

Harmonizing OPERAs voices

An investigation of different perspectives on the ecosystem services concept and their implications for research and practice

Verena Hermelingmeier

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LUCSUS

Lund University Centre for
Sustainability Studies



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Abstract

Over the past 150 years, industrialization, globalization and population growth have altered the planet and its natural conditions at a rapid pace. In this new era, the Anthropocene, environmental degradation has come to a state where sustainable ecosystem management has developed into an urgent quest for humans to maintain their own life-support system. The ecosystem services (ES) concept, initially introduced as potential facilitator to manage this quest, has been criticized for its vagueness to pose a barrier to the concept's use in research and its subsequent application in practice.

Focusing on the European research project Operational Potential for Ecosystem Research Applications (OPERAs), the objective of this thesis is to serve the research community with the identification of differences in conceptual perspectives on ES (differentiation), in order to recommend and enable an effective way of handling these differences (clarification) as a basis for interdisciplinary integration (synthesis). With an initial emphasis on differentiation and clarification, the research process concentrates on the derivation of a typology of perspectives from the literature (RQ 1), on the basis of which perspectives in OPERAs are assessed with the help of Q methodology (RQ 2) in order to derive implications and recommendations for how to handle the concept in the future (RQ 3).

The main findings suggest rather clear differences in the typology of three foundational perspectives from the literature but a more nuanced variety of viewpoints in OPERAs that can be summarized in five perspectives. Whereas the notion of interdisciplinarity has often steered the focus towards underlying disciplinary worldviews as the cause for different perspectives, the results point to the insight that perspectives on the ES concept seem to be influenced by a more complex interplay of underlying paradigmatic assumptions. Therefore, clarification is suggested to encompass more than the standardization of discipline-induced worldviews and to require open dialogue on underlying assumptions, values and ethical stances.

A final synthesis of findings reflects critically on broader implications by examining the relationship between the ES concept and the notion of sustainability. If the ES concept can really support sustainable ecosystem management in the future is a question that remains for iteration.

Keywords: Sustainability Science, Interdisciplinarity, Discourse, Q methodology, Human-Nature Relationship, Boundary Object

Word count: 13,752

Preface

Imagine an Opera – there is *one* song that the entire performance evolves around. Every singer knows the song, they all practice it one by one and sure enough, since they are all great singers, every single version of the song sounds amazing. The day of the great performance, the day where everybody is supposed to sing in concert, is not scheduled yet and lies far ahead in the future. After all, it is not the singers' task to plan the performance, it is their task to practice the song at the pitch of voice they were trained to sing – *or is it not?*

Imagine an Opera – there is *one* song that the entire performance evolves around. Every singer knows the song, they all practice it together and it sounds amazing. The day of the great performance, the day that everybody is supposed to sing in concert, is not scheduled yet but it seems like it is already happening every day. After all, it is the singers' task to collaboratively develop the performance. As they recognize that the pitch of voice is only one factor out of many influencing the way they sing the common song, they can finally make their voices harmonize all together – *performance saved?*

Acknowledgements

Making something harmonize, be it the voices in an Opera or the components of a master's thesis, is a venture that can only be accomplished in concert with many. From the first idea to the final piece of work I was greatly supported by important people that made this endeavor possible and that need special acknowledgment at this point. Firstly, I would like to thank my supervisor Kim Nicholas and my fellow thesis group companions Klara and Luisa for their support, patience and many motivating fika sessions. Secondly, my special thanks goes to all OPERAs participants that made this thesis possible by participating in my study, giving valuable feedback and showing an overwhelming interest in my ideas. Thirdly, I would like to highlight the great support of many people in LUCSUS throughout the last two years. Last but not least, I would like to thank my family for their long distance support, the amazing LUMESians that made the last two years special, everyone else who accompanied me throughout my time in Sweden, and my great friend and proofreader Laura for her support and constructive feedback to uncover the dissonances in the final composition.

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1 Introduction

1.1 Research context: The Anthropocene and the quest for sustainable ecosystem management

Over the past 150 years, industrialization, globalization and population growth have altered the planet and its natural conditions at a rapid pace (Millennium Ecosystem Assessment (MA), 2005). In the past 50 years, the natural environment has been changed more dramatically than in any comparable period of time in human history (Steffen et al., 2004), driving humanity out of a “safe operating space” and towards “planetary boundaries” (Rockström, 2009, p. 472).

Reflecting on the profound transformation that the planet has undergone in the past two centuries, Nobel Prize winner Paul Crutzen coined the term Anthropocene, denoting a new, human-driven geological epoch (Crutzen, 2002). Whereas human impact historically occurred on local levels only, today’s global impact has generated unprecedented complexities in human-nature interactions (Ostrom, 2009). While humans have more impact on ecosystems than ever before, they also increasingly depend on the maintenance of these ecosystems to preserve their own life-support system (Biermann et al., 2012).

Since the 1960s, “the early decade of environmentalism” (Liu et al., 2010, p. 59), and publications such as “Silent Spring” (Carson, 1962) and “Limits to Growth” (Meadows et al., 1972) ten years later, a range of approaches to nature conservation have been attempted. With the publication of the Brundtland Report (World Commission on Environment and Development (WCED), 1987), the popular notion of sustainable development as the quest for a reconciliation of economic development goals with environmental limits in the long-term was brought to the science and policy agendas (Clark & Dickson, 2003).

During the same time, conservationists introduced the notion of ecosystem services (ES) to label the benefits that humans derive from natural ecosystems in order to include their value into decision-making frameworks (Braat & De Groot, 2012). The novelty about the concept was the framing of the link between humans and nature in a “pragmatic way” (Potschin & Haines-Young, 2011, p. 577) and the “utilitarian and anthropocentric justification” (Lamarque, 2011, p. 488) for the need to manage this link sustainably. Utilitarianism, defined as “taking advantage of the greatest possible mix of resulting benefits [for humans]” (Daily & Ellison, 2002, p. 229), was considered an essential ingredient to the new approach. Using the language of services and benefits, the ES concept was intended to create awareness for the importance of nature’s functions in a society with decision-

making frameworks largely structured in economic terms (Daily, 1997). Arguably positioned at the “nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans” (Flint et al., 2013, p. 214) the concept has been claimed to indicate a fundamental shift in the perception of the relationship between humans and the ecosystems on which they depend: From a pluralistic perception of nature that we live *in* and *with* to a narrow and uni-directional perception of nature as resource (O’Neill, Holland & Light, 2008; Flint et al., 2013; Jax et al., 2013).

1.2 Research topic: Ecosystem services as way to tackle this quest?

In the face of nature degradation and growing resource scarcity, there is an urgent need for humanity to recognize and successfully manage the quest for sustainable ecosystem management (Steffen et al., 2004; Biermann, 2012). The ES concept has been proposed as one way to tackle this challenge and has rapidly gained momentum over the past decades (Carpenter et al., 2009). Many have acknowledged the concept’s „great capacity“ (Jax et al., 2013, p. 266) to highlight the importance of ecosystems and to foster collaboration for ecosystem management (Schröter et al., 2014).

However, as opposed to the ostensibly clear conceptual core that was supposed to serve as unifying framework in the first place (De Groot, 1987), the concept has attracted much criticism concerning its vagueness (Schröter et al., 2014). Due to “mixed interpretations” (Flint et al., 2013, p. 214), “disagreements about key terms and principles” (Turnhout et al., 2013, p. 157), and “discrepancies in definitions” (Vihervaara, Rönkä & Walls, 2010, p. 317), the concept was contended to, at best, “provide[...] a context for discussion” (Fisher et al., 2008, p. 2051) as opposed to an operationalizable framework (Boyd & Banzhaf, 2007; Wallace, 2007; Fisher & Turner, 2008). As a consequence of ambiguities around it, the effective implementation of the concept in practice has been argued to be at risk (Ash et al., 2010; Seppelt et al., 2011; Nahlik et al., 2012). Following this line of argumentation, the ES concept’s successful operationalization for practice, this thesis contemplates, starts with and depends on the clarification of conceptual differences in the scientific community.

In order to take on this research mission, the focus of this thesis will be on the European research project ‘Operational Potential for Ecosystem Research Application’ (OPERAs) as it is specifically centered on the task to identify the ES concept’s potential for implementation in practice (OPERAs, 2014). As OPERAs is comprised of people from many different disciplinary, cultural and institutional backgrounds, the project exemplifies the research community around the ES discourse for the purpose of this research venture.

1.3 Research focus: Deduction of working hypothesis and research questions

The research inquiry is based on an overarching working hypothesis that expresses the guiding assumption for the research process and is broken down into three research questions.

Working Hypothesis

Differences in perspectives on the ecosystem services concept in the research community pose a barrier to its practical implementation in support of sustainable ecosystem management.

The working hypothesis takes its point of departure in the ES concept's criticized vagueness - translated into differences in perspectives - as barrier to its use in research and subsequent application in practice. It relates this barrier to the declared goal of OPERAs to "establish whether, how and under what conditions the [ES] concept can move beyond the academic domain towards practical implementation in support of sustainable ecosystem management" (OPERAs, 2012a, p. 3).

1. How have perspectives on the ecosystem services concept developed since its introduction?

RQ 1: Development of perspectives

The first research question assesses the development of perspectives on the ES concept in the scientific community since the concept's introduction. The objective is to construct a first typology of foundational perspectives that will serve as basis for the second research question.

2. What are current perspectives on the ecosystem services concept in the research community?

RQ 2: Current perspectives

The aim of the second research question is to elicit, characterize and compare current perspectives on the ES concept in the research community represented by OPERAs.

3. What are implications for the future use of the ecosystem services concept?

RQ 3: Future use

The third research question takes the findings from research question 1 and 2 to derive implications for the use of the concept in the scientific community. Recommendations for OPERAs and the research community are assumed to be an essential pre-condition to the concept's practical implementation in support of sustainable ecosystem management (as outlined in chapter 2).

2 Theoretical Framework

2.1. Framing the topic: Concepts in the context of modernity and sustainability science

2.1.1 The lens: Sustainability science

In a social context that is “fundamentally re-ordered by modernity” (Turnhout et al., 2013, p. 158) and thus essentially driven by instrumental rationality (Weber, 1978), problem-solving approaches have often been subject to compartmentalization and standardization (O’Neill et al., 2008). Whereas problems we are facing are complex and “nondisciplinary”, our compartmentalized approaches to solve them have usually been “to divide the world into smaller and smaller units, hoping that in understanding the parts we will eventually understand the whole” (Lattuca, 2001, p. 1).

Whereas traditional disciplinary approaches to research have had a considerable and positive impact on the development of scientific method in the modern world (Stock and Burton, 2011), the new complexity that problems at the interface of society and nature have brought about surpass the means of disciplinary “normal science” (Lipton, 2005, p. 178). Rather, today’s “wicked problems” (Rotmans, 2005, p. 8) require the crossing of methodological, epistemological and ontological boundaries (Stock and Burton, 2011) in order to enable new innovative combinations and “clumsy solutions” (Verweij et al., 2006, p. 817).

Taking its point of departure in the notion of sustainable development, the relatively new field of sustainability science denotes a growing research agenda on the dynamic interactions between nature and society, assessing how social changes shape the environment and vice versa (Clark & Dickson, 2003; Heemskerk, Wilson & Paovo-Zuckerman, 2003). It is grounded in the recognition of the need to better understand these interdependencies and to normatively steer interactions towards a more sustainable trajectory (Kates et al., 2001; Jerneck et al., 2011). Challenging the reductionist modern approach, sustainability science is meant to be “essentially integrative” (Kates, 2011a, p. 3) as a “field defined by the problem it addresses rather than the discipline it employs” (Clark, 2007, p. 1737). It has thus been described as “unusual, inclusive and ubiquitous scientific” (Bettencourt & Kaur, 2011, p. 19540) and “vibrant arena” (Clark & Dickson, 2003, p. 8060) that postulates the need for collaboration in research and beyond (Kates, 2011b; Wesselink, 2008; Ziegler & Ott, 2011).

2.1.2 The approach: Interdisciplinarity as pre-condition for transdisciplinarity

In line with the claims made by sustainability science, many have discussed the need to move beyond traditional disciplinary boundaries, describing various approaches to do so (Brandt et al., 2013; Jerneck & Olsson, 2011; Klein, 1990; Turner & Carpenter, 1999). As opposed to *multidisciplinarity*, in

which researchers work on common problems utilizing their own disciplinary lenses (Holley, 2009), or *cross-disciplinarity*, in which researchers borrow methods from other disciplines to apply them to their own studies (Gardner, 2012), interdisciplinarity can be defined as

“[a] mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.” (National Science Foundation, 2009)

Going one step further, challenges concerning complex interactions in socio-ecological systems are transdisciplinary in nature (Max-Neef, 2005) and thus require approaches that move beyond bridging disciplines towards integrating stakeholders and practitioners into science as social process (Reyers et al., 2010). However, successful transdisciplinary approaches have been argued as hardly ever achieved due to barriers starting on the interdisciplinary level (Stock & Burton, 2011). Therefore, interdisciplinarity is seen as pre-condition and “step into the right direction towards the transdisciplinary path” (Liu et al., 2010, p. 59).

While on the one hand, complexity and heterogeneity of perspectives make interdisciplinary collaboration necessary to tackle complex challenges (Brandt et al., 2013), the same aspects make this kind of collaboration exceptionally difficult (Wesselink, 2008). Disciplines have their own culture established on the basis of paradigmatic assumptions, which often makes them “indecipherable to outsiders” (Holley, 2009, p. 63). Although defined in many ways (Kuhn, 1962, Lipton, 2005), a paradigm is understood as “basic set of beliefs that guides action” (Guba, 1990, p. 17). As collaboration is likely to fail when scientists communicate poorly (Heemskerk et al., 2003), researchers have to actively engage in a “process of translation” (Holley, 2009, p. 63).

2.1.3 The facilitator (or barrier?): Shared concepts in research

The use of concepts – a concept being defined as “an intellectual figure [...] that is part of the basic construction of the world by a scientific community” (Baumgärtner et al., 2008, p. 388) - can potentially facilitate communication and allow scientists to explore new areas of research (Hirsch-Hadorn et al., 2006). However, conceptual unification does not necessarily imply methodological or even theoretical unification, but is often subject to “multiple realisability” (Olsson & Thorén, forthcoming). As the operationalization process from conceptual understanding to application is thought to be guided by disciplinary worldviews (Becker, 2006), the use of the same concepts across disciplines can lead to completely different applications, misunderstandings and multidisciplinary approaches at best (Wesselink, 2008). As a consequence, a conscious use of terms and concepts (Jax,

2008) and thus the need for participants in an interdisciplinary setting to clarify different meanings, has been described as key to successful interdisciplinary communication (Strunz, 2011).

2.2 Operationalizing the research interest: Differentiation, clarification and synthesis for interdisciplinary research

The preceding line of argumentation has established that interdisciplinary integration requires researchers to communicate effectively and to engage in a process of translation. As concepts can potentially serve as facilitators for communication between researchers, but at the same time can pose a barrier if too vague and used ambiguously, they themselves have to be made subject to this process of translation (Lele and Norgaard, 2005).

In order to enhance communication for interdisciplinary research, MacMynowski (2007) proposes a three-stage iterative process consisting of (1) differentiation, (2) clarification and (3) synthesis. As core differences are encountered and characterized (differentiation), these differences require active engagement (clarification), in order to lead to integrated results that could not have been achieved in a disciplinary approach (synthesis).

Within this framework, concepts can be both subject to the process and final product. Accordingly, a concept can be made subject to differentiation and clarification in order to potentially be the product of this process in a new, synthesized form that can facilitate communication (MacMynowski, 2007). Therefore, existing concepts should be made part of the process of differentiation and clarification throughout any research process, starting “ideally at the outset” (MacMynowski, 2007, p. 9). The clarified concept can facilitate interdisciplinary synthesis and potentially subsequent transdisciplinary implementation.

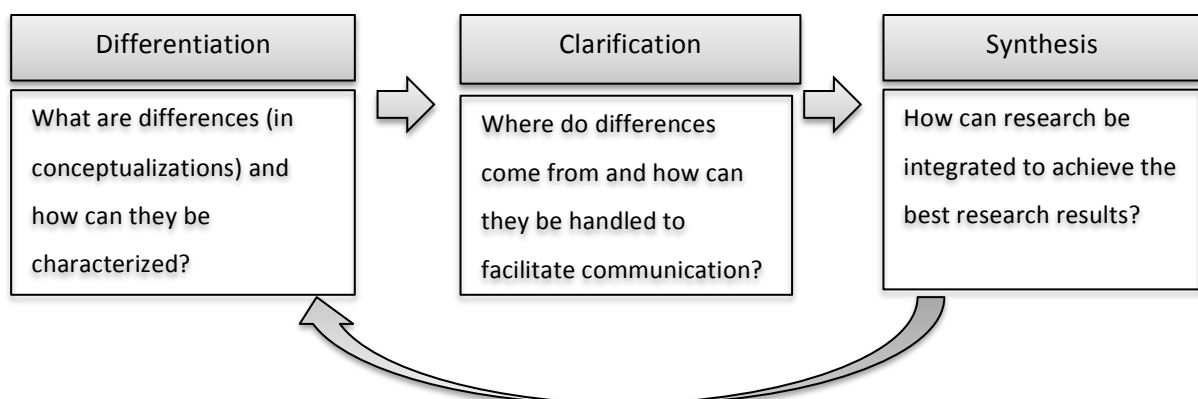


Figure 1: The iterative process of differentiation, clarification, and synthesis for collaboration. Interdisciplinary synthesis is enabled by assessing differences in theories, models and approaches and by subsequently clarifying the implications of these differences. The arrow indicates that in order to continuously enable synthesis, differentiation and clarification have to be made subject to iteration. Source: Own illustration based on MacMynowski (2007).

2.3 Reintroducing the research object: The surge of the ecosystem services concept in science

The ES concept was introduced alongside a number of concepts that emerged from normative convictions regarding human-nature interactions such as “resilience” (e.g. Adger, 2000), “biodiversity” (e.g. Margules & Pressey, 2000) or “social-ecological systems” (e.g. Ostrom, 2009). With the objective to spur efforts for nature conservation, the concept first evolved throughout the 1970s in research with a number of differently worded attempts such as “environmental services” (Study of Critical Environmental Problems (SCEP), 1970), “public service functions of the global environment” (Holdren & Ehrlich, 1974), and “nature’s services” (Westman, 1977). The term “ecosystem services” was finally coined by Ehrlich and Ehrlich (1981) and has rapidly evolved into a concept used by a wide variety of disciplines (De Groot, Wilson & Boumans, 2002; Flint et al., 2013). Although the concept was already spreading rapidly throughout the 1990’s, it experienced a surge in the number and range of publications after the release of the Millennium Ecosystem Assessment (MA) report in 2005 (Hubacek & Kronenberg, 2013; Gómez-Baggethun & Barton, 2013). Overt time, ES have often been mentioned together with the concept of natural capital (NC) denoting the stock (ecosystems) from which services (benefits) are derived.

Whereas early on, the ES concept has been introduced as a “unifying principle” (De Groot, 1987, p. 107) and “common language” (Mollinga, 2010, p. 4) to scientists from different disciplines, its proliferation in use led to the abovementioned vagueness of the concept. As a consequence, the concept’s use as ambiguous “label” (Seppelt et al., 2011, p. 630) referring to many different things, was more and more criticized to “hinder advancements of [the concept’s] study and application” (Nahlik et al., 2012, p. 27). Thus, a clear understanding of the ES concept has been noted as crucial for it to be effectively used in decision-making (Fisher, Turner & Morling, 2009).

2.4 Pulling the strings together: Differentiation, clarification and synthesis of interdisciplinary research efforts for sustainable ecosystem management

The theoretical framework is supposed to embed this research undertaking into a larger context, to concretize the working hypothesis and to guide the operationalization of the research questions. First, 2.1 embedded the quest for sustainable ecosystem management into the context of sustainability science as essentially inter- and transdisciplinary endeavor. Within that, concepts were introduced to play a potential role in facilitating communication between disciplines if not hindered by conceptual disorder and intransparent applications (Olsson & Thorén, forthcoming).

Subsequently, the ES concept as research focus was reintroduced as a concept that has evolved into a ubiquitously but, at the same time, ambiguously used label and that currently seems to lack the

clarity to facilitate communication for interdisciplinary synthesis. Therefore, the assessment of the concept in the research community guided by the research questions (as introduced in 1.3) is regarded as intermediate but necessary step towards the transdisciplinary quest for sustainable ecosystem management.

In order to do so, the thesis itself is structured around MacMynowski's framework (Fig. 2) by first identifying differences in perspectives on the ES concept (RQ 1 and 2), by then clarifying implications and deriving recommendations for the scientific community represented by OPERAs (RQ 3) and by finally synthesizing the findings in order to discuss broader implications through the lens of sustainability science.

At the same time, results provide OPERAs with the first step, *differentiation*, and facilitate *clarification* by providing insights and recommendations for this step. The aim on that level is to enable the achievement of interdisciplinary *synthesis* within OPERAs, thus providing the basis for the transdisciplinary quest for sustainable ecosystem management.

