# The tension between nature conservation and economic valuation of ecosystem services

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# Chapter 1

# General introduction

## 1. Overview

The general topic of this thesis is how a strong focus on nature conservation can be maintained in a situation where economic valuation of nature has become a dominant but troubled approach. This valuation approach rests on earlier introduced paradigm of ecosystem services, where nature provides services to society. The ecosystem services idea by now has been integrated and taken up both by nature conservationists and various governmental and non-governmental organizations for various reasons, with either good or bad prospects for nature conservation (Schröter *et al.* 2014). One consequence is that the values and methods underlying nature conservation have shifted (Jax *et al.* 2013), and so has the way in which the virtues of nature conservation are communicated in science and policy (Mace 2014). Just like the introduction of the idea of biodiversity, the ecosystem services and economic valuation of nature approach has created both opportunities and challenges for nature conservation. This thesis puts a focus on some of those challenges where the goals of nature conservation themselves are in danger of being lost, and provides a contribution towards solving these issues.

### 1.1 Nature conservation's struggle

Conservation biology is a science with a clear mission-driven aspect, which is nature conservation. The mission of nature conservation could be seen as having two parts: protecting nature and, lately, building capacity and policy voice (Meine *et al.* 2006). But the means of accomplishing these things are far from clear. How nature conservation is perceived and how it should be accomplished changes through time. The entire activity of nature conservation is a subject that is constantly evaluated on its means, its goals and effectiveness (Sodhi & Ehrlich 2010). Conservation biology came into being out of a social desire to conserve nature, and it is still this social desire and the peculiarities of this social desire that shape the scientific inquiries. What is crucial about this fact is that the goals of nature conservation are formed by the way we see the relationship between humans and nature (Flint *et al.* 2013). And this vision of a relationship between humans and nature influences how we protect it, and how we try to convince others to assist in this.

Ecosystem services is the current popular approach to express this relationship between humans and nature. Ecosystem services did not arise from nothing, but is a result of long-term trends and phases in the framing of nature conservation. Mace (2014) identified two phases of framing preceding ecosystem services, with ecosystem services being part of a third phase. Before and during the 1960s, nature conservation focused on protected areas, intact natural habitats and wilderness. Species conservation was a strong focus as well as the management of areas (Meine *et al.* 2006). In the 1970s and 1980s, the impact of humanity increased dramatically, leading to greater awareness of the consequences of habitat destruction. The focus of nature conservation shifted to a second phase (*cf.* Mace 2014), a development of protection of nature against the destructiveness of people. This lead to new concepts in nature conservation such as minimum viable population and sustainable harvesting. During the 1990s, it became clear that human pressure on nature was present everywhere and unceasing, and nature conservation adjusted to this by focusing more on ecosystems instead of species, and positioning nature conservation within the economic domain.

Ecosystem services arose to prominence within this third phase of nature conservation. The sequence of phases does not mean, however, that earlier framing of nature conservation disappeared, or was supplanted by new framing. All three discourses on nature conservation exist alongside each other and cause disagreement about ecosystem management practices (see for example Soule (2013) and Kaveira (2014)). Especially the ecosystem services frame causes friction with earlier frames because it involves human well-being as a measure of conservation success, while the frame of protection of nature against people sees humanity increasing its wellbeing as a threat to conservation.

**1.2 How ecosystem services got popular**

The concept of ecosystem services has gained global attention in recent years in the world of nature conservation and sustainable development. The concept existed for a longer time already, but a number of widely-read scientific publications and international initiatives grabbed hold of it to explore its implications, which catapulted ecosystem services into ubiquitous use. Well-known are the publications by Robert Costanza (Constanza *et al.* 1997) who published a calculation of the economic value of ecosystem services worldwide. Ecosystem services were further codified in classes and explored for various regions around the world in the Millennium Ecosystem Assessment (MEA 2005), which made the concept more accessible and relevant for policy makers on national and international levels.

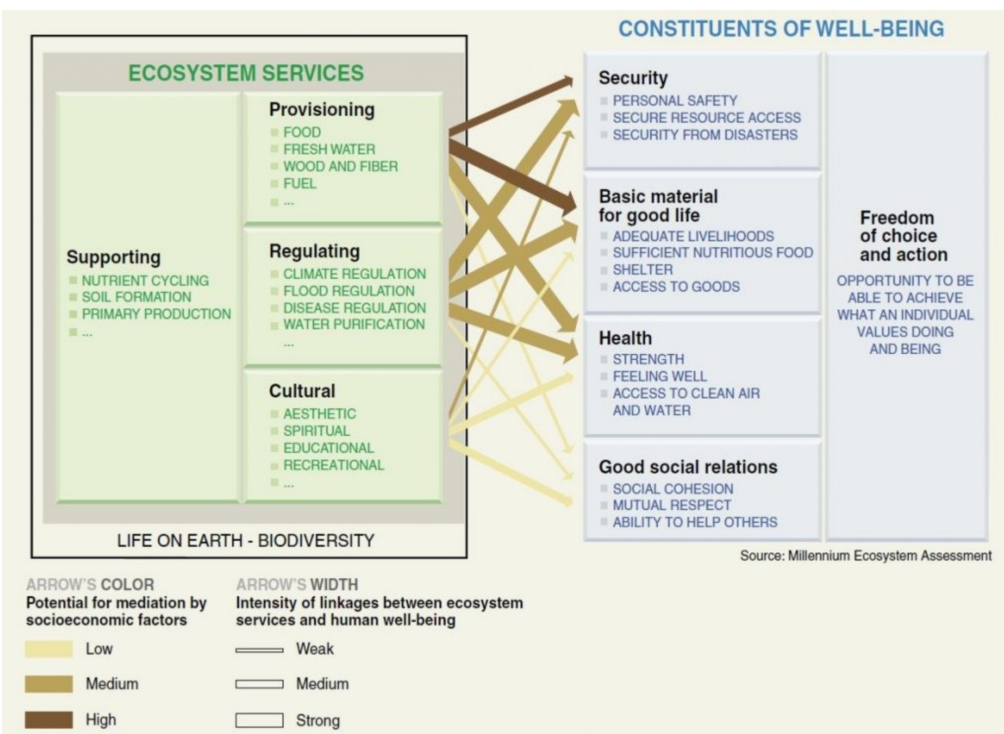

**Figure 1**: Ecosystem services explained for policy makers. Source: MEA (2005).

To understand why ecosystem services gained popular usage, it is important to clarify that it is useful for different people for different reasons. Many nature conservationists viewed the ecosystem services concept and the additional step of monetization of services as a promising development in the battle to prevent biodiversity degradation (Daily 2000). After decades of stressing the wonders of nature and showing doomsday messages of acid rain destroying the forests, nature conservation had enchanted some and depressed others, but the degradation of biodiversity had not halted and new strategies were needed to motivate nature conservation against an economic system that encroached upon natural habitats and transformed those habitats to agricultural land and economic capital. The MEA clarified that ecological theory with which conservationists were already familiar, such as theory about ecosystem functions, communities and nutrient cycles, also hinted at human benefits (Fig. 1), and this supplied ready arguments for nature conservation (Armsworth *et al.* 2007), which could be translated to management objectives (Daily 2000; Daily 2009).

In step with these developments came the idea to use this framework to start to clarify what the impact is of ecosystems on the economic systems of people (Common & Perrings 1992). From the perspective of economics, the concept of services flowing out from stocks inside the ecosystems was very useful, because it allowed economists to incorporate the effects of environmental damages and benefits from nature into an updated view of human welfare (Bockstael *et al.* 2000; Jax *et al.* 2013). A new 'green' GDP (Boyd 2007) that could now be calculated would be a closer approximation of the economic health of a state. Ecosystem services translated nature into a vision of natural capital, and environmental economists proposed that if natural capital entered market systems, people would gain a sense of scarcity about natural resources, and the market would regulate its maintenance (Dziegielewska 2009; Bateman *et al.* 2010). With this idea, nature conservationists too were handed a new strategy to involve the worlds of politics and business in nature conservation, for money would give nature a voice in decision making, and they would show that an economic system that consumed ecosystems was actually damaging itself (Norgaard 2010).

In addition, financial mechanisms and policy instruments could be devised that would help nature conservation on the ground (Pirard 2012). The perspectives of this vision of economic valuation of ecosystem services in service to nature conservation and sustainable development were set down in the reports of The Economic of Ecosystems and Biodiversity (TEEB 2013), which, just as the MEA aimed to, made the concept more accessible and relevant for policy makers.

However, precisely because ecosystem services and economic valuation speak to those involved in business and politics, it is important to remember that these concepts are useful for people for different reasons. Nature conservation is only one of those reasons and may not always be present as a motivating factor while talking about ecosystem services. The concept arose to speak to the concerns of economists, business leaders and politicians, to create so called policy relevant conservation science (Rose 2014). They may be concerned with wealth creation for humans and distribution of wealth to humans on limited scales of time and space. Ecosystem services and economic valuation offers a vision of nature that aligns itself with these concerns.

Studying these developments is important because of two main reasons that together create a sense of urgency to explore matters further: (I) an enthusiastic and ongoing adoption of the concepts by organizations, and (II) an increasingly passionate concern about the consequences and implications.

**1.3 The institutionalization of ecosystem services**

The use of ecosystem services is being increasingly institutionalized in policy declarations, conservation goals and practical applications. National governments, for example, integrate ecosystem services into their goals in environmental policy and development. China (Bennett 2008), Mexico (Muñoz-Piña *et al.* 2008), Costa Rica (Pagiola 2008) and many other developing and developed countries have financial schemes to pay landholders to manage and maintain the provision of ecosystem services, such as pharmaceutical compounds or hydrological services. Also in Europe, national visions about nature conservation and environmental policy are expressed through ecosystem services and natural capital. Some examples are the UK State of Natural Capital Report (NCC 2013) and the Dutch Natural Capital Report (PBL 2016). The green GDP or other forms of green national accounting use ecosystem services, and so do international initiatives in policymaking, such as REDD, Reducing Emissions from Deforestation and Degradation (Corbera 2012).

Various non-governmental conservation agencies also shifted their focus towards ecosystem services. The Nature Conservancy, the World Wildlife Fund, IUCN and Conservation International use the idea of ecosystem services to explain their goals. The Nature Conservancy and the World Wildlife Fund are involved around the world in projects that use financial instruments in which the maintenance of ecosystem services is set as a goal (Kazakova *et al.* 2007; The Nature Conservancy 2014). Not only nature conservation organizations but other influential transnational organizations such as the United Nations Environment Programme (UNEP 2008) and the World Bank's Wealth Accounting and the Valuation of Ecosystem Services partnership (WAVES 2015) take ecosystem services and economic valuation of natural capital as a starting point.

Both governmental and non-governmental organizations support the setup of so-called payment-for-ecosystems-services (PES) schemes (Wunder *et al.* 2008). These are practical on-ground applications in which a market for certain services is set up within predefined boundaries of space and participants. As the Millennium Ecosystem Assessment already clarified, ecosystem services come in a couple of categories, and only a few already have market values, such as timber. Values of other services can be elicited, and depend on the particular consumers, particular providers and particular services in demand. PES schemes are a way to actualize a market that did not arise on its own for such services, for a selection of stakeholders (Vatn 2010). Although these local characteristics of society and nature make PES schemes hard to export or duplicate (Norgaard 2010), and prices for ecosystem services hard to generalize, the flowering of a great number of PES schemes worldwide further underlines the popularity as a concept. The development can be seen as a great practical experiment to explore the promises of economic valuation of ecosystem services, with so far inconclusive results (Bartkowski *et al.* 2015; Silvertown 2015).

From the breadth of organizations – from governmental to non-governmental organizations, either involved with nature conservation, environmental policy or development – it becomes clear that the applicability and flexibility of ecosystem services is broad, and that the potential use of the concept partly depends on the institutional context of the organization. It is no wonder that each organization gives a slightly different definition of the idea, sometimes stressing the conservation aspects, other times the quantifiable services. It is clear by now, and was always the strength behind it, that the myriad advantages of ecosystem services go beyond the communication of nature conservation. It can be a decision-making tool for policy guidance and planning in the form of cost-benefit analyses, damage assessments, the identification of stakeholders and even holding people liable for environmental damages.


**Figure 2**: Ecosystem services apparently addresses everyone's problems. Source: US EPA (2015).

**1.4 Implications for nature conservation**

What also becomes clear by now is that using the concept of ecosystem services is relatively vague in its intentions. 'Nature conservation' as a concept is much clearer in its intended goals and direction of action, whereas the intention behind supporting ecosystem services depends on the context in which it is used. In the vaguest sense, it can be a buzzword to mean that we take into account nature conservation, human happiness and economic development in one package, and hence everyone has had their concerns listened to (Fig. 2). However, once maintaining ecosystem services starts to substitute notions of nature conservation, all sorts of problems start to emerge for nature conservation (Redford & Adams 2009; Norgaard 2010; Adams 2014).

From the perspective of nature conservation, the main problem that the ecosystem services frame of mind poses is that the justification of nature conservation changes to a strongly anthropocentric outlook (Jax *et al.* 2013). The more classical strategies of identifying rare species and biodiversity hotspots for conservation find their basis in ecological science and a stated goal of preserving a diversity of genes, species and ecosystems. In a world of limited funding and a scramble for surface area, nature conservation is necessarily selective, and the selection of nature to be protected needs justification. The argument of protecting diversity is rather loose and entangles researchers into a debate in which diversity is either protected for ecological stability, or stability is protected for diversity, but at the basis are a number of moral judgments about humanity as an instigator of extinctions and biodiversity as a source of wonder, function and even its own moral agency (Kals *et al.* 1999; Lockwood 1999; Nisbet *et al.* 2009; Gosling & Williams 2010). What ecosystem services does is specifically naming the function and use of nature for humans as the justification for conservation (Jax *et al.* 2013). This makes it considerably more difficult to justify the protection of rare species, and diversity itself.

Building on the anthropocentric view of nature as a service, the relationship between humanity and nature is reframed to that of a consumer and (an uncontrolled) producer (Nyborg 2000), while other forms of relationships such as stewardship of nature or participant in nature are discarded, alongside with what those words entail. Guilt about the extinction of a rare species will have little meaning if that species did not have a producer role for a service. The follow-up step of economic valuation of ecosystem services further narrows the justification of nature conservation, and rare species hardly ever carry the greatest monetary values. The shift of nature conservation to ecosystem services and then economic valuation thus caused first a blurring of the end goal of protection, and then a refocusing on anthropocentric use (McCauley 2006). If environmental policy then aims at safeguarding the production of ecosystem services, and economic ways of thinking lead to an optimization of that production, nature conservation itself has been removed as a central concern and may even be in direct conflict with maintaining ecosystem services and may be in competition for space and resources.

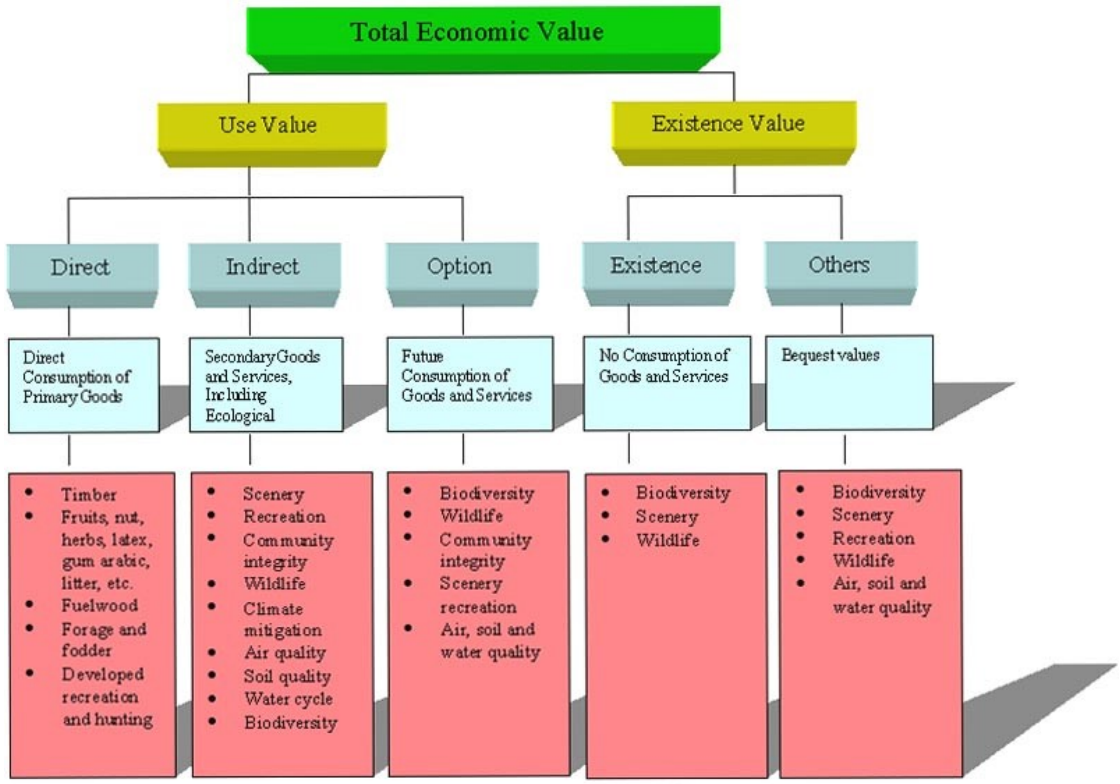


**Figure 3**: The ecosystem as a producer of economic value. The scheme shows the total economic value of a forest. Source: FAO (Cistulli 2002).

