represented among the 15 participating companies, others were not. Pharmaceutical and finance, two industries at risk from biodiversity loss according to KPMG (2020), did not participate in the study, despite being present in the sample. The findings of the thesis therefore lack perspectives on biodiversity from relevant industries. Moreover, proliferation of invasive species, one of the main drivers of biodiversity loss, did not occur in any of the interviews. According to WWF (2020), proliferation of invasive species is related to the shipping and transport sector. Therefore, the absence of the shipping and transport sector on an international level could explain the lack of mentions of proliferation of invasive species and their impact on biodiversity.

The survey had a relatively low response rate with 12 complete answers. Potentially, this could be derived to the length of the survey, consisting of 8 questions with multiple options which can be seen in Appendix A. Seven companies opened the survey and stated their anonymity choices, but did not proceed any further.

Regarding the sampling, there is a significant risk of a self-selection bias for the companies that participated in the study, meaning that the companies that replied to the surveys and participated in the interviews could be more interested in biodiversity than other companies in the sample. As for the interviewees, most of them were working with sustainability within the company, which might bias their answers towards prioritizing environmental issues as compared to other decision-makers in each company.

Another limitation concerns the classification of companies according to their relations to biodiversity. Said classification is based on the self-perception of companies regarding their uses and impacts on biodiversity. It is possible that a company does not consider itself neither responsible nor dependent and therefore would not be inside the classification. However, through indirect use and subordinate responsibilities, all companies are related to biodiversity and could be placed within at least one of the categories we supplied using external data. It is also worth noting that there is a high degree of uncertainty regarding how determined actions, for example the use of pesticides, contribute to biodiversity loss.

6.4 Contribution and recommendations

There are several contributions that stem from the study. In general, we have bridged the gap between academia and businesses by directly involving companies in the discussion about biodiversity. Furthermore, we have contributed to a research gap regarding how companies perceive biodiversity, explored how and why biodiversity hubs could interact with companies and described some of the benefits that considering biodiversity could have for companies. Our specific contributions and recommendations regarding research, biodiversity hubs and the private sector follow.

6.4.1 Research

This study has contributed to the understanding of how companies in different industries relate to biodiversity and also how they perceive their dependencies and responsibilities towards biodiversity by focusing on values and their considerations of impacts. More specifically, different aspects of biodiversity have been explored in the interaction between research and conservation networks and companies and how biodiversity research could benefit from such an interaction.

The thesis included exclusively large Swedish companies. For further investigation on the subject of business and biodiversity, medium and small companies could be considered, to see how the difference of public pressure and availability of resources influences which biodiversity strategies companies take and what drives them. Moreover, exploring the possibilities for companies and biodiversity hubs to interact on a regional or local level could be of interest, in particular if the biodiversity hub has a local base, such as the GGBC. The potential challenges or areas of interest that companies have related to biodiversity could be further investigated by research, in particular, the role of the government, since legislation was mentioned as an important driver, but also permit procedures sometimes could constitute a barrier for biodiversity protection. Additionally, the inclusion of governmental stakeholders would shed more light on this. Finally, exploring how the biodiversity hubs could efficiently use the obtained funds and communicate their achievements back to companies would also be of interest.

6.4.2 Biodiversity hubs

The thesis explores what potential incentives companies have for interacting with biodiversity hubs to improve their impact on biodiversity. Based on this, there are also suggestions of what activities that biodiversity hubs could offer to companies in order

to create value. Therefore, this thesis provides guidance to how biodiversity hubs could engage with companies in a mutually beneficial way.

In terms of recommendations, it seems that companies are interested in that the biodiversity hubs clearly communicate what type of research that they are conducting and what they want to achieve in the long run. In general, industry specific information and activities appeared to be particularly interesting to companies. It is of utmost importance for a biodiversity hub that wants a closer interaction with the private sector to select which companies could be interested in its activities, and appeal to their value proposition. Finally, biodiversity hubs should leverage network effects by presenting partners with different backgrounds and engaging with companies that could have an interest in connecting to each other.

6.4.3 Private sector

The thesis contributes with more knowledge about biodiversity initiatives in companies that belong to different industries. It could be valuable for companies to understand how other companies manage biodiversity and overcome challenges related to biodiversity, as well as how they can have dependencies and responsibilities regarding biodiversity that represent risks and opportunities. Furthermore, this thesis provides information of biodiversity hubs in general, but also why they could be of interest for companies to interact with.