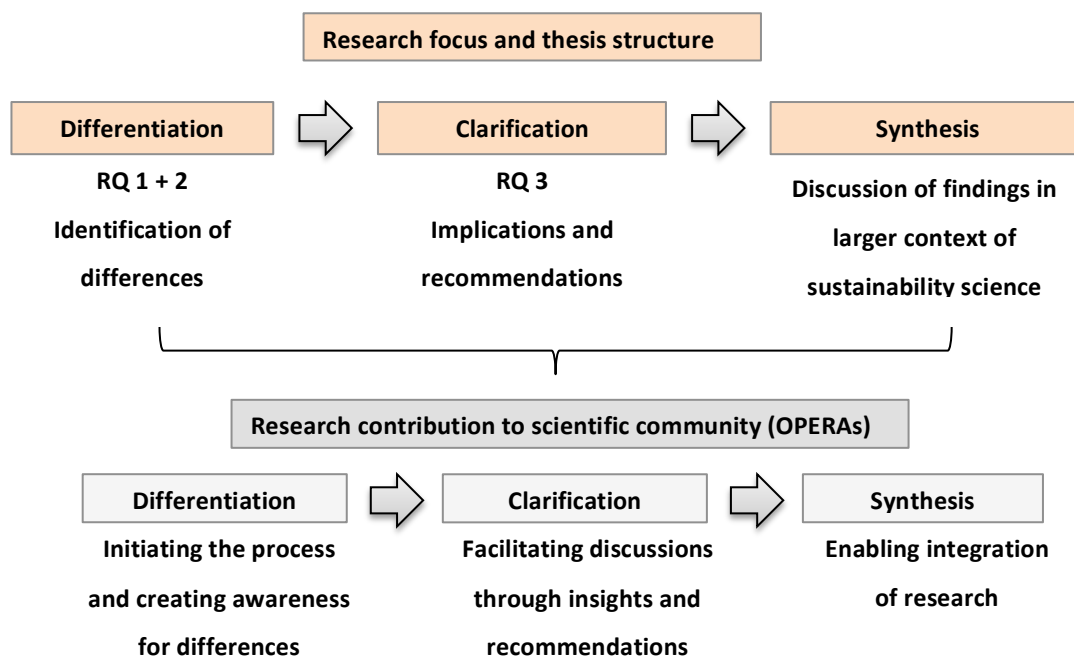


Figure 2: The two-tier framework for thesis structure and research contribution. By following the three-step process of identifying different perspectives, deriving implications, and discussing the findings in light of sustainability science, the thesis initiates the process in the scientific community (represented by OPERAs) and thus facilitates clarification around the concept in order to enable synthesis in research (the project). Source: Own illustration based on MacMynowski (2007).

3 Research Design

3.1 Research philosophy and theory

This thesis is grounded in a critical realist ontology and an epistemology closest to constructivist-interpretivism (Gephart, 2004). Critical realism is based on the idea that there exists a world out there independent of our own perceptions or ideas about it (Hardy & Bryman, 2004). How we perceive this world, constructivists or interpretivists assume, is dependent on the construction of our own worldviews (Sayer, 2000). Throughout my research design, I take on an active role as the researcher acknowledging the subjectivity that is necessarily forming the research design, process and analysis. By disclosing my own perspective explicitly and showing awareness for value judgments that enter the research process, I am avoiding faulty assumptions of “Wertfreiheit” (value freedom) (Strunz, 2011, p. 10).

The research methodology is inspired by the broad field of discourse analysis, with discourse being defined as “shared way of apprehending the world” (Dryzek, 1997, p. 8). Environmental problems specifically are subject to a “two order complexity” (Dryzek, 1997, p. 8) since they lie at the interface of ecological and social systems, which both are highly complex. Therefore, common language and shared concepts do not necessarily imply the same interpretations, but involve a variety of possible and plausible perspectives (Dryzek, 1997).

Fitting the constructivist epistemological stance and the relation to discourse analysis, the chosen framework and the research design are based on the logic of hermeneutics and dialectics (Gardner, 2012; Guba, 1990). Focusing on the depiction of individual constructions and a subsequent contrasting of these constructions allows for the synthesis of discourses around the ES concept (Guba, 1990).

3.2 Research approach

In order to approach the research questions, the research design is mostly focused on a specific case representing the scientific community around the ES concept (Figure 3). As briefly introduced earlier, Operational Potential for Ecosystem Research Application (OPERAs) is a European-wide project and collaborative venture comprised of 27 partner organizations, most of which are research institutions and universities. As of 2013, the number of participants amounted to 93 people from various cultural, disciplinary, and institutional backgrounds. In order to enhance “sustainable use of ecosystems by operationalizing the ES concept” (OPERAs, 2012b, p. 13), the project focuses on the need for “a new level of engagement of scientists with practitioners” (OPERAs, 2012b, p. 13). In order

to get there, the need for a “highly interdisciplinary approach” (OPERAs, 2012b, p. 13) is acknowledged¹.

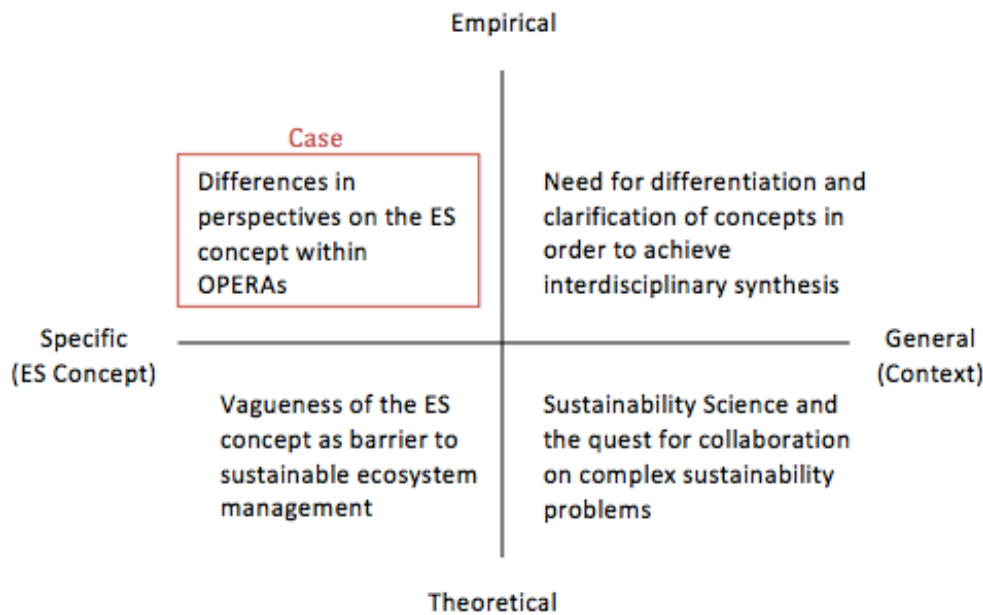


Figure 3: Matrix showing the research interest of this thesis with the specific interest (ES concept) on the left and the general interest (context) on the right side. Going from left to right and from top to bottom, the different fields answer the questions: “What is my case?” (Specific/Concrete), “What are the issues in my case?” (Specific/Theoretical), “What is this a case of?” (General/Concrete) and finally, “What is the larger context of my research topic?” (General/Theoretical). Source: Own illustration.

3.3 Research methodology and techniques

In order to answer the three research questions introduced in 1.3, I have chosen a multi-method approach that is mainly focused on qualitative data but includes quantitative analysis methods. The description of the chosen methods will be structured around the research questions to ensure comprehensibility of each step. Whereas the first two research questions will serve the *differentiation* of perspectives on the concept based on data collection and analysis, the third question will serve the *clarification* of the findings made in the differentiation part. In the final *synthesis* the wider implications of the findings with regards to the larger context of sustainability science will be discussed (Fig. 4).

¹ For a more detailed case description, see Appendix A.

² For the interview guide, see Appendix B.

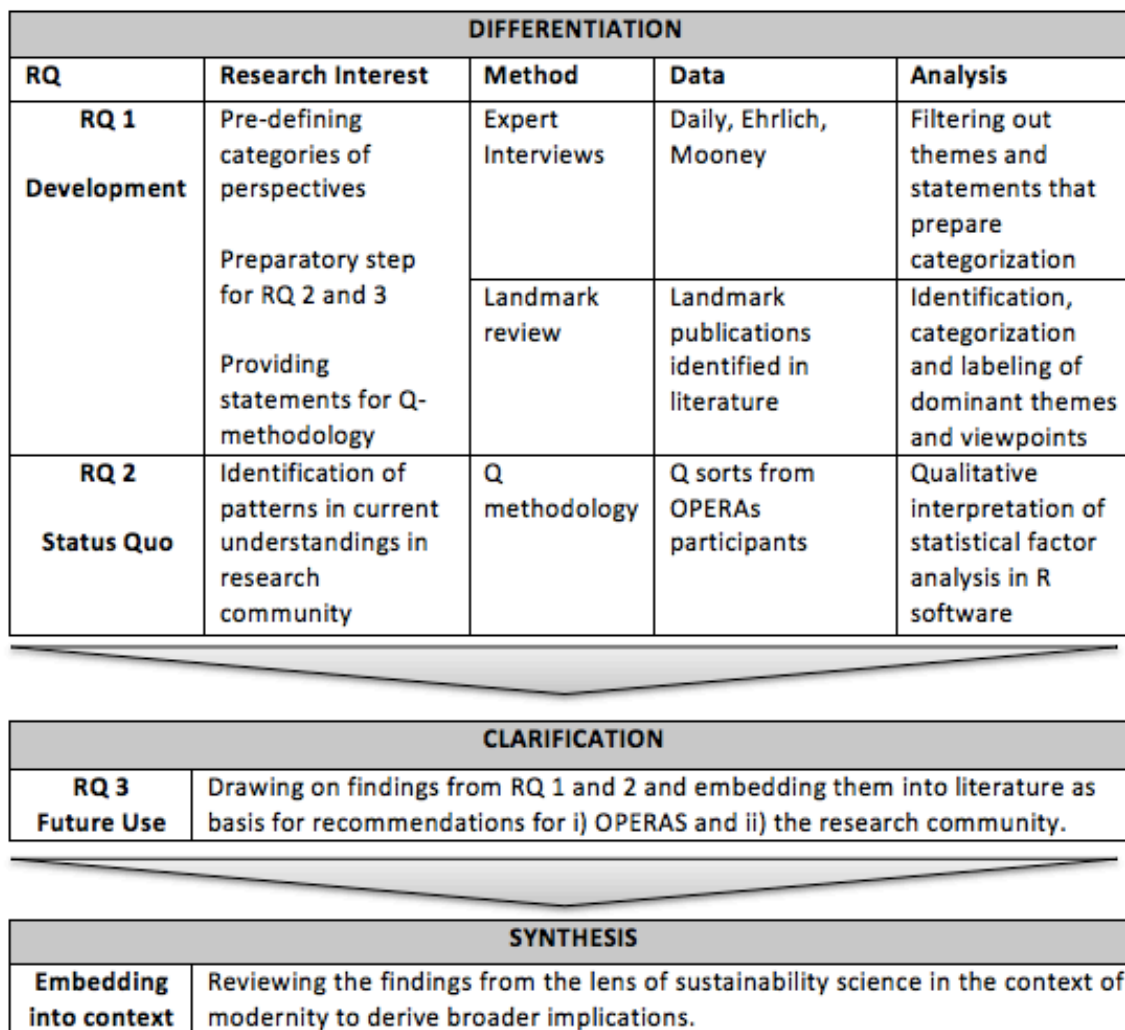


Figure 4: Overview of the relationship between framework and structure of this thesis, the research questions guiding the investigation and the methods chosen to answer the research questions. While the biggest part of the investigation is focused on differentiation, the essential implications of these findings are discussed in the clarification part before everything is integrated in the synthesis that relates back to the larger context of the research topic. Source: Own illustration.

3.3.1 Development: Foundational Perspectives

Based on the initial assumption that different understandings of the ES concept exist, the first research question refers to the development that the concept has undergone from its early introduction up to the current status. The process of developing a typology of foundational perspectives involved expert interviews and a review of landmark articles as main techniques.

3.3.1.1 Expert Interviews

As a basis for the categorization of literature and as general background information for the topic of this thesis, I conducted three semi-structured expert interviews (e.g. Hardy & Bryman, 2004) with people identified as key persons in the introduction and distribution of the concept (Table 1). The interviews were conducted via Skype or phone and lasted between 15 and 31 minutes. They were

recorded and transcribed. All interviewees were offered anonymity but agreed to being referred to by name. Citations from interviews have the following format: (Name of interviewee|transcription line number)².

Table 1: The three interview partners for expert interviews. All three interviewees have made essential contributions to the development of the ES concept. The third column provides examples of influential publications concerning the ES concept. Source: Own illustration.

No.	Name	Connection to ES	Publication on ES (example)
I	Gretchen Daily	Early distributor of the concept	Nature's Services: Societal Dependence On Natural Ecosystems (1997)
II	Paul Ehrlich	Coining of term; distribution	Extinction: The Causes and Consequences of the Disappearance of Species (1981)
III	Harold Mooney	Distribution of concept in science and international policy-making	Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment (2009)

3.3.1.2 Landmark review

From a literature review, I identified six landmark publications that seemed to be most influential in the development of the ES concept. These publications were assessed more in depth with regards to the stated overarching objective of using the ES concept, the terminology used in relation to the concept, the definition of ES and the described purpose of the ES concept (see Appendix C).

3.3.2 Status Quo: Perspectives in OPERAs

In order to assess current perspectives on the ES concept within OPERAs, I employed Q methodology, an approach introduced by William Stephenson in the first half of 20th century and designed as structured assessment of human subjectivity (Barry & Proops, 1999; Davies & Hodge, 2007). The basic idea of Q methodology is to let participants sort a number of statements into an order that reflects their perspective on a certain topic. The method has been noted to be of special relevance for the exploration of perspectives on environmental topics as area that is complex, value-laden and disputed (Dryzek, 1997; Frantzi, Carter & Lovett, 2009; Nijnik et al., 2013).

3.3.2.1 Background of Q methodology

Q methodology as approach “fitting under the broad umbrella of discourse analysis techniques” (Webler, Danielson & Tuler, 2009, p. 5) not only allows the researcher to investigate perspectives on a topic but can also help participants to understand their own assumptions on an issue (Stephenson, 1986). The method is rooted in the idea that the number of perspectives on a topic is limited and that the sorting exercise can reveal what these perspectives are and how they can be characterized

² For the interview guide, see Appendix B.

(Danielson, Webler & Tuler, 2010). While the number of dominant viewpoints is initially identified with the help of statistical factor analysis, the subsequent characterization is subject to the researcher's interpretation. Therefore, as opposed to widespread claims of objectivity in other scientific approaches, Q methodology explicitly acknowledges the investigator's subjectivity as being involved in the design, application and interpretation of the Q study (Brown, 1986; Van Exel & De Graaf, 2005).

3.3.2.2 Set up of study

The set up of a Q study typically follows four distinct steps:

(1) Identification of the concourse and collection of statements

A Q study is based on the discussion that exists around a topic, the so-called "concourse" (Brown, 1991, p. 3). A concourse can be found in academic literature, in interviews with experts or any other sources depending on the topic at hand (Du Plessis, 2005). In my case, the concourse was represented by the general literature on ES, the landmark publications, and by the three expert interviews. Once the concourse is identified, the task is to filter out opinion statements that mirror the variety of different perspectives on the topic (Davies & Hodge, 2007).

(2) Producing the final set of statements

In order to reduce the amount of statements in the concourse to a "miniature representation" (Brown, 1986, p. 187), it is helpful to construct a concourse matrix (see Appendix D). Based on my findings from the literature and the typology derived from it, I sorted statements by the three foundational perspectives I identified (RQ 1) and three main foci ("worldview", "concept", and "openings for deliberation") with subtopics³. The result was a 3x13 point matrix, into which I sorted all the statements I initially collected in order to identify overlaps or missing perspectives.

(3) Identification of the P set (Study participants)

In order to represent the "breadth of perspectives" (Brown, 1986, p. 260), two to three dozen people that are "knowledgeable about the issue and have well-formed opinions" (Webler et al., 2009, p. 21) are typically sufficient. OPERAs participants were assumed to have well-formed opinions since they are working with a project specifically designed for ES research and they were also assumed to represent the breadth of perspectives due to a diversity of backgrounds.

³ From the initial literature review, it was striking that many statements referred not directly to the concept but to underlying assumptions concerning ethics, the human-nature relationship, the problem framing and the transformational claim. These I summarized under "wordview". The second set of statements refers to the concept itself, to conceptual, methodological, terminological and critical claims made around the concept. The third set, "openings for deliberation", includes statements that were more reflexive in terms of the use of the concept and the need for standardization or diversity of approaches.

(4) Conducting the study

The Q sort, the study procedure of Q methodology, can be conducted in person or online. Due to time and budget constraints it was only feasible for me to conduct the study online. I employed the program Qsoftware⁴, an online tool specifically designed to conduct Q studies. Before adding the final number of 39 statements to the study, they were slightly edited and the source was deleted but following the advice of Brown (1986), ordinary language and spelling was kept the same (see Appendix D). I utilized a sorting range with nine categories following the recommendation for Q samples smaller than $n = 40$ and chose labels from “least like how I think” to “most like how I think” with no explicit labels in between as done by Webler et al. (2009). The sorting arrangement is supposed to represent a quasi-normal distribution that is symmetrical over the middle, but usually flatter than a normal distribution (Brown, 1991). For 39 statements, the best way to force this distribution was through the following arrangement:

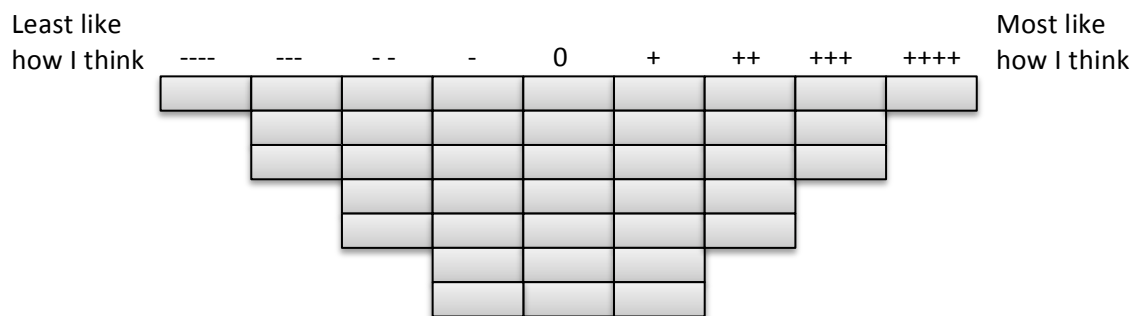


Figure 5: Outline of flattened normal distribution that the 39 statements had to be sorted into by study participants. The range is from “Least like how I think” to “Most like how I think” with a neutral position in the middle. Source: Own illustration based on Webler et al. (2009).

I added detailed instructions to the Q sort exercise, asked participants to provide demographic information and provided space to comment on the study after completion (see Appendix E). In anticipation of a response rate well below 100%, the study was sent out to all OPERAs participants, to 92 people in total⁵, in a personalized email between February 24th and March 7th 2014. I received responses between February 24th and March 14th. The final number of Q sorts amounted to 33.

3.3.2.3 Analysis and interpretation of results

(1) Statistical analysis

Although primarily considered a qualitative method, Q sort data are first analyzed quantitatively, which enables the understanding of connections in a more systematic way (Brown, 1996). The principal technique employed is factor analysis, originally invented by Charles Spearman in the

⁴ The program is free and available on <http://qsoftware.com>.

⁵ All OPERAs participants registered in 2013, excluding Kim Nicholas as the supervisor of this thesis.

beginning of 20th century, to reduce viewpoints in Q sorts to a small number of dominant perspectives (Brown, 1986). Statistics were carried out in the free statistical software RStudio (Version 0.98.501). The different steps of the analysis are explained in Appendix F.

(2) Factor interpretation

Resulting from the first analysis is a number of factors that each represents a group of Q sorts, which are most alike in how they ranked statements. Thus, factors can be regarded as common denominators of their components, the Q sorts. However, Q sorts overlap with factors with different intensities and therefore are more or less representative for the factor⁶. The next and essential stage is for the researcher to give the factors a meaning. By analyzing the rankings of statements within each factor in depth⁷, the researcher can construct and label the different perspectives that the factors represent. The resulting perspectives serve as heuristics for the categorization of commonalities and differences between viewpoints and thus represent Weberian⁸ “ideal types” (Brown, 1986, p. 30).

(3) Follow-up interviews

Ideally, a Q sort should be followed up by an interview, in which participants can elaborate their point of view (Brown, 1996). In addition to asking for comments from each participant after completion of the Q sort, I conducted short semi-structured follow-up interviews with the main representatives of each of the factor groups⁹. Interviews lasted 10-20 minutes, were conducted via phone or Skype and were recorded and transcribed in the same manner as the expert interviews¹⁰. The interviews helped with the interpretation of the factors and shed light on some of the most striking sorting results.

⁶ Each Q sort has a different factor loading that represents its degree of overlap with the factor. Some Q sorts overlap with several factors but are counted as components of the factor that they load highest onto.

⁷ Most important for the analysis are those statements that are ranked on both ends of the spectrum towards „Least like how I think“ and „Most like how I think“. Assessing these statements in terms of the category that they fall into (based on the concourse matrix), the researcher can draw conclusions on the main focus points of the represented perspective.

⁸ Weber (1949) refers to ideal types as heuristic categories. In reality, ideal types only exist in combinations but never in the pure form.

⁹ Main representatives are those people that have the highest factorial loadings (see Appendix G). In two out of five cases the person with the highest loading on the factor was not available for an interview so that I chose the person with the second highest loading instead.

¹⁰ Citations from the interviews have the same format as those from the expert interviews being (Q sort | Transcription line number). Since anonymity was guaranteed to them, people are not identified by name but just by Q sort number.

4 DIFFERENTIATION: Perspectives on the concept

“In order for interdisciplinary research to proceed more transparently in terms of the recombination of ideas [...], interdisciplinary environmental research needs to consciously embark on a process of differentiation [...] before or while moving towards synthesis.” (MacMynowski, 2007, p. 9).

In this chapter, differentiation, the results for the first two research questions will be presented and analyzed. The section is structured around each question, thus first displaying the typology of foundational perspectives drawn from the literature (4.1) and subsequently presenting the perspectives found in OPERAs (4.2).