In reaction to this distressing vision, a large number of critiques appeared in scientific literature about ecosystem services and economic valuation (Schröter *et al.* 2014). Not only the practical implications for nature conservation were discussed (Redford & Adams 2009; Nunes & Van den Bergh 2001; Fisher *et al.* 2008; Turner 2010), but ethicists, economists and philosophers discussed the ethical implications on which nature conservation rests (Luck *et al.* 2012; Jax *et al.* 2013), mainly in relation to the application of economic valuation (Knights *et al.* 2014). It is argued that human-nature relationships cannot be adequately expressed through economic valuation (O'Neill & Holland 1999), nor through the metaphor of consumer-producer (Nyborg 2000). A commodification of nature would see ecosystems and individual species as exchangeable with other commodities and land uses, which devalues nature, may create fragmentation of landscapes, and disregards certain values that humans attribute to nature (Hannis & Sullivan 2012; Gomez-Baggethun & Muradian 2015).

In a counter reaction against the critiques, some scientific literature is shockingly confident about the promise of economic valuation. 'The challenge then is to provoke society to acknowledge the value of ecosystem services. Ecosystem services valuation (ESV) is the tool that can tackle such a challenge.', Liu *et al.* (2010), while simultaneously being dismissive of the critiques: 'Much of the debate about the use of ESV has to do with not appreciating [its] range of purposes'. Proponents of the ecosystem services idea attempted to include more values into the ecosystem services framework, in the form of spiritual values, bequest values, existence values and others (Fig. 3) (Nijkamp *et al.* 2008), mainly under the umbrella of cultural ecosystem services, but economists have found it increasingly difficult to elicit monetary values for these services (Gould *et al.* 2015). Furthermore, the framework itself implies that in cost-benefit analyses, services are measurable by the same standard of money, meaning that the monetary values of provisioning services such as timber and freshwater may add to or compete against the monetary values of spiritual or existence services. So-called protest bids in value elicitation efforts show that people may react negatively to the entire notion (Burgess *et al.* 1995; Irwin 2001).

An institutionalization of ecosystem services and economic valuation may have greater sociocultural impacts as well. There is accumulating evidence that an imposition of monetary rewards as an incentive to get people motivated to act has limits and undesirable consequences (Rode et al, 2015). An external motivation such as a payment seems to cause internal motivations to disappear. This phenomenon is known as crowding out, and the worrying aspect is that once the monetary reward stops, the internal motivation does not seem to return. In effect, paying for ecosystem services seems to change people's mind about the value of acting for nature in such a way that it is branded forevermore as a service to be paid for in the minds of the providers or conservationists. For the goal of nature conservation, this creates a dependency on payments that brands nature useless once the flow of money stops. Coffey (2016) argues in addition that the very metaphors of ecosystem services and economic valuation narrow down the language with which to talk about environmental policy, which limits understanding and has political consequences.

Other problems that were already associated with the current economic systems now also rear their heads in the field of nature conservation, such as an unequitable distribution of goods and benefits amongst people (Farley *et al.* 2015). There is also a danger that economic valuation and commodification of nature will further disenfranchise the poor and empower the rich, and it doesn't change the institutional context enough to solve the environmental problems (Norgaard 2010). In the context of sustainable development, intergenerational equity also seems under threat once discount rates lower nature's value for future generations (Hare 2007).

### 1.5 Confusion and urgency

The critiques leveled at both ecosystems services and economic valuation are hardly represented by one unified voice or one point of view. Some authors see the two concepts as separate issues, while others see economic valuation as a natural continuation from a frame of mind that ecosystem services introduced (Gomez-Baggethun & Ruiz-Perez 2011; Silvertown 2015). The concerns also point towards various subtopics that are associated with both concepts. Some authors focus specifically at the precise limits of valuation techniques used to elicit economic values. Others list the technical problems associated with using rather arbitrary units for looking at ecosystems and services, such as using political boundaries. Again, others criticize the larger financial mechanisms such as biodiversity offsetting, or question whether ecosystems services and economic valuation should be incorporated into new ethical frameworks, or should even done away with entirely.

From the point of view of a policy maker, the criticism descends into a layered complexity, in which it is unknown how to deal properly with these concerns. Does the road to sustainable development lie in simply addressing some micro-issues about valuation methods (Christie *et al.* 2006), or should there be no valuation of services even as a decision-making tool in a toolbox, or should the problems be addressed at larger scales? And who exactly is being addressed in the critiques? The scattering of criticism across different scales creates confusion and hampers society in effectively taking them up (Schröter *et al.* 2014; Melathopoulos & Stoner 2015), while an enthusiastic application of the concepts is ongoing.

One way forward to dispel confusion and break through the apparent deadlock in the debate around the topic is to channel these critiques into practical adjustments of the way ecosystem services and economic valuation are implemented now. This PhD thesis works towards that aim in ways that are clarified in the next sections.

### 1.6 Objectives & outline of the thesis

The thesis can best be described as focusing on a single topic from different angles. Economic valuation of nature is explored in how it connects to ecological and economic theory, policy communication and human motivation. The different angles, meaning fields of study such as ecological economics, ecology and environmental policy and environmental psychology, together make for an interdisciplinary investigation that carries certain advantages with it. The interdisciplinary setup helps to build up a clearer image of the current use of economic valuation of nature and makes it easier to identify promising recommendations for the future.

The main research question is: what would be an appropriate role for economic valuation of nature in motivating nature conservation?
The sub questions to this research question are:

1. What do practitioners think about economic valuation?
2. How do EU research subsidy documents communicate the importance of biodiversity conservation?
3. How can we combine economic valuation with notions of sustainable use of ecosystems?
4. What are stakeholders' ideas about good indicators for conservation action success by farmers?
5. What are the motivations underlying committed conservation action?

The sequence of chapters follows a logical build-up of research questions. The thesis starts out with an exploration of the current opinions surrounding economic valuation, showing how practitioners in nature conservation consider its usefulness and limitations (chapter 2). Then, to investigate possible consequences of the ecosystem service language, chapter 3 looks at the trends within the language of policy and research subsidies. The two chapters following on this, explore new avenues for combining economic valuation and market approaches with ecological science. It is explored how economic valuation can be updated to take current ecological theories into account (chapter 4) and it is investigated whether ecological indicators can feasibly be used in a market based approach (chapter 5).

The final chapter (chapter 6) explores the motivations involved in successful conservation practices and considers the efficacy of economic valuation of nature as a motivational approach for nature conservation.

**Chapter 1: General introduction**
General introduction regarding ecosystem services and economic valuation of such services, and an outline of the thesis.

**Chapter 2**: **The polarization of opinion surrounding economic valuation of biodiversity**
What do practitioners think about economic valuation? Is there a consensus about its use? This chapter takes all the available information about the virtues and limits of economic valuation of biodiversity and its alternatives and investigates the current ideas about this information among people who are involved in the field and carry out such economic valuation in projects. Chapter two provides an exploratory investigation to identify the most up-to-date views on these issues on the ground, and what scope the results suggest for adapting economic valuation methods or embedding them in ways that take other values into account.

**Chapter 3**: **The loss of biodiversity conservation in EU research programmes**
How does the EU ask scientists to deal with biodiversity? What do they communicate as to its value for conservation? This chapter investigates how the value of biodiversity is communicated within European policy networks, and how this value is communicated via the subsidy mechanisms to European scientists. This provides us with an accurate description of the state-of-play concerning values in higher policy circles and the implications of this state for future biodiversity conservation. The chapter explores the prevalence of ecosystem services, economic valuation and other biodiversity values in European research policy documents.

**Chapter 4**: **More than total economic value: How to combine economic valuation of biodiversity with ecological resilience**
How can we combine economic valuation with ecological knowledge and how do ideas about biodiversity tie into it? This chapter looks into the economic methods that are used to value ecosystem services and to explore whether these methods could be augmented with ecological knowledge. Chapter four explores an avenue of how economic valuation could be embedded into a larger framework that takes sustainability values and environmental risk assessment into account, based on an application of ecological theory.

**Chapter 5**: **A stakeholders' view on indicators of farmers' biodiversity performance**
The fifth chapter investigates practitioners' ideas about fairness in judging success in biodiversity conservation by farmers. Across a range of stakeholders in an agricultural production chain, the same question was posed about how efforts of biodiversity conservation should be judged and whether ecological indicators are acceptable in such a market-based approach to nature conservation.

**Chapter 6**: **Motivations for committed nature conservation action in Europe**

On what kind of motivations were successful conservation efforts built? The people who pushed for those efforts, what were their motivations? In this chapter, the aim was to find people who already are passionate about protecting nature, and ask them what makes them motivated to do their work. By exploring which motivations trigger them to act, and which motivations bar their actions, we gain insight into the role that biodiversity plays in daily life of these people. Nature has certain values in their eyes, and these values are linked to a readiness to act to preserve these values. Chapter six explores how the values of nature are incorporated into people's ideas for meaningful actions. This information informs us of the values that need to be given freedom of expression in biodiversity conservation to trigger motivation.

**Chapter 7: General discussion**

### 1.7 BIOMOT project

This PhD thesis has been deeply connected in practice to the BIOMOT project (BIOMOT: MOTivational strength of ecosystem services and alternative ways to express the value of BIOdiversity). BIOMOT is a European research project, subsidized under FP7 Grant Agreement FP7 282625. Its goal was to investigate the efficacy of the ecosystem services concept in motivating people to protect nature and simultaneously to investigate alternative ways of expressing the value of biodiversity, also in service to the motivation for nature conservation. The project presumed the failing of the ecosystem services concept in getting people to act for nature conservation as a *fait accompli*, and was meant to build on this knowledge by identifying both the causes of this failure and alternative avenues for action.

The data collection for the papers in this thesis were simultaneously part of the work packages of the BIOMOT project. It was obvious from the start that the overarching research questions of BIOMOT would be too all-encompassing for a PhD project to answer. It was decided that the thesis would narrow its focus to investigate specific research questions within the broader topic of motivation for biodiversity. The first work package focused on the economic valuation of ecosystem services and produced a comprehensive overview of the criticism raised against the approach. The thesis contributed to this overview by exploring an avenue to connect economic valuation with current ecological science (chapter 4). Then, using this comprehensive overview, the opinions on economic valuation were explored of experts and practitioners in the field in Europe who played a part in the social debate surrounding it. This exploration, which is also part of the thesis, would clarify areas of consensus and opposition between different views on the matter (chapter 1).

Another work package explored the deeper motivations of people who have already involved themselves successfully with nature conservation, and a better understanding of those motivations allows us to investigate how ecosystem services and economic valuation either provide an avenue for people to follow those motivations, or how they fail to provide this. This thesis carried out an exploratory investigation into the motivations of such people and how they relate to ecosystem services (chapter 6). The BIOMOT project went on to study forms of governance and to look at what makes some projects successful compared to other projects, but on the topic of policy, the thesis confined itself to a study of the use of ecosystem services in subsidy documents of the European Commission (chapter 2).

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# Chapter 2

# The polarization of opinion surrounding economic valuation of biodiversity

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**Abstract**

Economic methods are increasingly used to express the value of ecosystems and biodiversity in monetary terms. The practice of monetary valuation is controversial and has been at the center of a wide ranging debate. In this paper we systematically examine the various different discourses about monetary valuation. We used Q methodology to clarify the discussions by identifying the underlying discourses behind the arguments. In Q methodology, respondents rank statements, and statistical analysis is used to ascertain which groups of statements cluster as discourses. In this study, we selected participants among economists and other relevant figures in the debate about the economic valuation of nature from seven EU Countries. The analysis showed four discourses: enthusiasm for economic valuation, value pluralism, social justice concerns and eco-deliberation. These results matter to policy making: by identifying the different discourses our results can improve environmental decision making by providing information that can help ensure all potential values of biodiversity are given a voice, and thus that the decision making process is procedurally just.

**Keywords**

Economic valuation; biodiversity; ecosystems; ecosystem services; Q methodology; total economic value

## 1. Introduction

Economic valuation of ecosystems and biodiversity plays an increasingly prominent role in policy making as a means to promote biodiversity conservation (Vatn, 2010; Pirard, 2012). In recent years, environmental accounting and valuation of ecosystem services have been widely institutionalized at an international level, for example in the global initiative TEEB (2013) and the World Bank's WAVES partnership (WAVES, 2015). This institutionalization of economic valuation has occurred in an effort to support biodiversity conservation, but has also provoked criticism and debate about its validity and desirability.

Economic valuation of biodiversity in its most elementary form and function is a support tool in decision making which expresses alternative land uses in monetary values for comparison. Such an assessment is said to determine the Total Economic Value (TEV) of an ecosystem, which is a monetary figure representing the total net value of the change in the flow of ecosystem services to society occasioned by a marginal change to the conditions of that ecosystem (Dziegielewska, 2009; Bateman et al., 2010). Economic valuation of biodiversity can be done by either creating actual markets or by using valuation methods to determine 'shadow' prices for environmental goods that biodiversity produces (Nunes and Van den Bergh, 2001). TEV has advantages as a concept because it answers the need to understand the economic consequences of environmental management and facilitates managers in taking stock of trends and creating an inventory of actors and relationships for stakeholder analyses. In addition, the exercise has value in demonstrating to decision makers and publics how valuable the natural world is (Constanza et al., 1997; Bockstael et al., 2000), and the information about the socio-economic values of ecosystems has helped to develop economic incentives to preserve biodiversity, such as in Payment for Ecosystem Services schemes.

Some have argued that it remains unclear whether using economic valuation of biodiversity will have positive long-term effects on biodiversity conservation (Redford and Adams, 2009; Bartkowski et al., 2015) and there is growing empirical evidence of undesirable consequences such as a crowding out of intrinsic motivation to engage in conservation efforts (Gomez-Baggethun and Ruiz-Perez, 2011; Rode et al, 2015). In this context of uncertainty, a debate about economic valuation of biodiversity has arisen in the past fifteen years and spread out to involve a broad range of research fields, such as environmental and ecological economics (Nijkamp et al., 2008), environmental ethics (Knights et al., 2014), environmental psychology (Fuller et al., 2007) and conservation biology (Fisher and Young, 2007). As each field offers opinions on economic valuation from a specific perspective, the resulting richness of contestable issues surrounding the topic complicates how the method is best put to use in biodiversity conservation and even whether it should be used at all.

Perhaps the most important realization coming out of the debate is that the use of economic valuation of ecosystem services and biodiversity not only hinges on its professed stimulation of environmental protection, but also on the social and ethical consequences of using this approach (McCauley, 2006; Adams, 2014). This makes the debate surrounding economic valuation of biodiversity interdisciplinary, straddling the boundary between science and society. The strongest critiques caution that not only may economic valuation of biodiversity lead to biodiversity loss (Vatn, 2010), but it may also have negative effects on equitable access to livelihood and resources with greater costs and environmental problems falling on the poor (Farley et al., 2015), on sustainable resource use (Common and Perrings, 1992; Admiraal et al., 2013) and may ignore what people value, personally and socially, in ecosystems (Nyborg, 2000; Hare, 2007).

The ethical implications are for example visible in protest bids in economic valuation surveys (Raz, 1986; Burgess et al., 1995; Irwin, 2001), where participants refuse to put even a hypothetical price on natural places. Through these bids, participants express that monetary valuation is a social act with social meanings and associations, and that monetary values are not commensurable with these social values (O'Neill and Holland, 1999). Similarly, the adoption of policies such as biodiversity offsetting – whereby losses on development sites are 'offset' by habitat creation or restoration elsewhere – are hotly debated because they treat ecosystems as being interchangeable (Hannis and Sullivan, 2012), thus ignoring the role of natural, cultural and personal history in the human relationship to nature (O'Neill, 2007). In particular, environmental psychology research has consistently shown that the protection of nature deeply depends on people's values, beliefs, and feelings about the natural environment (Kals et al., 1999; Lockwood, 1999; Mayer and Frantz, 2004; Nisbet et al., 2009; Gosling and Williams, 2010).

Given these critiques, the increased use of economic incentives in recent years to stimulate biodiversity conservation raises the urgency to engage with these criticisms of the valuation approach. Deeper considerations have been published on the best use of economic valuation and its place as a tool in decision making processes (Laurila-Pant et al., 2015). Some authors clarify that economic valuation has specific roles to perform in broader policy making frameworks and that its usefulness is dependent on scale (Costanza et al., 1997) and on particular situations when specific conditions are fulfilled (Fisher et al., 2008; Turner, 2010). Hybrid valuation techniques, such as deliberative monetary valuation and participatory multi-criteria analysis, hold promise for systematic and integrated treatment of utilitarian, ethical and aesthetic considerations (Munda, 2004; Fish et al., 2011). Ethical values such as intrinsic and sustainability values may be expressed in such procedures (Miller, 1992). Frameworks of ecological risk management enable sustainability values to be accommodated alongside monetary valuation (Figge, 2004).

