RENDERING BIODIVERSITY CALCULABLE: A CASE STUDY OF UK BIODIVERSITY ACCOUNTING AND THE CONSTRUCTION OF BIODIVERSITY INDICATORS

By

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ABSTRACT

This thesis seeks to explain how a national government becomes capable of rendering biodiversity calculable in a way that supports biodiversity conservation efforts. To do so, this research examines a single, explanatory case study of the construction of the annual UK Biodiversity Indicators Report using the theoretical framework of calculability – bringing together Callon's (1998a) notion of framing and overflowing and Callon and Law's (2005) three stages of calculation. This case is analysed to explain the process of framing a calculative space for biodiversity, thus enabling the UK government to see and understand its own biodiversity performance.

The construction of the UK Biodiversity Indicators Report relies upon data collected through non-governmental conservation and research work, statistical expertise of a small governmental project group and a governmental structure that enables the collaboration between these diverse actors and drives ongoing improvements of the indicators through the construction of continuous overflow aimed at making these Biodiversity Indicators useful for policy formulation.

This thesis contributes to the accounting for biodiversity literature by explaining how national governments can account for biodiversity in ways that allow the formulation of biodiversity policy and by outlining the process necessary to render biodiversity calculable. Additionally, the thesis has implications for biodiversity practitioners by highlighting the need for multi-organisation collaboration, the imperfectness of any calculability achieved and the possibilities for non-governmental engagement within the accounting process.

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DECLARATION OF PUBLICATION

Material included within this thesis also appears as part of a co-authored article titled "Framing sustainable development challenges: Accounting for SDG-15 in the UK" that is currently under review with the Accounting, Auditing & Accountability Journal. Although co-authored with Dr Thomas Cuckston and Prof Ian Thomson, the material that appears in both the article and my thesis was authored by myself.

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ABBREVIATIONS

BIF	Biodiversity Indicators Forum
BIGS	Biodiversity Indicators Governance Structure
BIYP	Biodiversity Indicators in Your Pocket
CBD	Convention for Biological Diversity
DEFRA	Department for Environment, Food and Rural Affairs
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
JNCC	Joint Nature Conservation Committee
NGO	Non-Governmental Organisation
RAG	Red, Amber and Green
SDGs	Sustainable Development Goals
SEA	Social and Environmental Accounting
UK	United Kingdom
UN	United Nations

CHAPTER 1: SETTING THE SCENE

1.1 Background of the Research

In 2019, a report published by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) identified a 47 percent decline in the condition and extent of natural ecosystems compared to the earliest estimates available and also stated that more species on earth are now threatened with extinction compared to any other time in human history (IPBES, 2019). Thus, the IPBES report concludes that global biodiversity[1] can only be saved through "transformative changes across economic, social, political and technological factors" (IPBES, 2019, p. 6), and as such halting biodiversity loss requires change on every scale ranging from the local to the global.

One of these scales considered within the IPBES report has been the scale of international biodiversity treaties, such as the CBD targets and the 2030 Agenda for Sustainable Development, including the Sustainable Development Goals (SDGs). As signatories to the international CBD targets – with the latest ones being the CBD Aichi targets –, countries have committed themselves to 20 ambitious biodiversity conservation goals ranging from protecting global forests to halting global species extinction by 2020. In line with that, 2011-2020 has been officially declared as the United Nations Decade on Biodiversity in order to promote the Strategic Plan for Biodiversity and its implementation on an international level. Additionally, under the SDGs 14 and 15 signatory countries committed themselves to the

[1] The most broadly accepted definition of biodiversity has been the definition agreed at the UN Convention on Biodiversity (CBD) in 1992. It states that biodiversity is : "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." (CBD, 1992, p. 3).

protection and restoration of marine and terrestrial biodiversity by 2030 in order to facilitate global sustainable development.

One of these signatory countries to the CBD targets as well as the UN SDGs has been the United Kingdom (UK), which also claims to be a leader in biodiversity conservation (HM Government, 2018). As such, the UK has published various biodiversity strategies and action plans since 1994, and since 2007 the UK has annually published a set of national biodiversity indicators called the UK Biodiversity Indicators Report. However, to what extent this UK Biodiversity Indicators Report has been able to support biodiversity conservation in the UK might be questionable. For example the 2016 State of Nature report identified a decline of 56 percent of wild species in the UK over the last 50 years (RSPB, 2016, p. 6) and the UK government's own UK Biodiversity Indicators Report in 2019 stated that only 3 percent of the UK's European protected habitats are in a favourable conservation condition (DEFRA, 2019).[2]

1.2 Research aims and objectives

Extant accounting for biodiversity literature has sought to explain how different organisations have achieved various forms of calculability for performance in relation to biodiversity (Cuckston, 2018b). In line with the dominant approach in social and environmental accounting (SEA) research, much of this work focusses on corporate reporting on biodiversity (Adler, Mansi and Pandey, 2018; Adler, Mansi, Pandey and Stringer, 2017; Atkins, Grabsch and Jones, 2014; Atkins, Maroun, Atkins and Barone, 2018; Boiral, 2016; Maroun and Atkins, 2018; Rimmel and Jonäll, 2013; van Liempd and Busch, 2013). However, the signatories to the UN

[2] Even though this indicator has been published within the 2019 UK Biodiversity Indicators Report, the underlying data set has been collected in 2013 and has not been updated up to this point in time. As such, the actual status of the European protected habitats in 2019 might be different.

Aichi targets as well as the 2030 Agenda for Sustainable Development, which incorporates the SDGs, are the 193 member states of the United Nations (UN, 2018a) and not corporations. Whilst corporations are being encouraged to engage with the SDGs (UN, 2018b), it is acknowledged within the 2030 Agenda that "primary responsibility" (UN, 2015, p. 10) for addressing the challenges of sustainable development lies with national governments.

> "[C]ountries are expected to take ownership and establish a national framework for achieving the 17 Goals. Implementation and success will rely on countries' own sustainable development policies, plans and programmes" (UN, 2018a).

Additionally, under the CBD Aichi targets as well as the SDGs countries are expected to calculatively measure and report progress on their biodiversity performance (CBD, 2006; UN, 2017). Accordingly, if accounting research is to contribute to the achievement of halting biodiversity loss (see further Bebbington and Unerman, 2018), national governments hold the primary responsibility to halt biodiversity loss and countries have to report on their biodiversity performance using calculative measure, then it is crucial to understand how national governments seek to achieve this required calculability for biodiversity challenges. This thesis adopts the position that the main purpose of accounting for biodiversity is to contribute to addressing the challenge of biodiversity loss (see further Bebbington and Larrinaga, 2014). Therefore, this thesis argues that any such accounting needs to begin with the work of conservation and that researchers should then seek to explain how (or whether) efforts to render biodiversity calculable have made this work possible (Cuckston, 2018c; Feger et al., 2018).

As discussed earlier, international frameworks such as the SDGs or the UN Aichi targets place primary responsibility for addressing the challenges of biodiversity loss with national governments. Therefore, if biodiversity loss is to be halted, it is essential to understand how national governments can render biodiversity calculable and how biodiversity accounting researchers and practitioners can understand the achievement of biodiversity calculability.

Thus, the research questions addressed within this thesis are:

RQ1: How can national governments achieve a calculability for biodiversity loss that enables the formulation of policies to facilitate effective biodiversity conservation?

RQ1.1: How can biodiversity data be detached from nature?

RQ1.2: How is biodiversity data transformed into biodiversity performance measures?

RQ1.3: How can a national account of biodiversity be extracted from the calculative space?

RQ2: How can the achievement of biodiversity calculability be theoretically understood and explained?

Hence, the present research will contribute to the extant accounting for biodiversity literature by explaining and critically analysing how a national government – the UK – undertakes the work of framing a space in which the challenge of biodiversity loss is rendered calculable in order to facilitate conservation. In doing so, this thesis will contribute to the accounting for biodiversity literature by providing an understanding of the work that goes into the construction of national biodiversity accounts. Moreover, this thesis outlines how national biodiversity accounts are inherently imperfect and temporary. Additionally, this thesis aims to re-centre ongoing discussions within the accounting for biodiversity literature away from its current debate on anthropocentric vs ecocentric framings and toward a focus on accounting practices and how they facilitate biodiversity conservation. Lastly, this thesis will contribute towards the accounting for biodiversity literature by following Bebbington and Larrinaga's (2014) call to study sustainable development accounting practices outside of traditional organisational boundaries by providing an empirical study of a multi-organisational effort in rendering biodiversity calculable.

Using the theoretical framework of calculability – particularly the notions of framing and overflowing (Callon, 1998a) and the three stage process of achieving calculability (Callon and Law, 2005) –, this thesis will also present a novel theoretical approach to conceptualising and understanding the process of framing biodiversity accounting and the work that goes into rendering biodiversity calculable as three distinct calculative challenges. In doing so, this thesis will provide a theoretical contribution by presenting a theoretical approach that enables this thesis to provide a detailed outline of the construction of this calculative framework while also tracing overflows and re-framings within the calculative process. Thus, the theoretical framework deployed within this thesis allows the examination of a complex, messy, multi-organisation process, taking into account micro and macro actors as well as change and continuity at the same time.

Lastly, the findings of this thesis also provide various implications for biodiversity practitioners. Highlighting the necessity for collaboration, this thesis will emphasise the need for policy makers and national statisticians to set up a multi-organisation structure – including NGOs, research centres and academics – in order to construct national biodiversity indicators.

Additionally, the findings will outline the importance of identifying appropriate biodiversity data sources and highlight how NGOs and research centres can use this dependency of public sector organisations on data availability to steer policy discussions and national reporting efforts through the collection and provision of data sets. Moreover, this thesis shows how accounting for biodiversity will always be imperfect. As such, the findings suggest that biodiversity accounting systems should strive for ongoing improvement in the biodiversity indicator development in order to take changes within international frameworks, scientific developments and political feedback into account and render national biodiversity accounts more useful for biodiversity conservation work and policy development.

1.3 Thesis structure

This thesis is structured as followed:

Following, Chapter 2 will provide a critical analysis of the extant accounting for biodiversity literature. Highlighting the current focus of the literature on corporate biodiversity disclosure analysis and single organisational research, this chapter will argue that the literature so far has lacked research on national biodiversity accounting. Additionally, this chapter will discuss the current distinction of ecocentric and anthropocentric frames of biodiversity and to what extent this debate has been helpful in actually facilitating biodiversity conservation. Afterwards, this chapter introduces the idea of biodiversity indicators and its potential for biodiversity conservation.

Next, Chapter 3 will provide an overview of the theoretical framework of calculability deployed within this thesis. Introducing the notion of framing and overflowing (Callon, 1998a) as well as the three step process of achieving calculability (Callon and Law, 2005), this chapter will explain and develop the theoretical framework used within the analysis of the empirical findings. It will also provide an overview of the use of the framing and overflowing framework within the extant accounting and environmental accounting literature before outlining the implications of the theoretical framework on this research project.

Chapter 4 will discuss the methodology and methods deployed within this project. It will start by outlining the underlying philosophical assumptions of this thesis before providing details on the qualitative case study research strategy deployed within this thesis and the choice of the data collection tools – e.g. document analysis, interviews and non-participant observation. Subsequently, it will discuss the data analysis process as well as the limitations of the research design and the ethical considerations taken within this project.

Afterwards, Chapter 5 will provide the case study context, particularly focussed on the UK history of biodiversity conservation policy and practice, the impact of UK devolution and the international context including international biodiversity frameworks and targets. It will also introduce the UK Biodiversity Indicators Report, the governmental structure in which the report is produced as well as the calculative processes identified within the research. As such, the three steps identified within this process – e.g. detachment, transformation and the extraction of results – will form the basis for the following three empirical chapters.

Chapter 6 will outline the detachment processes of the data sets used within the UK Biodiversity Indicators Process – including the detachment of data from nature, the detachment of data from the original data collectors and the detachment of data from its original purpose. In doing so, this chapter will argue that achieving calculability for biodiversity performance requires the identification of existing biodiversity data sets to be brought into the calculative space. It will highlight how in the case of the UK, these data sets are predominantly collected by outside organisations including NGOs for their day-to-day conservation work before being repurposed into UK biodiversity indicators and thus, data availability and pre-existing data collection infrastructures drive the development of UK biodiversity indicators.

Next, Chapter 7 will discuss the second stage of the calculative process focussing on the transformation and manipulation of data sets into distinct indicators. It will highlight how the process of developing UK Biodiversity Indicators is largely influenced by the data sets that have been brought into the calculative space beforehand and how the transformation work is predominantly influenced by the UK *Code of Practice* for official statistics. This chapter will also outline the process in which the data sets are being transformed into biodiversity indicators and the assessment of the final indicators using a traffic light system.

Then, Chapter 8 will conclude the empirical section of this thesis by outlining the extraction process of the final result. In doing so, this thesis will outline how various results have been extracted from the calculative process by different actors at different points in time. However, any individual extraction – such as the annual publication of the UK Biodiversity Indicators Report – has opened up the opportunity for feedback and thus overflow. Therefore, the extraction process has been found to be the main driver of the framing – overflowing dynamic within this process. These continuing overflows have led to an ongoing reframing process of the UK Biodiversity Indicators Report –described by interviewees as improvements – and as such the extracted results of the UK calculative process were inherently temporary.

Subsequently, Chapter 9 will provide a discussion of the empirical findings. Starting with a summary of the findings, this chapter will then discuss these findings in terms of the extant accounting for biodiversity literature. Afterwards, this chapter will outline the contributions to the theoretical framework.

Lastly, Chapter 10 will conclude this thesis. In doing so, it will provide a personal reflection on the research methodology and the practicalities as well as outline the limitations of this research. Lastly, it will explain the implications of the findings for researchers and practitioners and outline possibilities for future research.

CHAPTER 2: ACCOUNTING FOR BIODIVERSITY

2.1 Introduction

Issues around biodiversity are becoming increasingly prominent within the accounting literature, with a growing amount of accounting scholars recognising the significance of accounting practices to the issue of biodiversity (Jones, 2014). Motivated by that fact that “the erosion of the world’s biodiversity is widely recognised as one of the greatest current threats to the planet” (Jones and Solomon, 2013, p. 1) and with human action being identified as the main driver for extinction (Barnosky et al., 2011, Ceballos et al., 2015), a wide range of biodiversity accounting and reporting practices have been proposed and explored within the literature. Still, Gaia and Jones (2017) and Jones and Solomon (2013b) point out that accounting for biodiversity is, up to this point in time, an understudied area with the accounting literature more generally focussing on social or environmental accounting or reporting issues rather than biodiversity concerns.

The following section will explore the existing debates within the present literature on accounting for biodiversity by critically reviewing the current literature on accounting related to biodiversity conservation, particularly focussing on the corporate and public sector biodiversity accounting and reporting literature and its underlying anthropocentric or ecocentric framing. The aim of this chapter is not only to outline existing research in this area, but also to critically evaluate to what extent it has been able to support biodiversity conservation efforts and hence halt biodiversity loss.

The remainder of this chapter is divided into 4 distinct sections. Section 2.2 will focus on the broader accounting for biodiversity literature, starting with its historical development and its focus on corporate biodiversity accounting practices before summarising the rather limited extant research on biodiversity accounting within public sector entities. Afterwards, section 2.3 will explore the influence of the underlying philosophical framings of biodiversity on the way biodiversity is being accounted for. Subsequently, section 2.4 will explore the question of how biodiversity accounting might be able to support actual biodiversity conservation efforts by focussing on the use of biodiversity indicators. To conclude, section 2.5 will introduce a typology of the extant literature on biodiversity accounting before section 2.6 will provide a summary of this chapter.

2.2 Accounting for Biodiversity

The following section will introduce and critically examine the existing literature on corporate as well as public sector biodiversity accounting and outline how this stream of literature has been developed historically.

2.2.1 Development of biodiversity accounting research

Before the 1980s, accounting for environmental issues was rarely done. Environmental concerns were kept mostly 'invisible' (see further the literature review of Mathews, 1997) and at that time the discipline of environmental accounting can hardly be described as a distinct research discipline (Bebbington and Larrinaga, 2014). This changed with the publication of Gray's (1990) "The Greening of Accountancy. The Profession After Pearce" report alongside special issues within the journals of Accounting, Organizations and Society in 1992 and the Accounting, Auditing and Accountability Journal in 1991, which according to Bebbington and Larrinaga (2014) have laid the foundation from which environmental accounting was developed into a distinct discipline.

Strongly influenced by sustainable development concepts within economics and science literature and drawing heavily from the previously existing social accounting literature, Gray and Laughlin (2012) describe environmental accounting in the early 1990 as particularly focussed on the interplay between environmental valuation and accounting (Hines, 1991; Milne, 1991; Power, 1991). Since then, the discipline of environmental accounting developed rapidly, particularly as it became institutionalised within business schools and accounting departments (Bebbington and Larrinaga, 2014). Nowadays, environmental accounting concerns have reoriented towards core accounting themes such as annual disclosure, audit and assurance, management accounting or financial accounting (Thomson, 2007) and Gray and Laughlin (2012) highlight how current environmental accounting has rather little to do with the vision proposed by scholars in the early nineties. Instead, "[m]uch of this research has been routine descriptions of disclosure practices and/or attempts to link disclosure to theoretical explanations" (Gray and Laughlin, 2012, p. 238) and the earlier interdisciplinary focus of this discipline was replaced with a traditional organisational focus towards accounting.

Within the discipline of environmental accounting, various authors have focussed on particular environmental concerns such as climate change (e.g. Bebbington and Larrinaga, 2008; Milne and Grubnic, 2011), water (e.g. Russell and Lewis, 2014) or biodiversity loss and species extinction. As a consequence, one of the fields that emerged within the accounting literature has been the field of biodiversity accounting. While biodiversity accounting was described a few years ago as emerging but "not yet at the stage of development in academic terms for […] chapters devoted to [this] area" (Bebbington et al., 2014, p. 286), the accounting literature has recently experienced a rapid increase in publications within this area (Cuckston, 2018b).

Jones and Solomon (2013) and Russell et al. (2017) highlight how the idea of accounting for biodiversity and nature is broadly critiqued within the literature, particularly within earlier work in the field of environmental accounting. Within this stream of literature, scholars point out the harmful effects accounting for nature can have on how nature and biodiversity is perceived and valued (e.g. Cooper, 1992; Gray, 1992; Hines, 1991; Hines, 1988; Maunders and Burritt, 1991; Milne, 2007; Milne, 1996). Moreover, Wentzel et al. (2008) outline the arguments that have been used to question the appropriateness of accounting for wildlife and biodiversity in general. According to them, fauna is highly mobile and the scope of species to be included is too broad, making the process of counting highly expensive and complicated. In addition, the focus on accounting value does not 'add value' for wildlife and using accounting tools to value parks with a conservation purpose could lead to expectation of them having to generate profit.

More recently, various scholars have considered how to take ecological issues into account when designing and implementing calculative practices and how these practices might contribute to issues of accountability (Bebbington et al., 2001; Birkin, 2003; Egan, 2014; Hazelton, 2013; Samkin et al., 2014; Tello et al., 2016). Intertwined with this research have been attempts to conceptualise various human-nature relationships (e.g. Castree, 2005; 2013) that are themselves mediated by practices such as accounting, institutions or structures (Russell et al., 2017). Accountants are argued to have a particular skillset to support conservation, such as "independence, professional scepticism, information design and communicational expertise" (Jones, 1996, p. 286). As such, Russell et al. (2017) argue accountants have knowledge in measuring and reporting data necessary for biodiversity accounting and as experts in interacting with various teams are well-suited in coordinating multidisciplinary biodiversity teams.

Most of biodiversity accounting literature rests on the underlying assumption that accounting can be a "productive force" (Miller and Power, 2013, p. 558). Subsequently, accounting is not just a passive practice which records reality, but instead accounting has the potential of reshaping reality by influencing human behaviour (Hines, 1988). Accounting therefore cannot be described as just a technical activity, but instead the "the very idea of accounting is fluid, historically contingent, and constantly shifting [such that] there are always pressures for new accountings" (Hines, 1998, p. 588). By translating qualities into quantities, phenomena are rendered calculable and comparable (Miller, 1992; Power, 2015) and accordingly issues are made visible or are kept hidden. Thus, accounting constructs a condition which influences the perception of people about their possibilities and freedom (Espeland and Sauder, 2007), making accounting "the calculative practice that delineates the playing field and defines the rules of the game" (Kornberger and Carter, 2010, p. 340).

According to Jones and Solomon (2013), accounting for biodiversity was motivated by the belief that treating accounting as powerful will impact on the way people understand and see the world. By making biodiversity conservation possible and thinkable, biodiversity accounts are having an active rather than a passive role in shaping society. Biodiversity accounting "can, by reporting organisations' impacts on biodiversity and their efforts to enhance and protect biodiversity, raise stakeholders' awareness of corporations' impact on wildlife and the extent to which organisations are attempting to mitigate this impact" (Jones and Solomon, 2013, p. 670). Therefore, Jones and Solomon (2013) argue that making the impact of organisational behaviour on biodiversity visible for the organisation and their stakeholders will consequently lead to behavioural change.

One of the first biodiversity accounting models that tried to link visibility and biodiversity conservation was the natural inventory model by Jones (1996; 2003). It requires the recording, valuation and reporting on habitats and species that are affected by the organisations actions, in order to identify the organisations "natural assets" (1996, p. 283). According to Jones (2003) "if organisations have wider stewardship responsibility to the environment, then they should be aware of the environmental assets they own [and] the maintenance of natural inventories represents one possible way in which they can discharge their social obligations" (p. 781). Thus, making biodiversity issues visible could encourage organisations stewardship.

2.2.2 Corporate biodiversity accounting

In line with the dominant approach in social and environmental accounting research, much of the biodiversity accounting research focuses on for-profit organisations and ways in which their influence on biodiversity issues can be made visible (Jones and Solomon, 2013). Based on the belief that corporations "are accountable to society at large as well as to stakeholders for their stewardship of the environment" (Jones, 2003, p. 764), numerous mechanisms have been proposed in practice as well as academic literature, including ideas of stewardship accounting (Jones, 1996; 2003; Siddiqui, 2013), corporate reporting (Adler, Mansi, and Pandey 2018; Atkins, Grabsch and Jones, 2014; Atkins and Maroun 2018; Boiral, 2016; Rimmel and Jonäll, 2013; van Liempd and Busch, 2013), biodiversity offsetting (Cuckston, 2019; Ferreira, 2017; Sullivan and Hannis, 2017; Tregidga, 2013), certifications (Cuckston, 2013; Elad, 2014), and indicators (Thomson, 2014).

One of the most explored practices in the biodiversity accounting literature has been corporate biodiversity reporting, mainly based on content analysis of reports of Fortune Global 500 companies (Adler, Mansi and Pandey, 2018), mining companies (Adler, Mansi, Pandey and Stringer, 2017; Boiral, 2016) and listed corporations in the UK and Germany (Atkins, Grabsch and Jones, 2014), Sweden (Rimmel and Jonäll, 2013) and Denmark (van Liempd and Busch, 2013). Rimmel and Jonäll's (2013) study of the disclosure practice of 29 Swedish companies using a legitimacy theory framework found rather limited reporting on biodiversity issues. Similar findings have been published by van Liempd and Busch (2013) in the Danish context and by Atkins et al. (2014) looking at listed UK and German companies. In line with these conclusions, Boiral's (2016) study of the biodiversity disclosure of mining companies found that the biodiversity information released by companies was overall limited and biased, questioning the usefulness of sustainability reports as a tool to evaluate a firm's biodiversity accountability practices.

Besides corporate biodiversity reporting, extant accounting literature has focussed on biodiversity offsetting schemes. Biodiversity offsetting schemes are based on the assumption that biodiversity losses caused in one place can be 'offset' by biodiversity gains in another place, therefore enabling the calculation of an overall biodiversity net loss/gain. This assumption of a possible overall net loss/gain of biodiversity has been heavily criticised by Sullivan and Hannis (2017), as it is based on "contested assumptions about commensurability between different habitats, between different sites, and between the present and the future" (p. 1470). Likewise, Tregidga (2013) states that offsetting "represent a mechanism through which particular species and habitat destruction can be justified, or at least hidden in its accounting" (p. 827) and Boiral (2016) sees offsetting schemes primarily as a legitimising strategy. Similarly, Ferreira (2017) concludes that the UK biodiversity offsetting market examined within his research is "ineffective and incapable of delivering on the main promise of biodiversity offsets, no net loss of biodiversity. This contributed to fuelling the critics, who saw biodiversity offsets only as a license to trash nature" (p. 1579). He particularly points out that the complexities involved in biodiversity makes measuring and quantifying biodiversity highly problematic, as "accounting often operates by reducing biodiversity to simple components, losing track of the interrelations between the various components and the biophysical and social environment in which they live in the process" (p. 1573). In response to the critique of biodiversity offsetting, Cuckston (2019) seeks to explain how an ecological defensible calculation for biodiversity net loss/gain could be achieved. In his case study of a biodiversity offsetting mechanism in New South Wales, he argues that biodiversity offsetting mechanisms may have started as "little more than a legitimising strategy" (p. 1374), but "that biodiversity offsetting is evolving as proponents seek to produce a more ecologically defensible mechanism for reconciling economic development and biodiversity conservation" (p. 1378). By highlighting how the three offsetting mechanisms within this case have been able to capture anxieties expressed by conservationists, he argues that biodiversity offsetting became an ecologically defensible way of co-ordinating conservation.

Besides corporate reporting and biodiversity offsetting, a smaller stream of literature has looked at accounting mechanisms such as certifications and eco-labels. In a multitude of papers, Elad (2000; 2001; 2003; 2014) has analysed the establishment of forest ecocertifications, such as the Forest Stewardship Council label that is supposed to certify that forest products have been originating from 'well managed' forests (Elad, 2001; 2003). Nevertheless, some of the forestry projects receiving these eco-labels have been criticised for their social and environmental impact, raising controversy over the usefulness of these certifications to actually prevent the destruction of natural forests.

If treated like a purely calculative technique, corporate biodiversity accounting methods are often criticised for promoting a 'business as usual' program (Larrinaga-Gonzalez and Bebbington, 2001) without providing any material change (Gray, 2010). In general, literature on biodiversity disclosure concludes that even though corporate annual reports increasingly include disclosure of environmental issues (Bebbington et al., 2008), biodiversity disclosure practices are still limited showing particularly little disclosure on biodiversity impact. Additionally, biodiversity offsetting schemes have been criticised as purely being a legitimising strategy that rather than supporting biodiversity conservation efforts provides a "licence to trash nature" (Ferreira, 2017, p. 1579). In that case, corporate biodiversity accounting and reporting is merely used to engage in impression management and window dressing activities (Tregidga et al., 2014) rather than to provide actual conservation action.

According to Gray (2010), corporations are ultimately unable to achieve biodiversity conservation due their focus on short-term financial results. Similarly, Milne and Gray (2013, p. 16) question "whether business decision makers operating within the constraints of a capitalist system are capable of making sacrifices of profit to protect resources and ecosystems for future generations and other species". If profit seeking corporations are in the end incapable of achieving biodiversity conservation (Gray, 2010), to what extent are organisations whose main purpose is not to create profit but rather to deliver public services able to facilitate biodiversity conservation?

2.2.3 Public sector biodiversity accounting

With the accounting for biodiversity literature predominantly focussing on private, for-profit corporations, research into public sector biodiversity accounting is relatively limited (Ball et al., 2014). Even though all organisations, including third sector and governmental organisations, should be accountable for their impact on biodiversity (Russell et al., 2017), only a number of studies have looked at public sector reporting in general (e.g. Greco et al., 2015; Joseph and Taplin, 2012; Lodhia, 2010; Lodhia et al., 2012; Marcuccio and Steccolini, 2005; Sciulli, 2009, 2011; Williams et al., 2011; Williams, 2011) or forms of public sector biodiversity accounting and disclosure in particular (e.g. Gaia and Jones, 2017; Samkin et al., 2014; Schneider et al., 2014; Weir, 2018a; b)

One of the first studies looking at biodiversity reporting of public sector organisations has been Schneider et al.'s (2014) paper on the biodiversity disclosure practice of New Zealand local authorities. By using a stakeholder accountability perspective, their research examined the extent and ways in which biodiversity information were disclosed and communicated by 78 New Zealand local authorities. In line with corporate biodiversity reporting research, they also find a lack of useful biodiversity reporting practice within these organisations and biodiversity disclosure was scattered across a range of different documents such as Annual Reports, Regional Policy Statements and Annual Plans. Similar findings have been made by Barut et al.'s (2016) research on 151 Australian local government authorities and their biodiversity disclosure practice, who conclude that current reporting practices "do not provide a clear picture of the status of biodiversity, trends in biodiversity condition, extent of pressures or the success of interventions" (p. 216).

Besides examining the extent of biodiversity disclosure of public sector organisations, Weir (2018a), Samkin et al. (2014) and Gaia and Jones (2017) analysed the narratives used within the biodiversity disclosure of local government bodies.

By analysing the content of UK local council biodiversity reporting, Gaia and Jones (2017) highlight how biodiversity is largely framed from an economic perspective, focussing on ecosystem services and economic value provided by biodiversity. Similar findings have been made by Weir's (2018a) study on UK local councils. His findings highlight how accounting for biodiversity was predominantly used to generate species extinction or recovery reports to facilitate species protection programmes. However, he concludes that by using biodiversity accounting information, trade-offs between ecological and economic criteria for decision making emerged, leading to a strong focus on the economic value of biodiversity. In contrast, Samkin et al.'s (2014) analysis of the annual reporting practice of a New Zealand conservation organisation found the narrative to be predominantly framed in terms of a deep ecology philosophy. This contrast might be due to the focus of the study being on a conservation organisation rather than on local councils.

2.3 Framing of biodiversity within the accounting literature

According to Russell et al. (2017), the way in which biodiversity was historically defined was highly dependent on religious and philosophical beliefs on the definer. Particularly the western attitude towards nature was vastly influenced by Christianity (Wolloch, 2006) and the assumption that humans are on top of an ecological hierarchy, leading to biodiversity definitions in which all non-human species are subservient and subordinate to a primary human species. This hierarchical approach to animals contributed to an anthropocentric perspective on biodiversity in which human and non-human relations are described as "not just the general idea that the world revolves around human needs, but specifically the application of such thinking to attitudes towards animals" (Wolloch, 2006, p. 16). Such anthropocentric thinking has been established in various philosophical work, such as Aristotle's hierarchy in which humans were places on the top, followed by animals and lastly plants.

In contrast to anthropocentric philosophical developments, an emerging stream of philosophers and writers, such as Voltaire, Rousseau or Diderot began to oppose the subjugation of animals. Focussing on the improvement of animal treatment while still encapsulating underlying anthropocentric views, this stream of philosophy became known as theriophilic (Russell et al., 2017). In addition and opposing the idea of human superiority, streams of predominately non-religious philosophical writings have explored the idea of intrinsic value of nature, such as Naess' (1986) concept of deep ecology.

As a result of these different underlying philosophical assumptions about humans and nature, definitions of biodiversity are highly contested. Following, any attempt to account for biodiversity is vastly influenced by the underlying philosophical perspective of the researcher. In line with this assumption, Cuckston (2018b) points out how accounting for biodiversity research is preoccupied with the question of whether an anthropocentric (e.g. financial) or ecocentric (e.g. intrinsic value) perspective is conveyed. Within the following paragraphs the use of the two different frames within the accounting for biodiversity literature is outlined and further explained.

2.3.1 Anthropocentric framing of biodiversity

Within the accounting for biodiversity literature, the most prominent form of understanding biodiversity accounting is by framing biodiversity as being a provider of economically valuable services (TEEB, 2010). This enables organisations to see and comprehend biodiversity as a kind of 'natural asset' or so-called 'natural capital' (Barter, 2015). This framing has been heavily promoted within the accounting profession as a way to encourage organisations to recognise their responsibilities for stewardship of nature and biodiversity (ACCA et al., 2012; ICAEW, 2018). This form of accounting for biodiversity is, therefore, meant to encourage organisations to perceive their own self-interest in conserving biodiversity, thus incentivising responsible use of natural resources (Jones, 2003; 1996; Rimmel and Jonäll, 2013; van Liempd and Busch, 2013).

Similarly, biodiversity offsetting mechanisms have been found to frame biodiversity in terms of numerical scores, based on easily measurable attributes of sites (Boiral, 2016; Cuckston, 2019; Ferreira, 2017; Sullivan and Hannis, 2017; Tregidga, 2013). This framing enables the commensuration, financialisation and marketisation of biodiversity values, whereby supposed biodiversity gains from conservation work on one site can be traded to compensate for biodiversity losses caused by development on another site. This is meant to facilitate an overall 'no net loss' of biodiversity, thus providing an economically efficient means of appearing to achieve ecologically sustainable development (Spash, 2015). Along similar lines, calculations of commensurable carbon offsets generated from forest conservation work, which frames biologically diverse habitats as simple stores of carbon, facilitates financialisation and marketisation as forests take on a financial value determined by supply and demand in carbon trading markets (Cuckston, 2013; 2018a).

Within the accounting literature, valuing biodiversity in financial terms has been widely criticised (Gray, 2010; Gray and Milne, 2018). According to Hines (1991) economically valuing nature will be detrimental to its protection, as it will “alienate people from nature” (p. 29) and provide economic arguments justifying its destruction. Additionally, Cooper (1992) argues that economically valuing nature will lead to further environmental destruction, as “in a system where the “logos” is profit, and more profit is better than less, then, perhaps if we started to account for nature, even more profits would be squeezed from nature” (Cooper, 1992, p. 26). Similarly, Russell et al. (2017) discuss that such an anthropocentric perspective will lead to biodiversity accounting mechanism with “certainly no ecology” (p. 1436).

However, framing biodiversity in terms of its economic value is not just visible within the accounting or economic literature, but instead it is influential on a broad stream of conservation literature as well. Particularly the concepts of ecosystem services or natural capital are broadly used and debated within that stream of literature, with ecosystem services being used as a way to measure and quantify the economic benefits people can get from ecosystems (see for example Costanza et al, 1997; Lamarque et al., 2011; Laurila-Pant et al., 2015; Mace et al., 2012). Within that literature, biodiversity is being measured based on the value it provides to humans and economies, such as by providing natural resources, materials and food. To do so, concepts such as the total economic value (TEV) are being used in order to value environmental assets in monetary terms (e.g. Adger et al., 1995; Fromm, 2000;

Nijkamp et al., 2008; Oxford Economics, 2009, Pearce and Moran, 2013; Rolfe and Windle, 2010; Turpie et al., 2003,).

In addition to the ecosystem services approach, the idea of 'natural capital' is becoming increasingly popular within the conservation literature (see review of Fletcher et al., 2019). By framing ecosystems as capital assets, decision-makers are supposed to recognise and value how further economic development is dependent on natural resources – the so called 'natural capital' (Sullivan, 2014). Interestingly, the use of the term 'natural capital' to promote a growth-oriented economy seems to be a development away from the early usage of the term. For example, Schumacher (1973) argues in his book "Small is Beautiful: Economics as if People Mattered" that valuing 'natural capital' should lead to a downsizing of economic production in order to protect the "irreplaceable capital" (p. 4) of nature. According to him, modern economics make the huge mistake of consuming their capital which he argues is down to the fact that "[m]odern man does not experience himself as a part of nature but as an outside force destined to dominate and conquer it" (p. 3).

2.3.2 Alternative framings of biodiversity accounting

In stark contrast to these anthropocentric framings that seek to represent biodiversity in financial terms, many accounting scholars have sought to frame biodiversity in accordance with more ecocentric principles. A central belief underlying these alternative framings is that nature has intrinsic value, with intrinsic value being something that "exists independently of human valuation, perception, or consciousness – the value a thing has 'in itself', 'for its own sake' or 'in its own right'" (Curran, 2005, p. 56). Therefore, the value of biodiversity extends "beyond those of the tangible services provided to humans or direct economic worth. In other words, biodiversity also has intellectual, aesthetic, and religious significance" (Lee et al., 2005, p. 62). Framing biodiversity – i.e. nature – in financial terms, it is argued, enables the justification of destructive activities. Conversely, seeing and understanding nature as being intrinsically valuable and fundamentally priceless enables a more spiritual connection with nature, which encourages people to seek to live their lives, and possibly to manage their organisations, in ways that are more in harmony with nature (Gallhofer, 2018; Russell et al., 2017).

Equally to the distinction between anthropocentric end ecocentric framings within the biodiversity accounting literature, Swart et al. (2001) find a similar distinction dominating the conservation literature. While the majority of conservation literature is trying to represent biodiversity within one single composite indicator, such as through the number of species or habitats (Moonen and Barberi, 2008), Duelli and Obrist (2003) argue that biodiversity is too complex and that different indicators are required to measure the various aspects of biodiversity. In order to select these measures of biodiversity, Noss (1990) provides a conceptual framework in which the three main components of biodiversity – composition, structure and function (according to Franklin et al., 1981) – are organised in a hierarchical structure. The framework focusses on measuring biodiversity in itself and is not linked to economic, financial or political ideas. It is therefore described as "directly applicable to species, habitat and overall biodiversity conservation for their intrinsic, aesthetic, cultural and traditional values" (Moonen and Barberi, 2008, p. 11).

In line with a more ecocentric framing of biodiversity, Cuckston (2018b) identifies two attempts to lay out an alternative framework for accounting for biodiversity. Firstly, Samkin, Schneider and Tappin (2014) describe a tool for preparing as well as assessing biodiversity reporting based on principles of deep ecology (Naess and Sessions, 1984). The concept of deep-ecology is set on the belief that contemporary environmental problems including the current biodiversity crisis result from destructive human behaviour (Grey, 1993). It is underpinned by two normative principles, namely self-realisation and biocentrism (Jacob, 1994; Cramer, 1998; Davradou and Namkoong, 2001). The first principle, self-realisation, is based on the awareness of the potentialities of all life (Devall and Sessions, 1985) as "an identification of self that goes beyond humanity to include the nonhuman world" (Jacob, 1994, p. 480). In addition, biocentrism aims at adopting a holistic approach, combining four core beliefs: 1. Humans are not superior to other species, 2. All species are interdependent 3. All forms of life have intrinsic value and 4. Humans have no privileged position on earth (Taylor, 1986). Succinctly, Khisty (2006, p. 300) defines biocentrism[3] as "understanding that we are one with all other sentient beings, with no special rights, just because we are human".

Within their paper, Samkin et al. (2014) apply this framework of deep ecology to the annual reporting of the New Zealand Department of Conservation showing that a majority of the examined reporting reflects a deep ecological framing. However, Cuckston (2018b) points out that this finding seems particularly consistent with the organisations main purpose – to manage New Zealand's conservation land – but lacks clarity on how the framework can be applied to for-profit organisations.

[3] Often, the terminology of ecocentrism and biocentrism has been used interchangeably within the literature. However, Burns et al. (2011) point out that the main difference between these two terms is the focus of biocentrism on living, sentient parts of ecosystems, while ecocentrism goes beyond that by also including abiotic parts of nature as intrinsically valuable.

Building on the same framework of deep ecology (Naess and Sessions, 1984), Christian (2014) highlights the role of volunteers in recording biodiversity and contributing to national monitoring schemes and recording centres. He argues, that humanity is losing its interconnectedness with nature by assuming that it could separate humans from nature. As a result, he argues for biodiversity recording to focus on the interconnectedness of biodiversity and aiming to re-connect people with their local nature.

As an alternative to framing biodiversity accounting around a deep ecology philosophy, Atkins and Maroun (2018), Atkins et al. (2018) and Maroun and Atkins (2018) set out to construct a normative framework for corporate biodiversity disclosure described as 'extinction accounting'. Within this literature, the framework is set up as being "a hybrid of both anthropocentric and deep ecological views" (Atkins and Maroun, 2018, p. 761) and claims to be transformational and emancipatory by encouraging a narrative corporate account describing the corporation's self-understanding of species extinction and action taken to prevent such extinction. Given its hybrid nature, organisations are encouraged to understand their moral imperative to halt species extinction as well as to comprehend extinction as a business risk by estimating the loss of economic value caused by extinction. Within the authors study of the disclosure of South Africa listed companies, Atkins et al. (2018) conclude that corporate philanthropic contributions to rhinoceros conservation projects represent a shift in how corporations understand species extinction. The authors come to the conclusion that these corporations take action to preserve this species "because of the rhinoceros' intrinsic value" (Atkins et al. 2018, p. 693) rather than an immediate business case, which the authors consider as a deep ecological framing. By encouraging corporations to construct accounts of their own biodiversity extinction impact, Atkins et al. (2018) hope to change the corporate mindset, subsequently leading to changes in the corporate behaviour. However, Cuckston (2018b) critiques that the evidence provided on how it can actually achieve conservation is limited and only suggests that corporations will facilitate species protection based on a combination of a desire for legitimacy and self interest in reducing business risks due to species extinction.

These ecocentric biodiversity accounting frameworks have not been received without criticism, particularly based on the question whether any quantification of nature can really be ecocentric. According to Lohmann (2015), accounting for nature requires that the person who is constructing the account is clearly distinguished from the object of the account – in this case nature itself. In that situation, "humanity must first conceive of itself as different from "nature" and, from there erect the edifice of artificiality through which calculation and dominance over "nature" become (hyper) normal" (Gray and Milne, 2018). By doing so, Gray and Milne (2018) argue that the narrative of human stewardship over nature is privileged. Following that argument, any human made framing or calculation of nature cannot be truly ecocentric. Additionally, as humans take on the role of preparers of these accounts, the human voice is always going to be prioritised over the voice of nature, particularly given that "[accounts] are always engaged in interpreting a complex reality, partially, and in a way that is heavily weighted in favour of what the accountant is able to measure and chooses to measure, through the particular scheme of accounting to be adopted" (Morgan, 1988, p. 480).

2.4 Biodiversity accounting to support biodiversity conservation

So how can biodiversity accounting actually support biodiversity conservation and how is that capacity to act actually linked to the differences in the underlying framing explained above?

Whilst the tension between anthropocentric and ecocentric framings of biodiversity is important in terms of how humanity comes to think about its place on the Earth and its relations with other species (Gray and Milne, 2018), it is not clear how useful either form of calculability is for undertaking or managing biodiversity conservation or restoration work (Cuckston, 2018b). Particularly the current focus of accounting research on individual organisations does not seem to be helpful to achieve conservation as "any simple assessment of the relationship between a single organisation and planetary sustainability is virtually impossible. The relationships and interrelationships are simply too complex" (Gray, 2010, p. 48). As a result, Bebbington and Larrinaga (2014) call for researchers to focus on the underlying "socio-economic arrangement" (Bebbington and Larrinaga, 2014, p. 401) rather than being restricted by the traditional focus of accounting on individual entities.

Moreover, (Weir, 2018a) highlights a lack of research focussing on how or for whom biodiversity accounts have been produced for or are being used by (see further Boiral and Heras-Saizarbitoria, 2017; Tilt, 2015).

If the objective of accounting for biodiversity research is to contribute to addressing the challenge of biodiversity loss (see further Bebbington and Larrinaga, 2014), then it needs to begin by seeking out the work of conservation and then looking to explain how (or whether) efforts to render biodiversity calculable have made this work possible (Cuckston, 2018c; Feger et al., 2018). Some studies have sought to do this by examining how conservationists use accounting techniques to frame biodiversity in ways that enable them to restore and/or protect particular ecological systems (Cuckston, 2017; Dey and Russell, 2014; Feger and Mermet, 2017).

By conceptualising the socio-ecological system of the River Garry in Scotland as an accounting entity, Dey and Russell (2014) re-centred the focus of the analysis on the river basin rather than on a traditional accounting focus of an individual organisations. Similarly, Cuckston (2017) conceptualises the blanket bog habitat as an accounting entity in his study on accounting during the process of a degraded blanket bog restoration, enabling the tracing of accounting devices that enabled this ecological restauration process. He concludes that ecology-centred accounts can create "conditions in which forms of organising of human and non-human actors into socio-ecological systems become thinkable and possible." (p. 1560) and in which accounting can become a "productive force" (Miller and Power, 2013, p 558). Moreover, Feger and Mermet (2017) outline how conservation science and practices are embedded in complex institutional, political and organisational realities by analysing how the Natural Capital Project is used for assessing the management of ecosystems. Their research also highlights the importance of context and how context can extend beyond traditional boundaries of one economic entity.

Furthermore, Cuckston (2018c) explored how biodiversity conservation becomes possible through the construction of spaces of calculability. His examination of the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species highlights how calculative devices can support biodiversity conservation through the construction of new agencements. His findings show how accounting for biodiversity results in certain conservations strategies being seen as possible and thinkable.

Similar to Bebbington and Larrinaga's (2014) motivation "to keep open the possibility that the discipline of accounting might, under certain conditions, allow organisations to address sustainable development challenges” (p. 396), Cuckston (2018b, p. 218) points out how biodiversity accounting research has the potential to be a “force for conservation”.

2.4.1 Biodiversity Indicators to support conservation

One primary approach to tackle biodiversity loss within conservation sciences has been to track changes in single or multiple aspects of biodiversity over time using biodiversity indicators and indices (Butchart et al., 2010; Jones et al., 2011). Governing nature and environmental issues using indicator sets and other statistical techniques has been done since the early nineteenth century (Wise, 1995; Olesko, 1997). Since then, measuring and creating environmental accounts based on scientific indicators are an important part of governing biodiversity as using biodiversity indicators to account for biodiversity issues have been seen as helpful to govern and report on the impact of human actions on the natural ecosystem by measuring, valuing and reporting the influence of our society on our nature (Thomson, 2014).

Statistical indicators have been used extensively within conservation literature to make environmental issues visible (Mederly et al., 2003), with a widely used definition of an indicator being “something that provides a clue to a matter of larger significance or makes perceptible a trend or phenomenon that is not immediately detectable. [...] Thus an indicator’s significance extends beyond what is actually measured to a larger phenomena of interest” (Hammond, 1995, p. 1). Within that non-accounting literature, biodiversity indicators are often seen as practical tools to measure management practices and evaluate performance thresholds or standards with conservation literature focussing on which indicators to choose or how to record and sample biodiversity indicators (e.g. Duelli and Obrist, 2003; Gardner, 2015; Cook et al., 2017).

A broader range of literature outside the field of accounting highlights how trend indicators can be used to set policy agendas, get public attention or stimulate a public discourse (Balmford et al., 2005; Hammond et al., 1995; Jones et al., 2011; Pereira et al., 2013), therefore assisting policy decision making and measuring policy impact (Balmford et al., 2005; Nicholson et al., 2012; Walpole et al., 2009). Within this literature, biodiversity indicators are often advertised as the most effective technique to link biodiversity conservation science to biodiversity conservation policy (UNEP, 2000). As a result, sustainable development indicators including biodiversity indicators have been framed, developed and promoted by states (Bradley Guy and Kibert, 1998; Hanley et al., 1999; Smith, 2002), local governments (Eckerberg and Mineur, 2003; Journel et al., 2003; Spangenberg, Pfahl and Deller, 2002), international political institutions and NGOs and academics (e.g. Marks, 2006; Wackernagel and Rees, 1998), with a majority of the literature engaging with the challenging and underspecified political process behind them (Journel et al., 2003; Mederly, Novacek and Topercer, 2003; Rydin et al., 2003).

2.4.2 Biodiversity Indicators in the accounting literature

So far, accounting scholars have been relatively absent from this conversation with only a few publications looking at biodiversity indicators or sustainable development indicators in general (Russell and Thomson, 2009; Thomson, 2014). The main aim of this literature has been to analyse the relationship of biodiversity indicators and biodiversity strategies in order to examine the representation of the governing vision and rationalities within these strategies by the indicator sets. Based on the theoretical framework of governmentality, Russell and Thomson (2009) found a lack of alignment between the Scottish Sustainable Development Strategy and the Sustainable Development Indicators used to measure progress towards the strategic vision. They conclude that critical aspects of the Sustainable Scotland strategy were omitted within the indicator set, leading to an inefficient and probably distorting set of measurements. Based on a similar theoretical framework, Thomson (2014) examines the development of biodiversity indicators in the UK as a powerful governmental tool for the establishments of norms defining an 'acceptable' behaviour or to draw a line between positive and negative actions for biodiversity conservation. Indicators are seen as a technique to facilitate governance from a distance and to achieve visibility. Thomson (2014) points out the risk that the wrong indicators could distort the implementation of biodiversity into normal practice, by suppressing knowledge or areas of visibility which would be essential to biodiversity conservation. Consequently, the design of the basket of biodiversity indicators seems to be key to support biodiversity conservation. An inappropriate basket may lead to invisibility of biodiversity issues for government intervention or interventions being incorrectly classified as positive towards biodiversity conservation. Moreover, the indicators chosen will impact on the definition of biodiversity which influence on the actions taken for biodiversity conservation.

However, the accounting literature so far has been highly ambiguous in defining the terminology of what an indicator is and how an indicator can be distinguished from a measure or a metric. While these terms are clearly distinguished and defined within the conservation literature (see for example: Heink and Kowarik, 2010; McCool and Stankey, 2004; Singh et al., 2009; Veleva and Ellenbecker, 2001), accounting scholars seem to be using the terms interchangeable and without a clear definition. This lack of consistency within the terminology makes operationalising the idea of biodiversity indicators into practices that enable biodiversity conservation particularly difficult.

Additionally, Gray (2010) has critiqued the use of sustainability indicators based on a synthesis by Ranganathan (1998) on 50 studies on indicators in this context. Within this piece, Ranganathan (1998) outlines the struggle of getting indicators accepted and used if they have not been integrated into the financial performance measurement system. Along similar lines, sustainability indicators have been criticised for attempting to measure 'the immeasurable' (Bell and Morse, 2012) and Gray (2010) argues that indicator approaches lack value as they require key issues to be simplified leading to them not providing a full narrative of the issue they are trying to represent.

This general notion of 'imperfect' performance measures has been previously explored within a small stream of management accounting literature, particularly focussing on Latour's (1999) sociology of translation (see further Dambrin and Robson, 2011). As such, Chua's (1995) study of hospitals examined how imperfect accounting numbers became facts by tying together various interests within the network. Similarly, Briers and Chua (2001) research focussing on how organisation members dealt with flawed accounting numbers described the compromises taken by managers to extrapolate 'best guesses' and more reliable figures and the necessity for consent within the actors involved.

> "The network of interests and faith was strong enough for them all to continue with their technology construction efforts despite the many ''soft data problems'' they encountered along the way." (Briers and Chua, 2001, p. 266)

However, the idea of imperfect measures of biodiversity or sustainable development so far has not been conceptualised or theorised within the accounting literature. As such and while critiqued as only being incomplete representations of nature, the SEA literature has not been able to explain how these measures have been constructed in the first place or how actors involved are dealing with these partial performance measures. As a result, existing literature does not provide any understanding of how imperfect numbers become accepted by actors or perform in practice.

2.5 Typology of Accounting for Biodiversity Research

Based on the literature outlined within this chapter, the following section will introduce a typology of accounting for biodiversity research literature. The existing literature can be classified based on the accounting entity focussed on within the research, the accounting practice examined and the aim of the research. This typology is visualised in Table 2.1.

While the majority of literature focusses on corporations as accounting entities, research has also been centred on individuals, public sector organisations, specific ecosystems, distinct species, individual countries or the planet as an accounting entity. Within corporate biodiversity accounting research, practices examined range from corporate reporting over offsetting and certification schemes, natural inventory accounting as well as extinction accounting. Two of these practices, namely biodiversity reporting and extinction accounting, have also been explored focussing on public sector organisations.

In contrast, only a small part of the literature has explored biodiversity accounting outside of traditional organisational boundaries and has centred the analysis on ecosystems as accounting entities. Within that stream of literature, research has examined the construction of markets, the use of evaluative information systems, counter accounting, ecology-centred accounting as well as natural inventory. Additionally, extant research has explored the use of biodiversity indicators and offsetting markets on a national level, while research centred on a planetary perspective has criticised the disconnect of current reporting practices and global ecological systems. On the other end of the spectrum, research centred on individuals has examined in detail how biodiversity can be recorded and how individual people can be reconnected with nature.