4.1 Differentiation I: Foundational Perspectives

The first step of differentiation resulted from the analysis of landmark publications as introduced in 3.3.1.2 that I tied in with insights from the general literature review and the expert interviews. It enabled me to derive three foundational perspectives on the ES concept (RQ 1) (Table 2).

Table 2: Overview of the three perspectives and respective landmarks with their initial function in the development of the ES concept. The second publication in each category (highlighted in grey) was identified as main distributor of the specific perspective and thus is used for the creation of the word clouds for each perspective (see below). Source: Own illustration.

Perspective	Landmarks	Publication	Initial function
Pragmatic Conservationist	Ehrlich & Ehrlich (1981)	Extinction: The Causes and Consequences of the Disappearance of Species	Introduction of strategic term
	Daily (1997)	Environmental Functions as Unifying Concept for Ecology and Economics	Adoption/distribution of ES as conservation strategy
Instrumental Economic	Costanza et al. (1997)	The Value of the World's Ecosystem Services and Natural Capital	Introduction of economic use of ES
	TEEB (2010)	Nature's Services: Societal Dependence On Natural Ecosystems	Global distribution of economic use of ES
Broad Societal	De Groot (1987)	Ecosystems and Human Well-Being (synthesis report)	Introduction of ES as unifying concept
	MA (2005)	Mainstreaming the Economics of Nature (synthesis report)	Global distribution of ES as unifying concept

4.1.1 Typology from literature: Three foundational perspectives

4.1.1.1. Pragmatic Conservationist

The Pragmatic Conservationist perspective takes its point of departure in the insight that nature conservation is urgently necessary but that it has shown to not succeed “by charity alone” but to require “well-designed appeals to self-interest” (Daily & Ellison, 2002, p. 12). Whereas Ehrlich and Ehrlich (1981) introduced ES as term to refer to the importance of natural functions for humans, the term was “popularized” (Ehrlich|46) and distributed as a concept through several publication by Gretchen Daily and others in the 1990s and early 2000s (Mooney; Ehrlich). Initially, conservationists thought of it as “strategy” (Schröter et al., 2014, p. 12) to frame and convey the importance of nature to the general public (Daily, Ehrlich & Alberti, 1996; Daily et al. 2009). Accepting the dominance of the economic paradigm in society, the concept was intentionally positioned at the interface between ecology and economics, using “a language familiar to people” (Daily|69). A utilitarian stance, defined as the general utility that humans derive from nature in different ways, is regarded an essential ingredient to the new approach (Daily & Ellison, 2002). Therefore, nature is pragmatically looked upon in terms of its “value to society” (Mooney|89) that can take on many different forms (Mooney). As ES are defined as “the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life” (Daily, 1997, p. 3), the notion of NC does not play a role as the stock providing the service flows. Valuation of services is seen as one tool to guide decisions rather than solution in itself (Daily et al., 2000, p. 336) and economic valuation as “only one way of doing valuation” (Mooney|94).



Figure 6: Word cloud showing the 30 words used most often in Daily et al. (1996) and Daily (2000) (representative for Daily 1997 that was not available as digital copy) that reflect the “Pragmatic Conservationist” perspective. The size of the words corresponds to how often they were used. Common English terms were excluded. Among the words used most often are “values”, “human”, “policy”, “natural”, and “changes” but also “economic”, revealing a pragmatic view on nature conservation. Source: Own illustration created with wordle.net using the full text of Daily et al. (1996) and Daily (2000).

4.1.1.2 Instrumental Economic

The Instrumental Economic perspective is built on the insight that nature has become a scarce resource over the past century and, as opposed to the classical economic stance, can no longer be regarded as a free gift to production processes and markets (Ekins et al, 2003; Gómez-Baggethun et al., 2010). Departing from the economic terminology of services and benefits, this perspective interprets the ES concept as tool for monetary valuation and economic decision-making (e.g. Howarth & Farber, 2002; Farber, Costanza & Wilson, 2002; Fisher et al. 2008). With their estimation of the total monetary value of the planet's ecosystems, Costanza et al. (1997) set a "milestone" (Gómez-Baggethun et al., 2010, p. 1214) in the distribution of the concept and its economic interpretation. As a result, policy schemes such as Payments for Ecosystem Services (PES) and Markets for Ecosystem Services (MES) have increasingly been applied in different contexts (Norgaard, 2010). The economic conceptualization of ES has found its culmination in the Economics of Ecosystems and Biodiversity (TEEB) report (Ring et al., 2010) first published in 2009 and synthesized in 2010 with the objective "to show how economic concepts and tools can help equip society with the means to incorporate the values of nature into decision-making" (TEEB, 2010, p. 3). With the definition of ES as "flows of value to human societies as a result of the state and quantity of natural capital" (TEEB, 2010, p. 7), the NC as stock providing services and, at the same time, as "foundation of our economies" (TEEB, 2010, p. 3) plays a major role in this perspective. Valuation is seen as a "tool to recalibrate the faulty economic compass" (TEEB, 2010, p. 3) and as essential precondition for the integration of ES into the market mechanism (Farber et al., 2006).

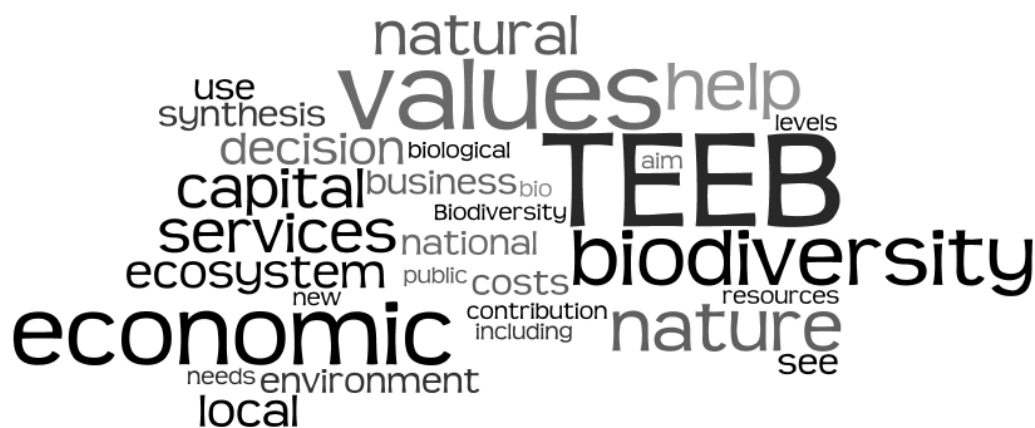


Figure 7: Word cloud showing the 30 words used most often in TEEB (2010), representing the "Instrumental Economic" perspective. The size of the words corresponds to how often they were used. Common English terms were excluded. Among the words used most often are "values", "economic", "resources", "business", "costs" and, as opposed to the other perspectives, the word "natural capital" (although taken apart here), suggesting an instrumental perspective of nature as capital stock from which services are derived. Source: Own illustration created with wordle.net from TEEB Synthesis Report (2010), pp. 3-4 (foreword).

4.1.1.3 Broad Societal

The Broad Societal perspective is rooted in the notion that a lack of understanding and knowledge about ecosystems and their benefits to humans is the core cause of nature degradation (De Groot, 1987; MA, 2005). Building on the original idea for the ES concept to highlight the link between ecosystems and humans, the MA (2005) has played a dominant role in broadening the ES concept to “denote a generic idea or metaphor” (Jax et al., 2013, p. 265) for describing these connections. In contrast with Costanza et al. (1997) and TEEB (2010), the MA (2005) takes on a mostly descriptive position with the aim to provide the “scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being” (MA, 2005, p. ii). In line with De Groot (1987), the MA specifically stresses the function of ES as shared concept for collaboration between disciplines and on the science-society interface. Although mostly anthropocentric, the MA explicitly postulates the recognition of an intrinsic value of nature that exists “irrespective of its utility for someone else” (MA, 2005, p. v). With regards to the human relationship to nature, people are seen as “integral parts of ecosystems” (MA, 2005, p. v). With ES being defined as “benefits people obtain from ecosystems” (MA, 2005, p. v), the NC notion does not play a role in the MA at all. The MA introduced the first internationally recognized guideline for the identification, categorization and labeling of ES by dividing them into provisioning, supporting, regulating, and cultural benefits to humans.



Figure 8: Word cloud of the 30 words used most often in MA (2005), representing the “Broad Societal” perspective. The size of the words corresponds to how often they were used. Common English terms were excluded. Among the words used most often are “well-being”, “scientific”, “knowledge”, “findings”, “information”, and “experts”, suggesting the perceived need for an increased understanding of nature’s benefits to humans. Source: Own illustration created with wordle.net from MA Synthesis Report (2005), pp. v-ix (foreword).

4.1.2 Comparison between perspectives

What the typology shows is that the concept was originally introduced and distributed from a Pragmatic Conservationist stance that postulated an anthropocentric, utilitarian and, to some extent, economic framing as strategy to convey the importance of nature conservation to a broader

audience. From that, I identified two main strands of perspectives that have their roots in one element of the original conceptual idea and taken it further. In the case of the Instrumental Economic perspective, the original economic connotation led to a perception of the concept as tool for economic valuation, thus suggesting a narrow definition of utility that nature provides to humans. Within that, NC as reference to the ecosystems that provide services has developed to be inherently interlinked with the ES concept. In contrast, in the case of the Broad Societal perspective, the original awareness-raising function of the ES concept has been taken as basis for a broadened perception of the concept as metaphor to enable knowledge creation and collaboration. Here, the utilitarian conceptualization of ES is interpreted broadly to include a plurality of values and the NC notion is completely left out. In sum, the definition of utilitarianism, an economic approach and the NC notion seem to be the main points of contestation and a development from a pragmatic awareness-raising function, to a management tool function (Instrumental Economic) on the one hand and an informational or educational function (Broad Societal) on the other can be observed. As a common consensus point, all perspectives share the anthropocentric and – although interpreted in various ways – utilitarian core that posits the maximization of human well-being as the overarching end to maintaining natural ecosystems.

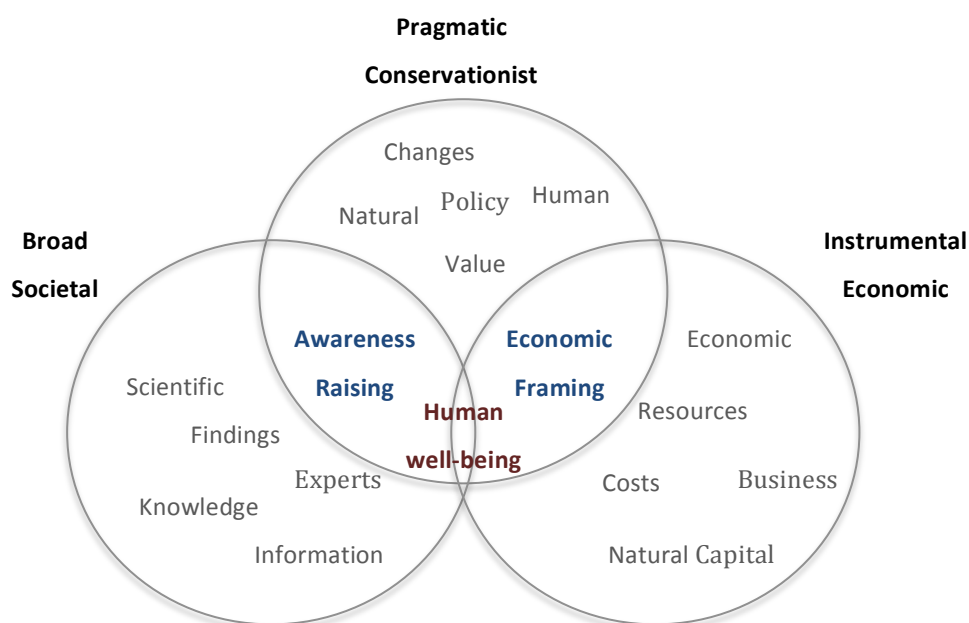


Figure 9: The foundational perspectives with terms taken from the word clouds (grey). The conceptual overlap between all three perspectives is the utilitarian framing of nature as contributing to human well-being (red). The Instrumental Economic and Broad Societal perspectives branch off from the original Pragmatic Conservationist perspective and focus on an economic framing and the awareness raising function of the Pragmatic Conservationist perspective respectively (blue). Source: Own illustration.

Differentiation I: Development of perspectives

From the literature, three foundational perspectives on the ES concept can be identified:
Pragmatic Conservationist, Instrumental Economic, and Broad Societal

4.2 Differentiation II: Perspectives in OPERAs

The second differentiation resulted from the Q study conducted in OPERAs with the aim to identify the breadth of perspectives on the ES concept among project participants (RQ 2). The results of the study were processed in R as described in Appendix G. The resulting factors (groups of similar Q sorts) with their components (Q sorts) and their characteristics (ranking of statements) served as the basis on which perspectives were identified, labeled and characterized¹¹.

4.2.1 Interpretation of factors from Q sorts: Five perspectives in OPERAs

The factor analysis resulted in five relevant factors that provided the basis for the interpretation of perspectives. As highlighted earlier, the factors represent a common denominator between groups of Q sorts but match some Q sorts more than others (for overview see Appendix G). Consequentially, the perspectives drawn from the factors never perfectly reflect any of the viewpoints held by individual participants but represent ideal types that all Q sorts in one factor can be identified with. In the following (4.2.1.1 to 4.2.1.5), each of the five perspectives is interpreted based on the ranking of statements and lined with insights from the follow-up interviews¹². The ranking order for each underlying factor is displayed in Fig. 10-14¹³.

4.2.1.1 Perspective I: The Non-Economic Utilitarianist

The first perspective represents a pragmatic view on nature conservation, probably most strongly in line with the Pragmatic Conservationist foundational perspective. The utilitarian character of the ES concept is acknowledged and appreciated as a useful tool to approach conservation and to stress the link between humans and ecosystems. The representative defined Utilitarianism as being anthropocentric but including a broad set of values as opposed to being constrained to economic valuation (Q11|34-35). An explicit economic focus of the concept or an economic approach to ecosystem management is strongly rejected, given that most statements on the lowest ranks are those representing an economic perspective on the concept and by the notion that the concept is

¹¹ As the statistical analysis only served as a tool to filter out the factors in pre-defined steps, the factors themselves are not the focus. Detailed descriptions of the factors can be found in Appendix G.

¹² Citations from follow-up interviews will be tied into the interpretation of factors and have the format (Q sort | transcription line number) as introduced in 3.3.2.3.

¹³ For clarity and want of space, only the four least agreed to and four most agreed to statements are written out for each factor. All other statements are traceable in the list of statements (Appendix D).

“much larger” and that it goes “beyond economic values” (Q11|63). Surprisingly, although rejecting an economic viewpoint, the statement ranked highest uses the NC terminology. Given that the main representative of this factor argues that he/she does not make use of the NC concept very often since people are less familiar with it, NC is apparently not seen as an inherent part of the ES concept (Q11|72/73). Nevertheless, the NC metaphor is positively reflected on as potentially useful addition to the ES concept to stress the non-substitutability of the stock providing the services to humans (Q11|74-80).

	----	---	--	-	0	+	++	+++	++++
19	5	39	22	31	37	30	12	3	
	28	34	21	6	9	15	1		
	26	35	14	16	20	13	8		
		11	2	23	32	7			
		27	17	4	33	29			
			10	36	24				
			25	18	38				

Most like how I think....

S3: “Maintaining stocks of natural capital allows the sustained provision of future flows of ecosystem services and thereby helps to ensure enduring human well-being.”

S12: “The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation.”

S1: “The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of dependencies of human well-being on natural systems.”

S8: “Decision-making frameworks must ensure the protection of humanity’s most fundamental source of well-being: earth’s life-support system.”

Least like how I think....

S19: “Nature can be seen as separate from humans and human activities as external disturbances to natural functions.”

S5: “The concept of ecosystem services fits in the nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans.”

S28: “The emphasis currently placed on the economic valuation of ecosystem services is perhaps inevitable given the financial terminology used to express the idea that people benefit from nature.”

S26: “Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels.”

Figure 10: Distribution of statements for the Non-Economic Utilitarianists with statement 3 ranked as “most like how I think” and statement 19 ranked as “least like how I think”. Source: Own illustration.

4.2.1.2 Perspective II: The Critical Idealist

The second perspective is dominated by a strong value-focused standpoint. Two opposite statements referring to the human-nature relationship were ranked at the extremes at both ends of the spectrum (S30 and S19). This perspective is mostly concerned with ethical issues, paradigmatic viewpoints and critical reflections on the valuation of nature, rather than concrete conceptual or methodological statements. Although closest to the Broad Societal foundational perspective (see 4.1) with regards to underlying ethical viewpoints, the important difference is that this perspective, other than the MA, seems to be quite skeptical or at least “always a little bit critical” (Q21|11) about the ES concept. As opposed to the explicit inclusion of intrinsic values of nature in the MA, they are here seen as necessarily excluded by the utilitarian character of the concept that only focuses on “what we need and what we want” (Q21|47/48).

----	---	--	-	0	+	++	+++	++++
19	24	12	1	9	36	17	39	30
	3	22	28	2	33	27	14	
	10	37	21	32	5	35	38	
		20	29	8	7	15		
		23	11	34	18	16		
			13	4	25			
			26	6	31			

Most like how I think.....

S30: “People are integral parts of ecosystems and a dynamic interaction exists between them and other parts of ecosystems.”

S39: “It is sensible to consider ecosystem services as a core and an essential piece to the bigger sustainability problem solving but it’s by no means the full piece.”

S14: “Valuation is a way of organizing information to help guide decisions but is not a solution or end in itself. It is one tool in the much larger politics of decision-making.”

S38: “Different contexts and purposes entail different needs for the definition of ecosystem services.”

Least like how I think....

S19: "Nature can be seen as separate from humans and human activities as external disturbances to natural functions."

S24: "The goal is a new economy: one in which the values of natural capital and the ecosystem services which this capital supplies are fully reflected in the mainstream of public and private decision-making."

S3: "Maintaining stocks of natural capital allows the sustained provision of future flows of ecosystem services and thereby helps to ensure enduring human well-being."

S10: "It is at the policy frontiers that lie the brightest prospects for converting the world's society to sustainable resource management regimes."

Figure 11: Distribution of statements for the Critical Idealists with statement number 30 ranked as "most like how I think" and number 19 ranked as "least like how I think". Source: Own illustration.

4.2.1.3. Perspective III: The Anti-Utilitarianist

Striking in this third perspective is the emphasis of an opposition to a utilitarian approach to nature and the denial of a utilitarian core of the ES concept with the first and last statements on both ends of the spectrum referring to utilitarianism (S4 and S12). The reason for such a position is, at least in the case of the representative of this perspective, obviously connected to a very narrow definition of utilitarianism as "specifically attaching a monetary value" (Q29|68) and as only valuing "what the market can capture" (Q29|77). At the same time, he/she acknowledges that there might be other views dependent on "how you define utilitarianism" (Q29|67). As in the second factor, in this perspective ethical and value statements play a more important role than more conceptual or methodological statements referring to the ES concept itself. Since the position towards the ES concept is much less critical than the Critical Idealist perspective though, a utilitarian approach is not criticized but simply denied as being an inherent part of the concept.

----	---	--	-	0	+	++	+++	++++
12	38	22	2	19	35	11	8	4
	31	16	36	17	24	23	7	
	25	28	27	32	30	15	21	
		37	26	20	34	14		
		13	1	18	3	10		
			6	29	9			
			33	39	5			

Most like how I think....

S4: "Ultimately, the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns including considerations of the intrinsic values of species."

S8: "Decision-making frameworks must ensure the protection of humanity's most fundamental source of well-being: earth's life-support system."

S7: "A prerequisite to successful stewardship of nature is knowing the basic features of the system being managed."

S21: "The Common International Classification of Ecosystem Services (CICES) provides a good framework to enable the translation between different classifications and the linking of different sources of information about economy and environment."

Least like how I think....

S12: "The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation."

S38: "Different contexts and purposes entail different needs for the definition of ecosystem services."

S31: "Choosing terms that evoke positive associations such as "services", "goods", and "benefits" shows the optimistic intention as well as the research interest of scientists working with the ecosystem services concept."

S25: "The spreading of the concept of ecosystem services has in practice set the stage for the perception of ecosystem functions as exchange values that could be subject to monetization and sale."

Figure 12: Distribution of statements for the Anti-Utilitarianists with statement number 4 ranked as "most like how I think" and number 12 ranked as "least like how I think". Source: Own illustration.

4.2.1.4 Perspective IV: The Methodologist

As opposed to all former factors, two of the highest-ranking statements in this factor refer to methodological aspects (S27 and S35), to valuation aspects specifically, rather than underlying ethics or values. Surprisingly, one of the lowest ranking statements rejects the idea that complexity of environmental degradation requires more than a simple fix (S15) suggesting a rather simplistic view on ecosystem management. Criticism on the concept with regards to its potential negative effect on the perception of the human-nature relationship rank among the lowest positions and allude to a rather uncritical attitude towards the ES concept. Whereas a focus on methodological statements is identifiable, any focus regarding one of the foundational perspectives on the concept is not detectable whatsoever, maybe suggesting a rather unreflective perspective. A reason for that could be a very instrumental view on the concept that is less sensitive to terminological nuances or underlying ethical stances. In line with that assumption, the representative of this perspective states that he/she found most statements agreeable and "not necessarily exclusive" (Q14|29) and that he/she hasn't really come across differences in the conceptualization of ES yet (Q14|68).

----	---	--	-	0	+	++	+++	++++
18	10	31	22	9	2	33	27	1
	25	16	23	4	36	11	3	
	15	6	29	37	26	24	35	
		38	17	5	14	39		
		20	21	8	13	12		
			32	28	7			
			30	19	34			

Most like how I think....

S1: "The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of dependencies of human well-being on natural systems."