We recommend companies to investigate which frameworks and measurements are currently in place, and if there are initiatives ongoing within business networks related to biodiversity. As the result shows, the halt of biodiversity loss is bound to become one of the essential pillars of sustainability, which is why companies should start evaluating the integration of biodiversity targets and initiatives in their strategies. Besides, they could look for a biodiversity hub that appeals to their business model and advance collaboration initiatives as the one suggested in this research.

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Appendix A

You are invited to participate as a representative of your company in an online survey on the interdependencies between biodiversity and business activities, which is directed to the 100 largest Swedish companies. The research project is a master's thesis conducted in the 5th year of study, by Verónica Romero and Jakob Streman, students at Chalmers University of Technology. The project benefits from the co-supervision of the Gothenburg Global Biodiversity Centre.

The survey should take approximately 10 minutes to complete. Your participation is voluntary. We kindly ask you to provide honest answers to preserve the quality of the research. All data acquired will be stored and processed according to data protection laws and published as a part of the master's thesis. If you wish, you can receive the finished report once it is published.

Your name will not in any case be displayed in the study. Please indicate if you wish your position and the company you work for to remain anonymous as well. If you select "no" in all the rows below, your answers in this questionnaire will be referred to "a company".

By completing and sending this questionnaire, you state that you understand and agree to the conditions explained above.

I agree that my position can be used in the published study.
I agree that the name of the company I am working for can be used in the published study.
I agree that the sector of activity of the company can be used in the published study.

For research purposes, please indicate the position you occupy in the company. If you stated above you want your position to remain out of the study, this information will only be available to the authors of this research project.

For research purposes, please indicate which company you represent. If you stated above that you want the company to remain unknown, this information will only be available to the researchers in the project.

1. In your own words, please explain how you define biodiversity.

2. Regarding company goals and values, please indicate how much you agree with the following sentences.
    a. The main goal of our company is to generate profits for shareholders.
    b. Our company has a moral duty towards society.
    c. Our company wants to reduce its environmental impact.

3. Regarding the importance of biodiversity within the company, please indicate how much you agree with the following sentences.
    a. Biodiversity is important for this company because it provides inputs in its supply chain.

b. Biodiversity is important for this company because it absorbs outputs from production that do not go to the market (waste flows).
c. Biodiversity is important for this company because we want the public to see we do not have a negative environmental impact.
d. Biodiversity is important for this company because it regulates the environment, preventing disasters such as floods and pandemics that could damage production.
e. Biodiversity is important for this company because it provides food, water and the raw materials that keep the economy as a whole working.
f. Biodiversity is important for this company because it is essential for the physical and mental health of society.
g. Biodiversity is important for this company because all living beings have value.

4. Regarding the impact of the company on biodiversity, please indicate how much you agree with the following sentences.
    a. Our company has a significant impact on biodiversity due to its direct or indirect greenhouse gases emissions.
    b. Our company has a significant impact on biodiversity due to waste flows after the end of life of its product or during the production process which causes pollution.
    c. Our company has a significant impact on biodiversity due to its extensive land use.
    d. Our company has a significant impact on biodiversity due to its large direct or indirect consumption of natural resources.
    e. Our company has a significant impact on biodiversity due to its contribution to the proliferation of invasive species.
    f. Our company does not directly have a large impact on biodiversity, although it might affect the environment in a different way.
    g. Our company has other significant impacts on biodiversity (please specify).

5. Regarding some sustainability measures the company is taking or willing to take, please indicate how much you agree with the following sentences.
    a. Our company is reducing its greenhouse gases emissions.
    b. Our company is reducing waste.
    c. Our company is actively protecting biodiversity.
    d. Our company is prioritizing the improvement of psychosocial working conditions.
    e. Our company is prioritizing the efficient use of resources.
    f. Our company is willing to reduce its environmental impact, even if it means a decrease in profitability.
    g. Our company is willing to reduce its environmental impact, even if it means an increase in prices for the customers.
    h. Our company is willing to reduce its environmental impact, even if it means stagnation or decrease in traditional production levels in the short term.
    i. Our company is willing to reduce its environmental impact, even if it means an internal restructuring.

j. Our company is willing to reduce its environmental impact, even if it means the need of a new business strategy.
k. Our company is willing to reduce its environmental impact, even if it does not directly improve its image.