Table 2.1: Typology of Accounting for Biodiversity Research

Accounting entity	Accounting Practices	Aim	Examples
Planetary	Sustainability reporting	Critiquing the disconnect between sustainability reporting practices and sustaining ecological systems	Milne and Gray, 2013
National	Biodiversity Indicators	Exploring the development of UK Biodiversity Indicators	Thomson, 2014
	Biodiversity Offsetting	Examining UK biodiversity offsetting practices	Ferreira, 2017; Sullivan and Hannis, 2017
Ecosystem	Evaluative information systems for conservation (EISC)	Examining the use of EISC in complex ecological and social contexts	Feger and Mermet, 2017
	Counter Accounts	Conceptualising socio-ecological systems as accounting entities	Dey and Russell, 2014
	Ecology-centred accounting	Analysing the role of ecology-centred accounting	Cuckston, 2017
	Natural Inventory	Production of a natural inventory report for a mangrove forest	Siddiqui, 2013
Species	Species accounts	Providing a counter-narrative to specific species extinction accounts	Gray and Milne, 2018
Public sector organisations	Public sector reporting	Understanding the narratives and extent of public sector biodiversity accounting	Samkin et al., 2014; Schneider et al., 2014; Gaia and Jones, 2017; Weir, 2018a
	Extinction Accounting	Exploring the use of extinction accounting in the public sector	Weir, 2018b

Corporations	Corporate Biodiversity Reporting	Exploring the extent of biodiversity reporting practices	Rimmel and Jonäll, 2013; van Liempd and Busch, 2013; Atkins, Grabsch and Jones, 2014; Boiral, 2016, Adler, Mansi, and Pandey 2018; Adler et al., 2017
	Biodiversity Offsetting	Calculation of an overall biodiversity net loss/gain	Tregidga, 2013; Cuckston, 2019
	Natural Inventory	Operationalise the reporting of corporate natural assets	Jones, 1996; 2003
	Extinction Accounting	Encouraging corporate accounts of species extinction	Atkins and Maroun, 2018; Atkins at al., 2018; Maroun and Atkins, 2018
	Certifications	Critique the Forest Stewardship Council's (FSC) certification scheme	Elad, 2014
Individuals	Biodiversity Recording	Highlight the role of volunteer engagement in recording nature	Christian, 2014

As visible in Table 2.1 above, extant research on biodiversity accounting – while still being predominantly centred on corporations – has explored a broad range of diverse accounting entities and accounting practices. With the majority of research critiquing the corporate centred biodiversity accounting research proposing to focus on alternative accounting entities, such as the individual, ecosystems or the planet, the current literature has explored a broad range of perspectives on biodiversity accounting. As such, alternative accounting practices have been explored and established accounting practices have been critiqued within that stream of alternative literature, leading to a variety of aims being pursued.

2.6 Summary

This chapter has critically analysed the current literature relevant to the research topic and questions examined within this thesis. By outlining the historical development of the field of biodiversity accounting, this chapter has highlighted how the institutionalisation of environmental accounting ideas into Business Schools and Accounting Departments has led to a shift away from the early focus of the field on interdisciplinary research outside of traditional organisational boundaries towards research on core accounting themes such as annual disclosure, assurance or financial accounting (Gray and Laughlin, 2012; Bebbington et al, 2014).

While concerns about biodiversity loss are becoming increasingly prominent within the accounting literature, literature on biodiversity accounting is still rather limited (Gaia and Jones, 2017). In line with a traditional accounting focus, most of the extant research on biodiversity accounting has focussed on corporations and for-profit organisations and their ways in making biodiversity issues visible (Jones and Solomon, 2013). As visible in Table 2.1, this stream of literature has been particularly occupied with routine descriptions of corporate disclosure and reporting practices and overall concluded that corporations engage in fairly limited biodiversity reporting (Atkins, Grabsch and Jones, 2014; Boiral, 2016; Rimmel and Jonäll, 2013; van Liempd and Busch, 2013). Along similar lines, studies on public sector biodiversity reporting practices have highlighted a lack of useful disclosure practices within the examined local authorities (Barut et al, 2016; Schneider et al., 2014).

With the biodiversity accounting literature being focussed on corporations and individual public sector organisations, one accounting entity that is vastly absent from the literature have been national governments. Even though national governments have been acknowledged by the UN (2015) as primarily responsible for addressing sustainable development challenges such as biodiversity loss, the question of how national governments can construct accounts of their biodiversity performance has not been explored within the literature so far. Additionally, extant biodiversity accounting literature has lacked a focus into how accounts of biodiversity – whether corporate, public sector or national – have been constructed and the work necessary to render biodiversity calculable.

By highlighting how the accounting for biodiversity literature is predominantly focussed on drawing a distinction between anthropocentric and ecocentric framings of biodiversity, this chapter has also outlined the two main underlying philosophical framings and their influence on accounting for biodiversity research. Overall, this literature review has reasoned that even though this distinction is important in terms of understanding the relationship between humans and nature, it does not necessarily help to understand how accounting can support biodiversity conservation. Instead, this chapter argues that research into accounting for biodiversity should start by seeking out conservation work and subsequently analyse how accounting tools and techniques have enabled this work to take place (Cuckston, 2018c; Feger et al., 2018). By focussing on ecology-centred accounting, forms of organising human and non-human actors can be understood and explained in ways that can enable biodiversity conservation to take place.

One approach that has been promoted extensively within the conservation and public policy literature in order to measure biodiversity performance and influence policy agendas has been the construction and implementation of biodiversity indicators. So far, biodiversity indicators as a tool to account for biodiversity performance have not been explored within the SEA literature (with the only exemption being Thomson, 2014; Russell and Thomson, 2014). While Thomson (2014) predominantly focusses on analysing the relationship between the chosen indicators and the underlying strategic goals, no research so far has actually tried to understand how biodiversity indicators have been constructed in the first place. Understanding how biodiversity can be rendered calculable will provide important insights into the question of how accounting can make conservation possible. Additionally, understanding how and by whom biodiversity indicators are being used will provide important insights into the question of how accounting for biodiversity can support conservation efforts and as such contribute to the challenge of halting biodiversity loss.

Lastly, the notion of imperfect performance measures has not been widely explored within the existing biodiversity literature. As such, a gap exists within the literature between the analysis of existing biodiversity accounting practices – often critiqued as flawed within the literature – and the question of how these practices became accepted by the actors involved. Thus, understanding how biodiversity measures have been constructed in the first place will also provide an insight into how actors cope and make do with imperfect biodiversity measures and the effect biodiversity indicators have on actual conservation performance.

CHAPTER 3. FRAMING AND OVERFLOWING

3.1 Introduction

In the previous chapter, relevant literature on biodiversity accounting was reviewed. This chapter highlighted how the biodiversity accounting literature, up to this point in time, lacks a convincing explanation on how accounting for biodiversity can actually support biodiversity conservation. According to Gray and Milne (2018, p. 831), "species extinction, as with other examples of environmental degradation, is a systematic consequence of humanity and its current ways of organising". As a consequence, Cuckston (2018b) highlights the imperative of researchers seeking to understand the relations between humans and other species on earth, in order to be able to understand how these relations can be re-organised to make conservation possible. This level of conceptual and theoretical explanation of human-nature relations and the way they are organised will enable accounting researchers to contribute to conservation (see further Cuckston, 2018b; Russell, Milne and Dey 2017). So far, Cuckston (2018b) critiques that accounting for biodiversity research has – while being driven by a shared concern about global biodiversity and passionate to solve this ecological crisis – lacked a theoretical rigour that ultimately enables this research to make a substantial impact on biodiversity conservation (see further Bebbington and Unerman 2018; O'Dwyer and Unerman 2016).

Aiming to introduce a theoretical lens that can support the understanding of how accounting can enable biodiversity conservation, the following chapter will present the theoretical framework deployed within this research. By outlining the twin notion of framing and overflowing and the concept of calculability (Callon, 1998a; Callon and Law, 2005) the subsequent chapter will provide the theoretical grounding for the empirical findings emerging from this case study. Section 3.2 will introduce the theoretical concepts of calculability, framing and overflowing. Subsequently, section 3.3 will highlight how the theoretical concept of framing and overflowing (Callon, 1998a) has been previously used within the accounting literature, particularly focussing on the discipline of environmental accounting. Afterwards, section 3.4 will outline the implications of adapting this theoretical framework before section 3.5 will provide a summary of the chapter.

3.2 Achieving Calculability

> "Calculation and agency are two sides of the same coin. The agent-network is by construction calculative, but calculativeness could not exist without calculating tools, most notably the lowly and often disclaimed tools of accounting." (Miller and O'Leary, 2007).

A basic tenet of research into accounting as a social practice – including research into accounting for biodiversity– is that accounting does not simply record reality (Hopwood and Miller, 1994). Instead, accounting actively constructs and transforms the reality it purports to represent (Hines, 1988; Miller and Power, 2013) and can therefore be understood as a "productive force" (Miller and Power, 2013, p. 558). In line with that assumption, Callon (1998b, p. 23) states that "the most interesting element is to be found in the relationship between what is to be measured and the tools used to measure it. The latter do not merely record a reality independent of themselves; they contribute powerfully to shaping, simply by measuring it, the reality that they measure".

Thus, the hope that lies behind accounting for biodiversity research is that accounting can be used to make biodiversity challenges visible to organisations in ways that enable forms of thought and action conducive to addressing these challenges (Unerman and Chapman, 2014). By constructing spaces of calculability accounting is enabling people to think about their own agency – their ability to act (Miller, 1992; Miller and O'Leary, 1987; Power, 2015). The question therefore becomes, how are these spaces of calculability framed and constructed? And how do these spaces of calculability enable action and agency?

3.2.1 Framing

A powerful way of analysing the capacity of accounting to construct and transform reality is offered by Michel Callon's (1998a) concept of framing a calculable space. Underpinning this concept is the idea that calculation involves complex socio-technical arrangements of human beings and material devices, including calculating tools. To make sense of this, Callon makes use of Goffman's (1974) metaphor of framing, whereby a socio-technical arrangement is understood to frame a space in which certain forms of calculation become possible. According to Goffman, interactions are organised within boundaries and their sets of "entities, postulates and rules" (Goffman, 1974, p. 21). These boundaries act as implicit frameworks in everyday interactions of actors. According to Callon (1998a), the framing process is grounded on diverse organisational and physical devices and is not just dependent on human actors. Therefore, objects and devices are part of the establishment of these boundaries (Callon, 1998a).

Overall, a frame refers to all material arrangements that set up a boundary in which the interaction between actors takes place. Similar to Goffman's (1974) notion of a theatre building where material devices such as the stage or curtains are part of the frame, accounting devices can also create such a frame. Within such a frame, some things are brought in and some things are excluded, such that actors can see and comprehend the world in ways that enable them to judge possible courses of action and the potential consequences of these actions. For instance, by constructing a set of biodiversity indicators, a boundary is drawn between biodiversity indicators taken into consideration and the ones left outside. Based on this set of indicators, government interventions and policies will be decided and assessed on, as opposed to the indicators that have been excluded. Thus, the boundary drawn will establish a set of definitions and assumptions of biodiversity which are then taken for granted in the implementation of biodiversity into practice. According to Callon (1998a), the frame created makes the calculation of the outcomes of interactions possible. Neither the actors nor the outcomes can be taken for granted as stable entities or ready-made (Mouritsen and Thrane, 2006). Instead, the outcome as well as the actor has to be understood by the interaction between them (Granovetter, 1985).

3.2.1.1 Achieving agency

A main aim of the framing process is the construction of a space of calculability and a mechanism for framing such a calculative space is an agencement (Callon, 2007). The taken for granted assumptions and calculations within this frame are rooted within human beings and material devices that established the frame collectively. Since those framing boundaries have to be established in order to define ideas and issues that are taken inside or kept outside the frame, constructing the calculative space is work intensive (Callon and Muniesa, 2005; Callon, 2016). Overall, the calculative devices as well as human actors that comprise the agencement are setting the boundaries of the nature of the calculative space and consequently the forms of calculations that take place within it. Thus, agency should be treated as a collective achievement and therefore the network of relations which equip and embed their world view and enables them to act has to be looked at in order to analyse the agent's capacity to act and calculate (Callon, 1998b). Following, the capability to act (MacKenzie, 2009) of any socio-technical arrangement depends upon how it frames a calculable space, using an assemblages of calculative devices.

According to Muniesa et al. (2007, p. 2) calculative devices are "objects with agency":

> "[D]evices do things. They articulate actions; they act or they make others act" (p. 2).

Following, agency has to be seen as a collective achievement which can only be understood by looking at the relationships and networks in which the actors are embedded as these make actor capable of organising information in ways that enable action (Callon, 1998a)

This understanding of calculative agencies forms the base of conceptualising accounting as embodied in numerous material devices which frame the calculative space of agencements. Therefore, calculation and agencies are dependent on each other since calculation cannot exist without the calculation devices, for example accounting tools (Miller and O'Leary, 2007). In this way, agencements define the forms of possible calculations by defining the nature of the calculative space (Cuckston, 2017). Agencements are therefore "arrangements endowed with the capacity of acting in different ways depending on their configuration" (Callon, 2007, p. 320).

Building on this, Miller and O'Leary (2007) point out that understanding calculative agency, as something that emerges from an assemblage of humans and devices, offers the possibility to conceptualise accounting as influential in creating action. Accounting, as being embodied within material and calculative devices, thus defines the calculative capabilities of agencements.

3.2.1.2 Framing a calculable space

In order to construct spaces of calculability, Callon (1998b) lists three problems that have to be faced. First, if relations should be brought into account, their material reality has to be identified and a tangible object has to act as a medium between the actor's interactions. Thus, framing processes are centred on a special object, which can be seen as a central dimension of the interaction (Callon, 1998a; Slater, 2002; Beckert, 2009). In cases where a pre- or easily defined product or object is the centre of the interaction, the object's relevant properties can be effortlessly agreed on by the parties involved, which is mostly the case for physical and standardized products. In contrast, indicator sets and measures on biodiversity and biodiversity conservation are constructed around something with less specific dimensions and a broad set of definitions. Therefore, specific challenges are raised in order to frame the measurement of biodiversity and biodiversity conservation.

The second problem concerns identifying the agents, which is linked with the identification of their reality material to the relation. Before this, actors may not be conscious about the nature of their relations with others. Thus, identifying the agent is ultimately linked with the identification of the materiality of the relation between them.

The third problem that has to be faced in order to create calculability is the construction of a metrological framework in order to measure the relations effects. In order to compare the effects, mechanisms to quantify them have to be established. Overall, these three problems of calculability (Cuckston, 2018c) are therefore an essential part of the framing process.

3.2.1.3 Achievement of calculation

The work of framing a calculable space is further articulated by Callon and Law (2005), who define the achievement of calculation, within a framed space, in terms of three stages:

> **"First, the relevant entities are sorted out, detached, and displayed within a single space.** Note that the space may come in a wide variety of forms or shapes: a sheet of paper, a spreadsheet, a supermarket shelf, or a court of law – all of these and many more are possibilities. **Second, those entities are manipulated and transformed.** Relations are created between them, again in a range of forms and shapes: movements up and down lines; from one place to another; scrolling; pushing a trolley; summing up the evidence. **And, third, a result is extracted.** A new entity is produced. A ranking, a sum, a decision. A judgement. A calculation." (Callon and Law, 2005, emphasis added).

The framing of a calculable space, therefore, requires consideration of each of these three stages. If a national government seeks to pursue a challenge like biodiversity loss, then three questions, corresponding to these three stages, will need to be answered. Firstly, what entities are to be brought within the framed space? For the challenge of halting biodiversity loss, this means deciding what kinds of biodiversity data are going to be included. Secondly, how are these entities going to be manipulated and transformed within the space? In the case of biodiversity, this means deciding how this data will be combined and turned into useful measurements of performance in relation to addressing biodiversity loss. Thirdly, what kind of result will be extracted; what new entity will be produced? This means deciding how these measurements of biodiversity performance will be reported. By exploring the process of detachment, transformation and extraction of data sets into UK Biodiversity Indicators, this thesis offers insights into how a national government has framed and is framing a space in which their performance in relation to biodiversity is rendered calculable, enabling the formulation of their biodiversity conservation policies.

By redefining the process of a calculation Callon and Law (2005) argue that quantitative calculations and qualitative judgement should be understood in the same terms and the distinction commonly drawn between them should be resolved. Consequently, and following the work of Cochoy (2002), Callon and Law suggest the use of the terminology 'qualculation', highlighting how qualitative and quantitative elements come together in calculations. Thus, spaces should be evaluated based on the question on whether they enable 'qualculation' – i.e. calculation and judgement – rather than separating the two processes. Going forward, this thesis will use the term calculation synonymous with the concept of qualculation, i.e. bringing together quantitative and qualitative dimensions of calculative processes.

3.2.2 Overflowing

Whereas the notion of framing enables the identification of actions taken and the actors involved in stabilising relationships between parties, the notion of overflows establishes the idea of an incompleteness of the frame. Callon (1998a) refers to overflow as a sociological amendment of the economic concept of positive and negative externalities. It takes the original concept of situations lacking accounting for external relations, like costs, further by highlighting how attempting to internalise these existing externalities led to additional externalities. According to Callon (1998a), framing has to be seen as a never completed process. Therefore, internalising all externalities is impossible and as Callon states: "Overflows are the norm and framing is expensive and always imperfect" (Callon, 1998a, p. 252). This contrasts the economists' view of imperfections being accidental and an exemption as well as the way externalities are treated as market failure in the classical economic approach. To illustrate the normality of overflows, Callon (1998a) mentions a research contract to frame the interactions between a company and a university which defines and structures the elements of the interaction. This contract automatically leads to possible controversies and overflows as the research progresses over time for example if staff transfers to the other contractual party. Even if the actors involved strive to complete the framework and to internalise all externalities, they will not be able to succeed in this attempt, due to conduits provided by the terms of the contract. Due to such overflows, new agencements and spaces of calculability can be constructed (Revellino and Mouritsen, 2015) and the impossibility of internalising all overflows highlights that any reframing will automatically create new possibilities for overflows to emerge. Thus, framing will inevitably lead to a perpetual framing-overflowing circle where new agencements and calculative arrangements emerge and replace current frames (Callon, 2007).

Besides just identifying overflows, it is also important to identify who is responsible for them and who is affected by them (Callon, 1998a). Moreover, framing agents might try to contain overflows, as they are threatening the framing attempt (Callon, 1998a). In addition, measuring overflows could lead to a following reframing process of interactions.

According to Callon (1998a) two types of overflows exist. First, actors are not able to account for everything relevant or everything that may turn out to be relevant in their framing process. In addition, the second probable sources of overflow are the structures, actions and techniques used by the actors in order to frame the relationship. The prerequisite in order to design calculative devices is to reduce complexity and to disentangle relationships, which

Callon (1998a, p. 249) describes as “bracket[ing]” the outside world. If forced back into the debate, everything which has been bracketed before can be actualised during the framing process. For example, Callon (1998a) highlights how strong actors forced environmental considerations into the calculations during the framing process. Following this argument, disentanglements are potential sources of overflows. Therefore, it is necessary to not just analyse the actions that facilitate the interaction examined, but in addition to see how these actions are built on disentanglements. On the other hand, measures implemented to reduce the risk of overflows can be at the same time causes of overflows. In their framing process, actors make use of various elements and actions, for example contracts, measurements and definitions. These elements can be sources of overflows, for example a contract can make it easier to predict the actions of the other parties and ties the actors together. On the other hand, it provides the backing of a legal system in which overflows are created.

3.3 Framing within the accounting literature

The concept of framing a calculable space has been influential within the accounting literature, particularly by explaining how accounting is used to simultaneously define and measure organisational performance (Miller and Power, 2013). Skaerbaek and Tryggestad’s (2010) paper examines the role of calculative devices, such as value investment appraisals and net present value investments play in formulating and performing corporate strategy. Rather than being set up in response to the strategic framing, Skaerbaek and Tryggestad (2010) highlight that these calculative devices are integral to the production process as they create conditions enabling the framing of the strategy in the first place. They outline how the availability of a specific calculative device defines the boundary of what is considered to be inside or outside of a possible strategic frame or intervention. Simultaneously, by setting up this inside/outside boundary, the strategic framing creates the condition for possible overflow. By defining issues as outside of the frame and therefore incalculable, it enables efforts to obtain calculative equipment that allows those issues to be brought inside. As such, this paper uses Callon's notion of performativity to highlight the contingent nature of strategy by extending the question of who a strategic actor is into the question of who or what – in terms of accounting devices – is part of the reformulation of strategy. Additionally, this paper draws on Callon's (1998a) notion of overflow to show the performative link between the development of strategy and calculative equipment. Concluding, Skaerbaek and Tryggestad (2010, p. 122) point out that their findings has resulted in them understanding "strategy as an emerging calculative collective and temporary achievement".

Likewise, Kornberger and Carter's (2010) research on the response of city managers on various city rankings has highlighted the influence of calculative devices on strategic decision making. According to them, these ranking devices and their embodied accounting calculations enable direct comparisons between cities by reducing intricate differences between cities into a clear-cut set of quantifiable qualities. By doing so, they establish a priori conditions – "rules of the game" (p. 340) – enabling cities to compete, which as a result frame strategic decision made by city managers. These results have been echoed by Espeland and Sauder's (2007) work on law school rankings. Their work on the "transformation of qualities into quantities that share a metric" (p. 16) highlighted how these rankings influenced managers' decision making.

> "Commensuration shapes what we pay attention to, which things are connected to other things, and how we express sameness and difference (p. 16)."

Therefore, ranking devices' constitutions of calculative spaces influence actors' own understanding of their agency and therefore possibilities for action (see further Jeacle and Carter, 2011; Pollock and D'Adderio, 2012).

In this sense, the ability to set organisational objectives, goals, or targets, the ability to know what the organisation is seeking to achieve, is intimately tied up with the socio-technical arrangements used to measure performance (Miller, 2001). Consequently, rather than first laying down policies and then seeking to measure performance, the ability to formulate policies and make decisions is deeply entwined with the building of performance measurement infrastructure (Power, 2015; Skaerbaek and Tryggestad, 2010; Kornberger and Carter, 2010; Jollands and Quinn, 2017; Georg and Justesen, 2017). As such, rendering the UK's national biodiversity performance calculable will be inherently intertwined with the UK's capacity to formulate biodiversity strategies and policies. Thus, the way the UK Biodiversity Indicators Report has been constructed will inherently influence the UK's ability to develop policies enabling biodiversity conservation work.

Additionally, Callon's (1998a) framework has been applied in various accounting research to highlight how accounting numbers do not just represent situations, but also perform them. In that sense, Kastberg (2014) argues that accounting is causing stabilisation and destabilisation, by simultaneously being a framing device and a source of overflow. As such, Kastberg (2014) uses Callon's (1998a) notion of framing and overflowing to observe how accounting and control – while contributing to the stabilisation of relationships – also became a source of overflow by reconnecting previously separated issues and cutting of relations through disentanglement.

Additionally, Vinnari and Skærbæk (2014) have examined how multiple frames can be linked and how their interaction can create unexpected dynamics. Focussing on Callon's notion of economic performativity within the area of risk management, they argue that framing devices establish links to other frames and as a result risks cannot only be managed within one specific frame. In doing so, Vinnari and Skærbæk (2014) extend the notion of accounting as performative and argue that "inscription devices not only offer conduits for overflows but also assume an active role whereby they become involved in reconfiguring the duties and interests of actors who are equipped with them" (p. 518).

Besides the idea of performativity, Callon's (1998a) and Goffman's (1974) notion of framing has been the basis for Vollmer's (2007, p. 583) concepts of "reproductive" – thus regulated by rules of calculation – and "consumptive" – thus as "indicators of information and meaning" (p. 583) – frames. Focussing on the mean-making process for accounting numbers, Vollmer highlights how accounting plays a role in ordering social situations by differentiating consumptive and reproductive usages of numbers. Within his paper, Vollmer concludes that framing enables numbers to combine calculative, existential and symptomatic characters and as such order social situations.

An overview of the use of framing and overflowing within the accounting literature can be found in Table 3.2.

Table 3.2: Overview of the use of Framing and Overflowing within the accounting literature

Paper	**Question asked**	**Findings revealed**	**Use of Framing and Overflowing**
Christensen and Skærbæk (2007)	"What influences the success, failure or imperfection of accountability innovations?" (p. 103)	Public sector accountability innovations (accountability report) produced overflow as expected users failed to get benefits from the reports.	Focus on the mobilisation of actor-networks and the construction of entities. Highlighted the framing of the involved actors by an accountability frame. Identification of overflows and the conversion of the accountability frame into a resource frame.
Vollmer (2007)	"How can the manifest transformative effects of proliferating numbers across situations be aligned with the fact that social order arises (evolves, deteriorates, reproduces, recoils) fundamentally within social situations? If the use of numbers changes social situations, in what sense do ongoing social situations conversely transform the use of numbers as well as the informations and involvements which the numbers come to represent?" (p. 579)	Numbers –in contrast to writing – acquire a three-dimensional character, including calculative, existential and symptomatic qualities, through framing and keying.	Goffman's (1974) method of frame analysis. Framing as fundamental social process to manage the use of numbers between interacting actors.
Lohmann (2009)	"Can restating current controversies over environmental accounting in terms of	The paper highlights how carbon accounting tools frame new relations, spaces and agents. It	Calculative devices are considered as necessary to frame markets or market-like spaces.

	the metaphor of framing and overflowing rather than the metaphor of territories, boundaries and essentialized objects lead to new insights and resolutions?" (p. 503)	concludes that the concept of framing and overflowing can enable a better engagement between critiques and defenders of carbon accounting techniques by providing new challenges and narratives to the existing debates.	Framing has been described as inherently imperfect and as only possible by creating overflows that carbon accounting tools were unable to account for.
Callon (2009)	What is "the nature of the [carbon] markets that should be setup and their forms of socio-technical organization [?]" (p. 535)	Carbon markets are affected by ongoing controversies and refinement. As such, they are continuing experiments and further understanding of how to civilize markets is needed.	Markets as ongoing experiments. Framing/ overflowing necessary to define the qualification of goods and to construct the calculative equipment.
Skærbæk and Tryggestad (2010)	Can "accounting devices […] assume other roles, apart from subordinating themselves to strategy during the implementation of the latter?" (p. 108)	Accounting devices can change, reject or defend corporate strategy development through the mobilisation of concerned groups. As such, accounting plays an active role in formulising and configuring strategy and strategic change.	Framing and overflowing is used to highlight the contingent nature of accounting and strategy. Non-human actors – e.g. accounting systems and report – can take an active role in formulating or reshaping strategy and strategic actors are closely linked to calculative devices. As such, calculative devices actively reshape strategy.
Kastberg (2014)	"How [can] accounting and control contribute to both the stabilization and the destabilization of [horizontal organizational relations (HORs)?]" (p. 744)	Accounting and control does not only function as a stabilisation device through framing but also becomes a source of destabilisation through overflows. Overflows were caused through the reconnection of earlier separated relations and the disentanglement and subsequently cutting off of relations.	Framing and overflowing used to highlight the establishment of relationships and entities, the instability of these relationships and the effects of the framing attempt. As such, framing is treated as a source of stabilisation and overflow as a source for destabilisation.

Vinnari and Skærbæk (2014)	"What types of effect do risk management systems generate while being implemented?" (p. 490)	The paper concludes that risk management itself resulted in unexpected uncertainties that would not have been created otherwise. Additionally, the paper highlights the linkages between multiple frames and the dynamics emerging through these linkages.	Focus on risk management as a socio-technical network that creates sources of overflow. As such, the paper emphasises Callon's work on economic sociology and economic models in facilitating market transactions.
Ferreira (2017)	"How [can] accounting for biodiversity […] be employed as a mechanism for creating market-like biodiversity governance mechanisms [?]" (p. 1568)	Impossibility of stabilising the assemblages necessary to construct the biodiversity market due to ongoing disagreements between the actors involved and the continued entanglement between the project and existing biodiversity. Thus, the lack of stability resulted in the eventual demise of the market due to the difficulties of establishing an assemblage providing a stable market infrastructure. However, individual components of the offsetting market lived on and have the potential for interacting with existing regimes and the creation of new assemblages.	Focus on framing as a market construction device in which actors have to be equipped with calculative tools in order to set up a market. This is made possible through the construction of rules, devices and mechanisms allowing the identification and quantifications of non-market externalities in order to make them part of the actors' calculation.
Georg and Justesen (2017)	"How [was] environmental accounting […] framed and, in turn, helped assemble the design of a new 'green, zero-energy' building [?]" (p. 1066)	Accounting has been highlighted as having a strong performative role in enacting possible future scenarios and entangling nature and architecture. The process of environmental accounting has been described as	Focus on the construction of a space of calculability. As such, the concept of framing and overflowing was used to understand the process of determining the object that had to be rendered calculable, the methods used to calculate it

		complex if the object of the accounting process has to be agreed on and framed in ways that allow the establishment of a calculative space. As such, the process of establishing that object is ongoingly contested and results in the production of overflows.	and the boundaries drawn around the object. The notion of 'hot' situations was drawn upon to describe a highly contested framing process leading to ongoing overflow.
Cuckston (2018a)	"How has the UNFCCC sought to construct a socio-technical arrangement that frames a space of calculability in which the calculation of financial value for tropical forests has been made possible?" (p. 222)	It is only through disentanglement that the relationships between nature and humans can be framed. As such, the alienation of humans from nature is a result of the necessary disentanglement essential to create conditions that enable the calculation of a financial value of nature.	Focus on systematic disentanglement, including detachment and separation, of the human-nature relationships. As such, detachment seen as necessary to allow a financial value of nature to be rendered calculable.
Cuckston (2018c)	"How is the prevention of species extinction made possible by calculative devices?" (p. 850)	The overflow created through the calculative devices constructed within the Red List have created prospects for calculative innovations. Overflows have enabled the construction of new agencements capable of supporting biodiversity conservation efforts.	Use of the concept of agencements-e.g. the capacity to act as being dependent on a collective achievement of a socio-technical assemblage of human and non-human actors (calculative devices) in order to frame spaces of calculability. Focus on the three problems faced Callon 1998b) when framing a calculative space and the role of calculative devices in enabling overflows. Overflows as creating conditions for calculative innovations that frame the calculative space in

			different ways and lead to new agencements.
Cuckston (2019)	"How should losses and gains in biodiversity be made commensurable such that calculation of a net loss/gain becomes possible?" (p. 1360)	The Biodiversity Offsetting Scheme examined framed a calculative space of biodiversity in a way that enabled an ecologically defensible net loss/gain calculation. This was achieved by capturing overflow created by conservationists' concerns within the calculation.	Overflows to the framed space were identified within the academic literature and reframings of the calculative tools to capture these overflows were traced.

To summarise Table 3.2, the notion of framing and overflowing (Callon, 1998a) has been used predominantly in two ways within the accounting literature. First of all, framing and overflowing has been used to highlight the performativity of accounting (e.g. Christensen and Skaerbaek, 2007; Skaerbaek and Tryggestad, 2010; Kastberg, 2014; Vinnari and Skaerbaek, 2014; George and Justesen, 2017; Cuckston, 2018c) by outlining how the framing of any accounting device leads to the production of unintended consequences – according to Callon 'overflow'. As such, accounting is not a neutral or passive tool, but rather shapes and frames relations, strategy, innovations and future scenarios. On the other hand, framing and overflowing has been used to examine the construction of markets (for example Lohmann, 2009; Callon, 2009; Ferreira, 2017) and as such has been deployed in order to understand the configurations and assemblages necessary to construct environmental markets.

Thus, the existing accounting literature has deployed the concept of framing and overflowing to study calculability at the level of organisational accounting and at the level of constructing market mechanisms. However, the literature so far has not addressed the work that goes into constructing such a calculative framework or the usage of the calculative outcome provided through framing and overflowing.

3.3.1 Framing environmental concerns

Within the environmental accounting literature, the concept of framing has been predominantly used to examine the construction of markets aimed at addressing global environmental issues. Following Callon's (1998a) ideas on making interactions between market participants calculable, various construction processes of environmental markets have been outlined.

One example of this has been the field of carbon accounting. Studies within this stream of literature have examined how carbon accounting efforts can render the challenge of climate change visible in ways that enables society to address the problem. Similarly, to research in accounting for biodiversity, research on accounting for carbon is facing each of Callon's (1998b) three problems. Firstly, international assemblages of calculative devices and human actors are ongoingly constructed aiming to define greenhouse gases. Secondly, the agents responsible for greenhouse gas emissions have to be specified. Thirdly, a metrological framework measuring the impact and effects of various activities on climate change has to be constructed (Lohmann, 2009).

Furthermore, MacKenzie (2009) highlights how the effort to render emissions of various greenhouse gases calculable, in ways that allows their impact upon global warming to be articulated in the same currency, relies on contested data and relations. He finds that once the outcomes of this process are written into final conversion tables, they are taken on unquestioned and factualised by carbon market participants. In that way, this calculative device enables new actors to frame strategies on how to participate in carbon markets. Concluding, MacKenzie (2009) proposes that by constructing (re)frames of human activities that create novel possibilities to address climate change, characteristics of our current market system "can be changed by changing the calculative mechanisms that constitute it" (p. 441).

By building on these findings, Cuckston (2013) examines a tropical forest conservation project and highlights how calculative devices for carbon accounting have played a role in creating new conservation actions to protect the tropical forest and its inhabitants. By rendering the forest calculable and economically framing it in terms of carbon content, the communities dependent on the forest managed to construct new agencements that ultimately benefitted its conservation. Nevertheless, Cuckston (2013) also notes how this new carbon accounting frame also led to new overflows. For example, conservation groups have been anxious that framing forests based on carbon could ultimately result in replacing natural forests with more carbon dense, but less biologically diverse, plantations. Efforts to contain these overflows eventually resulted in the creation of new calculative devices, including carbon credit certification standards for forests.

Lastly, Vesty et al. (2015) studies a public utility company and the way that carbon accounting numbers were integrated into their management accounting calculations and systems (for example within net present value calculations). By doing so, calculations of organisational impact on climate change became part of the organisational decision making on capital investment. Within their study, Vesty et al. (2015) show how calculative devices can become detached from their original purpose and how they can be reattached somewhere else with a new purpose in ways that we unpredictable at the start of the project. Consequently, calculative devices can evolve over time making the construction process of a device chaotic and complex.

Besides the examination of carbon markets, Ferreira (2017) examined the failing of the UK biodiversity offsetting market using Callon's (1998a) ideas on market framing. Drawing on Callon's (1998a) idea that calculative devices have the role to quantify and measure non-market entities to frame them in ways that allows them to be turned into market commodities, his research highlighted how the existing standards to account for biodiversity could not disentangle biodiversity from the physical nature to successfully turn it a market commodity.

Additionally, the notion of framing and overflowing has been applied to understand how controversial environmental performances can be made measurable. For example, Georg and Justesen (2017) examine how numbers and calculations played a role in constructing a 'zero-energy building'. Drawing on Callon's notion of 'hot' situations (1998a), they show how energy accounting is messy and any framings became subject to ongoing overflows. Additionally, the analysis highlighted how accounting inscriptions were not just mobilised at different times within the process, but in turn also mobilised different either not yet considered or already rejected ideas.

The challenge of biodiversity conservation and halting biodiversity loss is hugely complex, with the scale and complexity involved making it a daunting task society is facing (Kolbert, 2014). So far, it is unclear to what extent society has the capability to prevent species extinction and to act on biodiversity conservation (Gray, 2010).

Asking how accounting for biodiversity can equip actors with agency to act and conserve biodiversity, Cuckston (2018c) has analysed the construction of the Red List as a calculative device that has the capability to act as an agencement. He argues that the calculative space created through the Red List produced agencements favourable to conservation by constructing collective conservation capabilities. His research particularly highlights how overflows have enabled the construction of new agencements and calculative innovations creating opportunities for conservationists. By drawing on Callon's (1998a; b) framework, Cuckston (2018c) argues that accounting for biodiversity can create conditions enabling biodiversity conservation by framing spaces of calculability and thus acting as a productive force (Miller and Power, 2013).

Following that argument, this thesis argues that the capability of a national government to address the challenge of biodiversity loss, thus depends upon how it is able to frame a space in which this challenge becomes calculable, such that the government can see and comprehend possible courses of action. Governments make extensive use of quantitative performance indicators to frame the task of governing (Miller, 1990). This includes rendering the challenges of biodiversity loss calculable in ways that enable the formulation of strategies and policies to address these challenges (Russell and Thomson, 2009). In rendering the biodiversity challenge calculable, a national government is identifying an objective for governing and defining how its own performance in relation to this objective is to be understood and measured. Thus, rendering calculable the challenge of halting biodiversity loss means framing a space in which the government's performance in relation to this challenge can be defined, measured and transformed. How biodiversity loss is framed will, therefore, have a significant impact on a government's capability to address it.

3.4 Implications of the framework

In operationalising Callon's (1998a) thoughts on framing, overflowing and calculability, this research sets out to explore how national biodiversity performance can be made calculable and thus be displayed in an account of national biodiversity. Incorporating this theoretical framework will enable the prediction and explanation of the empirical findings of this research as well as the conceptualisation of the result in a broader context. Following, the next paragraph will outline the implications of this theoretical framework as well as provide possible predictions of how an accounting for biodiversity system would look like according to Callon's (1998a) and Callon and Law's (2005) framework.

First of all, according to Callon (1998a) no individual actor will be able to achieve calculability for a complex and contested issue such as biodiversity. Instead, making biodiversity calculable will involve complex socio-technical arrangements of various actors and devices, including accounting tools, framing the issue of biodiversity conservations in ways that enable calculations to take place. Furthermore, agency to actually achieve biodiversity conservation is not just inherent to any individual organisation, but rather it is a collective achievement for the network of actors and the result of process of achieving calculability. By equipping actors with the ability to make biodiversity calculable it enables them to comprehend biodiversity challenges in ways that allow action and decisions that facilitate conservation. Thus, agency to conserve national biodiversity will not inherently lie within a single national environmental ministries or government agency. Hence, studying biodiversity accounting practices within traditional organisational boundaries often employed within accounting research will not be particularly helpful in this context and instead the focus should be shifted towards a broader network of various actors that work together to achieve calculability. Consequently, this research will not be guided by an a-priori distinction between macro and micro actors imposed at the beginning of the research and it will also not just focus on a single organisational setting. Instead, it will include various groups, organisations and actors involved in the biodiversity accounting process and it will empirically follow their interactions and how they collectively work together to render biodiversity calculable.

Additionally, Callon's theoretical framework also implies that drawing a clear distinction between anthropocentric and ecocentric frames of accounting for biodiversity is virtually impossible. Given that the final calculations are a result of a broad network of actors and devices and their interaction, accounts of biodiversity will most likely be motivated by various identities, aims and objectives of a broad range of actors making the underlying philosophical framing of the final set of measurements messy and less distinct. Thus, national accounts of biodiversity will most likely incorporate ecocentric and anthropocentric elements and cannot be clearly placed within the existing biodiversity accounting distinction in the literature.

Lastly, no account of biodiversity will ever be perfect, complete or stable. Taking Callon's (1998a) notion of overflow into account also means accepting the idea that any biodiversity accounting tool will be inherently temporary and subject to overflows and reframings. As framing biodiversity in ways that allow to take place will always require boundaries to be set, issues to be excluded and challenges being prioritised it will always open up the possibility of overflows. Within a lot of the existing accounting literature, consistency is seen as a strength of an accounting tool whereas inconsistencies are perceived as a weakness (see for example Bowen and Wittneben, 2011 and Andrew and Cortese, 2011 on carbon accounting).

Calculations are set up without overflows being expected or taken into account. But following Callon (1998a), as soon as you make any issue calculable, overflows will occur that either have to be incorporated into the calculation or they will distort the implementation of the calculative practice. Constructing an account of biodiversity therefore is not about getting the measurements right from the start, but rather Akrich et al. (2002) would argue that the focus should be on experimentation and constant adaptations.

> "[T]he real history of innovations does not generally follow a simple schema, to solve the technical problems first and then deal with the market. [Instead], it is made of adaptations, series of trial and error and countless negotiations between numerous social actors, and it is a genuine combat from which conquerors, who know how to choose good representatives, emerge." (Akrich, Callon, and Latour, 2002, p. 207)

Therefore, following Callon's framework on calculability, overflows would be expected when setting up biodiversity accounting systems and ways of internalising them should be thought of and included. Additionally, based on the framework, one would expect any accounting for biodiversity to never be perfect, but rather based on constant reframings of existing calculative techniques.

3.5 Summary

This chapter has outlined the theoretical framework of calculability – including the notion of framing and overflowing (Callon, 1998a) and the three-stage calculative process (Callon and Law, 2005) – deployed within this thesis. In doing so, it has presented a theoretical conceptualisation of the human-nature relation underlying this thesis and provided the theoretical lens adopted to better understand how accounting can enable conservation action.

Starting with the idea of accounting as a social practice, this chapter argues that accounting does not simply represent, but rather actively constructs and transforms the reality it is trying to record. Thus, accounting for biodiversity can empower biodiversity conservation action by rendering biodiversity problems calculable and therefore visible.

By introducing the twin notion of framing and overflowing (Callon, 1998a), a powerful way of understanding how socio-technical arrangements create conditions of possibility for calculation has been presented. Following Callon's (1998a) idea that any calculation requires complex socio-technical arrangements of human and material devices to frame a calculative space, any calculative outcome achieved by this frame has to be understood through the interaction between these various actors. Following, agency is a collective achievement which can only be understood by examining the relations in which the actors are embedded. Subsequently, the capability to act depends on how a calculable space is framed and how embedded the actor is within such a social-technical arrangement. This chapter also introduced Callon and Law's (2005) framework of achieving calculability. By outlining the three-step process of any calculation, Callon and Law (2005) argue that the commonly drawn distinction between qualitative judgements and quantitative calculations should be resolved and any calculation should be better understood as 'qualculation'.

Additionally, the notion of overflows was introduced within this chapter. In doing so, this chapter established the idea of frames being incomplete and imperfect and always resulting in overflows threatening the framing process. Thus, any framing attempt will ultimately result in a perpetual framing-overflowing circle in which new calculative arrangements emerge and reframe current frames (Callon, 2007).

By outlining the use of framing within extant accounting literature, this chapter also outlines the novelty of the theoretical approach within this thesis. While the notion of framing has been extensively used to explain the interactions between strategic framing and performance measurement (Miller and Power, 2013) as well as the creation of environmental markets (e.g. Lohmann, 2009; MacKenzie, 2009; Cuckston, 2013, Ferreira, 2017), the focus of this thesis on bringing together the notion of framing and overflowing (Callon, 1998a) and the three steps of achieving calculability (Callon, 2005) is novel. By focussing on the calculative process as three distinct problems that have to be solved, rather than a linear three step process in which one stage follows the other, this original use of the calculability framework allows this thesis to focus on the micro level work necessary to render biodiversity calculable while also taking macro-level actors into account. As such, it enables the analysis of a complex, messy, multi-organisational calculative process and the conceptualisation of this process as three distinct challenges. Using the notion of framing and overflowing, this thesis also highlights how this process is non-linear, a source of constant overflows and undergoes ongoing reframings. As a result, the novel application of Callon's (1998a) and Callon and Law's (2005) ideas within this thesis extends the current explanatory power of the framework and provides a theoretical contribution in better understanding how ideas of calculability, framing and agency could be used within the accounting for biodiversity or accounting for sustainable development literature .

By focussing on network of actors involved and the work necessary to render a complex problem such as biodiversity calculable, this framework will be useful in overcoming previous philosophical distinctions within the accounting for biodiversity research. Accepting the idea of biodiversity accounting as imperfect and constantly in flux allows this thesis to examine the day to day work of the actors involved in the UK biodiversity accounting work without placing any a priori assumptions about power, politics or philosophy onto them. As such, this theoretical framework allows this thesis to contribute to the existing accounting for biodiversity literature.

CHAPTER 4: METHODOLOGY

4.1 Introduction

According to Ryan et al. (2002) research is defined as a process of intellectual discovery aiming to transform existing understanding and knowledge of the world. Part of that discovery journey is the interpretation and communication of observations, readings, conversation and findings in order to contribute to existing knowledge (Ryan et al., 2002). Within social science research, various ways of understanding the world have been outlined, resulting in numerous ways of research being seen as valid and credible or invalid and unreliable (Johnson et al., 2006). In order to ensure the credibility and validity of the findings and conclusions drawn from within this thesis, specifics of the research methodology deployed within this project have to be unveiled and cannot be ignored. Following Lukka and Modell´s (2010) argument that validity can be achieved by convincing the readers about the authenticity and plausibility of the research, the following chapter is going to unveil this research's hidden assumptions and describe the process of data collection and analysis. Additionally, Crotty (1998) argues that four main questions have to be answered before a research project can be designed. According to him, any researcher has to think about:

1. What epistemology informs the research approach?
2. What is the theoretical perspective of the research?
3. What methodology governs the choice of methods?
4. What methods are proposed to be used?

With the last chapter already introducing the theoretical framework deployed within this project, the following chapter will outline the underlying philosophical assumptions of this project as well as the theoretical framework. In doing so, this chapter aims to outline the nature of this PhD project and its underlying assumptions about the world, the production of knowledge and the role of the researcher. Additionally, this chapter will outline the methodology and methods chosen to answer the underlying research questions. In doing so, it will reflect on the way this research project was designed and conducted.

Following, section 4.2 will discuss the researcher's underlying philosophical assumptions, including the ontological and epistemological assumptions of this thesis. Afterwards, section 4.3 will outline the research strategy before section 4.4 will explain the data collection methods including the case selection, the methods deployed within this research and the ethical considerations underlying this project. Next, section 4.5 will outline the data analysis process before section 4.6 will go into detail about the limitations of this research design. Lastly, section 4.7 will summarise this chapter.

4.2 Underlying Philosophical Assumptions

Even though underlying philosophical assumptions are often hidden in social science research, Creswell (2012) argues for their significance, especially during the design stage of any research project. According to Saunders et al. (2015) the underlying research philosophy influencing the researchers view about the world and the production of knowledge should always guide the decisions around the methodology deployed, as it will influence which methods that are perceived as 'valid' to answer the research questions. As a result, Saunders et al. (2015) argues that it is necessary to reflect on these hidden assumptions before deciding on a specific research design or research strategy. Similarly, unveiling the underlying philosophical assumptions will answer Crotty's (1998) question of the philosophical and epistemological perspective of the research approach.

Ontology refers to the personal assumptions about the nature of reality and what reality consists of, whereas epistemology describes the assumptions about the existence and knowledge of the relationship between the researcher and the field of research. Axiology describes the roles of values within the research and according to Creswell (2007) researchers should acknowledge that "research is value-laden and biases are present" (Creswell, 2007, p. 17). Similarly, Creswell (2007) points out how differences within philosophical understandings will ultimately lead to different questions being asked by the researcher and different methods to be seen as suitable to answer these questions. Therefore, underlying philosophical assumptions have a big impact on a particular research practice (Creswell, 2007) and are therefore important to consider.

Various broad philosophical stances have been identified, described and criticised within the literature (see further Saunders et al., 2015). For instance, a positivistic philosophical stance follows the assumption that research outcomes should be generalisable to wider populations, and credibility and validity can be achieved by focussing on observable and quantifiable testing of theories and hypotheses. Positivists see the world as something that exists independently of the researcher (Sayer, 1992) with the underlying assumption being that "there exists a reality 'out there', independent of observers" (Easton, 2010, p. 120). Along similar lines, direct realism assumes that reality is as we experience and perceive the world, whereas critical realism suggests that reality is influenced by our assumptions about we are experiencing in that moment, rather than an external, objective and observable reality itself.

In stark contrast to positivism, interpretivist philosophies place a strong focus on understanding subjective meanings of social interactions and individuals' perspectives and experiences (Ormston et al., 2013). This view diverges largely from the positivistic focus on objective knowledge (Crotty, 1998) as it rejects the idea of universal laws and objective observations. As individuals perceive the world differently, no objective reality can be observed and interpretivistic research findings do not aim to be generalisable (Saunders et al., 2015).

As an alternative view to these two opposing perspectives, the philosophy of pragmatism places emphasis on the research question that should be informing the methodological decisions taken within a research project. Additionally, it proposes the idea that philosophical positions are not fixed categories researchers have to choose from. Following Tashakkori and Teddlie (1998), philosophical positions can therefore be thought as continuums rather than competing or fixed categories. In line with this assumption, the underlying ontological and epistemological assumptions of this research do not fit within any pre-defined, fixed categories. Rather they show hybrid tendencies between various categories, which will be outlined below.

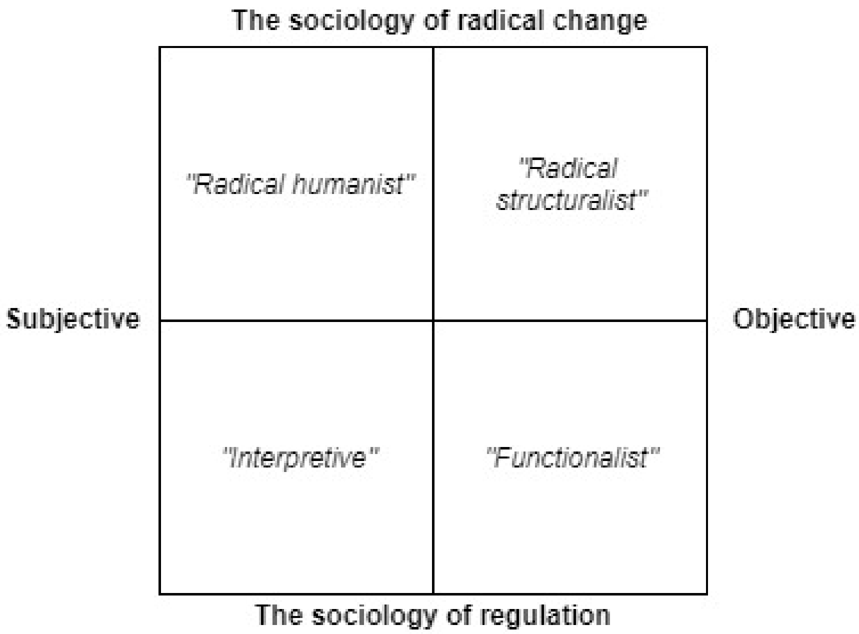
The research design deployed within this thesis was mainly driven by the research questions as outlined in section 1.2. Still, a broad range of underlying philosophical assumptions about reality, knowledge production and the role of the researcher within this have shaped this research project and thesis.

First of all, the methodology deployed within this project is positioned around the perspective of a reflexive epistemological relativism, rejecting the idea that research can be value-free. As the research methodology is designed, the data collected and the results interpreted by the researcher, the findings within this will necessarily reflect the researcher's philosophical assumptions. As a result, these underlying worldviews and biases have to be unveiled and the following sections will outline the ontological and epistemological assumptions that have shaped this thesis.