S27: "The issue of valuation is inseparable from the choices and decisions we have to make about ecological systems. We can choose to make these valuations explicit or not. But as long as we are forced to make choices we are going through the process of valuation."

S3: "Maintaining stocks of natural capital allows the sustained provision of future flows of ecosystem services and thereby helps to ensure enduring human well-being."

S35: "In principle monetary valuation needs not exclude other value dimensions in that it may be complemented with alternative valuation languages and real processes of deliberation in ecosystem services valuation."

Least like how I think....

S18: "A utilitarian framing of landscape engagement as done with the concept of ecosystem services could crowd out more affective moralistic intrinsic or social motivations and thus impede broader and longer landscape commitment."

S10: "It is at the policy frontiers that lie the brightest prospects for converting the world's society to sustainable resource management regimes."

S25: "The spreading of the concept of ecosystem services has in practice set the stage for the perception of ecosystem functions as exchange values that could be subject to monetization and sale."

S15: "There is no simple fix to the problems of environmental degradation since they arise from the interaction of many recognized challenges each of which is complex to address in its own right."

Figure 13: Distribution of statements for the Methodologists with statement number 1 ranked as "most like how I think" and number 18 ranked as "least like how I think". Source: Own illustration.

4.2.1.4 Perspective V: The Moderate Economist

The fifth perspective represents the only one with an obvious economic focus, thus getting closest to the Instrumental Economic foundational perspective (4.1). The highest-ranking statements reflect an economic paradigm that sees the main problem in the lack of accounting for NC and the solution in an economic approach to environmental decision-making. As opposed to all other factors, this one

strongly disagrees with the idea that with a growing number of users the ES concept is “becoming multiform and harder to grasp” (S6). This observation could be assigned to the economic view on the concept that lowers the awareness for other understandings and uses. Despite the economic focus of this perspective though, two of the most disagreed with statements were still the one denoting humans as separate entities from nature (S19) and the one positioning the ES concept at the “nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans” (S5). This is quite interesting since it denies the assumed relationship between an economic perspective and a resulting human-nature-relationship, in which nature is a mere resource for humans. Thus, while the “worldview” part of statements is rather reflecting a broad value perspective, the “concept” part is clearly dominated by economic statements. This is reflected by the representative that sees the concept as being “highly compatible with economics” (Q25|64) but at the same time emphasizes that there are “diverse ways in which people gain well-being” (Q25|87-88). Therefore, while seeing his/her own view as rather going “down the practical line” (Q25|30), this perspective does not reflect a purely instrumental view on nature.

	----	---	--	-	0	+	++	+++	++++
6	5	13	35	39	15	28	23	26	
	19	25	22	34	32	31	10		
	4	2	9	7	3	20	30		
		18	29	33	36	24			
		1	37	17	38	27			
			12	8	11				
			16	21	14				

Most like how I think.....

S26: *“Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels.”*

S23: *“The failure to incorporate the values of ecosystem services and biodiversity into economic decision-making has resulted in the perpetuation of investments and activities that degrade natural capital.”*

S10: *“It is at the policy frontiers that lie the brightest prospects for converting the world’s society to sustainable resource management regimes.”*

S30: *“People are integral parts of ecosystems and a dynamic interaction exists between them and other parts of ecosystems.”*

Least like how I think....

S6: *As the number of scientific disciplines that refer to the concept of ecosystem services grows the concept is becoming multiform and harder to grasp.*

S5: *"The concept of ecosystem services fits in the nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans."*

S19: *"Nature can be seen as separate from humans and human activities as external disturbances to natural functions."*

S4: *"Ultimately the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns including considerations of the intrinsic values of species."*

Figure 14: Distribution of statements for the Moderate Economists with statement number 26 ranked as "most like how I think" and number 6 ranked as "least like how I think". Source: Own illustration.

Differentiation II: Current perspectives

The findings within OPERAs show a more nuanced distinction between perspectives than suggested by the three foundational perspectives. The five perspectives were identified as (1) Non-Economic Utilitarianist, (2) Critical Idealist, (3) Anti-Utilitarianist, (4) Methodologist, and (5) Moderate Economist.

4.2.2 Comparison between perspectives

Striking differences or "compromise points" and similarities or "consensus points" (Webler et al., 2009, p. 35) were revealed by the range between ranks of statements across factors (Table 3). In addition, the sum of the factor ranks could show, which statements seemed to elicit the strongest opinions into one direction. Interlacing these findings with insights from the follow-up interviews and the comments given by participants allowed for a more comprehensive picture of key points that constituted the different perspectives.

Table 3: Overview of compromise points, consensus points and strongest reactions. Statements that were sorted most differently reflect compromise points, those ranked most similarly show consensus points, and those with the highest sum (positive/negative) show the strongest reaction towards one side across factors. Columns F1 to F5 (Non-Economic Utilitarianist, Critical Idealist, Anti-Utilitarianist, Methodologist, Moderate Economist) show the ranking of each statement across factors among the nine possible positions with 4 being “most like how I think” and -4 being “least like how I think”. The columns “Sum” and “Range” display the sum of rankings (column F1 to F5 added up) and the maximal range between rankings (difference between those rankings that were furthest apart) respectively. Source: Own illustration.

			F1	F2	F3	F4	F5		Sum	Range
Compromise Statements	S3	Maintaining stocks of natural capital allows the sustained provision of future flows of ecosystem services and thereby helps to ensure enduring human well-being.	4	-3	1	3	1		6	7
	S4	Ultimately, the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns including considerations of the intrinsic values of species.	0	0	4	0	-3		1	7
	S12	The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation.	3	-2	-4	2	-1		-2	7
	S26	Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels.	-3	-1	-1	1	4		0	7
Consensus Statements	S9	Successful inter- and transdisciplinary research requires an explicit reflection on shared concepts.	0	0	0	0	-1		-7	1
	S22	Researchers started talking about ecosystem goods and services to use a language that is familiar to people.	-1	-2	-2	-1	-1		-1	1
Strongest reaction	S19	Nature can be seen as separate from humans and human activities as external disturbances to natural functions.	-4	-4	0	0	-3		-11	4
	S25	People are integral parts of ecosystems and a dynamic interaction exists between them and other parts of ecosystems.	2	4	1	-1	3		9	5

4.2.3.1. Compromise points

Compromise points show the main points of contestation between perspectives. Remarkably, points found here match the main differences that constituted the categorization into the three foundational Pragmatic Conservationist, Instrumental Economist and Broad Societal perspectives (4.1). They are discussed here using insights from the follow-up interviews¹⁴.

Utilitarianism

Substantial differences came up in the realm of utilitarianism that two out of four compromise statements explicitly referred to (S4, S12). Apparently being aware of these differences, respondents

¹⁴ For simplicity, interviewees are here referred to with the name of their perspective (e.g Non-Economic Utilitarianist), although still being aware of the difference between the “ideal type” perspective and the real viewpoints of people.

in the interviews indicated “different ways” (Q25|86/87) or “big discussions” (Q21|56/57) that exist around the definition of utilitarianism. Whereas the Non-Economic Utilitarianist stressed the utilitarian framing of the ES concept as essential to highlighting also the “intangible” or “non-economic” (Q11|53) benefits that humans receive from nature, the Anti-Utilitarianist rejected a utilitarian character of the concept since, by definition, utilitarianism would exclude any non-monetary values of nature (Q29|69-71). The Critical Idealist agreed with the Non-Economic Utilitarianist that the concept is inherently utilitarian but viewed that as a critical issue since intrinsic values of nature are always left out in this framing (Q21|56-58).

Economic approach

The statement referring to an economic approach as best way to guide decision-making (S26) showed disagreement between the Moderate Economist perspective ranking it first place and all other perspectives. The Moderate Economists reflected on ES as being “highly compatible with economics” (Q25|64). As opposed to their negative ranking of this statement, all the others did not directly reject an economic connotation to the concept but argued that it is only one way of looking at it (Q14|105-107; Q11|63-64). Even the Critical Idealist acknowledged that an economic approach is not “by definition wrong or something that we should not do but [...] just not the only thing” (Q21|82-84).

Natural Capital

With regards to the NC terminology, the first compromise statement (S3) referring to “[m]aintaining stocks of natural capital” was ranked positively in all perspectives except for the Critical Idealists. In the interview, the representative rejected using the NC concept as it is “framed in a very economic way” (Q21|37) that “makes it sound as if you have a stock somewhere and you can easily replace it with a stock somewhere else” (Q21|38-39). In contrast, the Non-Economic Utilitarianist and the Moderate Economist both stressed the importance of the NC metaphor to denote the stock providing the flow of services and to therefore link the ES concept to the notion of strong sustainability¹⁵ (Q11|80-84; Q25|102-104). The Methodologist and the Anti-Utilitarianist both referred to the NC as having little meaning for their work with ES (Q14|48; Q29|82-87), although the Anti-Utilitarianist even stated that the difference between ES and NC was not clear to him/her.

¹⁵ The distinction between strong and weak sustainability stems from the field of Ecological Economics that distinguishes approaches to sustainability by their position with regards to the substitutability of the NC stock (Baumgärtner & Quaas, 2009, Dietz & Neumayer, 2007, Faran, 2010). Whereas in weak sustainability approaches, the NC stock is regarded as substitutable with other types of capital (Solow, 1993), strong or critical sustainability approaches contemplate the non- or limited substitutability of this stock (Costanza & Daly, 1992).

4.2.3.2 Consensus points

Consensus points show those aspects that people across perspectives ranked similarly.

Importance of terminology

With one of the statements (S22), people across all factors disagreed with the idea that the ES concept was supposed to create awareness for conservation through the specific terminology of goods and services. This is surprising since the terminology, as the framing of the problem in terms that people would understand, has been pointed out as one key aspect of the concept (Daily|48-51, Ehrlich|31-35, Mooney|72-80). It is even more surprising since all interviewees agreed on the concept's essential function to "highlight" (Q25|33), to "make people more aware of" (Q21|27), to "clarify to people" (Q14|41), or to "emphasize" (Q11|28) the importance of the link between nature and human well-being.

Reflection on concept

Drawing on the neutral rankings of the other consensus statement (S9) that claims the necessity of and explicit reflection on concepts, one could assume a general indifference or even a lacking willingness to actively reflect on differences. However, and as opposed to the appearing indifference, interviewees noted that differences in understandings can develop into a problem if people get "confused by this diversity" (Q11|119) due to a lack of transparency. Thus, they saw the need to "discuss these differences in understanding" (Q11|130-131) and to "acknowledge that your way of doing things is not the only way of doing things" (Q21|91) in order to be able to "build upon each other" (Q21|92) and to "co-design a common understanding of what we really mean by ecosystem services" (Q25|123).

4.2.3.3 Strongest reactions

A point of reference for discussion is additionally provided by those statements that evoked the strongest reactions in some perspectives whereas treated with indifference by others. Remarkably, both statements found here refer to the human-nature relationship and the question if people can be seen as integral part or as separate from nature. According to rankings here, the Critical Idealists react most strongly to these statements, whereas the Anti-Utilitarianists and Methodologist show indifference towards them. The widest range exists between Critical Idealists and Methodologist, which confirms the general impression from the sorting as well as the follow-up interviews.

Transfer from Differentiation to Clarification

Differences exist especially with regards to the utilitarian character of the concept, an economic connotation of ES and its relationship with the NC concept (**Compromise Points**). People disagree on the strategic choice of terminology and they show indifference towards the need for reflection on the concept (**Consensus Points**). Two statements referring to the human-nature relationship provide an additional point of reference for discussions.

5 CLARIFICATION: Future use of the concept

“Therefore, if the goal is to increase interdisciplinary research [...], it is not enough to point out conceptual differences [...]. It is essential to take the next step and ask why the difference is there.” (MacMynowski, 2007, p. 6)

In line with claims in the ES literature, the results of a differentiation on two levels could generally confirm that there *are* differences in the understanding and use of the ES concept. Whereas the literature review led to the first conclusion of having three foundational perspectives on the concept, a closer look within OPERAs suggested a more nuanced variety of perspectives. After having identified the differences, the next step is to clarify *why the difference is there* in order to draw conclusions on how to handle it in OPERAs and the wider research community (RQ 3).

5.1 Clarification I: Implications in theory

5.1.1 Why the difference is there

The entire framework of this thesis is set up around interdisciplinarity and the observation that the main cause for conceptual differences has commonly been assumed to lie in peoples' disciplinary backgrounds and related scientific paradigms (Baumgärtner et al., 2008; Gardner, 2012; Lipton, 2005). As a result, claims to try and integrate “different disciplinary basic constructions of the world” (Baumgärtner et al., 2008, p. 388) have often been the focus of discussions. However, the results in OPERAs alluded to the fact that perspectives are much less clear-cut or simply attributable to paradigmatic differences between disciplines for at least two reasons:

Firstly, although the small sample size in Q methodology does not allow for significant conclusions on the causal relationship between perspectives and demographic aspects, striking patterns are still observable. In this case, it was obvious that demographic aspects were mixed across factors without showing any patterns. In terms of the relationship between disciplinary background and perspective,

there was a general accumulation of natural scientists by training (22 out of 33) in the sample but they split across the five perspectives and mixed with all other disciplines. Only the Methodologist perspective was defined by natural scientists only and the Moderate Economist perspective showed an accumulation of Economists, which seems to fit the perspectives and thus could allude to a relationship here. In all other cases, no pattern could be derived at all.

Secondly and even more importantly, whereas the perspectives found in the literature could potentially be argued to be attributable to the realms of natural sciences (Pragmatic Conservationist), economics (Instrumental Economic) and social sciences (Broad Societal), the perspectives found in OPERAs are clearly more nuanced. They all seem to combine different aspects of the foundational perspectives in new ways. For example, in the case of the Moderate Economist, an economic perception of the ES concept is combined with a view on humans being an integral part of nature, the Non-Economic Utilitarianist explicitly rejects a purely economic approach but sees the NC concept as valuable addition to ES and the Critical Idealist has a strong ethical focus but does not seem to follow any of the foundational perspectives on the concept. Generally, statements concerning the “worldview” category and statements concerning the human-nature relationship have evoked stronger reactions than conceptual or methodological statements and thus suggest the importance of underlying ethical stances in connection with the ES concept.

Both insights point to the fact that differences in perspectives arise from more complex causes than merely from disciplinary paradigms. Taking into account the notion that the concept “inevitably involves judgments about human actions with respect to nature” (Jax et al., 2013, p. 261) and thus taps on “contentious issues” (Turnhout et al., 2013, p. 157), perspectives can be assumed to arise from an interplay of one’s social, economic, cultural, and political backgrounds that form individual paradigmatic standpoints. Thus, a simple distinction of disciplinary worldviews and attempts of standardization between them will not be helpful in coping with the diversity of perspectives.

Clarification Ia: Cause for differences

As opposed to the assumption that differences most likely result from disciplinary worldviews, the nuanced perspectives that were found in OPERAs seem to allude to a combination of many influential factors. Individual values come into play that require more than standardization across disciplines.

5.1.2 How to handle the difference

Another important insight from the research within OPERAs is that diversity in the conceptualization of ES is commonly not seen as a problem per se but, on the contrary, as “very normal”, “not a

problem in itself” and sometimes even “more of an advantage” (Q29|132-133) to the concept and that naturally comes about when you work with the concept on a more concrete level (Q14|90). Thus, one of the participants noted:

"[This study] confirmed that ES can be interpreted in different manners and lead me to think perhaps that is OK. Maybe we should not strive towards one over-arching definition but rather recognize its different meaning in different contexts and advocate pluralism instead of unification of ES" (Q 21).

The participants therefore pointed to an important insight that has been discussed in the literature and that Star and Griesemer (1989) have captured with the notion of “boundary objects” (p. 387). In order for concepts to facilitate communication in interdisciplinary research, they argue, conceptual understandings do not necessarily have to be the same. Quite to the contrary, flexibility has been described as essential for allowing concepts to be used by different disciplines (Becker, 2006; Olsson & Thorén, forthcoming; Star & Griesemer, 1989). As the research here has shown, perspectives on ES show some consensus and some compromise points and thus might comply to the definition of a boundary object being “both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites” (Star & Griesemer, 1989, p. 393).

However, the core question is not if a concept can theoretically serve as “locus of unification” (Olsson & Thorén, forthcoming, p. 15) but rather, under which circumstances it can actually facilitate communication (Strunz, 2011). Put differently, the crux of the matter lies in the question how differences in the sense of “arbitrary openness” (Baumgärtner et al., 2008, p. 391) can be turned into “reflexive and guided pluralism” (Baumgärtner et al., 2008, p. 392). This is where the causes for differences have to be taken into account.

As conceptual differences have been shown to arise from nuanced alterations in individual paradigmatic stances rather than from clearly identifiable disciplinary worldviews, standardization and common frameworks across disciplines will not be effective in avoiding misunderstandings in uses. What is needed is the acknowledgment that the ES concept cannot be taken for granted as shared objective or what Ratner (2004) refers to as “unifying ethic” (p. 61). Instead, establishing a common ground for research will require the explication and discussion of underlying values and assumptions. Therefore and as opposed to standardization, an open dialogue or, what O’Hara (1996) refers to as “discursive ethics” (p. 95) is needed.

In sum, what has been brought forward as major criticism in the literature and what has led to the formulation of the initial working hypothesis, requires some rephrasing: It is not the difference itself

but the missing awareness for the existence of these differences and especially the insufficient explication of the causes for the differences that poses a barrier to interdisciplinary integration. Thus, communication can only be facilitated if these particular causes are targeted in the step of clarification.

Clarification Ib: The need for an explication of paradigmatic differences

Findings point to the idea that it is not the existence of differences in perspectives per se but rather the lacking awareness and explication of these differences and possible drivers that poses a barrier to the use of the concept as facilitator for interdisciplinary integration.

5.2 Clarification II: Implications in practice

5.2.1 Implications for OPERAs

Although striving for a “highly interdisciplinary approach” (OPERAs, 2012b, p. 13), research within OPERAs is still on a multidisciplinary level. Symptomatic for this apprehension was the notion that “the backgrounds [people in OPERAs] are coming from and the subparts [they] focus on are so different that everybody at the moment does their small parts and in the end the synthesis working package will have the most work to put everything together” (Q29|95-99). Albeit the obvious need for a project of this size to divide its work into manageable pieces, synthesis should not be the outcome of a separate task force but the overarching procedural principle. In order to achieve synthesis, standardization measures such as using the Common International Classification for Ecosystem Goods and Services (CICES)¹⁶ or blueprints (guidelines) that exemplars follow in their research will most likely be insufficient since they do not tackle the root causes for differences but simply address the symptoms.

As synthesis is here understood as being based on the awareness for differences and thus on the differentiation of perspectives, this thesis provided a starting point on two levels:

Firstly, as Webler et al. (2009) note, the “intriguing use of Q is to help groups clarify what they agree and disagree about” (p. 35). Generally, participants seemed to be aware that differences in perspectives exist but did not agree on where they came from or what they looked like. Whereas some located them on the conceptual level (Q11;Q21;Q25), others referred to individual (Q29) or context-specific (Q14) differences. Hence, displaying and summarizing points of agreement and disagreement in a succinct number of perspectives as done under 4.2 is a way of creating awareness

¹⁶ This framework has been proposed by Haines-Young & Potschin (2010) and is the main framework used in OPERAs research.

for the nuances between perspectives that exist and that they entail more than the simple distinction of disciplinary worldviews.

Secondly and at least as importantly, “Q help[s] individuals understand their own thinking on an issue” (Webler et al., 2009, p. 35). Confirming this assumption, everyone that was interviewed found the sorting exercise useful as “good tool to explore perceptions on the concept” (Q11|12-13), and as way to reflect on the concept “much more in depth” (Q14|15). In addition, comments that were given by all participants were overwhelmingly appreciative and reflexive.

The next step on the way to synthesis is the clarification of how to handle the differences in perspectives. For that, four main recommendations from 5.1 can be derived¹⁷.

(1) Awareness

Firstly, there has to be the collective awareness for different positions and for the necessity to make these more transparent instead of wrongly taking the concept as established ground for research. Although some of the interviewees recognized the need to reflect on the concept, rankings across factors rather alluded to indifference towards the need for reflection. Therefore, an explication of assumptions as initiated by this thesis has to actively be encouraged and conveyed as important to people throughout OPERAs’ research process.

Whereas the working packages “Resource Hub” and “Outreach” are designed to “increase understanding” (OPERAs, 2012b, p. 74) and to provide policy makers with “guidance on the use and effectiveness of the concepts in specific situations” (OPERAs, 2012b, p. 74) there is no explicit arrangement for increasing understanding among OPERAs participants in the first place. The same is true for the task force “Synthesis” that is meant to “synthesize lessons-learned and best practice in the use of tools and instruments” (OPERAs, 2012b, p. 16) and thus only has an ex-post summarizing rather than an ex-ante facilitation function.

(2) Time

Secondly, the project requires more, what Gardner (2012) refers to as, “structured time” (p. 249) to understand, discuss and integrate ideas throughout the research process. Judged from own observations, research meetings and scheduled Skype calls pre-dominantly serve an informing or updating purpose. Apart from that, time should deliberately be dedicated to discussions beyond deliverables and short-term objectives.

¹⁷ The recommendations partly refer to OPERAs structure and the working packages. An overview of OPERAs organizational structure as well as a more detailed case description can be found in Appendix A.

(3) Space

Thirdly, it is not only time but also the space that is required for open dialogue as “arena where normative values are explicitly called for” (O’Hara, 1996, p. 104). Such an arena could take on many forms including face-to-face as well as digital solutions. With its research meetings as well as digital space like the blog on the website, attempts to gather people and to encourage exchange between them do exist. Nevertheless, a space specifically designed to serve a discursive rather than an informative function would be more effective in engaging people in the dialogue.