The debate about economic valuation thus exhibits a layered complexity, which impedes society from engaging with the critiques. It is even suggested that the critiques themselves further complicate a social transformation towards a sustainable society (Melathopoulos and Stoner, 2015). Some critiques focus solely on the greater social questions of whether marketization helps or hurts environmental protection and people (O'Neill, 2007). Others focus on the specific methods employed to determine monetary values of ecosystem services and whether those methods are appropriate or should perhaps be adapted (Burgess et al., 1995; Christie et al., 2006). Still others question whether economic valuation answers to the original goal of motivating people to protect biodiversity. There are no clear answers to whether the methods of the approach simply need adjustments, or whether the whole approach is fundamentally helpful or destructive.

Reducing the complexity of the debate will help policy makers in taking criticisms of economic valuation into account. This study seeks to provide insights into the opinions of EU economic experts and practitioners, as well as critics, on economic valuation relative to alternative or complementary valuation methods. We have used Q methodology, a method particularly suited to studying those issues around which there is much debate and contestation. Through this method, we aim to find shared viewpoints, named 'discourses', that transect the layered complexity of economic valuation support and criticism by gathering statements from different perspectives and levels into coherent viewpoints. Following the definition of Dryzek (2005), a discourse can be seen as '*a shared way of apprehending the world. […] Each discourse rests on assumptions, judgements, and contentions that provide the basic terms for analysis, debates, agreements, and disagreements'*. Studying the discourses allows us to map differences and consensus areas in expert opinions, which is a necessary step towards subsequent improvement of economic tools and their appropriate application in environmental decision making.

**2. Methods**

Q methodology has been used before to investigate a diverse range of issues within environmental policy (Barry and Proops, 1999; Addams and Proops, 2000), including forest management (Steelman and Maguire, 1999); global climate change (Lorenzoni et al., 2007); value plurality among conservation professionals (Sandbrook et al., 2011); competing visions among ecologists (Neff, 2011); shifting environmental perspectives among farmers (Davies and Hodge, 2012); if conservation should involve private land (Kamal et al., 2014); and landscape aspirations (Milcu et al., 2014).

In Q methodology, first a set of statements is prepared, then participants sort the statements along a continuum of preference between strong agreement and strong disagreement and the sorting data is subjected to factor analysis. An initial full set of 148 statements (the 'concourse') was collected through a review of the scientific literature, as well as blogs and journalism, to ensure a full coverage of the statements on the topic. For the selection of a final representative set of statements, a matrix was used that arranged the statements into themes (Table 1). The Q set, the final 36 statements that were used for the study, is given as part of Table 3. To further ensure content validity, the statements were reviewed by domain experts and tested in two pilot studies. For considerations of time and clarity for the respondents, the statements were made as concise as possible.

| | Environmental valuation methods and their relations to the causes of and potential solutions to environmental problems | Environmental valuation methods: strengths and weaknesses | Environmental valuation methods and motivation: ethical and motivational concerns, and institutional capacity |
|---|---|---|---|
| **Broadly supportive of economic valuation** | REASONS WHY EV is fine and helps solve environmental problems<br><br>Statements: 4 | REASONS WHY the EV tool as such is a good way to value nature<br><br>Statements: 2 | REASONS WHY EV motivates people to use it<br><br>Statements: 4 |
| | REASONS WHY EV is flawed but could still be a solution with the right changes implemented<br><br>Statements: 4 | REASONS WHY the EV tool as such is flawed but could still be good with the right changes implemented<br><br>Statements: 1 | REASONS WHY alternative methods are not more motivating than EV<br><br>Statements: 2 |
| **Broadly critical of economic valuation** | REASONS WHY EV in general is just making things worse<br><br>Statements: 5 | REASONS WHY EV is in principle NOT a good tool for valuation<br><br>Statements: 4 | REASONS WHY EV does not motivate people<br><br>Statements: 4 |
| | REASONS WHY other decision making processes are better<br><br>Statements: 3 | REASONS WHY certain other tools might be better in a technical sense<br><br>Statements: 2 | REASONS WHY other tools are more motivating for people<br><br>Statements: 1 |

**Table 1: Matrix used to select statements for the Q set.** The number of statements selected for each cell in the matrix is mentioned. The statements are not evenly spread over the matrix, because the arguments in the total concourse on which the Q set is based do not refer evenly to all subjects. The uneven spread is therefore a more precise reflection of the concourse.

Participants were selected from the following four categories to gather the full range of opinions on the subject: (i) environmental, behavioral and ecological economists based in universities; (ii) economists based in organizations, including governmental agencies, other than universities; (iii) representatives from NGOs and other groups critical of the economic valuation of nature; and (iv) any other individuals prominently involved in the economic valuation of nature debate (e.g. policy makers, environmental philosophers, conservation biologists). Based on these selection criteria, collaborating researchers selected and contacted possible participants at a national level in seven EU countries.

In total, 40 respondents from seven EU countries and all four categories participated in the study (Table 2). The respondents received an invitation to participate by email. Once accepted, a link was sent through which the online Qsortware (http://www.qsortouch.com/) software could be accessed. This software displayed the Q set in a randomized order, and respondents were asked to rank each of the statements on a seven-point scale from -3 (strongly disagree) to +3 (strongly agree). The reversed pyramid shape of the Q-sorting grid presents a quasi-normal distribution, and had a predefined shape (Fig. 1) which forced respondents to carefully evaluate and relocate statements.

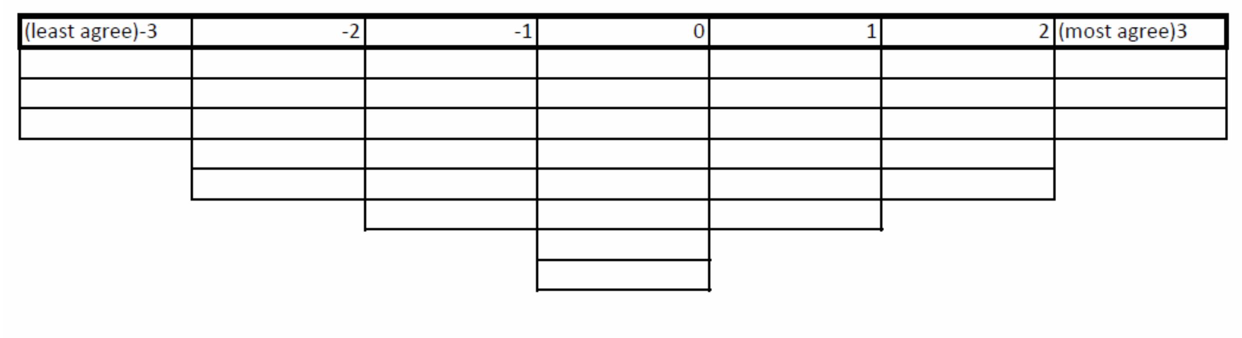


**Figure 1**: the Q-sorting grid for the 36 statements that comprise the Q set. Respondents received the 36 statements in randomized order to place in the grid.

| Respondent | Country of origin | Category | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|---|---|---|---|---|---|---|
| 1 | Belgium | University | 0,0080 | 0,4327 | 0,1385 | 0,6979X |
| 2 | Belgium | University | 0,0857 | 0,2628 | 0,6744X | -0,0333 |
| 3 | Finland | non-univ. | 0,8134X | 0,0497 | -0,0943 | 0,2736 |
| 4 | Finland | non-univ. | 0,1019 | 0,6038X | 0,4600 | 0,1713 |
| 5 | Finland | non-univ. | 0,7413X | 0,3133 | 0,1225 | 0,1754 |
| 6 | Finland | University | 0,6789X | -0,0109 | -0,0927 | 0,1721 |
| 7 | Finland | University | -0,5115 | 0,3787 | 0,5739 | 0,0330 |
| 8 | Finland | University | 0,4416 | 0,1311 | 0,0311 | 0,1977 |
| 9 | Germany | NGO | -0,3249 | 0,5415 | 0,4225 | -0,0932 |
| 10 | Germany | NGO | 0,7399X | -0,1713 | -0,2796 | 0,1559 |
| 11 | Germany | non-univ. | 0,2599 | 0,3780 | 0,0307 | 0,1254 |
| 12 | Germany | other | -0,0690 | 0,6797X | 0,1806 | -0,0126 |
| 13 | Germany | other | -0,3774 | 0,4837 | 0,3872 | 0,0072 |
| 14 | Germany | other | -0,1301 | 0,6591X | 0,2643 | 0,3117 |
| 15 | Germany | other | -0,0686 | 0,8223X | 0,0981 | 0,0913 |
| 16 | Germany | other | -0,2947 | 0,5843 | 0,2548 | -0,1378 |
| 17 | Germany | other | 0,0590 | 0,7843X | -0,0096 | -0,0634 |
| 18 | Germany | University | 0,8824X | 0,1169 | 0,0379 | -0,0019 |
| 19 | Germany | University | 0,7148X | -0,1225 | 0,1619 | 0,2603 |
| 20 | Italia | non-univ. | 0,3093 | -0,1718 | 0,0291 | 0,7720X |
| 21 | Netherlands | NGO | 0,2409 | -0,0054 | -0,0100 | 0,0022 |
| 22 | Netherlands | non-univ. | 0,7651X | 0,1767 | -0,0647 | 0,3278 |
| 23 | Netherlands | other | 0,5469 | 0,1460 | -0,0512 | 0,2609 |
| 24 | Netherlands | University | -0,1518 | 0,0971 | 0,8517X | 0,1045 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 25 | Netherlands | University | 0,3122 | 0,1898 | 0,5655 | 0,4102 |
| 26 | Netherlands | University | 0,7481X | -0,1638 | -0,0420 | 0,0470 |
| 27 | Netherlands | University | 0,8138X | -0,1493 | -0,2127 | -0,0792 |
| 28 | Netherlands | University | 0,0034 | 0,1450 | -0,0916 | 0,0039 |
| 29 | Slovenia | NGO | -0,6365 | 0,3229 | 0,3275 | -0,0264 |
| 30 | Slovenia | NGO | 0,1877 | -0,1228 | 0,0433 | 0,1311 |
| 31 | Slovenia | non-univ. | 0,7889X | -0,1086 | -0,3435 | 0,0988 |
| 32 | Slovenia | University | 0,0622 | 0,0308 | 0,1703 | 0,5267 |
| 33 | UK | NGO | -0,5264 | 0,5142 | 0,3700 | -0,0316 |
| 34 | UK | NGO | -0,2717 | 0,6843X | 0,1137 | -0,0613 |
| 35 | UK | NGO | -0,4512 | 0,3628 | 0,6857X | -0,0011 |
| 36 | UK | non-univ. | 0,7524X | -0,0412 | 0,1943 | -0,3146 |
| 37 | UK | non-univ. | 0,8424X | -0,2448 | -0,0767 | 0,0573 |
| 38 | UK | non-univ. | 0,7733X | -0,2564 | -0,0844 | 0,1722 |
| 39 | UK | non-univ. | 0,8176X | -0,1765 | -0,0387 | -0,1466 |
| 40 | UK | University | 0,8468X | -0,1936 | -0,0097 | -0,0781 |
| % Explained variance | | | 29 | 14 | 9 | 6 |

**Table 2. Matrix of factor loadings.** Sorts flagged with an X indicate defining sorts for the factor.

Q methodology aims to find the main ordered patterns in opinions, commonly referred to as 'discourses'. Discourses are identified via factor analysis. Each respondent's rank-ordered sort of statements is transformed into an array of numerical data according to the seven-point scale, and is then inter-correlated with the arrays of all the others. The correlation matrix is then subjected to factor analysis to obtain correlated groupings of statements. A free software package (PQMethod, 2014) was used for the factor analysis. The resultant factor analysis is then rotated using the varimax rotation in the program to extract factors that explain the most variance in the data.

A benefit of Q methodology is that statistically meaningful results are obtained with relatively low numbers of respondents, regarding the discourses to be found in a debate (Barry and Proops, 1999). The factor analysis focuses on how statements rate against each other, instead of how individuals differ in their sorts. Therefore, each sort of a respondent generates a large amount of information because each statement is implicitly ranked against every other statement by a respondent in a Q sort, meaning that in our setup each placing of a statement in the grid (Fig. 1) implies 35 judgements against the other statements in the set. A second benefit of Q methodology is that the formation of discourses is largely driven by the ideas and responses of the participants and actors in the debate, while the role for the researcher in this formation is relatively small. The original statements derive from the actors in the debate themselves and those statements are then sorted by participants who too are actors in the debate. Consequentially, the discourses identified most closely reflect the debate.

The formation of discourses follows two steps of interpretation in our study. First, factor analysis identifies aggregations of statements from the Q set, which are then interpreted as discourses. Second, to further refine the discourse descriptions while keeping them as respondent-driven as possible, the respondents were asked to explain their choices for the three statements they most agreed with and the three they least agreed with. Each respondent each received a factor loading score for the identified factors, which is a correlation coefficient between the sorting of the respondent and the factor and informs us of how much the sorting of each respondent defines the factor (table 2). Defining sorts are identified by PQMethod using two criteria: (1) the factor loading for that particular factor and that particular respondent must explain at least half of the total variance that is explained by all the factors together for that particular respondent, and (2) the loading must be significant at $p < .05$. The respondents with defining sorts provide us with further information for describing the discourses through their explanations of their sorting results.

## 3. Results

The recommended procedure for analyzing the Q-sort data is to use the eigenvalues of factors to select salient factors (eigenvalue >1). An eigenvalue is a factor's relative contribution to explaining the total variance in the data-set. The procedure generated eight factors with eigenvalues >1. Factors 1 and 2 have high eigenvalues of 13.94 and 7.52 respectively, a consequence of having high percentages of variance that these two factors account for in the data. Using the criterion of cumulative explained variance, factors 1 and 2 were judged highly fit for selection, with factors 3 and 4 inhabiting a boundary area of decreasing importance for explaining variance in the data. It was possible however to make working descriptions of factors 3 and 4 and we provided the descriptions for a fuller treatment of data interpretation. Factors 5 to 8 were left out of the discussion because of low explained variance, which in addition caused many statements to receive the same factor scores with the consequence that no sensible interpretation could be made of them as discourses.

### 3.1 Identified discourses

Describing the factors as discourses allows us to explore the patterns of opinions among experts. The following descriptions of the factors are based on the statements that were scored as significant for the factor. For the four factors, z-scores of the statements are generated that indicate scores of agreement within the factors (Table 3). A z-score is a standardized score, which eases cross-factor comparison. This allows us to compare the relevance of each statement for each factor, despite the fact that the factors differ in the number of defining sorts (Table 2). The basis of our descriptions of the factor is the significance of the scores of the statements for the factor. Significance in this instance is not linked to how high or low the z-score is, but whether the z-score itself is a significant rating for the factor. For factors 1 to 3, respondent comments provide a deeper nuance to the discourse descriptions.

| No | Q set | F1 | F2 | F3 | F4 |
|---|---|---|---|---|---|
| 1 | The economic approach to nature fails to respect that people value the particular irreplaceable history of the places they know. | -1,04 | 1,56** | -0,22 | -0,4 |
| 2 | A better understanding of the total economic value of ecosystem services will lead to more effective biodiversity protection. | 1,2** | -<br>1,53** | -0,61 | 0,23 |
| 3 | The economic approach to nature is dangerous because it assumes that no natural place is valued as unique or irreplaceable. | -1,79 | 0* | -0,82* | -1,77 |

| | | | | | |
|---|---|---|---|---|---|
| 4 | The goals of sustainability and equity are not served by economic valuation methods. | -1,24** | 0,86** | -0,15 | -0,23 |
| 5 | Economic valuations highlight the importance of ecosystems for human well-being. | 1,61** | -0,08 | -1,5 | -0,8 |
| 6 | A weakness of economic valuations of ecosystems is that they do not provide an indication of the ability of the ecosystem to provide services into the future. | -0,89 | -0,59 | -0,08 | 1,77** |
| 7 | If the environment is brought into a market system, environmental harms will fall most severely upon the poor. | -0,78 | -0,3 | 1,5** | -0,8 |
| 8 | A single, monetary measure of value is needed to weigh the value of the environment against other societal goals. | -0,25* | -2,23 | -1,73 | -0,97 |
| 9 | We can still make rational decisions about the environment even without translating all its values to money. | 0,56 | 1,01 | 2,03** | 0 |
| 10 | Environmental problems can be created not by the absence of markets but by the expansion of market institutions into the environmental domain. | -1,41** | -0,35 | 0,84* | -0,12 |
| 11 | Placing an economic value on ‘free’ environmental goods will help justify their protection. | 1,27* | 0,43 | -1,42** | 0,4 |
| 12 | No single unit of measurement, such as money, can capture all the distinct dimensions of environmental values. | 0,81 | 2,13** | 0,46 | 0,86 |
| 13 | Fairer environmental decision making is achieved by open public debate, not economic valuation. | -0,56** | 1,21 | 0,52 | 0,69 |
| 14 | Decision makers should have the conflicting values involved in environmental problems made clear to them, rather than having them reduced to a single monetary figure. | 0,53* | 1,46 | -0,45** | 1,26 |
| 15 | Economic valuation methods have been applied convincingly to many components of biodiversity and ecosystem services. | 0,89 | -0,98 | -0,38 | 0,29 |
| 16 | Introducing economic values for changes to biodiversity and ecosystem services will support better policy decisions about land use. | 1,31 | -0,37 | 0,07 | 1,49 |
| 17 | Economists should include ecological theories in their models so they can better analyze trade-offs between ecosystem sustainability and economic growth. | 1,09 | 0* | 1,72 | 1,09 |
| 18 | Even though there are still gaps in scientific knowledge about ecosystems, we can still build appropriate scenarios upon which to base the economic valuation. | 0,87 | -1,2** | -0,31 | 0,52 |
| 19 | Putting a monetary value on nature demotivates people to protect it because it treats biodiversity as a commodity to be exploited. | -1,34 | 0,47 | 0,76 | -0,69 |
| 20 | Economic valuation of nature is necessary to be realistic and engage in the decision making process. | 0,5* | -1,53 | -1,73 | -0,29* |
| 21 | A major cause of environmental problems is the failure of the market to reflect the scarcity of ecosystem services in prices. | 1,2** | 0,2** | -0,76 | -1,26 |
| 22 | Bringing the environment into the market system will help solve environmental problems. | 0,59* | -1,21 | -1,51 | -0,17* |
| 23 | Since people feel that they have an obligation to hand on ecosystems to future generations, the economic approach fails to understand that to offer money for them is an act of bribery and to accept money for them is an act of | -1,33* | 0,39* | -0,37* | -2,06* |