4.2.1 Ontological assumptions

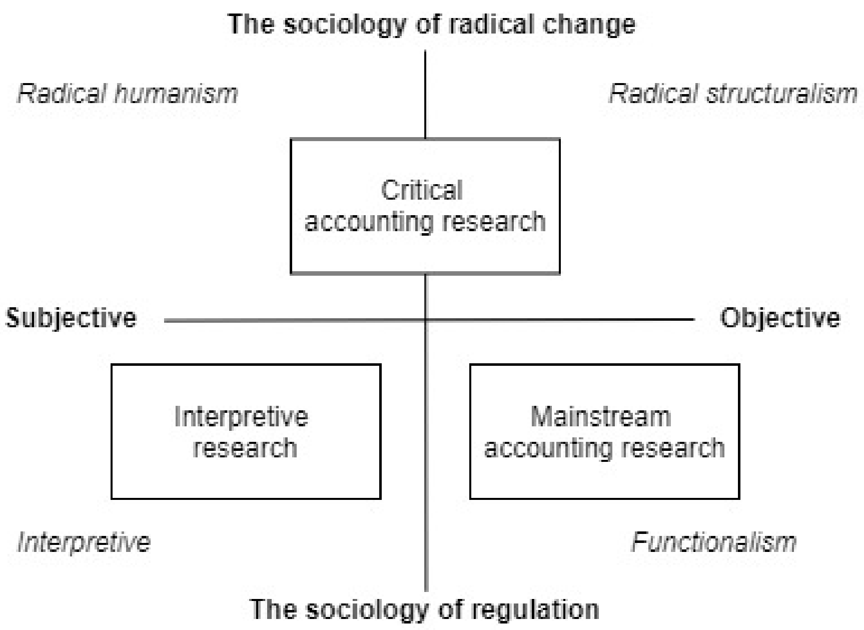
One of the most seminal classification of ontological assumptions in social sciences research is the classification of Burrell and Morgan (1979), who divided ontological assumptions into four distinct paradigms that ‘distinguish between different approaches to the study of organizations’ (p. xii). These paradigms can be illustrated by a two-by-two matrix, where the axes describe a division between objectivism versus subjectivism and between regulation versus radical change. An illustration of this matrix can be found in Figure 4.1.

Figure 4.1: Classification of organisational research (based on Burrell and Morgan, 1997, p. 22)



This two by two classification has been adopted by accounting scholars and distinct accounting research fields have been placed within that matrix. According to Ryan et al. (2002) mainstream accounting research, being mostly based on neoclassical economics, can be placed within the functionalist paradigm combining objectivists and regulatory assumptions. In contrast, critical accounting research can be placed anywhere within the remaining three quadrants, which are radical structuralism (objectivism-radical change), radical humanism (subjectivism-radical change) or interpretive (subjectivism-regulation). A visualisation of this matrix can be found in Figure 4.2.

Figure 4.2: Taxonomy of Accounting Research (based on Ryan et al., 2002, p. 40)



Following the idea of pragmatism and the rejection of classifications using dichotomies and strictly pre-defined categories, this research project's underlying ontological assumptions are best described as hybrids between realist, relationist, constructivist and interpretivist ideas.

The underlying ontological assumption of this project is the existence of a material reality with physically existing actors, which is overall mostly based on realism. Moreover, human beings can be as real and capable of acting as an agent as non-human entities. However, actors are only considered real if they are inside a network of relations and if it affects relations and actors which highlights a relationist ontological view. Furthermore, actors and their identities are seen as dynamic and redefine themselves constantly due to network interactions. On the other hand, subjectivist assumptions such as that theories about the world are endogenous within the actors and cannot be imposed on them. This idea of self-constructed reality of actors also shows a constructivist perspective and support ideas of change and innovation although they are regulated and restricted by existing structures and the existing material reality.

Following the idea of social constructivism, this research treats accounting processes not as natural phenomena but rather as socially constructed. Subsequently, accounting practices can be changed by the actors themselves and rather than seeking to find universal laws and statistical generalisations, this research aims to understand the social structures, rules and behaviours that structure biodiversity accounting practices. Lastly, this project also includes interpretivist ideas, by understanding social reality as "emergent, subjectively created and objectified through human interaction" (Chua, 1986, p. 615). As such, this research project tries to uncover how the actors themselves understand the UK biodiversity accounting process. Thus, the aim of this thesis is to let actors "define the world in their own terms" (Latour, 1999, p. 20).

The underlying ontology of this research can be seen as relatively 'flat'[4], implying a missing a priori distinction between macro- and micro-actors. As mentioned above, the ontological assumption of the theoretical framework deployed within this thesis is that actors are defined by their network of relations. As such, the influence, size or power of an actor is not predefined by particular hierarchal, institutional or structural levels, but rather determined through the actor's embeddedness within a network of relations. Thus, Latour (1996) suggests shifting the

[4] The term 'flat ontology' was first introduced by Manuel DeLanda in 2004. Within his work on the relationship between species and organisms, he described the idea of flat ontology as following: "while an ontology based on relations between general types and particular instances is hierarchical, each level representing a different ontological category (organism, species, genera), an approach in terms of interacting parts and emergent wholes leads to a flat ontology, one made exclusively of unique, singular individuals, differing in spatio-temporal scale but not in ontological status".

focus of research away from multiple scales or layers and towards networks and relationships. As a result, Callon (2002) argues that:

> "You don't need several layers, different layers. You don't need infrastructure and superstructure and embeddedness. You only need places that are connected and the possibility of actors and information to circulate from one place to another one." (Callon, 2002 in Barry and Slater, 2002, p. 293).

However, this ontological assumption does not deny that power and structures exist, but rather that they should not be pre-imposed onto a network or an actor. Instead, structures and relations are being traced empirically and analytically within my research as presented within this thesis.

4.2.2 Epistemological assumptions

As the researcher's epistemological perspective will influence what is "regard[ed] as knowledge or evidence of things in the social world" (Mason, 2002, p. 16), the following section will explain the epistemological assumptions underlying this thesis.

Epistemology is concerned about what we accept as knowledge and the way knowledge is produced (Ryan et al., 2002). According to Burrell and Morgan (1979), epistemological assumptions can be divided into two distinct perspectives: positivism and anti-positivism. Whereas positivists believe in the verification or falsification of hypotheses, anti-positivists believe that "the social world can be understood only by first acquiring knowledge of the subject under investigation" (Hopper and Powell, 1985, p. 431). As such, this thesis follows an anti-positivist idea, in which social science research does not have to be subject to a similar methodology as does the majority of natural science research. Instead, the focus of this thesis lies on understanding actors within their social and environmental context.

This research project does not aim to produce statistical generalizable propositions or universal laws. Instead it highlights a single case and draws conclusions based on the understanding of that individual case using the theoretical framework of calculability (Callon, 1998a, Callon and Law, 2005). As such, the case study is used to highlight how the theoretical framework of calculability can be used to explain how issues – such as sustainable development challenges including biodiversity loss – can be rendered calculable. As such, this research aims to produce theoretical generalisation rather than statistical generalisation.

The focus is on describing and observing existing practices and therefore structures, social and political forces or other conceptualisations are not pre-defined. By focusing on the specific framing of biodiversity conservation, this study does not address underlying macro issues such as the political, economic or social structures of society. By contrast, political power is seen as inseparably connected with the material configuration and the specific case and will therefore be exposed by describing and examining the actors and relationships within the case study.

4.3 Research Strategy

According to Saunders et al. (2015) every research needs a clear research strategy which should be decided on based on the research questions and the research objective(s). The chosen research strategy can be of quantitative or qualitative nature (Creswell, 2012) with both strategies being better equipped to answer different types of questions in the context of different ontological and epistemological stances. As stated by Maxwell (2012), a quantitative research strategy often examines questions around the issues of 'if' and 'to what extent', whereas qualitative research focuses on questions around 'how' and 'why' a certain thing plays a role in causing another phenomena or 'how' we understand the process that brings both together.

Based on the research questions – as outlined in section 1.2 –, the decision was made that a qualitative research strategy would be most appropriate. As indicated by the name, qualitative research is based on non– numeric research techniques, focussing for example on words or images, whereas quantitative research usually uses numerical research data (Bryman, 2006). Saunders et al. (2015) highlight that qualitative research can cut across different subject and research disciplines and it can be based on various philosophical assumptions.

According to De Vaus (2001), any social science research needs to make decisions about its design and structure before the start of the data collection and analysis process. Part of this process has to be to ensure that all components used within the research work together harmoniously in order to ensure a successful and efficient functioning (Maxwell, 2012). The following section will outline the research design chosen as well as provide details on why was considered an appropriate research design for this research project.

4.3.1 Case Study Research

Given the aim of the study – to understand how national governments can achieve calculability for biodiversity loss that enables the formulation of policies to facilitate effective biodiversity conservation – an explanatory case study was considered to be an appropriate research design (Scapens, 2004). This case study design has been chosen due to the following reasons. First, a case study design can provide rich and in-depth understandings of a particular problem area (Saunders et al., 2015). It is a research design that provides a holistic view of the examined area of interest and allows the researcher to get a comprehensive understanding of the research question and problem area (Scapens, 2004). As a result, a case study can enrich the researcher's understanding of a particular organisational practice (Morris and Wood, 1991). Additionally, case studies have been often used and proven effective within previous research using the theoretical framework of framing and overflowing as all studies included in Table 3.2 were based on case study research.

Robson (2002, p. 178) defines a case study approach as "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence". According to Thomas (2011, p. 13):

> "Case studies are analyses of persons, events, decisions, periods, projects, policies, institutions or other systems which are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame – an object –within which the study is conducted, and which the case illuminates and explicates."

A case study usually implies a single unit of analysis (Scapens, 1990), even though the boundaries around what this unit consist of are understood differently within the literature. As a result, case studies might focus on a single department, a single company, a single region or a single industry. In general, single case studies as well as multiple case studies are possible, both of which have various advantages and disadvantages associated with. Given the scope of this study is to understand how the UK has achieved calculability for its national biodiversity performance, this research can be classified as a single case study project.

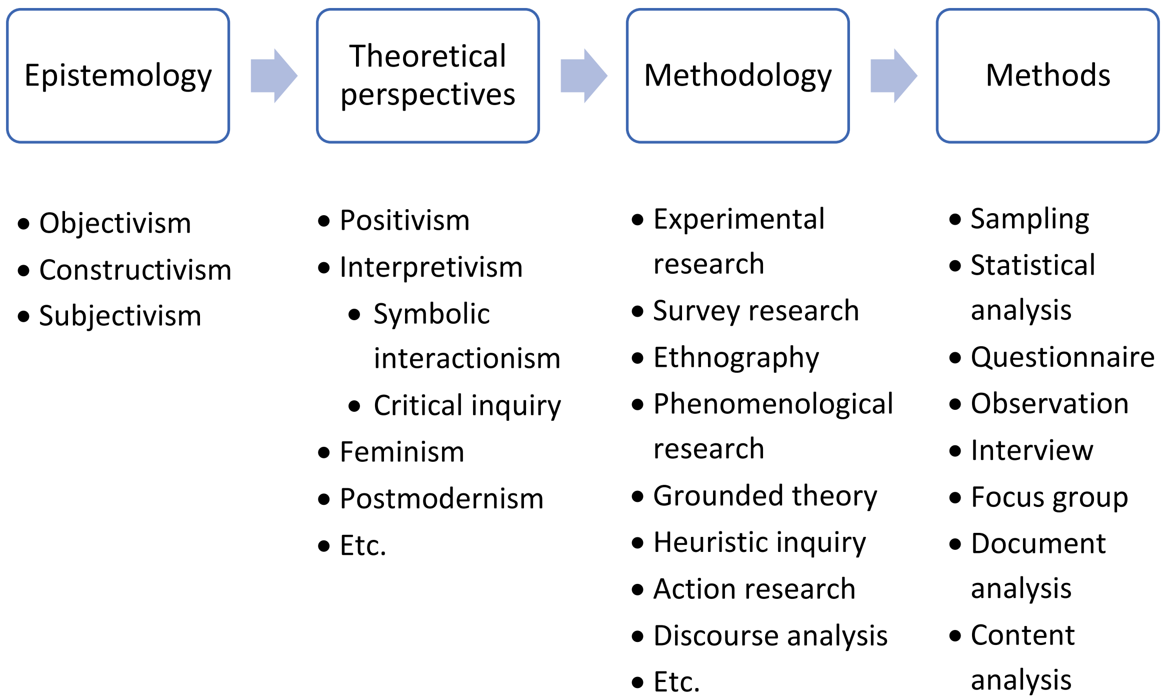
Scapens (2004) distinguishes between five different types of accounting case studies. First, he outlines descriptive case studies which describe existing accounting systems or procedures and have the aim to provide a description of different accounting practices. The second type are illustrative case studies attempting to highlight new and innovative accounting practices. In addition, Scapens (2004) lists experimental case studies as a type of case study aiming to examine the difficulties in implementing new accounting procedures or to evaluate their benefits. Lastly, he distinguishes between exploratory case studies acting as preliminary investigations in order to later generate generalisable theories and explanatory case studies aiming to explain one specific case rather than to produce statistical generalisable findings. However, drawing a distinction between these different types is not necessarily a clear-cut decision and Scapens (2004) highlights that the distinction between exploratory and explanatory case studies is rather ambiguous. Nevertheless, and as mentioned earlier, given the nature of this research project it is best classified as an explanatory case study. The limitations of choosing this research design will be discussed within section 4.6.

Case studies normally collect data using various methods and instruments. Within this project, document analysis and interviews have been used as the two main data collection methods, allowing for triangulation of the findings. According to Ryan et al. (2002) the aim of triangulation is to enrich the researcher's understanding of a case by collecting data from various alternative sources to understand the same issue, a technique that is especially useful in achieving contextual validity. Within this project, data has been triangulated either between various interviewees or between the official documents and the interviews.

4.4 Research Methods and Data Collection

According to Frey et al. (1991), research methods are the specific strategies researchers use to collect data in order to answer their research question(s). In addition, Arleck and Settle (2004) define research instruments as referring to the methods a researcher is using to collect data. Therefore, the term research method is understood as a particular technique used within the research project, whereas methodology refers to the research process and the underlying ontological and epistemological assumptions during the data collection and analysis. The term method can therefore be seen as a subset of methodology, even though the terminology of methodology is sometimes reduced to those of method (Ahrens and Chapman, 2006) and subsequently a specific research method can therefore be used under various methodologies. The relationship between philosophy, theoretical framework, methodology and methods can be seen in Figure 4.3.

Figure 4.3: Relationship between epistemology, theoretical framework, research methodology and methods (based on Gray, 2016, adapted from Crotty, 1998)



Empirical data within this thesis has been collected through fieldwork. Fieldwork is normally understood as the study of social practices, in the field in which these activities take place (Scapens, 2004). According to Ahrens (2008) “a growing body of interpretive management accounting studies, often based on fieldwork, is continuing to develop approaches that seek to overcome distinction between objective and subjective research by exploring the various ways in which accounting can become part of the contexts in which it operates" (p. 292). Following, the case study selection, the data collection methods as well as ethical considerations for this study will be outlined and explained.

4.4.1 Selection of the Case

The first part of the research process was the selection of the case study. The case chosen within this research has been the United Kingdom (UK), with a particular focus on their annual UK Biodiversity Indicators publication. Besides practical reasons, including access to the actors being available and the language of the official document being English, the UK has been chosen due to the following reasons. First of all, the UK has a long history of recording and reporting on nature (Atkins and Thomson, 2014; Thomson, 2014) and is described in the literature as a country with a highly developed infrastructure on collecting and reporting nature information (UKEOF, 2016). As a result, it was one of the first countries to account for biodiversity using indicators and has an extensive record of biodiversity indicators to be studied.

Additionally, the UK describes itself as a country "with a record of global environmental leadership" (HM Government, 2018, p. 19) and a country that "has shown leadership […] needed to address biodiversity loss" (JNCC and DEFRA, 2012, p. 4). Furthermore, JNCC claims that the "UK approach to biodiversity indicators [….] has helped to place the UK at the forefront of international work on this subject." (DEFRA, 2019) and as such has influenced international approaches to account for biodiversity and construct biodiversity indicator sets. As a result, the UK was seen as an appropriate case to understand a successful – as understood by the actors involved – attempt of rendering biodiversity calculable in a way that not only facilitates national biodiversity conservation work, but also influences international biodiversity accounting initiatives.

4.4.2 Data collection

Once the UK was decided on as an appropriate case for this research, a data collection strategy was designed. This research project was set around a flexible data collection design frame, allowing it to be developed as the data collection progressed, in line with Robson and McCartan's (2016, p. 146) idea that "flexible designs are a work in progress and therefore can adapt as the research evolves". In addition, Hammersley and Atkinson (1995) point out that particularly a qualitative research design should be "a reflexive process operating through every stage of a project" (p. 24). Following Robson and McCartan's (2016, p. 80) statement that particularly in a case study "the details of the design typically emerge during data collection and analysis", this research and data collection process can be best described as iterative.

The data collection approach for this research was to follow the actors through interviews, document analysis and observations. Therefore, evidence has been collected using various instruments in order to allow for a broader understanding of the case and the triangulation of findings.

The data collection process started with an in-depth document analysis in order to understand the context of this case, track the UK Biodiversity Indicators over time and identify possible interviewees for this research. Policy reports, biodiversity strategies, SDG and Aichi indicator sets and national and international biodiversity reports between 2002 and 2018 were collected and analysed. This initial analysis informed the interview themes and facilitated the identification of the first interviewees. Themes emerging from the documents were followed up with semi-structured interviews with various actors involved in national biodiversity accounting practice.

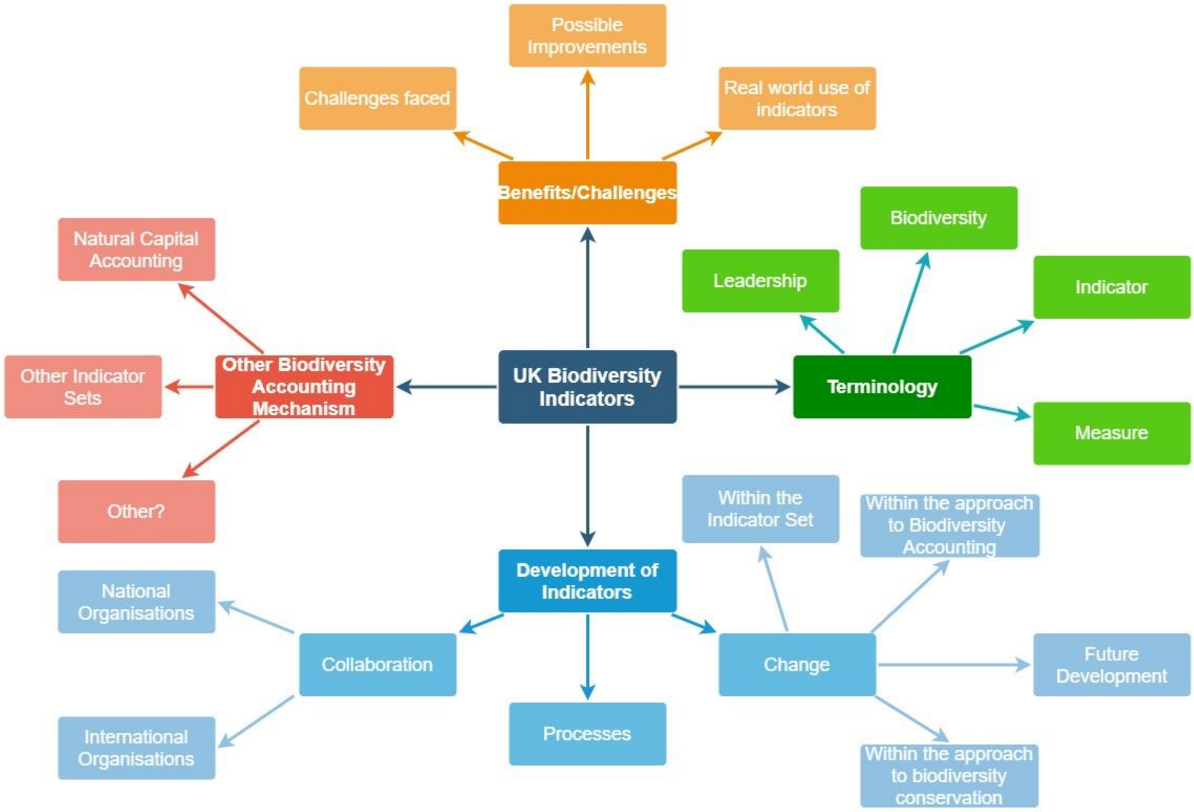
4.4.2.1 Document analysis

While preparing for the data collection process, the research commenced with document analysis to frame the development of UK biodiversity indicators. A substantial number of documents such as policy reports, biodiversity strategies, SDG and Aichi indicator sets and national and international biodiversity reports between 2002 and 2018 were collected and analysed. The starting date of 2002 was chosen due to the first Biodiversity Indicators Forum taking place that year with the UK Biodiversity Indicators being first discussed in any publicly available document. A list of the documents analysed can be found in Appendix 1.

As a first step, individual indicators used within these publications have been quantitatively and qualitative traced back over this 16-year time frame. In addition, the narrative and language used within these documents was examined in order to identify common pattern and themes but also gaps and potential questions.

This initial analysis was then used in order to prepare the interview schedule and identify the first interviewees as well as the unit of analysis. Themes emerging from the documents – as visualised in Figure 4.4 – were then followed up with semi-structured interviews with actors involved in the national biodiversity accounting practice. Hence the initial document analysis served as a foundation for the following data analysis and shaped the data collection as well as analysis process.

Figure 4.4: Themes emerging from the document analysis



4.4.2.2 Semi-structured interviews

According to Saunders et al. (2015), interviews are a data collection method in which information about the case is obtained by a direct interaction between the participant and the researcher in which a variety of questions from diverse contexts are asked. Semi-structured interviews are normally based on open-ended questions asked by the researcher covering a range of pre-prepared themes and topics. The questions do not have to be asked in a specific order and the amount of questions asked can be adapted in order to ensure all themes are covered (Bryman and Bell, 2015), giving researchers flexibility to react to the answers given by the participant. As a requirement to collect interview data, Yeo et al. (2014) outline the skills necessary for good interviewers in order to maintain in-depth conversations such as the ability of being an active listener, establishing trust and rapport, being aware of their own behaviour during the interview and being flexible about their own position as an interviewer. In addition, interviewers have to be aware of their own values and assumption and recognise the different relationships that are possible between researchers and participants. According to Kvale and Brinkmann (2014) interviewers themselves become research instruments and therefore have to face various intellectual, emotional, cognitive and psychological challenges.

Interviews were done in order to "look beyond the "official" story and expose constraints imposed by the written records" (Christensen, 2009, p. 88), particularly as most of the analysed documents were official government published reports and policy papers. In addition, interviews were used in order to reconstruct historical developments and getting a better insight in the accounting processes in practice. However, the choice of using interviews to reconstruct historical events does not come without its limitations. Given that oral histories rely on memory, they have often been critiqued based on a perceived lack of reliability and generalisability (Hobsbawn, 1997). As such, the memory of interviewees can be inconsistent, particularly if interviews are conducted a long time after the event took place (Hoffman, 1996 cited in Roberts, 2002). In order to overcome this limitation, findings from the interviews were triangulated between different interviewees as well as documents.

In general, interviews, as a common data collection tool in social science research (Alvesson and Ashcraft, 2012), can be categories into five main types according to Lindlof and Taylor (2002).

1. Ethnographic or informal interviews, in which questions are asked spontaneously in the field

2. Informant interviews, in which experts or specific knowledge is sought.

3. Respondent interviews, in which experiences, feelings, views and emotions are shared by the participants

4. Narrative interviews, including life stories or other forms of storytelling.

5. Focus groups, in which a debate is purposefully stimulated by asking questions to several participates.

According to Alvesson and Ashcraft (2012) identifying which type of interviews are suited for a particular research project can be seen as a practical choice done by researchers rather than an ontological or epistemological issue. As this research focusses on interviewing individuals with specific knowledge about the UK biodiversity accounting practice, the interviews done within this project can be best classified as informant interviews.

Overall, 19 semi-structured interviews with various biodiversity accounting actors in the UK took place over a period of 7 months between February and August of 2018. A list of interviewees is provided in Appendix 2, respectively.

A purposeful sampling method (Patton, 1990) was used to select interviewees, including document analysis driven and snowball sampling based on their involvement in various groups, committees and panels in the biodiversity accounting process. All interviewees were either still involved in the process or have been part of setting up or reviewing process of the indicators over the last year. The interview process started with interviews with two members of the Biodiversity Indicators Project Group identified during the document analysis stage, which helped to identify further participants for the research based on their knowledge about the individuals involved in the biodiversity accounting process. All interviewees were asked to recommend other involved individuals to be included in this study. These individuals were then contacted via email and asked about their willingness to participate in the research. Additional interviewees were identified and contacted during the attendance of policy meetings, workshops and conferences. In that case, possible interviewees were approached and introduced to the research project. If they indicated willingness to participate in the study, they were then followed up by email and an interview date was scheduled.

Overall, 27 individuals were contacted and of these 19 individuals were interviewed. It was noted that particularly the political actors contacted did not want to participate in the research and did not agree to be interviewed. Further reflections about this limitation in the interviewee selection will be outlined within section 4.6.

To allow the comparison between official policy opinions and NGO or academic opinions and to ensure a balance in views and insights, a variety of organisations, professional backgrounds, and job descriptions have been included in this research. Overall, interviews were done with individuals from 11 different organisations, including country governments, environmental agencies, research centres, NGOs and academics. Organisations included in this research are DEFRA, Joint Nature Conservation Committee, National England, the Welsh Government, Scottish National Heritage, Northern Ireland Environmental Agency as well as involved NGOs such as The Royal Society for the Protection of Birds, British Trust for Ornithology, Zoological Society of London, Centre for Ecology and Hydrology and the UN Environment World Conservation Monitoring Centre.

In addition, interviewees came from a broad range of backgrounds and held various positions within the organisations, ranging from statistician, biologist to policy advisor or strategy advisor. As mentioned before, interviewees included within this research tend to work predominantly on the technical side of the indicators, as a majority of political actors involved in the process did not want to participate within this study. It was decided to end the data collection process once the same names kept recurring or only individuals outside of the UK were named.

All interviews were structured around a pre-designed set of open-ended questions. The questions were chosen to encourage in-depth conversations and to enable participants to share their experience, knowledge and insight. All participants were encouraged to speak freely, and the goal was for the interview to feel more like an everyday conversation (Kvale and Brinkmann, 2014). In order to achieve this, the order of the open-ended questions was changed in order to follow the thought processes and insights shared by the participants and to allow the conversation to flow naturally and as uninterrupted as possible. However, the semi-structured interview schedule also served as a checklist ensuring all areas of interest were covered (Qu and Dumay, 2011). It also allowed the researcher to 'probe' the participants´ answer (Saunders and Thornhill, 2007) or ask for further details or clarifications if needed. Additionally, and if wanted, participants had the chance to express opinions off the record and this data has not been included in the final analysis.

All interviews were recorded, and notes were taken during as well as after the interview in order to capture observations, informal comments before or after the interview, the setup of the interview environment as well as particular questions or wishes raised by the participant outside of the formal interview.

Interviews took between 30 min up to 2.5 hours dependent on the participant's schedule, willingness to share information and breadth of involvement in the process. In all cases, it was ensured that the whole set of interview questions was covered, and all interviewees had the opportunity to raise further issues or topics they wanted to talk about at the end of the interview. Interviews were either done face-to-face, or if wished by the interviewee over Skype or telephone. Overall, 11 participants either explicitly asked to be interviewed over Skype/Phone or due to a last-minute scheduling face-to face meetings were not possible.

4.4.3 Ethical Considerations

As this project involved human participants, clear ethical procedures had to be followed in order to ensure the integrity of the research. According to Weinberg (1983) researchers have to ensure that questions are open and ethical. In this context, open implies that researches place no fear or force on participants to answer the questions and ethically means not to place unnecessary stress on participants and to treat all collected data with respect, which includes complying with the UK Data Protection Act and the EU General Data Protection Regulation (GDPR). Researchers should never make participants feel guilty about answering the questions (Fraenkel and Wallen, 2006).

All participants were informed clearly about the research aims and were given the information leaflet and the consent form in advance. They were also made aware about the possibility to withdraw either during the interview, or up to 12 weeks after the interview or to not answer one or more of the questions asked. Participants had to give their formal consent before the interview started and they also had the option to give or to not give consent for the interview to be recorded.

Before any potential interviewees were contacted or any data was collected, this project went through a thorough ethical approval process done by the University of Birmingham

Humanities and Social Science Ethical Review Committee. Part of the application process was the submission of the interview questions, the participant information sheet and the participant consent form and the project got full ethical approval by the Committee. A copy of the ethical approval as well as the participant information sheet and the participant consent form can be found in Appendix 3.

4.5 Data Analysis

Data analysis refers to the process of making sense of large sets of data (Marshall and Rossman, 2014). Qualitative research analysis processes usually aim to explore the meaning and identify patterns within the data sets (Miles et al., 2013) and are guided by the research aims, objectives and questions set before the analysis process. With the aim of this study to get an in-depth understanding of the current UK biodiversity accounting practice as well as being able to explain and communicate the information gathered within this research, the data analysis process required the description and exploration, the deduction of the meaning and the depiction of themes within the data (Matthews and Ross, 2010).

Various approaches to analyse case study data have been suggested in the literature and according to Robson (2002) the decision of the data analysis method should be done based on the types of research question. In contrast to quantitative data analysis, no standardised approach of data analysis exists for qualitative data. Corresponding to the data collection strategies used Saunders at al. (2015) proposes four basic data analysis approaches:

1. Understanding the characteristics of language
2. Discovering regularities

3. Comprehending the meaning of text or action

4. Reflection.

The flexible research approach taken within this study led to a simultaneous, ongoing analysis and interpretation of the data. During the design of the case study, various documents were analysed in order to inform the interviews. The interviews were undertaken over a seven-month period, and the data collection and analysis process can be best described as a back and forth between data collection, primary analysis and thoughts about the theoretical framework and literature. This process was decided on as it fits best with the philosophical assumptions outlined above and enabled methodological flexibility while still having coherency within the emerging findings and interpretations.

The interview data was organised and analysed using the thematic data analysis process outlined by Braun and Clarke (2006). Arguing against Boyatzis (1998) and Ryan and Bernard’s (2000) opinion that thematic analysis is not a specific method on its own but rather a tool that can be used across different methods, Braun and Clarke (2006) set out a guideline for thematic analysis as its own specific analysis method. The aim of thematic analysis is to uncover hidden themes at various levels of the text and to enable a structuration of the themes. According to Mathews and Ross, (2010, p. 373) “thematic analysis is a process working with raw data to identify and interpret key ideas or themes”. Overall, thematic analysis focusses on the segmentation and categorisation of themes in order to allow the consideration of different angles and perspectives.

Braun and Clarke (2006) divide the thematic data analysis process into six different phases, starting with the familiarisation with the data and the generalisation of initial codes.

Following, these codes are collated into potential themes which are then reviewed and afterwards defined and named before the final report is produced.

The familiarisation process of this research started by transcribing the interview recordings, repeatedly listening to the recording and reading through the transcripts and importing the data into NVivo. Recordings have been transcribed as a ‘non-verbatim’ accounts, focussing on the content of the interviews rather than all verbal utterances. As the recordings were re-listened to, initial ideas and themes were noted in order to get a first overview over the data.

NVivo was then used to initially code through the entire data set. Following Boyatzis (1998, p. 63) description of a code being “the most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenomenon” any parts of the data that appeared interesting or helpful in answering the research questions were coded. In order to avoid the omission of certain ideas, the entire data set and as many potentials elements as possible were coded resulting in 516 codes. During this process, these 516 codes were named as close as possible to the actual wording of the participants in order to minimise researcher’s bias.

In order to re-focus the analysis at a broader level, initial codes where then reviewed and collated into themes. At that time, the theoretical framework of Callon (1998) and Callon and Law (2005) was considered in order to structure overarching themes in line with the theoretical approach of this study. First decisions about the relationship between themes and codes were made and codes were linked to the overarching themes identified from the theoretical framework. Themes were also labelled in line with the language of the theoretical framework.

Lastly, these themes were then reviewed and revised in order to achieve cohesiveness. At that stage, similar themes were collated, themes were revised in order to ensure their appropriateness to the particular stage outlined in the theoretical framework. The final coding structure is shown in Appendix 4.

4.6 Limitations of the research design

Despite the considerable thought that went into designing this research, the research approach applied within this project is not without its limitations. The following section will outline these limitations as well as describe measures taken in order to mitigate them.

First of all, this thesis focusses on a single explanatory case study design. Traditionally, case study research was criticised for a perceived lack of academic rigour and difficulties in generalising the findings (see further Ryan et al., 2002; Scapens, 1990; 2004), particularly if the research was based on a single case study design (Gilbert, 2008). Nonetheless, Scapens (2004) argues that with considerable attention and care during the collection and analysis of the data, case study research – including single case study research – can have its own internal rigour and the capability of generalisation. In addition, Flyvbjerg (2006) argues that "one can often generalize on the basis of a single case, and the case may be central to scientific development via generalisation as supplement of alternative to other methods. But formal generalisation is overvalued as a source of scientific development, whereas "the force of example" is underestimated" (p. 228). As a result, case studies, if done rigorously, can be a valid and useful research design to generate knowledge and advance research. They can also be a useful research design to apply theoretical frameworks in a novel context, thus allowing theoretical concepts to be refined, modified and adapted (Scapens, 2004).

Moreover, the issue of researcher's bias can also be seen as an additional limitation of this research project. Given the philosophical assumption of accounting as being socially constructed rather than a natural phenomenon, no accounting system can be examined independent of the observer. As such, studying any social system as a neutral independent researcher is impossible. Additionally, as any data has to be interpreted by the researcher, no truly 'objective' case study research is ever possible. Rather, researchers should acknowledge their involvement in the collection and interpretation of the research data and the possible biases it might contain. Therefore, any underlying assumption have been openly discussed throughout this chapter, hopefully unveiling underlying biases and prejudices influencing this research. Still, it has to be noted that this research provides a subjective interpretation of the social system studied rather than an objective representation and as such might hold limitations in terms of its generalisability and truth claims.

Another limitation of this research comes with the necessity of drawing boundaries around the case study, which might limit the possibility of relating that particular case within a larger economic or political system. Being able to draw a holistic picture requires the research to study interrelations of the case with the surrounding, larger system. As a researcher, it is necessary to place a limit on the subject matter and studying all aspects of the surrounding system is unattainable. In this case, the boundary was draw around the set of UK national biodiversity actors excluding non-UK interviewees and interviewees outside of the indicator construction process. In addition to the boundaries actively drawn during the research design, this research project also had to deal with the difficulty of accessing certain individual actors. Particularly individuals working within the policy side of the indicator construction turned out to be hard to access, with most interview requests being turned down by these particular actors. As a result, the majority of interviewees included within this research are working predominantly on the technical, scientific or statistical side of the construction process. In order to mitigate this limitation, an increased amount of policy documents, strategies, meeting summaries, publicly available presentations and other forms of documents were analysed in order to capture the political voice within this project.

4.7 Summary

The overall research methodology – e.g. the approach to conduct research (Ryan et al., 2002) – has been outlined within this chapter. Focussing on the remaining three out of four questions that according to Crotty (1998) researchers have to consider when designing a research project, this chapter details the philosophical underpinning, methodology and methods deployed within this thesis.

Informed by the philosophical stance of pragmatism, the methodological decisions taken have been informed by the research questions answered within this thesis. Additionally, rejecting the idea of research as value-free, the methodology deployed can be best described as centred around a reflexive epistemological relativism.

However, appreciating the influence of the underlying philosophical assumptions about reality and knowledge production on the research design and outcome produced by this thesis, this chapter has also explained the hybrid ontological and epistemological assumptions fundamental to this thesis. Best described as hybrids between the ontological categories of realism, relationism and constructivism, reality in this thesis is seen as materially existing with physically existing actors. Yet, the identity of these actors is defined through their network of relations and interactions and thus should be seen as dynamic and constantly in flux.

Furthermore, actors have a self-constructed reality and organisations are treated as social constructs within this thesis. As a result, this thesis treats accounting processes as socially constructed rather than natural phenomena that exist independently of the actors. Subsequently, the aim of this research is to understand the underlying structures and interactions that have shaped and constructed the UK biodiversity accounting practices examined within this thesis.

Additionally, the epistemological assumptions of this thesis are best captured by the concept of anti-positivism, the idea that research should focus on interpreting social actions and understand the social world the actors are part of. Examining a single case study, this thesis does not aim to produce statistically generalisable findings, but rather to provide an in-depth understanding of a particular area of interest.

To do so, this thesis follows a qualitative research strategy and is designed as a single, explanatory case study approach. The case chosen has been the UK Biodiversity Indicators Set, due to the UKs long standing history in recording nature, highly developed citizen science data collection infrastructure and proclaimed leadership in accounting for biodiversity. Data collection methods included were semi-structured interviews and document analysis. Starting with an in-depth document analysis, changes of indicators over time were tracked, the context of biodiversity legislation and accounting in the UK was examined and the first interviewees were identified. Themes emerging from the documents were then followed up with semi-structured interviews with 19 actors involved in the UK Biodiversity Indicators practice.

In order to be included in the data analysis process, interviewees were transcribed and analysed following Braun and Clarke’s (2006) method of thematic analysis. As such, initial codes were generated and then collated into themes identified in line with the theoretical framework using NVivo.

Even though this research was thoughtfully designed, it does not come without its own limitations. First of all, following a single case study approach limits the ability to generalise findings of this study. Moreover, personal biases might have been reflected in the data collection or analysis process and as such this thesis does not aim to be an objective representation of reality. Furthermore, boundaries had to be drawn around the case and as such certain issues might have not been considered within this study. Lastly, having difficulties accessing interviewees on the UK biodiversity policy side, interviewees included within this study predominantly represent the technical or statistical side of the indicator construction process.

CHAPTER 5: CASE STUDY CONTEXT

5.1 Introduction

The aim of this chapter is to provide significant background information for understanding the UK biodiversity conservation context, the development of UK biodiversity accounting and the international landscape of biodiversity conservation, including international biodiversity treaties and goals. By doing so, this chapter will introduce the case study context in which this research took place and outline historical development in the way biodiversity has been governed and accounted for on a national and international level.

Following, paragraph 5.2 will outline the historical developments of biodiversity conservation legislation and practices in the UK. Next, paragraph 5.3 will explain the international context in which UK biodiversity conservation is taking place and their influence on the UK Biodiversity Indicators Report. Subsequently, paragraph 5.4 will provide details on the current UK biodiversity accounting practice by describing the current UK Biodiversity Indicators Report, the Biodiversity Indicators Governance Structure (BIGS) and the changes that happened to the biodiversity indicators set since it was first published in 2007. Within that, section 5.4.4 will provide an overview of the process in which the UK Biodiversity Indicators Report is being produced. The three main stages within that process – detachment of data, transformation into indicators and extraction of a result – will form the basis for the following three empirical chapters of this thesis. Lastly, this chapter will be summarised in paragraph 5.5

5.2 History of biodiversity conservation in the UK

The UK is a country with a longstanding tradition in biodiversity conservation and biodiversity conservation legislation (e.g. Wildlife and Countryside Act, 1981) and has historically contributed significantly to the scientific understanding of nature (e.g. Darwin, 1872: Muir and Gifford, 1996). Furthermore, the UK was the first country worldwide to produce and publish a national biodiversity action plan (UK BAP) in 1994, outlining in detail the actions planned to conserve national biodiversity.

In order to understand biodiversity conservation practices in the UK, it is important to comprehend the context of devolution in the UK and its implication on nature conservation and legislation. Since 1998, following the introduction of devolved governments in Wales, Scotland and Northern Ireland, primary responsibility for nature and biodiversity conservation lies predominantly at the country level. Biodiversity conservation legislation is governed on a four-country basis – including England, Scotland, Wales and Northern Ireland -, leading to a production of separate biodiversity conservation strategies and legislation by the four countries. In addition to the country specific strategies and action plans, the UK published a UK wide Biodiversity Framework, with the last one being the "UK Post 2010 Biodiversity Framework" in July 2012, aiming to set common priorities on UK wide biodiversity conservation practices. During the production of this plan, representatives from all four developed administrations were involved and the framework has been endorsed by all four countries' environmental ministers.

This complex network of devolved biodiversity strategies and action plans has led to a variety of actors being involved in biodiversity policy, legislation and conservation in the UK, including a range of statutory, voluntary and academic bodies. A more detailed outline of the actors involved can be found in paragraph 5.4.2 below. In order to aid the coordination of conservation action and research in the UK, the Joint Nature Conservation Committee (JNCC), works together with the Department for Environment, Food and Rural Affairs (DEFRA) on joining up the work of the four UK countries and to deliver biodiversity conservation on a UK level. While DEFRA is responsible for UK environmental and biodiversity conservation as the ministry, JNCC was set up as a public body to provide evidence and advice on conservation issues affecting the whole of the UK or international treaties.

5.3 International frameworks

One of the first international biodiversity conventions seeking to support biodiversity conservation worldwide was the Convention of International Trade in Endangered Species in 1973. This was followed by the RAMSAR Convention on Protection of Wetlands in 1976, the Bonn Convention on Migratory Species and Wild Animals in 1985 and probably most importantly the UN Convention for Biological Diversity (UN CBD) which was introduced at the 1992 Rio Earth Summit.

With its 168 signatory countries in 1993, the UN CBD became the major international convention aimed at conserving global biodiversity, as well as the first global treaty to lay out a legal framework for biodiversity conservation. Under its framework, it requires contracting countries to create nation action plans and strategies to conserve and protect national biodiversity.

The latest set of targets under the CBD framework have been the ‘Aichi targets’, a set of 20 targets aimed at holding biodiversity loss under the ‘Strategic Plan for Biodiversity 2011-2020’

(CBD, 2010). The targets can be seen in Figure 5.5. These global targets are intended to be a flexible framework for countries to establish national or regional targets and measures, commensurate with national priorities and needs. As a result, each signatory country has to set up its own set of biodiversity indicators to measure progress towards the Aichi targets and report to the CBD on its national biodiversity in regular reporting cycles.

Figure 5.5: CBD Aichi Targets (Source: World Economic Forum, 2018)

Interviewees confirmed that the CBD framework is a big influence on UK conservation policy, as achieving the CBD targets is seen as the main goal for the UK.

> "Everything we do works towards CBD targets, the Aichi targets […]. Every single thing, every policy we've got is there to make sure that we achieve the targets that were set place by the CBD. It's our overarching sort of thing. It's very much in the consciousness,

> we're very much aware of that. Then obviously things that come underneath that are there to reach those targets […]. Everything we do works towards that." (Interviewee 4, Devolved Administrations)

As a result, interviewees have described how the Aichi targets have heavily influenced the latest UK Biodiversity Strategy, shaping the strategic direction of UK conservation in line with the CBD framing.

> "They did underpin very importantly the Biodiversity 2020 strategy, that we published a little while back and the government did. Some of the targets in there were absolutely closely reliant to the Aichi targets." (Interviewee 15, Biodiversity Steering Group)

As the CBD targets run in a ten-year cycle, with the current Aichi targets running till 2020 and the previous 2010 Biodiversity Targets having been negotiated to run between 2000 and 2010, interviewees also highlighted how the strategic framing of biodiversity conservation in the UK changes in line with the CBD framing. As a result, interviewees described a shift from a more habitat and species focus towards an ecosystem services and natural assets focus within the latest UK Biodiversity Strategy, in line with CBD framing.

> "The biodiversity strategies tend to change on a decade basis, so they follow the CBD which ran 2000 to 2010 and now we're on the one that's on the run up to 2020. And those are the major changes in the framing of the issues. The big change from the one before 2010 was very species and habitat orientated. That's classic biodiversity conservation. The biodiversity strategy that came along in 2010, I think, was much more talking about benefits to people, ecosystem services, natural assets. It reframed conservation as a way of promoting these benefits that […] society gets from nature. And associated with that then, I think there were necessary changes in the way that the monitoring had to be done." (Interviewee 11, Research Centre)

Besides the CBD, the most recent international framework including biodiversity related targets has been the UN Sustainable Development Goals (SDGs). The SDGs were one of the main outcomes of the UN Rio de Janeiro conference in June 2012, aiming to transform the world into a more sustainable, just and inclusive environment. Out of the 17 SDGs particularly SDG 15 'Life on Land' and SDG 14 'Life under water' relate strongly to the UN CBD with their aim of halting global biodiversity loss. However, according to interviewees the SDGs had rather little impact on the UK Biodiversity Indicators at the time of this study. Given the contemporary focus on achieving the Aichi Target indicators, interviewees did not feel the necessity to also incorporate the SDGs into the current indicator set.

> "I'm aware of [the SDGs] and I'm going to have to quickly try and look it up. It's a valid question but it's not necessarily something that we've looked at specifically." (Interviewee 2, Environmental Agency)

This section introduced the international biodiversity conservation goals and targets. Probably the most prominent international biodiversity framework influencing UK Biodiversity legislation is the Convention for Biological Diversity (CBD) and the current CBD Aichi targets running till 2020. Under these targets, countries such as the UK have to come up with their own indicators to measure and account for their national biodiversity performance. Besides the CBD, the SDGs also include two targets specifically on biodiversity. However, in the UK, interviewees confirmed that while the CBD targets are highly influential on UK biodiversity legislation and biodiversity accounting, the SDGs did not have a similar impact at the moment.

5.4 Accounting for biodiversity in the UK

One of the first attempts to integrate biodiversity conservation into the way institutions, practices and processes are governed in the UK has been the previously mentioned UK BAP in

1994. It established a set of 59 targets related to species and habitat protection and monitoring, understanding and public awareness of biodiversity conservation as well as governing international biodiversity. Biodiversity conservation priorities necessitating governmental change were identified, including air and water quality, energy consumption and production, farming, transportation, woodland, coastal zone management, urban development as well as marine governance and conservation (Thomson, 2014).

Since then, global and national political developments and pressures have shaped the UK biodiversity governance, leading to an increase in standardised calculative definitions and accounting practices surrounding biodiversity conservation, going along with more standardised measures, evidence-based UK governance in general and a political favouring of characteristics such as cost effective, reliable, robust and relevant (Thomson, 2014).

Whereas the first CBD framework led to a rise of economic and social elements in the scope of biodiversity within political discourse, a more radical shift towards a more outcome orientated governance process including calculative capturing biodiversity happened with the following CBD frameworks. The 2010 Biodiversity Targets and later on the Aichi Biodiversity Targets and the Strategic Plan for Biodiversity 2011–2020 (SCBD, 2010) positioned biodiversity accounting and indicators as a principal part of the UN biodiversity conservation strategy. Biodiversity accounting, targets, indicators or statistics were not incorporated into the first CBD agreement in 1992. Due to the shift within the UN CBD programmatic, national biodiversity performance had to be accounted for using standardised calculative measures, making biodiversity conservation a fundamental part of national political governance and accountability practices.

This change towards standardised biodiversity performance measures was adopted in the UK in 2007 with the publication of the first Biodiversity Indictors in Your Pocket (BIYP) report. Preceding the BIYP, biodiversity had not been cohesively accounted for within the UK government as reporting on biodiversity issues took place in a range of policy documents, reports or annual reports of different governmental agencies. Biodiversity reporting was fragmented and not systematically framed. Reporting and accounting practice on biodiversity was characterised in the first UK Report to the UN CBD as "biodiversity information, however, remains scattered across the country in many different and incompatible forms; from modern, computerised, databases to scraps of paper kept in shoe boxes" (DETR, 1998, p. 26).

5.4.1 UK Biodiversity Indicator set

Following the UN CBD shift in framing biodiversity based on national biodiversity indicator sets, the UK government has produced a report of biodiversity indicators, called Biodiversity in Your Pocket, annually since 2007[5]. The 2018 report contains 24 indicators, including information about individual species and habitats, ecosystem services and mainstreaming. All indicators are grouped according to the five Aichi Strategic Goals. A list of indicators included within the 2018 set can be found in Appendix 5.

According to DEFRA, the main aim of the indicator set is to summarise complex data sets into standardised and therefore simpler and better communicable figures (DEFRA, 2007). The indicators are being communicated towards the general public as well as government officials and policy makers. Interviewees confirmed that this set of indicators formed part of the

[5] The UK Biodiversity Indicators Report was named 'Biodiversity in Your Pocket' between 2007 and 2013. Since 2014 the name of the report has been changed to 'UK Biodiversity Indicators'. This change within the naming of report had no influence on the content and the indicators included within it.

evidence base for UK government biodiversity policy formulation, performance measurement and decision making.

Historically, the decision to set up a national set of Biodiversity Indicators was taken by DEFRA in 2006. To do so, the interviewee below described a process in which interested stakeholders were invited to a workshop aiming to identify possible metrics and leading to the first Biodiversity in Your Pockets publication in 2007.

> "So in probably about 2006, there was a decision taken through DEFRA […] that we should try to develop a set of metrics to measure progress towards what was then the 2010 Biodiversity Targets, which was agreed through the Convention for Biological Diversity to significantly reduce the rate of biodiversity loss. And to do that, what we did was to pull together a workshop of a number of interested stakeholders to try and identify what sort of metrics we might need and what sort of metrics would be available – what was easily available. There's of course throughout all of this been the [issue] of resources, being the [issue] of what would we like to do versus what can we do […]. That lead into a first publication of what we call at that point Biodiversity Indicators in Your Pocket […]. That's the latest version which has now become called UK Biodiversity Indicators […] and we've published pretty much annually ever since." (Interviewee 5, Project Group)

In 2018, the UK Biodiversity Indicator set contains 24 indicators, with four indicators being under development and 20 indicators being composed of at least one measure. While the majority of indicators are composite indicators with a single measure, certain indicators have more than one measure if the underlying data could otherwise not be combined logically (DEFRA, 2007).

5.4.2 Governmental Structure

The production of the UK biodiversity indicators involves a broad range of statutory, non-governmental and academic bodies, organised in what was named by interviewees as the 'Biodiversity Indicator Governance Structure' (BIGS)[6]. A visualisation of this structure can be found in Figure 5.6.

Within this section the structure of BIGS is explained. BIGS is comprised of the Four Countries Group, the Biodiversity Indicators Steering Group, the Biodiversity Indicators Forum and the Biodiversity Indicators Project Group. Each of these groups comprises of overlapping representatives from different institutions.

The Four Countries Group consist of representatives of the four UK Devolved Administrations – namely England, Scotland, Wales and Northern Ireland – , DEFRA and JNCC.

The Biodiversity Indicators Steering Group is made up of representatives of DEFRA, the Devolved Administrations, JNCC, Country Agencies and one NGO link.

The Biodiversity Indicators Forum comprises representatives of Statutory and Non-Governmental Organisations and Academia.

The Biodiversity Indicators Project Group consists of a JNCC Biodiversity Indicators Manager and three[7] DEFRA Statisticians.