The planned ‘Resource Hub’ in Working Package 5 probably gets closest to such a space as “online platform to find, share and contribute knowledge, information and resources for innovative, interdisciplinary, ecosystem-based management” (OPERAs, 2012b, p. 22). Although explicitly meant to serve interdisciplinarity, it is only based on the instrumental logic of standardization across disciplines in assuming that “there is a need for a consistent framework for ES assessments based on documenting data and reporting of results” (OPERAs, 2012b, p. 22). Thus, a similar space but more focused on the function of exchanging viewpoints and discussing them openly is required.

(4) Iteration

Most importantly, awareness, time and space alone will have no impact on the project if they are of short endurance or not iteratively reflected on. As one of the interviewees stated:

“I think it is an iterative process [...]. So every step we are doing, everybody has to reflect again what the contribution to the bigger context is and how we can adapt our next steps to contribute to it. I don’t think at the moment we can know where we are going to end in four years. But in order to work together we really need to understand what others are doing.”
(Q29|112-120)

In sum, if OPERAs manages to achieve its objectives under the premise of effective interdisciplinary synthesis, it can and should serve as role model for the feasibility of such a venture on a large scale. It thus has important implications for the wider research community.

5.2.2 Implications for the wider research community

On the basis of the findings and the recommendation for OPERAs, two main recommendations for the wider research community can be derived:

(1) Active attempts to achieve Interdisciplinarity

Whereas OPERAs is a project that has taken on the challenge of interdisciplinary integration already, the research community around ES has yet to acknowledge the need for such integration for the

most part. Although discussed a lot in the literature, a transgression of disciplinary boundaries that moves beyond multidisciplinary approaches is still in its infancy in many areas (Brandt et al., 2013). Before even getting close to the point of synthesis, a first step to “create space, time and a corresponding reward system” (Gardner, 2012, p. 250) to encourage interdisciplinary approaches has to be undertaken. As the ES concept is already used by many disciplines, it can possibly facilitate attempts for more interdisciplinarity as discussed above. On the other hand, the wide use of the concept, partly as a mere “buzzword” (Brown, Berstrom & Loomis, 2014, p. 329), might obscure and even hinder more integrative attempts.

(2) Transparency and open dialogue on a large scale

Ambiguities around the concept require the same clarification as OPERAs – only in a different dimension. Whereas on the level of OPERAs, awareness, time, space and iteration are thought to enable direct dialogue between participants, it is much more difficult to initiate the same process across the entire research community. Also, the ES concept has been discussed in a variety of reviews on many different levels including ethical standpoints and underlying value claims (e.g. Flint et al., 2013; Jax et al., 2013; Schröter et al., 2014). Accordingly, differentiation and clarification has been attempted for many aspects and in many partial attempts. What is largely missing so far is the step of synthesis and, even more so, the one of iteration that leads to a more transparent use of the concept. Therefore, it is on each participant in the scientific community to reflect, question and consciously apply the ES concept instead of putting the ES tag on every publication. For this, OPERAs should function as role model and other multipliers such as the relatively new journal specialized in ES with the same title, “Ecosystem Services”, should try to encourage more reflexive uses of the concept.

Transfer from clarification to synthesis

Within the core framework of this thesis, recommendations for OPERAs and the research community could be derived, thus superficially responding to the question of how to handle the concept in the future. In order to shed light on more far-reaching implications though, the discussion has to be embedded into the broader context that guided this research process.

6 SYNTHESIS: Embedding of findings into the context

“Synthesis, the final step of this engagement, is the intellectual fruit after the labor of differentiating and clarifying the research models, concepts, and philosophies at hand.”
(MacMynowski, 2007, p. 10)

6.1 Synthesis I: Reviewing the findings through the lens of sustainability science

Zooming out of the specifics of OPERAs, the point of departure was the notion that humanity is facing severe sustainability challenges and that sustainability science in the wider context of modernity provides the lens for this thesis. Thus, the synthesis and ‘intellectual fruit’ of the preceding research process shall be a discussion of the ES concept’s actual potential to guide sustainable ecosystem management by reviewing its link to the notion of sustainability.

6.1.1 First impression: The link between sustainability and ecosystem services

With the initial working hypothesis and the research framework, the focus so far was on the assessment of the ES concept’s potential to facilitate interdisciplinary collaboration and thus to potentially enable sustainable ecosystem management. Accordingly, the entire research process evolved around the concept’s vagueness as one criticism discussed in the literature. The overall insight was that vagueness is not a barrier per se but that it requires the explication of viewpoints. Consequentially, sustainable ecosystem management can potentially be facilitated if people engage in an open dialogue and enable interdisciplinary integration. Despite the differences that were encountered, people agreed on the ES concept’s essential aim to spur awareness for the need to maintain natural ecosystems and thus, implicitly as well as explicitly, referred to the connection between the ES concept and the notion of sustainability.

Within this line of argumentation, sustainability, although itself criticized for its “plethora of meanings” (Marshall & Toffel, 2005, p. 673), can be regarded as “normative anchor” (Strunz, 2011, p. 9) that can guide discussions around the ES concept. In that sense, the claim for sustainability can facilitate the necessary “dialogue of values” (Ratner, 2004, p. 50) on an overarching level. Viewing the link between the ES concept and sustainability from this perspective, both concepts are closely interlinked and the ES concept can benefit from sustainability as its “orientation point” (Strunz, 2011, p. 9).

6.1.2 Problematizing this link: Ecosystem services as pathway to sustainability?

With the former focus on the concept’s vagueness, a more critical reflection on other criticisms surrounding the concept has been limited so far. As noted early on in the introduction, the concept

was described as fundamental change of our view on nature and thus has evoked much dispute. Interestingly, the three main points of criticism that are brought up in this context are again the same ones that have been revealed as the main points of contestation in the literature as well as in OPERAs:

(1) Utilitarian Framing

In this thesis, the utilitarian framing, although defined in various ways, was shown to be a core part of the ES concept. Assuming a narrow definition of the utility of nature for humans, this framing was criticized to stress a one-sided human-nature relationship that resembles living of nature as a resource rather than living in or with nature (O'Neill et al., 2008). Against this background, the concept was argued to crowd out any kind of ethical considerations for preserving the natural environment (Jax et al., 2013; Raymond et al., 2013).

(2) Economic focus

An economic connotation of the concept turned out to be a major axis dividing perspectives on the concept, in the literature as well as within OPERAs. Indeed, the initial introduction of the concept with its terminology had “the economic perspective in mind” (Daily|63-64). Accordingly, a large body of literature criticizes the concept for being prone to economic interpretation (Gómez-Baggethun et al., 2010), for fostering a “technocratic and economic perspective” (Turnhout et al., 2013, p. 156), and for promoting “commodity fetishism” and the “commodification” of nature (Kosoy & Corbera, 2010, p. 1228). Instead of raising awareness for nature’s value to humans, the concept was argued to “eras[e] these very services from public consciousness” (Peterson et al., 2010, p. 116).

(3) Oversimplification (Natural Capital Stock)

The NC notion was another major compromise point between perspectives in the literature and in OPERAs. A point of criticism has evolved around this aspect arguing that the stock-flow framework that the ES and NC concepts together provide “blinds us to the complexity of the human predicament” (Norgaard, 2010, p. 1220). The notion of NC has been argued to convey a “function view of the natural and cultural worlds” and to wrongly suggest that we live from “bundles of assets” (O'Neill et al., 2008, p. 200).

That the main points of criticism on the concept coincide with the most contested points that divide perspectives on the concept could lead to two different conclusions:

On the one hand, one could argue that the findings of this thesis highlighted the fact that these points of criticism are based on a very narrow perspective on the concept and that they are not

necessarily shared by people working with the concept. Accordingly, the utilitarian framing was interpreted to include a wide range of values, the economic connotation seen as only one interpretation and the stock-flow metaphor was even interpreted as argument *for* sustainability by some. In line with Raymond et al. (2013) and Orenstein (2013) one could therefore argue for the need to broaden the concept's scope to explicitly include all these interpretations.

On the other hand, the dispute around these specific aspects and the ostensibly clear positioning of the concept as referred to in the introduction might as well lead to the conclusion that the concept is not contested in itself but that it is misinterpreted in many cases. As individual paradigmatic standpoints are not compatible with the utilitarian and, ultimately, economic paradigm that the concept is rooted in (Chan Satterfield, Goldstein, 2012; Luck et al., 2012), interpretations have taken on dimensions that transgress the boundaries of the actual meaning of the concept. This becomes apparent especially in the case of the Anti-Utilitarianist perspective that rejects a utilitarian core of the concept simply because the definition of utilitarianism would not correspond to the way nature is seen in that perspective. Thus, using the concept and admitting its utilitarian stance on nature would create dissonance that is simply faded out in the first place.

In sum, although surely not being the "silver bullet" (Chan et al., 2007, p. 59) to solving sustainability problems, one might argue that the ES concept can be "one among various alternative approaches" (Luck et al., 2012, p. 1020) and "part of a larger solution" (Norgaard, 2010, p. 1226) to tackle the need for sustainable ecosystem management. Taking on a more critical view as sustainability scientist though, the concept might not suffice to induce a real sustainability transition (Kates & Parris, 2003), a transition being defined as "deep structural changes" (Geels, 2011, p. 24). As paradigms¹⁸ are the "sources of systems" (Meadows, 1969, p. 18), a concept like ES that has been argued to be rooted in the same (modern) paradigm constituting the current system will reinforce rather than change it (Norgaard, 2010; Peterson et al., 2010). Thus, the concept's distribution as "panacea" (Ostrom, 2009, p. 15176) to ecosystem management and its innocent use in a wide range of contexts could ultimately hinder rather than support sustainability objectives. This thesis started out with the notion that the social context we live in is fundamentally reordered by modern thought. As discourses are part of the social context, in which they arise, this context has to be taken into consideration (Phillips & Hardy, 2002). Therefore, 6.2 will close the contextual loop with a synthesis in the context of modernity.

¹⁸ Paradigm is now understood as overarching paradigmatic structures. Just as individual or disciplinary paradigmatic structures (as referred to earlier) guide a person's perceptions and actions, overarching paradigms can constitute entire societal orders (Meadows, 1969).

Synthesis I: ES for Sustainability

In sum, the ES concept can potentially be part of a larger solution for sustainable ecosystem management but, reviewed more critically, is unlikely to induce a paradigm change that can evoke a transition towards a more sustainable system.

6.2 Synthesis II: Embedding the findings into the context of modernity

6.2.1 Point of departure: Ecosystem services as part of the cure

Initially, modern rationality was alluded to as cause for the disciplinary compartmentalization that is not fit for the problems we are facing nowadays and thus has to be overcome by collaborative efforts in interdisciplinary research ventures. In that sense, the ES concept has been discussed as potential facilitator for an integration of disciplinary approaches. Subsequently, modern thought implicitly played a role throughout this thesis. Firstly, the insight that there is more to conceptual differences than disciplinary boundaries confirmed Weber's notion of a fragmentation of values that subliminally accompanies the instrumentally rational modern thought (Weber, 1946). Nevertheless and secondly, highlighting the need for open dialogue instead of standardization in order to acknowledge and explicate value differences, opposes Weber's notion of the inescapability of his view on modernity. Rather, it is guided by the Habermasian idea of "communicative action"¹⁹ (Habermas, 1987, p. 1) or, as referred to earlier "discursive ethics" (O'Hara, 1996, p. 95) as way to enable holistic problem solving as opposed to compartmentalization. The recommendations for OPERAs were derived from this notion and essentially implied the potential of the ES concept to function as facilitator for collaboration as long as the need for an explication of underlying values is acknowledged.

6.2.2 Going deeper: Ecosystem services as inherently modern phenomenon

Initially, the idea that we "divide the world into smaller and smaller units, hoping that in understanding the parts we will eventually understand the whole" (Lattuca, 2001, p. 1) was taken as reference to the problem of compartmentalization between disciplines. However, reflecting more on it, the quote could just as well be a description of the ES concept's approach to environmental problem-solving. Striving for a deeper understanding, the concept essentially divides nature into ecosystems and single services that they provide to humans. Thus, it has been argued to reflect the modern separation of humans and nature and to serve the "ideals of comprehensive knowledge, control and commodification" (Turnhout et al., 2013, p. 158).

¹⁹ Habermas postulates a second type of rationality, communicative rationality, that arises from communicative action (open dialogue) between people. Exercising this kind of rationality is necessary to escape the hegemony of the instrumental rationality imposed on many lifeworlds (Habermas, 1987).

Therefore, connecting to the criticisms in 6.1 and taking the need for open dialogue a step further, not only underlying assumptions but also the ES concept itself should be made subject to reflections. If the specific framing and terminology of the concept is not perceived as essential to conveying the importance of nature, then the use of the concept and its paradigmatic nature should be reflected upon more critically in the first place. Niemelä et al. (2010) report from their study with Finnish stakeholders that the term services was suggested to be replaced by a different expression and thus conclude that “it is debatable whether the negative stigma associated with the word services will stay with the concept” (p. 3238). If the wording is an essential part of the concept though, I would go even further and ask if the concept itself will stay with efforts targeted towards sustainable ecosystem management in the long term.

Synthesis II: ES in Modernity

Closing the contextual loop: Whereas the ES concept was initially treated as potential facilitator to overcome the modern predicament by facilitating interdisciplinary collaboration, a reflection on the concept as modern phenomenon in itself supports the suspicion that the concept could hinder rather than advance efforts towards sustainability.

7 ITERATION: Reflections, outlook, and conclusion

7.1 Limitations

Firstly, the research interest and the interpretation of findings were based on the implicit assumption that only communicative aspects played a role for interdisciplinary integration, thus turning a blind eye on important influential factors such as power structures (MacMynowski, 2007). Especially for a project like OPERAs, power structures arising from budget allocations, organizational hierarchies, research positions, age, disciplinary and knowledge differences can be assumed to play an important role for the way that research is framed and carried out independent from the individual understanding of concepts.

Secondly, the research design has explicitly been described as the outcome of a subjective thought process, in which I assign myself an active role as a researcher with a certain lens on the research topic. Nevertheless, I would like to critically reflect on some of the choices made for the research design.

(a) Landmarks and Expert Interviews

The landmarks chosen for answering the first research question are by no means to be regarded as the only important drivers in the development of the concept, nor do the chosen experts for the interviews represent an exhaustive range of perspectives on the topic. Both were not meant to be the focus of the thesis but helped to reduce complexity and facilitate a rough categorization of perspectives in order to prepare the Q study in OPERAs.

(b) OPERAs as case study

Focusing on OPERAs made the research feasible and focused. It provided a study ground with clear-cut borders and with people that are engaged with the concept as well as with an interdisciplinary project. Nevertheless, it has to be noted that OPERAs is not necessarily representative for the wider research community for at least two reasons: First, although quite diverse, the project participants almost exclusively come from a European or at least Western background. Second, although representing a variety of disciplinary backgrounds, the humanities were not at all represented among my study participants, while natural sciences were overrepresented (with about two thirds of participants).

(c) Q-methodology

Q methodology as main approach to assess perspectives within OPERAs with its purpose to reveal subjective viewpoints has proven to be perfectly fitted to the research philosophy, theory and interest. However, reflecting on the methodology and its weaknesses, is imperative to view results in perspective. As a major point of criticism, the set up of a Q-study allows the researcher to enter his or her subjective viewpoints at many stages throughout the research process and could therefore be regarded as not reliable²⁰ (Kampen & Tamás, 2013). However, these criticisms have been taken into account as I made my subjective position as the researcher explicit throughout the reporting and discussion of results.

7.2 Further research

Based on the findings of this thesis, further research is required essentially on three levels regarding (1) the ES concept, (2) pathways for effective collaboration in ecosystem and sustainability science and (3) the further development of Q methodology.

(1) As the research focus here was on perspectives on the ES concept within the research community (OPERAs) only, conducting a similar study with practitioners could reveal important

²⁰ Due to the want of space, these criticisms are outlined in depth in Appendix I.

insights concerning the effect that the framing of the ES concept has on people that have not worked with it before and that don't have a research background.

(2) Ethical stances and values have been suspected to play a substantial role in forming perspectives on the ES concept and the same can be assumed for sustainability science as normative research field in general. Thus, in order to establish a more transparent basis for dialogue, it would be essential to assess paradigmatic drivers of perspectives beyond disciplinary cultures more systematically.

(3) For Q methodology to develop its full potential in research, it has to be tested and developed further. A major instrumental barrier to using it is the lack of well-tested and sophisticated programs to set up, conduct and analyze Q sorts. Qsortware proved as functioning but still rather rudimentary program for the purpose of conducting the Q sort. Programs specifically designed for the analysis of Q sorts were either outdated or costly at this point.

7.3 Summary and conclusion

The point of departure for this research venture was the notion that environmental degradation has come to a state where sustainable ecosystem management is an urgent quest for humans to maintain their life-support system. The ES concept as potential facilitator to manage this quest has been criticized for its vagueness to pose a barrier to successful interdisciplinary collaboration and the subsequent application in practice.

Employing MacMynowski's framework for interdisciplinary collaboration and focusing on the case of OPERAs, this thesis aimed at serving the identification of differences in perspectives on the ES concept (differentiation), in order to enable an effective way of handling these differences (clarification) as a basis for interdisciplinary integration (synthesis). A main insight and basis for recommendations was the fact that rather clear differences in foundational perspectives from the literature are much more nuanced in the research community represented by OPERA. Whereas the notion of interdisciplinarity steers the focus towards disciplinary boundaries that have to be overcome, perspectives seem to be influenced by paradigmatic factors beyond disciplines, especially in the realm of the human-nature relationship. Consequentially, clarification has to be much more than the standardization of discipline-induced worldviews. It has to encompass the notion of a fragmentation of values that requires open discussions on underlying ethical stances.

Zooming out of the specifics of OPERAs, the final synthesis pointed to a more fundamental insight: While the ES concept has been made subject to the process of differentiation and clarification

throughout this research process, synthesis from the sustainability science lens highlights the need to reflect on the use of the concept in the first place. As, arguably the ES concept is a modern phenomenon itself, its potential to tackle challenges arising from this very paradigmatic context should be questioned and made a critical point for iteration.

Credits

Imagine an Opera – there is *one* song that the entire performance evolves around. Every singer knows the song, they all practice it together and it sounds amazing. The day of the great performance, the day that everybody is supposed to sing in concert - as they have practiced it many times - is not scheduled but it seems like it is happening everyday. In the end, it is the singers' task to form the performance and they all know that the pitch of voice is only one factor out of many that influences they way they sing the common song. With a lot of practice, they give a great performance and the audience loves it. But then they become aware of something: Is this one song really what they want to sing? Is it the same audience they want to attract? Or do they want to try something different, something that they cannot only sing in harmony but something that reaches a different audience? *The singers get together and plan their next performance – as they harmonize so well, it will surely be a great one.*

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Appendix

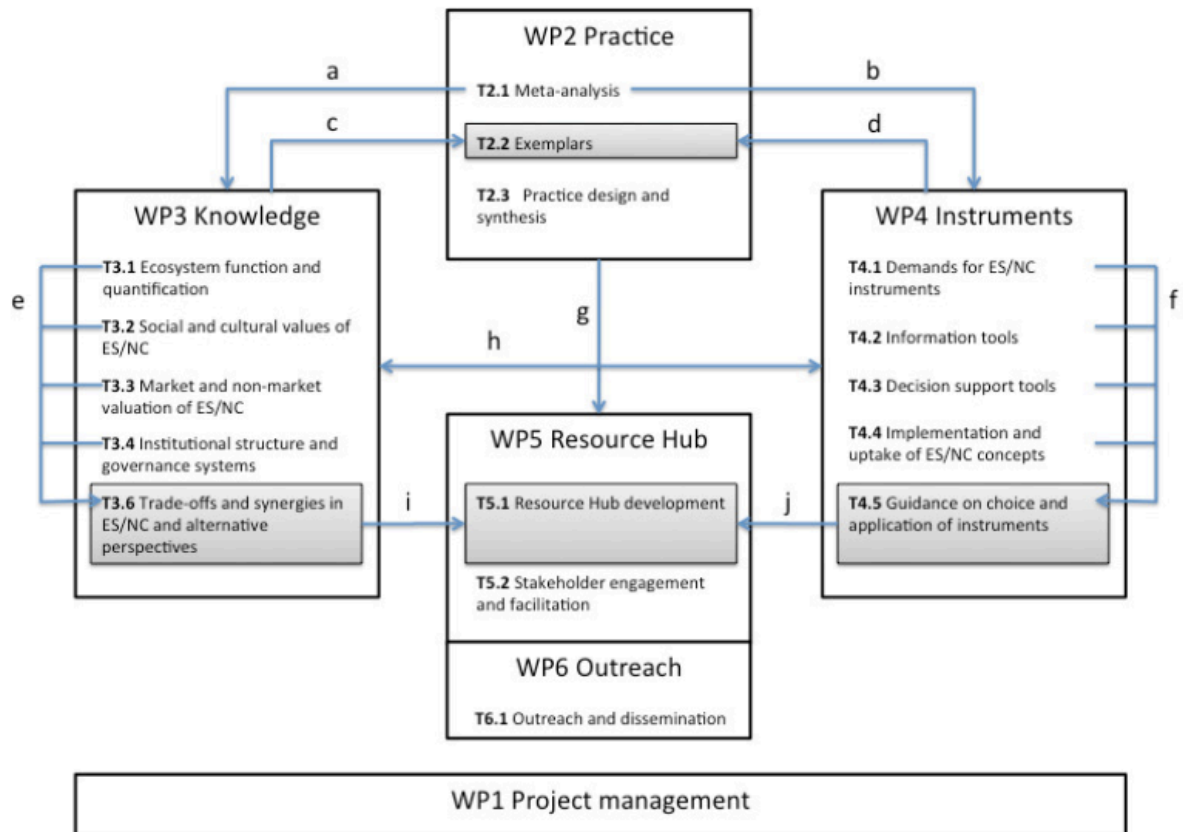
Appendix A: Case description OPERAs

General Information

OPERAs (Operational Potential for Ecosystem Research Application) is a European research project “undertaken jointly by academics, research institutes, NGOs and SMEs that bring specific strengths in the process of bridging science and practice” (OPERAs, 2012b, p. 83). The stated objective of the project is to “establish whether, how and under what conditions the concepts [of ecosystem services and natural capital] can move beyond the academic domain towards practical implementation in support of sustainable ecosystem management” (OPERAs, 2012b, p. 3). Therefore, the “mission and major challenge is to bridge the domains of science and practice” (OPERAs, 2012b, p. 2).