| | | | | | |
|---|---|---|---|---|---|
| | betrayal. | | | | |
| 24 | Environmental decisions should be guided by debate amongst different interested parties in which each must state their reasons and allow others to challenge them. | -0,11 | 0,61** | -0,37 | 1,66** |
| 25 | Quantifying the financial benefits of ecosystems is key to accessing private funding and generating income for protected areas. | 0,14 | -1,96* | -1,2* | 0,12 |
| 26 | Clarity about the economic benefits of maintaining ecosystem services could increase political support for protection. | 0,89 | 0,08 | -0,53 | 1,09 |
| 27 | Monetary payment for environmental action can undermine people's sense of duty as a citizen and therefore result in poorer environmental outcomes. | -0,75* | 0,11 | -0,14 | 0,57 |
| 28 | Economic valuation that is sophisticated enough to take account of the enormous complexity of ecosystems will be too complicated to be used in practice. | -0,46* | 0,08 | 0,53 | 1,2 |
| 29 | Pricing biodiversity and incorporating that price into the cost of goods and services creates an economic incentive for its protection. | 0,79* | 0,1 | 0,14 | 0 |
| 30 | A decision making process that recognizes the multiple values of nature rather than reducing them to a monetary value can reveal the differences between and the potential consensus among interested parties. | 0,01 | 1,28 | 0,89 | 0,57 |
| 31 | Economic valuation leads to maximizing the current value of an ecosystem at the expense of the future. | -1,3* | -0,62 | 0,83** | -0,4 |
| 32 | Damage to the environment needs to be reflected in the prices of market goods so that people cease to think of it as being 'free'. | 1,05** | 0,05 | -0,01 | -1,09* |
| 33 | A participatory approach can lead to better decisions and more commitment among interested parties than economic valuation because it is more democratic. | -0,49 | 0,67* | 0 | -0,86 |
| 34 | The costing and sale of nature represents another transfer of power to corporations and the very rich. | -1,55 | -0,09** | 1,36* | -1,49 |
| 35 | Ecosystems and biodiversity are valued by people in a different way to ordinary goods they buy in the market, so we should use a different non-monetary language to value them. | -0,66** | 0,91 | 1,43 | 0,97 |
| 36 | Deliberative alternatives to economic valuation can be dominated by those who have the loudest voice. | 0,63 | -0,58* | 1,21 | -1,37* |

**Table 3. Distinguishing statements per factor**. Asterisk (*) indicates significance at P < .05. Double asterisk (**) Indicates Significance at P < .01.

3.1.1 Factor 1: *Enthusiasm for economic valuation of ecosystems and biodiversity*.

The discourse of enthusiasm for economic valuation of ecosystems and biodiversity is the most prominent in the data. It claims that a better understanding of the TEV of ecosystems will justify and lead to more effective protection and highlights the importance of ecosystems for human well-being. Economic valuation is also claimed to be necessary to be realistic and to engage in the decision making process and that a market system will help solve environmental problems. Furthermore, a major cause of environmental problems is the failure of the market to reflect the scarcity of ecosystem services in prices and that damage to the environment needs to be reflected in the prices of market goods. This incorporation of damage into the cost of goods and services creates an economic incentive for environmental protection. However, decision makers should also have the conflicting values involved in environmental problems made clear to them, rather than having them reduced to a single monetary figure.

The discourse also claims that certain critiques do not apply to economic valuation. It is not the case that environmental problems are created by the expansion of market institutions into the environmental domain; nor that to offer money for environmental goods is an act of bribery and to accept money for them is an act of betrayal, and therefore a different non-monetary language to value them is not a necessity; and it claims that monetary valuation neither undermines people's sense of duty as a citizen, nor maximizes the current value of an ecosystem at the expense of the future.

The replies from the respondents whose sorting matched the discourse provide nuance and further insight into the above description based on the Q set statements. These respondents propounded the strengths of economic valuation, arguing that economic valuation has an important role to play and that a good understanding of it would probably lead to better decisions by clarifying the constraints and trade-offs apparent while making it more difficult for strong arguments for nature conservation to be ignored. It also aids in our understanding of the linked reality of the human economy and the natural world. These respondents also defended economic valuation from the criticisms implicit in many of the Q set statements. For example, the criticism that economic valuation does not account for the future sustainability of ecosystems was rebutted, with one respondent noting that economic valuation often happens in projections or scenarios that include concerns of sustainability and future service provision. The motivations of environmental economists were defended from criticism, with the claim that such valuations are performed by economists and policy makers whose motivations do not necessarily include a commodification of nature . Hence, criticisms of valuation that focus on a lack of values and unwanted motivations are unreasonable. Further, these techniques are not claimed to be a panacea and should be supplemented with other assessments. All matching respondents explained that the final monetary figure produced by EV is not necessarily the most important addition to the decision making process; it's rather the thinking, debate and revelations of the values and relationships at stake that the process of producing this monetary figure involves.

3.1.2 Factor 2: *Value pluralism*.

The value pluralism discourse claims that no single unit of measurement, such as money, can capture all the distinct dimensions of environmental values; that economic valuation fails to respect that people value the particular irreplaceable history of the places they know and is dangerous because it assumes that no natural place is valued as unique or irreplaceable; that since people feel that they have an obligation to hand on ecosystems to future generations, to offer money for them is an act of bribery and to accept money for them is an act of betrayal; and that the goals of sustainability and equity are not served by economic valuation methods. In contrast, a participatory decision making approach can lead to better decisions and more commitment among interested parties than economic valuation because it is more democratic. Furthermore, environmental decisions should be guided by debate amongst different interested parties in which each must state their reasons and allow others to challenge them.

The value pluralism discourse claims that it is not the case that quantifying the financial benefits of ecosystems is key to accessing private funding and generating income for protected areas; and neither is it the case that a better understanding of the TEV of ecosystems will lead to more effective biodiversity protection. There are, rather, no appropriate scenarios upon which to base economic valuation.

Respondents agreeing the most with this discourse made further comments on the relationships people have with nature, noting that this relationship is neither a service, nor a commodity, and that monetary expressions are meaningless and inappropriate as descriptions of such relationships. The essence of the value pluralism discourse is summed up in the following comment from one respondent: 'Neither environmental nor social values can be meaningfully translated into money – and often they can't be weighed against each other either. There are many dimensions involved, not just one'. Human-nature relationships also vary in time and space for different human populations, and this variation and uncertainty about future values are not included in monetary valuation. In addition, biodiversity is a public good and should be valued and distributed as such.

3.1.3 Factor 3: S*ocial justice concerns*.

The third most salient discourse is one of social justice. The social justice concerns are mostly focused on the equity aspects related to the economic valuation of nature. This discourse claims that if the environment is brought into a market system, environmental harms will fall most severely upon the poor; the costing and sale of nature represents a transfer of power from poor to rich; environmental problems are created by the expansion of market institutions into the environmental domain; and economic valuation leads to maximizing the current value of an ecosystem at the expense of the future. It also claims that rational decisions about the environment are possible without translating all its values to money.

This discourse claims that placing an economic value on 'free' environmental goods does not necessarily help to justify their protection and that economic valuation is not central to accessing private funding and generating income for protected areas. It follows that this social justice discourse has similarities with the *value pluralism* discourse, but is less engaged with capturing all environmental values. According to this discourse it does not hold, for instance, that the economic approach to nature is dangerous because it may ignore the uniqueness or irreplaceability of natural places.

Respondents most closely agreeing with this score note that economic valuation of the environment is a moral issue, specifically because it involves commodification and enclosure of public goods that is a profit-creating process, which transfers access to and control of those resources socially upwards. In addition, respondents noted that the idea that rational decision making equals economic decision making should be resisted and likewise the supposed commensurability of values in economic valuation.

However, standardized indicators for health and biodiversity performance may help in the decision making process.

3.1.4 Factor 4: *Eco-deliberation*

The fourth discourse is less visible in the data than the ones mentioned above but distinct enough for recognition. The eco-deliberation discourse claims that economic valuation of biodiversity has weaknesses. For instance, economic valuations of ecosystems do not provide an indication of the ability of the ecosystem to provide services into the future. Also, environmental decisions should ideally be guided by debate amongst different interested parties in which each must state their reasons and allow others to challenge them. There is no concern that such debates are dominated by those who have the loudest voice.

The eco-deliberation discourse also claims that it is not the case that economic valuations betray unrecognized values. The approach of payment for ecosystem services is not, according to this discourse, an act of bribery to hand over unique places, or a betrayal of future generations. But that does not mean either that economic valuation is the sole answer to solve environmental problems. Bringing the environment into the market system may not necessarily help to solve environmental problems, and is not necessary to be realistic and to engage in the decision making process.

**3.2 Consensus and conflict between group preferences**

A further exploration of the relative agreements among the discourses about economic valuation allows us to identify areas of consensus and conflict between the discourses. The Q set of 36 statements highlight different themes related to the economic valuation of ecosystems and biodiversity. In selecting the Q set, we created six groups of statements, represented by the rows and columns in Table 1. Statements about environmental valuation methods may refer to their relations to the causes of environmental problems and potential solutions; or to their strengths and weaknesses; or to ethical and motivational concerns, and institutional capacity. The statements are also either broadly supportive or broadly critical of economic valuation with regard to these themes.

Areas of consensus and conflict among the discourses about these themes are shown in Figure 2. The greatest consensus among the discourses can be found on the topic of weaknesses of economic valuation methods — all discourses agree that these exist. The greatest conflict can be found on the topic of causes and solutions of environmental problems, where the *enthusiasm* discourse supports to a far greater extent the notion that economic valuation offers one kind of solution to environmental problems, while the other discourses take a more sceptical position. The *value pluralism* and *social justice concerns* discourses are largely in agreement. The differences between the two can be found in the scores of statements within the themes. The *eco-deliberation* discourse straddles the other discourses as an intermediate that agrees with some statements upheld by the *enthusiasm* discourse while also sharing the concerns of *value pluralism* and *social justice concerns*.

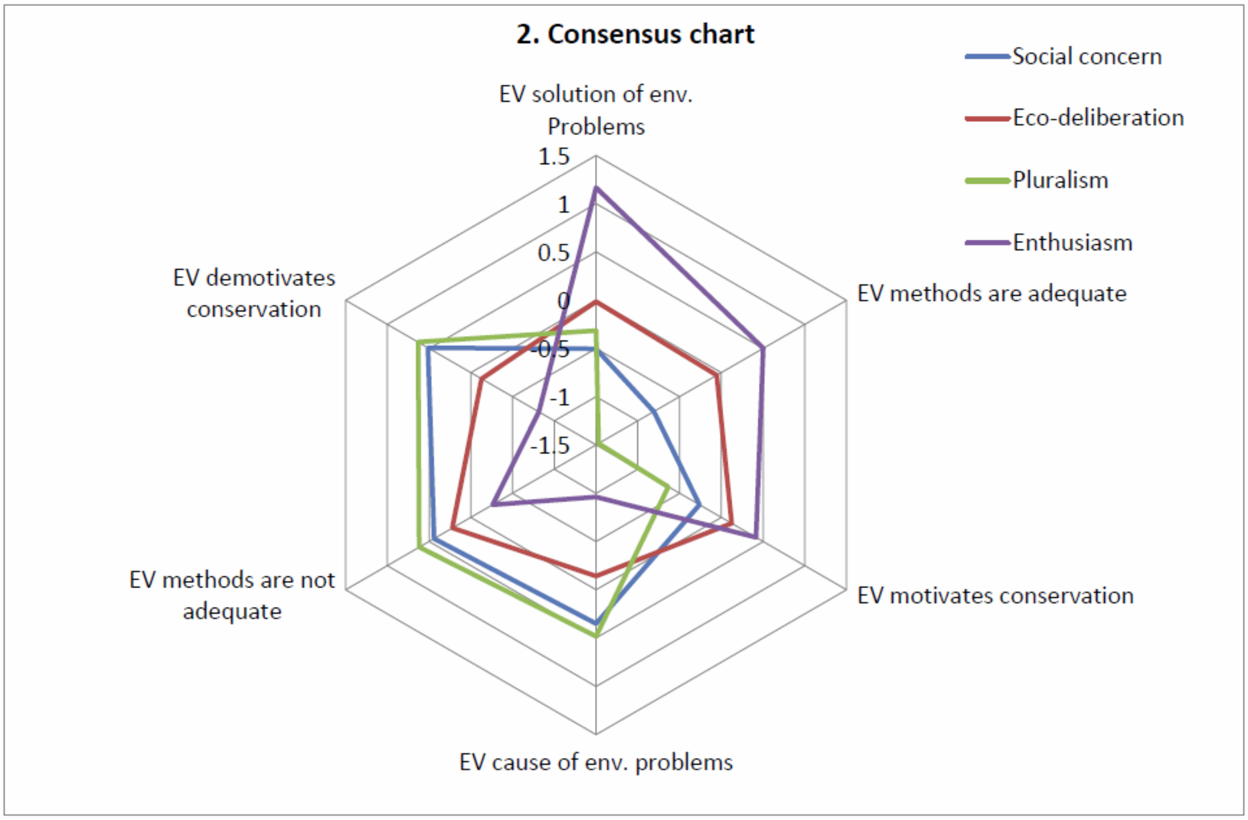


**Figure 2**: Areas of consensus and conflict between the discourses. For six themes in the Q set that form the columns and rows of the matrix in Table 1, the discourses are ranked on their averaged z-scores of the statements that are part of each theme.

**4. Discussion**

This paper has identified the most salient discourses concerning economic valuation of biodiversity and ecosystems. As the discourses show, the same arguments may be marshalled for different collections of ideas. The four discourses can be used to show how individuals or groups align themselves to a certain extent with different sets of ideas and arguments.

The sequence of salience of the four identified discourses illustrates a polarization of opinions. Surprisingly, only one discourse is in clear agreement with economic valuation of ecosystems and biodiversity. The three discourses besides *enthusiasm* express different forms of disagreement with economic valuation. This shows that economic valuation is a salient approach through the *enthusiasm* discourse, but also that disagreements about the virtues of such methods are strongly expressed in the debate and that these disagreements take shape as discourses around different topics. The two discourses that are most salient in the data— the *enthusiasm* and *value pluralism* discourses — have very few points of consensus among the contested issues surrounding the economic valuation of ecosystems and biodiversity (Figure 2). With the *social justice concerns* discourse largely overlapping with *value pluralism* and the *eco-deliberation* discourse weakly expressed in the dataset, a polarization in opinions appears in which *enthusiasm* forms one extreme and *value pluralism* and *social justice concerns* the other extreme. This finding of the polarization of opinion regarding the monetary valuation of nature is in accordance with Stevenson's (2015) finding in her own Q study of international debates about sustainable economic development. Her factor *statist progressivism* contains claims similar to those of our *enthusiasm* discourse, such as although caution should be exercised regarding commoditizing nature and opening it up to trade, we should not assume that pricing nature is inherently dangerous. In contrast, her factor *radical transformationism* contains claims similar to our *value pluralism* and *social justice concerns* discourses, such as that pricing nature is dangerous insofar as it 'leads to the commodification of the natural world and legitimizes the privatization of essential common resources'.

It should be kept in mind that the discourses identified here are an outcome of a study with limits in scope and provides a snapshot in time of the arena of debate. The identification of discourses is also constrained by the choice of statements for the Q set. Various statements used in this Q set rest on assumptions and convictions that may change through time by additional future empirical research into the ecological and social consequences, and motivational strengths or weaknesses, of economic valuation of biodiversity. The ongoing discussion on the topic shows that the scope, the arguments and the implications of economic valuation are not set but are still in development and subject of research. Furthermore, as debates evolve over time, it may be instructive to periodically review the discourses that are assumed to exist on sensitive topics, and to trace whether new sets of concerns appear in time and old ones disappear (Davies and Hodge, 2012). Nevertheless, the discourses identified here fulfill a role in both identifying the complexity of the debate in its current form and an illumination of coherent points of view on the topic.