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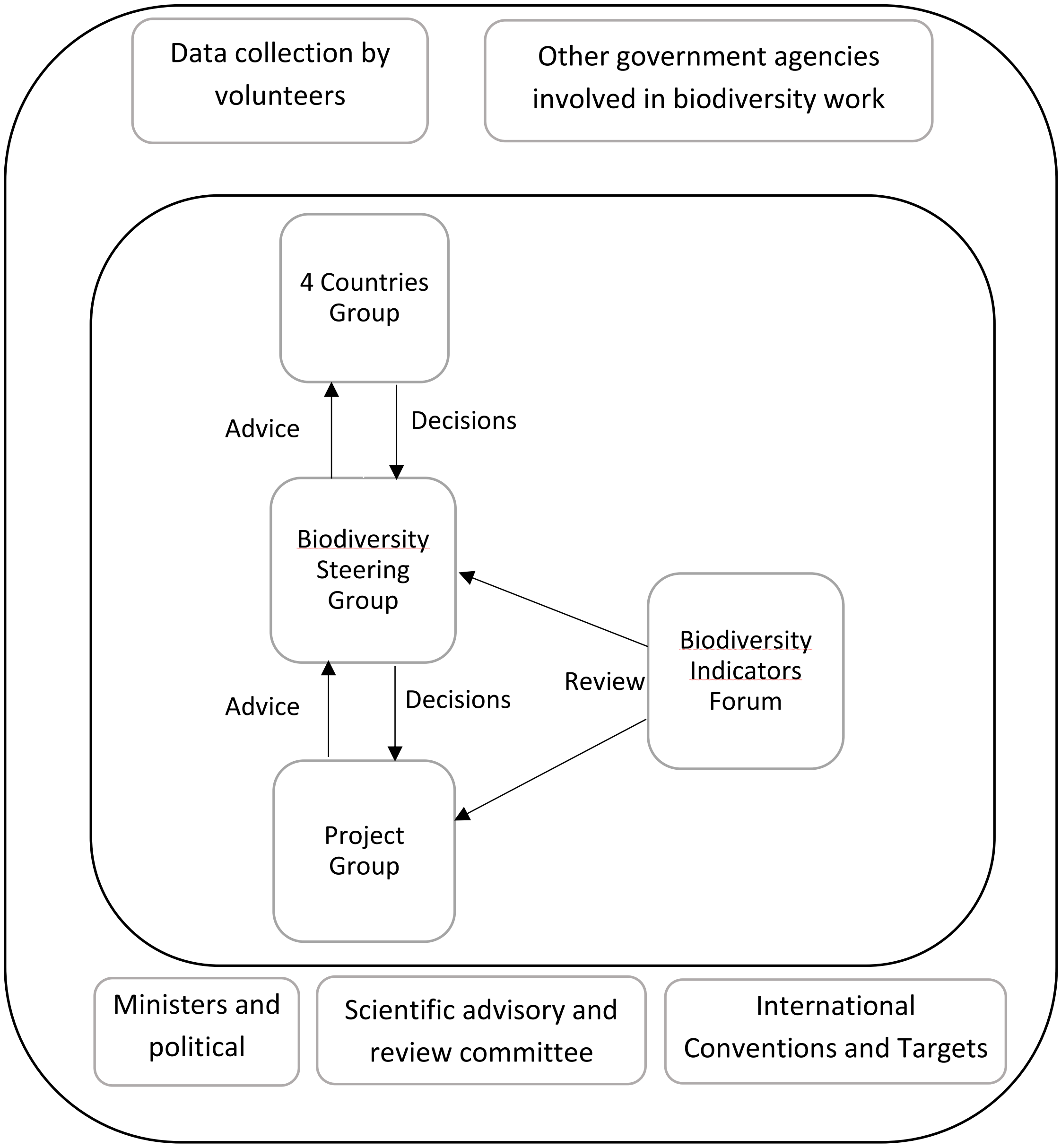
[6] The remainder of this thesis will refer to the Biodiversity Indicators Governance Structure as 'BIGS'. However, this acronym was not used by the interviewees themselves.

[7] In 2018

This structure enables the collaboration of various actors considered necessary for the production of the final indicator set, as it brings together representatives of DEFRA, JNCC all four devolved administrations and country agencies, selected NGOs, academia and research centres.

Figure 5.6: UK Biodiversity Indicators Governance Structure (BIGS)



> "Let's just look at this from the government's perspective. At the top level we've got what's called the Four Countries Group, that's very senior civil servants from the devolved administrations and their statutory advisory bodies. So that's statutory only. And that basically sets direction. That's your mechanism for looking at what's going on as a result of devolution because environment is a devolved matter. We've got an indicator Steering Group and the idea of that is that that's my overall governance group in terms of who I am responsible to. […] And that includes people from an operational level from devolved administrations of the four countries and also includes an NGO representative. But no big steering group is ever going to actually produce a set of indicators because they're all busy doing their own jobs. What you need is a little Project […]. We are that Project Team. […] We report to the Indicator Steering Group on what we're doing and they give us direction […]. So it's a slightly organic governance process." (Interviewee 5, Project Group)

As a result, BIGS comprises a multitude of organisations, including the twelve organisations included in this research. A list of all organisations included within this research can be found in Appendix 2.

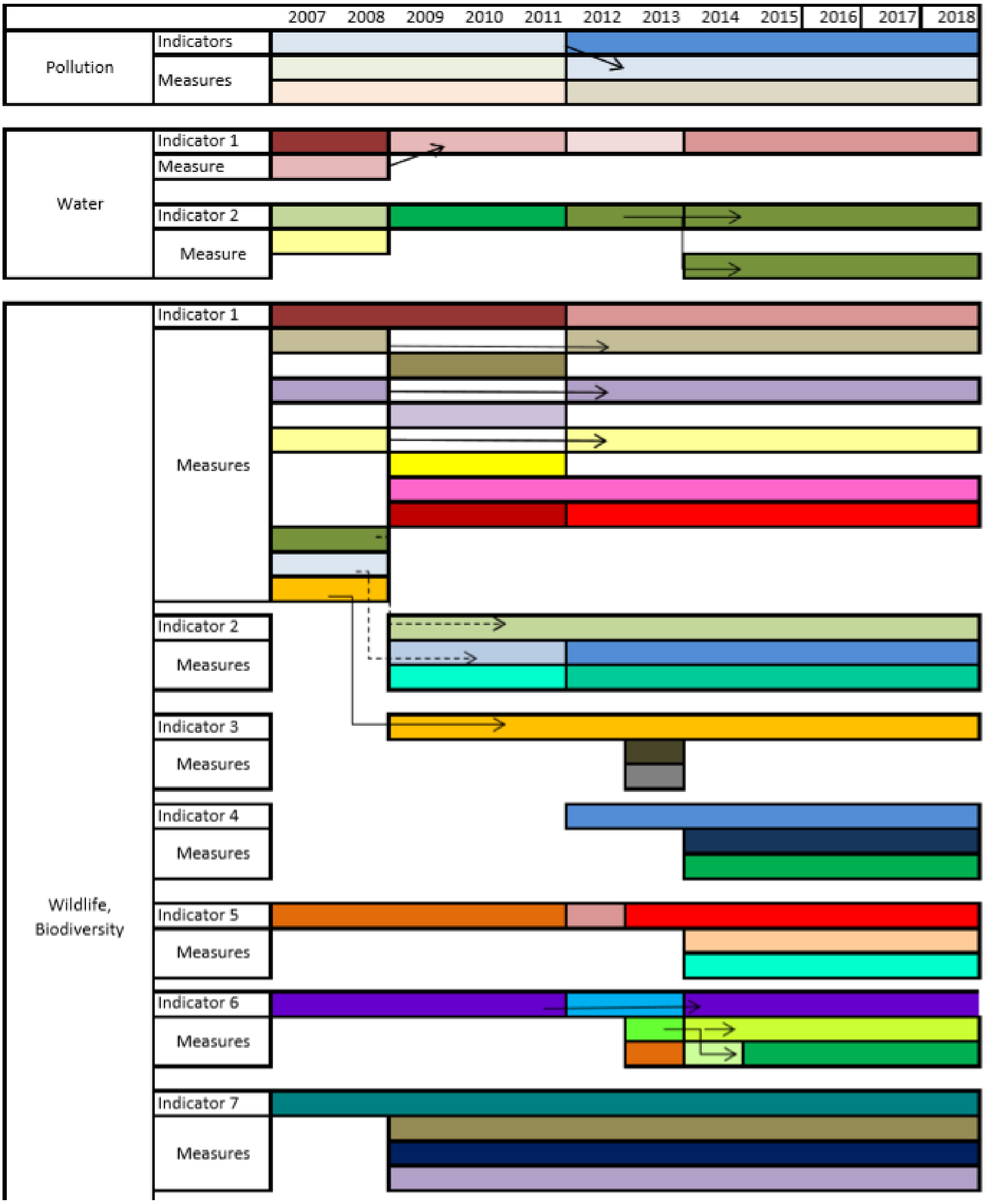
5.4.3 Changing nature of the indicator set

Interviewees have described the development of the UK biodiversity indicator set as an ongoing work in progress.

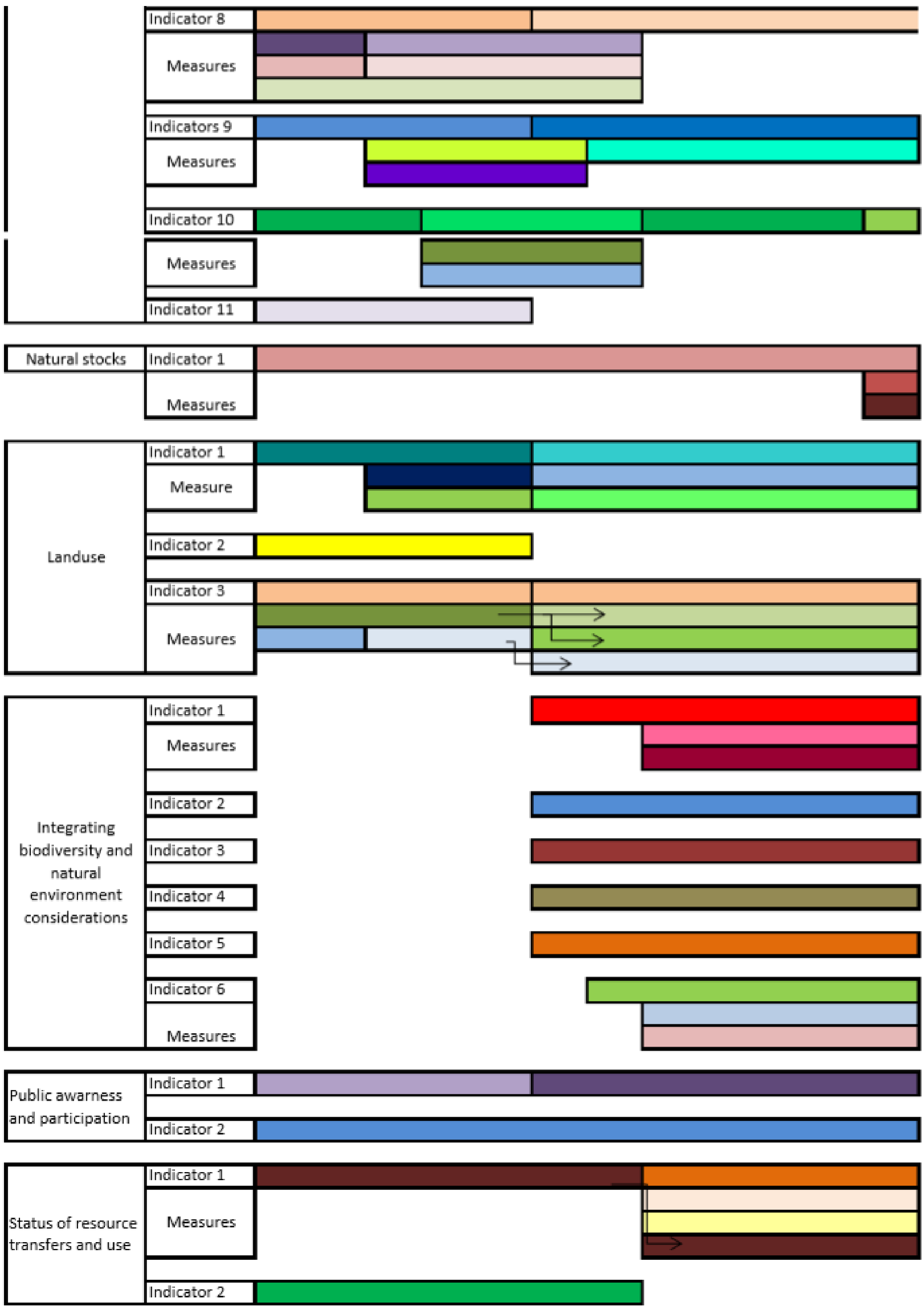
> "The UK biodiversity indicators now, I think, are very impressive in terms of the way they can be updated. […] It's a huge improvement over what we had in the past. I think it's a continuing process. They're not as good as we would wish but they are very much better than anything we've had to date." (Interviewee 2, Environmental Agency)

Evidence of this ongoing process can be observed in the annual changes in the reported UK biodiversity indicators between 2007 and 2018 (see Figure 5.7, constructed from analysis of the UK Biodiversity in Your Pocket reports). In this period new indicators were introduced, changes in level of analysis, indicators removed, measures becoming labelled as indicators, and indicators becoming labelled as measures.

Figure 5.7: Changes in Indicators reported on in the UK Biodiversity Reports between 2007 and 2018. [8]



[8] Colour change indicates change in indicator; change within one colour family indicates smaller change, the introduction of a new colour family indicates bigger changes. Arrows relate to splitting of indicators or return to a previously existing indicator.


Indicator 8
Measures
Indicators 9
Measures
Indicator 10
Measures
Indicator 11
Natural stocks
Indicator 1
Measures
Landuse
Indicator 1
Measure
Indicator 2
Indicator 3
Measures
Integrating biodiversity and natural environment considerations
Indicator 1
Measures
Indicator 2
Indicator 3
Indicator 4
Indicator 5
Indicator 6
Measures
Public awarness and participation
Indicator 1
Indicator 2
Status of resource transfers and use
Indicator 1
Measures
Indicator 2

With Figure 5.7 the extent of how the UK government official reports reframed their biodiversity calculable space in which they are able to see and understand their performance is highlighted. Within that Figure, it becomes particularly obvious how the UK Biodiversity Indicator set has not been stable over the last years and exhibits regular reframings.

Interviewees described this process as a process of ongoing improvements and as necessary to better capture and measure the UK national biodiversity performance. As such, various changes to the UK Biodiversity Indicators and the process in which this indicator set is produced have been perceived by interviewees as improvements. These changes between the first UK Biodiversity Indicator set in 2007 and the UK Biodiversity Indicators set in 2019 can be found in Table 5.3.

Table 5.3: Perceived Improvements within the indicator set between 2007 and 2019

UK Biodiversity Indicators 2007	UK Biodiversity Indicators 2019
- Includes 18 biodiversity indicators	- Includes 24 biodiversity indicators
- Relies on pre-existing indicators (e.g. under the UK Sustainable Development strategy)	- Combines pre-existing indicators with indicators developed for the UK Biodiversity Indicators Report
- First thoughts about making the indicators fit with CBD 2010 biodiversity target	- Allignment of all indicators with CBD Aichi targets
- Implementation of BIGS and collaboration with governmental and non-governmental organisations	- Better involvement of Research Centres, NGOs and Academics in BIGS and the indicator development
	- Independend academic review of indicators and indicator methodologies
	- Update of indicators in line with scientific developments
- No guideline on indicator interpretation	- Publication of Evidence Statements for the indicator interpretation

As such, the thesis will use the term ‘improvement’, as defined by the interviewees, to refer to the changes outlined above. These changes include

- increase in indicators included,

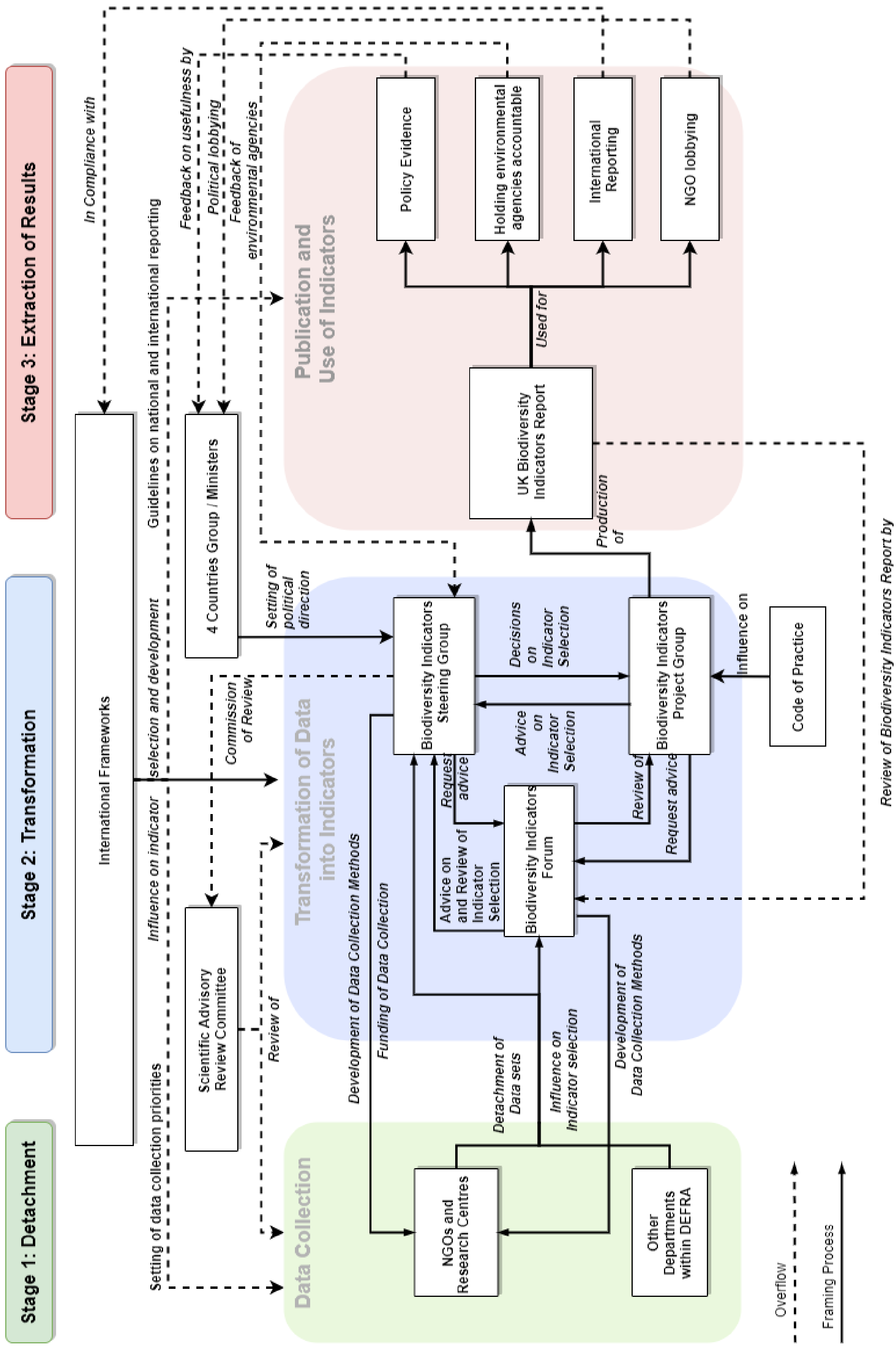
- development of new biodiversity indicators to be included in the UK Biodiversity Indicators Report,
- alignment of the existing national biodiversity indicators with the international CBD framework,
- better collaboration between governmental and non-governmental organisations – including NGOs, research centres and academia,
- changes to the indicators and indicator methodologies following scientific advancements and an independent academic review panel,
- publication of evidence statements alongside the indicators report in order to support the interpretation of indicators.

5.4.4 UK Biodiversity Indicator Reporting Process

As mentioned in section 5.4.2, the process of producing the final UK Biodiversity Indicators Report relies on a complex, multi-organisational structure, including a wide range of governmental, non-governmental and academic organisations. The following section will highlight the process in which the final Indicators Report is produced through an integrated calculability theoretical framework comprising of Framing and Overflowing (Callon, 1998a) and Callon and Law's (2005) three-stage process of calculation. The framework will be applied within the governmental structure of BIGS and to interpret the empirical findings detailing the process of producing UK Biodiversity Indicators Reports. In doing so, this section will provide an overview which will be explored in more depth in the following three empirical chapters, each focussing on one of the stages of calculability (Callon and Law, 2005).

The process of producing the UK Biodiversity Indicators Report has been visualised within Figure 5.8.

Figure 5.8: The UK Biodiversity Indicators Reporting Process



Interviewees described the procedure of producing the indicators as relatively structured and linear. According to them, once the Biodiversity Indicators Steering Group has decided on the indicators included in the report, the Project Group starts preparing the report – using data sets from NGOs, Research Centres and other departments within DEFRA – before the final data set is being published online. However, the empirical findings within this thesis suggest that the actual process is neither straightforward nor linear (contrary to the BIGS process outlined in Figure 5.6), with a range of additional connections and overflows being identified during the research.

In order to make sense of the empirical findings, the three stages of achieving calculability (Callon and Law, 2005) were used to represent the process and data collected within this project. Each of the three stages comprises its own set of process, actors and challenges to be overcome. As a result, the following three empirical chapters will focus in detail on each of the three stages of calculation and how each of these stages have been approached order to render national biodiversity performance calculable. Collectively these chapters provide a detailed analysis of the processes involved in the UK Biodiversity Indicators reporting process and highlight the work that went into the challenge of rendering biodiversity calculable.

5.5 Summary

The aim of this chapter was to provide necessary background information and the case study context to better understand UK biodiversity legislation and accounting as well as the international context in which this work takes place.

The UK has been chosen as a case study for this project due to its longstanding tradition in biodiversity conservation monitoring and legislation. Biodiversity has been framed as a distinct part of the UK governance since the publication of the UK BAP in 1994. Given that UK biodiversity conservation is a devolved issue in the UK, all four countries have their own legitimated biodiversity legislation and action plans, with DEFRA and JNCC being responsible for a national coordination of conservation efforts.

Additionally, the UK signed up to various international biodiversity conservation conventions and targets, including the CBD Aichi targets as well as the SDGs. Interviewees confirmed that the Aichi targets have a major influence on UK biodiversity legislation with any legislation ultimately working towards reaching the Aichi targets. As part of this international framework, countries have to come up with their own set of biodiversity measures and indicators, which in the UK underpins the UK Biodiversity Indicators in Your Pocket Reports produced annually since 2007.

The 2018 set of UK Biodiversity Indicators contained 24 indicators that has been significantly reframed since 2007, with intervening indicator sets showing change every two to three years. The reframing of these indicator sets is governed by the 'Biodiversity Indicator Governance Structure' (BIGS) and depicted in Figure 5.6. This reflexive and iterative reframing process has been described by interviewees as ongoing improvements. Table 5.3 has outlined the changes that interviewees referred to when talking about improvements between the UK Biodiversity Indicators Report in 2007 and 2018 including the development of new indicators, the update of existing indicator methodologies, a better collaboration between organisations involved and a better alignment of indicators with international frameworks.

Lastly, this chapter has visualised the process of how UK Biodiversity Indicators Report are produced using the framework outlined in Chapter three to provide a theoretically informed overview of the empirical findings as to the key stages of how the reports are produced. Each of the following chapters will analyse in detail one of the stages of calculability, which are detachment, transformation and extraction (Callon and Law, 2005). As such, the following chapters will also analyse how this calculative work s have been approached by the actors involved in resolving the challenges in in rendering UK biodiversity performance calculable.

CHAPTER 6: DETACHMENT AND LAYOUT IN A SINGLE SPACE

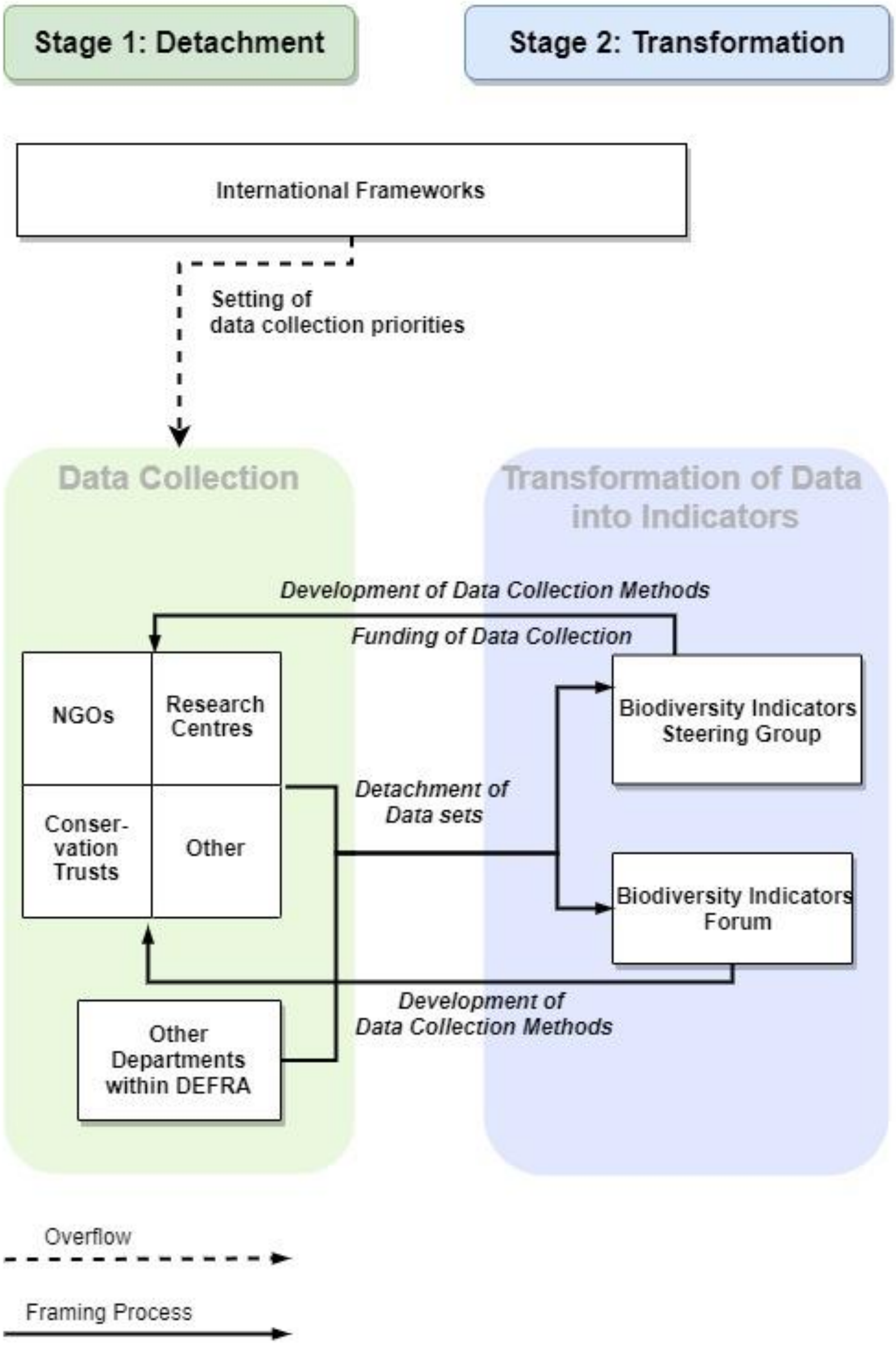
"The problem we always have is the data really and the resources to gather the data."

(Interviewee 14, Biodiversity Steering Group)

6.1 Introduction

This chapter will outline Callon and Law's (2005) first stage of calculation concerning the detachment of relevant entities and how they are brought together within a single framed space. As such, it will focus on the first stage of the process of rendering biodiversity calculable as visualised in Figure 6.9.

Figure 6.9: Stage one of the calculative process



This chapter will highlight the different detachment processes including the detachment of data from nature, the detachment of data sets from their original organisations and the detachment of data sets from their original purposes. This chapter will argue that achieving calculability for biodiversity performance requires work to identify the kinds of biodiversity data suitable to be brought into the BIGS space. It will also highlight how data collected by outside organisations such as NGOs becomes detached from its original purposes and organisation in order to be repurposed for the UK biodiversity indicator reporting. In doing so, this chapter will show how data availability and pre-existing data collection infrastructures underpin the development of UK biodiversity indicators.

Following, Section 6.2 will outline the work that is necessary to identify appropriate data sources and detach them from their original organisation and purpose. Next, Section 6.3 will highlight how rendering national biodiversity calculable requires an already developed, pre-existing infrastructure that allows these data collection work to take place in the first place. Afterwards, section 6.4 will outline how this dependency on data availability influences the calculative process and the quality of the indicators that actors are able to construct. Following, the example of bird indicators will be used in section 6.5 to illustrate this process of data collection and detachment before section 6.6 will summarise the chapter.

6.2 Detachment of data

This section will outline how rendering UK national biodiversity calculable requires actors to identify outside data sources, which then require work to detach them from the original organisation and purpose in order to be brought into the calculable space.

6.2.1 Exploration of data sources

In order to achieve calculability for national biodiversity performance in the UK, the calculative process begins with the exploration and identification of appropriate data sources suitable for use within the calculations. In the UK, most of the data sets used within the UK Biodiversity Reports have not been collected by DEFRA itself, but rather the data sets come from outside organisations who have been collecting them to support their day to day conservation work.

> "Lots of the biodiversity indicators that are in the twenty indicators[9] that [JNCC puts] together, they were designed, constructed, developed by lots of the NGOs." (Interviewee 7, Biodiversity Steering Group)

Empirical investigation identified a network of nearly 100 organisations involved in the production of the UK Biodiversity Indicators Reports. Thus, data included in the UK Biodiversity Indicators Report has been originally collected by and detached from a broad range of organisations – including governmental organisations, NGOs and research centres – and repurposed for inclusion in reports.

> "The UK Biodiversity Indicators are dependent on a wide variety of data, provided by Government, research bodies, and the voluntary sector – in total nearly 100 organisations are involved." (DEFRA, 2018, p. 2)

These 100 organisations are involved in a variety of typically bottom-up data collection schemes as part of their biodiversity conservation work rather than the collection of data sets to be specifically used in UK Biodiversity reporting. However, interviewees have highlighted how these bottom-up data sets must comply with international biodiversity frameworks – such as the CBD Aichi targets – and BIGS' data collection requirements. Some of these targets and goals are decided on at an international level, –such as the SDGs, – which prescribe a set of fixed, top-down indicators that signatory countries have to report on in order to track their progress towards achieving the SDGs. In contrast, the CBD Aichi targets allow for countries to

[9] In total, the UK Biodiversity Indicators Report includes 24 indicators. However, four are still under development and thus only twenty indicators include measures and data sets.

develop their own set of national indicators and indicator methodologies to report on nationally determined biodiversity performance. This diversity in international requirements results in tensions and difficulties when countries – such as the UK – have to work with data sets that are available to them, but also comply with the international targets and goals.

> "It is in some cases quite difficult to come up with really good evidence and data that describe in a very tightly defined way [the] progress towards particular Aichi biodiversity targets." (Interviewee 8, NGO)

Aiming to resolve that tension between international biodiversity frameworks and the available local biodiversity data sets, interviewees described how the UK translated the international CBD biodiversity targets into local UK biodiversity targets as well as local UK biodiversity indicators. This step enabled the UK to use local, bottom-up data sets for international reporting purposes and still being considered as compliant with the international frameworks. This translation into local targets and indicators has also been described as useful to support biodiversity conservation efforts while international frameworks were seen as valuable to provide a ´common goal´. However, at present interviewees noted that there remains a set of unresolved challenges in how to measure performance against the SDGs.

> "I think the existence of those high-level international frameworks and targets is useful because in principle at least it allows everyone to develop more local targets and indicators to fit in with that framework and aim towards a common goal." (Interviewee 8, NGO)

In order to identify appropriate data sets, members of BIGS – particularly the Project Group – have to actively explore what data sources might be available that could be used within UK Biodiversity Indicators Reports. To do so, members of the Project Group have highlighted the necessity for good collaboration with external organisations such as academia, NGOs or

Research Centres, as in most cases they collect and own the majority of biodiversity data sets used within reports. This collaboration is enabled by the inclusive, and multi-organisational structure of BIGS, which accommodates the collaboration between governmental, public service organisations and NGOs and Research Centres.

> "It takes tapping into academic knowledge […]. We do that and we have some good links. […] Where it gets into the more technical sort of areas we tend to go to [research centres]." (Interviewee 6, Project Group)

Once possible data sets have been identified, the organisations holding these data sets – mostly NGOs or research centres – have to agree for the data sets to be shared and later on used within UK Biodiversity Indicators Reports. Thus, data sets are first mobilised by outside organisations for their purposes, prior to being brought into the BIGS structure and to be used in any subsequent calculative and reporting processes. To do so, interviewees have highlighted the necessity of governmental funding available to support the outside data collection work.

> "The challenges [was] getting the range of organizations [motivated], that we knew had relevant data sets that could be used to develop indicators. […] I think, [the challenge has] been generating the commitment and momentum within the organisations that hold data to actually mobilize them and to make them available when there isn't really any funding to support that work". (Interviewee 8, NGO)

It is within these outside organisations that the detachment of data from nature takes place through various data collection processes. Additionally, outside organisations are also responsible for the development of the majority of indicator methodologies, which are then made available to governmental organisations. Besides the occasional provision of funding, this work takes place completely independent of governmental actors and structures.

Additionally, depending on the willingness for collaboration by the outside organisation, this work also takes place independently of any academic review process or input, with the academic interviewee below highlighting his challenges of even accessing the data sets in the first place.

> "How ready are [the NGOs] to share their information, because any of these indicator developments, a lot of the issues associated with it are 'Well that's my data'. That is a constraint on new indicator development." (Interviewee 9, Academic Institution)

As mentioned before, most of the data has been collected by outside organisations rather than by DEFRA itself and most of the initial detachment work of data from nature takes place outside of the BIGS structure. Consequently, the data collection organisations become highly influential and important for governmental organisations in the process of rendering biodiversity calculable.

> "I think the people who provide the data have a very big influence. […] They put quite a lot of effort into helping the work of the Indicators Steering Group." (Interviewee 15, Biodiversity Steering Group)

As a consequence of this outside data collection, UK Biodiversity Indicators Reports include data from various different organisations such as NGOs, public websites or other parts of DEFRA and other government agencies. An overview of the data sources included in the 2018 UK Biodiversity Indicators Report can be found in Appendix 5. Consequently, even though the UK publishes one single UK Biodiversity Indicators Report, data underlying each indicator within that set comes from different places and has been collected using diverse data collection methodologies, leading to inconsistencies in the quality of the data sets included.

> "For example, we have an indicator on the amount of volunteering work that people do. We get data from organisations that have volunteers, for example the Wildlife Trusts. […] Some data would even come from people's websites. There's a spend indicator that, some of it is from non-governmental bodies [and] you just go to the website and look at what they have spent on biodiversity. […] Other parts of DEFRA is another example where we would go for marine indicators. Go to the marine part of DEFRA and ask for their data. Or to the air quality part." (Interviewee 6, Project Group)

This variety of data sources makes it difficult for all data sets to be meaningfully and calculatively combined into a single report. As a result, these data sets have to be first detached from their original purpose and data collection methodology in order to be subsequently manipulated and transformed into legitimated UK Biodiversity Indicators, a process that will be outlined in detail in Chapter 7.

> "To bring together the UK assessment for different biodiversity [indicators] is really difficult because everything's been measured in different ways. So that's a real problem." (Interviewee 7, Biodiversity Steering Group)

In conclusion, the UK Biodiversity Indicators Report integrates a broad range of detached data sources into a single account. Given that DEFRA does not collect most of the data needed to set up this national biodiversity account itself, members of the project team have to actively go out and identify appropriate data sources. To do so, they rely on an extensive network of contacts and their knowledge of pre-existing data sets as well as the willingness of these organisations to share their data set. Additionally, this process results in the detachment of the data taking place outside of BIGS or any other governmental structure and within the outside organisations and NGOs.

Given that data included in the final UK Biodiversity Indicators Report is being provided by a broad range of actors and organisations, the quality of the data as well as the underlying data collection methodologies vary greatly. As a result, the datasets used do not only have to be detached from nature, but the data also has to be detached from its original organisation, collection methodology and purpose in order to be combined into a single biodiversity account. This additional necessary detachment work will be described within the next sections.

6.2.2 Detachment of data from collecting organisation

After appropriate data sources have been identified and access to them has been negotiated, data sets now have to be detached from their original organisations in order to be used within the national biodiversity accounting process.

6.2.2.1 Data collection

As mentioned before, most of the data used within BIGS was originally collected by conservation organisations across the public and third sector and therefore outside of governmental control. Each of these data collection institutions had to previously develop their own data collection processes, which were predominantly driven by their own data needs.

For example, the indicator A2. Taking action for nature: volunteer time spent in conservation is based on data on volunteer hours reported by 13 UK conservation organisations and charities. However, these volunteer hours were not recorded aiming to be used within the UK Biodiversity Indicators Report. As a result, some organisations only report estimations of their volunteer hours while others report their data in line with their financial year rather than the calendar year used within the UK Biodiversity Indicators Report. As a result, these reported numbers have to be manipulated in order to be transformed into a standardised biodiversity indicator. Another indicator, C9. Genetic resources for food and agriculture is based on data originally reported by breed societies. Initially, these data sets have been collected for pedigree animals to obtain pedigree certificates. It was only afterwards that this data are transformed into the UK Country Report on Farm Animal Genetic Resources (FAnGR), which becomes an input into official UK governmental reports.

However, there does appear to be some recognition of national data requirements through government funding of biodiversity work that includes the provision of data. However, most of the time, data collection takes place outside of the boundaries and controls of BIGS or other governmental institutions.

> "[JNCC] actually fund people to go and do it, but the actual people who are doing it are the NGOs I guess. […] All the specific NGOs that work for endangered species or wildlife." (Interviewee 4, Devolved Administrations)

All the data collection work takes place prior to the data being extracted and detached from its original calculative space in order to be selected and repurposed for national biodiversity indicator calculations. It is important to note that the underlying data used for indicator calculations were originally framed by research centres and NGOs to support their specific everyday biodiversity groundwork.

> "We produce these indicators […] on the contract, but they obviously rely on all the data that we already have. […] All of that, the regional data collection and almost to the stage of species trends is all done outside" (Interviewee 13, Biodiversity Indicators Forum)

The scope of this biodiversity groundwork varies considerably and can be geographically specific, species specific or specific to the purpose or mission of a charity or NGO. For example, the indicator C8. Mammals of the wider countryside only combines data from eight different bat species, excluding data on all other mammals as well as rarer bat species. This is due to the data sets being provided by the Bat Conservation Trust, who only collects data in line with their conservation focus on particular bat species. Additionally, the indicator C2. Habitat connectivity is only measured through butterflies with most butterfly monitoring sites being in England. A more detailed discussion about the geographical bias within the UK Butterfly monitoring scheme can be found under section 6.2.3 and in Graph 6.10. As such, it excludes any other species or habitat focus due to the data provider being the Butterfly Conservation charity.

To sum up, the majority of biodiversity data in the UK is not detached from the work of government statisticians but rather originates from on-the-ground action by volunteers and NGOs. As a result, data has been mostly collected to support conservation decision making and can be highly variable in terms of its scope or geographic focus depending on the organisations work. As a result, these data sets have to become detached from their original organisation in order to be transformed into national biodiversity indicators. This detachment process from nature takes place outside of the BIGS structure and is predominately being done by the conservation NGOs and research centres.

6.2.2.2 Ownership of the data

Even though the underlying data sets and indicator methodologies have been collected and developed by outside organisations, interviewees felt that the published UK Biodiversity

Indicators do not belong to these external organisations. Instead, interviewees stated that once that the indicators have been detached from the outside organisations and brought into the governmental calculative space, indicators now belong to the statutory organisations – often DEFRA and JNCC – and in turn are completely detached from the collecting bodies and NGOs.

> "Well, typically biodiversity indicators are owned if you like by statutory organisations so that could be probably UK level for environmental indicators is very often DEFRA." (Interviewee 8, NGO)

Particularly the provision of funding for the data collection was named as driving this detachment of data sets, leading to a feeling of ownership of statutory organisations of the UK Biodiversity Indicators. As such, once data sets become part of the BIGS structure and their calculative processes, they are seen as completely independent from organisations outside the BIGS structure.

> "If people pay budget for things, they've got a stake in them. It is a bit strange the situation that DEFRA sort of [looks] after this and other people therefore say well it's theirs. […] It´s their ownership." (Interviewee 14, Biodiversity Steering Group)

Additionally, this detachment of the final indicators from their original collecting organisation creates a form of independence between the reporters (the government) and the data gatherers (the biodiversity workers). This independence seems particularly important given that the UK Biodiversity Indicators are published as an official UK governmental statistic, requiring governmental statisticians to oversee the production process.

> "As Official Statistics, the presentation and assessment of the indicators has been verified by the data providers, and the production and editing of the indicators has been overseen by Government statisticians." (DEFRA, 2018, p. 2)

Overall, even though the underlying data sets have been collected by NGOs, research centres or other outside organisations, the published UK Biodiversity Indicators were perceived as belonging to DEFRA and JNCC. As such, data sets are seen as completely detached from the outside organisations involved in the data collection and as independent entities that are brought into the calculative process. This detachment of data sets and methodologies from the data collection organisations has been described as resulting from the governmental funding related to the data collection. Additionally, this detachment has been perceived as an essential prerequisite necessary to manipulate the data sets into official UK statistical publications within the next stage of the calculative process.

6.2.3 Detachment from original purpose

Besides data sets having to be detached from their original organisation, they also have to be detached from their original purpose. Mostly, data sets focus on a localised area and single species in line with the activities of the individual NGO. For example, and as mentioned earlier, the indicator C8. Mammals of the wider countryside only includes bats, in line with the activities of the Bat Conservation Trust. Similarly the indicator C6. Insects of the wider countryside only comprises data on butterflies, as the main data provider is Butterfly Conservation.

Moreover, as most data sets require volunteers to collect data – such as the indicators based on bird or butterfly data –, geographic bias within the data sets becomes an issue. As a result, while most of the data for these schemes is collected in the south of England, there is a lack of data from more remote, sparsely populated areas of the UK.

> “Geographic bias is a huge one particularly when you're dealing with voluntary data because of course the majority of the population is in the south of England. Because as you go north the number of observers to be able to get out onto the ground in Wales and Northern Scotland is actually really quite limited. So that does limit the amount of data available.” (Interviewee 5, Project Group)

A visualisation of the data collection locations for the UK Butterfly Monitoring scheme – a data set used for the indicators C2. Habitat connectivity and C6. Insects of the wider countryside (butterflies) – can be found In Figure 6.10.

Figure 6.10: Locations of Butterfly Monitoring Scheme (Source: JNCC, 2019c, p. 6)

Figure C6i. Locations of the 3,164 sites (blue) and 1,940 Wider Countryside Butterfly Survey squares (red) of the UK Butterfly Monitoring Scheme as at 2 May 2018.

As the data sets are being brought into the BIGS calculative space, these data sets as well as their calculative framing, tools and infrastructures, have to become detached from the underlying biodiversity conservation work and their original purpose. These extracted data sets now become individual entities within the BIGS calculative frame regardless of whether or not they have been collected for national biodiversity accounting purposes. This detachment is a necessary step in order to enable the repurposing of these data sets within the next stage of the calculative process.

6.3 Requirement of pre-existing infrastructure

Based on the process of members of BIGS actively identifying, negotiating and accessing possible already available data sources, the calculative process is highly dependent on pre-existing data collection infrastructures established by a range of institutions involved in biodiversity conservation work. Each of these institutions have developed their own infrastructures enabling them to collect data that fulfils their own performance measurement needs. Accordingly, most of the time, data calculations and collection infrastructures were developed before and independently of the need for biodiversity indicator reports. As a result, it cannot be assumed that these infrastructures are easily adapted to suit UK government accounting or policy needs. Thus, rather than accounting needs of users driving the data collection, it is the available data collection infrastructure that is influencing the accounting process by dictating what data sets are being collected, how they are being collected as well as when and how often they are collected and updated.

> "You need a whole infrastructure underneath it. […] I think that a lot of people, the policy makers, […] just don't realize all that effort and complexity that sits underneath the species trends that they find or get. The demands you sometimes get to do them

> a different way or, "Oh, wouldn't it be nice if they were like this" or six months earlier and you realize these people don't understand what's the amount of work, not just in this little indicator contract, but in the whole set of stuff that has to happen before that.” (Interviewee 13, Biodiversity Indicators Forum)

As a result, the process of rendering biodiversity calculable in the UK is highly dependent on pre-existing data collection infrastructures. Without these data collection procedures in place, the whole process of rendering biodiversity calculable would be threatened and the production of UK Biodiversity Indicators Reports would become problematic. Interviewees have particularly described the dependency of the data collection schemes on governmental funding as well as volunteers as a necessity to produce the UK Biodiversity Indicators Report.

> “Those data [are] provided by volunteers who contribute data to schemes. If the underpinning funding to the maintenance of those schemes is under threat, then the whole system is under threat.” (Interviewee 8, NGO)

To summarise, rendering national biodiversity calculable depends on the presence of pre-existing data collection infrastructures. In the UK, these infrastructures have been primarily implemented by NGOs and research centres in advance of and independently of the first publication of UK Biodiversity Indicators Report, but have an immense impact on rendering biodiversity calculable in the form of UK Biodiversity Indicators Reports. However, as such the UK Biodiversity Indicators Reports are highly depended on these pre-existing data collection structures and rather inflexible in adapting already existing collection methods if necessary.

6.4 Dependence on data availability

Given the dependency on pre-existing data collection infrastructure, data availability becomes one of the main drivers of the UK calculative process. As such, the process of producing the

UK Biodiversity Indicators Report does not start by making a decision on the indicators to be included within the report first and subsequently collecting the data necessary. Rather the data available drives the choice of indicators to be included in the report.

> “It is largely a pragmatic set of indicators to term them by data sets that are available, rather than what you might ideally end up with if you sat down with a big cheque, and a blank sheet of paper.” (Interviewee 8, NGO)

As a result, the question of how biodiversity is rendered calculable in the UK is predominantly influenced by the biodiversity data that has been made available to the calculative actors. Thus identifying, negotiating access to and detaching biodiversity data sets are imperative steps in achieving calculability for national biodiversity performance in the UK and pre-requisites for the following repurposing process.

6.4.1 Repurposing of already existing data sets

Interviewees highlighted that rather than BIGS constructing UK biodiversity indicators purely based on the accounting needs of statutory organisations, national governments and international treaties, most of these indicators have been mainly driven by the data made available from biodiversity conservation work. As a result, already existing data sets are repurposed for the use within the indicator set, as resources to collect new data are not available.

> “I think it's fair to say that what we've done with the indicators is to take what's available and reuse it. We've also developed new techniques to be able to analyse those data and that's good news. But saying I want to have a biodiversity statistic – ’Go away and collect me lots of new data’ is never going to work.” (Interviewee 5, Project Group)

While the interviewee above stated that this process of repurposing already existing data sets has led to novel ways of analysing data and thus biodiversity indicator innovation, other interviewees have stated that this dependence on already available data sets limits the development of new and innovative biodiversity indicators. As a result, the way biodiversity data is collected strongly influences the outcome of the calculable process – thus the UK Biodiversity Indicators Report – by determining the focus of the indicators as well as their complexity and novelty.

> "When it comes to doing something a little bit more complex, [you are] still having to return to the same old data sets, which are some of the standard biodiversity data sets. […] I don't think […] that we're monitoring everything that we could monitor in order to ask the questions that we're asking in a sensible manner or to address those questions in a sensible manner." (Interviewee 11, Research Centre)

The section above has highlighted how it is not the accounting needs that drive the data collection process, but it is the data that drives the accounting process. Consequently, the UK Biodiversity Indicator process relies on data availability and the repurposing of already collected data sets, rather than the development of new data collection methodologies or infrastructures. However, while some interviewees highlighted how this repurposing process enables the development of new calculative innovations, other interviewees have expressed their opinion that the dependence on pre-existing data limits the development of certain more complex indicators. Accordingly, while some actors felt that even though they were highly restricted by the available data, their ability to develop new analysing techniques to repurpose these data sets has been important to ensure the indicators appropriateness to be used within the UK Biodiversity Indicators Report, others felt that better and more intricate indicators to measure biodiversity cannot be developed due to the current underlying data collection process. This tension between the available data sets and the development of new indicators is further visualised in section 7.2.3.2, highlighting the challenge of developing ecosystem service indicators due to a lack of available data.

6.4.2 Pragmatic rather than idealistic work

Given that interviewees described the possibility of collecting additional or new data as highly unlikely, the availability and accessibility of pre-existing data sets is essential to the framing and calculative work of producing UK biodiversity indicator sets. As a result of the constraint of data availability on the UK Biodiversity Indicators Report, interviewees described the process of UK Biodiversity Indicator development as predominantly driven by pragmatic rather than ideological concerns.

> "You're extremely constrained by the data that's available, so they're a very pragmatic set of indicators." (Interviewee 9, Academic Institution)

Overall, the data collected strongly influences the focus of the biodiversity indicators included in the UK Biodiversity Indicators Report. As such, actors collectively decide to accept or not accept data sets and indicator methodologies based on the data that has been made available to them, rather than deciding on the indicators to be included first. As such, it is not the actors involved that are necessarily setting the focus and boundaries of the indicator set, but rather the data available. Additionally, interviewees have criticised that indicator development approach as negatively impacting on the quality of the indicators.

> "I think the overall perception was that [the indicators] were often driven by the information that was available, not by the information that you would choose to answer the question that they were necessarily targeted towards answering. […] Decisions had been made basically, to accept data in the form that it existed in and do

> the best that could be done with that rather than saying, 'Right, this is what we need to know. This is how we would have to find it out.' […] I think there's no doubt that the quality of those indicators is limited by the data available to inform them." (Interviewee 10, Academic Institution)

Additionally, interviewees highlighted how this choice of relying on existing data sets and indicator methodologies has been primarily a political decision. By limiting the funding available to collect additional biodiversity data, any indicator development had to rely on already available data. As a result, it is not the lack of academic or scientific knowledge that is limiting the development of new biodiversity indicators, but rather the lack of financial support for biodiversity monitoring initiatives.

> "No, it's a resourcing issue. We know enough about monitoring species to know how to generate the kind of data we need for a robust indicator. What we don´t have is the money to fund the manpower to do the monitoring." (Interviewee 10, Academic Institution)

To summarise, the process of constructing UK Biodiversity Indicators is predominantly influenced by pragmatic decisions involving data availability, accessibility and resources. It is not a process in which data collection processes are being designed to allow the calculation of pre-constructed biodiversity indicators but rather a process in which the available data influences the construction of pragmatic indicators. As a result, the quality of the UK Biodiversity Indicators Report is highly dependent on what data has been made available within the calculative process and to what extent this data was able to be repurposed to answer the specific questions asked within that report.

6.5 Example of Bird Indicator

To illustrate the whole data collection and detachment process outlined above, the following section will focus on the process necessary and involved in setting up the suite of UK Bird Indicators included within the UK Biodiversity Indicators Report.

Within the current indicator set, many indicators and indicators methodologies have not been developed for their specific use within a national biodiversity account. Rather, they pre-existed the publication of the first biodiversity indicators set in 2007 and have been constructed for on the ground conservation work by NGOs and Research Centres. One of these pre-existing indicators have been the UK Bird Indicators, which were described by interviewees as one of the oldest UK biodiversity indicators. According to the British Trust for Ornithology (BTO), national bird monitoring schemes have been in place since the 1970 in the UK, providing one of the oldest comprehensive biodiversity data sets worldwide (BTO, 2019). Based on that long history of the UK with bird data sets, interviewees highlighted the immense pre-existing data collection infrastructure in place, particularly relying on volunteers going out, counting and recording the number of particular bird species.

Following, the data collection and detachment process of the bird indicators will be outlined, in order to highlight how data availability, pre-existing data collection infrastructures and the work of volunteers and NGOs drive the final bird indicators. In doing so, this chapter will illustrate how the process of constructing UK national biodiversity indicators is not just dependent on statistical data transformation or the final publication of the indicator, but rather data accessibility and availability as well as the work done outside of the governmental BIGS structure by NGOs and research centres are central in rendering biodiversity calculable.

6.5.1 Data pre-existed the indicator

As mentioned above, the data collection infrastructure underpinning the UK Bird Indicators has been developed many years before the first set of national UK biodiversity indicators has been published. As described by the interviewee below, most of the bird surveys building the foundation of the data sets used within these indicators have been collected regularly since the year 2000, with some of the data sets even going back to the 1970s. These data sets have been collected by the British Trust for Ornithology (BTO) in collaboration with the Royal Society for the Protection of Birds (RSPB) mainly for their own bird conservation work and were described as being regularly used to inform the NGO's day to day conservation work and decision making.