Organizational Structure

The project is running under the umbrella of the European commission and is comprised of 27 partner institutions. As of 2013, the number of participants amounted to 93 people. Having started out in 2012, the project is scheduled for 60 months and thus to be finalized in 2017. The project is set up around six work packages (WP) that are divided into several sub-tasks. With the working package ‘practice’ at its core, research approaches, methods and instruments are tested in 12 different exemplars (case studies) across Europe. Thus, the exemplars are where science meets practice and the “venues for collaboration between work packages across the project” (OPERAs, 2013, p. 3). Besides the practice work package (2) are the work packages knowledge (3), instruments (4), resource hub (5) and outreach (6). The coordination is done by the project management work package (1). Just as the practice work package is central to the project as “testing grounds” (OPERAs, 2013, p. 3), the resource hub has a central function as summarizing and synthesizing body for the knowledge that is generated (OPERAs, 2012).



Source: OPERAs (2012b, p. 25)

Resource Hub

As the central platform bringing together resources, tools and results throughout the research process, the resource hub will essentially represent the way the ES concept is understood and used in OPERAs. It will thus guide the further development, communication and implementation of the concept in science and practice to a certain extent. The web-based portal will be co-developed by scientists and practitioners and will provide the main interface between OPERAs and the ‘Community of Excellence’ (CoE).

Relevance for this thesis

OPERAs is specifically designed to work with the ES (and NC) concept and thus composed of participants that are assumed to have worked with the concept for a while or at least to have reflected on the concept before. In addition, participants are from a variety of backgrounds and thus expected to represent different perspectives on the ES concept. The risk that perspectives are influenced by working on a common project are rather low since the project only started out in 2012 and is still in its starting phase. This is also the reason for the interest of this thesis to assess and clarify perspectives within the project now since it is something to be done “ideally at the outset” (MacMynowski, 2007, p. 9) and iteratively throughout the entire research process.

Appendix B: Expert Interview Guide

Introduction

I am a master's student in Lund University's master program in Environmental Studies and Sustainability Science and am currently working on my thesis with the working title: The Ecosystem Services Discourse – Perceptions of the concept and implications for its OPERationalization. My main interest in this topic is the relevance of the Ecosystem Services concept for Sustainability Science and therefore its potential to successfully tackle the (environmental) sustainability problems that we are currently facing. Building on the scientific debate around differences in understandings and uses of the concept, I would like to (1) assess the concept's development over time as a basis to (2) study the current understandings within the research community (in my case represented by the participants of the research project OPERAs) in order to (3) discuss implications of differences in understandings for the concept's operationalization and successful inter- as well as transdisciplinary collaboration.

OPERAs (Operational Potential of Ecosystem Research Applications) is a European-wide research project running from 2012 to 2017. It is a collaborative venture composed of twenty-seven institutions, most of which are universities and research institutes. Participants within OPERAs come from a wide range of disciplinary backgrounds and have different levels of experience with the Ecosystem Services concept.

Questions

No.	Category	Question
1.	Concept	1 a. What is – in your view – the original core or purpose of the Ecosystem Services (ES) concept?
		1 b. To what extent has this purpose changed over the last decades?
2.	Research community	2 a. Would you say that there are conceptual differences within the scientific community? How would you categorize them?
		2 b. Where do you think these differences come from?
		2 c. To what extent do you think conceptual differences are a problem for the operationalization of the concept?
3.	Broader implications	3 a. What is the role of the ES concept for inter- and transdisciplinary collaboration?
		3 b. To what extent does the ES concept have the potential to tackle our environmental sustainability challenges in the long term?

Appendix C: Analysis of Landmark Papers

Landmark	Problem addressed	Objective	Definition of ES	Main purpose of concept	Human-nature relationship
Ehrlich & Ehrlich, (1981)	"Now all of these people [decision-makers] are certainly not crazy or malign. Most of them are in fact simply uninformed. " (preface)	"Fortunately, the accelerating rate of extinctions can be arrested. It will not be easy; it will require both the education of, and concerted action by, hundreds of millions of people." (preface)	"Important benefits to humanity" (preface)	Raising general awareness for species extinction and the loss of services to humanity; way of referring to benefits that functions have for humans.	"The natural ecological systems of Earth [...] are analogous to the parts of an airplane that make it a suitable vehicle for human beings." (preface)
De Groot (1987)	The lack of appeal [of conservation] with economists and decision-makers may partly be due to a communication problem [...] " (p. 105)	"[T]here is an urgent need for conservationists, economists and policy-makers to unite in a true partnership [...], based on clearly defined and universally accepted concepts [...] " (p. 109)	"[E]cological and socio-economic benefits of environmental functions to human society." (p. 105)	"spread[ing] the message" (p. 109)	"[N]ature provides many resources [...], a suitable substrate for many human activities and [...] opportunities for reflection [...]" (p. 106)
Daily (1997)	"[The] near total lack of public apprehension of societal dependence upon natural ecosystems" (p. 3)	"To effectively convey the necessary information to the public." (p. 4)	"The conditions and processes through which natural ecosystems [...] sustain and fulfil human life." (p. 3)	"[T]o translate this information to the general public as well as to policymakers, in ways that will prompt the action needed" (p.xix)	"[H]umanity's most fundamental source of well-being: earth's life-support system" (p. 2)
Costanza et al., (1997)	"Ecosystem services are not fully captured in commercial markets [...] and therefore are given too little weight in policy decision." (p. 253)	"We must begin to give the natural capital stock that produces these services adequate weight in the decision-making process." (p. 254)	"[F]lows of value to human societies as a result of the state and quantity of natural capital " (p. 253)	Raising awareness for importance of natural capital and its monetary value.	"[N]atural capital stocks [...] are critical to the functioning of the Earth's life-support system." (p. 253)
MA (2005)	"[A] lack of awareness among decision-makers of [...] the opportunities that more sustainable management of ecosystems could provide."(p. 20)	"[T]o establish the scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being."(p. ii)	"Ecosystem services are the benefits people obtain from ecosystems. " (p. v)	"[To] add value to existing information by collating, evaluating, summarizing, interpreting, and communicating it in a useful form."(p. v)	"[P]eople are integral parts of ecosystems and [...] a dynamic interaction exists between them and other parts of ecosystems" (p. v)
TEEB (2010)	"The failure to incorporate the values of ecosystem services [...] into economic decision making has resulted in the perpetuation of activities that degrade natural capital. " (p. 3)	"[T]he development of a new economy: one in which the values of natural capital [...] are fully reflected in the mainstream of public and private decision-making." (p. 3)	"From an economic point of view, the flows of ecosystem services can be seen as the ' dividend ' that society receives from natural capital. " (p. 7)	"[A]n economic approach to environmental issues [that] can help decision makers to determine the best use of scarce ecological resources at all levels" (p. 24)	"[The] prosperity and poverty reduction depend on maintaining the flow of benefits from ecosystems and [...] sustainable use of natural resources." (p. 3)

Appendix D: Q Methodology Design

D.1 Introduction to logic of Q methodology

Q methodology is commonly contrasted with R methodology used in regular surveys. Most importantly, whereas survey respondents are meant to represent the distribution of perspectives throughout society, Q participants are supposed to be representative for the “breadth of perspectives” (Brown, 1986, p. 260). Thus, the dataset in Q is inverted in comparison to R with the Q sort being the variable and the Q statements being the subjects.

	R-methodology	Q methodology
Variable	Survey question	Q sort done by a Q participant
Subject	Respondent	Q statements
Population	All possible respondents	All possible statements ('concourse')
Result	Patterns in how the subjects (respondents) answer the survey questions	Patterns in where subjects (Q statements) appear in the different Q sorts
Overall goal	Find distributions and generalize them to the general population of possible respondents	Find patterns and generalize them to breadth of (possible) dominant viewpoints in the concourse
Factor analysis	Normal	Inverted

Source: Own illustration based on Webler et al. (2009, p. 6)

D.2 Selection of statements

As described in 3.2 the final statements for the Q study were selected from a concourse matrix that allowed for the identification of statements that best covered all aspects around the ecosystem services concept. The concourse matrix is organized by the perspectives identified from the literature (Pragmatic Conservationist, Instrumental Economic, Broad Societal) and the categories of discussions (Paradigm, Concept, Openings for deliberation) that are subdivided into even more specific categories (e.g. Ethics, Human-Nature Relationship, Problem Framing). Statements in the category “openings for deliberation” are those that concern a reflection on the vagueness of the ecosystem services concept and its link to sustainability. They don’t match a specific perspective and are therefore highlighted in orange in the table below. The table following the matrix shows the final list of slightly edited and re-worded statements although grammar and spelling was mostly kept the same. Sources were taken out and the order was randomized.

		Foundational perspective		
		Pragmatic conservationist (Framing, awareness)	Instrumental Economic	Broad Societal (understanding, knowledge, communication)
Worldview	Ethics/Values	Daily, 1997: Decision-making frameworks must ensure the protection of humanity's most fundamental source of well-being: earth's life-support system	TEEB, 2010: Maintaining stocks of natural capital allow the sustained provision of future flows of ecosystem services, and thereby help to ensure enduring human well-being	MEA, 2005: Ultimately, the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns, including considerations of the
	HNR	Daily et al. 1996: A prerequisite to successful stewardship is knowing the basic features of the system being managed.	Flint et al. 2013: Nature can be seen as "separate from humans" and "human activities as external disturbances" to natural functions	MEA, 2005: [P]eople are integral parts of ecosystems and [...] a dynamic interaction exists between them and other parts of ecosystems
	Problem Framing	Daily, 2002: [T]he record shows that conservation can't succeed by charity alone. It has a fighting chance, however, with well-designed appeals to self-interest."	TEEB, 2010: The failure to incorporate the values of ecosystem services and biodiversity into economic decision making has resulted in the perpetuation of investments and activities that degrade natural capital.	MEA, 2005: There is no simple fix to these problems [of environmental degradation] since they arise from the interaction of many recognized challenges [...] each of which is complex to address in its own right.
	Transformational Claim	Daily, 1997: It is at the policy frontiers that lie the brightest prospects for resolving the human predicament and converting the world's society to new and sustainable resource management regimes	TEEB, 2010: [We are striving towards establishing] a new economy: one in which the values of natural capital, and the ecosystem services which this capital supplies, are fully reflected in the mainstream of public and private decision-making	Daily et al. 1996: The academic community now has an unprecedented opportunity to lead in the development of fundamental and applied research, of policy instruments, and of regional and global institutions oriented toward sustainable Earth management
Concept	Connection worldview-concept (Judgement)	Jax et al: [T]he concept inevitably involves judgements about human actions with respect to nature, and about what we value in nature. 'Ecosystem services' is thus a value-laden (i.e., normative) concept.	Flint et al. 2013: [T]he concept of ES fits in the nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans	Flint et al. 2013: [T]he broader ES framework [provides the potential] to include cultural and intrinsic motivations for conservation
	Conceptual (Descriptive)	Schröter, 2014: [T]he ES concept [is] a strategy to get the conservation idea across in societal discourses by appealing to peoples' own interest	Jax et al. 2013: [Ecosystem Services are used as] conceptual tool with the capacity to make environmental externalities explicit, and [...] to internalise the value of such externalities in market transactions and decision making processes	Jax et al., 2013: The concept denote[s] a generic idea or metaphor about the contribution of ecosystems to sustain life and human well-being [...] to facilitate communication between different disciplines and interest groups and to increase awareness of dependencies of human well-being
	Conceptual (Purpose)	Braat & de Groot, 2012: [The ES concept provides a] utilitarian framing of those ecosystem functions which are deemed beneficial to society as services in order to increase public interest.	TEEB, 2010: Using an economic approach to environmental issues can help decision makers to determine the best use of scarce ecological resources at all levels	Jax et al., 2013 The position of ecosystem services at the science-society interface provides it with the capacity to promote dialogue between academic disciplines and to improve communication between interest groups
	Methodological (Valuation)	Daily et al., 2000: Valuation is a way of organizing information to help guide decisions but is not a solution or end in itself. It is one tool in the much larger politics of decision-making.	Costanza et al., 1997: The issue of valuation is inseparable from the choices and decisions we have to make about ecological systems [...]. We can choose to make these valuations explicit or not [...]. But as long as we are forced to make choices, we are going through the process of valuation.	Jax et al. 2013: In principle, monetary [valuation] needs not exclude other value dimensions in that it may be complemented with alternative valuation languages and real processes of deliberation in ecosystem services valuation
	Methodological (Models)	Daily, 1997: [I]t is impossible to classify the services into entirely distinct, independent conditions and processes [...] it thus follows that the number of services contributing to a given source of human benefits is necessarily arbitrarily specified.	Haines-Young & Potschin 2010: [CICES can provide] a framework that would enable the translation between different classifications and the linking of different sources of information about economy and environment.	Lamarque, 2011: Following the MEA, Ecosystem services are broadly defined as the benefits people obtain from ecosystems and are classified in four categories: provisioning services, regulating services, cultural services, and supporting services.
	Terminology	Daily, 2014: [Researchers] started talking about goods and services to use a language that is familiar to people.	Potschin & Haines-Young, 2011: The emphasis currently placed on the economic valuation of ecosystem services is perhaps inevitable, given the financial terminology used to express the idea that people benefit from nature.	Schröter et al. 2014: Choosing terms that evoke positive associations such as "services", "goods", and "benefits", shows the optimistic intention as well as the research interest of scientists working with the
	Critique	Flint et al. 2013: [A] utilitarian framing of landscape management as done with the ecosystem services concept could crowd out more affective, moralistic, intrinsic or social motivations and thus impede broader and/or longer landscape commitment	Gómez-Baggethun et al., 2010: The spreading of the ecosystem service concept has in practice set the stage for the perception of ecosystem functions as exchange values that could be subject to monetization and sale	Lamarque, 2011: As the number of scientific disciplines that refer to the ecosystem services concept grows, and with its incorporation into political and corporate discourse, the concept is becoming multiform and harder to grasp
"Openings" for deliberation	Vagueness of the concept	Fisher, 2009: To effectively use the ecosystem services concept in decision-making will require a clear understanding of the concept (definition and characteristics).	Flint et al. 2013: To achieve such a unifying [ES] framework,[there is a need to make] implicit norms more explicit as well as thinking beyond existing paradigms about ecosystems and human-nature relationships.	Baumgärtner, 2008: A successful inter- and transdisciplinary research requires an explicit reflection on the different concepts
		Jax et al: Different contexts and purposes entail different needs for the definition of ecosystem services	Daily, 2014: I think it's application has evolved a lot but the concept [...] at its heart is still the same	Daily, 2014: I think it would be sensible to consider ecosystem services as a core and an essential piece to the bigger sustainability problem solving but it's by no means the full kind of piece

No.	Statement
S1	The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of dependencies of human well-being on natural systems.
S2	To achieve a unifying ecosystem services framework there is a need to make implicit norms more explicit as well as thinking beyond existing paradigms.
S3	Maintaining stocks of natural capital allows the sustained provision of future flows of ecosystem services and thereby helps to ensure enduring human well-being.
S4	Ultimately the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns including considerations of the intrinsic values of species.
S5	The concept of ecosystem services fits in the nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans.
S6	As the number of scientific disciplines that refer to the concept of ecosystem services grows the concept is becoming multiform and harder to grasp.
S7	A prerequisite to successful stewardship of nature is knowing the basic features of the system being managed.
S8	Decision-making frameworks must ensure the protection of humanity's most fundamental source of well-being: earth's life-support system.
S9	Successful inter- and transdisciplinary research requires an explicit reflection on shared concepts.
S10	It is at the policy frontiers that lie the brightest prospects for converting the world's society to sustainable resource management regimes.
S11	Ecosystem services are used as tool to make environmental externalities explicit and to internalize the value of such externalities in market transactions and decision-making processes.
S12	The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation.
S13	The concept of ecosystem services is a strategy to get the conservation idea across in societal discourses by appealing to peoples' own interest.
S14	Valuation is a way of organizing information to help guide decisions but is not a solution or end in itself. It is one tool in the much larger politics of decision-making.
S15	There is no simple fix to the problems of environmental degradation since they arise from the interaction of many recognized challenges each of which is complex to address in its own right.
S16	It is impossible to classify ecosystem services into entirely distinct independent conditions and processes. It thus follows that the number of services contributing to a given source of human benefits is necessarily arbitrarily specified.
S17	The concept of ecosystem services inevitably involves judgments about human actions with respect to nature and about what we value in nature. Ecosystem services is thus a value-laden (i.e. normative) concept.
S18	A utilitarian framing of landscape engagement as done with the concept of ecosystem services could crowd out more affective moralistic intrinsic or social motivations and thus impede broader and longer landscape commitment.
S19	Nature can be seen as separate from humans and human activities as external disturbances to natural functions.
S20	The academic community now has an unprecedented opportunity to lead in the development of fundamental and applied research of policy instruments and of regional and global institutions oriented toward sustainable Earth management.
S21	The Common International Classification of Ecosystem Services (CICES) provides a good framework to enable the translation between different classifications and the linking of different sources of information about economy and environment.
S22	Researchers started talking about ecosystem goods and services to use a language that is familiar to people.

S23	The failure to incorporate the values of ecosystem services and biodiversity into economic decision-making has resulted in the perpetuation of investments and activities that degrade natural capital.
S24	The goal is a new economy: one in which the values of natural capital and the ecosystem services which this capital supplies are fully reflected in the mainstream of public and private decision-making.
S25	The spreading of the concept of ecosystem services has in practice set the stage for the perception of ecosystem functions as exchange values that could be subject to monetization and sale.
S26	Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels.
S27	The issue of valuation is inseparable from the choices and decisions we have to make about ecological systems. We can choose to make these valuations explicit or not. But as long as we are forced to make choices we are going through the process of valuation.
S28	The emphasis currently placed on the economic valuation of ecosystem services is perhaps inevitable given the financial terminology used to express the idea that people benefit from nature.
S29	The Millennium Ecosystem Assessment provides a good framework to define and classify ecosystem services.
S30	People are integral parts of ecosystems and a dynamic interaction exists between them and other parts of ecosystems.
S31	Choosing terms that evoke positive associations such as “services”, “goods”, and “benefits” shows the optimistic intention as well as the research interest of scientists working with the ecosystem services concept.
S32	To effectively use the ecosystem services concept in decision-making will require a clear understanding of the concept (definition and characteristics).
S33	The position of ecosystem services at the science–society interface provides it with the capacity to promote dialogue between academic disciplines and to improve communication between interest groups.
S34	The application of ecosystem services has evolved a lot but the concept at its heart is still the same.
S35	In principle monetary valuation needs not exclude other value dimensions in that it may be complemented with alternative valuation languages and real processes of deliberation in ecosystem services valuation.
S36	The broader ecosystem services framework provides the potential to include cultural and intrinsic motivations for conservation.
S37	The record shows that conservation cannot succeed by charity alone. It has a fighting chance however with well-designed appeals to self-interest.
S38	Different contexts and purposes entail different needs for the definition of ecosystem services.
S39	It is sensible to consider ecosystem services as a core and an essential piece to the bigger sustainability problem solving but it's by no means the full piece.

Appendix E: Set up of online Q study

Introduction

After having sent a personalized email to each participant with an explanation of my research topic, the introduction to the study was supposed to familiarize the participant with Q methodology and the details of the following exercise.

Introduction

Dear participant,

Thank you so much for participating in this study and supporting the research for my master's thesis with the working title:

The Ecosystem Services (ES) Discourse - Perceptions of the concept and implications for its OPERationalization.

This study is based on **Q-methodology**, an approach coming from the broad family of discourse analysis and specifically designed to assess different perspectives on a certain topic.

The following exercise will take approximately 20-25 minutes. You will be asked to sort statements into different categories with the aim to create an overall image of your personal viewpoint.

First sorting stage
In the first stage, you will sort statements into three different boxes labeled "Less like how I think", "Neutral", and "More like how I think". You can always re-arrange statements between boxes as long and often as you wish. Please be aware that this is a preparatory step for the more fine-tuned sorting in the second stage, it is therefore advisable to aim for a rather equal distribution of statements between the different boxes.

Second sorting stage
Once you are done with the initial sorting, in the second stage you will be asked to sort statements from the three initial boxes into nine boxes labeled from "Least like how I think" to "Most like how I think" with a neutral point in the middle. The distribution of statements requires a forced normal distribution so that you have to decide on a few statements that represent your perspective most strongly and a broader set of statements that you do not have a strong opinion on. The number of statements that you can sort into each category is indicated in brackets at the top of each box. The detailed sorting will be easiest if you start with the "extremes" of the continuum and work your way towards the broader middle.

Goal
The final sorting should represent your viewpoint as accurately as possible. Some statements might seem quite similar in their general content. Therefore, it is important that you consider differences in wording and finer differences in the meaning - according to your own interpretation - of the statement.

Demographics and Comments
Please provide the demographic information asked for before the sorting. After the sorting, you will be asked for some reflections on the exercise and this study. Your thoughts are very important for me and it would be great if you could take the time to reflect on them in a couple of sentences.

Confidentiality
In the end, I will ask you for your agreement to be contacted for follow-up questions if necessary. Since this is a personalized invitation, I will have your contact information if you click "yes". Nevertheless, data will of course be handled confidentially and presented anonymously in the results.