Our findings relate to recent studies that search for practical solutions in environmental management. For example, Laurila-Pant et al. (2015) propose situating economic valuation of biodiversity in a framework that takes critiques into account. In this framework, economic values are restricted in use to provide globally comparative values, and for local decision making primarily the language of ecosystem services could be used. Our study suggests this proposal should be modified to one of local decision making being augmented by expressing *all* discourses in addition to economic valuation of ecosystem services, through for example participatory decision making. Also, the use of market-based instruments in environmental policy is accompanied by heated debates that refer to the discourses identified in this study. Gomez-Baggethun and Muradian (2015) clarify that some instruments such as biodiversity banking generate greater discussion about ethical perspectives than others, such as carbon markets. Such instruments differ in their setup and hence in the opposition they may provoke. The identified discourses help support a more appropriate application of such instruments, suited to local conditions and the desires of stakeholders.

On a more theoretical level, our identification of discourses helps to differentiate between understandings of sustainable development. During the past decades, competing paradigms about sustainable development have been put forward, such as *green economy*, *green accounting*, *gross national happiness* and others. These paradigms see a different role for economic valuation. For instance, a rejection of economic valuation can be found in the paradigms of *green politics* and *green* *consciousness* which incorporate deep ecology sensibilities, but less so in other recent interpretations of sustainable living (Stevenson, 2015).

The identification of these discourses and their polarization into two opposing groupings has further implications for environmental policy. There is a danger in environmental policy making that only a narrow range of the discourses is represented. The consequence of such an action is that the resulting decisions lack social legitimacy. The identification of the different discourses by means of Q methodology can improve decision making, by ensuring that all the potential values of biodiversity are given a voice. In particular it can inform the improvement of representation for deliberative methods in economic decision-making (Davies et al., 2005, Dryzek and Niemeyer, 2008). This study further supports the claims that socio-cultural perspectives are an integral part of biodiversity valuation approaches. Giving voice and appropriate expression to different modes of valuing biodiversity is a necessary condition for defensible procedures for arriving at environmental policy.

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# Chapter 3

# The loss of biodiversity conservation in EU research programmes

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**Abstract**

Society has been seeking ways to express biodiversity's value to stimulate its protection. Economic valuation of ecosystem services has had limited success to motivate biodiversity protection and reaching the EU 2020 biodiversity strategy targets is in danger of failure. The framing of biodiversity's value in policy documents thus becomes a topic of discussion, because it greatly influences the ways policy makers think about environmental problems. We present an analysis of the framing of biodiversity's value in the FP7 and Horizon 2020 work programs of the European Commission in the period of 2007 to 2014, and the projects accepted under these programs. We conclude first that biodiversity was lost as a topic in the transition from FP7 to Horizon 2020, accompanied by a three-quarters loss of biodiversity topics in the projects accepted under these work programs. Moreover, the use of 'ecosystem services' was 1.5 times higher at the end of that period compared to the beginning in the work programs, to the detriment of the use of 'sustainability' and 'conservation' which halved during that same period. In the light of international commitments to biodiversity conservation, the focus towards ecosystem services and away from conservation is of great concern.

**Keywords:**

Biodiversity conservation, economic valuation, ecosystem services, environmental policy, European Commission.

**1. Introduction**

As biodiversity in Europe is in degradation, scientists have been seeking ways to express its value to society (Wood 1997; Pimentel et al. 1997; De Groot et al. 2002). During the last two decades, it became popular in scientific and policy documents to express the value of biodiversity as ecosystem services and in money, in hopes of  boosting our willingness to protect it (Costanza et al. 1997; Nunes & van den Bergh 2001; Losey & Vaughan 2006; Perrings et al. 2010; TEEB 2010). The economic value of ecosystem services is often calculated as being very high, but as a means to protect biodiversity its success is limited so far (Pearce 2007). Furthermore, the current expression of biodiversity's value in ecosystem services may in itself be a troubled development that hampers successful biodiversity conservation (Mace et al. 2012). Alternative expressions and incorporating frameworks of biodiversity's value have been proposed to address some of the shortcomings of the notion of ecosystem services (Mace 2014). The expression of biodiversity's value has thus become a topic of discussion.

The expression of biodiversity's values is of immediate concern in Europe because of uniquely European approaches to biodiversity conservation. European biodiversity conservation is frequently framed as an interactive partnership and a bottom-up approach between humans and nature, as explained by Boitani and Sutherland (2015), in which areas of conservation are human dominated agricultural landscapes and the species to be protected are dependent on human interference. This contrasts with the North American model in which a greater dualistic view is seen between nature and society. As food production and conservation overlap spatially and coexist in strong tension (Hodge et al. 2015), biodiversity conservation in Europe is therefore expected to feel a more immediate effect if the expression of the uses and values of biodiversity changes in society. In addition, biodiversity conservation and changes in expression of biodiversity's values in Europe acquire significance worldwide, because the tension between food production and conservation that underlies the European approaches is anticipated to increase in areas around the world. Therefore, a closer look at European experiences in biodiversity conservation may be beneficial for countries who are moving along a similar development path (Boitani and Sutherland 2015).

With the UN Convention on Biological Diversity Aichi targets in danger of being missed in the European Union (Tittensor et al. 2014; EC 2015; EEA 2015), a critical look is warranted at the expression of biodiversity's value in EU research frameworks that are in service of reaching these targets. Programmes of great influence in this regard are the EU Seventh Framework Research Programme (FP7) and the follow-up EU Framework Programme for Research and Innovation – Horizon 2020 – ,which influence the direction of scientific research in the European Union. Horizon 2020's open calls for research projects are in service of the EU 2020 biodiversity strategy (EP resolution 2014), which was in turn set up in response to a UN mandate to reach the UN Convention on Biological Diversity Aichi targets. In addition, Horizon 2020 compliments national efforts in scientific research by co-funding other subsidy networks such as BiodivERsA and the European Cooperation in Science and Technology (COST). Finally, the Horizon 2020 subsidy mechanisms are a direct communication from the European Commission to European scientists about desired research topics and the social and politic context that such research would be in service of.

Previous analyses of EU research programmes illuminate shared topics of accepted projects, but investigations of trends through time have been rare. Both the BiodivERsA database (BiodivERsA 2013) and the Biodiversity Information System for Europe (BISE 2011) aim to create clarity in the distribution of topics among accepted research projects of EU research programmes via a searchable database, but do not expand upon trends through the years. Trends through time that have been recognized in literature, however, give cause for concern. A trend has been identified by Matei et al. (2011), concluding that budget allocated to biodiversity-related projects in the Environment theme in FP7 has significantly decreased between 2007 and 2010. Similarly, an analysis of themes was presented on the abstracts of projects accepted under the European BiodivERsA research infrastructure from 2004 to 2011, concluding that research funded in Europe shifted focus from organismal and population levels to a focus on larger organizational levels such as ecosystems, with a changed emphasis on monetary costs and benefits of biodiversity protection (Gambette et al. 2014).

Our study builds on this by analyzing the visibility and recognition of biodiversity and its conservation in the wording of open call research subsidy documents of the EU. More precisely, trends in word use are traced for the open call descriptions on the topic of biodiversity conservation in the documents of the environment theme in the EU Seventh Framework Research Programme (FP7) from 2007-2013 and the EU Framework Programme for Research and Innovation - Horizon 2020 of 2014-2015. Our focus is on the prevalence of 'conservation' of biodiversity, and how this differs in prevalence from to other mentioned keywords related to biodiversity, such as 'ecosystem services'. This content analysis allows us to make inferences on thematic shifts underlying biodiversity conservation in the EU research programmes. Clarity on the trends of wording of biodiversity's value in EU research programmes is a necessary investigation to ensure a tight focus on efforts to halt biodiversity degradation in the EU.

**2. Methods**

We performed an analysis on the open call research descriptions of FP7 and Horizon 2020 work programs, focusing on the documents published as the thematic work program '*Environment (including climate change)'* from FP7 2007 to 2013 and its follow-up theme '*Climate action. environment. resource efficiency and raw materials'* from Horizon 2020, because these are most directly concerned with biodiversity conservation. Furthermore, the project objectives have been analyzed of projects that were accepted under these specific open calls. This would illuminate whether any trends we find in the open call descriptions of the work programmes are mirrored in the stated objectives of projects that are submitted to these open calls. For a complete explanation of the methods used, we refer to the supplementary materials. All FP7 and Horizon 2020 documents were retrieved from http://ec.europa.eu/research/index.cfm and http://cordis.europa.eu/projects/home_en.html.

First, the location of biodiversity as a topic in chapters and subchapters was traced in the structure of the work programs through the years as a reflection of its priority as a research subject. Secondly, we traced word use in the documents through the years. In this analysis we aimed to trace why biodiversity is considered important in the work programs and to what end. For the coding of words, first all places in the work programs where biodiversity or a related term is mentioned were identified, and then it was noted manually which values were attached to it in the same paragraph. This procedure generated a list of values that was summarized in nine groups (Table S3). Then the visibility of the groups in the text was traced through the years by counting in the documents the words for the values. In addition to these nine groups, we traced referrals to ‘costs and benefits’ and ‘stakeholder participation’. These referrals too can be seen as indicators of either a focus on economic valuation or a widening view on biodiversity values.

## 3. Results

### *3.1. Structure of the FP7 and Horizon 2020 work programs*

The foremost observation regarding the structure of the FP7 documents is that biodiversity loss in itself is not a recognized topic at a high organizational level in the text, but that it is embedded five levels down within the structure (Table 1). FP7 has five different sections: *Cooperation*, *Ideas*, *People*, *Capacities* and *Euratom*; only in the *Cooperation* section are distinct research fields delineated. It has ten themes, and two themes in particular concern values of biodiversity: theme two, ‘*Food, agriculture and fisheries, and biotechnology’* and theme six, ‘*Environment (including climate change)*’. Each theme has subsections named *Activities* and these are further broken down into *Sub-Activities* and then into *Areas*, and on this level a specific focus on biodiversity can be found as part of *Area 6.2.1.4 Biodiversity* (Table 1).

*Ideas*
- European Research Council (ERC)

*People*
- Marie Curie Action

*Capacities*
- Reseach infrastructures (7 subchapters)

*Euratom*
- Euratom

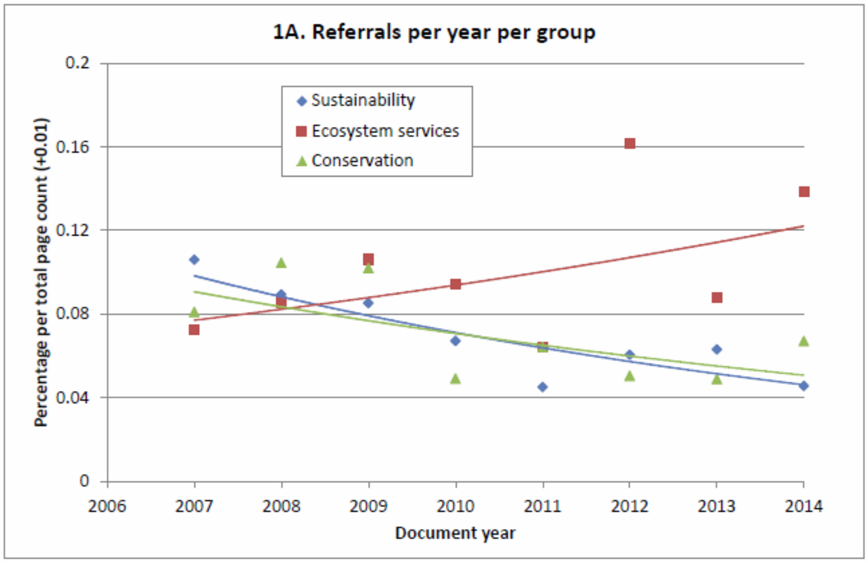
*Cooperation*
- Health
- Food, agriculture and fisheries, and biotechnology
- Information and Communication Technologies
- Nanosciences, Nanotechnologies, Materials and new Production
- Technologies
- Energy
- Environment (including Climate Change)
    - Activity 6.2 Sustainable management of resources
        - Sub-Activity 6.2.1 Conservation and sustainable management of natural and man-made resources and biodiversity
            - **<u>Area 6.2.1.4 Biodiversity</u>**
- Transport (including Aeronautics)
- Socioeconomic Sciences and the Humanities
- Space
- Security

**Table 1:** Location of biodiversity related activities within the themes of the FP7 work program (http://ec.europa.eu/research/participants/portal/desktop/en/funding/reference docs.html#fp7).

The FP7 program ran from 2007 to 2013 and in 2012 biodiversity disappeared entirely from the titles. *Activity 6.2* changed towards *Challenge 6.2. Sustainable use and management of land and seas*, and in here biodiversity disappeared as a specific subtopic. Onwards to 2013, the topics inside the environment theme were further rearranged under different headings for the transition towards the Horizon 2020 program, and the biodiversity topic did not reemerge in the rearrangement. To bridge the FP7 program towards Horizon 2020, the focus of the FP7 program in 2012 shifted towards a stronger focus on innovation measures in support of market-uptake of products and services and to a stronger emphasis on participation of small and medium enterprises. The environment was henceforth framed within this new focus and was therefore made part of a theme concerned with resource efficiency. In Horizon 2020, biodiversity issues are touched upon in the call *Growing a Low Carbon, Resource Efficient Economy with a Sustainable Supply of Raw Materials*, but a specific focus on biodiversity did not reemerge.

### *3.2. Word use in the FP7 and Horizon 2020 calls*

The total number of referrals to values or uses of biodiversity decreased by a quarter between 2007 and 2014 (Fig. 1b) and simultaneously the expression of biodiversity's values changed significantly in the documents. Within this time frame, 'ecosystem services' increased 1.5 times in use as an expression of the use or values of biodiversity, while goals related to 'sustainability' and 'conservation' decreased to half of their original word use (Fig. 1a; Table S1). In the early years of FP7, 'sustainability' values, 'conservation' values and 'ecosystem services' were the three main arguments for acting for biodiversity in the texts. By the end of FP7 in 2012-'13 and at the start of Horizon 2020 in 2014, 'ecosystem services' had become the foremost expression of the value of biodiversity mentioned, while values of 'conservation' and 'sustainability' have dropped significantly in comparison to 'ecosystem services'. There is a significant difference in change of word use between the referrals to 'ecosystem services' and referrals to other values through the years (Table S1; Fig. S1).



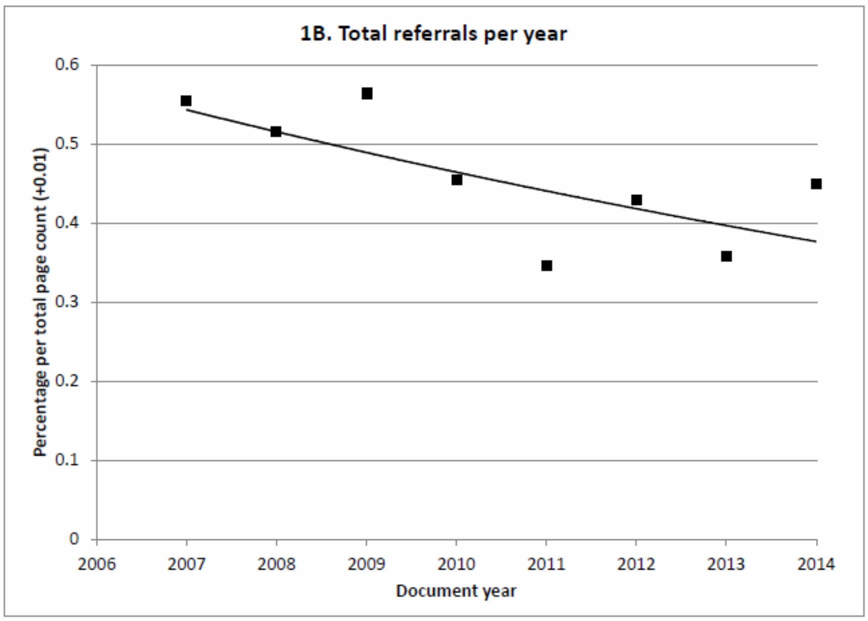




**Figure 1.** Word use analysis on FP7 Environment (Including Climate Change) and Horizon 2020 Climate action, environment, resource efficiency and raw materials. A = the percentage of words referring to values for each year, as a percentage of the total word count of the documents. Only sustainability, ecosystem services and conservation are taken up in this figure. For all 11 traced values and themes, see Fig. S1. B = the total referrals for each year, as a percentage of the total word count of the documents.

Sustainability values have a strong presence in the text, even when declining through the years. Values of equity and democratic decision making can be seen in either direct referrals or in referrals to stakeholder participation, but have a low presence in the text. Intrinsic values of biodiversity and associated ethical considerations are mentioned only three times in calls that specifically search for non-economic values and are therefore marginal in the text. The explicit mention of costs and benefits of biodiversity remains low in the documents. FP7 2012 introduces the word natural capital alongside ecosystem services as another expression of the economic value of biodiversity.

*3.3. Word use in the FP7 project objectives*

The projects accepted under FP7 research calls show first of all a trend of disappearance of biodiversity related subjects; i.e. a nearly three-quarters loss of biodiversity referrals between 2007 and 2013 (Fig. 2b). In the projects that still refer to biodiversity, the same trend is visible as observed in the call descriptions of the work programs, in that 'ecosystem services' emerges as the dominant expression of use or value and other goals referring to sustainability or conservation decreased in importance (Fig. 2a; Fig. S2). Referrals to 'costs and benefits' remained stable too. There is a significant difference in change of word use between the referrals to 'ecosystem services' and referrals to other values through the years in the project objectives (Table S2).