> "We first did those in about 2000. […] We run a lot of annual programs like the breeding bird survey, the wetland bird survey, which is a winter bird survey of water birds, mainly. Then lots of special surveys on particular species, not all of them every year. […] That's the data we use in the indicators, but it's also the data we use for everything else. These long-term data sets are one of the BTO's most valuable resource. Because they go back in time, some of them back to the 1970s, we can use them to address, investigate all kinds of issues, even issues we don't know are a problem now." (Interviewee 13, Biodiversity Indicators Forum)

Additionally, the Farmland Bird Indicator was named by interviewees as one of the first multi-species indicator ever constructed in the UK and has been developed around the year 2000. At that point in time, this indicator was chosen by DEFRA as a UK Sustainable Development Indicator and included within their set of national governmental indicators. It was only later on, that this indicator was repurposed in order to be used within the UK Biodiversity Indicators Report as a legitimated biodiversity indicator. Since then, birds have been regularly used to represent the condition of the wider countryside within the UK Biodiversity Indicators Report. Additionally, this particular indicator has provided the underlying methodology that was later on used for all additional bird indicators included within the wider suite of UK bird indicators included in the UK Biodiversity Indicators Report.

> “Part of the first work developing biodiversity indicators in the UK was developing a thing called the farmland bird index that was one of the first kind of synthetic multi-species indices that was dreamt up at a time […]. People at RSPB and BTO came up with the idea and I was the first person to create that index and publish a version of it around 2000. […] And that was in response to the UK government at the time – the Department of the Environment – were very interested in understanding how they could measure Sustainable Development […] in terms of how it affected the countryside so the farmland bird indicator birds were chosen […] as emblematic of the environment and the wider countryside”. (Interviewee 7, Biodiversity Steering Group)

To summarise, the Bird Indicators included in the UK Biodiversity Indicator set have not been constructed with the purpose of national biodiversity reporting in mind but have rather pre-existed any national biodiversity reporting. Instead, they have been developed by NGOs relying on data sets from the 1970s and early 2000s and have later on been adapted to be used by DEFRA in the UK Biodiversity Indicators Report. As such, the inclusion of bird indicators as species indicators within the UK Biodiversity Indicators Report predominantly results from the availability of already existing bird indicators within the set of UK Sustainable Development Indicators and the possibility to repurpose these into legitimated biodiversity indicators.

6.5.2 Data collected by volunteers

As described by interviewees, most of these bird data sets have been collected by volunteers going out, counting and recording birds. Once volunteers record the numbers of individual bird species, these data sets are then being collated by the BTO and transformed into distinct bird data sets to be used for the production of bird species trends. As stated below, part of this data collection work is being funded by governmental organisations including DEFRA and JNCC, while other data collection work takes place outside of governmental funding. However, and despite the provision of funding from DEFRA, the whole data collection process as well as the initial detachment of the data from nature takes place outside of BIGS and as part of the volunteer work in counting bird species.

> "You've got volunteers for the most part collecting that data. That data is collated, archived and analysed by organizations like BTO and we produce the species trends. Some of that has funding, some of it doesn't." (Interviewee 13, Biodiversity Indicators Forum)

Once these bird data has been collated into comprehensive data sets and transformed into distinct bird species trends by the BTO, the indicators are then detached from their original data collectors – the volunteers – and brought into the BIGS structure through the BTO and RSPB. In this case, the BTO and RSPB act as intermediaries between the volunteers collecting the data and the governmental statisticians transforming the data sets into legitimated indicators. As a result, the first detachment of the data sets and the volunteers takes place within BTO and outside of BIGS or any other governmental structure.

> "We don't get data directly from the volunteers. But for example, with the bird data, we buy it. We pay for the data through BTO, […] but ultimately the data comes from people counting birds." (Interviewee 6, Project Group)

To summarise, the UK bird indicators depend heavily on the work done by volunteers, who go out and record the number of bird species. These individual species counts are then being collated by the BTO into distinct species trends and data sets. This process results in the detachment of the bird data from nature in the first place as well at the detachment of the data sets from their original providers – the volunteers.

6.5.3 Collaboration between public sector and NGOs

Now that the data is collated into distinct data sets and detached from the original data collectors, the bird indicator construction process becomes a collaboration between the NGOs – mainly BTO and RSPB – and the public sector organisations. This collaborative process is framed through an official contract between DEFRA – now JNCC – and the BTO and RSPB, outlining and specifying the public funding obligations, the deadline for the indicator provision and other details of the indicator production.

> “The bird indicators have always been a close collaboration with RSPB, so BTO and RSPB. We essentially produce them. We're paid to do it by Defra, the government and […] now it's actually under our JNCC contract. […] They pay for it, but we hold the data, BTO runs the schemes and we lead.” (Interviewee 13, Biodiversity Indicators Forum)

The interviewee below highlighted how this contract has framed and formalised the collaboration between the organisations involved. However, the interviewee highlighted how the contract only covers a small part of the work necessary to produce the bird indicators and as such only provides a partial framework for the collaboration. As a result, a lot of work included in the bird indicators is done outside of any contractual arrangement as part of BTO’s normal day to day work resulting in overflow to the existing contractual frame.

> "Obviously, we are under contract to deliver these. Although we develop them in the first place, now they've paid for it so it's a job. We have deadlines, we have to deliver, we have a budget that has to be negotiated every year so it's very much like that even though a lot of the work depends on the underlying data that we already hold and have collected ourselves." (Interviewee 13, Biodiversity Indicators Forum)

Once the data sets and indicators have been brought into the governmental space, they become detached from the BTO and RSB. This detachment results in a sense of ownership of governmental organisations over the indicators and has been described as necessary for the transformation of this NGO data into official national governmental statistics.

> "I feel like they have a bit more ownership of them now because they have taken the lead on producing the national statistics report, so that's been good." (Interviewee 13, Biodiversity Indicators Forum)

Overall, the production of the UK bird indicators is a collaboration between BTO, RSPB, DEFRA and JNCC, with DEFRA and JNCC funding parts of the collection and collation of bird species counts into distinct UK Bird Species data sets and indicators. Afterwards, these indicators are brought into the governmental space through the detachment of the indicators from the BTO and RSPB, a step described as necessary for the indicators to be included in the official UK Biodiversity Indicators Report.

6.5.4 Dependence on existing infrastructure

As mentioned before, counting and recording bird species has a long tradition in the UK and the infrastructure to account for birds has been around for years before the decision to set up UK Bird Indicators was taken. As highlighted in the quote below, producing the final bird indicator is just the last step of a process which heavily relies on already implemented structures and pre-existing work. Additionally, interviewees highlighted how maintaining this infrastructure is work intensive and reliant on ongoing funding. As a result of this dependency on an already existing infrastructure, indicators such as the bird indicators cannot be easily replicated for other species and the pre-existence of the data collection infrastructure are a necessity for the production of biodiversity indicators.

> "The contract that we're talking about, […] is a very top of the pile of work, which is aggregating this, producing and interpreting the final indicator. You couldn't replicate that just for anything […]. You need a whole infrastructure underneath it and that's why it's another reason why it's worked for birds, for butterflies, for bats, but you can't just immediately implement that for anything. […] Even though the infrastructure was developed a long time ago, it still requires a lot of that effort." (Interviewee 13, Biodiversity Indicators Forum)

Additionally, the UK bird indicators do not only rely heavily on a pre-existing infrastructure, but also on the repurposing of already collected data sets and methodologies. Consequently, the final bird indicators included in the UK Biodiversity Report tend to be repurposed versions of indicators already produced and sometimes even published in a vaguely different version by the BTO.

> "Yes, they tend to take what we've already produced generally or bits of it, then reproduce it in their own, often presented slightly different, but it's essentially the same data and the same message." (Interviewee 13, Biodiversity Indicators Forum)

As a result of this pre-existing infrastructure and the UKs history with collecting bird data sets, UK species indicators tend to nowadays be heavily dominated by bird species. Up to this point in time, the only species represented and accounted for within the UK Biodiversity Indicators Report have been birds, butterflies and bats, with the interviewee below pointing out the rationales behind the domination of bird indicators and some of the criticism received for it.

Particularly the data availability for bird indicators has been pointed out as a reason for the inclusion of these indicators in the UK Biodiversity Indicators Report. However, bird indicators might not optimally reflect the ecosystems that they are claiming to be indicators for, but up to this date no additionally indicators focussing on other species have been introduced into the UK Biodiversity Indicators Report.

> “I think there was some criticism of the whole suite of biodiversity indicators group, that maybe we had too many. […] There’re quite a few bird ones. [Do] we need so many bird ones compared to some of the others? The reason there were so many bird ones is that's one of the best data sets. They go back a long time. They turned out to be a really effective. […] They're reliable. But I think people are worried they dominate the indicator set. It's fine as long as people think what the bird ones tell them are reasonably representative of the countryside, but if birds were doing really well and insects and things were doing really badly, obviously, people would start to think, "Oh, they're not very effective." (Interviewee 13, Biodiversity Indicators Forum)

In addition to the criticism received for bird indicators maybe dominating the indicator set, the bird indicators show inconsistencies in the time frames in which certain data sets are being collected. As mentioned by the interviewee below, how often certain data sets are being collected varies between different species, with the majority of the collection schemes being run annually while around one fourth of the data is coming from periodic surveys which might only take place every 10 years. Thus, the timeframe of data used within these indicators can be highly inconsistent and indicators can vary in their abilities to highlight timely issues.

> “The bulk of the data in the indicators comes from annual surveys. I would say about 75% of the data, in the bird indicators, this isn't true of all the biodiversity indicators, but of the bird indicators, this is collected every year so that information is updated every year. The other 25% comes from periodic surveys so they might be done every

> 10 years, for example. You'll go nine years without it really being updated, but then, every 10 years, you can add a new point to the line and extend it further.” (Interviewee 13, Biodiversity Indicators Forum)

As a result of this limitation, the 2018 UK Biodiversity Indicators Report has not been able to update its Seabird Indicator and had to rely on the 2016 version of the same indicator. Consequently, the lack of more up to date data for this indicator has resulted in irregularities within the bird indicators used and a lack of consistency within UK Biodiversity Indicators Reports.

> “In 2016, the Seabird Monitoring Programme Steering Group made the decision to put the analysis and publication of the annual SMP report on hold for two years. The reason for this was to enable staff time to be dedicated to the breeding seabird census, Seabirds Count. Although data is still being collected, and in higher volumes for the census, the absence of analysed data for 2016 means this indicator has not been updated.” (DEFRA, 2018, p. 38)

Additionally, interviewees recognised the limitations of the final indicators arising from the data collection methods deployed. In case of the bird indicators, the data sets are based on people going out and counting birds within the UK. However, birds migrate between different countries particularly between different seasons. As a result, the current temperature can be highly influential on whether high counts of particular birds are being reported in the UK or not, which is not necessarily an indicator for the state of this species in general. Nevertheless, up to this point, the bird indicators have not been able to capture the migration of birds in any sensible manner, due to the lack of alternative data.

> “The wintering waterbirds, it's still a challenge because we know that wintering waterbirds is based on counts. […] The degree to which they come to the UK for the winter depends a lot on climate. Perversely, if it's a warm winter across Europe, […]

> they may choose to stay in Scandinavia for the winter and not come to the UK, so we have low numbers. Though as conditions are warmer, we get low numbers of some species. There are quite complex relationships." (Interviewee 13, Biodiversity Indicators Forum)

However, even though interviewees were aware of these limitations, the bird indicators have been part of UK Biodiversity Indicators Reports without interruptions – while still undergoing change within the methodology and presentation of the indicator – since its first publication in 2007 and have been considered by interviewees as one of the best indicators available in the UK. This confidence arises particularly from the UKs longstanding history of recording bird species and its trust in its existing infrastructure and underlying data set. Additionally, the dependence of any biodiversity indicator on a data collection infrastructure makes the replication of the bird indicators for other species difficult and thus bird indicators were seen by interviewees as one of the most available and reliable indicators.

To summarise, this paragraph has illustrated the data collection and detachment process for UK Biodiversity Indicators using the example of the UK Bird Indicators. These indicators have not been constructed with the purpose of being included into a national Biodiversity Report but have rather been developed by NGOs – particularly BTO and RSPB – relying on data sets collected since the 1970s and early 2000s. Since 2000, they have been adapted to be used by DEFRA as Sustainable Development Indicators before being modified to be UK Biodiversity Indicators.

The work of calculating these indicators depend on volunteering work, by which volunteers count and record the number of particular bird species in a specific geographical area. These individual bird species numbers are then being integrated by BTO into distinct data sets before being transformed into bird indicators. As part of this process, the original data sets are being detached from their original data providers before being transformed into UK national biodiversity indicators.

Once this detachment took place, the process of constructing the indicators becomes a collaboration between BTO, RSPB, DEFRA and JNCC, which is formalised through official funding contracts. As a result, DEFRA and JNCC become owners of the final indicators while BTO remains owner of the underlying data sets. However, publishing the final indicators is only the last step of a process that heavily relies on the availability of pre-existing infrastructure and the repurposing of already existing indicators. Particularly the dependence on this pre-existing infrastructure makes it difficult for other species indicators to be constructed. Thus, although the bird indicators have been criticised for various flaws, they are still seen as the most reliable, available and robust indicators that the UK is able to construct.

6.6 Summary

This chapter has aimed to understand the first stage of Callon and Law's (2005) process of achieving calculability – the detachment of relevant entities to be brought into the single framed space. Overall, this chapter has argued that rendering biodiversity calculable requires work in identifying, collecting and detaching datasets to be used within biodiversity reporting. On a UK level, most data sources used within the UK Biodiversity Indicators report have not been collected by DEFRA or with the purpose of being used within a national report in mind. Rather, non-governmental data collected by a broad range of research centres and NGOs for their day to day conservation work becomes repurposed for inclusion within this report. It is within these non-governmental organisations that the detachment of data from nature takes place, driven by their own data needs.

There does appear to be some recognition of national data requirements through government funding of biodiversity work that includes the provision of some data. However, most of the time, these data calculations and collection infrastructures were developed before and independently of the need for the UK Biodiversity Indicator Reports. In order to be used within this official, governmental report, data sets now have to also be detached from their original organisation and underlying collection purpose. It is at this stage, that the data sets are brought into the BIGS structure and become available for the following transformation and manipulation work.

As a result, this chapter has highlighted how data availability and pre-existing data collection infrastructures have been driving the indicator development work done by the UK government. Moreover and as a result of this outside data collection process, data included in the final UK biodiversity indicators reports originated from a broad range of different organisations and was collected using diverse data collection methodologies. Additionally, the scope of the data collected varies considerably depending on the purpose or mission of the collecting organisation or the original purpose of the data. Thus, the quality of data collection and consequently the quality of the data sets differs significantly, making it challenging for these data sets to be combined meaningfully into a single biodiversity indicators report.

Moreover and because of the data collection methods and infrastructures being developed outside of the government space and already before the first biodiversity indicators report, the infrastructures and methods cannot be easily adapted to fit UK biodiversity indicator accounting or policy needs. Thus, it is not the accounting needs that are driving the data collection process, but rather the data availability that is driving the accounting and the decisions on indicators to be included in the report. As a result, the quality, focus and boundaries of the UK biodiversity indicators are pre-defined by non-governmental data collection schemes and pragmatic data choices influenced by governmental funding constraints.

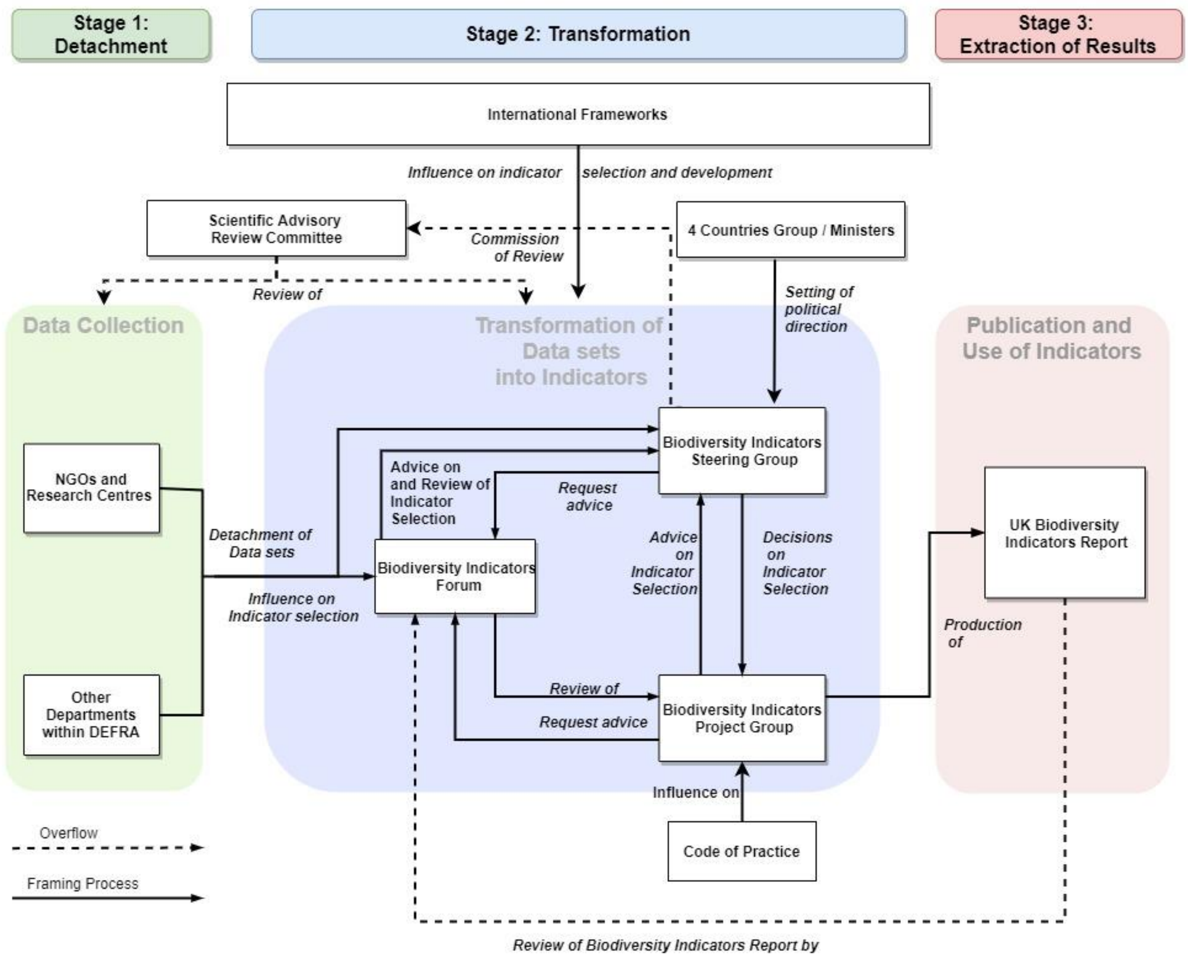
CHAPTER 7: TRANSFORMATION AND MANIPULATION OF DATA SETS INTO INDICATORS

"When we produce Biodiversity Indicator[s], which is sort of [a] little kind of machine that we run out every year, it is basically taking all of the species which we got models, stacking them up and producing a summary and that becomes the indicator." (Interviewee 1, Biodiversity Indicators Forum)

7.1 Introduction

Within this chapter Callon and Law's (2005) second stage of calculation concerning the transformation and manipulation of those entities brought into any framed space will be explained. It will be argued that achieving calculability for performance and policy formulation in relation to biodiversity requires work to determine how biodiversity data will be combined and transformed into legitimated measurements. Within BIGS, this transformation and manipulation work is mainly undertaken by the Biodiversity Indicators Project Group (Project Group). This is the group responsible for producing the UK biodiversity indicators. An overview of the calculative process discussed within this chapter can be found in Figure 7.11.

Figure 7.11: Second stage of the calculative process



This chapter will outline the steps considered necessary in BIGS to complete the manipulation and transformation process in order to address the challenges faced by the Biodiversity Indicator Steering Group and the Project Group. As such, it will outline how the process of selecting biodiversity indicators is influenced by the imported data sets, compliance with the statistical *Code of Practice* and the need for the selected indicators to fulfil UK policy needs whilst complying with international frameworks. However, this chapter will explain how the process of transforming data sets into biodiversity indicators is predominantly influenced by the UK *Code of Practice* for official statistics and how the manipulation process does not only involve the transformation of data sets into legitimated indicators but also a qualitative judgment of indicators trends over time using a red, amber and green (RAG) traffic light system.

Following, section 7.2 will analyse how the UK Biodiversity Indicators are selected and curated by the Biodiversity Steering Group. To begin with, the selection and curation process will be outlined, identifying the factors that are influential within that work. This selection process will be illustrated using the examples of the Habitat Connectivity Indicator and the Status on Pollinating Insects indicator. Subsequently, section 7.3 will highlight how the Project Group transforms the previously detached data sets into legitimated Biodiversity Indicators. To do so, section 7.3.1-7.3.3 will outline the process and the steps deemed necessary for the transformation process, while sections 7.3.3.1 and 7.3.4 will use the examples of the Sustainable Fisheries Indicator as well as Bird Indicators to illustrate this process in practice. Lastly, the chapter will be summarised in section 7.4.

7.2 Development of biodiversity indicators

Before the Project Group can start the transformation and manipulation of the biodiversity datasets into national biodiversity indicators, the Biodiversity Steering Group has to decide the composition of the forthcoming UK Biodiversity Indicators Report. The Biodiversity Steering Group under the leadership of JNCC, has to determine whether new biodiversity indicators have to be developed or whether existing indicators require modification or are suitable for inclusions.

> "Led by the JNCC. You probably know the Joint Nature Conservation Committee. They chaired and led in collaboration with DEFRA. They are effectively working on behalf of DEFRA for the whole of the UK. The main interest there is in producing a UK-wide account." (Interviewee 2, Environmental Agency)

This selection, modification and exclusion process involves extensive collaboration between different voluntary and public service actors working together within the BIGS sub-space created by the Biodiversity Steering Group.

> “The development of biodiversity indicators in general in the UK is, I guess you could say, a collaboration between the voluntary sector and government.” (Interviewee 8, NGO)

This collaboration incorporates recommendations made by the Biodiversity Indicators Forum, which includes NGOs and research institutions. As part of this work, the Biodiversity Indicators Forum brings together, two to three times a year, various scientific, statistical and political perspectives and priorities to specify regularly which indicators should be included in UK Biodiversity Reports and which data sets should be manipulated and transformed into legitimated to measures of each individual indicators.

> “The Biodiversity Indicators Steering Group, we have meetings two or three times a year to review the progress on the creation of the indicators, often by advice under different organizations, but then collated by JNCC for DEFRA.” (Interviewee 15, Biodiversity Steering Group)

Researchers and academics also play an important part in advising governmental actors in the legitimation of existing indicators and providing advice on how to develop new biodiversity indicators. Overflow created by scientific indicator methodologies or monitoring is brought into BIGS through academic review panels and advisory committees.

> “We have a scientific advisory committee. It is made up of largely academics and they are a group that we go to and say: ‘Right, we want to develop indicators; what do you think would be good things to put in there?” (Interviewee 12, Biodiversity Steering Group)

Thus, developing UK Biodiversity indicators becomes a collaborative process between political, conservation, statistical and scientific actors working together within BIGS. As such, the final indicators to be included in the UK Biodiversity Indicators Report are selected by the Biodiversity Indicators Steering Group, which is however advised by various academic, non-governmental and scientific organisations.

7.2.1 Factors influencing the selection process

This section will discuss the factors influencing the selection process of UK Biodiversity Indicators. These include the need for pragmatism when deciding which indicators to publish, the necessity for indicators to be policy relevant as well as indicators having to comply with international obligations and frameworks such as the CBD treaties.

7.2.1.1 Balance Idealism and Practice

Interviewees described the need to balance idealism and practice as a main influence on how indicators are selected and developed. As discussed earlier in chapter 6, the development of indicators is heavily influenced by the data imported into the calculative space resulting from prior detachment decisions outside of BIGS. Furthermore, the process of selecting the final indicator set was described as iterating between what the ideal indicators should be according to the international frameworks and the scientific and academic advice and what was realistic in terms of the data that was made available to the Biodiversity Steering Group through the previous detachment work. This iterative, reflexive process aims to achieve a pragmatic consensus between the actors as to which indicators are acceptable, even though they might not fulfil all criteria established at the beginning of the indicator selection process.

> "Okay well we have these data sets, they're not ideal, are we willing to accept them as […] indicators even though they're possibly not ticking all the boxes? In that sense, you see what I mean of it being iterative. […] It starts with a concept and an aim. Then you put it through the filter of what data is available." (Interviewee 11, Research Centre)

Interviewees stated that their aim within this process is to publish some form of legitimate acceptable biodiversity indicators even though they might not be considered ideal or perfect by all actors or might be non-compliant with international frameworks or latest scientific methods or findings. Publishing BIGS legitimated indicators that are able to pragmatically demonstrate trends and developments in UK biodiversity – even if recognised as imperfect – was seen as preferable by interviewees over not publishing any indicators at all. In that sense, publishing any form of acceptable, – to the actors involved, – and judged sufficiently compliant with the UK official *Code of Practice* and the international biodiversity frameworks – was preferable over a complete absence of any calculative measures.

> "In terms of development of these indicators. There is a huge balance between idealism and practice. We've tended to go with a very strong dollop of pragmatism on the basis of it's better to have something that we can measure and that we can show some trend with rather than […] going 'oh no it's too difficult'." (Interviewee 5, Project Group)

Selecting, manipulating and transforming legitimate UK Biodiversity Indicators can be described as a process of finding consensus on pragmatic measures and mediating between the different actors involved in the calculative process, rather than as a process aiming to construct perfect – as defined by international biodiversity frameworks and the scientific advisors – indicators to measure UK biodiversity. As a result, while the indicators have been perceived as acceptable by the governmental actors involved, the independent Academic

Review Panel commissioned by DEFRA in 2015-2016 has criticised the indicators as not being ‘perfect’, with the indicators critiqued as being heavily biased towards whatever was seen as realistic to be measured.

> “You're extremely constrained by the data that's available, so they're a very pragmatic set of indicators. […] These aren't necessarily the perfect indicators, these are the indicators we can measure. […] When we produced the [review] report for those first sets of indicators, [we] identified areas where we felt work to develop more and better indicators will be useful” (Interviewee 9, Academic Institution)

In general, actors involved in the construction of biodiversity indicators mentioned that the indicator development involves two interconnected processes. One process starts by imagining what each particular indicator should be, what it should be able to indicate and what data would need to be collected for this indicator. In most cases, this stage requires public service organisations to collaborate with academia and research centres in order to identify which indicators could or should be developed and associated data qualities or other requirements.

The other process is driven by the reliance of actors on existing data sets and their inability to resource new data collection infrastructure. This process requires reviewing existing data sets to identify whether any these data can be used for the imagined ideal indicator. If this is not possible, the indicator specification set out at the beginning is revised and these two processes iterate until a compromise indicator that can be calculated using the available data is identified and agreed on by the actors.

Overall, this section highlights how developing national biodiversity indicators involves balancing idealistic and pragmatic concerns and mediating between the different actors involved in the process. Interviewees highlighted that they are aware that the indicators developed are limited by pragmatic concerns around data availability and are not perfect in the sense of fulfilling all requirements that were set out at the beginning of the indicator development process. Still, it was felt by the interviewees that a pragmatic approach of publishing some indicators is better than not publishing anything at all. As a result, interviewees preferred publishing what they considered non-ideal indicators and subsequently working on improving them, rather than trying to develop imaginary perfect, but currently incalculable indicators that will not be published in time to meaningfully inform policy or conservation work.

7.2.1.2 Need for usefulness

During the transformation and manipulation work, actors were influenced by the need to ensure the usefulness, as determined by the actors comprised within BIGS, of these indicators. This usefulness deliberation process required mediating between the needs of UK policy makers, agencies of the 4 countries', the conflicting requirements of international biodiversity frameworks, scientific advisors and external stakeholder legitimation. In order to ensure policy relevance at all four UK country levels, the UK Biodiversity Indicator set was developed in line with the information needs articulated by each country's environmental agency. As a result, the indicators developed have to be able to indicate progress at varying geographical scales – including international targets and goals, national strategy and targets as well as local conservation initiatives. They also have to be able to be updated regularly and ideally need an underlying reliable data set that is collected timeously using consistent collection protocols.

> "Criteria for indicator selection were examined in relation to the main information needs of country agencies. Criteria included: illustrating outcome relative to policy objectives; providing clear trend data; being applicable at a variety of geographical scales; and allowing for frequent updates." (Biodiversity Indicators Forum, 2002, p. 4-5)

Likewise, policy makers are concerned to ensure that the indicators included within any UK Biodiversity Indicators Report were policy relevant and that funding provided for data collection was used efficiently i.e. to support their policy objectives. As a result, policy aims were an important influence on the manipulation and transformation of UK Biodiversity Indicators, particularly as political actors were making funding decisions on specific data collection schemes, influencing the resourcing and transformation of data into politically relevant and appropriable indicators or evidence.

> "A lot of it was dealing with JNCC and the data that they collect and working with [Project Group] to try to steer them in the way that we wanted them to go in terms of data collection and the things that they could provide and analyse for us. […] How can we maximize the efficiency of our funding by getting the most out of [Project Group]? How can they help us?" (Interviewee 4, Devolved Administrations)

Besides policy advisors ensuring that the UK Biodiversity Indicators were useful for their work, members of environmental agencies and the Biodiversity Steering Group also mentioned the benefits of working together with policy makers. Particularly the process of identifying which data sets are already available within other governmental departments enabled members of the Biodiversity Steering Group to find gaps and issues that currently have not been rendered calculable on a UK national basis.

> "There is always a link to government policy. Which sounds as though it could be quite awful, but in practice tends to work out quite well. You know things like planting trees sounds like a good thing. Well, ok, if planting trees is good, do we need an indicator for woodland quality, or can we capture that through our site conditioning monitoring – Forest commission captures that on a wider basis." (Interviewee 12, Biodiversity Steering Group)

As a result, any biodiversity indicator included within any UK Government Biodiversity Indicators report had to be framed as policy relevant by the actors involved in the calculative process. Additionally, members of the Biodiversity Steering Group highlighted the importance of internalising the overflow created by international framework into the indicator development process. International biodiversity frameworks were identified as hugely influential in setting policy directions and aims and as such shape the political dimension of the space in which the UK Biodiversity Indicators process is framed. Particularly the CBD strategic goals were identified as an important source of overflow to be considered when negotiating policy relevant biodiversity indicators.

> "What I think is important is thinking about the framework that underpins the choice of the indicators. And the idea here is that this is about the sorts of questions that policymakers want to be able to ask and to answer so. Why are we losing biodiversity? How is it changing? What's the implications? What are we going to do about it? […] But it's actually also really important those matches very nicely with those strategic goals. So, in fact it provides a really nice way of thinking about the indicators." (Interviewee 5, Project Group)

To summarise, as the indicators have to be considered policy relevant, information needs articulated by country agencies were taken into account during the indicator selection. Policy advisors felt the need to steer – using the provision of funding – the data collection and analysis process underlying the UK Biodiversity Indicators Report in directions that enabled them to use the final UK Biodiversity Indicators for policy decision making. As such, overflow created by the UK signing up to international biodiversity frameworks has been internalised into the construction of the UK Biodiversity Indicators through the multi-organisational, collaborative BIGS structure.

7.2.1.3 Compliance with international frameworks

In addition to the need of the indicators being policy relevant, the UK Biodiversity Indicators also have to comply with the data requirements set out under the international frameworks signed up to by the UK, such as the latest CBD Aichi targets. Particularly the UN CBD targets have therefore been described as a huge influence on developing UK Biodiversity Indicators and have been named as the reason on why the UK Biodiversity Indicators Report has been developed in the first place.

> “The core of our ambition is the CBD and of course, […] everything relates ultimately to [the] CBD. That's why we produced that account[10].” (Interviewee 2, Environmental Agency)

As such, the UK Biodiversity Indicators were not just developed for policy making, but also in order to fulfil international obligations towards the CBD, which from 2005 onward required their signatories to track national biodiversity performance using self-developed indicators. As part of this, signatories were considered compliant if they developed and reported indicators towards the CBD targets, without further specification on how these indicators have to look like in detail. However, interviewees highlighted how their understanding of being

[10] Within this quote ‘account’ relates to the UK Biodiversity Indicators Report.

compliant with the CBD also included regular publications of these biodiversity indicators on a national level. As such, the terminology of consistency used by the interviewees related to the fact that indicators were published every year, rather than that the UK Biodiversity Indicators Report contained consistent indicators.

> “Maybe certain of our indicators are very relevant to the national level [...]. But at the international level […] the CBD is […] influential on the fact that we consistently and regularly produce the full set.” (Interviewee 6, Project Group)

Additionally, interviewees highlighted that the whole set of biodiversity indicators was framed by the strategic context given by the CBD framework. As such, the CBD targets shaped the national policy context including the UK Biodiversity Strategies under which the UK Biodiversity Indicators were embedded.

> “The national level strategy is saying well "We've signed up to the CBD, what are we going to do to deliver it?". Then the indicators are developed within that setting, within that context. It's something that's come down from the CBD.” (Interviewee 11, Research Centre)

With the latest set of CBD targets, namely the Aichi targets, being agreed on in 2010, all existing indicators in the UK were mapped against this new international framework in 2011 (DEFRA, 2011). In this process, all previously used UK biodiversity indicators were reviewed to ensure their compliance – as defined by the actors involved – with this new international framework. As described by the interviewee, ensuring compliance with the Aichi targets was particularly understood as the necessity to reframe the presentation of the indicators in line with the Aichi targets, rather than the development of a whole new suite of biodiversity indicators. Additionally, the conclusion drawn from that review process was that all of the existing indicators are appropriate within the new CBD framework, but that there were gaps within the UK Biodiversity Indicators Report and targets under the CBD Aichi framework which currently could not be rendered calculable using the existing set of indicators.

> “We recognized in the run up to 2010 as the Aichi targets were being negotiated and obviously post 2010 once we actually got them, that we would need to rethink the presentation of our indicators. What we did was to do a review of them and in order to try and identify which were still needed, which ones we could fit within the new framework. That became fairly quickly clear that we basically needed all of them plus some.” (Interviewee 5, Project Group)

Subsequently, mapping existing indicators against the Aichi Biodiversity Targets led to the identification of gaps, which resulted the development of new indicators in line with the CBD strategic framing of biodiversity. The following section, section 7.2.3.2 will outline this process using the example of the indicator on the Status of Pollinating Insects. However, it was also highlighted by the interviewee below that this mapping has not been a straightforward process and that linking the UK Biodiversity Indicators and the CBD Aichi targets can be messy and complicated.

> “The UK certainly looked to things like the […] Aichi biodiversity targets to guide […] areas where it would be sensible to try and have indicators. […] That provides a useful context and framework. […] There are some places where you read the text of that report for a particular Aichi biodiversity target and it matches very neatly onto some existing biodiversity indicators […]. In other cases, it's much harder to make those links. There isn't a simple one to one mapping.” (Interviewee 8, NGO)

Still, the UK has attempted to map all of the existing indicators onto the Aichi targets. The final mapping – as published by JNCC in 2011 – can be found in Appendix 6 with Table 7.4 below visualising the mapping of indicators onto the CBD Strategic Goal E as an example.

Table 7.4: Mapping of the UK Biodiversity Indicators against the Aichi Targets (Source: JNCC, 2011)

CBD Strategic Goal	CBD Strategic Target (Aichi Target)	Indicators of primary relevance	Indicators of indirect relevance
Strategic Goal E: Enhance implementation through planning, knowledge management and capacity building	Target 17: By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.	No indicator proposed	
	Target 18: By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels	No indicator proposed	
	Target 19: By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred and applied.	E1	
	Target 20: By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan 2011-2020 from all sources and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels. This target will be subject to changes	E2	

CBD Strategic Goal	CBD Strategic Target (Aichi Target)	Indicators of primary relevance	Indicators of indirect relevance
	contingent to resources needs assessments to be developed and reported by Parties.		

Additionally and as visualised in Appendix 6, all of the indicators used from 2011 onwards were grouped and labelled in accordance with the five Aichi Strategic Goals. This mapping was based on the actors' subjective judgment of the appropriateness of particular indicators as measuring progress towards these individual targets, with the final mapping being published for feedback and critique online. As such, the feedback process was used to achieve consensus between the actors on a mapping structure that was pragmatically acceptable for all actors involved. As a result, the UK Biodiversity Report underwent a major restructuring process in 2010-2011, particularly focussed on the reorganisation of the indicators in line with the Aichi targets.

> "What we did was to reorganise the indicators in order that they were clearly mapped to the goals and the targets." (Interviewee 5, Project Group)

To summarise, with the UK Biodiversity Indicators aiming to be compliant – as understood by the actors involved – with the CBD framework and targets, CBD targets – such as the latest Aichi targets – have been a major influence on the UK biodiversity indicators. As such, indicators have been developed in line with this international calculative frame provided by these targets. Interviewees particularly highlighted the influence of the CBD framework as a reason why the UK is annually publishing a UK Biodiversity Indicators Report. Additionally, reframings of the international frameworks have also led to reframings within the UK

Biodiversity Indicators set, as they resulted in internal review processes, the identification of gaps and the development of new indicators. One example of this has been the mapping of the existing indicators onto the new Aichi targets in 2011-2012, resulting in major changes particularly on the presentation and structure of the UK Biodiversity Indicators Report as well as the individual indicators included within this report.

7.2.3 Examples of the development of biodiversity indicators

With the previous sections outlining the development process of indicators as described by the interviewees, the following section will use two particular UK biodiversity indicators to illustrate how the factors described above play together in enabling the development of biodiversity indicators. In doing so, it will show how the UK Biodiversity Indicators were not just developed and published at one point in time and then consistently used from that point forward, but rather the development and publication process of UK Biodiversity Indicators can be best described as an ongoing review and reframing process in which various actors collaboratively work together to render biodiversity calculable.

Following, the selection and curation process of the habitat connectivity indicator will be outlined. Up to this point in time, this indicator is still being classified as an indicator 'under development' meaning that no calculative assessment or legitimated indicator has been included in the UK Biodiversity Indicators Report but rather a narrative outlining a possible indicator methodology being explored by the Project Group. However, over the last decade various indicators on habitat connectivity have been explored, tested and published. This process will be described within the following section.

7.2.3.1 Indicator on habitat connectivity

The first indicator on habitat connectivity was introduced within the first UK Biodiversity Indicators in Your Pockets report in 2007 as an indicator 'under development'. At that point in time, only a narrative outline of how this indicator could look like was proposed, without any actual data set or analysis being included in the report.

> "This indicator is under development, therefore no data or assessments are presented. The following text outlines the development work underway to produce an indicator by 2008." (DEFRA, 2007, p. 28)

The habitat connectivity indicator stayed 'under development' till 2010, when an indicator on 'Change in habitat connectivity for selected broad habitats in the wider countryside, 1990 to 2007' measuring 'Broad-leaved, mixed and yew woodland' and 'Neutral grassland' was included in the Biodiversity Indicators in Your Pockets 2010 report. Within subsequent publications, neither the indicator nor the underlying data set was updated resulting in the Biodiversity Indicator in Your Pockets report in 2013 still publishing the indicator based on the 2007 data set. An image of the 2013 report can be found in Figure 7.12.

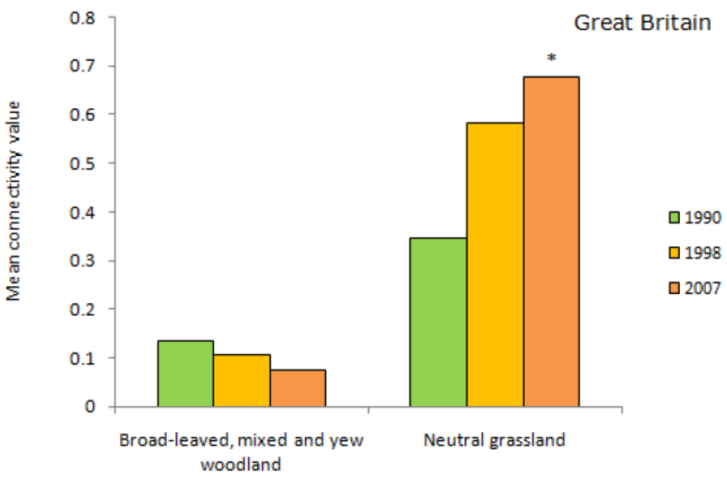
Figure 7.12: Indicator C2. Habitat connectivity (Source: DEFRA, 2013, p. 27)

C2. Habitat connectivity

a. Broad-leaved, mixed and yew woodland
b. Neutral grassland

Type: State Indicator

Figure C2i. Change in habitat connectivity for selected broad habitats in the wider countryside, 1990 to 2007.



Due to this lack of up to date data, the Biodiversity Indicators Steering Group made the decision that this indicator does not fulfil the scientific standards to assess change and that a new indicator should be developed. This decision was published within the UK Biodiversity Indicators Report in 2014 and as a result the indicator was removed from the Report.

> “A measure of connectivity has been published previously within the biodiversity indicators set […]. The measure required further analysis to better explain the causes of the changes in connectivity and, as a result, the information available was insufficient for an assessment of change to be made, despite the statistically significant increase seen in connectivity in neutral grassland habitat observed. It has not been possible to undertake the analysis required and, given the latest data available for the indicator is from 2007, it has been decided by the UK Biodiversity Indicator Steering

> Group that this indicator is now too out-of-date to be retained within the indicator set, and the previous data and analysis has been moved to the background. […] It is hoped that a new interim measure can be published in 2015." (DEFRA, 2014, p. 27)

As a result, the Biodiversity Steering Group was responsible to develop a new habitat connectivity indicator and asked the UK Biodiversity Indicators Forum for expert advice on new indicator developments that could potentially be used within the UK Biodiversity Indicators Report.

> "The existing UK indicator of habitat connectivity […] has been viewed as too constrained in its application […], too reliant on expert judgement and too complex. The UK Biodiversity Indicators Steering Group (BISG) has, therefore, identified that there remains a need to develop alternative options that address these issues or that replace the indicator." (JNCC, 2012b, p. 6)

As a result, the sixth UK Biodiversity Indicators Forum (BIF6) taking place in 2012 discussed three possible new indicators on habitat connectivity proposed by 'leading experts' (JNCC, 2012b, p. 2). The summary report of that meeting concluded that 'habitat connectivity as an indicator is very context specific, and therefore finding a generic option is a challenging task'. (JNCC, 2012a, p. 7).

Nonetheless, the UK Biodiversity Indicators Forum made the recommendation that one of the three proposed indicators – the indicator of functional connectivity – was the "most suitable choice to take forward at this stage" (JNCC, 2012a, p. 8) and the Biodiversity Steering Group began the development work of this particular indicator. Nevertheless, from the point that indicator decision was made, it took six years to develop an indicator on functional connectivity to be included in a UK Biodiversity Indicators Report.

Finally, in 2018 a new indicator on habitat connectivity was published within the UK Biodiversity Indicators set. However, this indicator was ongoingly labelled as an ‘experimental statistic’, with the Project Group asking for feedback on the methodology of the indicator within the report.

> “Experimental statistic: The UK biodiversity indicators project team would welcome feedback on the novel methods used in the development of this indicator.” (DEFRA, 2018, p. 29)

At the point of data collection for this research project in 2018, interviewees made clear that this indicator is still under development and that this indicator is especially difficult to develop. According to the Project Group, habitat connectivity is particularly hard to be captured within an indicator due to its complicated nature as well as the budget constraints faced by the Project Group. As a result, the UK is continuously working on rendering habitat connectivity calculable.

> “We don't currently have an indicator of connectivity we'd like to have. One of the difficulties is that there isn't an obvious simple indicator. One of the difficulties is perhaps to get one costs money. So that's a practical difficulty that we have to have the budget. […] Some of the things we want to measure are just not obvious tangible things to measure. I mean it's not difficult to measure the relative change in abundance of birds because people go and count them. It's more difficult to measure something like connectivity because how do you do it.” (Interviewee 6, Project Group)

This paragraph highlighted the extensive work taken place to develop an UK indicator on habitat connectivity. Besides the first version of an indicator on habitat connectivity being proposed in the Biodiversity Indicators in Your Pockets Report in 2007 and included in Report 2009, this indicator was considered by the Biodiversity Steering Group as too labour-intensive and out-dated and was subsequently removed from the report. As a result, a new indicator had to be developed, a process which included getting options for possible indicators proposed by expert, which were then discussed within the UK Biodiversity Indicator Forum in 2012 before one option was approved by the Biodiversity Steering Group. Up to this date, the indicator on habitat connectivity is labelled by the Project Group as being under development, with interviewees highlighting how the difficult nature of biodiversity connectivity and the funding constraints placed upon them make it difficult to render this particular indicator calculable.

7.2.3.2 Example of Status of Pollinating Insects

Following, the construction process of another biodiversity indicator – the indicator on the Status of Pollinating Insects – will be described. This indicator was predominantly developed in order to comply with the CBD Aichi targets and as such the development of this indicator was politically supported and funded.

After the indicator mapping against the Aichi targets in 2011, the Project Group felt that there was a gap of existing indicators within the Aichi Strategic Goal D: 'Enhance the benefits to all from biodiversity and ecosystem services'. As a result, the Biodiversity Indicators Steering Group and the Project Group tried to identify possible indicators to fill that gap and to report on that particular Aichi target. This work was funded by DEFRA and led to various indicator options being explored aiming to construct appropriate biodiversity indicators to measure ecosystem services.

> "When we moved from 2010 to doing the 2020 indicators, we identified that we got a number of gaps. And DEFRA actually came up with some research money to try and fill

those gaps. And that was on a number of topics, one of them was ecosystem services." (Interviewee 5, Project Group)

This development process started with the Project Group compiling a preliminary list of already existing indicators that could potentially be repurposed to be used as a UK Biodiversity Indicator. Afterwards, these indicators were discussed within three specialist workshops before being presented to the 7th UK Biodiversity Indicators Forum in 2013.

> "The process of indicator development started by compiling a preliminary list of potential indicators. […] UK specialists in the field of ecosystem services then met at a series of three workshops to tackle issues surrounding definitions, refine indicator suggestions, and develop indicator options that would be possible for implementation within a short timeframe. […] Three indicator options were short-listed for development, and were reviewed through the 7th UK Biodiversity Indicators Forum." (JNCC, 2013, p. 9)

Subsequently, the UK Biodiversity Indicators Steering Group reviewed the proposed indicators, rejecting some for being too simplistic or having insufficient underlying data (DEFRA, 2014). Others were put forward for inclusion in the UK Biodiversity Indicators Report in 2014, once they had been undergone change in accordance with the recommendations made by the Biodiversity Steering Group. One of the proposed indicators was the indicator on the Status of Pollinating Insects.

> "The measures on pollinators were considered by the Forum to be the most sound, and to complement each other well. At the UK Biodiversity Indicators Steering Group in July 2013, it was noted that there is insufficient data for the first measure (bumblebee abundance), which is based on information obtained from bee-walks, to be published in 2013, although it may be possible to publish this measure after an additional year of data has been collected, in 2014. The second measure (species richness of hoverflies and solitary bees) is to be incorporated within other work

assessing trends in species distribution data to ensure the methodology being employed is consistent with that being used for other species indicators. Work assessing trends in species distribution data is on-going, and it is hoped a new measure based upon it will be published in 2014." (JNCC, 2013, p. 43)

As described by the interviewee below, one of the biggest problem actors were facing during the development of this particular indicator was the identification of appropriate data sets. As a result of this lack of data, the development process of this indicator was complicated, with involved actors meeting for three times in person in order to discuss the issue and potential data sources to be used for this assessment.

> "We started off having a workshop going 'Ok what are we after?', 'What can we do?'. And we ended in a circle somewhat. We ended up having a second workshop, but we still weren't really getting there. So, we ended up having a third workshop – which sort of was banging heads together saying 'look come on guys we need to come up with some metrics here'. And part of the issue around this was we could think of really important things that we ought to measure, but where the hell are the data to measure them. And that's why we've ended up actually with only three ecosystem services indicators within the set. So we've got the pollinators one that we´ve been able to do which is measuring change in distribution of pollinators." (Interviewee 5, Project Group)

Nonetheless, the interviewee described that the actors involved in these development workshops were not able to come up with the ideal indicators hoped for by the Biodiversity Indicators Steering Group. As a result, compromises had to be made and more realistic indicators had to be developed, one of which has been the indicator on the Status of Pollinating Insects.

> "To take an example of that for the pollinators indicator [...] which is about the ecosystem benefits for pollination. Ideally what we'd like to be able to measure is the

pollination service. But actually that's really quite difficult. So what we're able to do is to measure the number of bees and hoverflies through people actually submitting observations.” (Interviewee 5, Project Group)

Given the difficulties in developing this indicator, a decision was made to develop what interviewees described as an experimental statistic to be first published in the UK Biodiversity Indicators Report in 2014. In that case, rather than constructing the indicator methodology and deciding on a data set only within BIGS, efforts were made to get a broader range of input and feedback from outside actors to be subsequently incorporated into the indicator. This decision was taken to ensure the indicators appropriateness, its academic rigor as well as usefulness for all actors involved. As a result, rather than publishing a final indicator within the UK Biodiversity Indicators report, the indicator was first published for feedback without any assessment of the data before being improved and further developed in subsequent years.

> “We started off with what we would call an experimental statistic where we didn't assess it. We come up with something, we put it out there to say ‘Ok guys does this work for you? Can we get some feedback on it?’ and then over the following couple of years we were able to improve the modelling techniques. We were able to increase the number of species that we could put within that indicator and we've then said ‘Ok that´s good enough, we can assess it’.” (Interviewee 5, Project Group)

As the underlying indicator methodology was reframed, the published indicator showed reframings as well. As a result, the UK Biodiversity Indicators Report in 2017 highlighted how the version of the indicator included within that year cannot be compared to the indicator published in previous years. As such, this indicator cannot be described as consistent.

However, as these reframings were again labelled as improvements, actors seem to be acceptant of the lack of consistency within this particular indicator.

> "The [indicator on the] status of pollinating insects (indicator D1c) [has] benefited from methodological improvements to the underlying modelling techniques, which have allowed many more species to be brought into these measures. As such [the indicator is] not directly comparable with the indicators previously published." (DEFRA, 2017, p. 9)

Up to this point in time, interviewees highlighted how they feel the need to continually improve the quality of this particular indicator. Additionally, interviewees outlined how that approach is supported by their understanding of the official governmental statistical *Code of Practice*[11]. As such, the one of the three pillars of the *Code of Practice* – namely the pillar value – includes the principle V4: Innovation and Improvement, requiring governmental statistics to be continuously amended and enhanced, while it also supports the idea of being accountable to the public by publishing information timely.

> "We also need to continually improve it as well. So that's a quality improvement over time that fits very strongly with the *Code of Practice*. Improve the quality of your statistics over time but also get stuff out there." (Interviewee 5, Project Group)

Additionally, interviewees measured the success of the indicator by tracing how this indicator has overflown the political space and as such became relevant to policy makers and public figures including the UK Prime Minister – at the time of data collection – Theresa May. As a result, this indicator has influenced political and public debates and the calculative outcome

[11] "The Code of Practice provides producers of official statistics the detailed practices they must commit to when producing and releasing official statistics. The Code ensures that the statistics published by government serve the public. When producers of official statistics comply with the Code, it gives users of statistics and citizens confidence that published government statistics are of **public value**, are **high quality** and are produced by people and organisations that are **worthy of trust**." (UK Statistics Authority, 2019, p. 1).

– a pollinators’ decline of 10 % – became a separate entity outside of the UK Biodiversity Indicators Report.