In the very end: Please make sure to click "yes" when you are asked if you want to save your data in order to send your results. Otherwise your responses will be lost.

If you experience any troubles with the method itself or with technological matters, or if you have any questions or comments, please contact me on ess12vhe@student.lu.se.

Thanks again for your participation and happy sorting!

Kind regards,
Verena Hermelingmeier

Demographics

First, participants were asked to provide their demographic information in order to get an idea about the diversity of academic backgrounds and other factors. Gender was not specifically asked for since results were personalized and gender could therefore be identified in each case.

Demographics

User Information

Which primary field is your highest academic degree in?: Economics

Which perspective do you relate to most in your ES research?: Ecology

How much have you worked with the ES concept?: a lot (main research focus)

What was your main motivation to join OPERAs?: integrating my research into the proje

What is your current occupation?: PhD student

What is your year of birth?: before 1950

OK

First sorting

In a first step, 39 statements had to be sorted into three boxes labeled “less like how I think”, “neutral” and “more like how I think” as a preparatory step for the second, more nuanced sorting exercise. All statements had to be dragged and dropped into one of the boxes before the participant could click “continue”. It was always possible to rearrange statements between boxes as long as desired.


The Ecosystem Services Discourse / Step 1 of 1...

Please sort the following 39 statements one by one into the three categories "Less like how I think", "Neutral", and "More like how I think" by dragging them into the boxes below. You can always re-position the statements by dragging them from one box to another. Please make sure to distribute the statements between the three boxes as equally in number as possible, which will help you in the next sorting step. There is no right or wrong and the categories are relative to each other. Please sort the statements according to your own view and your first impression when reading the statement. When you are done with the initial sorting, please click "continue".

Drag the following item into one of the boxes below:

Valuation is a way of organizing information to help guide decisions but is not a solution or end in itself. It is one tool in the much larger politics of decision-making.

Less like how I think	Neutral	More like how I think
<ol style="list-style-type: none"> 1 To achieve a unifying ecosystem services framework, there is a need to make implicit norms more explicit as well as thinking beyond existing paradigms. 2 Ultimately, the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns, including considerations of the intrinsic values of species. 3 The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation. 4 The concept of ecosystem services is a strategy to get the conservation idea across in societal discourses by appealing to peoples' own interest. 	<ol style="list-style-type: none"> 1 The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of dependencies of human well-being on natural systems. 2 Maintaining stocks of natural capital allows the sustained provision of future flows of ecosystem services, and thereby helps to ensure enduring human well-being. 3 As the number of scientific disciplines that refer to the concept of ecosystem services grows the concept is becoming multiform and harder to grasp. 4 It is at the policy frontiers that lie the brightest prospects for converting the world's society to sustainable resource management regimes. 5 Ecosystem services are used as tool to make environmental externalities explicit, and to internalise the value of such externalities in market transactions and decision making processes. 	<ol style="list-style-type: none"> 1 The concept of ecosystem services fits in the nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans. 2 A prerequisite to successful stewardship of nature is knowing the basic features of the system being managed. 3 Decision-making frameworks must ensure the protection of humanity's most fundamental source of well-being: earth's life-support system. 4 Successful inter- and transdisciplinary research requires an explicit reflection on shared concepts.

Continue 

Second sorting

In the second step, statements had to be sorted from the initial three boxes into nine different boxes from "least like how I think (----)" to "most like how I think (++++)". Numbers in brackets indicated the amount of statements that had to be sorted into each box, thus forcing the normal flattened distribution as shown in Fig. 6 in 3.3.2.2. Only when all statements were sorted into one of the boxes and when each box contained the right amount of statements, the participant could move on to the next page.

The Ecosystem Services Discourse / Step 1 of 1...

Please sort the statements now into nine different categories from "Least like how I think" (indicated by ----) to "Most like how I think" (indicated by ++++), with a neutral position (indicated by 0) in the middle. Please note that the number of statements allowed in each category is indicated in parentheses at the top of each box. The number of missing items is indicated in red at the bottom of each box. When the number is right, you will get a green "OK". You can always re-arrange statements by dragging them from one box to another. It might be helpful to start with sorting from the extremes on either side towards the broader middle of the continuum. When all boxes show the green "OK", please press continue.

Drag the items to the boxes below:

Less like how I think	Neutral	More like how I think
1 Ultimately, the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns, including considerations of the intrinsic values of species. 2 A utilitarian framing of landscape engagement as done with the concept of ecosystem services, could crowd out more affective, moralistic, intrinsic or social motivations and thus impede broader and longer landscape commitment.	1 The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of dependencies of human well-being on natural systems. 2 To effectively use the ecosystem services concept in decision-making will require a clear understanding of the concept (definition and characteristics).	1 The concept of ecosystem services fits in the nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans. 2 The position of ecosystem services at the science–society interface provides it with the capacity to promote dialogue between academic disciplines and to improve communication between interest groups. 3 The record shows that conservation cannot succeed by charity alone. It has a fighting chance, however, with well-designed appeals to self-interest. 4 Different contexts and purposes entail different needs for the definition of ecosystem services.

Least like how I think ---- (1)	--- (3)	-- (5)	- (7)	0 (7)	+ (7)	++ (5)	+++ (3)	Most like how I think ++++ (1)
1 The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation. 2 There is no simple fix to the problems of environmental degradation since they arise from the interaction of many recognized challenges, each of which is complex to address in its own right. 3 The Millennium Ecosystem...	1 To achieve a unifying ecosystem services framework, there is a need to make implicit norms more explicit as well as thinking beyond existing paradigms. 2 There is no simple fix to the problems of environmental degradation since they arise from the interaction of many recognized challenges, each of which is complex to address in its own right.	1 The concept of ecosystem services is a strategy to get the conservation idea across in societal discourses by appealing to peoples' own interest. 2 It is impossible to classify ecosystem services into entirely distinct, independent conditions and processes. It thus follows that the number of services contributing to a...	1 As the number of scientific disciplines that refer to the concept of ecosystem services grows the concept is becoming multiform and harder to grasp. 2 It is at the policy frontiers that lie the brightest prospects for converting the world's society to sustainable resource management regimes. 3 The Millennium Ecosystem...	1 Ecosystem services are used as tool to make environmental externalities explicit, and to internalise the value of such externalities in market transactions and decision making processes. 2 Maintaining stocks of natural capital allows the sustained provision of ecosystem services, and thereby helps to...	1 Researchers started talking about ecosystem goods and services to use a language that is familiar to people. 2 The goal is a new economy: one in which the values of natural capital, and the ecosystem services which this capital supplies, are fully reflected in the mainstream of public and private decision-making. 3 Using an economic approach to environmental...	1 Successful inter- and transdisciplinary research requires an explicit reflection on shared concepts. 2 A prerequisite to successful stewardship of nature is knowing the basic features of the system being managed. 3 The academic community now has an unprecedented opportunity to lead in the development of fundamental and...	1 The spreading of the concept of ecosystem services has in practice set the stage for the perception of ecosystem functions as exchange values that could be subject to monetization and sale. 2 The issue of valuation is inseparable from the choices and decisions we have to make about ecological...	1 The emphasis currently placed on the economic valuation of ecosystem services is perhaps inevitable, given the financial terminology used to express the idea that people benefit from nature.
OK	OK	2 item(s) missing	OK	3 item(s) missing	3 item(s) missing	OK	OK	OK

Continue

Comments

Finally, the participant was asked to leave comments on the sorting exercise and the study in general. I also asked if participants agreed to being contacted in the aftermath. Participants that responded with “no” were not contacted for follow-up interviews.

Reflection questions: Please enter n/a if you have no comments

User Information

How did this exercise make you reflect on the ES concept?:

Please comment on your experience with the sorting activity.:

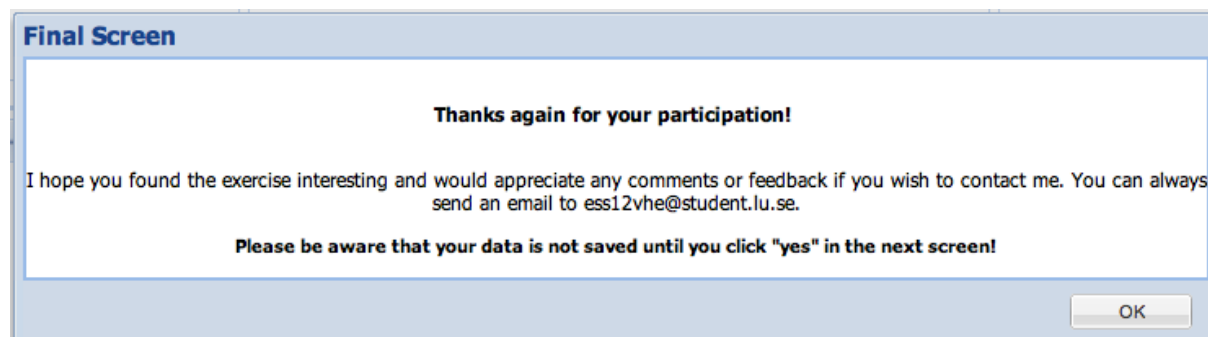
Please leave your general comments on the study here.:

Would you agree to being contacted for follow-up question?:

OK

Final Screen

Finally, participants were thanked one more time and provided with my email address for questions or comments.



Appendix F: Analysis of Q sorts – Theoretical Steps

Goal

The aim of the statistical analysis of a Q study is to find factors that can be interpreted as the dominant perspectives on a topic. Factor analysis is “the orderly simplification of a number of interrelated issues to make sense out of the apparent chaos of the environment” (Du Plessis, 2005). In Q, just as each Q sort portrays a version of the world as the individual sees it, so do the dominant factors represent a version of the world commonly held by a number of individual, expressed in the “unison of the factor scores” (Brown, 1991, p. 23). The factor analysis conducted in Q methodology can be referred to as “inverse factor analysis” (Kline, 1994, p.78) since the normal data matrix is turned on its side with the Q sorts representing the variables and the statements the observations. Thus, Q factors load on individuals or their Q sorts rather than on pre-defined variables.

Overview of different steps

	Analysis	Explanation	Result	Purpose
1	Correlation between all Q sorts	Testing the relationship between the sorts. +1 would be perfect agreement, -1 perfect disagreement	39x39 correlation matrix	Preparatory step for factor analysis
2a	Eigenvalues of factors in the correlation matrix	The variance that is explained by a factor, the higher the eigenvalue the more relevant it is for the factor analysis	Scree Plot that displays all possible factors and their eigenvalues	First step in factor analysis, finding relevant factors for further analysis with eigenvalue > 1 (Kaiser’s criterion)
2b	Factor extraction with Principal component analysis (PCA)	Finding out which Q sort belongs to which factor	Table with unrotated factor loadings for each Q sort	In depth factor analysis; which Q sort belongs to which factor

2c	Factor rotation with VARIMAX	The data is rotated along its axis so that the final output of factors has as little overlap as possible	Table with rotated factor loadings for each Q sort	Not a modification but clearer perspective on the data
3a	Factor reliability	Identifying the number of Q sorts that define each factor. Each factor should be defined by at least 5 participants	Barplot showing the number of Q sorts loading onto each factor	Making sure that the factors are relevant
3b	Factor variables	After having identified the number of Q sort loading onto each factor, in this step each Q sort is assigned to a factor	Taking the varimax rotated table, one can identify the Q sorts for each factor; ranking it by loadings, the main representative of the factor can be detected	The final outcome: Which Q sort belongs to which factor and who loads highest onto each factor
4a	Factor Scores	Factor scores represent estimates of common parts of the variables, the variables being the Q sorts in this case; common parts refer to rankings of statements	Numbers of those statements that have been chosen most commonly within a factor weighted with the loading of the sorts onto the factor	Preparatory step for ranking of statements in step 6
4b	Ranking of scores within each factor	The factor scores for each statement can now be ranked for each factor	List of statements in a ranked order	"Ideal sort" for each factor
5a	Compromise and consensus statements	Comparing the factor scores and filtering out those statements where the difference between scores is highest and lowest respectively	List of those statements that represent the compromise/consensus statements	Signifying the most striking differences and similarities between perspectives
5b	Strongest reactions	Comparing the sum of factor scores for each statement and filtering out the highest (positive/negative) sum	List of statements that evoked the strongest reactions	Point of reference for discussion of perspectives

Step 1: Correlation

First, the creation of a correlation matrix is the initial numerical treatment of the data and thus “a necessary way station” (Brown, 1991, 14) on the way to revealing their factorial structure. As the mean of the Q-sort has relatively the same meaning from subject to subject and statements categorized as ‘neutral’ are assumed to have an “equivalent insignificance from individual to individual” (Brown, 1986, p. 22), the conditions for applying correlational procedures are satisfied (Brown, 1986). A correlation measures the degree of agreement between two sets of scores in a correlation coefficient between +1 (complete agreement) to -1 (complete disagreement) (Kline, 1994). The resulting table indicates the extent to which each Q sort is correlated or uncorrelated in terms of significant or insignificant loadings (Brown, 1991).

Step 2: Factor Analysis

a) Determining Eigenvalues

Eigenvalues represent the sum of squared factor loadings for each factor that can be found in the correlation matrix (Brown, 1986). In order to identify those factors that are worth investigating further, their eigenvalues are calculated and those with a value > 1 are extracted. Those with an eigenvalue < 1 (Kaiser’s criterion) are regarded as insignificant and too little interest to take into account for further investigation (Du Plessis, 2005). The percentage of total variance explained by each factor is equal to the eigenvalue divided by the number of variates in the matrix, which in Q are the number of Q sorts that are factored in. Thus, the larger the eigenvalue, the more variance is explained by a factor (Kline, 1994). A variance of around 10 % or more is considered sufficient for a factor to be of relevance.

b) Extracting relevant factors

Once the eigenvalues have been determined, the relevant factors can be extracted using the principal component analysis for those factors with an eigenvalue >1 . After factor extraction, the resulting factors and the corresponding loadings for each Q sort on that factor are displayed in a table. Factor loadings represent the extent to which each Q sort is associated with each factor (Brown 1991) and thus can be seen as correlations between variables (Q sorts) and factors (Child, 1970).

c) Factor rotation

The initial principal component analysis results in unrotated factor loadings that tend to relate to and overlap with each other. In order to get a mathematically equivalent but clearer separation between

factors, the factor matrix is rotated into a different form (Child, 1970, Brown 1991). This method of “manipulating the reference axes” (Child, 1970, p. 52) usually results in factor constructs that are much more useful for analysis than the unrotated ones (Du Plessis, 2005). The most commonly used technique for rotating factors in Q methodology is VARIMAX rotation that rotates factors in a way that correlations between them are reduced to a minimum (Brown, 1991).

Step 3: Identifying the factor components

a) Determining the factor reliability (*How many sorts load onto the factor*)

The composite reliability of a factor depends on how many participants define it. As a rule of thumb, a factor should have at least five participants defining it (Brown, 1986, Webler, 2009). Adding more responses only marginally clarifies the picture (Brown, 1986).

b) Determining the factor variables (*Which sorts load onto the factor*)

Once a table with rotated factor loadings has been generated, the Q sorts loading onto each factor and thus defining it, can be identified. Although some Q sorts might still load onto multiple factors, they will be assigned to the one that they load onto strongest. By looking at each factor separately and ranking the factor loadings from highest to lowest, the Q sorts can be brought into the order in which they define the factor. This way, the Q sort with the highest loading can be identified and kept in mind for potential further investigations (in my case the follow-up interviews).

Step 4: Characterizing each factor

a) Calculating the factor scores

Since interpretations of factors are primarily based on factor scores, once the factors have been identified, their scores have to be determined. A factor score is the score for a statement as an average of the scores that were given by all of the Q sorts associated with the factor (Brown, 1991). In addition to simply taking the average, Q sorts are weighted with their loadings to take into account that some are closer approximations of the factor than others (Brown, 1991).

b) Interpreting the factor arrays

Once factor scores have been calculated, each factor is presented in the form of a factor array, that is, a table showing the average ranking of statements for this factor (Du Plessis, 2005). In this essential step, factors blend elements into a final pattern that represents the ideal type version of a Q sort that best mirrors the viewpoints of all its components (all Q sorts defining the factor).

Step 5: Comparing factors

a) Compromise and consensus statements

By comparing the factor scores for each statement across factors, one can identify those statements that were ranked with a high difference between factors (compromise statements) and those that were ranked similarly (consensus statements). These compromise and consensus points across factors can allude to the most important ‘axes’ that constitute different perspectives.

b) Opening for discussions

Those statements with a strikingly high positive or negative sum and a relatively high difference in rankings between factors indicate, which statements elicited strong reactions into one direction. They can thus serve as points of departure for further discussions or the need for clarification.

Appendix G: Analysis of Q sorts – Results

The steps as outlined above were mostly conducted in the free software RStudio Version 0.98.501 and, where indicated, in Microsoft Excel Version 14.3.6 for Mac. In order to conduct the factor analysis the package “psych” was installed (`install.packages("psych")`). The essential steps are outlined below with the R code always following the “>” (for the data set labeled “data”).

Step 1: Correlation

After having imported the csv file into R, all Q sorts were correlated with the “cor” function in order to generate a correlation matrix. The following table shows an extraction for Q sorts 1-7 out of 33.

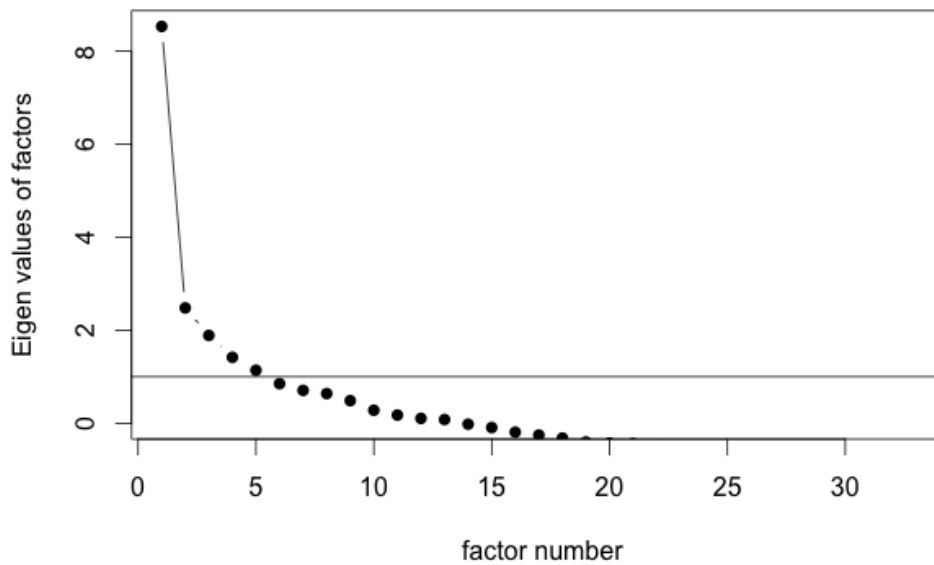
	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Q1	1.0000	0.0643	0.4571	0.1500	0.0571	-0.2571	-0.0286
Q2	0.0643	1.0000	0.3857	0.4857	0.6929	0.5643	0.5571
Q3	0.4571	0.3857	1.0000	0.2714	0.3571	0.1500	0.1000
Q4	0.1500	0.4857	0.2714	1.0000	0.2000	0.3500	0.3571
Q5	0.0571	0.6929	0.3571	0.2000	1.0000	0.5429	0.3071
Q6	-0.2571	0.5643	0.1500	0.3500	0.5429	1.0000	0.3286
Q7	-0.0286	0.5571	0.1000	0.3571	0.3071	0.3286	1.0000

Step 2: Factor analysis

a) Eigenvalues

The eigenvalues (eigen) were tested and the following screeplot (“scree”) generated. The scree plot shows that only 5 factors that can be found in the correlation matrix have an eigenvalue >1 (above the line) and are therefore relevant for further analysis.