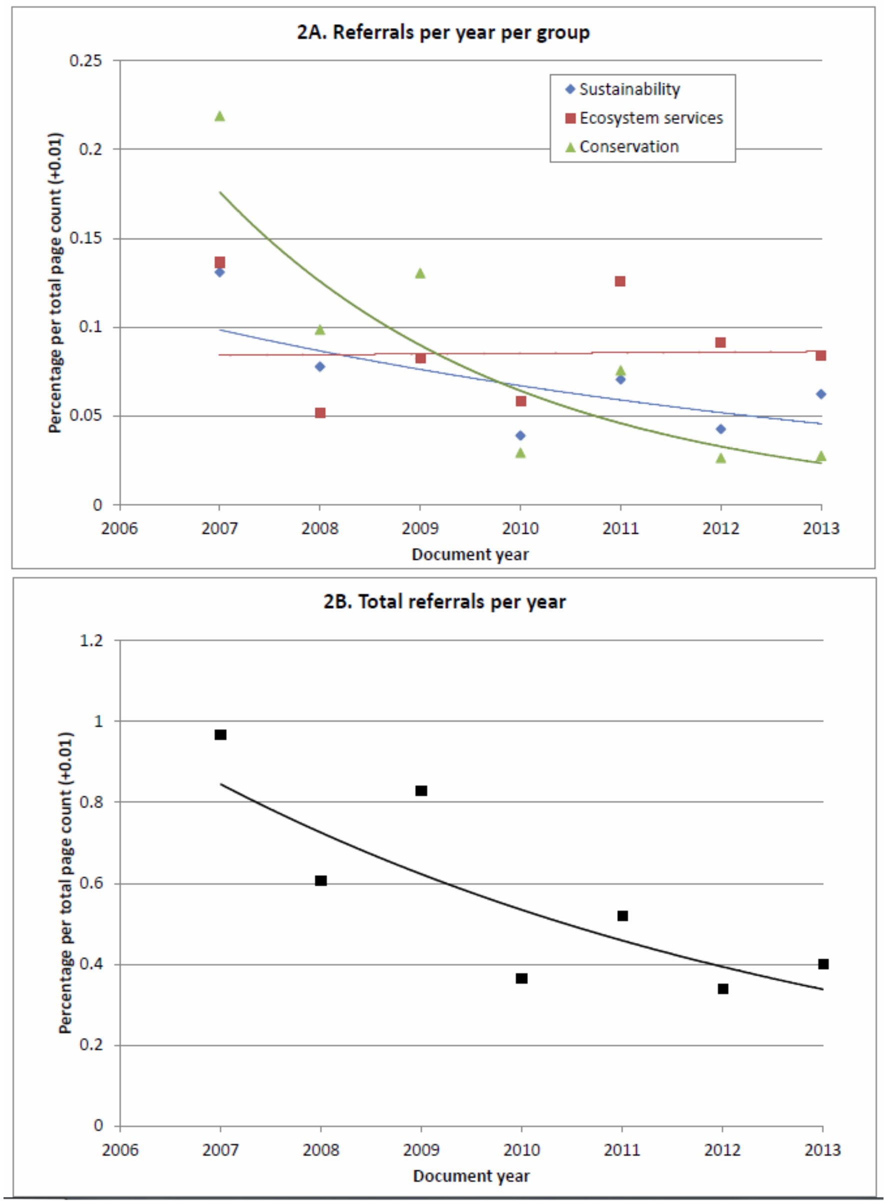


**Figure 2**. Word use analysis on the descriptions of the objectives of projects that were accepted under the FP7 Environment (Including Climate Change) theme. A = the percentage of words referring to values for each year, as a percentage of the total word count of the documents. Only sustainability, ecosystem services and conservation are taken up in this figure. For all 11 traced values and themes, see Fig. S2. B = the total referrals for each year, as a percentage of the total word count of the documents.

## 4. Discussion

### *4.1. Discussion of results*

A clear shift in word use is visible in the environment themes of the FP7 and Horizon 2020 work programs towards using 'ecosystem services' as the foremost way to express the value of biodiversity. There is little explicit referral to economic valuation of biodiversity in the FP7 and Horizon 2020 documents, but determining ecosystem services is a strong precursor to economic valuation as it exists within the same frame of value expression (McCauley 2006; Gómez-Baggethun & Ruiz-Pérez 2011). Coupled with a simultaneous decrease of other expressions of values and goals such as 'conservation' and 'sustainability', 'ecosystem services' substitutes other expressions of value in the work programs. Because biodiversity research is funded on a competitive basis through FP7 and Horizon 2020, 'ecosystem services' is being put forth as the main motivating factor for future scientific research.

There are limitations to the methods used and the scope of this study. In our study of the call descriptions of the environment themes of the FP7 and Horizon 2020 documents, no conclusions can be drawn about the setup of the research projects accepted under these frameworks, or the thematic emphasis during their run and their practical research outcomes regarding biodiversity conservation. The word clouds we used can therefore only be used as an indicator of shifts in word use in the documents of the EU framework programmes. Nevertheless, the word frequency analysis allows us to infer changes in the importance of topics over time (Stemler, 2001). The shifts in word use observed in this study indicate a thematic shift over time in the underlying concepts related to biodiversity conservation in the environment themes of the FP7 and Horizon 2020 documents.

The EU research work programmes investigated here constitute only a part of subsidized research on biodiversity in Europe, being an addition to other networks such as BiodivERsA, COST and the European Science Foundation (ESF) and national efforts to subsidize a great number of research projects (BISE 2011; BiodivERsA 2013). The accepted projects investigated in this study, however, follow the same shift in their stated objectives as is observed in the open call descriptions. This suggests a trickle-down effect in which the shift towards 'ecosystem services' values in the work programs may lead to scientists adapting their language to that of the open call descriptions. This practice of highlighting keywords and contexts in adapting the research project objections to the call descriptions may not necessarily impact the conservation success of the accepted projects, but the value framework set down in open call descriptions may thus lead to a narrowing of expressions of value in scientific research and may lead to a greater focus on ecosystem services in the projects. The databases of BISE (2011) and BiodivERsA (2013) indicate that research projects still cover a richness in themes, but the question to ask is whether ecosystem services is a good substitute for notions of biodiversity conservation in open call descriptions.

*4.2. Implications and recommendations*

A complex relationship exists between the clouds of ideas that make up biodiversity and ecosystem services. As explained by Mace et al. (2012), ecosystem services management may not always mean biodiversity conservation per se, and the expectation that managing ecosystem services will automatically enhance biodiversity is unfounded (Ridder 2008). Spatially, priority areas for biodiversity conservation and for ecosystem services generation may only weakly overlap and conservation success becomes dependent on trade-offs between ecosystem services (Chan et al. 2006). If the focus of conservation changes towards the maintenance of ecosystem services as end products, biodiversity's role as a regulator of ecosystem processes may be neglected in environmental policy (Isbell et al. 2015). Instead, biodiversity's role as underpinning the stability or quality of ecosystems and the flow of services should be at the center of describing its value.

The field conservation biology itself is divided on the issue of whether applications of the ecosystem services concept will lead to greater conservation success or not (Schröter et al. 2014). The argument of protecting nature for nature's sake only works for the converted, and we need the idea of ecosystem services to get more people involved in efforts of conservation. Ecosystem services might work in this regard because it uses the language of connection, emphasizing how biodiversity is part of people's lives (Armsworth et al. 2007). Conservation judgements are after all value judgements (Mace et al. 2012), and conservation priorities may be taken up quicker when they are reframed within relevant political contexts (Rose 2014).

But the language of ecosystem services has severe limitations in describing these connections, and is most suited to talk about biophysical goods and services such as food or water purification. It may only get people involved with nature in a limited way. To use ecosystem services to make people concerned about biodiversity loss therefore may not lead to successful biodiversity conservation but to a focus on the production of quantifiable services. There is a danger that nonmaterial values of biodiversity that describe the deeper connections between individuals and nature, such as identity values, spirituality, artistic and intergenerational values, are glanced over in ecosystem assessments unless special attention is paid to them. Nonmaterial values are difficult to elicit and take up in assessments, and frequently overlooked (Gould et al. 2014). The easier-to-express biophysical ecosystem services then sooner become the language of connection between society and nature, and they can be expressed in monetary terms as a decision support strategy for policy makers. But this introduces further complications for biodiversity conservation (Adams 2015), as the monetary valuation of biodiversity is currently inconsistent and incomprehensive about the values and functions of biodiversity (Bartkowski et al. 2015).

If one goal of conservation biology is to speak the language of connection to harness human values for successful biodiversity conservation, then ecosystem services addresses only a part of those values, and a focus on them confronts us with their limitations. There are efforts to embed ecosystem services language in broader frameworks, where it becomes useful at particular steps in a decision making process. Laurila-Pant et al. (2015) suggests to use the language of ecosystem services for local decision analysis, and use biodiversity science to keep ecosystems stable for the services. Newer frames of valuing biodiversity are yet emerging in scientific literature focusing on socio-ecological resilience to solve problematic aspects of the ecosystem services framework (Norgaard 2010; Mace 2014). Alternative ways to express the value of biodiversity also exist. As Butler and Acott (2007) and Van der Born (2008) show, a majority of people already regard nature not from the perspective of a user, but as a tender or partner of nature on the planet.

The critiques mentioned above are not addressed in the environment themes of the FP7 and Horizon 2020 documents. The results show a decline of sustainability values, a lack of recognition of intrinsic values of biodiversity and of equity values in biodiversity management. Moreover, the general trends of European policy language in research away from biodiversity conservation as observed in this study are in stark contrast to recent publications on the state of biodiversity in Europe. Both the decrease of biodiversity-related projects and the marginal appearance of biodiversity loss as a recognized topic in the work programs is surprising in light of the struggle to reach the UN CBD Aichi biodiversity targets (Tittensor et al. 2014). Both the recent mid-term review of the EU biodiversity strategy to 2020 (EC, 2015) and the European Environmental Agency report on the State of Nature in the EU (EEA, 2015) show that no significant progress has been made towards the target to halt biodiversity loss in Europe by 2020. Also, the Eurobarometer survey on public attitudes towards biodiversity conservation (EU, 2015) shows that biodiversity loss is considered a very serious topic by eight out of ten Europeans.

The EEA report on the State of Nature in the EU (EEA, 2015) mentions measureable targets to fulfill the EU nature directives, but the language shift in FP7 and Horizon 2020 documents towards ecosystem services instead obscures concrete, measureable goals for conservation. The same need for concrete targets is apparent in the implementation of the European network of protected areas Natura 2000, in which a need is recognized by scientists for more basic research on species inventories and habitats (Kati et al. 2015). An obscuration of conservation goals is also observed in the BiodivERsA database from 2004 to 2011, in that the projects do not directly relate to targets to halt biodiversity loss (Gambette et al. 2014). For successful biodiversity conservation, we recommend that European research policy documents refrain from a total shift to ecosystem services and retain biodiversity conservation *an sich* as a policy goal via updated frames of biodiversity value. We think that the shift away from projects that refer to biodiversity conservation is of great concern.

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**Appendix A. Supplementary data**

**Methods:**

The FP7 and Horizon 2020 framework programmes comprise an inner universe of official documents, but the focus in this study is on the documents published as the environment theme work programs that list the open research calls, which are the key documents for scientists who want to apply for research subsidies and are the most direct communication among the documents from the European policy sphere to scientists working in Europe. The following documents we consider to be outside the scope of this paper: original proposals for the programs and impact assessment reports that detail the expected impacts of the programs on the world. Also outside the scope are a number of documents on their legal basis and their grant and funding mechanisms, including proposals for public-private and public-public partnerships and manuals on proposal submissions.

The method used here is an analysis of the FP7 and Horizon 2020 environment theme work programs at two levels: the structure of the work program in chapters and subchapters, and a coding of terms that are to be searched for in the documents. In the writing of the open calls of work programs of Horizon 2020 and FP7 there are necessarily constraints in word use and word number. Out of necessity, the calls need to be short and clear in communication yet leaving enough room in interpretation for multiple possible projects to be send in, and using vocabulary from the respective fields of research they are addressing. Such documents offer no room for nuanced discussions of meaning in the call descriptions. However, the specific words used in the documents are reflections of a state of discussion within a field of research, and as such carry assumptions with them and expectations of proposals that answer the call.

A word use analysis was performed on the documents of the FP7 '*Environment (including climate change)'* theme from 2007 to 2013 and its follow-up theme '*Climate action. environment. resource efficiency and raw materials'* from Horizon 2020*.* Even though other themes in the framework documents may touch on biodiversity, the analysis focused only on this theme, because the focus of the study is on biodiversity wording for conservation purposes. Only '*Environment (including climate change)'* and its follow-up theme in Horizon 2020 address the environment as a concern on its own and is therefore the theme in which multiple values of biodiversity for conservation can be most readily expressed. In contrast, other themes that touch on biodiversity in the call descriptions, such as '*Food, agriculture and fisheries, and biotechnology',* focus on sustainable use and stimulation of production systems in which biodiversity is seen as playing a role in production processes, for example as genetic stock or industrial micro-organisms. We chose therefore to exclude these from the textual analysis to get trends of biodiversity wording for conservation purposes into sharper focus. All FP7 and Horizon 2020 documents were retrieved from http://ec.europa.eu/research/index.cfm.

In the word use analysis a coding of terms is applied to two aspects of the value of biodiversity: (1) what is being referred to at instances in the documents when biodiversity or a related term is mentioned and (2) what value is attached to it. For example, the documents might refer to either nature, ecosystems or biodiversity, with each term overlapping in meaning. We take all terms as direct or indirect referrals to biodiversity. The following terms comprise our search list of referrals to biodiversity: biological/ecological resource(s), ecosystem(s), bio-/biological diversity, nature, biological/ecological diversity, genetic resource(s) and green infrastructure. For each instance when a referral is made to one of these terms, the context of the paragraph clarifies which values are attached to this term. For example, ecosystems can be mentioned in the context of economic productivity, sustainable growth, food security, certain classes of ecosystem services for the economy or society or other values. After locating the relevant paragraphs in the documents via an initial automatic search for referrals to biodiversity, the paragraphs are read and analyzed for these values manually. Thus, a list is built up of all the values of biodiversity that are recognized in the text as relevant (Table S3). Only paragraphs in which biodiversity is referred to are taken up in this analysis. The frequency with which the values are mentioned in the paragraphs where biodiversity is referred to is taken as an indicator of the weight that is given to these values.

The list of mentioned values is summarized into groups: ecosystem services, sustainability values, socio-economic values, conservation value, etc. (Table S3). Some groups, such as climate change mitigation and livelihood values, could be counted as ecosystem services but are mentioned separately to enrich the data. In addition, we kept track of referrals to stakeholder participation and cost benefit analyses. These are not necessarily values of biodiversity but give us further information about how biodiversity values are expected to be expressed in the projects. The resulting eleven groups of values were tracked through the years in the documents and trends become visible (Figure S1).

The same word use analysis using the same stepwise plan is done on descriptions of the objectives of accepted projects under the FP7 '*Environment (including climate change)'* theme from 2007 to 2013. The analysis of descriptions of projects is done primarily to investigate whether any trends we find in the open call descriptions of the work programmes are mirrored in the stated objectives of projects that are submitted to these open calls. For the descriptions, we took the text mentioned as the objective of a project on the project page on http://cordis.europa.eu/home_en.html.

For testing the difference in trend between the use of the words referring to 'ecosystem services' and those of the other groups, we made a dataset of the word count per group per year. This dataset was analyzed by applying a linear model that assumes that the word count per group per year is depending on year, group and the interaction between year and group. The interaction terms of this model give the coefficients of the regression of word count by year per group. The differences of these regression coefficients between that of 'ecosystem services' and the other groups show how the trends differ. These can be tested on being significantly different from zero – no difference in trend between 'ecosystem services' and the one tested – by testing the difference between the interaction terms of the model and zero, because the interaction terms of the model are actually contrasts between the regression coefficient of 'ecosystem services' and the other regression coefficients. This statistical analysis was performed using the program R-3.0.2, using a linear model, after log transformation of the word counts as percentage for optimal distribution of residuals values: lm(ln(percentage+0.01)~year*group). For the results we consider p-values below 0.1 as a significant difference.