> “Now, of course, the indicator will carry on and we'll deviate from it over the time, but at the moment [it] is quite widely known that the pollinating insects have declined by 10% roughly over that period. […] I was lucky enough to go to the launch of the 25-year plan and that was one of the two statistics that Theresa May mentioned. That was very gratifying to be in there, the room, and she said, ‘Pollinating insects have declined by 10%.’” (Interviewee 1, Biodiversity Indicators Forum)

This example of the Status of Pollinating Insects indicator highlighted the process in which the Biodiversity Indicators Steering Group worked together with the Project Group and the Biodiversity Indicators Forum to construct a new indicator. This perceived need to set up a new indicator in the first place was triggered by the mapping of the existing indicators onto the new CBD Aichi targets in 2011-12 and the identification of gaps. Subsequently, the Project Group identified possible pre-existing indicators that were then discussed by experts in three workshop sessions before a shortlist of possible indicators was discussed at the UK Biodiversity Indicators Forum. Following, the UK Biodiversity Indicators Steering Group reviewed the indicator option, realising a gap between the desired and the practically possible indicators. As a result, compromises had to be made and one of the indicators accepted within the process was the Status of Pollinating Insects indicator. This indicator was then published as an experimental statistic with feedback being sought by the Project Group. With the feedback being incorporated, the published indicator changed over the years and previous versions of the same indicator became incomparable to the newer versions. However, actors labelled the ongoing change as improvements and as such accepted the lack of comparability of the indicator. Additionally, this particular indicator has been able to produce overflow into the political space with the calculative outcome being used in political and public debates.

7.3 Transforming data sets into indicators

After the final choice of indicators for inclusion in a report have been decided on by the Biodiversity Indicators Steering Group, the Project Group starts the actual work of transforming biodiversity data into a biodiversity indicators report which will be outlined in the following section.

As described by the interviewee below, this is the step in which the actual Biodiversity Indicators report becomes produced.

> "We are a Project Group who actually do the doing." (Interviewee 5, Project Group)

The team that at this point is actually involved in doing the calculations and writing the final report is rather small, particularly when compared to the multi-organisational effort that went into doing the conservation work, collecting the data, constructing and selecting the indicators in the previous step. At that point, only two Statisticians and one Lead Statistician at DEFRA as well as the Biodiversity Indicators Manager at JNCC are involved in constructing the final reporting document and doing the necessary statistical calculations.

> "I have a small team. Two members of a staff and they look after sort of half of the full set of indicators each." (Interviewee 6, Project Group)

Within that step of the calculative process, the main aim of the project team is to combine the multitude of data into legitimated biodiversity indicators that can then be published within a single report. Likewise, the project team has to make sure that the outcome of their work is not just useful for decision making, but that it also complies with the official *Code of Practice* for governmental statistics.

7.3.1 Repurposing data sets according to *Code of Practice*

The manipulation and transformation work, which involves the repurposing of pre-existing biodiversity numbers to fulfil UK government needs is subject to additional standardised socio-technical requirements. In particular, indicators must adhere to the UK government statistical *Code of Practice*, ensuring that "published government statistics are of public value, are high quality and are produced by people and organisations that are worthy of trust" (UK Statistics Authority, 2019, p. 1).

This transformation process changes the qualitative attributes of the fragmented data produced by a range of different institutions into a single authoritative national account produced by the UK Government. As part of this process, the governmental statistician is going out to the data sources in order to assure data quality, making it possible for outside data sources to be subsequently transformed into official governmental data sets.

> "That involves for each of the indicators going out to the data sources, getting the data in, quality assuring the data, [...] so for each one […] there is a standard format […]. As a government statistician, I am also concerned that they adhere to the *Code of Practice* for official statistics." (Interviewee 6, Project Group)

During the transformation work, the Project Group's main concern is to ensure they are producing and publishing information that is compliant with the *Code of Practice* and as such is trustworthy, of high statistical quality and provides value to policy makers and the public. It is through the socio-technical arrangements and calculative tools contained within the *Code of Practice* that the biodiversity data collected by conservationists is transformed and manipulated into legitimated statistical indicators that can be processed by any government statisticians for inclusion in official government documents or reports. Part of this process are various compliance regulations, including the involvement of political actors, the assurance of high quality data as well as the drive for ongoing improvements.

In order to comply with the *Code of Practice*, indicators cannot be distributed to any stakeholders before the publication of the official report. Even though policy makers have been able to steer the selection process of the biodiversity indicators in ways that they felt ensured the indicators usefulness for decision-making, once the indicators are selected and the Project Groups starts the transformation work on the data sets, policy makers cannot take any further influence on the final report. This regulation is put in place in order to ensure the independence of the UK Biodiversity Indicators Reports.

> “These are official statistics and what that means is that they are produced without interference from government. [...] And what [the *Code of Practice*] does is to expect you to work with policy customers users in terms of identifying the right statistics. But once you've done that, we then produce those statistics without the policy customers [saying] ‘I am going to look at that number. Can you change it?’ ‘No.’ […] And that's really important because it's about the impartiality of official statistics.” (Interviewee 5, Project Group)

This section highlighted how the transformation process has to comply with the standardised socio-technical requirement of official governmental statistic by complying with the official *Code of Practice*. Only by doing so, the final UK Biodiversity Indicators report can be legitimised as an official governmental statistic and thus be published by DEFRA.

7.3.2 Bringing together a multitude of information

At this transformation stage of the calculative process the Project Group main task lies in combining multiple heterogeneous data sets into a single scientifically acceptable and politically relevant set of biodiversity indicators. As stated by the interviewee below, the Project Groups aim is to create objective facts of how the UK biodiversity performance has changed in the short and long term. The Project Group does not aim to make any policy recommendations within that report but focusses on the provision of evidence of biodiversity trends.

> "We´re bringing together a multitude of information and what we're trying to do […] is to represent it in a fair way. That needs to be true to what's the data that we can do, it also needs to be fair to the users […]. What we're really trying to do is to say 'these are the facts', 'these are the percentage changes that are going on with this indicator'. And here's the assessment objectively of whether that's going up or down compared with on a short-term or a long-term basis. What we're not trying to do is to say 'and this is the policy change that needs to happen.' That's a policy response and that's their business not ours. And that again is important because it's not our job to drive the policy. Our job is to give the evidence of whether the policy is working or not." (Interviewee 5, Project Group)

Besides the UK Biodiversity Indicators Report, the Project Group also publishes an additional technical document for most individual indicators[12], outlining the detailed indicator methodology and data sets used within that indicator. This comprehensive information is not part of the original indicators report and can only be found on the JNCC website. As such, the

[12] The reasoning behind the indicators chosen to publish an additional technical document for has not been explained online. However, it seems like if the technical detail provided exceeds a certain length the information is published as a separate file while in other cases the technical detail is only explained at the individual indicators' website.

publication of this detailed information complies with the *Code of Practice* requirement of transparency and has been treated by the Project Group as an accountability mechanism to the public and the policy makers.

> "For many but not all of the indicators there's a technical document explaining how they've been derived and that in a lot of times gives information about exact calculations and so on. There's also for every single one, where we have a graph, there is a data sheet that downloadable so that anybody who wants to can download the data re-graph it, reuse it." (Interviewee 5, Project Group)

To summarise the main task of the Project Group is the integration of multiple data sources into legitimated biodiversity Indicators that can be published within one individual UK Biodiversity Indicators Report. Interviewees highlighted their focus on objectivity, aiming not to provide any policy recommendations but to simply state the 'facts'. Additionally, the Project Group does not just publish the final indicator set but also the underlying methodology and data sets in separate technical documents on the JNCC website in order to fulfil *the Code of Practice* requirements on transparency and accountability.

7.3.3 Assessment of change

As described in the previous section, the Project Group aims to objectively assess the development of UK biodiversity performance within the indicator set. Part of that process to assess whether an indicator is going up or down on a short and long-term basis. To do so, the Project Team assesses each measure using a set of 'traffic lights', showing change over time by assigning either a green, amber, red or white traffic light sign to each indicator. The outcome of this assessment process can be seen in Figure 7.13.

"One of the things that we do is to try then to take an assessment using a set of traffic lights, so red, amber or green which is trying to look at whether things are going up or down." (Interviewee 5, Project Group)

Figure 7.13: Overview of the Indicator Assessment using a traffic light system (Source: DEFRA, 2018, p. 4)

UK Biodiversity Indicators 2018

Indicator / measure(s)			Long-term change[2]	Short-term change[3]
B1. Agricultural and forest area under environmental management schemes	B1a. Area of land in agri-environment schemes		1992–2017	2012–2017
	B1b. Area of forestry land certified as sustainably managed		2001–2018	2013-2018
B2. Sustainable fisheries	B2a. Proportion of fish stocks harvested sustainably		1990–2015	2010–2015
	B2b. Biomass of stocks at full reproductive capacity		1990–2016	2011-2016
B3. Climate change adaptation			Under development	
B4. Pressure from climate change (Spring Index)			Not assessed	Not assessed
B5. Pressure from pollution	B5a. Air pollution	B5a(i). Area affected by acidity	1996–2015	2010–2015
		B5a(ii). Area affected by nitrogen	1996–2015	2010–2015
	B5b. Marine pollution		1990–2016	2011–2016
B6. Pressure from invasive species	B6a. Freshwater invasive species		1960–2017	Not assessed
	B6b. Marine (coastal) invasive species		1960–2017	Not assessed
	B6c. Terrestrial invasive species		1960–2017	Not assessed

Interviewees pointed out that this assessment is only an assessment of trend and not distance to target. This means that the indicators only highlight whether a particular indicator is getting higher or lower, rather than how well the UK is performing in relation to a particular biodiversity target. This is due to the fact that the UK at that point in time does not have any numerical targets against which distance to or progress towards could be measured and as such only a trend assessment of the UKs biodiversity performance is considered practically possible within these constraints that lie outside BIGS.

> "We measure trends not distance to target with those traffic lights. Because it is a practicality. We don't have an X percent is what we're aiming for." (Interviewee 5, Project Group)

This assessment is heuristic in nature and predominantly based on what the Project Group identified as a 'rule of thumb'. As part of that assessment, the calculative outcome for a particular indicator in the current year is compared to the calculative outcome from previous years. If the current indicator improved by more than three or five percent – dependent on the particular indicator – it gets assigned a green traffic signal, if it gets worse by three or five percent it gets a red signal and if it did not change by more than three or five percent it is marked as amber. In cases where no historical data to compare the current indicator to is available, the traffic sign will be white. As such, this part of the manipulation stage combines the quantitative assessment of the indicator trend with the qualitative judgement of which change in percentage – rule of thumb on three or five percent – is being used to assess a particular indicator. Thus, Callon and Law (2005) would describe this process as 'qualculation' combining qualitative judgment and quantitative calculations. It is to be noted here, that the Project Team's concern was not necessarily on whether the three or five percent rule was scientifically accurate, but rather on the fact that the individual decision taken has been included transparently within the report. As such, transparency to the public was seen as more important than necessarily scientific accuracy, relevance or consistency.

> “Now ideally, we use a statistical test to be able to assign those traffic lights but in practice that's not possible for many of them. So what we tend to do is to use what we call a three or a five percent rule of thumb, to say look if something is going up or down by more than that amount then we will put a traffic light on it, if it hasn't we put an amber traffic light on it to say look it´s basically stable. So, we've got those four traffic lights: red for going down, amber for stable, green for going up and white for we don't have enough information to make an assessment” (Interviewee 5, Project Group)

However, the usage of this traffic light system seems to contradict the claim of objectivity provided by the Project Group. By clearly marking an indicator within the UK Biodiversity Indicators Report as red – deteriorating, yellow – little or no overall change and green – improving (DEFRA, 2018), the Indicators Report is providing an interpretation of the change observed within the indicator that goes beyond the objective reporting of the indicator and incorporates subjective judgement.

As a result, interviewees outside of the Project Group criticised that assessment as biased based on the lack of context provided. According to them, any change indicated within the UK Biodiversity Indicators Report does not necessarily has to be good or bad and is highly context specific.

> “You can say that this species is declining, and does it matter? That's a much more difficult question to answer. The response in conservation is often ‘There's some thing's declining. It's nothing bad and for non-native species that's good’. […] All of that involves […] prejudices and biases whether or not [a trend is] good or bad. It depends very much in the context in which it occurred.” (Interviewee 3, Environmental Agency)

As these interviewees are aware of their underlying biases and the importance of context in interpreting the UK Biodiversity Indicators, particularly interviewees involved in the data provision were very cautious to not ‘oversell’ their work.

> “So we are advocates of what can be achieved, but you have to manage expectations as well. I'm a salesman, but I'm also trying not to oversell my own product” (Interviewee 1, Biodiversity Indicators Forum)

However, this caution of the data providers is not necessarily reflected within the final UK Biodiversity Indicators Report. Instead, every indicator included is clearly interpreted at the beginning of the report as either getting better, worse or stagnating with the use of RAG giving a visible assessment of each individual indicator based on the judgment of the Project Group.

Even though the indicator are interpreted using a traffic light system, interviewees 1 and 16 noted that civil servants still had problems interpreting the result of the assessment. This was due to the lack of verbal interpretation, potential causes or possible solutions of the indicators with the UK Biodiversity Indicators Report. Therefore, the Project Group – in collaboration with a research centre – developed additional evidence statements, aimed to help the interpretation of some of the UK Biodiversity Indicators. These evidence statements are not included within the UK Biodiversity Indicators Report but can be downloaded online.

> “They're called evidence statements. It's basically a one-page of A4, set of bullet points for each of the eleven species indicators. The idea was they would provide a means for civil servants to interpret the indicators.” (Interviewee 1, Biodiversity Indicators Forum)

To summarise, the Project Group assesses every indicator included in the UK Biodiversity Indicators Report using a set of green, amber, red or white traffic lights. This assessment is done in order to highlight trends within the indicators that the Project Group identifies as deteriorating, stagnating or improving. However, the provision of this traffic light assessment has been criticised by other interviewees as biased and subjective and as such contradicting the Project Group's claims of objectivity. In addition to the traffic light assessment, evidence statements were published online aimed at supporting the interpretation of the UK Biodiversity Indicators Report by civil servants. As such, transforming the underlying data sets into UK Biodiversity Indicators can be best described as 'qualculation', a process combining quantitative statistical assessments and qualitative judgment.

7.3.3.1 Example of sustainable fisheries indicator

One example of the intricacies of this assessment of change has been the sustainable fisheries indicator. In order to make this trend assessment, the current calculative indicator outcome has to be compared to a historical one. In cases in which both the current indicator as well as the historical one is based on data sets that have been collected using the exact same methodology and scope, this assessment might be straight forward. In case of the UK Biodiversity Indicators though, data sets are collected in an ongoingly changing environment and do not always include the same scope of information. As an example, the data set used for the sustainable fisheries indicator started by combining and manipulating data from 22 stocks into the single indicator, whereas at the point of the research interviews taking place the data set only includes 13 stocks due to assessment regulations within the *Code of Practice*. As a result, this indicator has been given a green traffic light symbol even though this assessment did not necessarily reflect the actual reduction of stock observed within the data collection and the interviewee felt that the indicator should have gotten a red traffic light assessment.

> "For example, the sustainable fisheries indicator B2, which is one we've had difficulties with. […] We started off with something like 22 stocks and it's gone down to about 13. And the issue there is the stocks for which there is an agreed assessment are the only ones that you can actually use. So as those have changed, […] every time we published it we've had to change the entire graph and at one level that's gone up. So that gets a green assessment but actually if we only got 50 percent of our stocks being fished sustainably why the hell are we giving that [a] green assessment because quite frankly it is not green. So therein lies the difficulty about assessing the difference between distance to target and trend." (Interviewee 5, Project Group)

As a result of this, the assessment of this particular indicator becomes inconsistent and misleading.[13] However, it was still being used as interviewees felt it still complied with the *Code of Practice*. Thus, compliance with the *Code of Practice* was seen as more important than the consistency, representational faithfulness and relevance within the indicators set.

To summarise, the example of the Sustainable Fisheries indicator was used to visualise the problems that lie within the current assessment practice. As the Project Team is only assessing a change in trend on a contested indicators, rather than distance to target, the final assessment using a traffic light system can be misleading and inconsequential. Particularly in cases of change within the underlying data set, the assessment practice aimed at being objective and based on facts becomes ambiguous and intricate and relies on various subjective judgements by the Project Team.

[13] Using a fisheries indicators based on fish stocks has been also criticised within the ecology literature. See for example Hueting and Reijnderson (2004) on the discussion of the importance of fish flows, climate, size and age structure and relation to predators and prey and Degnbol and Jarre (2004) on the discussion of the need to assess sustainable fisheries based on ecosystem assessments rather than stock indicators.

7.3.4 The transformation process at the example of the bird indicators

The following section will use the example of the bird indicators to illustrate the transformation process of a data set into a legitimated biodiversity indicator. It will outline the process in which data sets are combined into legitimated indicators which are then assessed to identify trends. It will also explain the implications of the *Code of Practice* on this process and how these indicators have changed over time.

7.3.4.1 Integrating a multitude of data sets

At the beginning of the construction process, the indicators were agreed on by the UK Biodiversity Indicators Steering Group. In case of the bird indicators, some of the indicators – namely Farmland birds, Woodland birds and Seabirds – have been part of the UK Biodiversity Indicators set continuously since the first publication in 2007, while only showing change in the underlying methodology. Additionally, two further bird indicators have been introduced since 2007 with the UK Biodiversity Indicators 2018 report including one indicator each on: Farmland birds, Woodland birds, Wetland birds, Seabirds and Wintering waterbirds.

In order to calculate these indicators, the Project Group works together with the British Trust for Ornithology (BTO) and the Royal Society for the Protection of Birds (RSPB) – the data providers of the bird data – to transform the data sets into individual indicators. In case of the bird indicator a multitude of different species have to be combined into legitimated bird indicators.

> “Most of the [bird] indicators have about 20 to 30, 40 species in each one.” (Interviewee 13, Biodiversity Indicators Forum)

As a result, data sets, that originally only contained data on the number of birds collected by individual species, are transformed into composite indicators, signifying the average change of numbers of species that are commonly associated with a particular form of ecosystem such as farmland or woodland. Consequently, a 'number of birds' data set becomes a 'average trend of an ecosystem' indicator, focussing on combining the average trends of a broad range of species within that ecosystem.

> "[The] bird indicator isn't the number of birds. It's the average trend. It's a composite indicator. For example, you say there were 12 different species within it, each of those species has it trendline and the farmland [indicator] for example […] is the average of all those trends. When you look at a line on the chart. It's on average the relative change of all of the trends is this which is quite a hard thing for people to understand and it masks what's behind that." (Interviewee 6, Project Group)

As mentioned before, the bird indicators have pre-existed the UK Biodiversity Indicators report with BTO and RSPB being responsible of their construction. Given that the bird indicators are now part of the official national statistics since their inclusion in the UK Biodiversity Indicators in Your Pocket report in 2007, interviewees highlighted the necessary changes within the analysis process of the indicators to make them compliant with the *Code of Practice.* Particularly rules around confidentiality and who can be involved in the interpretation of the indicators have changed since the indicators are part of the UK Biodiversity Indicators Report in order for the indicators to comply with the *Code of Practice*.

> "They're national statistics now so the rules are much stricter than when we started in terms of who you can show them to. Once we get the production and we have the final indicator of this rather small group of people that are allowed to see them and get involved in the interpretation, obviously, the team working on them, a few people at

> Defra and JNCC. We can't share them outside that group until the day of the publication.” (Interviewee 13, Biodiversity Indicators Forum)

The final indicators are being assessed using the traffic light system described during this chapter, being assigned either a green, amber or red light. In line with the other UK Biodiversity Indicators, no interpretations of the indicators are included in the final report. Interviewees saw this as particularly problematic and ambiguous, given that the transformation process changed the nature of the data set focussing on particular species numbers into composite indicators representing trends of particular ecosystems. Thus, the detachment and transformation work changed the nature of the underlying data in a way that has significant implications for the interpretation and understanding of the final bird indicators, without this manipulation being substantially discussed within the UK Biodiversity Indicators Report.

> “I think there is another kind of a problem there though, that the indicators can be interpreted in ways other than they are used for and so they are appropriate for. […] [T]he Farmland Bird Indicator – which is statistically perfect – it is used as an indicator of the state of farmland and to infer things about the impacts of agriculture intensification and the effectiveness of agro-environment schemes. […] And that works if that line represents what is happening on farming but it isn't what's happening on farming. […] What they've done is they've taken 18 bird species and they are the ones that they say best represent farmland. They are the ones that are closest tied to farmland, but the data for those 18 species covers the whole country. Including things that are very far from Farmland. If you didn't know that […] it's slightly misleading. It's not the status of farming, it's the status of things that are part from it. There's a degree of separation which requires some explanation, nuance. It's a lot of grey area there.” (Interviewee 1, Biodiversity Indicators Forum)

This manipulation of a multitude of data sets into legitimated UK Biodiversity Indicators was described as a deliberate political decision taken in order to create a clear communication tool towards policy makers. As such, the nature of the underlying data sets – based on species counts – was manipulated intentionally into an ecosystem trend indicator in order provide a simple, easy to understand trend assessment that can be used for policy decision making.

> “Of course, the main initial reason for indicators was this strong communication tool, because the trouble with when you look at all the species, there's so many species that, to get the message across, it was confusing to the public, to policy makers, "Oh, this one's going up, this is going down, this is flat, what does it all mean?" Here you get it is essentially the average so you get a strong message, which really worked well for the farmland birds. On average, this whole set of species is going down.” (Interviewee 13, Biodiversity Indicators Forum)

However, over the last years the bird indicators have been criticised as too simplistic and as not providing the level of detail useful and necessary for policy making. Given that the bird indicators only provided an overall trend line for all species within a particular ecosystem combined, they were not able to show details on the individual species included and as such important positive as well as negative trends of certain species were hidden within the final calculation.

> “If you look at bird data, for example, we've got some birds that are doing so well and others that lost their population by 95%. If you're dumping all that together in birds, you're not going to get that intricacies coming out, are you? I think you need to know all those intricacies. Then even if you look at wetland birds and farmland birds you still got the differences between that.” (Interviewee 4, Devolved Administrations)

As a result of this policy overflow, the bird indicators have been reframed regularly and the most important changes will be described in the following section.

7.3.4.2 Change over time

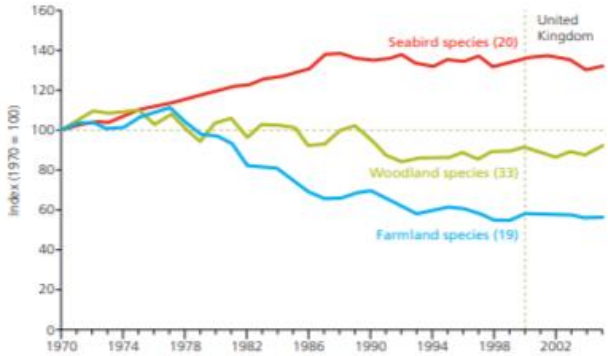
In order to internalise the overflow created by policy makers criticising the lack of detail within the bird indicators, the presentation of these indicators within the Biodiversity Indicators report was changed. Rather than only showing the overall trend, the indicators are now presented in a way that shows the trends behind each species included in the report, thus revealing a higher level of detail while still being overall composite indicators. Figures 7.14 and 7.15 illustrate this change using the Farmland Birds Indicator as an example.

> “So there's an improvement in presentation in that we now also have little bar charts at the side of the line chart so that you can see that okay on average the trends are going down. But within that behind that in the detail, some will be going down, some will be going up, some will be going down strongly, some would be going up weakly, some would be not changing. We add this extra illustration to show the percentage within the overall trend that are going up, the percentage going down and whether that´s what we call strong.” (Interviewee 6, Project Group)

Figure 7.14: Presentation of Bird Indicators in 2007 (Source: DEFRA, 2007, p. 11)

1a. Trends in populations of selected species (wild birds)

Wild bird populations: farmland birds, woodland birds and seabirds, 1970-2005



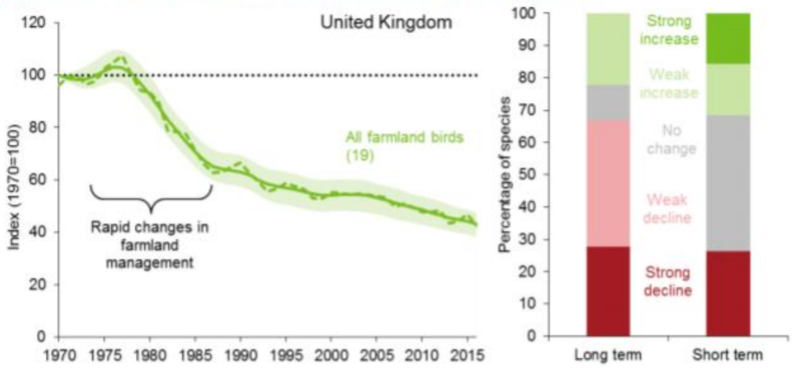
Note: Figures in brackets show the number of species included in each category
Source: Royal Society for the Protection of Birds, British Trust for Ornithology, Defra, Joint Nature Conservation Committee

Bird populations			
Since 1970		Since 2000	
Farmland birds	✗	Farmland birds	≈
Woodland birds	✗	Woodland birds	≈
Seabirds	✓	Seabirds	≈

Figure 7.15: Presentation of Bird Indicators in 2018 (Source: DEFRA, 2018, p. 37)

UK Biodiversity Indicators 2018

Figure C5ai. Breeding farmland birds in the UK, 1970 to 2016.



Notes:

1. The figure in brackets shows the number of species.
2. The line graph shows the unsmoothed trend (dashed line) and smoothed trend (solid line) with its 95% confidence intervals.
3. The bar chart shows the percentage of species within the indicator that have increased, decreased, or shown no change, based on set thresholds of annual change.

Source: British Trust for Ornithology, Defra, Joint Nature Conservation Committee, Royal Society for the Protection of Birds.

As such, the improvements to the indicator described by the interviewees included better and timelier underlying data sets, an improvement of the indicator methodology and a better representation of species within the indicator. In order to achieve that, new data sources were explored, the data collection methods were enhanced and the criteria to judge data sets included in the indicator calculation became stricter.

> "What's changed since then is greater scrutiny of the data sets going in. On one hand, we've dropped some species from the indicators over time, probably sometimes because the data has become too old, too historical, there hasn't been a repeat survey so although we may have several surveys in the past, we can't extend the time series to the present day, sometimes we've later decided that the data's not good enough, it's unrepresentative, more or so restrictive. At the same time, we knew we were always missing species because we didn't have the data so we were working hard to get data from other sources and not just from our surveys, but it could come, for example, now from the rare breeding bird panel, which already collects data on very scarce species and we bring them in where possible. That's been stricter with the data we use, looking for new sources." (Interviewee 13, Biodiversity Indicators Forum)

Additionally, there have been changes in the traffic light assessment of the indicators. Following an academic review panel that took place in 2016, the decision was made to no longer assess the Seabird indicator as part of the UK Biodiversity Indicators Report. This assessment is currently reviewed by the Project Team and will most likely be updated over the next few years.

> "The traffic light assessment for the seabirds' measure has been removed until a way of assessing variability is devised. This follows recommendations in a quality assurance science panel report, dated January 2016." (DEFRA, 2018, p. 7)

To summarise, this section highlighted the transformation of multitudes of individual bird data sets into legitimated composite bird indicators. To do so, the Project Group works together with the BTO and RSPB – the data collectors –, manipulating data sets of bird counts into average species trends of particular ecosystems. In doing so, it changes the nature of the original data set in order to turn it into a UK Biodiversity Indicator that is compliant with the *Code of Practice*.

As part of this transformation, the bird indicators are being assessed using the earlier described traffic light system. However, given the issue of out dated data sets used within one of the bird indicators – the seabird indicator – this particular indicator has been excluded from the assessment process and is currently under review. Besides the change to the assessment of the indicators, overflow particularly created by policy makers has also led to a reframing of the presentation of the bird indicator suite within the UK Biodiversity Indicators Report to better highlight the underlying intricacies and details of the species included. As such, policy feedback has been internalised into the report as to make the indicators more policy relevant and policy useful.

7.4 Summary

The purpose of this chapter was to outline the second stage of the calculative process according to Callon and Law (2005) - the transformation and manipulation of the entities brought into the framed space in the first stage of the calculative process. To summarise, the UK government's answer to the question of how prior accounts of biodiversity entities are to be manipulated and transformed within the framed space is shaped by a range of socio-technical factors and priorities, including political, institutional, scientific, biodiversity conservation work, but finally determined by the *Code of Practice* for government statistics.

The first stage within this manipulation process consists of the Biodiversity Steering Group making decisions of the composition of the UK Biodiversity Indicators Report every single year – thus determining which indications to include, modify or exclude from the forthcoming report. The work of selecting and transforming biodiversity indicators is massively influenced by the data constraints brought into BIGS through the previous detachment work. Aiming for indicators that are policy useful and compliant with international frameworks, while being massively constraint by the data available means that actors involved in this process have to able to balance idealism and practice when constructing indicators. Consequently, indicators have to be seen as acceptable by the actors – thus having to be policy relevant, statistically accurate and compliant with international frameworks – while still being able to be measured with previously identified and accessible data sets. Additionally, interviewees highlighted their preference to publish any form of legitimised indicators – which includes any indicator being accepted by the actors involved and compliant with the *Code of Practice* – over a complete absence of any calculative performance reporting. As a result, the process of selecting biodiversity indicators can be best described as a process aimed at finding consensus and pragmatic indicators rather than a process aimed at constructing perfect – in line with international frameworks and scientific expertise – indicators to measure and report on UK biodiversity. Moreover, the curation of UK Biodiversity Indicators is an ongoing review and reframing process in which various actors collaboratively work together, rather than a one-off decision on which indicators to include.

Once indicators have been selected by the Biodiversity Indicator Steering Group, the work of manipulating the mass of data collected using the civil infrastructure discussed earlier into useful measurements of biodiversity performance is undertaken by a small team of trained government statisticians, aiming to produce what they consider to be a fair and impartial factual account of UK Biodiversity. The main aim of that Project Group during that stage is to ensure that the final biodiversity report is compliant with the *Code of Practice* and as such statistically accurate, of public value and trustworthy. It is through this process of manipulation that the qualitative attributes of the fragmented data is transformed into a single official governmental statistic.

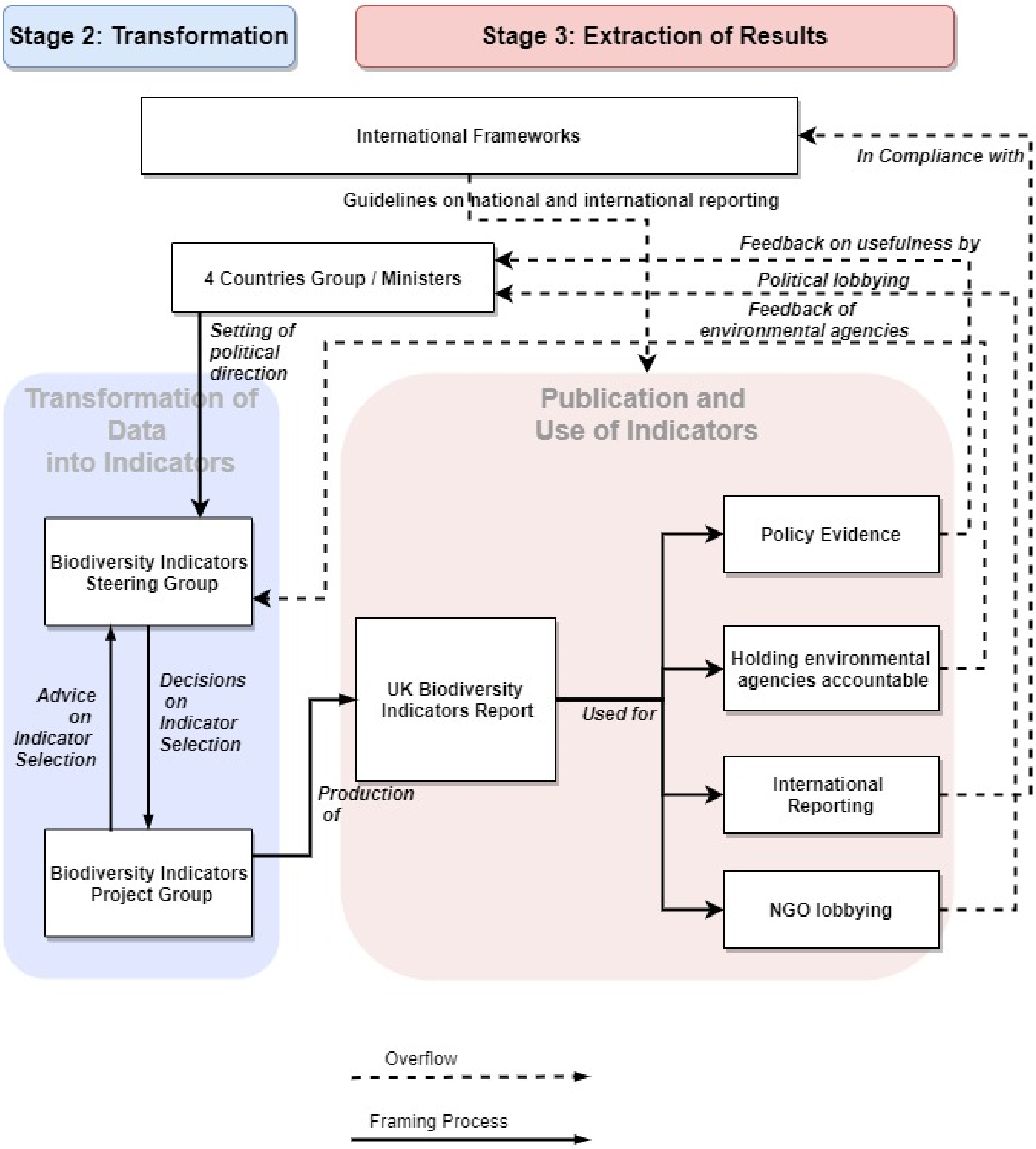
Part of this manipulation process is an assessment of change using a set of 'traffic lights' for each individual indicator. Using a 'rule of thumb' the current year indicator is compared to the calculative outcome from previous year and assessed as getting worse –red – , no change – amber – , or getting better – green –. Consequently, this process combines the quantitative assessment of the indicator trend with the qualitative judgement of the rule of thumb and can be best described as 'qualculation' (Callon and Law, 2005) and as such goes beyond the factual reporting of the indicator data and the objectivity claims by the Project Group.

CHAPTER 8: EXTRACTION AND USE OF RESULTS

8.1 Introduction

This chapter will analyse the findings using Callon and Law's (2005) third and final stage of calculation, which is the extraction of results from the framed space. As such, it will focus particularly on the final part of the annual UK Biodiversity Indicators Reporting cycle highlighted in Figure 8.16.

Figure 8.16: Stage three of the calculative process



By focussing on the UK Biodiversity Indicators Report and the different ways the biodiversity indicators have been used for national and international reporting, policy formulation, accountability purposes and lobbying, this chapter will highlight how different actors have extracted various results from the calculative process at different points in time. In doing so, this chapter will also show how any of these extractions has automatically opened up the opportunity for feedback and thus overflow. Over time, these overflows – including ministerial feedback, scientific developments, change within the international framework and the feeling that the indicators are imperfect – and have led to ongoing reframings of the UK Biodiversity Indicators. Thus, this chapter highlights that the extracted results are inherently temporary and undergo constant changes, described by interviewees as ongoing improvements.

Additionally, this chapter will highlight how interviewees felt that the UK Biodiversity Indicators set has been predominantly used to legitimate policy decisions taken rather than to actually influence new policy development. Moreover, it will outline how the UK Biodiversity Indicators set has been used for accountability purposes towards the public, NGOs as well as the government in terms of environmental agencies having to be accountable for their work.

This chapter will start by analysing how the results of the calculative process – in this case the UK Biodiversity Indicators – are being used to fulfil national and international reporting obligations in section 8.2. Afterwards, section 8.3 will explain the range of ways the indicators are being used once they have been published, including the use for policy making, keeping governmental agencies accountable and NGO lobbying. Next, section 8.4 will outline how the extracted results are constantly changing, how this change is being seen as necessary and as constant improvement by interviewees and what influences are causing the constant modifications of the UK biodiversity indicator set. Finally, section 8.5 will provide a summary of this chapter.

8.2 Publication of Biodiversity Reports

Once the indicators have been constructed and the statistical calculations completed, the set of UK Biodiversity Indicators is extracted and published within a single UK Biodiversity Indicators Report. This national report has been published annually since 2007 and in 2018 it contained 24 legitimated biodiversity indicators (see Appendix 5 for the full list of indicators included).

In addition to the national UK Biodiversity Indicators Report, the same set of UK Biodiversity Indicators are also used to fulfil the international reporting obligations towards the CBD. Under the CBD framework, signatory countries have to report on their national biodiversity performance in regular pre-defined timeframes, with the last round of reporting taking place in 2018. These national reports are compiled by the CBD Secretariat to assess the status of global biodiversity and the progress towards the 2020 CBD Aichi Goals.

Within the 6th National Report to the United Nations Convention on Biological Diversity: United Kingdom of Great Britain and Northern Ireland published in January 2019, this set of UK Biodiversity Indicators has been used – together with supplementary information – as the main assessment tool for the UK progress towards the Aichi targets. For example, the UK Biodiversity Indicators: C3b: Status of UK species of European importance, C4a: Status of UK priority species -Relative abundance, C4b: Status of UK priority species –Distribution, C5:Birds of the wider countryside and at sea, C6: Insects of the wider countryside (butterflies) and C8: Mammals of the wider countryside (bats) have been used within the 6th National Report of the UK to the CBD in order to assess progress towards Aichi Biodiversity Target 12: By 2020, the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained. An extract of the 6th National Report of the UK to the CBD on Aichi Biodiversity Target 12 can be found in Figure 8.17.

Figure 8.17: Extracts from the 6th UK Report to the CBD (JNCC, 2019c, p. 180 and p. 188)

Aichi Biodiversity Target 12

By 2020, the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

Category of progress towards the implementation of the selected target:

☐ On track to exceed target
☐ On track to achieve target
☒ Progress towards target but at an insufficient rate
☐ No significant change
☐ Moving away from target
☐ Unknown

Date the assessment was done:
18 January 2019.

Indicators used in this assessment

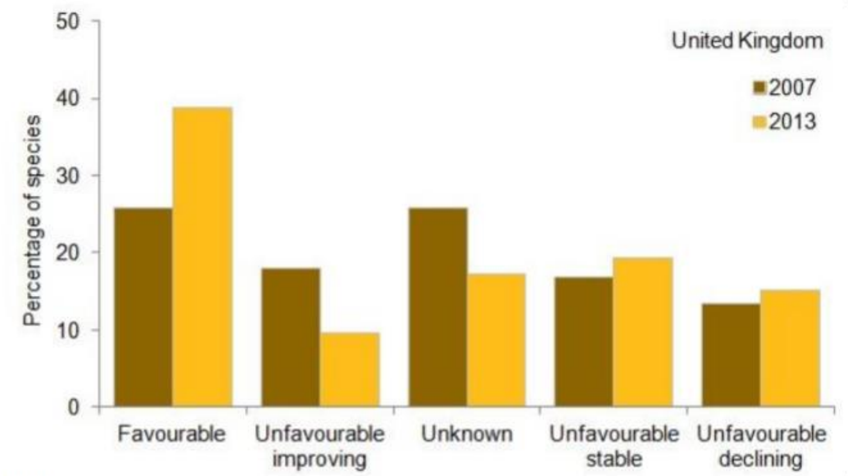
UK Biodiversity Indicator **C3b**: **Status of UK species of European importance**
http://jncc.defra.gov.uk/page-6566.

In 2007, 26% of UK species listed on Annexes II, IV or V of the Habitats Directive were in favourable conservation status, increasing to 39% in 2013.

The conservation status of 18% of species was improving in 2007, decreasing to 10% in 2013.

The conservation status of 13% of the species was declining in 2007, increasing to 15% in 2013.

Figure C3bi. Percentage of UK species of European importance in improving or declining conservation status in 2007 and 2013.



Notes:

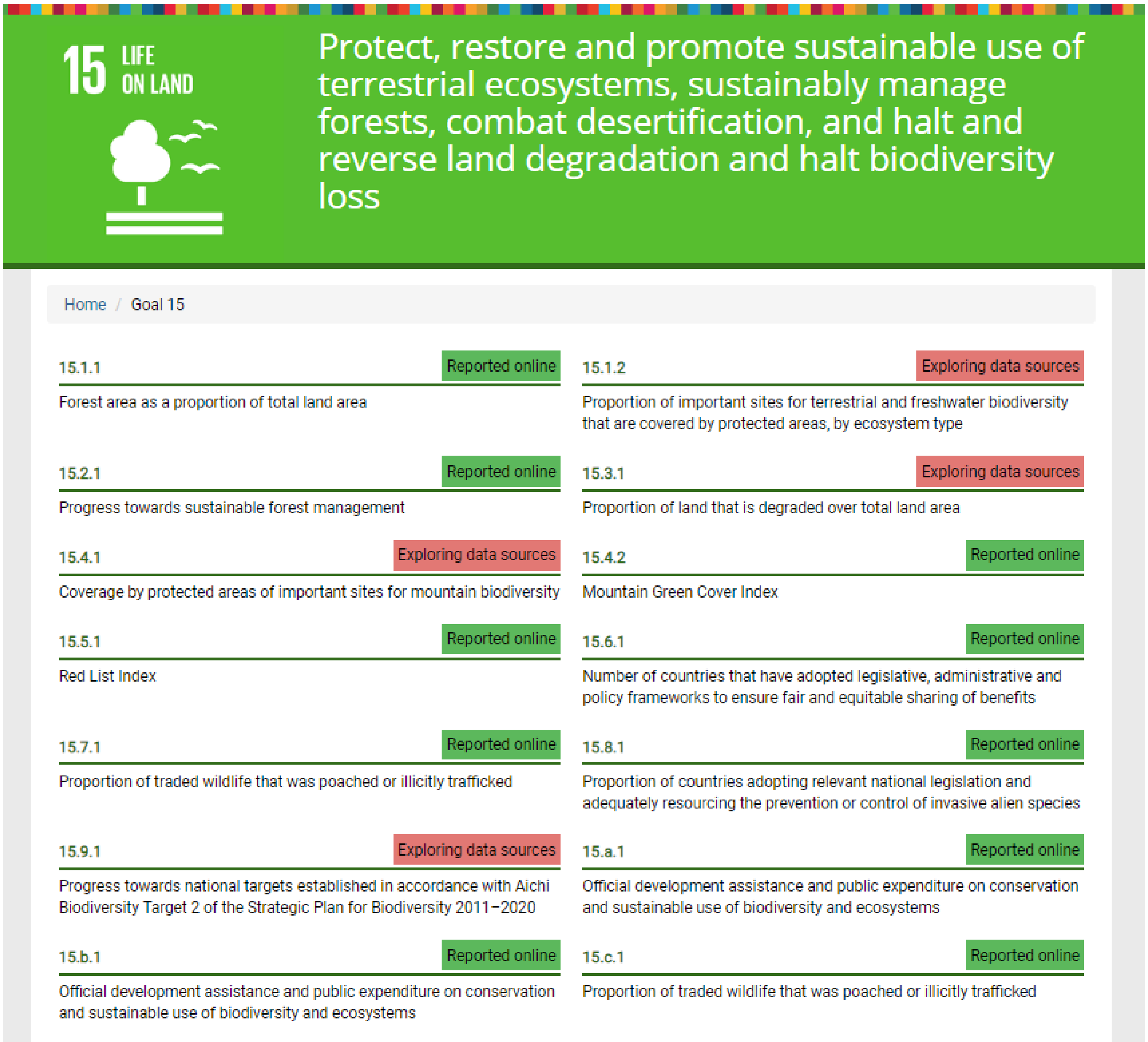
4. The number of species assessed was 89 in 2007, and 93 in 2013.
5. The chart is based on species listed on Annexes II, IV and V of the Habitats Directive, but excluding vagrants.
6. The aim of the Habitats Directive is to achieve favourable conservation status for the species and habitats listed in its Annexes. An assessment of status and trends for each species and habitat is undertaken every 6 years. Trends in unfavourable conservation status allow identification of whether progress is being made, as it will take many years for some habitats and species to reach favourable conservation status.

Source: UK Habitats Directive (Article 17) reports 2007 and 2013.

UK Biodiversity Indicator **C4a**: **Status of UK priority species - Relative abundance**
http://jncc.defra.gov.uk/page-4238.

However, the UK Biodiversity Indicators have not been used to report towards the SDGs. Instead, the Office for National Statistics reports on the prescribed SDG indicators which differ from the set of UK Biodiversity Indicators. The indicators reported under the SDGs are visualised in Figure 8.18.

Figure 8.178: UK Reporting on SDG 15 (Source: ONS, 2019, no page)



With the UK Biodiversity Indicators set being used to inform the UK's accountability to the CBD, there is a question as to what extent they are being used to inform national biodiversity policy making and conservation action. Interviewees raised their concern that the UK

Biodiversity Indicators – besides being used for international reporting purposes – have no influence on UK biodiversity conservation action. Rather, they described the process of constructing the UK Biodiversity Indicators Report as purely driven by reporting obligations with the intention of getting numbers that ´sound about right´. As such, rendering UK biodiversity calculable has been perceived as a form of showing compliance with international frameworks rather than to enable biodiversity conservation work.

> "We seem to have had a proliferation of a desire to collect information. Not necessarily to actually use it for anything useful, but simply just to report back to […] the Joint Nature Conservation Committee who then pass that on. […] We seem to be just wanting to get some information that actually sounds about right; to put on a bit of paper, to send off to someone and that's it. […] I don't really know what is actually driving things in England, in JNCC and Defra, but we strongly suspect it […] is to collect some information, stick it on paper and give it to someone and they will stop seeing that we're not reporting." (Interviewee 9, Academic Institution)

Additionally, interviewees highlighted how in their opinion the final indicator reports are largely technical products. As such, these reports are not aimed towards the general public, but have been set up as a formal reporting device towards top-down targets and goals. For example, the UK Biodiversity Indicators Report does not provide any explanation or interpretation of the indicators or data collection methodologies. Moreover, the additional files uploaded to the JNCC are highly complex and technical documents outlining the indicator methodology and data collection strategy while again not providing any guidance on understanding or interpreting the result. As a result, the UK Biodiversity Indicators Report tends to attract rather little attention from the public and seems predominantly used within a small circle of biodiversity experts.

> "I think, the indicators data sets are always widely publicized and published but I suspect they penetrate rather little into the mind or the attention of the general public. Maybe a bit more nowadays with fairly intensive social media coverage. It might be that they attract a bit more attention than they used to do but I always had the impression that they are very largely quite technical products that are made use of within the government sector for formal reporting of progress against various forms of government targets from top and right up to Aichi ultimately." (Interviewee 8, NGO)

As a result and while the indicators are clearly used for national and international reporting on the status of UK biodiversity, interviewees questioned to what extent the indicators are actually used and understood outside of these reporting obligations. Additionally, interviewees questioned whether the UK Biodiversity Indicators do ultimately lead to better conservation action and thus support biodiversity conservation. As a result, the following section will outline the uses of the UK Biodiversity Indicators traced within this project outside of the formal reporting obligations.

8.3 Use of Indicators

Besides the use of the UK Biodiversity Indicators set for national and international reporting, this project has traced three additional ways in which the UK Biodiversity Indicators are being used. As such, the following section will focus on the use of biodiversity indicators for policy formulation, holding governmental agencies accountable and dealing with NGO lobbying.

8.3.1 Part of evidence base for policy formulation

To start with, interviewees highlighted how the UK Biodiversity Indicators are used as part of the evidence base for biodiversity policy formulation. As such, policy makers were identified by interviewees as the main users of the UK Biodiversity Indicators besides the CBD reporting.

> “Mainly our own policy people [use the indicators]. I'm sure that they are used in research and obviously they have been used to report to CBD. But largely policy makers.” (Interviewee 4, Devolved Administrations)

However, the policy process as well as the actual policy impact was described differently by different interviewees. While some saw these indicators as highly influential in policy making, others questioned whether and to what extent the indicators actually influence biodiversity policy.

On the one hand, interviewees have described the set of UK Biodiversity Indicators as being used to assess current environmental policies. As such, the indicators were described as part of a broader evidence portfolio used within DEFRA and as supplementary information used in combination with other evidence to assess to performance of different environmental policies.

> “This is part of the DEFRA evidence portfolio in terms of what is the information that we can bring to bear on whether or not policies are working.” (Interviewee 5, Project Group)

Furthermore, as stated by the interviewee below, UK Biodiversity Indicators are also being used to inform and engage with ministers and NGOs. As such, interviewees have described how the UK Biodiversity Indicators are used to provide evidence of successful or non-successful policies, respond and engage with NGOs as well as brief ministers on the current state of the UK biodiversity.

> “These [indicators] give the figures that allow those policy individuals (a) to respond back to ministers on questions that they get of what is happening, (b) to give objective figures in response to NGO lobbying because clearly the NGOs always want more. […]

> But what's the evidence of what works and what doesn't?" (Interviewee 5, Project Group)

Additionally, policy-makers confirmed that having a reliable evidence base for new policy formulation and to review existing policies and practices is important. The indicators within that evidence base are seen as consistent and reliable tools to inform action and policy decision making. However, consistency within that context referred more to the annual publication of an indicator set, rather than the consistency of that indicator set used within each annual report. Given the interviewees notion of improvements – as described in section 5.4.3 – changing indicator methodologies, introducing new indicators or relabelling a measure as an indicator was not seen as an inconsistency but rather an improvement in order to strengthen the reliability of the indicators. Additionally, the publication of the UK Biodiversity Indicators set was seen as an accountability mechanism to the public, by providing accessible assessments of the UK biodiversity performance as well as the performance of environmental policies implemented.

> "Well, for us [the benefits of the indicators are] having a good, reliable, consistent evidence base to inform policy and action and evaluate success and making it accessible for all." (Interviewee 4, Devolved Administrations)

Additionally, indicators were seen as an early warning system to identify negative biodiversity trends within the UK. As such, identifying negative trends within for example common species including the farmland bird were seen as important in order to assess long-term trends and identify possible areas of concern to be tackled by policy makers.

> "The biggest benefits are that we have a proper evidence base for judging both policy and practice success or failure, I guess. Also, to with luck any emerging problems as

> they arise or before they become too big.” (Interviewee 15, Biodiversity Steering Group)

However, even though policy makers confirmed the use of the UK Biodiversity Indicators for policy development, they also highlighted how the nature of the political context limits to what extent indicators actually lead to identifiable policy developments. It was pointed out by the interviewee below, that the indicators themselves do not lead to immediate policy actions. Rather the indicators were described as providing a source of overflow that influences policy conversations and adds an additional evidence layer. As a result, no direct policy developments or changes could be traced back to individual reports or individual indicators. This made it difficult to judge the extent of the influence indicators had on policy development.

> “Policy development is really […] why [the indicators are] used. Are we going in the direction we want and if we are not, what can we do? I think it influences and it will spark conversation, but I don't think it's ‘Oh god, that's happened, right, we need to do something quickly.’ That's just not how government works really […]. It's an added layer to the evidence-base on help inform on future actions. It's not immediate reactive. It doesn't promote that immediate reaction I guess” (Interviewee 4, Devolved Administrations)

Additionally, interviewees expressed their opinion that even though the indicator set is published as a national UK Biodiversity Indicators Report, the indicators themselves have only limited resonance outside of England. As a result, countries such as Scotland or Wales develop their own set of indicators such as the Ecosystem Health Indicators in Scotland (see further SNH, 2017) that interviewees perceived as better suited to measure Scottish biodiversity.

> “I mean, it's interesting that many of the indicators that are produced in the UK level and those are often funded by organizations like DEFRA and JNCC are still presented and reported as UK indicators, but politically, they have very little traction outside England.” (Interviewee 8, NGO)

Interviewees also highlighted how indicators are being used to justify policy decisions made to stakeholders and public interest groups. As a result, the UK Biodiversity Indicators have been described as being used as a tool to legitimate policy decisions rather than to influence actual policy formulation. Particularly in the case of publicly controversial issues, indicators are being used to justify and legitimate the policy approaches taken by providing numerical evidence backing up political decisions. In that case, indicators are not necessarily used as evidence for new policy development, but rather as evidence to defend previous policy decisions.