Scree plot



b) + c) Principal Component Analysis (PCA) and VARIMAX

For the principal component analysis, the package “GPA rotation” has to be installed (install.packages(“GPArotation”). Having identified 5 factors with an eigenvalue > 1, a PCA (principal) was conducted for 5 factors and the result was rotated with VARIMAX (rotate=“varimax”) leading to the following table:

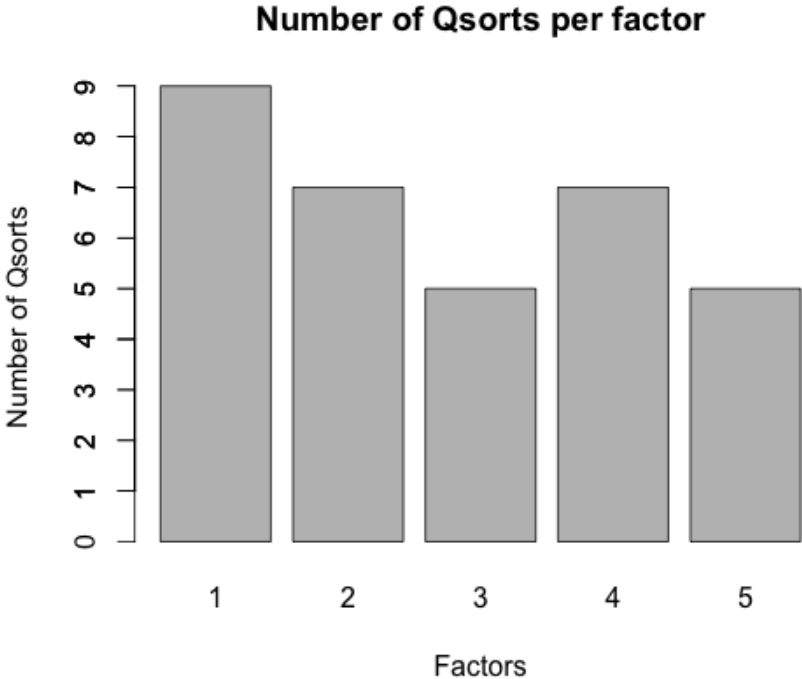
Loadings:						
	RC3	RC2	RC4	RC5	RC1	
Q1		0.722	-0.191	-0.258		
Q2		0.453	0.369	0.455	0.380	
Q3		0.675	0.210	0.138		
Q4		0.407	0.199	0.547		
Q5	0.282	0.408	0.373	0.175	0.512	
Q6	0.499		0.331	0.325	0.380	
Q7		0.265	-0.287	0.578	0.425	
Q8	0.141	0.229		0.151	-0.582	
Q9	0.530				0.404	
Q10	-0.142	-0.149	0.293	0.383	0.411	
Q11	0.807		0.144			
Q12		0.222		0.744	-0.123	
Q13		0.154	0.470	0.102	-0.383	
Q14	0.107	-0.103	0.178	0.703	0.164	
Q15	0.386	0.381	0.135	0.493		
Q16	0.399		0.276	0.233	0.535	
Q17	0.288	0.470	0.448		0.259	
Q18	0.123	0.559		0.146		
Q19	0.703	0.185				
Q20	0.145		0.779		0.187	
Q21	0.269	0.711		0.107		
Q22		0.620	0.253		-0.491	
Q23	0.414	0.336	0.122	-0.225		
Q24	0.530	0.164	0.634			
Q25	0.153	0.104	0.168	0.432	0.651	
Q26	0.733	0.181	0.205	0.294		
Q27	0.723		0.338	0.235	0.145	
Q28	0.576	0.241	-0.380	0.236	-0.130	
Q29			0.738	0.128	0.238	
Q30	0.357		0.618	0.413		
Q31	0.470	0.112	0.350	0.252	0.164	
Q32	0.318	-0.280	0.120	0.629		
Q33	0.239	0.384	0.259		0.515	
		RC3	RC2	RC4	RC5	RC1
SS loadings		4.702	3.858	3.808	3.739	3.067
Proportion Var		0.142	0.117	0.115	0.113	0.093
Cumulative Var		0.142	0.259	0.375	0.488	0.581

The “Proportion Var” in the right table shows the proportional variance that is explained by each of the factors. All factors here account for a variance around 10 % or more (factor 5 is the lowest with only 0.093). Thus, they all fulfill the requirement for a relevant factor.

Step 3: Identifying the factor components

a) Factor reliability

First, the number of Q sorts per factor is identified to make sure that each factor is defined by at least five people so that it can be regarded as reliable. The bar plot (barplot) made from the table with factor loadings below shows that this is the case here: Factor 1 = 9 Q sorts, factor 2=7 Q sorts, factor 3 = 5 Q sorts, factor 4 = 7 Q sorts, factor 5 = 5 Q sorts).



b) Factor variables

Second, I filtered Q sorts by loadings onto each factor (loadings) and ranked them according to their loadings onto the factor (sorted.loadings). This way, I was able to identify those Q sorts with the highest loading onto the factors and thus the main representatives of the perspective. In two cases (factor 2 and 3) the first representatives were not available for interviews. Therefore I took the second person in the list instead.

Factor 1			Factor 2			Factor 3		
Rank	Sort	Loading	Rank	Sort	Loading	Rank	Sort	Loading
1	Q 11	0.81	1	Q 1	0.72	1	Q 20	0.78
2	Q 26	0.73	2	Q 21	0.71	2	Q 29	0.74
3	Q 27	0.72	3	Q 3	0.68	3	Q 24	0.63
4	Q 19	0.70	4	Q 22	0.62	4	Q 30	0.62
5	Q 28	0.58	5	Q 18	0.56	5	Q 13	0.47
6	Q 9	0.53	6	Q 17	0.47			
7	Q 6	0.5	7	Q 8	0.23			
8	Q 31	0.47						
9	Q 23	0.41						

Factor 4			Factor 5		
Rank	Sort	Loading	Rank	Sort	Loading
1	Q 14	0.74	1	Q 25	0.65
1	Q 12	0.74	2	Q 16	0.53
3	Q 32	0.63	3	Q 5	0.51
4	Q 7	0.58	4	Q 33	0.51
5	Q 4	0.55	5	Q 10	0.41
6	Q 15	0.49			
7	Q 2	0.45			

Step 4: Characterizing each factor

a) Factor Scores

The factor scores as the average score that each statement received within a factor from all the Q sorts defining the factor are calculated as basis for the factor arrays (scores).

	Foundational perspective	Statement	F1	F2	F3	F4	F5
S7	Pragmatic Conservationist	A prerequisite to successful stewardship of nature is knowing the basic features of the system being managed.	2	1	3	1	0
S8	Pragmatic Conservationist	Decision-making frameworks must ensure the protection of humanity's most fundamental source of well-being: earth's life-support system.	3	0	3	0	0
S10	Pragmatic Conservationist	It is at the policy frontiers that lie the brightest prospects for converting the world's society to sustainable resource management regimes.	-1	-3	2	-3	3
S12	Pragmatic Conservationist	The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation.	3	-2	-4	2	-1
S13	Pragmatic Conservationist	The concept of ecosystem services is a strategy to get the conservation idea across in societal discourses by appealing to peoples' own interest.	2	-1	-2	1	-2
S14	Pragmatic Conservationist	Valuation is a way of organizing information to help guide decisions but is not a solution or end in itself. It is one tool in the much larger politics of decision-making.	-1	3	2	1	1

S16	Pragmatic Conservationist	It is impossible to classify ecosystem services into entirely distinct independent conditions and processes. It thus follows that the number of services contributing to a given source of human benefits is necessarily arbitrarily specified.	0	2	-2	-2	-1
S17	Pragmatic Conservationist	The concept of ecosystem services inevitably involves judgments about human actions with respect to nature and about what we value in nature. Ecosystem services is thus a value-laden (i.e. normative) concept.	-1	2	0	-1	0
S18	Pragmatic Conservationist	A utilitarian framing of landscape engagement as done with the concept of ecosystem services could crowd out more affective moralistic intrinsic or social motivations and thus impede broader and longer landscape commitment.	0	1	0	-4	-2
S22	Pragmatic Conservationist	Researchers started talking about ecosystem goods and services to use a language that is familiar to people.	-1	-2	-2	-1	-1
S37	Pragmatic Conservationist	The record shows that conservation cannot succeed by charity alone. It has a fighting chance however with well-designed appeals to self-interest.	1	-2	-2	0	-1
S3	Instrumental Economic	Maintaining stocks of natural capital allows the sustained provision of future flows of ecosystem services and thereby helps to ensure enduring human well-being.	4	-3	1	3	1
S5	Instrumental Economic	The concept of ecosystem services fits in the nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans.	-3	1	1	0	-3
S11	Instrumental Economic	Ecosystem services are used as tool to make environmental externalities explicit and to internalize the value of such externalities in market transactions and decision-making processes.	-2	-1	2	2	1
S19	Instrumental Economic	Nature can be seen as separate from humans and human activities as external disturbances to natural functions.	-4	-4	0	0	-3
S21	Instrumental Economic	The Common International Classification of Ecosystem Services (CICES) provides a good framework to enable the translation between different classifications and the linking of different sources of information about economy and environment.	-1	-1	3	-1	0
S23	Instrumental Economic	The failure to incorporate the values of ecosystem services and biodiversity into economic decision-making has resulted in the perpetuation of investments and activities that degrade natural capital.	0	-2	2	-1	3
S24	Instrumental Economic	The goal is a new economy: one in which the values of natural capital and the ecosystem services which this capital supplies are fully reflected in the mainstream of public and private decision-making.	1	-3	1	2	2
S25	Instrumental Economic	The spreading of the concept of ecosystem services has in practice set the stage for the perception of ecosystem functions as exchange values that could be subject to monetization and sale.	-1	1	-3	-3	-2
S26	Instrumental Economic	Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels.	-3	-1	-1	1	4
S27	Instrumental Economic	The issue of valuation is inseparable from the choices and decisions we have to make about ecological systems. We can choose to make these valuations explicit or not. But as long as we are forced to make choices we are going through the process of valuation.	-2	2	-1	3	2
S28	Instrumental Economic	The emphasis currently placed on the economic valuation of ecosystem services is perhaps inevitable given the financial terminology used to express the idea that people benefit from nature.	-3	-1	-2	0	2

S1	Broad Societal	The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of dependencies of human well-being on natural systems.	3	-1	-1	4	-2
S4	Broad Societal	Ultimately the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns including considerations of the intrinsic values of species.	0	0	4	0	-3
S6	Broad Societal	As the number of scientific disciplines that refer to the concept of ecosystem services grows the concept is becoming multiform and harder to grasp.	0	0	-1	-2	-4
S15	Broad Societal	There is no simple fix to the problems of environmental degradation since they arise from the interaction of many recognized challenges each of which is complex to address in its own right.	2	2	2	-3	1
S20	Broad Societal	The academic community now has an unprecedented opportunity to lead in the development of fundamental and applied research of policy instruments and of regional and global institutions oriented toward sustainable Earth management.	1	-2	0	-2	2
S29	Broad Societal	The Millennium Ecosystem Assessment provides a good framework to define and classify ecosystem services.	2	-1	0	-1	-1
S30	Broad Societal	People are integral parts of ecosystems and a dynamic interaction exists between them and other parts of ecosystems.	2	4	1	-1	3
S31	Broad Societal	Choosing terms that evoke positive associations such as “services”, “goods”, and “benefits” shows the optimistic intention as well as the research interest of scientists working with the ecosystem services concept.	0	0	-3	-2	2
S33	Broad Societal	The position of ecosystem services at the science–society interface provides it with the capacity to promote dialogue between academic disciplines and to improve communication between interest groups.	1	1	-1	2	0
S35	Broad Societal	In principle monetary valuation needs not exclude other value dimensions in that it may be complemented with alternative valuation languages and real processes of deliberation in ecosystem services valuation.	-2	2	1	3	-1
S36	Broad Societal	The broader ecosystem services framework provides the potential to include cultural and intrinsic motivations for conservation.	0	1	-1	1	1
S34	Opening	The application of ecosystem services has evolved a lot but the concept at its heart is still the same.	-2	0	1	1	0
S39	Opening	It is sensible to consider ecosystem services as a core and an essential piece to the bigger sustainability problem solving but it’s by no means the full piece.	-2	3	0	2	0
S2	Opening	To achieve a unifying ecosystem services framework there is a need to make implicit norms more explicit as well as thinking beyond existing paradigms.	-1	0	-1	1	-2
S9	Opening	Successful inter- and transdisciplinary research requires an explicit reflection on shared concepts.	0	0	0	0	-1
S32	Opening	To effectively use the ecosystem services concept in decision-making will require a clear understanding of the concept (definition and characteristics).	1	0	0	-1	1
S38	Opening	Different contexts and purposes entail different needs for the definition of ecosystem services.	1	3	-3	-2	1

b) Factor arrays

The factor array represents an ideal Q sort that best represents a factor based on the factor scores for each statement. The scores for each statement are first displayed in a list (frame) for each factor and then brought into the order of highest factor score to lowest (sorted). Based on the results here, figure 11-15 in section 4.2.1 in the body text have been created.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Rank	Statement	Statement	Statement	Statement	Statement
1	3	30	4	1	26
2	12	39	8	27	23
3	1	14	7	3	10
4	8	38	21	35	30
5	30	17	11	33	28
6	15	27	23	11	31
7	13	35	15	24	20
8	7	15	14	39	24
9	29	16	10	12	27
10	37	36	35	2	15
11	9	33	24	36	32
12	20	5	30	26	3
13	32	7	34	14	36
14	33	18	3	13	38
15	24	25	9	7	11
16	38	31	5	34	14
17	31	9	19	9	39
18	6	2	17	4	34
19	16	32	32	37	7
20	23	8	20	5	33
21	4	34	18	8	17
22	36	4	29	28	8
23	18	6	39	19	21
24	22	1	2	22	35
25	21	28	36	23	22
26	14	21	27	29	9
27	2	29	26	17	29
28	17	11	1	21	37
29	10	13	6	32	12
30	25	26	33	30	16
31	39	12	22	31	13
32	34	22	16	16	25
33	35	37	28	6	2
34	11	20	37	38	18
35	27	23	13	20	1
36	26	10	25	15	4
37	28	3	31	25	19
38	5	24	38	10	5
39	19	19	12	18	6

Step 5: Comparing factors

By listing all statements and their rankings across factors in excel, the sum as well the difference between rankings could be assessed and compared. That way compromise statements (highest difference), consensus statements (lowest difference) and those that evoked the strongest reaction (highest positive or negative sum) could be identified. The entire table is displayed below, identified statements are marked in the following color coding:

- Lowest difference (1) = Consensus Statements
- Highest difference (7) = Compromise Statements
- Highest (positive/negative) sum > |7| = Strongest opinions

	Statement	F1	F2	F3	F4	F5	Sum	Diff
S1	The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of dependencies of human well-being on natural systems.	3	-1	-1	4	-2	3	6
S2	To achieve a unifying ecosystem services framework there is a need to make implicit norms more explicit as well as thinking beyond existing paradigms.	-1	0	-1	1	-2	-3	3
S3	Maintaining stocks of natural capital allows the sustained provision of future flows of ecosystem services and thereby helps to ensure enduring human well-being.	4	-3	1	3	1	6	7
S4	Ultimately the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns including considerations of the intrinsic values of species.	0	0	4	0	-3	1	7
S5	The concept of ecosystem services fits in the nexus of anthropocentrism, utilitarianism, and notions of nature as separate from humans.	-3	1	1	0	-3	-4	4
S6	As the number of scientific disciplines that refer to the concept of ecosystem services grows the concept is becoming multiform and harder to grasp.	0	0	-1	-2	-4	-7	4
S7	A prerequisite to successful stewardship of nature is knowing the basic features of the system being managed.	2	1	3	1	0	7	3
S8	Decision-making frameworks must ensure the protection of humanity's most fundamental source of well-being: earth's life-support system.	3	0	3	0	0	6	3
S9	Successful inter- and transdisciplinary research requires an explicit reflection on shared concepts.	0	0	0	0	-1	-1	1
S10	It is at the policy frontiers that lie the brightest prospects for converting the world's society to sustainable resource management regimes.	-1	-3	2	-3	3	-2	6

S11	Ecosystem services are used as tool to make environmental externalities explicit and to internalize the value of such externalities in market transactions and decision making processes.	-2	-1	2	2	1	2	4
S12	The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation.	3	-2	-4	2	-1	-2	7
S13	The concept of ecosystem services is a strategy to get the conservation idea across in societal discourses by appealing to peoples' own interest.	2	-1	-2	1	-2	-2	4
S14	Valuation is a way of organizing information to help guide decisions but is not a solution or end in itself. It is one tool in the much larger politics of decision-making.	-1	3	2	1	1	6	4
S15	There is no simple fix to the problems of environmental degradation since they arise from the interaction of many recognized challenges each of which is complex to address in its own right.	2	2	2	-3	1	4	5
S16	It is impossible to classify ecosystem services into entirely distinct independent conditions and processes. It thus follows that the number of services contributing to a given source of human benefits is necessarily arbitrarily specified.	0	2	-2	-2	-1	-3	4
S17	The concept of ecosystem services inevitably involves judgments about human actions with respect to nature and about what we value in nature. Ecosystem services is thus a value-laden (i.e. normative) concept.	-1	2	0	-1	0	0	3
S18	A utilitarian framing of landscape engagement as done with the concept of ecosystem services could crowd out more affective moralistic intrinsic or social motivations and thus impede broader and longer landscape commitment.	0	1	0	-4	-2	-5	5
S19	Nature can be seen as separate from humans and human activities as external disturbances to natural functions.	-4	-4	0	0	-3	-11	4
S20	The academic community now has an unprecedented opportunity to lead in the development of fundamental and applied research of policy instruments and of regional and global institutions oriented toward sustainable Earth management.	1	-2	0	-2	2	-1	4
S21	The Common International Classification of Ecosystem Services (CICES) provides a good framework to enable the translation between different classifications and the linking of different sources of information about economy and environment.	-1	-1	3	-1	0	0	3
S22	Researchers started talking about ecosystem goods and services to use a language that is familiar to people.	-1	-2	-2	-1	-1	-7	1
S23	The failure to incorporate the values of ecosystem services and biodiversity into economic decision-making has resulted in the perpetuation of investments and activities that degrade natural capital.	0	-2	2	-1	3	2	5
S24	The goal is a new economy: one in which the values of natural capital and the ecosystem services which this capital supplies are fully reflected in the mainstream of public and private decision-making.	1	-3	1	2	2	3	5

S25	The spreading of the concept of ecosystem services has in practice set the stage for the perception of ecosystem functions as exchange values that could be subject to monetization and sale.	-1	1	-3	-3	-2	-8	4
S26	Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels.	-3	-1	-1	1	4	0	7
S27	The issue of valuation is inseparable from the choices and decisions we have to make about ecological systems. We can choose to make these valuations explicit or not. But as long as we are forced to make choices we are going through the process of valuation.	-2	2	-1	3	2	4	4
S28	The emphasis currently placed on the economic valuation of ecosystem services is perhaps inevitable given the financial terminology used to express the idea that people benefit from nature.	-3	-1	-2	0	2	-4	5
S29	The Millennium Ecosystem Assessment provides a good framework to define and classify ecosystem services.	2	-1	0	-1	-1	-1	3
S30	People are integral parts of ecosystems and a dynamic interaction exists between them and other parts of ecosystems.	2	4	1	-1	3	9	5
S31	Choosing terms that evoke positive associations such as “services”, “goods”, and “benefits” shows the optimistic intention as well as the research interest of scientists working with the ecosystem services concept.	0	0	-3	-2	2	-3	5
S32	To effectively use the ecosystem services concept in decision-making will require a clear understanding of the concept (definition and characteristics).	1	0	0	-1	1	1	2
S33	The position of ecosystem services at the science–society interface provides it with the capacity to promote dialogue between academic disciplines and to improve communication between interest groups.	1	1	-1	2	0	3	3
S34	The application of ecosystem services has evolved a lot but the concept at its heart is still the same.	-2	0	1	1	0	0	3
S35	In principle monetary valuation needs not exclude other value dimensions in that it may be complemented with alternative valuation languages and real processes of deliberation in ecosystem services valuation.	-2	2	1	3	-1	3	5
S36	The broader ecosystem services framework provides the potential to include cultural and intrinsic motivations for conservation.	0	1	-1	1	1	2	2
S37	The record shows that conservation cannot succeed by charity alone. It has a fighting chance however with well-designed appeals to self-interest.	1	-2	-2	0	-1	-4	3
S38	Different contexts and purposes entail different needs for the definition of ecosystem services.	1	3	-3	-2	1	0	6
S39	It is sensible to consider ecosystem services as a core and an essential piece to the bigger sustainability problem solving but it’s by no means the full piece.	-2	3	0	2	0	3	5

Appendix H: Follow-up interviews

Follow-up interviews were conducted with those people that loaded highest onto each of the factors and thus were assumed to represent the associated perspective most strongly. The objective was to get feedback on the exercise, to clarify rationales behind perspectives, and to assess peoples' view on a diversity of perspectives with regards to the concept. The interviews were semi-structured and questions asked varied slightly depending on the perspectives that people represented but generally followed the interview guide outlined below. Since the main points of contestation were found to be the utilitarian character of the concept, the economic connotation and the notion of natural capital, those three points were specifically assessed in each of the interviews.

No.	Category	Question (e.g.)
1.	Reflection on exercise	What were your thoughts when conducting the sorting exercise?
		To what extent did the exercise make you reflect on the ES concept?
		What were your thoughts about the statements?
2.	Perspective on the concept	In your view, what is the main purpose of the ES concept?
		Does the concept imply a utilitarian framing of nature?
		Does the concept have an economic connotation?
		What is the relationship between the ES and the natural capital concept?
3.	Use of concept in the research community (OPERAs)	Is there a common understanding of ES in OPERAs? Are there differences? What are these differences?
		Is diversity in perspectives a problem? If yes how?
		How should diversity in perspectives be handled? (within OPERAs)?

Appendix I: Criticisms on Q methodology

The main point of criticism on Q methodology centers on the subjectivity of the researcher that enters the research process throughout including especially (i) the selection statements, (ii) the design of the Q-sort exercise, and (iii) the interpretation of factors. A fourth point of criticism that is less related to subjectivity refers to the (iv) the mode of conducting the study.

(i) Selection of statements

With regards to the somewhat arbitrary selection of statements by the researcher, Brown (1986) acknowledges that the final design of the set of statements “remains more an art than a science” (p. 186). However, arbitrariness can be reduced through the deduction of categories, by which to select statements as done in my case through the literature review and the expert interviews.

(ii) Design of Q-sort exercise

The choice of the scale on which to sort the statements as well as the exact form of the normal distribution curve will always have advantages and disadvantages (Brown, 1991). Participants in my case experienced it as difficult to decide for one statement on either side of the continuum and some would have wished for a flatter distribution curve, allowing for more statements on the extremes. While running the risk to ask too much of participants with this kind of design, forcing clearer sorts this way can lead to more clear-cut results (Webler et al., 2009).

(iii) Interpretation of factors

In the interpretation of factors subjectivity plays a major role and people with different views will interpret results in different ways (Kampen & Tamás, 2013). Nevertheless, being aware of this, explicitly allowing completely unexpected results to play a role in the interpretations and finally presenting results in a transparent way were all aspects that I tried to pursue at all times in order to turn arbitrariness into subjective but valid research.

(iv) Mode of conducting the study

The disadvantage of conducting the sorting via internet is that the researcher does not get to hear peoples' reflections while doing the sort (Webler et al., 2009; Kampen & Tamás, 2013). The comments that were asked for and the follow-up interviews helped to reduce this limitation to a minimum.