**Figures:**

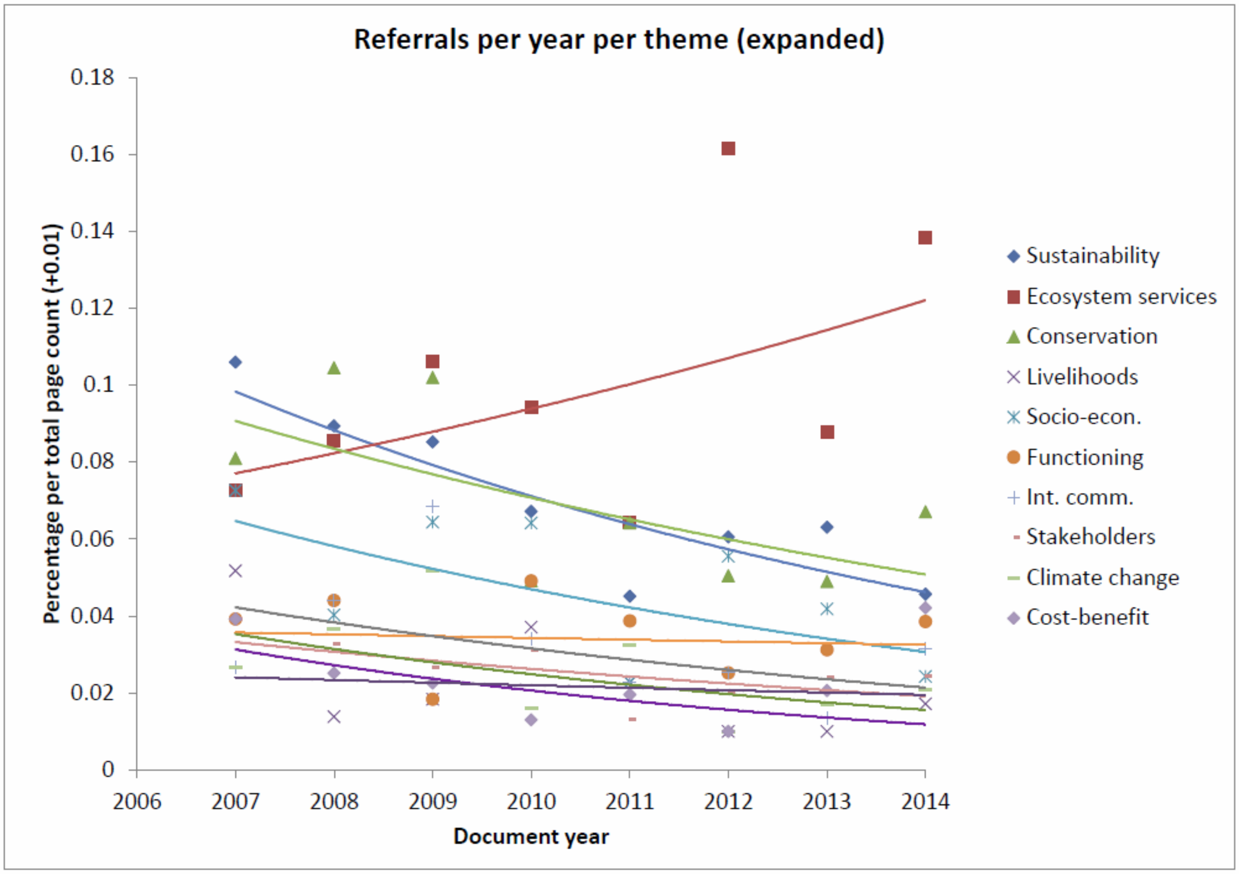


**Figure S1:** Word use analysis on FP7 Environment (Including Climate Change) and Horizon 2020 Climate action, environment, resource efficiency and raw materials. Shown is the percentage of words referring to values for each year, as a percentage of the total word count of the documents. The trend lines represent the predicted values of our statistical model.

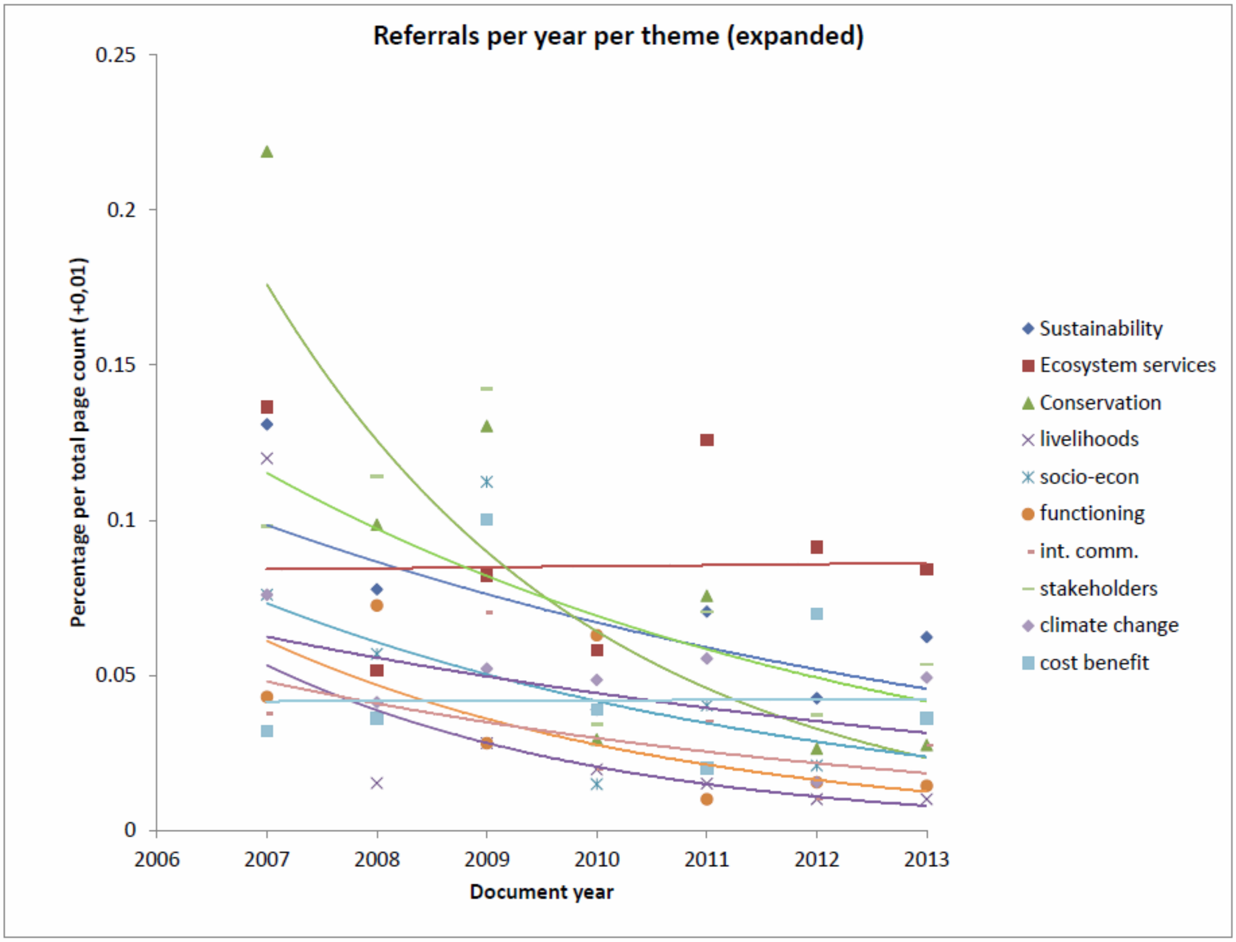


**Figure S2:** Word use analysis on the descriptions of the objectives of projects that were accepted under the FP7 Environment (Including Climate Change) theme. Shown is the percentage of words referring to values for each year, as a percentage of the total word count of the documents. The trend lines represent the predicted values of our statistical model.

**Tables:**

**Table S1**: Estimated contrasts between the regression coefficient of the group 'ecosystem services' by year and other groups in the work programs of FP7 and Horizon 2020. Based on the interaction terms of the linear model lm(ln(percentage+0.01)~year*group). For the results we consider p-values below 0.1 as a significant difference. Signif. codes: '*'p <0.05, '.' p<0.1.

| Table S1: Estimated contrasts between groups in FP7 and Horizon 2020 | | | | | |
|---|---|---|---|---|---|
| Value of biodiversity | Estimate | Std. Error | t value | Pr(>\|t\|) | Significance |
| Sustainability | -0.17362 | 0.08521 | -2.038 | 0.0456 | * |
| Conservation | -0.14855 | 0.08521 | -1.743 | 0.0859 | . |
| Livelihood | -0.20440 | 0.08521 | -2.399 | 0.0193 | * |
| Socio-economic | -0.15737 | 0.08521 | -1.847 | 0.0693 | . |

| | | | | | |
|---|---|---|---|---|---|
| Functioning/production | -0.07922 | 0.08521 | -0.930 | 0.3540 | |
| Competition | -0.13422 | 0.08521 | -1.575 | 0.1200 | |
| International commitments | -0.16297 | 0.08521 | -1.913 | 0.0601 | . |
| Stakeholder participation | -0.14408 | 0.08521 | -1.691 | 0.0956 | . |
| Climate change mitigation | -0.18245 | 0.08521 | -2.141 | 0.0360 | * |
| Costs and benefits | -0.09575 | 0.08521 | -1.124 | 0.2652 | |

**Table S2**: Estimated contrasts between the regression coefficient of the group 'ecosystem services' by year and other groups in the descriptions of the objectives of projects accepted under FP7 '*Environment (including climate change)*'. Based on the interaction terms of the linear model lm(ln(percentage+0.01)~year*group). For the results we consider p-values below 0.1 as a significant difference. Signif. codes: '*'p <0.05, '.' p<0.1.

| Table S2: Estimated contrasts between groups in project objectives | | | | | |
|---|---|---|---|---|---|
| Value of biodiversity | Estimate | Std. Error | t value | Pr(>\|t\|) | Significance |
| Sustainability | -0,132187 | 0.137462 | -0,962 | 0.3409 | |
| Conservation | -0,340472 | 0.137462 | -2,477 | 0.0167 | * |
| Livelihood | -0,322341 | 0.137462 | -2,345 | 0.0230 | * |
| Socio-economic | -0,191958 | 0.137462 | -1,396 | 0.1688 | |
| Functioning/production | -0,268850 | 0.137462 | -1,956 | 0.0561 | . |
| International commitments | -0,163342 | 0.137462 | -1,188 | 0.2403 | |
| Stakeholder participation | -0,174070 | 0.137462 | -1,266 | 0.2113 | |
| Climate change mitigation | -0,118666 | 0.137462 | -0,863 | 0.3921 | |
| Costs and benefit | -0,001333 | 0.137462 | -0,010 | 0.9923 | |

| Table S3: Values of biodiversity found in the work programs, summarized in groups | |
|---|---|
| Ecosystem services: | Sustainability: |
| Ecosystem services | Sustainable management |
| Ecosystem's services | Sustainability |
| Environmental services | Sustainable way |
| Goods and services | Sustainable development |
| Products and services | Sustainable use |
| Service provision | Ecologically sustainable |
| Service delivery | Sustainable utilization |
| Natural capital | Sustainable policy actions |
| Human health | Sustainable pathways |
| Quality of life and health | Sustainable economic activities |
| Coping with noise | Sustainable processes |
| Health and wellbeing | Sustainable exploitation |
| Energy efficiency | Sustainable societies |
| Ecosystem water use | Green economy |

| | |
|---|---|
| Flood protection<br>Environmental goods and services<br>Biotechnological potential<br>Biotechnological applications<br>Industrial use<br>Capacity to deliver services<br>Multipurpose green infrastructure<br>Public goods<br>Range of services<br>Wood production<br>Water quality<br>Combat desertification<br>Value of pollination<br>Assimilative capacity of ecosystems<br>Natural products<br>Tourism<br>Coastline protection<br>Groundwater renewal<br>Recreation<br>Payments for ecosystem services<br><br>Socio-economic:<br><br>Social and economic impacts<br>Costs and social consequences<br>Social economic and other values<br>Species of socio-economic importance<br>Species of community interest<br>Species of policy relevance<br>Socioeconomic valuation<br>Economic risks<br>Economic impacts<br>Quantify economic and ecological values<br>Economic objectives<br>Economic dimensions<br>Multiple use<br>Economic valuation of impacts<br>Economic valuation<br>Greening the economy<br>Ecological and economic resources<br>Socioeconomic aspects/dimensions/context<br>Socioeconomic implications<br>Minimizing risks for society<br>Mitigating risks<br>Economic and social wellbeing<br>Quantify economic value | Sustainability goals<br>Offsets<br>No net loss<br><br>Conservation:<br><br>Ecosystem conservation<br>Ecosystem protection<br>Ecosystem restoration<br>Ecosystem resilience<br>Ecosystem enhancement<br>Future protected areas<br>Ecosystem health<br>Protect and conserve<br>Stability and resilience<br>Ecosystem recovery<br>Reverse biodiversity loss<br>Tipping points<br>Ecosystem quality<br>Preservation<br>Thresholds<br>Regime shifts<br>Ecological connectivity<br>Fragmentation<br>Ecological value<br>Good environmental status<br>Vulnerability of ecosystems<br>Support the diversity of life<br>Adaptation and restoration<br>Viability of populations<br>Favorable conservation status<br>Essential habitats<br>Biological quality<br>Ecological quality<br>Rebuilding<br>Environmental damage<br><br>Functioning:<br><br>Potential of green infrastructure<br>Functions<br>Innovation potential<br>Functioning<br>Eco-innovation<br>Eco-efficiency<br>Functional |

| | |
|---|---|
| Economic sectors<br>Market and nonmarket impacts<br>Social and economic consequences<br>Social and individual wellbeing<br>Support economies. societies and individual wellbeing<br>Economic and social assessment<br>Valuation of biodiversity<br>Socioeconomic criteria<br>Human welfare<br>Relevant economic activities<br>Socio-cultural and economic contributions<br>Economic. social and cultural development<br>Societal impacts<br>Involvement industrial sector<br>Contribution to SMEs<br><br>Climate change:<br><br>Regulating the climate system<br>Adapting to climate change<br>Carbon sink<br>Mitigation of climate change<br>Carbon uptake<br>Response to climate change<br>Carbon and greenhouse gas<br>Carbon pools<br>Carbon sequestration<br>Adaptation to climate changes<br>Carbon storage<br>Terrestrial sinks<br>Feedback on the climate system<br>Resilience to climate change<br><br>Cost-benefit:<br><br>Benefits<br>Cost-effectiveness<br>Extensive benefits<br>Maximum benefit<br>Deliver major benefits<br>Costs and benefits<br>Costs<br>Quantification of the costs<br>Use and nonuse values<br>Societal benefit | Applications<br>Functions and processes<br>Ecosystem function<br>Functional ecological networks<br>Production<br>Functional elements<br>Productivity<br>Functioning or productive capacity<br>Significant ecological functions<br>Functionalities<br>Multi-functionality<br><br>International cooperation:<br><br>International cooperation<br>International efforts<br>International biodiversity targets<br>Building on the outcomes of the MEA<br>Supports the recent Communication<br>International commitments<br>Strategy<br>Strengthening work of EU scientific institutions<br>UN Convention<br>Implementation of Directive<br>International obligations<br>International agreements<br>Natura 2000<br>Transferability between countries<br>Knowledge transfer<br>Promoting strategic partnerships<br>Boosting international research<br>International initiatives<br>Contribution to Millennium Development Goals<br>Scientific collaboration<br>Participation for countries<br>European cooperation<br>Global network<br>Integrated maritime policy<br>International conventions<br>Relevant EU legislation<br><br>Stakeholders:<br><br>Participatory approaches<br>Stakeholder perspective<br>Interests of different stakeholders |

| | |
|---|---|
| Opportunities and risks<br><br>Livelihoods:<br><br>Human wellbeing<br>Urban and rural development<br>Contribute to food security<br>Regional economies<br>Impact at local and regional levels<br>Environmental safety and welfare<br>Livelihoods<br>Equitable<br>Rural and urban environments<br>Interdependencies'<br>Coupled human-environment system<br>Equitable way<br>Urban development<br>Relationship urban area and surrounding landscape<br>Human dependence on biodiversity<br>Welfare dependent<br>Vulnerability of livelihoods<br>Husbanding<br>Rural marginal areas<br>Deal with conflict<br>Conflict reconciliation | Awareness raising<br>Public access to data<br>Involve civil society<br>Stakeholder concerns<br>Relevant actors<br>Relevant stakeholders<br>Public at large<br>Engagement with local communities<br>Multi-stakeholder dialogues<br>Participatory initiatives<br>Engage citizens<br>Citizen awareness<br><br>Competitiveness:<br><br>Economic competitiveness<br>European competitiveness<br>Commercially important<br>Commercial interest |

# Chapter 4

# More than total economic value: How to combine economic valuation of biodiversity with ecological resilience

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**Abstract**

The assessment of total economic value has become a pragmatic and popular approach in nature valuation, yet criticisms have been raised. One major point of critique is that total economic value bases the monetary value of ecosystems purely on the flow of human benefits of services of ecosystems and consequently ignores questions of sustainable use of natural capital per se. This paper explains why total economic value by itself is in principle an inadequate concept to guide sustainable use of ecosystems and gives an overview of essential ecological theory that needs to be taken into account in addition to total economic value to fully include ecosystem sustainability. The paper concludes with suggestions on how to combine ecological theory with economic valuation. The key elements here are theoretical ecological insights about ecosystem resilience and portfolio theory which offers an economic perspective on investment in biodiversity. Portfolio theory puts total economic value in a framework where investment in biodiversity can cover functional diversity and mobile link species in order to maintain ecosystem resilience and so fosters sustainable use of ecosystems.