> “Having evidence and having the numbers and the figures and backing up decisions is really important. […] It's probably driven by the more controversial things that come out. […] Those things that are high in the public profile, where you got somebody saying something and somebody saying something else. And where's the evidence? And people who feel very passionately about something want to know why the government is making the decisions its making. […] And having to be accountable to the public, and to ministerial scrutiny. Typically, with controversial issues, somebody's arguing against you and saying, ‘Why have you done that?’. You need to be able to prove why you've done it, also to stakeholders.” (Interviewee 4, Devolved Administrations)

Overall, the relationship between policy and evidence is complicated and messy, rather than simple as the term evidence-based policy might suggest (similar findings have been made by for example Allen, 2017; Krapp and Pannowitsch, 2017; Strassheim and Kettunen, 2014). It appears that the complexity of biodiversity conservation, the involvement of a variety of different actors and the various interpretations of the indicators leads to constant reframings of the calculative space and the relationship between the calculative outcome and policy. Thus, the relationship between policy and evidence is not one-sided, fixed or straight forward, but rather non-linear, iterative, reflexive and co-evolutionary. Furthermore, interviewees have challenged the scientific validity of the distinction between indicators and measures. While the literature has presented clear definitions and distinctions between these terminologies (see for example: Heink and Kowarik, 2010; McCool and Stankey, 2004; Singh et al., 2009; Veleva and Ellenbecker, 2001), in reality the separation between these terms is rather fuzzy. As such, constant reframings of the indicators and measures allow for various meanings and interpretations to be attached to them. This is further amplified by unexplained changes in how these categories are used in different annual reports.

> "Well, the relationship between evidence and policy is anything but simple. There is a kind of mantra which you have no doubt heard about, 'evidence makes policy', which is totally fatuous and over simplistic understanding of policies. It's a mantra that policymakers […] drop out all the time. It's particularly difficult where you're dealing with complex issues like the state of nature, which can be variously understood and interpreted and with different meanings attached to it and so on. Then the relationship between measures, indicators, and so on, become pretty fuzzy to say the least." (Interviewee 3, Environmental Agency)

As a result of that complexity, interviewees highlighted how individual indicators in indicator sets might be extracted and used for different purposes and appropriated into different processes, rather than having one universal contribution to the whole set.

Interviewees outside of the political government have been highly critical on the actual use of indicators in political decision-making. The case of marine plastics has been used by various interviewees to highlight how the policy response has been mainly driven by public opinion and media coverage, rather than the UK Biodiversity Indicators. It was argued that the calculative nature of the UK Biodiversity Indicators struggles to foster the emotional connection between people and species necessary for a particular policy response.

> “Let's look at marine plastics for example. Marine plastic has been an issue for maybe 15 years. People have been talking about marine plastics but what's driven the big response? The thing that drives the big response is pictures of a dying whale on blue planet. So that's not a biodiversity indicator […], that's a very visceral response to a single image. Those species and habitats, people's emotional connection to species and habitats is really important in driving policy responses in some cases.” (Interviewee 11, Research Centre)

Besides the lack of the UK Biodiversity Indicators to provide an emotional response to the issue of biodiversity loss, the indicators have also been criticised for a lack of economic reasoning with them, despite their calculative nature. According to the interviewee below, the indicators as a whole compiled within the UK Biodiversity Indicators report are insufficiently linked to economic principles and therefore less relevant and appropriable for economic policy or economists. In this case ‘economic’ biodiversity policy makers prefer to use calculations from the Natural Capital Asset Index. This is an index also developed by DEFRA but outside of the BIGS structure with no overlap between the statisticians involved in the Natural Capital Asset Index or BIGS. This is a clear example of overflowing the frame set by the UK Biodiversity Indicators Report.

Instead, the UK Biodiversity Indicators Report seem to be used by actors particularly focused on habitat and species related concerns. The underlying knowledge and disciplinary underpinning of the report production cycle has an impact on its extractability and incorporation into other decision processes. Despite the range of expertise and institutions involved in BIGS, there still appears to be a privileging of certain forms of calculations. As mentioned by the interviewee below, that there is selective extraction and appropriation of indicators depending on the policy or decision context. This limits the collective impact of the carefully curated set of UK Biodiversity Indicators as a whole in political decision making.

> "Depending on who you're talking to, you use different indicators. […] What you tend to find is that the people [giving] immediately ministerial advice often have an economics training. In those cases, then it's probably better to look at things like the Natural Capital Asset Index because we're talking about assets, it's something they can immediately relate to. If you're talking to [MP's], you're much better talking about species and habitats in many cases because that's what they relate to. […] They're unlikely to get letters about the decline in […] Natural Capital. They are likely to get letters about the decline in particular species and habitats. Depending on who you're talking to in the net of policy and discussions, you might take different data sets." (Interviewee 11, Research Centre)

The indicators included in the UK Biodiversity Indicators Report rarely make an explicit connection to economic concerns or financial implications of biodiversity loss. As a result, they do not provide an economic argument for the development of biodiversity conservation policy. As such, the calculability achieved within the UK Biodiversity Indicators set is neither anthropocentric, nor intrinsically ecocentric (as distinguished by Cuckston, 2018b). As a result, interviewees highlighted how the UK Biodiversity Indicators struggle to lead to a direct policy response given the privileging of economic reasoning in the UK political context. However, they do seem to be creating an overflow into the economically dominated biodiversity policy-making space and as such influence biodiversity policy making indirectly.

> "In other cases, it's a much harder economic argument that makes the policy response happen. The response to the thinning of the ozone layer was a […] very quick international response and […] it is because if the ozone layer continues to thin, skin cancer will go up like this. And the costs are going to be X because you can just calculate the number of additional people [that] will get skin cancer and how much on average [it] can cost to treat them. […] It's not like we particularly care about the ozone layer but we certainly care about not having to pay for skin cancer treatment. There, you get a very quick response on a hard-economic argument. I don't think it's one or the other that necessarily drives a policy response. You've got to try all these different possibilities if you want to achieve a policy response." (Interviewee 11, Research Centre)

Additionally, policy responses seem to be driven by the ability to complement the indicators and include the non-calculative representation of a biodiversity crisis in ways that allow the translation of this representation into policies and economically appropriate evidence. Moreover, interviewees highlighted how the issue of concern has to be clearly defined so that boundaries can be drawn around it and the problem can be rendered calculable and manageable. Only then are indicators able to highlight ways of managing the biodiversity issues by rendering visible the causes and potential solutions of the issue – a characteristic seen as important by interviewees.

> "Does policy actually result from knowledge of our indicators? In some cases, it does. […] Now, when you get a crisis, very sharply defined then policy does respond, and it responds quickly and there can be effective solutions. […] Where indicators are perhaps less effective is where they give good information about what's changing but no real pointers as to what you can do about it. It's explaining the causes and consequences of what indicators are telling us." (Interviewee 2, Environmental Agency)

Overall, interviewees highlighted how effectively they consider UK Biodiversity Indicator sets are used as part of the evidence base for biodiversity policy decision making. It was reported in interviews that the UK Biodiversity Indicators allow ministers to understand the current status of UK biodiversity, judge biodiversity policy decision, legitimise policy decisions taken, be accountable to the general public as well as respond to and engage with NGO lobbying. However, interviewees have also highlighted how the relationship between evidence and policy making is anything but simple. While interviewees felt that the indicator set is shaping the discussions taking place around biodiversity policy, indicators were not able to lead to any direct short-term policy response. Additionally, it was pointed out by interviewees that different indicators are used in different contexts and that the indicators themselves do not provide any emotional or economic reasoning for biodiversity conservation. Overall, the usefulness of the UK Biodiversity Indicator set seem to be dependent on the particular biodiversity concern and to what extent this concern can be rendered calculable within clearly defined boundaries. Additionally, the UK Biodiversity Indicators, even though they might not lead to direct policy change, are one source of overflow within the economically dominated policy making space that is influential in changing policy debates.

8.3.2 Holding government organisations accountable

Besides being used as part of the evidence base to assess current government policies and influence future policy making, interviewees mentioned that the set of indicators is also used to hold environmental bodies accountable to the government and DEFRA in particularly as well as NGOs and the public. Given that the UK Biodiversity Indicators provide an assessment of which selected aspects of UK biodiversity are getting better or worse, they are providing a tool to assess the work done or enabled by governmental environmental agencies and conservation NGOs.

As a result, the interviewee below described this set of indicators as ‘measures of success’ for his work and the performance of the environmental agency. As a result, the UK Biodiversity Indicators are not just seen as performance measures to measure the progress on UK biodiversity conservation, but also performance measures for environmental agencies, NGOs and their biodiversity conservation work.

> “[This environmental agency] is accountable through these measures of success, as measured by indicators which government can review and also the NGOs can review and say that, ‘This isn't good enough or we need to do better’. As a result, government are essentially accountable for these changes and if they think that something needs to be done, then they can ask [this environmental agency] to do it and say, "You ought to do more of this in order to improve the situation." (Interviewee 15, Biodiversity Steering Group)

Within that context, biodiversity indicators are also setting priorities for conservation work done by the environmental agencies and NGOS. As a result, change within the UK Biodiversity Indicators can create pressure to increase particular conservation activities or to reduce effort on other aspects of conservation work. The selection, deselection or modification of indicators included in the Report can have this affect, as can the calculability as determined by BIGS, of a biodiversity issue. The calculative framing of this space creates a risk of hiding biodiversity issues if they were not rendered calculable within the indicator set, thus creating conditions in which conservation efforts are only focussed on legitimated calculable biodiversity problems.

> "We are accountable for how things are done but the pressure to change things will come from government, in terms of whether they deem the changes are a priority or not, for us to do." (Interviewee 15, Biodiversity Steering Group)

Overall, the UK Biodiversity Indicators set is used to hold governmental environmental agencies accountable for their work to the government, NGOs and the general public. Additionally, by rendering certain aspects of biodiversity visible and excluding others, it sets political conservation priorities and as such focussed biodiversity conservation efforts on issues that can be rendered calculable within the indicators set.

8.3.3 NGO lobbying

Additionally, interviewees highlighted how the published UK Biodiversity Indicators reports are used by NGOs to lobby the UK government. As part of this, NGOs use the indicator set to argue for additional resources to be devoted for conservation and more conservation actions to be taken, particularly in areas that the indicators identified as getting worse. Even though most of the data sets have been originally collected by NGOs or conservation organisations, the detachment and transformation process of these former NGO data sets into official government indicators published by DEFRA allow NGOs to use the biodiversity indicator as an official representation of UK national biodiversity. This official UK Biodiversity Indicator set is used as evidence of areas in which the UK government is not doing enough to fulfil its national and international biodiversity conservation obligations, and is thus a basis for NGO lobbying in these areas.

> "Certainly, the NGO sector, the environmental conservation sector does make use of them as an advocacy tool. For example, we know RSPB and other conservation NGOs will make strong use of indicator trends to argue for actions to be taken or for

> resources to be devoted in particular areas where clearly there are problems." (Interviewee 8, NGO)

Particularly as the UK Biodiversity Indicators are purported to be trend indicators, which are assessed as getting better or worse using traffic light notation, they can legitimately identify areas in which the calculated state of UK biodiversity is not improving and deteriorating. Therefore, they allow targeted interventions by NGOs that appear more legitimate after passing their data through the BIGS calculative processes.

> "The NGOs, conservation charities, and so on also find them very important because their job is to lobby government and to say, 'Look, you're not doing enough on this' and so they find these indicators very important to say that 'There's still a problem, government isn't doing enough'." (Interviewee 15, Biodiversity Steering Group)

Additionally, the BIGS calculative process renders the Biodiversity Indicators useless for NGOs and environmental agencies for their everyday conservation work. Due to the detachment of data and its transformation into UK wide indicators, interviewees have described the indicators as removed from their everyday work. As a result, interviewees have described how they would extract and appropriate the indicators in order to provide a political justification for their conservation work rather than influencing actual conservation decisions.

> "The indicators are in a way more to help government understand its overall policies. I think we're closer to the data on the ground, in a way. Although they provide a rationale for our work, they aren't necessarily driving our work." (Interviewee 15, Biodiversity Steering Group)

To summarise, NGOs use the UK Biodiversity Indicators set to lobby government and highlight conservation issues that are perceived as needing further government interventions. Even though the underlying data sets have been predominantly collected by NGOs and outside organisations, the transformation and manipulation has created a new level of legitimacy to enable political activism. However, this same process has rendered the indicators sets useless for governing and evaluating on the ground conservation work.

8.4 Constantly changing indicators

However, the extracted result of the calculative process of rendering biodiversity calculable in the UK – the UK Biodiversity Indicators Report – is not a stable or fixed entity. Rather, and as outlined in section 5.4.3 and Figure 5.7, the indicators included in the UK Biodiversity Indicators Report have been frequently reframed and changed on a regular basis. Interviewees highlighted various influences that caused these changes, which the theoretical framework deployed within this thesis identifies as overflows to the existing indicator framing. These overflows will be discussed within the following section.

Interviewees recognised the impossibility of creating perfect measures of biodiversity, due to a number of factors, including competing and sometimes contradictory concepts or purposes. As a result, interviewees described how various reiterations of indicators were necessary in getting the metrics 'right' and aligned with the complex conceptual understandings of biodiversity that is associated with competing definitions and changes in the external developments that provide constant overflows to the existing framing of the indicators.

> "Well I think that there are quite a few challenges around getting our biodiversity metrics right and measuring the right things and summarising them in a correct fashion. […] I think one of the difficulties for biodiversity monitoring in the biodiversity field is how you go about perfectly measuring biodiversity in order to understand how it's changing. There are so many competing kind of ideas out there. Some of them contradict each other and some of the just confuse each other and policymakers. […]

> There's a big challenge to simplify our information and have a clearer message just so you know what's the status of biodiversity and how is it changing and how we capture that for […] biodiversity in one go." (Interviewee 7, Biodiversity Steering Group)

Following, examples of these changes to the indicator set will be described and analysed, including the main influences and the extent of these changes. It is important to note that interviewees framed these changes as a process of continuous improvements. These improvements were seen as positive reactions to scientific developments, high level political feedback and changes to international frameworks. These ongoing reframings were seen as evolutionary with interviewees arguing that the underlying calculative structure has not been significantly changed over the last decade.

8.4.1 Notion of improvements

To start with, interviewees highlighted how in their opinion the ongoing change within the indicator set should be framed as continuous improvements. An overview of the changes that interviewees perceived as improvements can be found in Table 5.3. This table identifies a number of legitimate reasons for the development of new indicators, for example updates in indicator methodologies in line with scientific and academic recommendations, mapping of the indicators against international frameworks, a better integration of political strategies and ministerial feedback.

Interviewees also stated that they feel that these improvements resulted in the current version of the UK Biodiversity Indicator set (DEFRA, 2018) as the best version of the indicator set in the UK. All these changes were considered necessary and useful to better calculatively capture UK biodiversity.

> "The UK biodiversity indicators now, I think, are very impressive in terms of the way they can be updated. […] It's a huge improvement over what we had in the past. I think it's a continuing process. They're not as good as we would wish but they are very much better than anything we've had to date." (Interviewee 2, Environmental Agency)

During the research, various sources of potential overflow to the indicator frame were outlined by interviewees or traced within the documentary analysis. The four most significant sources of overflow that have been uncovered during this research will be outlined and described in detail, including the actors' awareness of gaps, ongoing scientific developments, ministerial feedback as well as changes within international biodiversity frameworks.

8.4.1.1 Awareness of gaps

Interviewees highlighted that in their opinion the way biodiversity is currently framed is imperfect, partial and could be improved. There was a recognition by interviewees that they had not fully resolved the problem of calculating UK biodiversity within the set of UK biodiversity indicators. As a result, interviewees highlighted how they acted on their own intrinsic motivation to make improvements, which led to an independent review panel.

> "In a way it's the department's own desire to make improvements. Because I could say that over the last couple of years […] what has influenced this is the Chief Scientist[14] asking questions. We had an ad hoc independent science panel[15], a bunch of scientists who looked up species indicators and made recommendations for changes, which we are doing as soon as we can. But it's not that somebody from outside, another organisation, said you want to do this. So, it´s that we´ve asked for that." (Interviewee 6, Project Group)

[14] The Chief Scientist referred to here is a public sector employee and not part of the scientific review panel.
[15] Also referred to as the scientific review panel.

As a result the review panel recommended a series of areas for improvement and according to the interviewee below has already led to the reframing of at least one indicator in the UK Biodiversity Indicators at the time of this study.

> “We commissioned a review of our indicators by a set of experts from different universities including statisticians and ecologists, to think about whether the indicators we were producing were good enough or not, and how they could be improved. As a result of that, we then had discussions about them. One of the indicators has been changed as a result because it wasn't considered good enough.” (Interviewee 15, Biodiversity Steering Group)

Additionally, interviewees highlighted the influence of the changing policy context on the indicators and how the continuous change was necessary to keep the indicators more policy relevant (see Table 5.3).

> “We didn´t want metrics that were just about what was available, what we can use. We did have a context. We had a policy context that was used to say, ‘What information do we need?’. Then we tried to map that against the available data and we came up with a partial match. Where we did have available data sets, we started to develop them into an indicator form, which was new to us. Because they should be policy relevant and they have the characteristics of these more structured ways of expressing information within a policy context. Also, there were gaps and we started to work out ways of how we could fill knowledge gaps. That's a process that's continued to then in terms of trying to make the metrics that were used more directly relevant to the policy objective. I think on the whole, certainly in terms of biodiversity action, that ambition has provided a lot of stimulus for creating a better evidence base, making better use of the evidence that we have, putting it into a standardised format.” (Interviewee 2, Environmental Agency)

At the time of the interviews (2018), interviewees consistently highlighted that the current indicator set is still imperfect and contains gaps. Thus, interviewees ongoingly considered the indicator set as work in progress.

> “One of the things we found when we […] first published [the indicators] was that we clearly got some gaps. Some of those gaps we´ve been able to fill over the last few years, some of them are actually still fairly intractable […]. I think it’s fair to say that we’ve had a decent stab at doing it but there is still room for improvement.” (Interviewee 5, Project Group)

To summarise, interviewees showed an understanding of the UK Biodiversity Indicators as being imperfect and in need for continuous improvement. As a result, reframings were understood by actors in BIGS as necessary enhancements of an evolving indicator set. Additionally, interviewees highlighted how they have not been able to render everything that they would like to calculable yet and as a result, they have identified gaps and issues of biodiversity concern in which an indicator could not yet be constructed.

8.4.1.2 Scientific Developments

Besides the identification of gaps, interviewees highlighted the desire for progress driven by scientific developments in biodiversity calculative methodologies. As the science associated with biodiversity challenges develops, so do the possibilities of more sophisticated and accurate calculative representations of biodiversity. Given that BIGS creates a space for different institutions to interact and work collaboratively, this has enabled new scientific developments to inform UK Biodiversity calculations, including the extraction work involved in producing the UK Biodiversity Indicators Reports and influencing international and supranational accounting for biodiversity. An example of these developments includes the adaption of taxa specific methodologies for application to other taxa.

> "The methods rapidly developed to be more sophisticated and have better measurement in them and all these sorts of things that you need. And considered bias and precision. At the same time while that was happening that also stimulated lots of other people to copy that methodology, basically. So, once we published, you know, Wild Bird Indicators in the UK and Europe, people started to use our methodology to produce butterfly indicators across Europe and butterfly indicators in the UK and bat indicators in the UK and all sorts of different taxa groups have used the same methodology. […] There are twenty plus European countries now producing farmland bird indicators." (Interviewee 7, Biodiversity Steering Group)

Additionally, interviewees felt that there are still unresolved scientific challenges, particularly incorporating all scales of nature and biodiversity – from local to global levels – into indicators was highlighted as an area of concern.

> "One of the challenges that we have in terms of measurements is to provide systems that can apply and focus at a very local, contextual level [of] nature […] and then how do they aggregate that to provide a meaningful story at a regional or a national level. I don't think we've cracked that yet. It's that whole issue of nature because it operates its functions and its benefits to people at varying scales from the local to the global. How you then divide the measures that reflect that and including all the diversity at the local scale? Good luck to you." (Interviewee 3, Environmental Agency)

Overall, ongoing scientific developments have created the possibility for more sophisticated biodiversity indicators and improvements to the UK Biodiversity Indicator set. As the science around biodiversity developed further over the last decade, indicator methodologies were updated and the understanding of interviewees improved. However, interviewees have also highlighted scientific challenges that could not be solved yet and issues in which further scientific development would be needed.

8.4.1.3 High Level Political Feedback

In addition to the development of new indicators methodologies, interviewees highlighted how actors outside of BIGS, such as ministers or other political actors, initiated reframings over the last years. Given that interviewees reported that they wanted these indicators to be useful for political decision making, decisions on what should be extracted for inclusion in formal biodiversity reports changed accordingly to the feedback received from ministers and political decision makers.

> "I think the format and the information that goes into [a Biodiversity Report] has come down over the years in response to minister saying, 'Well, what does this mean? What is this?' Which is why you have all of these different bits and pieces. I've never [been] entirely sure that the design and the concept is as clear as it could be. I tend to think that it evolves rather. […] I sense that it is more like an evolutionary process than a directed designed system." (Interviewee 1, Biodiversity Indicators Forum)

What political actors found to be problematic was how to interpret and meaningfully extract any results presented within these Biodiversity Indicator reports. Political actors in particular highlighted the need for indicators to not just calculatively represent changes in national biodiversity, but to also flag the causes or even potential solutions. As a result of this feedback, interviewees have highlighted how indicators have been reframed to better highlight the causes of change within the UK biodiversity in order to improve the indicator set and to make it more policy relevant. This reframing was also influenced by the actors' personal interpretation of what each indicator represents and what roles an indicator has to play when extracted from the Report. As such, interviewees from the policy space require indicators to be tools that have to be able to indicate not just developments and trends but also the causes of these trends in a way that allows them to relate the calculative representation of a particular indicator to the wider environment and political context

> "I think indicators have changed by moving from ones that report changes, to ones which do report changes but are linked much more closely to the causes of those changes, trying to understand what it is that they're exactly indicating rather than just assuming that they're indicating. There's been quite a lot of work to understand how the changes in each indicator relates to the environment. I still don't think we've got there yet entirely. That's important because, otherwise, they aren't really indicators, they're just a trend line of population changes. I think an indicator should be trying to indicate something else in a way." (Interviewee 15, Biodiversity Steering Group)

Overall, interviewees pointed out how political feedback has overflowed the indicators framing over time, leading to constant change and reframings. Particularly the need for political actors to better understand how the indicators can be interpreted has led to change within indicator publications. As a result, indicators were reframed to better allow the extraction of the causes and potential solutions for biodiversity issues, making the set of indicators more policy relevant and also influencing the political understanding of what an indicator is and what an indicator has to be able to do.

8.4.1.4 International Frameworks

As mentioned in section 7.2.1.3, international frameworks such as the CBD had a major influence in the selection and construction process of UK Biodiversity indicators. Interviewees described how any change within this international CBD framing resulted in overflow to the UK national framing of biodiversity and as such to a reframing of national biodiversity strategies and policies.

> “The Aichi targets came along. We knew we had the 2010 targets and then we had these new ones. We knew they were for 2020. There's an England biodiversity strategy due to report on in 2020, a lot of the thinking is that it provides a sort of multi-year medium term frame for thinking about these things.” (Interviewee 1, Biodiversity Indicators Forum)

Accordingly, changes within the CBD framework have led to the reframing of specific biodiversity indicators, particularly after the publication of the new CBD Aichi targets in 2010. This was evident within the UK indicator publications between 2011 and 2012 (see Figure 5.7 for a visualisation) as the UK decided to map all their existing indicators onto the new Aichi targets (see Appendix 6). As a result of this mapping work, the Project Group identified gaps within their current indicator set and reorganised all the existing indicators in order of the Aichi targets and goals, leading to a major reframing of the UK Biodiversity Indicators Report content and layout (as visualised in Table 7.4).

> “What we did was to reorganize the indicators in order that they were clearly mapped to the goals and the targets.” (Interviewee 5, Project Group)

As such, any extraction of the UK Biodiversity Indicators set has been heavily influenced by the current international framing of biodiversity – such as through the CBD targets. However, interviewees have also pointed out how any extraction is fundamentally still limited by the work done within stage one and two of the calculative process (Callon and Law, 2005) and as such any extracted result is limited by similar factors. These restrictions also limit future reframings and possible results.

> “But I know that these organizations are already starting to think about what comes after, so we [can] report about them. The reality is I don't think it would change all that

> much. We are fundamentally still limited by the data we've got." (Interviewee 1, Biodiversity Indicators Forum)

However, future reframings of international frameworks have also been described as an opportunity to streamline existing indicators and international targets. Within this research, interviewees did not see the Sustainable Development Goals as a main influence on the UK Biodiversity Indicators. However, interviewees highlighted how they assumed that the SDGs will overflow the current biodiversity framing in the future and thus might impact on the current UK Biodiversity Indicators set.

> "I think the current set of UK biodiversity indicators has kind of spread out to such a degree that the message is diluted, and I think it's confused as well. So I think there's an opportunity to streamline it and maybe the streamlining against a new set of biodiversity targets in 2020 and again the Sustainable Development Goals would be a god idea too." (Interviewee 7, Biodiversity Steering Group)

Overall, international frameworks such as the CBD Aichi targets also provided a source of overflow to the framing of the UK Biodiversity Indicators. Changes within the international framework subsequently also led to reframings of the national UK indicator set, in order to ensure compliance with international frameworks. In doing so, international frameworks did not just create a source of overflow to the existing UK Biodiversity Indicators set but also resulted in tension between the international top-down nature of the targets and the local bottom-up conservation entities and groundwork.

However, any extraction of the UK Biodiversity Indicators was heavily influenced by previous calculative decisions. As such, interviewees pointed out that reframings of the international framework have only led to limited reframings of the calculative outcome. As such, the extracted indicators have often been only mapped onto the new international framework without any underlying change.

8.4.2 No substantive change in underlying calculative structure

Along similar lines, interviewees have highlighted how the calculative structure – the three-stage process by Callon and Law (2005) – has not been changed. Beside the constant change within the indicators and indicator methodology described above, this section will highlight that there has not been a substantive change in the underlying calculative structure over the last decade particularly due to the dependence on similar data sets.

To begin with, interviewees did not feel like the originally constructed frame has been completely replaced. Rather, the calculative frame constructed in 2007 has stayed relatively unaffected, with the process of the indicator development (as outlined in Figure 5.8) staying the same over the last decade. Moreover, interviewees felt that the main reframings of the UK Biodiversity Indicators Report focussed on updating the underlying methodology of individual indicators, but that the calculative frame stayed mostly unaffected.

> "The main things, the indicators right from the start, they were more or less what they are now, which is an aggregate trend made from individual species trends and split mainly by habitat or we can split them other ways. What's changed since then is greater scrutiny of the data sets going in." (Interviewee 13, Biodiversity Indicators Forum)

Additionally, interviewees highlighted how they perceived the change within the debate around nature and biodiversity as a change in labels. Given the limitations in the data available to measure nature, interviewees felt that they had to adapt the indicators to fit into the current debate without being able to completely restructure the calculative frame or the calculative process. This relabelling process became obvious during the mapping of the existing indicators onto the new international CBD targets. During this process, the existing indicators were relabelled and mapped onto the new targets without showing major changes in the underlying data sets and indicator methodologies.

> "I mean I think the labels have changed to some degree. So you we used to talk about nature, then we used to start talking about biodiversity and we started to talk about ecosystem goods and services, then seem to lose the goods bit but we kept the services bit and we've now moved into natural capital. Actually, all of those are the same thing I think and certainly from a data perspective. I don't have a magic wand so I will now need to create a natural capital indictor. What I need to do is to say ok how does the indicator that we've got fit within that conversation." (Interviewee 5, Project Group)

Moreover, interviewees felt the need to stick to the original indicator set over a longer period of time in order to use it as a strong public communication tool. In doing so, the indicator set portrayed a sense of consistency even if when indicators included or the underlying methodologies changed. As a result, the UK Biodiversity Indicators Report has been able to merge together the policy aim of having consistent measures as well as the scientific aim to continuously improve and update the methodologies as well as to incorporate new indicators in line with changes within the international framework.

> "I think you'd still want to stick with your original indicator set which has been used for a long time, same message to the public. […] I think there's a certain reluctance after the indicators have been done so long here in a particular way not to suddenly change the rules because I think people would find that confusing. (Interviewee 13, Biodiversity Indicators Forum)

Overall, even though the UK Biodiversity Indicator set has showed a lot of reframings and change over the last decade, the underlying calculative structure of the indicator set stayed unchanged. Interviewees highlighted how the indicators have been more or less similar right from the start with a lot of the changes being perceived as simply changes in labels. This opinion contrasts the empirical findings outlined in section 5.4.3 and Figure 5.7, which identified ongoing and significant change within individual indicators. However, the empirical analysis has also been able to confirm that even though individual indicators have been regularly reframed between 2007 and 2018, the underlying calculative structure – as manifested in BIGS and visualised in Figure 5.6 – has not been reframed or changed. This finding might be cause by the reluctance of actors to change certain parts of the calculative structure and the extracted indicator set in order to display stability and to have an unchanging and clear public message.

8.5 Summary

The aim of this chapter was to outline the third and final stage of Callon and Law's (2005) process of calculation - the extraction of results from the framed space. To summarise, the UK government's answer to the question of how a result is to be extracted from the framed calculable space is determined by an array of influences from interested actors, which collectively drive the ongoing evolution of the biodiversity indicator reporting over time through BIGS.

This chapter has highlighted how in the UK, multiple results of the calculative process have been extracted from various actors at different point in time, leading to a multitude of usages of the UK Biodiversity Indicators. First of all, the indicators included in the UK Biodiversity Indicators Report were used in order to fulfil reporting obligations towards the CBD and reported within the compulsory UK Reports to the CBD in regular pre-defined timeframes.

However, given the prescribed indicators that have to be reported towards the UN SDGs, the UK biodiversity indicators were not used to report progress on these goals and instead the UK Office for National Statistics reports a completely different and detached set of indicators towards the SDGs. Additionally, interviewees did raise their concerns that this particular extracted result – in form of a national and international report – has not been influential in improving UK biodiversity conservation action but instead has been a paper exercise aimed at getting numbers that 'sound about right' and that can be reported back to the CBD. As a result, the reports were described as highly technical products that do not penetrate the general public or provide any guidance on understanding and interpreting the indicators.

Besides, the UK Biodiversity Indicators are part of the evidence portfolio for policy evaluation and decision making. However, this research was not able to trace any direct policy change caused by the indicators. Instead, the analysis showed how interviewees felt that the UK Biodiversity Indicators set has been predominantly used to legitimate policy decisions taken rather than to actually influence new policy development and to engage with NGOs and external organisations and to justify the policy decisions taken. Additionally, interviewees have outlined how they might extract different indicators from the indicator set different times and for different purposes, rather than using the full indicator set depending on the context in which the indicators are being used. Thus, there appears to be a privileging of certain form of achieved calculability and a selective extraction of particular indicators depending on the policy context. As a result, indicators focussing on species and habitats might be used to influence MPs, however outside indicators focussing on economic reasoning of biodiversity conservation might be drawn on in conversations with economically trained policy makers. One of these economics based indicators has been the Natural Capital Asset

Index that is developed and reported by DEFRA but is completely independent of the UK Indicators Report and thus provides and overflow to the UK indicators framing.

Moreover, this chapter has highlighted how the relationship between evidence and policy is anything but simple and linear. Instead, policy decision making was deeply entwined with the construction and reframing of the UK Biodiversity Indicators Report. As such, the report produced overflows reframing ongoing policy debates. Additionally, these policy debates were then brought back into the BIGS structure via the Four Countries Group as well as the Biodiversity Steering Group leading to reframings within the UK Biodiversity Indicators set.

In addition to policy making, the UK Biodiversity Indicators are being used as an accountability tool for government organisations, including environmental agencies. As such, the way in which biodiversity was rendered calculable in the UK influenced conservation priorities as well as provided ‘measures of success’ for conservation work within these agencies. In doing so, the indicator set created conditions in which it became possible that conservation decisions might only focus on calculable biodiversity problems, thus hiding non-calculable biodiversity issues.

Lastly, the UK Biodiversity Indicators have been described by interviewees as a useful tool for NGO lobbying even though the underlying data sets have been predominantly collected through these NGOs and research centres. However, through the detachment and transformation of the data sets into official governmental indicators, the UK Biodiversity Indicators Report becomes an official governmental report that allow NGO interventions to appear more legitimate, but has been described as useless for actual conservation groundwork due to the detachment of the report from the actual groundwork. As a result, interviewees indicated that individual indicators can be extracted to provide rationales for their conservation work rather than to influence actual conservation decisions.

Additionally, this chapter has highlighted how any extraction of the annual Biodiversity Indicators Report inevitably created an opportunity for overflow (Callon, 1998a). As such, this research found the extraction element of the UK Biodiversity Indicator to be the driving factor for large parts of the framing – overflowing dynamic and the ongoing change within the UK Biodiversity Indicator Set. Interviewees described the need for various reiterations of indicators in order to align the metrics with competing definitions of biodiversity, ongoing external changes and internal feedback. As such, any calculability achieved in relation to biodiversity was seen to be a temporary achievement, subject to perpetual efforts at refinement and reframing, but still largely drawing on repurposed data created by and relevant to those undertaking biodiversity conservation work.

Interviewees used the notion of ongoing improvement when talking about change and the temporality of these indicators was predominantly seen as something positive. This was due to the following reasons. First of all, interviewees perceived the framing of the indicators as imperfect and partial, recognising gaps and need for future improvements. Additionally, as the science associated with the indicator set development and new scientific developments were made, indicators were reframed to capture a more sophisticated underlying methodology or data collection strategy. Besides, any ministerial or political feedback also caused the framing of the indicator set to overflow, with indicators now highlighting more clearly the causes of biodiversity trends and change to provide a better understanding for political actors. Lastly, any change within the international framing of biodiversity, particularly the CBD targets, has also led to change within the national UK Biodiversity Indicator set.

However, besides all of these reframings taking place, the underlying calculative structure and process of the indicators stayed fairly stable over the last decade. As such, the calculative process – analysed within this research using Callon and Law's (2005) three step process – remained broadly unchanged, such portraying an image of consistency important for policy makers, while still incorporating overflow from scientific development or international frameworks by reframing individual indicators.

CHAPTER 9: DISCUSSION AND IMPLICATIONS OF THE FINDINGS

9.1 Introduction

This thesis has sought to use the case of UK government biodiversity indicators to illustrate and critically analyse how a calculative space for biodiversity is framed and calculability for biodiversity is achieved. The case findings – set out in sections 6-8 above and theorised using Callon's (1998a) notion of framing and overflowing and Callon and Law's (2005) three step process of achieving calculability – have shown how the UK government works to render calculable the challenges of biodiversity loss, in a way that enables policy formulation in pursuit of biodiversity conservation and other related political purposes.

The analytical and methodological approach adopted did not seek to judge individual UK Biodiversity Indicators themselves as being either 'good' or 'bad'. Rather, the analysis sought to reveal and critically analyse the socio-technical arrangements that iteratively and reflexively work to frame a space in which these indicators can be produced and reported. In doing so, this thesis has been able to highlight potential limitations of the UK approach, mainly from the interviewees themselves who do not claim the UK approach to be flawless or perfect. What is important in this context is understanding how, through these socio-technical arrangements, the UK government is able to create conditions in which it can see and understand biodiversity loss and its own performance in addressing this problem. In this way, the analysis offers useful insights into how national governments and other organisations could achieve the calculative capabilities necessary to address the challenge of biodiversity conservation.

Following, Section 9.2 will first summarise the empirical findings outlined within in chapters 6-8. Subsequently, these findings will be discussed in Section 9.3 in line with the extant literature on accounting for biodiversity and sustainable development. Next, the contributions to the theoretical framework will be explained in section 9.4, followed by the conclusion of this chapter in section 9.5.

9.2 Summary of findings

In order to answer research question 1 – How can national governments achieve a calculability for biodiversity loss that enables the formulation of policies to facilitate effective biodiversity conservation? –, the analysis highlighted how framing a calculable space for biodiversity requires consideration of three distinct stages in line with the theoretical framework provided by Callon and Law (2005). An overview of the calculative process has been provided in Figure 5.6.

Firstly, a decision had to be made about what entities are to be brought within the framed space and therefore what kinds of biodiversity data are going to be included within the space. Rather than government agencies designing specific indicators and subsequently going out to collect the necessary data, indicators are largely driven by data that has already been collected for other purposes. As a result, most of the data collection processes are largely driven by institutions undertaking their own conservation work as those producing the national biodiversity report are not able to collect the data they would like. This makes data availability, and a dependency on the nature of the detachment, transformation and extraction work undertaken by others critical parts of this work. As such, these findings answer research question 1.1 – How can biodiversity data be detached from nature? – and add to the conclusions drawn by others that have problematised the assumption that institutions start with their strategies and then seek to measure performance (Georg and Justesen, 2017; Jollands and Quinn, 2017; Kornberger and Carter, 2010; Power, 2015; Skaerbaek and Tryggestad, 2010) by highlighting how in the context of UK Biodiversity Reporting, it was not only the ability to formulate policy and make decisions that was deeply entwined with the building and repurposing of the performance measurement infrastructure, but also that these connections occurred at different distinct stages throughout the calculative process. As such this thesis has been able to provide a new conceptualisation of this intertwined relationship within the empirical analysis outlined in Chapter 6-8.

Secondly, these entities are manipulated and transformed within BIGS space, and the biodiversity data sets are integrated and turned into *Code of Practice* compliant measurements of biodiversity performance. In this case study, it is the Project Group that repurposes the mass of biodiversity data into legitimate biodiversity indicators, trying to ensure compliance with the *Code of Practice*, whilst meeting a range of other extractions from the published reports. By outlining this transformation and manipulation work, this thesis answers research question 1.2 – How is biodiversity data transformed into biodiversity performance measures? – and follows Weir's (2018a) call for research to better understand how biodiversity accounts are being produced. So far, this second stage of achieving biodiversity calculability has been relatively absent from the accounting for biodiversity literature, showing a lack of research into the way biodiversity data becomes actually transformed and manipulated into biodiversity accounts.

And thirdly, diverse results of the calculative process are extracted, a process done by different actors for different purposes. One of these extractions is done by the Project Group, operating in the socio-technical context of BIGS, which decides how the biodiversity performance measurements will be reported on as a set of national biodiversity indicators within the UK Biodiversity Indicators Report. However, this extracted result undergoes perpetual modification which is described by interviewees as a process of continual improvement and evolution (as outlined in Table 5.3). The analysis within chapter 8 has also shown how these ongoing reframings are driven by ongoing input from political actors, environmental agencies and external organisations, experts from research centres, universities and NGOs, as well as changes in international treaties or conventions. This continual process of improvements means that the UK government's achievement of calculability for its biodiversity performance is inherently temporary and ongoing, which will impact on how the government can see and comprehend possible courses of action. These findings add to the current biodiversity reporting literature, by extending the predominant focus of biodiversity reporting literature on disclosure content (for example Rimmel and Jonäll, 2013; van Liempd and Busch, 2013; Atkins, Grabsch and Jones, 2014; Boiral, 2016, Atkins and Maroun 2018; Adler, Mansi, and Pandey 2018) towards the temporary nature of any achieved outcome and its subsequent use. In doing so, these findings answer research question 1.3 – How can a national account of biodiversity be extracted from the calculative space? – while also providing an understanding of biodiversity reporting as a collective and inherently imperfect and temporary calculative achievement. However, the analysis has also highlighted how the underlying calculative process – theorised using Callon and Law's (2005) three stage process – remained relatively stable during this time. As such, the achievement of the calculative outcome was always depended on the work within these three distinct stages.

9.3 Discussion of the findings

The following section will discuss the empirical findings of this thesis in terms of the extant accounting for biodiversity and accounting for sustainable development literature. In doing so, it will focus on four main themes drawn from the empirical analysis and discuss the implications for understanding biodiversity accounting as well as accounting for sustainable development more generally.

9.3.1 Anthropocentric vs. ecocentric accounting for biodiversity

First of all, taking the challenge of halting biodiversity loss as a case in point, extant accounting literature on this topic has been largely fixated with critiquing the anthropocentrism underpinning corporate reporting on biodiversity (Cuckston, 2018b), highlighting the influences of neoliberal ideology, commensuration, marketisation and financialisation upon accounts of biodiversity as so-called 'natural capital'. In contrast, the analysis in this thesis has not sought to problematise the underlying philosophical assumptions of the UK government's accounting for biodiversity per se. Rather, the analysis has explained and critically analysed how the UK government has worked to construct a form of accounting that it considers useful for enabling the pursuit of biodiversity conservation. The calculative framing, tools and infrastructure adopted makes very little reference to financialisation or marketisation, although it does attempt to make the numbers produced commensurable and compliant with a nexus of regional, national and international policies, treaties and conventions.

In line with this, the analysis has highlighted how constructing an account of national biodiversity depends on a social-technical arrangement in which various organisations have to work together to achieve calculability for biodiversity. Following Callon's (1998a) work on framing a calculable space, the findings emphasise how agency to act on biodiversity loss is a collective achievement within this network and a result of the process of achieving calculability. Within this network, a broad range of organisational identities, including organisational aims and motivations to engage in biodiversity accounting, have to work together in order to render biodiversity calculable. As a result, the drawn distinction between ecocentric and anthropocentric underpinnings within extant biodiversity accounting literature becomes messy and less clear within this particular case study.

The analysis has made clear that pragmatic factors instead of ideological factors play a significant role in shaping the form of accounting that can be constructed. Rather than UK biodiversity indicators being set up purely based on the accounting needs of statutory organisations and national governments, most of these indicators have been-driven by the data made available from pre-existing infrastructure and organisations involved in biodiversity conservation work. Interviewees described the opportunity to collect new data as highly unlikely making the availability and accessibility of pre-existing data sets essential to the framing and calculative work of producing these indicator sets.

There does appear to be some recognition of national data requirements through government funding of biodiversity work that includes the provision of some data. However, most of the time, these data calculations and collection infrastructures were developed before and independently of the need for biodiversity indicator reports. Biodiversity data collection processes in the UK were not designed for indicators selected by BIGS, but instead the data already collected for other purposes drive the calculation and communication of the numbers representing the official UK biodiversity performance and policy formulation. Thus, the UK government's answer to the question of what gets brought into their framed space is, in very large part, dependent on conservation work taking place outside of government. The biodiversity data that underpins the UK government's work to establish calculability for biodiversity depends on a complex civil infrastructure of people and technologies recording nature for their own work but doing so in a way that enables the government to make use of this data.

As such, understanding how biodiversity is rendered calculable requires more than just understanding the underlying philosophical frameworks. Overcoming the current distinction between anthropocentric and ecocentric framings of biodiversity accounting will enable accounting research to better understand the actual process in which biodiversity can be measured and accounted for. Furthermore, focussing on the process of how biodiversity is rendered calculable will also help to better understand how the boundaries around what is included and excluded within an account of biodiversity is drawn, based on practical challenges and limitations within the construction process of the final report.

9.3.2 Importance of overflows

Following Callon's (1998a) idea that framing is inherently imperfect, leading to a perpetual cycle of overflows and reframings, the analysis has highlighted the temporary nature of the achieved calculability for biodiversity. The UK national indicator set has shown changes in the indicators, underlying methodologies and the data sets to assess indicators on average every two to three years. As a result, the published UK accounts of biodiversity lack continuity, consistency and comparability over time.

The extant accounting literature on measures for sustainable development issues has called for measures to be consistent over time (for example Bowen and Wittneben, 2011 and Andrew and Cortese, 2011 on carbon accounting). Continuity and consistency are perceived a positive aspects of the quality of an accounting system with constant change seen as problematic. However, interviewees within this research perceived changes within the indicator set as improvements in the quality of their accounts and a necessary process in order to ensure the political usefulness of indicators and alignment with scientific development or changes in the international biodiversity related framework. Interviewees rejected the notion of trying to produce a perfect measurement system from the start, and instead highlighted how they had built in space for experimentation, trial and error as well as the necessity to incorporate sources of feedback and contextual changes – what Callon (1998a) refers to as ‘overflow’. As a result, rather than treating overflows as something unexpected and unwanted, the UK set up BIGS to allow overflows to be brought in and internalised into their calculative process to enhance rather than distort the reporting process.

BIGS as a governmental structure enables regular interactions with entities outside of its frame (e.g. within the Biodiversity Indicators Forum) as well as the various actors inside the frame (e.g. within the Biodiversity Indicators Steering Group). BIGS explicitly acknowledges the need for various governmental and non-governmental actors to work together in order to construct this national biodiversity account. By bringing together the statistical as well as political actors within the Biodiversity Indicators Steering Group, ministerial and political feedback can be incorporated within the indicator set. It is this internalisation of overflows and constant reframing of the calculative framework that has enabled the UK Biodiversity Indicators Report to become accepted by the actors involved.

In addition, this multi-organisational governmental structure acknowledges the need for cooperation between a broad range of organisations in order to render biodiversity calculable. By comprising governmental organisations from all four countries, non-governmental organisations, academia and research centres it allows the calculative process of the biodiversity accounts to involve a broad range of organisations, with selected stakeholders having a voice within the process.

As mentioned earlier, actors within the biodiversity accounting processes were aware of the limitations and gaps within their measures of biodiversity. However, rather than deciding to not account for biodiversity at all, actors within this study felt that using imperfect measures of biodiversity was preferable over not accounting for biodiversity at all. Rather, actors focussed on how to achieve any sort of pragmatic temporal consensus on biodiversity indicators, knowing these measures would need what they considered to be improvements in subsequent years.

So far, the concept of intentionally imperfect and temporary measures has not been significantly conceptualised within the extant accounting for biodiversity literature outlined in chapter 2. As a result, this research also highlights a novel approach of studying intentionally temporally bounded and imperfect measures of biodiversity or more broadly sustainable development using the theoretical framework of framing and overflowing.

Overall, this research points out how rendering national biodiversity calculable necessitates experimentation, ongoing adaptations of measures and countless interactions between a broad set of actors. It cannot be achieved within a single organisational setting but rather requires the collective work of a broad range of actors, including governmental, non-governmental, academic and research focussed organisations. However, any achieved calculability will also be inherently imperfect and subject to overflow and reframing. Thus, incorporating overflows has been a way for actors included within this research to deal with intentionally imperfect measures of biodiversity, while still being able to achieve some form of temporary consensus and meaningful accountability.

9.3.3 Distinction within the terminology

The terminology used by interviewees within this research showed a clear distinction between the terms ‘indicators’, ‘measures’ and ‘data sets’, even though their use within the official documents such as the UK Biodiversity Indicators Reports or strategies seems more intertwined, shows changes over time and does not contain a clear definition.

While the terms ‘indicator’ or ‘measure’ lack a clear definition within the accounting literature (see for example Russell and Thomson, 2014; Thomson, 2014), this research found a more nuanced understanding of the terminology within UK biodiversity accounting actors involved in BIGS. As such, interviewees highlighted the complex and intertwined relationships between the definitions of indicators and measures. The impact on reporting practice can be observed through the changes taking place within the UK Biodiversity Indicators Report over the last decade, in particular how indicators were transformed into measures and measures transferred into indicators without any explanation. As such, separating these two concepts in practice seems rather fuzzy and less clear than the definitions provided within the literature (see for example Heink and Kowarik, 2010; McCool and Stankey, 2004; Singh et al., 2009; Veleva and Ellenbecker, 2001). This finding is consistent with Callon's (1998a) notion of entanglement, pointing out the interconnectedness of different concepts and the difficulty in drawing such as clear cut separation between these terminologies.

Additionally, this research has highlighted how the definitions of the term indicators varies between different actors involved. While some interviewees saw indicators as tools to render trends or phenomena of larger significance visible, other interviewees felt that indicators do not just have to show trends in a politically acceptable way, but also have to highlight the causes and potential solutions of these biodiversity changes.

However, the extent to which indicators have to be able to provide these information characteristics was debated by the interviewees. Some interviewees felt that assigning causes and potential solutions would make the indicators less objective as they interpreted *the Code of Practice* as stipulating that indicators should only focus on providing unbiased and neutral facts (a similar discussion on whether accounting can be neutral and unbiased can be found for example within Dillard, 1991; Hopwood, 1994; Roberts and Scapens, 1985).

The analysis also identified how various data sources have been manipulated and transformed into what interviewees considered to be legitimated indicators. This transformation process changes the qualitative attributes of the fragmented data sets produced by a range of different institutions into a single authoritative national account produced by the UK Government. The primary transformation device was adherence to the UK government statistical *Code of Practice*. This transformation process therefore turns a multitude of information and data sets into statistically legitimated individual indicators intended to provide an objective assessment of whether a particular aspect of biodiversity is getting better or worse. Thus, the aim of an indicator in that context is to clearly indicate change by simplifying and linking together a broad range of data.

Given that data sets are not collected by BIGS, but rather selectively brought into the frame from outside organisations, the process of accounting for biodiversity in the UK becomes mainly a process of bringing together data from multiple sources. These data sets are then turned into what is perceived by the interviewees as useful, legitimated, authoritative measurements of UK government biodiversity performance. While this transformation and manipulation process enables the UK to annually publish a national biodiversity account and national accounts to CBD, it creates an indicator set lacking a central or internal cohesive logic dependent on existing data availability and external quality processes.

Additionally, whereas biodiversity metrics are often criticised within the accounting for biodiversity literature for being inadequate to represent the complex nature of biodiversity (see for example Tregidga, 2013; Gray, 2010), interviewees predominantly did not question the adequacy of using calculated indicators in this context. Particularly due to the fact that indicators are a requirement of international frameworks such as the CBD and the UK has to report on them to fulfil its reporting obligations towards the framework; indicators were seen as a valid tool to measure and report on national biodiversity. Additionally, this indicator approach was aligned with the practices of many of the organisations and disciplines involved in BIGS. What has to be noted in this context is that interviewees within this particular case study did not aim to construct a single indicator that could describe biodiversity in its entirety habitats (as for example aimed at by Moonen and Barberi, 2008). Rather, the focus was on designing an appropriate set of complementary indicators that together render biodiversity calculable.

9.3.4 Tension between top-down vs bottom-up accounting approaches

The case highlighted how particular accounting tools – in that case biodiversity indicators – are used to mediate tension between the top-down setting of political and international goals and targets (as discussed within section 5.3) versus the bottom up nature of the data collection and calculative practices (as discussed within chapter 6).

International frameworks such as the CBD were named by interviewees as the biggest driver for the UK to report indicators at all, as the CBD framework requires signatory countries to report on how they have been implemented indicators and measurements to track progress in national biodiversity conservation. With the CBD adopting a more outcome and measurement focussed approach, the UK also shifted towards a more measurement-based biodiversity accounting framework. Additionally, changes within this international framework have resulted in overflows leading to reframings of the national biodiversity indicator set. For example, the mapping of existing indicators against the Aichi Biodiversity Targets in 2011 and the grouping of these indicators against the Aichi Strategic Goals has led to the identification of what interviewees considered to be gaps in the indicator set. As a result, new indicators were developed in order to be compliant with this international framework. All indicators are currently grouped (see Appendix 6) and labelled according to the CBD Aichi targets. The language within that international framework has been adopted within the national indicator set in terms of labelling individual indicators (see Table 7.4 and Appendix 6).