6. Regarding barriers to implementation of biodiversity protection measures, please indicate how much you agree with the following sentences.
    a. Our company could do more if it had more knowledge about its impacts.
    b. Our company could do more if it had more knowledge about available measures to decrease or offset its impacts.
    c. Our company could do more if it had more economic resources.
    d. Our company could do more, but the current strategy prioritizes other areas.
    e. Our company could do more, but it has encountered other obstacles (please specify).

7. Regarding actions that the company has taken, or will take, to overcome barriers to implementation of conservation measures as the ones in previous questions, please check all those that apply:
    a. Our company has tried to improve the impact on biodiversity by hiring consultants.
    b. Our company has tried to improve the impact on biodiversity by buying education.
    c. Our company has tried to improve the impact on biodiversity by hiring someone with competencies in biodiversity.
    d. Our company has tried to improve the impact on biodiversity by following trends or indicators set by other companies.
    e. Our company has tried to improve the impact on biodiversity by joining biodiversity networks.
    f. Our company has implemented other actions to improve biodiversity (please specify).

8. Regarding connections with biodiversity conservation networks, please answer the following questions.
    a. Is your company aware of research and conservation networks?
    b. Would you like to engage with a network that is primarily focused on biodiversity research and conservation?
    c. Would you be interested in supporting independent research on biodiversity conservation?
    d. I would like to participate in an interview regarding the interactions between our company, biodiversity and conservation networks.

Appendix B

PRELIMINARY INFORMATION ABOUT THE STUDY

1. Verónica Romero - International Master in Circular Economy / Jakob Streman - Management and Economics of Innovation.

2. The aim of the study is understanding the perspective of companies about their relation with biodiversity and which incentives could they have for protecting biodiversity through the participation in research and conservation networks.

3. Ask if it is okay that the interview is recorded.

4. The recordings will be deleted after the publication of the study. Transcriptions or notes of the interview will be sent to them for confirmation (they have two week to say if there is something they want out of the study).

5. Anonymity check. (Confirm what they had in the survey, ask if they want something different).

6. Questions?

- **VALUES, UNDERSTANDING, AND KNOWLEDGE**

1. Could you tell us about your background and a little bit about what you do in the company?

2. Regarding biodiversity, we saw you replied (...). Is it anything you would like to add or deepen for that definition?

    a. Note: Look for in the answer if they are concerned about biodiversity.

3. What is the priority within your sustainability strategy? What values are behind it?

4. We saw you included/We might have missed it, but I think we didn't see biodiversity in your *document* Could you tell us more about that?

    a. Value of biodiversity/Importance

    b. Dependencies/Ecosystem services

    c. Responsibilities/Impacts

5. Does your company see itself as dependent on biodiversity?

6. Does your company see itself as responsible for biodiversity?

7. How do you see the connection between climate change and biodiversity loss? Similarities, differences.

    a. How does this reflect in their agenda?

8. Where do you look for information about biodiversity? Is there something you would like to know?

- **ACTIONS AND INCENTIVES**

1. Could you elaborate on what the protective measures for biodiversity include? What would you do if there were no difficulties or restraints?

2. Could you elaborate on what difficulties that you have encountered regarding implementing biodiversity protective/general sustainability measures?

3. What would motivate the company to protect biodiversity? *Legislation, values?*

4. What help would you appreciate in furthering protective measures?

- **COLLABORATION**

1. Is your company collaborating with the supply chain in order to implement biodiversity conservation measures/sustainability measures and why/why not? How?

2. Are you currently cooperating with other parties for biodiversity protection?

3. If they replied they know about biodiversity initiatives: Which ones do you know? Do you know about GGBC?

4. If the answer to the survey was that they would like to interact with a biodiversity network: what would you value in such an exchange?.
   If the answer was that they are not interested in interacting with a biodiversity hub: why?

5. Would you be available for a 2nd interview to ask your opinion about a value proposition for ways of interacting with GGBC? If not, what do you think of

    a. Sponsorship
    b. Venue availability
    c. Lectures or general info (attendance to seminars at venues)
    d. One-time lectures at the company
    e. Others

6. Questions? Do you want to add something they feel they need to follow up somehow?

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