In contrast to this top-down approach of international biodiversity frameworks, biodiversity conservation action in the UK typically seems to be based on a highly local bottom-up process. This can also be seen in the UK biodiversity accounting process with its reliance on local non-governmental data sets. As a result, accounting for national biodiversity has to resolve an underlying tension between the top-down approach used within international frameworks and the bottom-up approach used within the national biodiversity accounting process.

Biodiversity in itself is a complex and intertwined concept that is highly regional specific and difficult to measure particularly on a national or global scale (Gaston, 2000). In contrast, the CBD framework requires biodiversity to be reported on a national level, which is in stark opposition to the devolved nature of biodiversity conservation in the UK, which consists of four countries. Given that most of the data sets result from such local conservation work, there seems to be strong tension between the national outlook of the indicator set and the setting of global biodiversity goals versus the local nature of the data sets used to report on national biodiversity performance and to measure progress towards these goals. As a result, these local data sets have to be detached from their original purpose and have to be reframed as UK wide indicators in line with the national *Code of Practice*. Thus, the process of statistical compliance and scale adjustment is aimed to reduce the tension between the different scales in which the data is supposed to be used.

While this process of detachment, repurposing and manipulation might be able to resolve some of the underlying tensions within the data sets used for the national biodiversity accounts, it limits the general usefulness of the achieved calculability. While this set of indicators is being used by the UK to report on their national biodiversity, fulfil their international reporting requirements and brief ministers and policy advisors, on the ground conservation actors did not find them helpful for their everyday conservation work.

9.4 Contribution to the theoretical framework

According to Crane et al. (2016), academic research can provide theoretical contributions by either testing and refining theory, applying theory or generalising theory. As such, this thesis provides new insights into the application of Callon's (1998a) framework of framing and overflowing in combination with Callon and Law's (2005) three step process to achieve calculability within the literature on accounting for biodiversity and more broadly accounting for sustainable development.

By applying Callon's (1998) and Callon and Law's (2005) framework in the context of national biodiversity accounting, this thesis has followed Cuckston's (2018b) call for more theoretical rigor within the accounting for biodiversity accounting literature. The analysis in this thesis offers a way to pursue accounting for biodiversity research, using Callon and Law's (2005) notion of framing a space and Callon's (1998) concept of framing and overflowing in which biodiversity conservation challenges are rendered calculable. In this sense, accounting for biodiversity is not merely the reporting of performance indicators. This reporting is the third stage of an iterative process, extracted from the framed calculable space. Rather, accounting for biodiversity should comprise all three of Callon and Law's (2005) stages of achieving calculation, encompassing all the processes of collecting useful data and then manipulating this in ways that produce selective, politically infused useful measures of biodiversity performance. Informed detachment, transformation and manipulation, and extraction that repurposes data initially designed for on-the-ground biodiversity conservation work can be seen to mitigate against the partial and problematic detachment from nature that arises from trying to design and impose internationally comparable accounts for monitoring biodiversity performance.

This thesis has highlighted how rendering biodiversity calculable is a non-linear and messy process, with each of the three calculative stage providing a unique set of challenges that have to be overcome. In doing so, this thesis has outlined a way of examining non-linear calculative processes and has highlighted a way of combining Callon's (1998a) notion of framing and overflowing and Callon's and Law (2005) three stage process. As a result, this novel theoretical framework allowed this thesis to examine micro-level day-to-day work necessary to render UK biodiversity calculable, while still allowing to place this work within the broader, macro-level context of UK biodiversity policy, strategy development and international biodiversity frameworks. As such, this theoretical framework enabled this thesis to locate overflows and re-framings within the calculative process, but also to provide a detailed outline of the construction of this calculative framework at the same time. Thus, it allowed the tracing of sources of stabilisation and destabilisation, micro and macro actors, linearity and messiness as well as change and continuity.

By providing a theoretical approach that allowed this thesis to bring out these different components of the calculative process that allow the final indicator report to be constructed, this thesis has applied the framework of Callon (1998) and Callon and Law (2005) in a novel and original way. Therefore, this thesis expands the explanatory power of the theoretical framework by highlighting an innovative way of applying this theoretical framework in an empirical setting. As a result, it enables accounting for biodiversity research to go beyond routine descriptions of corporate reporting practices and to overcome limitations that come with its current predominant focus on single organisational context. In doing so, the theoretical framework applied enables this thesis to make novel contributions to knowledge by expanding the current literature on accounting for biodiversity and answers research question 2 – How can the achievement of biodiversity calculability be theoretically understood and explained? – .

9.5 Conclusion

To conclude, this chapter has summarised the empirical findings outlined within chapters 6-8. By highlighting how rendering biodiversity calculable required the consideration of three distinct but interconnected stages – the detachment of data, the transformation into indicators and the extraction of a result – this chapter has outlined how the UK Biodiversity Indicators are largely shaped by the data that is made available at the detachment stage. It has also explained how the process of transformation is largely a process of repurposing data sets to be included within the UK Biodiversity Indicators Report while trying to ensure compliance with the *Code of Practice* and mediating different perceived user needs. Lastly, it has been outlined how the extracted result has undergone constant reframings, driven by the internalisation of multiple overflows and a continuous process of refinement.

Afterwards, this chapter has discussed these findings in line with the extant accounting for biodiversity literature. In contrasting with the ongoing debate between ecocentric and anthropocentric framings of biodiversity (see further Cuckston, 2018b), these findings have highlighted how the process of rendering biodiversity calculable in the UK was neither driven by any of those two frames, but rather by pragmatic decisions, political priorities and practical limitations. As such, this chapter has highlighted how understanding biodiversity calculability requires more than just criticising the underlying philosophical framing of biodiversity. As such, by focussing on the actual calculative process behind the UK Biodiversity Indicators this research has enabled a better understanding into how biodiversity can be rendered calculable and measureable in ways that enable actual biodiversity conservation.

Following, the necessity of ongoing adaptations of the measures and countless interactions between a broad set of actors involved in the UK Biodiversity Indicators process was outlined. Contrasting the academic call for consistency in environmental measures (for example Bowen and Wittneben, 2011 and Andrew and Cortese, 2011 on carbon accounting) the analysis has highlighted how rendering biodiversity calculable required the collective work of a broad range of actors and was inherently imperfect and subject to overflow and reframings.

Next, the discussion has outlined how actors within this research showed a more nuanced understanding of the terminology of an indicator or a measure, compared to the definitions provided in Chapter 2.4.1. As such, interviewees have described the distinction as messy and the definition of the term indicator varied between interviewees ranging from a tool to analyse trends to a tool to highlight the causes of changes. As such, this thesis proposes a more refined understanding of what constitutes a biodiversity indicator and what the process of transforming data sets into indicators requires.

Lastly, this chapter discusses the tensions arising between top-down international frameworks and bottom-up biodiversity accounting processes. In doing so, the discussion highlights how the BIGS and UK Biodiversity Indicator Reports mediate between these two processes by transforming data sets in line with international indicator requirements.

Following, the theoretical contribution of the thesis was outlined. By combining the notion of framing and overflowing (Callon, 1998a) and the three steps of a calculative process (Callon and Law, 2005), this thesis has shown a novel way in understanding and examining complex calculative process, bringing together macro and micro actors and tracing sources of continuity and ongoing change. This original theoretical framework has allowed the examination of the calculative process that enables the construction of the final indicator report, while still placed it into the wider national and international context.

CHAPTER 10: CONCLUSION

10.1 Introduction

The purpose of this chapter is to provide an overall conclusion of this thesis aimed at answering the following research questions:

> RQ1: How can national governments achieve a calculability for biodiversity loss that enables the formulation of policies to facilitate effective biodiversity conservation?
>
> > RQ1.1: How can biodiversity data be detached from nature?
> >
> > RQ1.2: How is biodiversity data transformed into biodiversity performance measures?
> >
> > RQ1.3: How can a national account of biodiversity be extracted from the calculative space?
>
> RQ2: How can the achievement of biodiversity calculability be theoretically understood and explained?

The national UK Biodiversity Indicators Report was used as a single, explanatory case study of how the UK has achieved calculability for their biodiversity performance. In order to examine and critically analyse this particular calculative process, a qualitative research strategy focusing on document analysis and interviews was adopted. The findings were structured and examined using the framework of calculability and particularly Callon's (1998a) notion of framing and overflowing and Callon and Law's (2005) three stage process of achieving calculability.

This chapter is structured into four sections. Following, section 10.2 will provide the researcher's personal reflections on the research and the methodology adopted within this project. Next, section 10.3 will outline the limitations of the case and section 10.4 will consider the implications of the findings as well as suggestions for further research.

10.2 Reflections on the methodology and its practicalities

Given the research questions of this project, as outlined in section 1.2, and the underlying philosophical assumptions of the researcher, a qualitative case study research design was considered to be most appropriate. One of the main assumptions of this thesis has been that accounting is a social practice. As such accounting does not just record reality (Hopwood and Miller, 1994), but it actively constructs and transforms the reality it purports to represent (Hines, 1988; Miller and Power, 2013). Thus accounting can be a 'productive force' (Miller and Power, 2013, p. 558) and an enabler of biodiversity conservation. Given that constructivist dimension of biodiversity accounting, biodiversity accounting practices can only be understood through an examination of the subjective interpretations of these processes by the involved actors. Thus, deploying a case study research design allowed the researcher to interview the actors involved, examine the publicly available documentation of the calculative processes and gather an understanding of the case through additional observations and informal interviews. As such, this research strategy has been proven useful in order to understand the relationships between the actors and the environment in which they operate in and has therefore been a valuable research design to uncover the complexities and interactions of this particular case and the calculative process examined within this thesis.

However, this research design has also resulted in various challenges which will be reflected on within this section. First of all, getting access to the actors involved was rather difficult and time consuming. Each individual interviewee had to be identified and contacted separately as interviewees worked for twelve different organisations, in different positions and were not in contact with each other regularly. While the statistical and scientific actors approached mostly agreed to take part in this study, policy actors often declined the invitation for an interview. Most of the time, the actors contacted did not respond to any email and had to be approached personally at meetings and conferences. These personal meetings did enable informal conversations and shaped the researcher's understanding of the policy space, however the majority of political actors approached still declined the formal interview request. As a result, other options for accessing policy information had to be considered including the analysis of policy documents and the informal observation of policy meetings and conferences.

Furthermore, some interviewees were not able to recollect memories from their early work on the UK Biodiversity Indicators in the years 2007-2015, and as such certain processes had to be reconstructed and triangulated using document analysis. To do so, meeting reports and presentations given at official Biodiversity Indicator Forum Meetings had been proven valuable and no major discrepancies between the statements recollected by interviewees and the official documents were visible at any time during the research. However, relying on personal memory of interviewees might has influenced the empirical findings presented within this study and as such this reliance on memory should be most certainly considered as a limitation of this study.

Additionally, analysing such a vast data set of empirical data examining such a complex, multi-organisational calculative process has proven challenging. As a result, the analysis process of the data set can be best described as a back and forth between the documents, interview transcripts and the theoretical framework. In order to analyse the data, a theoretical framework combining the notion of framing and overflowing (1998a) and the three steps of calculation (Callon and Law, 2005) was developed and deployed within this research. As a result, the empirical findings were structured within the three stages of Callon and Law (2005) and overflows created within each of these stages were traced. This novel theoretical framework has allowed this thesis to structure the empirical data, retrace the calculative process and reconstruct the relationships between various actors involved. As such, the theoretical framework proposed within this research might be helpful for other researchers trying to understand and examine a similar multi-organisational, non-linear, messy calculative process or to trace relationships and influences of actors and calculative devices.

10.3 Limitations of the case

This thesis has focussed on a single national government's efforts to render calculable the challenge of biodiversity loss. Given the disparity in history and resources of governments in different countries, and the complexities of the challenge of biodiversity conservation, the findings in this thesis are not straightforwardly generalisable. The UK is a densely populated country, dominated by a mosaic of urban and agricultural landscapes. The problem of halting biodiversity loss in the UK is going to be very different to countries with large tracts of relatively undeveloped natural habitat. Global priorities for halting biodiversity loss tend to be framed around biodiversity 'hotspots', like rainforests, which support vast numbers of species in complex ecological systems (see Myers et al., 2000), not in highly industrialised landscapes, like the UK. Therefore, different governments may take different approaches to framing a space in which their own biodiversity performance becomes calculable.

Likewise, the findings presented within this research might not be generalisable to any other challenges or areas of concern examined within the broader area of Social and Environmental Accounting or Accounting for Sustainable Development. Other environmental issues such as climate change might lend themselves to more universally and globally applied indicators compared to the highly local circumstances of biodiversity, and further research into a broader range of sustainable development issues would be required.

However, in examining a single case study, this thesis has demonstrated the potential insights from a form of analysis that can significantly advance the understanding of how accounting for biodiversity could enable the pursuit of biodiversity conservation. This analysis represents a shift away from a concern with the ideological motivations behind corporate reporting on biodiversity and towards a way of explaining how it becomes possible to account for biodiversity in ways that are useful for the pursuit of conserving biodiversity. This thesis's analysis of the UK government's work to report on its biodiversity performance has revealed how achievement of calculability depends upon a complex socio-technical arrangement of governmental and non-governmental actors and is inherently temporary.

If accounting research is to become a force for biodiversity conservation then researchers will need to conceptualise the link between accounting and the organising of actions conducive to conserving biodiversity (see further Bebbington and Larrinaga, 2014; Unerman and Chapman, 2014). This thesis has aimed to do so by rendering the link between the construction of a performance measurement system and the policy space in which this work takes place visible and thus highlight how the relationship between evidence and policy is anything but simple. In doing so, this thesis has highlighted how the development of UK Biodiversity Indicators has been a source of overflow into political debates, however it has not traced any direct links between the indicators and biodiversity policy. As such, this might be an area for future research.

While the research design employed in this thesis has enabled new insights into how the accounts of biodiversity conservation workers have impacted on the production of national reports, the researcher has not been able to investigate the impact of these national accounts on biodiversity conservation work. This is a limitation of this research and an area that requires further investigation.

10.4 Implications of the research and suggestions for future research

The research presented within this thesis has various implications for the accounting for biodiversity as well as accounting for sustainable development literature as well as the biodiversity accounting practice and policy. First, by outlining the calculative process in which the UK Biodiversity Indicators have been rendered calculable, this thesis provides an insight into the construction and development process of national biodiversity indicators. In doing so, it allows biodiversity practitioners – including policy makers, statisticians, NGOs and researchers – to better understand and interpret national accounts of biodiversity.

Additionally, this research highlights the need to understand any measures of biodiversity or sustainable development as inherently temporary and imperfect. No measurement system of biodiversity or sustainable development will be complete or flawless, but rather frequent reframings will be necessary. By 'bracket[ing]' (Callon, 1998a, p. 249) the outside world and reducing the complexity of the problem that is to be rendered calculable, certain elements of biodiversity are always going to be excluded. As a result, no biodiversity accounting tool will be ever able to capture biodiversity and its internal and external connections in its entirety. Creating a biodiversity accounting system will as a result never be a completed process and studies of biodiversity accounting practices should reflect this ongoing change. As a result, changes within biodiversity accounting systems should be embraced rather than avoided, and accounting practices should be understood and studied taking this ongoing reframing into account. As such, this research has highlighted how actors strive for collaboration and ongoing change in order to deal with imperfect measures of biodiversity. This finding has implications for practitioners involved in the development and construction of biodiversity – or potential other sustainable development – indicators, as it highlights the necessity of incorporating ways of internalising potential overflows into the design of the indicator development process. However this thesis has not been set up to understand the effects of these imperfect measures on actual conservation performance. As such, this might be an area for future research.

In line with Bebbington and Larrinaga's (2014) call to study accounting for Sustainable Development outside of traditional organisational boundaries, this research highlights how accounting for biodiversity requires a network of various actors from different knowledge disciplines working together to render biodiversity calculable. Achieving biodiversity conservation will require collaboration between governmental, non-profit and corporate organisations and goes beyond boundaries of a single traditional economic entity. As a result, research on accounting for biodiversity or sustainable development has to overcome its current predominant focus on a single organisational context and for-profit organisations if it wants to make a contribution to biodiversity conservation. By focussing on a multi-organisational setting, this research has been able to show the role accounting plays in organising multi-organisational biodiversity conservation efforts. Besides its contribution to the accounting for biodiversity literature, this finding also has implications for biodiversity practitioners. First of all, it highlights the need for policy makers and national statisticians to set up an accounting process that allows the collaboration with various non-public sector organisations, including NGOs and research centres. On the other hand, this finding also highlights ways in which NGOs and research centres can be involved in national accounting processes. Given the reliance of public sector organisations on already available data sets, understanding the data compliance standards and the national accounting and reporting process provides opportunities for NGOs and researchers to steer national policy discussions and reporting practices by collecting data and making them available to the individual public sector organisations.

Furthermore, this thesis has aimed to re-centre the current discussion within the accounting for biodiversity literature away from its recent focus on anthropocentric versus ecocentric framings and towards a discussion that focusses on the question of whether a particular accounting practice enables biodiversity conservation. If the ultimate aim of accounting for biodiversity research is to contribute to the field of biodiversity conservation, then it has to show how accounting has made conservation work possible. One way of doing this is by highlighting how relations between human and non-human actors are organised through accounting tools and techniques (Cuckston, 2018b). As such, this thesis has contributed to the accounting for biodiversity literature and has provided a novel theoretical conceptualisation of researching biodiversity accounting concerns by bringing together the notion of framing and overflowing (Callon, 1998a) and the three steps of calculability (Callon and Law, 2005). In doing so, this thesis has outlined an original way of understanding and analysing multi-organisational, complex and intertwined calculative processes that could be useful within future accounting for biodiversity research. Additionally, this theoretical framework could be useful for research into other sustainable development areas. As such, future research might be able to use the methodological and theoretical set up deployed within this thesis to better understand the construction process of other national sustainable development indicators and accounts including for example national indicators on poverty, inequality, education or health.

Additionally, this thesis has highlighted how the different scales in which biodiversity conservation takes place influence the way in which biodiversity can be rendered calculable. Particularly given that biodiversity conservation is such a regional specific issue, attempts at constructing a national biodiversity account might result in tension between the national outlook of the account and the local scale in which biodiversity conservation takes place. This tension becomes even bigger when international targets, such as the CBD targets in case of national biodiversity, are involved. Biodiversity indicators have been one tool aiming to resolve that tension by combining a multitude of local data sets into legitimated indicators constructed to represent biodiversity on a national level. Rendering biodiversity calculable will always include facing the challenge of scale, whether this is on an international, national or organisational level. Given that the current CBD Aichi targets are being renegotiated in 2020, the findings within this thesis can also contribute towards the work going into the currently ongoing development of the new set of global biodiversity targets and the potential reframing of the UK Biodiversity Indicators after the agreement on a new CBD framework. Interviewees within this research have highlighted the importance of global targets, if they can be translated into national and regional targets and measurements. As such, these findings show the limitations of globally developed and fixed biodiversity indicator sets that have to be reported on by all signatory countries. In doing so, this thesis has also highlighted the limitations of the current SDG indicators approach – which relies on global indicators – by showing how in the case of biodiversity conservation, the SDG indicators were side-lined and not particularly taken into consideration during the reframing of the UK Biodiversity Indicators set. Additional research would be needed to better understand how the SDGs could be better streamlined against the new CBD targets and to see whether the SDGs will become more relevant within the UK biodiversity accounting process in the future.

Additionally, further case studies on the construction of biodiversity reporting by other national governments could help establish whether the findings here translate to different settings. Of particular use would be studies of governments in countries containing biodiversity hotspots, such as large tracts of natural rainforest, or countries facing different biodiversity concerns compared to the UK. Similarly, additional cases concerning efforts by governments to render calculable the challenges specified by other SDGs could further contribute to an understanding of how the work of accounting for sustainable development makes it possible to pursue sustainable development. As such, understanding how other sustainable development challenges – e.g. poverty, inequality, education, disability or health – are rendered calculable can be useful in order to understand to what extent the findings presented within this thesis are applicable to other forms of national accounts. By highlighting to what extent the national calculative process outlined within this thesis is a usual or unusual way of constructing national indicators, future research could provide a better understanding of the applicability of the findings for other forms of national accounts and performance measurement systems.

The insights generated in this study may be relevant in organisational contexts beyond national governments. If other kinds of organisations, such as corporations, are to effectively contribute to biodiversity conservation then extensive capacity-building will be necessary in order to build and refine the kind of organisational infrastructures needed to render calculable their biodiversity performance. Organisational-level accounting for biodiversity has largely been driven by top-down standards – most notably the Global Reporting Initiative (GRI) – purporting to empower organisations to understand their sustainability impacts and thus make informed decisions (Jones and Solomon, 2013a). Yet, numerous studies of corporations' reporting on their biodiversity performance has found this to be almost universally superficial and inadequate for informing management decisions or for discharging any meaningful form of accountability to stakeholders (see Cuckston, 2018b). Indeed, the vast majority of corporate sustainability reports simply declare biodiversity reporting standards to be irrelevant to their operations (Atkins et al., 2014a, Adler et al., 2018b).

This thesis suggests that for corporations to achieve a form of calculability for their biodiversity performance that will actually enable them to contribute to biodiversity conservation, these corporations will need to engage in the kind of framing work seen to be taking place within the UK Government. Crucially, rather than rely on top-down standards like the GRI, which are highly unlikely to be directly relevant to the specific circumstances of a particular corporation's impacts on biodiversity (Boiral, 2016), corporations instead will need to develop bottom-up measures of their biodiversity performance based upon the context of their own operations. This thesis implies that this requires extensive framing work to detach relevant data, manipulate and transform this data into coherent and credible measures, and then extract these to produce a useful account of biodiversity performance.

Developing the capacity to account for biodiversity performance would thus likely require considerable investment of effort and resources at each of these three stages of calculation. The detachment of relevant data could require scrutiny of existing data sources (both within the organisation and from other organisations, such as conservation NGOs) that can be repurposed. It may also be that corporations have the resources to be able to work with conservation NGOs to identify new data needs and devise ways to extract such data. The manipulation and transformation of data into measures of performance would likely require clear procedures, akin to the UK Government's *Code of Practice*, for ensuring that measures of performance are derived in a way that is seen to be credible and legitimate. The extraction of results into an account of a corporation's biodiversity performance would likely require mechanisms to enable reflection on these results, perhaps by a range of internal and external stakeholders comprising a broad range of expertise, to drive refinement and evolution of this account, with the aim of continually improving the calculability of the corporation's accounts of its biodiversity performance.

In summary, by analysing the work that went into the construction and publication of its annual UK Biodiversity Indicators Report, this thesis has explained and critically analysed how the UK government has framed a space in which it was able to render biodiversity calculable. Using the framework of calculability – and thus bringing together the notion of framing and overflowing (Callon, 1998a) and the three step process of calculability (Callon and Law, 2005) –, this thesis has outlined how rendering biodiversity calculable required work on three distinct challenges: First, the detachment of data from nature as well as the detachment of that data from its original data collection organisation. Second, the transformation of this data into distinct and legitimated biodiversity indicators. And third the extraction of these results from the calculative space.

In doing so, this research has highlighted how rendering biodiversity calculable in the UK relied upon a broad collaborative structure of a wide range of government and non-governmental organisations – including DEFRA, devolved administrations, devolved environmental agencies, NGOs, research centres and academia. Moreover, this thesis has traced various overflows affecting the framing of the UK Biodiversity Indicators Report, resulting in continuous change and improvement – as defined by the actors involved – of the indicator set. In doing so, this thesis has highlighted how rendering biodiversity calculable is inherently imperfect and ongoing. Lastly, this thesis has highlighted how government agencies were not designing specific indicators first and going out to collect the necessary data subsequently, but rather the construction of indicators was largely driven by data that had already been collected by non-governmental conservation organisations and research centres for other purposes. As such, this thesis concluded that the process of constructing Biodiversity Indicators in the UK is predominantly influenced by pragmatic decisions involving resource allocation as well as data availability and accessibility.

APPENDIX 1: LIST OF ANALYSED DOCUMENTS

Year	Organisation	Title
Reports towards the CBD		
1998	DETR	First National Report to the United Nations Convention on Biological Diversity
2001	DEFRA	Second National Report to the United Nations Convention on Biological Diversity
2005	DEFRA	Third National Report to the United Nations Convention on Biological Diversity
2009	DEFRA	Fourth National Report to the United Nations Convention on Biological Diversity
2014	JNCC	Fifth National Report to the United Nations Convention on Biological Diversity
2018	Scottish Natural Heritage	Scotland's interim assessment of progress towards the Aichi Targets (2016)
2019	JNCC	Sixth National Report to the United Nations Convention on Biological Diversity
Biodiversity Indicators and Strategies UK		
1994	HMSO	Biodiversity. The UK Action Plan
2007	DEFRA	Biodiversity Indicators in Your Pocket 2007
2007	DEFRA	Conserving Biodiversity – The UK Approach
2008	DEFRA	Biodiversity Indicators in Your Pocket 2008
2009	DEFRA	Biodiversity Indicators in Your Pocket 2009
2010	DEFRA	Biodiversity Indicators in Your Pocket 2010
2011	DEFRA	Biodiversity 2020: A Strategy for England’s Wildlife and Ecosystem Services
2011	DEFRA	Biodiversity Indicators in Your Pocket 2011
2012	DEFRA	Biodiversity Indicators in Your Pocket 2012
2012	DEFRA	A Strategy for England’s Wildlife and Ecosystem Services: Biodiversity 2020 Indicators
2012	DEFRA & JNCC	UK Post-2010 Biodiversity Framework
2013	DEFRA	Biodiversity Indicators in Your Pocket 2013
2013	JNCC	UK Post-2010 Biodiversity Framework: Implementation Plan
2013	JNCC	UK Post-2010 Biodiversity Framework Implementation Plan: 1st Report
2014	DEFRA	Biodiversity Indicators in Your Pocket 2014
2015	DEFRA	Biodiversity Indicators in Your Pocket 2015
2015	JNCC	UK Post-2010 Biodiversity Framework Implementation Plan: 2nd Report
2016	DEFRA	Biodiversity Indicators in Your Pocket 2016
2017	DEFRA	Biodiversity Indicators in Your Pocket 2017

2018	DEFRA	Biodiversity Indicators in Your Pocket 2018
2018	DEFRA & JNCC	UK Post-2010 Biodiversity Framework: Revised Implementation Plan (2018–2020)
2019	DEFRA	Biodiversity Indicators in Your Pocket 2019
International Biodiversity Conventions		
1992	SCBD	UN Convention on Biodiversity
2002	SCBD	2010 Biodiversity Targets
2010	SCBD	Strategic Plan for Biodiversity 2011–2020
2012	SCBD	Quick Guides to the Aichi Biodiversity Targets
2015	UN	Transforming our world: the 2030 Agenda for Sustainable Development
The UK Biodiversity Indicators Forum (BIF)		
2002	JNCC	A report to the Department for Environment, Food & Rural Affairs of the UK Biodiversity Indicators Forum: An exchange of experience in the development and use of biodiversity indicators
2003	JNCC	UK Marine Biodiversity Indicators: A Report from the Second Meeting of the UK Biodiversity Indicators Forum
2004	JNCC	3rd UK Biodiversity Indicators Forum (BIF3) Meeting Report
2004	UNEP-WCMC	Outcome from CoP7 - global indicators
2004	DEFRA	Development in Europe - EU Biodiversity Strategy, EEA Core Set, PEBLDS
2004	JNCC	National Reporting issues
2004	UNEP-WCMC	Biodiversity Trends & Threats in Europe: Development and test of a species trend index
2004	DEFRA	Biodiversity Statistics review
2004	DEFRA	Country Report: England
2004	Scottish National Heritage	Country Report: Scotland
2006	JNCC	4th meeting of the UK Biodiversity Indicators Forum
2006	WCMC	The Global Biodiversity Indicators Partnership
2006	DEFRA	Developing UK indicators for the 2010 target
2011	JNCC	BIF5 Meeting Report
2011	DEFRA	Policy Context - Nagoya and the EU Biodiversity Strategy
2011	DEFRA & JNCC	Reviewing the UK biodiversity indicators
2011	WCMC	Ecosystem Service Indicators - Global and National initiatives
2011	DEFRA	Volunteering/ Public awareness - how can we improve our measurements of engagement with biodiversity?
2012	JNCC	BIF6 Meeting Report
2012	AEA	Habitat connectivity indicators
2012	AEA	Climate change indicators
2012	CEH	Developing a Species Indicator based on distribution data
2012	RSPB	Priority Species Indicator

2012	UNEP-WCMC	Plant genetic resources
2012	UNEP-WCMC	6th UK Biodiversity Indicator Forum: Ecosystem Service Indicators
2012	York University	Global Impacts: Measuring the Impact of UK Consumption on Biodiversity Overseas
2013	JNCC	UK Biodiversity Indicators Forum Summary Report
2014	JNCC	Biodiversity indicators Forum 8th Meeting
2014	Natural England	Assessing confidence and communicating meaning: the experience of the LWEC Climate Change Impact Report Cards
2014	DEFRA	Introduction to the species indicators: data, modelling approaches, and trends
2014	DEFRA	A policy perspective – aligning indicators to strategies and targets

APPENDIX 2: LIST OF INTERVIEWEES

APPENDIX 3: ETHICAL APPROVAL DOCUMENTS

Application for Ethical Review ERN_17-1274

Samantha Waldron

Tue 03/10/2017 12:07

Phd

To: Ian Thomson <I.Tho

Cc: Madlen Sobkowiak <MXS

Dear Professor Ian Thomson

Re: "Biodiversity Conservation Leadership in UK Public Sector Organisations"
Application for Ethical Review ERN_17-1274

Thank you for your application for ethical review for the above project, which was reviewed by the Humanities and Social Sciences Ethical Review Committee.

On behalf of the Committee, I confirm that this study now has full ethical approval.

I would like to remind you that any substantive changes to the nature of the study as described in the Application for Ethical Review, and/or any adverse events occurring during the study should be promptly bought to the Committee's attention by the Principal Investigator and may necessitate further ethical review.

Please also ensure that the relevant requirements within the University's Code of Practice for Research and the information and guidance provided on the University's ethics webpages (available at https://intranet.birmingham.ac.uk/finance/accounting/Research-Support-Group/Research-Ethics/Links-and-Resources.aspx) are adhered to and referred to in any future applications for ethical review. It is now a requirement on the revised application form (https://intranet.birmingham.ac.uk/finance/accounting/Research-Support-Group/Research-Ethics/Ethical-Review-Forms.aspx) to confirm that this guidance has been consulted and is understood, and that it has been taken into account when completing your application for ethical review.

Please be aware that whilst Health and Safety (H&S) issues may be considered during the ethical review process, you are still required to follow the University's guidance on H&S and to ensure that H&S risk assessments have been carried out as appropriate. For further information about this, please contact your School H&S representative or the University's H&S Unit at healthandsafety@contacts.bham.ac.uk.

Kind regards,

Miss Sam Waldron
Deputy Research Ethics Officer
Research Support Group
C Block Dome (room 132)
Aston Webb Building
University of Birmingham
Edgbaston B15 2TT
Tel: 0121 414 8101
Email: s.m.waldron@bham.ac.uk

Web: https://intranet.birmingham.ac.uk/finance/accounting/research-support-group/Research-Ethics

Please remember to submit a new Self-Assessment Form for each new project.

UNIVERSITY OF BIRMINGHAM

Birmingham Business School

Department of Accounting

Participant Information Sheet

For the study of:

Biodiversity Conservation Leadership in UK public sector organisations

The purpose of this document is to provide you with the information necessary to decide whether or not you would like to participate in this study which requires interviews, informal discussions and documentary analysis. If there are any additional information you require or any questions you have please do feel free to contact me and I will be happy to be of assistance.

1. **The research study and research objectives:**

   This research is conducted to understand and explain the design and use of biodiversity accounting tools in order to lead the biodiversity conservation process with a special focus on UK public sector organisations.

   The objectives of this research are to:
   - Understand and explain biodiversity conservation leadership using biodiversity indicators.
   - Understand and explain the formation of the actors and relations involved. The main focus will be on national actors but international actors will also be considered.
   - Reconstruct the framing process of biodiversity conservation leadership and indicators in the UK.
   - Describe how public sector organisations lead the field of biodiversity conservation and how biodiversity indicators are used to evaluate their current and future actions.

2. **What is expected of me as a participant?**

   - If you agree to participate in this research you will be interviewed for a period of between one and one and a half hours at a time and place convenient for you.
   - This interview will be audio recorded if you agree to that. If you otherwise disagree then notes will be taken instead.

- The interview questions will all be related to the research topic and objectives identified above .You have the right not to answer any question(s) you do not wish to answer and to stop the interview anytime you desire.
- You will be kindly requested to sign a consent form that indicates your approval to be interviewed.
- You have the right to withdraw from the study up to 12 weeks after participation. You can communicate the wish to withdraw either to me in person during the field study or afterwards via email. In the event of your withdrawal, all data related to you will be destroyed as soon as possible after receiving your desire and you will be notified once your data has been destroyed. No consequences will fall on you if you wish to withdraw.
- You have the right to request for your data to be treated confidentially. Your data will not be treated confidentially if you give express permission to do so. This permission is completely voluntary and no consequences will fall on you from not giving permission. Data included in the thesis or any written publication will be anonymised and no names will be included.
- You have the right to see how your comments are written in the thesis before it is submitted or an analysis of your data has been included in any material submitted for publication (an approximate date of submission will be provided in due time).
- Documents are also needed for this study especially those such as organisation charts, minutes of the meetings, training material and handouts. You are under no obligation to provide those documents. No documents will be removed off the organisation's premises unless authorised to do so by the organisation. Only documents that are necessary for the purpose of the research and that participants are willing to provide, upon the organisation's approval, will be collected. All documents collected will be analysed and used for the academic purposes of the research <u>only</u>.

3. Risks of participating:

Your honest opinions and views are highly appreciated and valued and as such all care will be taken not to divulge any information given to any kind of management. No negative consequences will follow you from consenting or declining to participate in this research. The only risk of participating in this research is a possible loss of confidentiality of the data provided. Section 5 provides further information on how this risk is managed.

4. Benefits of participating:

While you will not be compensated and no direct benefit will be provided to you, yet you will be helping your organisation gain awareness of the issues discussed in this research particularly with respect to biodiversity conservation leadership and accounting. You will also be contributing to the academic literature by providing insights into a less researched area of how biodiversity accounting tools such as indicators enables public sector organisations to lead the field of biodiversity conservation. A copy of the PhD thesis will be available at the organisation for circulation to those interested.

5. **Promises of confidentiality, anonymity and data protection:**
    - Your data will not be treated confidentially and work related details such as your job position or level of management might be included in the thesis. However, any personal details you provide will not be included in the thesis and your identity will be anonymised and no names will be included. No manager will be notified of any information you provide and they will not be notified of whether you did or did not participate in the study. Therefore, treat your participation in the study as voluntary.
    - The data you provide will only be available to the researcher and the supervisor. Recordings from interviews will be transcribed as soon as possible after the interview.
    - All data transcribed will be stored securely and kept for a period of 10 years after the thesis is submitted after which they will be destroyed immediately.
    - All forms of data whether in soft or hard form will always be kept under password protected software and hardware or under lock by the researcher. No document will be removed off the organisation's premises without authorisation.

6. **Funding:**

This research is funded by a full scholarship provided by the Birmingham Business School.

This research has full ethical approval by the University of Birmingham Ethics committee.

Lead Supervisor

Professor Ian Thomson
Email: i.thomson@bham.ac.uk

PhD Researcher:

Madlen Sobkowiak
Email: MXS1057@student.bham.ac.uk

UNIVERSITY OF BIRMINGHAM

Birmingham Business School

Department of Accounting

Interview Consent Form

For the study of: Biodiversity Conservation Leadership in UK public sector organisations

Dear Potential Participant,

Thank you for considering participating in this study about biodiversity conservation leadership and accounting in UK public sector organisations.

My name is Madlen Sobkowiak and I am a PhD researcher at the University of Birmingham. I am conducting this study in order to understand and explain the influence of accounting tools in leading biodiversity conservation particularly in UK public sector organisations. I am conducting this research in fulfilment of my PhD Degree.

I would like to invite you for an interview and I am writing to elicit your consent. Before you consent, however, I would like to provide you with the following information:

- This interview is voluntary. Participation in this interview is totally at your discretion.
- You will not be compensated for this interview.
- The interview will last between one to one and a half hours.
- All questions will be related to the research topic outlined above. More details about the research are available in the accompanying participant information sheet.
- You have the right to stop the interview anytime you desire.
- You have the right not to answer any questions you want.
- You have the right to withdraw from the study up to 12 weeks after participation and you have the right to withhold any reasons thereof. You can communicate this wish either to me personally during the field study or afterwards via email. Your data will then be destroyed as soon as possible. No consequences will fall on you from withdrawing.
- You have the right to request for your data to be treated confidential. Your data will not be treated confidential if you give expressed permission to do so. This permission is completely voluntary and no consequences will fall on you from not giving permission. Data included in the thesis or any written publication will be anonymised and no names will be included.
- Data provided will only be available to the researcher and the supervisor. The interview recordings will be transcribed as soon as possible. The interview and the transcribed data will be stored on password protected hardware and will continue to be securely

stored till 10 years after the thesis has been submitted, after which they will be permanently deleted.

- The interview will be audio recorded at you consent.
- You have the right to view how your comments are presented in the thesis before it is submitted or an analysis of your data has been included in the material submitted for publication (an approximate date will be provided in due time).
- Notes will also be taken during the interview.
- If you have any further questions regarding your rights as a participant or have any ethical concerns with regards to this research, please feel free to communicate them to the Research Ethics Team at the University of Birmingham on ethics-queries@contacts.bham.ac.uk .

If you agree to participate in this study please indicate your consent below:

Consent:

I confirm that I have read and understand the participant information leaflet for this study. I have had the opportunity to ask questions if necessary and have had these answered satisfactorily.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. If I withdraw my data will be removed from the study and will be destroyed.

I understand that my personal data will be processed for the purposes detailed above, in accordance with the Data Protection Act 1998.

I agree for the interview to be recorded.

Based upon the above, I agree to take part in this study.

Name of participant:..

Signature:..

Date:...

Please tick this box if you **<u>do not</u>** wish for the interview to be recorded ☐

Please tick this box if you **<u>do</u>** wish for all of your data to be treated confidential ☐

I confirm that all information and promises outlined above are true and I intend to keep my words.

Name of researcher: Madlen Sobkowiak

Signature:

Date:

Lead supervisor:

Professor Ian Thomson

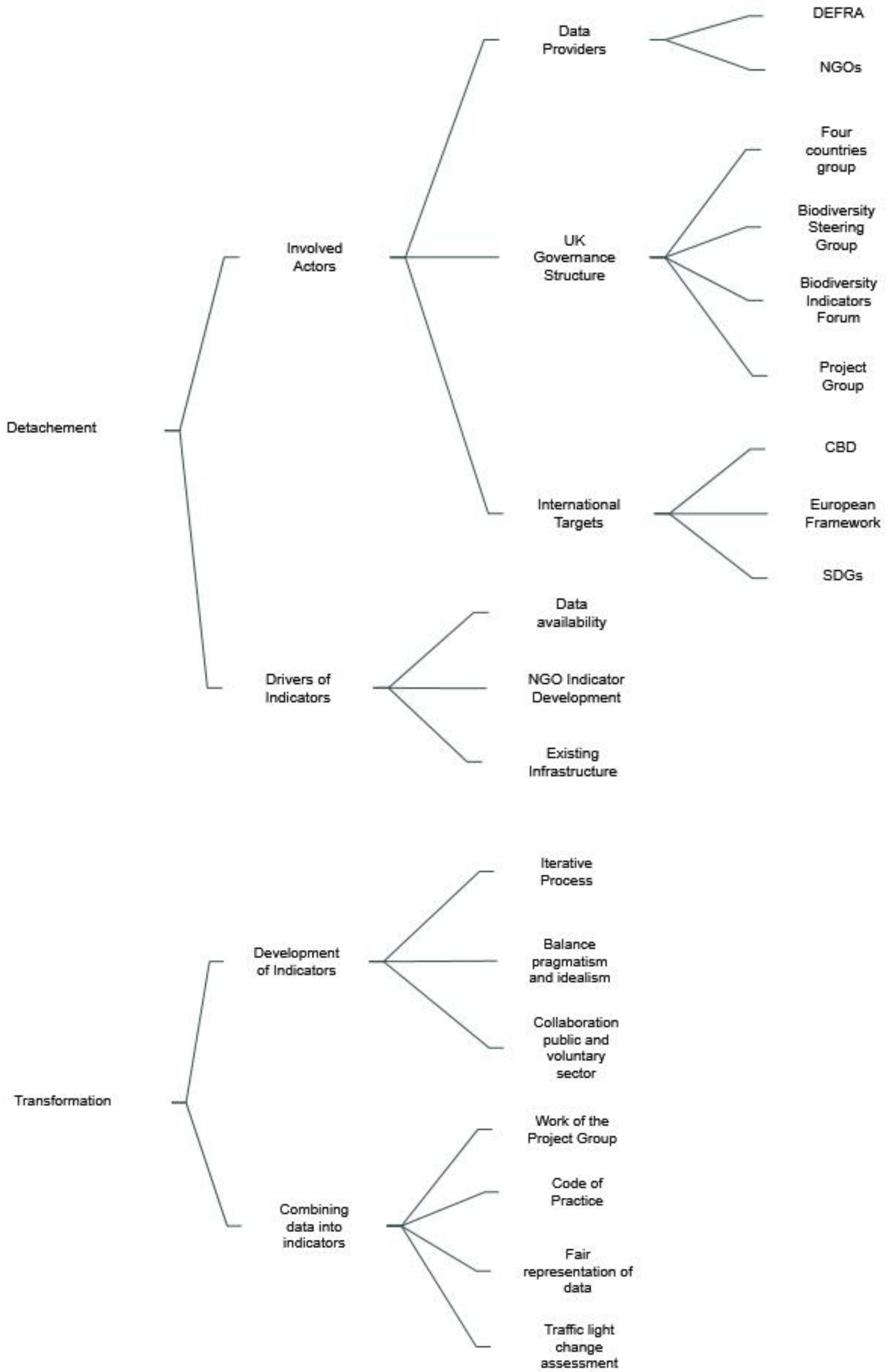
Email: i.thomson@bham.ac.uk

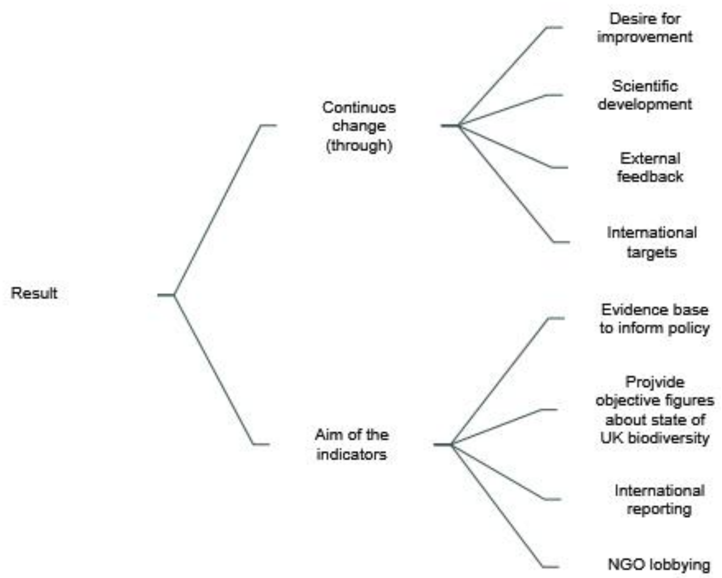
Researcher:

Madlen Sobkowiak

Email: MXS1057@student.bham.ac.uk

APPENDIX 4: CODING STRUCTURE




Result
Continuos change (through)
Desire for improvement
Scientific development
External feedback
International targets
Aim of the indicators
Evidence base to inform policy
Projvide objective figures about state of UK biodiversity
International reporting
NGO lobbying

APPENDIX 5: LIST OF UK BIODIVERSITY INDICATORS 2018

Indicator	Measure(s)	Data Source
A1. Awareness, understanding and support for conservation		Department of the Environment Northern Ireland, Natural England, Natural Resources Wales, Scottish Natural Heritage.
A2. Taking action for nature: volunteer time spent in conservation		Bat Conservation Trust, Botanical Society of Britain & Ireland, British Trust for Ornithology, Butterfly Conservation, Canal & River Trust, The Conservation Volunteers, Loch Lomond & The Trossachs National Park Authority, Natural England, National Parks England, Plantlife, RSPB, The Wildlife Trusts, Woodland Trust.
A3. Value of biodiversity integrated into decision making		Under development
A4. Global biodiversity impacts of UK economic activity/ sustainable consumption		Under development
A5. Integration of biodiversity considerations into business activity	A5a. Environmental Management Systems	DEFRA
	A5b. Environmental consideration in supply chains	
B1. Agricultural and forest area under environmental management schemes	B1a. Area of land in agri-environment schemes	Department of Agriculture, Environment and Rural Affairs - Northern Ireland, Defra, Natural England, Scottish Government, Welsh Government.
	B1b. Area of forestry land certified as sustainably managed	Forestry Commission
B2. Sustainable fisheries	B2a. Proportion of fish stocks harvested sustainably	Centre for Environment, Fisheries and Aquaculture Science; International
	B2b. Biomass of stocks at full reproductive capacity	

		Council for the Exploration of the Sea.
B3. Climate change adaptation		Under Development
B4. Pressure from climate change (Spring Index)		1891 to 1947 – Royal Meteorological Society; 1999 to 2017 – UK Phenology Network
B5. Pressure from pollution	B5a. Air pollution B5a(i). Area affected by acidity B5a(ii). Area affected by nitrogen	Centre for Ecology & Hydrology.
	B5b. Marine pollution	Defra Marine Strategy and Evidence Division, using data provided by: Environment Agency, Northern Ireland Environment Agency, Scottish Environmental Protection Agency.
B6. Pressure from invasive species	B6a. Freshwater invasive species	Botanical Society of Britain & Ireland, British Trust for Ornithology, Centre for Ecology & Hydrology, Marine Biological Association, National Biodiversity Network.
	B6b. Marine (coastal) invasive species	
	B6c. Terrestrial invasive species	
B7. Surface water status		Department of Agriculture, Environment and Rural Affairs for Northern Ireland, Environment Agency, Natural Resources Wales, Scottish Environment Protection Agency.
C1. Protected areas	C1a. Total extent of protected areas: on-land	Joint Nature Conservation Committee, Natural England, Natural Resources Wales, Northern Ireland Environment Agency, Scottish Natural Heritage
	C1b. Total extent of protected areas: at-sea	
	C1c. Condition of Areas/Sites of Special Scientific Interest	Natural England, Northern Ireland Environment Agency, Scottish Natural Heritage.
C2. Habitat connectivity		UK Butterfly Monitoring Scheme.

C3. Status of European habitats and species	C3a. Status of UK habitats of European importance	UK Habitats Directive (Article 17) reports 2007 and 2013.
	C3b. Status of UK species of European importance	
C4. Status of UK priority species	C4a. Relative abundance	Bat Conservation Trust, British Trust for Ornithology, Butterfly Conservation, Centre for Ecology & Hydrology, Defra, Joint Nature Conservation Committee, People's Trust for Endangered Species, Rothamsted Research, Royal Society for the Protection of Birds.
	C4b. Distribution	Biological records data collated by a range of national schemes and local data centres
C5. Birds of the wider countryside and at sea	C5a. Farmland birds	British Trust for Ornithology, Defra, Joint Nature Conservation Committee, Royal Society for the Protection of Birds.
	C5b. Woodland birds	
	C5c. Wetland birds	
	C5d. Seabirds	
	C5e. Wintering waterbirds	
C6. Insects of the wider countryside	C6a. Semi-natural habitat specialists	Butterfly Conservation, Centre for Ecology & Hydrology, Defra, Joint Nature Conservation Committee.
	C6b. Species of the wider countryside	
C7. Plants of the wider countryside		Under Development
C8. Mammals of the wider countryside (bats)		Bat Conservation Trust
C9. Genetic resources for food and agriculture	C9a. Animal genetic resources – effective population size of Native Breeds at Risk C9a(i). Goat breeds C9a(ii). Pig breeds C9a(iii). Horse breeds C9a(iv). Sheep breeds C9a(v) Cattle breeds	British Pig Association, Defra, Grassroots, Rare Breeds Survival Trust, and participating breed societies
	C9b. Plant genetic resources – Enrichment Index	EURISCO Catalogue
D1. Biodiversity and ecosystem services	D1a. Fish size classes in the North Sea	Centre for Environment, Fisheries and Aquaculture Science; Marine Scotland.

	D1b. Removal of greenhouse gases by UK forests	BEIS Land Use, Land Use Change and Forestry greenhouse gas inventory.
	D1c. Status of pollinating insects	Bees, Wasps & Ants Recording Society; Hoverfly Recording Scheme; Biological Records Centre (supported by Centre for Ecology & Hydrology and Joint Nature Conservation Committee).
E1. Biodiversity data for decision making	E1a. Cumulative number of records	National Biodiversity Network.
	E1b. Number of publicly accessible records at $1km^2$ resolution or better	
E2. Expenditure on UK and international biodiversity	E2a. Public sector expenditure on UK biodiversity	Defra, HM Treasury.
	E2b. Non-governmental organisation expenditure on UK biodiversity	
	E2c. UK expenditure on international biodiversity	

APPENDIX 6: INDICATOR MAPPING (SOURCE: JNCC, 2011)

CBD Strategic Goal	CBD Strategic Target (Aichi Target)	Indicators of primary relevance	Indicators of indirect relevance
Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society	**Target 1:** By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	A1, A2	A5, B1a, B1b
	Target 2: By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.	A3	A1, A2, A5, B 1a, B1b, E2
	Target 3: By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions.	B1a, B1b	A3, A5, B2, E2 a,b
	Target 4: By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.	A3, A4, A5	A1, A2, B1a, B 1b, B2, D1a
Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use	**Target 5:** By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	C2, C3a	B1a, B1b, B7, C1c, C3b, C4a , C4b, C5, C6, C7, C8
	Target 6: By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable	B2, D1a	C1b

CBD Strategic Goal	CBD Strategic Target (Aichi Target)	Indicators of primary relevance	Indicators of indirect relevance
	ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.		
	Target 7: By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.	B1a, B1b, C5a,b, C6a	B2, C2, C7, D1b, D1c
	Target 8: By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.	B5a, B5b, B7	C1c, C3a
	Target 9: By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.	B6	
	Target 10: By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.	B3, B4	B5a, B5b, B7, C2
Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity	**Target 11:** By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.	C1, C3a	C2, C3b, C4a, C4b, C5, C6, C7, C8
	Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.	C3b, C4a, C4b, C5, C6, C7, C8	C1, C2, C3a, C9a, C9b
	Target 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed	C9a, C9b	

CBD Strategic Goal	CBD Strategic Target (Aichi Target)	Indicators of primary relevance	Indicators of indirect relevance
	and implemented for minimizing genetic erosion and safeguarding their genetic diversity.		
Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystems	**Target 14:** By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.	D1a, D1b, D1 c	B7
	Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.	B3, D1b	B4, C2, D1a, D1c
	Target 16: By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.	Development of a UK indicator should await further international guidance	
Strategic Goal E: Enhance implementation through planning, knowledge management and capacity building	**Target 17:** By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.	No indicator proposed	
	Target 18: By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels	No indicator proposed	
	Target 19: By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the	E1	

CBD Strategic Goal	CBD Strategic Target (Aichi Target)	Indicators of primary relevance	Indicators of indirect relevance
	consequences of its loss, are improved, widely shared and transferred and applied.		
	Target 20: By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan 2011-2020 from all sources and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels. This target will be subject to changes contingent to resources needs assessments to be developed and reported by Parties.	E2	

Note: Indicators are defined as either 'primary' – suggesting they are of direct relevance to the Target; or 'indirect' – suggesting their relevance or importance is less direct.

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