**Keywords**

Total economic value, biodiversity, ecosystem services, ecosystem functioning, functional diversity, natural capital, ecosystem resilience, insurance value, portfolio theory

## 1. Introduction

Economic valuation of the services provided by nature is widely perceived by scientists and policy makers as an appealing and important approach to support management decisions (Costanza et al., 1997; Losey and Vaughan, 2006; Nunes and Van den Bergh, 2001; Pimentel et al., 1997). The use of economic values is attractive in that it enables nature to be taken into account in social development, research and policy and promises sustainable use of natural resources, landscape restoration and efforts of conservation. The most inclusive way of economic valuation of nature is through a total economic value assessment. Total economic value is an expression of the total value of the benefits derived from a marginal change in an ecosystem, expressed in monetary terms, which can subsequently be used in cost-benefit models. Total economic value is especially attractive because it aims to cover all expressions of value, including use values and non-use values of ecosystems. For an overview, see Bateman et al., (2011), Dziegielewska, (2009) and TEEB (2010).

Yet, during the last decade criticisms have been raised (Bockstael et al., 2000; Chee, 2004; Gatto and De Leo, 2000; Ludwig, 2000; Morse-Jones et al., 2011). Existing economic valuation methods that are used in total economic value calculations, such as production function approaches and contingent valuation methods, refer to the value of nature to humans, supposedly acting as rational actors (Bockstael et al., 2000; Farber et al., 2002). The aggregate of their individual preferences forms total economic value and supports decisions in ecosystem management. However, if consumer preferences are not in line with the requirements of ecosystem sustainability, total economic value will not express these requirements either (Common and Perrings, 1992). Assuming that ecosystem sustainability would be a preferred status by consumers, one reason why consumer preferences might not be in line with such requirements is an information problem, where the consequences of action and decision on ecosystem sustainability are not well known by consumers (Chee, 2004; Ludwig 2000). For example, Peterson et al., (2003) describe an ecosystem management model of oligotrophic lakes, which deliver ecosystem services such as water for consumption, irrigation and industrial use, recreation and fish catch. The example shows how a management decision making process that aims to maximize net present value of a lake does not take into account ecosystem resilience, and leads to ecosystem collapse.

There is a necessity to solve this information problem. Ecosystems behave in erratic ways and display time-lagged responses (Holling, 1992; Scheffer et al., 2001, Scheffer and Carpenter, 2003), and because economic valuation of services tracks marginal changes in ecosystem's benefits to humans, the method is blind to erratic behavior of ecosystems. Loss of species and resilience can happen unobserved while ecosystem functioning itself can remain largely unchanged (Chillo et al., 2011; Scheffer et al., 2001, Sundstrom et al., 2012; Walker et al., 2010). Hence, total economic value by itself cannot give an indication of an ecosystem's ability to maintain future provision of services, as collapse of an ecosystem may be only one marginal change ahead (Fisher et al., 2008). Thus, projects that use economic valuations to inform decisions on how much nature to keep and how much to convert to other uses, fail to safeguard ecosystem functioning for future benefit. Anderies et al., (2006) describe an example from management of an agricultural system in Southeastern Australia in which too much vegetation was cleared to keep the ecosystem resilient against flooding. Decision making based on enhancing economic efficiency and productivity became increasingly reactive and incremental, leading to loss of resilience and a lock-in to an unsustainable management trajectory.

Examples of ecosystem collapse in the literature on ecosystem management suggest that higher levels of caution are required in modifying or removing nature for the purpose of economic efficiency (Anderies et al., 2006, Steneck et al., 2011). A more fundamental criticism comes from Ridder (2008), who argues that more cautious management trajectories are not in line with economic valuation of ecosystem services. This is because total economic value resides mainly in certain functional species or species groups, except for some specific ecosystem services such as scenery and ecotourism. According to this reasoning, only the species needed for generating the ecosystem service of choice are to be maintained or cultivated and non-intervention in an ecosystem only applies to those cases where ecosystem services are provided by species or groups that are rare or very sensitive to human disturbances. Then, why have more species than just those that contribute to human benefits as reflected in total economic value? Steneck et al. (2011) consider the case of lobster monocultures in the Gulf of Maine that are threatened by collapse. Through relying on a few economically valuable species and removal of most apex predators through fishing, the lobster fisheries are on the verge of closure and collapse. Lobster monocultures offer large financial gains, but are vulnerable to perturbations such as rising ocean temperature, causing a decline of more than 70% in lobster abundance and potential great socio-ecological consequences. Low diversity cultivation has been known to increase the chances of pest outbreaks, disease outbreaks, fire and other expected or unexpected consequences (Hooper et al., 2005; Larsen, 1995; Weitzman, 2000). In addition, strategies in land use that support the maintenance of bundles of ecosystem services are recognized as practices to confront negative environmental impacts, while maintaining economic benefits and ecological resilience (Foley et al., 2005).

As is seen from these examples, economic valuation bases the monetary value of ecosystems only on the output of ecosystems at one point in time and space and not on the state of ecosystems (Morse-Jones et al., 2011) (see Fig. 1.). Hence, a major economic challenge is left unaddressed through the total economic value concept, namely how to manage biological diversity to assure a provision of ecosystem services through wider time and space (Perrings et al., 2009). In other words, how to manage the sustainable use of ecosystems (Farber et al., 2002). Using the analogy with factory production, the Millennium Ecosystem Assessment (2010) describes how the flow of goods sold is neither an accurate measure of manufacturing performance nor of the factory's management. The goods could either have been newly produced or taken from an existing built-up stock that is depleting.

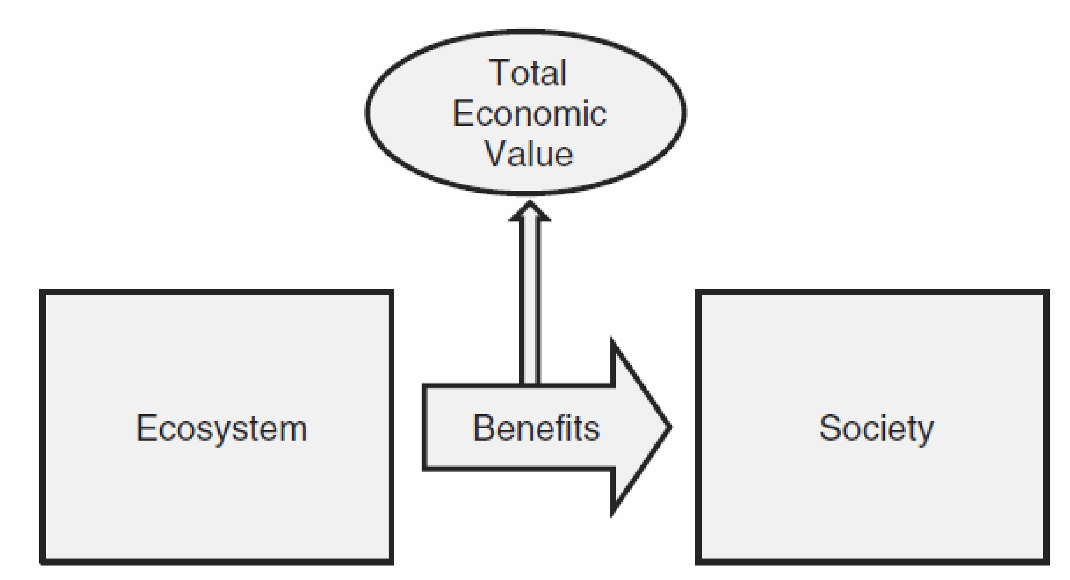


**Fig. 1.** Total Economic Value represents the value of the output of ecosystems to society, but is no indication of the state of ecosystems.

In sharp contrast to these characteristics of the total economic value approach, the ecological way of describing the functionality of ecosystems is non-anthropocentric. It describes causal relationships between parts of a system. If ecosystems are seen as assets of humankind, as stocks of natural capital from which ecosystem services flow, ecological “valuations” concern themself with effects within the stock (Banzhaf and Boyd, 2005). Ecological valuation of ecosystems concerns itself with the maintenance of an ecosystem’s complexity, structure, capacity for self-renewal and resilience (Gamborg and Rune, 2004). Ecology may, for example, describe how trees can stabilize slopes or the survival value of certain traits in organisms (Farber et al., 2002). With that, ecological theories are intimately linked to the concept of ecosystem sustainability and therefore have a potential to fill in the information gap in economic valuation, as it offers a perspective on ecosystem functioning that has economic meaning.

These problems cannot be resolved within total economic value theory as it exists today, because the empirical methods used to calculate total economic value are inadequate to address the ecological importance of species functions to sustain ecosystems. This is because, as pointed out by Diamond and Hausman (1994), existing valuation methods suffer from embedding effects in addition to several other limitations. This weakness of economic valuation methods has been recognized, and inclusion of some ecological theory in economic models has become commonplace. The decision on what ecological theory should be included in the economics depends on the spatial scale of the projects considered. Eppink and Van den Bergh (2007) give an overview of the ecological theories already in use in economic models. Some ecological theories tell us something about small-scale dynamics and are therefore useful in small scale cost-effectiveness and resource extraction models. Other theories offer broader system-wide views, and are more useful for economic models that are applied at large spatial scales. Eppink and Van den Bergh conclude that these applications predominantly deal with ecological theory at the species level with a clear absence of ecosystem wide theories of ecosystem resilience. This absence of theory about ecosystem resilience in economic models is problematic.

Inclusion of notions of ecosystem sustainability is essential for sound decision making in ecosystem management. We define ecosystem sustainability in line with the resilience concept (Holling, 1973) as the ecosystem’s ability to maintain the provision of ecosystem services into the future. We address the following research questions to explore how the concept of Total Economic Value can be combined with ecosystem sustainability in economic models of nature conservation:

1. What notions of ecosystem resilience need to be added to Total Economic Value assessments in decision making to foster sustainable use of ecosystem services?
2. How can the concept of Total Economic Value be combined with these notions of ecosystem resilience?

The subsequent sections follow this order of research questions. The research questions imply that we maintain an economic and functional outlook on nature. Hence we will not touch on intrinsic values and priorities to protect endangered or characteristic species.

## 2. Notions of ecosystem resilience to foster sustainable use of ecosystems

### *2.1. Ecosystem Resilience*

As mentioned above, we define ecosystem sustainability in line with the resilience concept of Holling (1973). More specific, ecosystem resilience according to Holling is the amount of perturbation an ecosystem can withstand before relations between organisms (predator and prey, herbivore and resources, or competing species) cause local extinctions and as a consequence cause the ecosystem to shift to another state. Consequently, so-called 'Holling Sustainability' defines an ecosystem as sustainable if it can maintain its self-organization through time by adapting to stresses imposed on it (Common and Perrings, 1992). A second interpretation of ecosystem resilience has been formulated by Pimm (1984) who states that resilience can be defined as the speed with which an ecosystem returns to its former equilibrium state rather than the extent of perturbation it can withstand. The terminology has become more complex ever since (see Loreau et al., 2002) and resilience thinking has expanded to incorporate social-ecological systems (SESs) and the entire Earth System (Folke et al., 2010). In this framework, fostering ecological resilience is seen as a contribution to SES resilience and Earth System resilience. In this paper, we focus exclusively on ecological resilience, for which the definition by Holling remains most in use. Hence, we can refine the information problem in economic valuation to: a lack of information concerning the amount of perturbation an ecosystem can withstand before a shift to another state occurs.

The ecological theory discussed in sections 2.2 and 2.3 attempts to fill up this lack. There are limits to this exercise, as the precise requirements of ecosystems to maintain their self-organization through time depend on the ecosystem in question and the preferred state of an ecosystem depends on the services desired from it. For example, Carpenter et al. (2001) discuss very practical measures of ecological resilience in an example of lake eutrophication, where the author uses indicators for ecological resilience such as soil P concentration, animal stocking densities, and land area under construction. In the causal chain from human action to an ecosystem adapting to the effects, the indicators such as those used by Carpenter et al. (2001) are the direct causes of perturbations, and not ecosystem adaptability itself. If the physical relations in ecosystems are well understood, such indicators are valid for resilience measurements. However, if such relations are exceedingly complex, ecological theory about ecosystem adaptability still needs to be taken into account and can provide guidelines in maintaining ecosystem resilience. In addition, ecology is limited in its predictive power to describe the sustainable use of any ecosystem service, the relationships between ecosystems and ecosystem services differ per location, and ecological theory can be ill-fitted in the strict framework of stocks and flows with which ecosystem services are regarded and economic valuation relies on (Norgaard, 2010). Therefore, as a necessity the ecological theory presented in this paper is general in outlook.

*2.2. Ecosystem Resilience and Biodiversity*

Work on ecosystem resilience has been expanded with work on state changes. If adaptability falls in an ecosystem due to human-induced disturbances, that ecosystem is more likely to change state, and acquire a new stable state. The new ecosystem after the disturbance will have a lower functional diversity and species richness, and ecosystem services it once provided might be lost. Folke et al. (2004) and Scheffer et al. (2001) describe evidence for increased likelihoods of regime shifts in real world ecosystems as groups of species go extinct due to human pressure on ecosystems and give many examples of regime shifts in different biomes. Walker et al. (2004) adds three aspects to ecosystem resilience that describe the local stability of the current state of the ecosystem: latitude, resistance and precariousness (see Fig. 2).

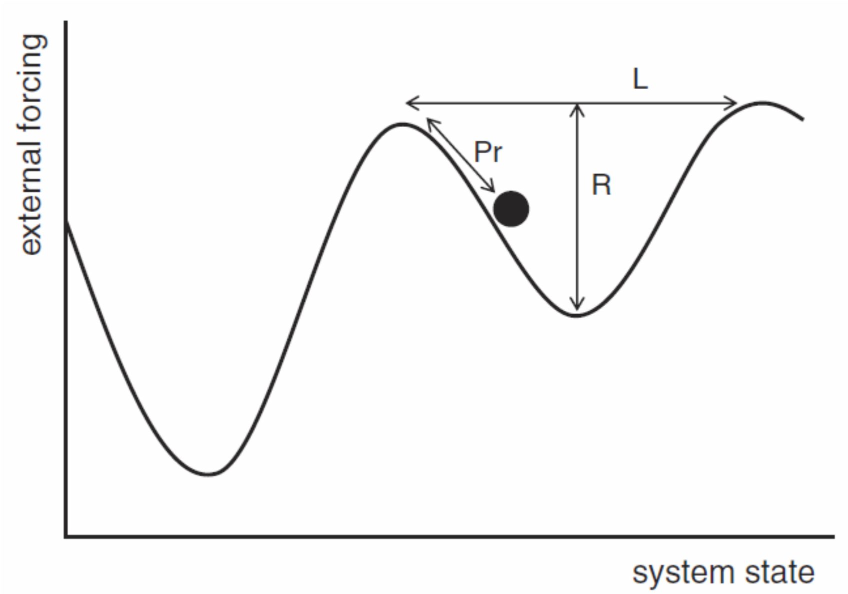


**Fig. 2**. Ecosystems can switch between states in a stability landscape. A stability landscape is a phase space diagram representing all possible states of an ecosystem. Ecological resilience describes the local stability of the current state of the ecosystem. The black dot represents the state of the ecosystem at a point in time and movement along the hills represents change in the ecosystem. As an ecosystem moves out of a basin, it approaches a threshold, and a regime shift occurs when the ecosystem “falls” into another basin of stability. Resilience has three aspects that describe the ecosystem's location in a stability landscape: latitude, resistance and precariousness. L: latitude, R: resistance, Pr: Precariousness. Adapted from Walker et al. (2004).

Research on ecosystem resilience has direct implications for biodiversity management. In matters of resilience, biodiversity is seen as protection against loss of productivity or variability of productivity of ecosystems. Experiments with plant species richness confirmed that to ensure the provision of an ecosystem service over time, greater biodiversity improves ecosystem functioning and the stability of an ecosystem’s productivity (Isbell et al., 2011; Tilman et al., 1996). Conversely, if an ecosystem service depends on an ecosystem function that is provided by a single species, the loss of that species will be of greater concern. And loss of biodiversity has a small effect on ecosystem functioning only if no species are lost with singular contributions to ecosystem functioning.

Biodiversity relates to diversity in genes, species and ecosystems, and in the last decade functional diversity has occasionally been added to this list. During this decade, a consensus has been reached among ecologists that the provision of ecosystem services is impacted not so much by species diversity per se in an ecosystem, but by the functional diversity in an ecosystem (Díaz, 2006; Peterson, 1998). As formulated by McCann (2000), biodiversity by itself is not the driver of ecosystem stability, but ecosystem stability depends on functional diversity capable of differential response to environmental disturbances. Species with different traits react differently towards environmental changes. If species compete for the same resource, decline of one species will lead to an increase of another, which contributes to maintain a stabilization of ecosystem functioning. And in case one species is lost, another will be able to do well under changed conditions, and so contribute to the continuation of the ecosystem as a whole (Vasseur, 2007; Yachi and Loreau, 1999). Thus, the functional diversity in an ecosystem impacts ecological resilience. A greater variety of functional groups in an ecosystem will lead to the presence of more pathways for energy flow and nutrient recycling (Cadotte et al., 2011), which decreases the susceptibility of ecosystems to environmental disturbances and the establishment of invasive species and so leads to a greater ecological resilience (Hobbs et al., 2007; Hooper et al., 2002; Loreau et al., 2002; McCann, 2000; Peterson, 1998).

### *2.3. Ecosystem Resilience Across Spatial Scales*

Biodiversity is recognized for its role in the preservation of ecological structures at local, regional and global scales. As functional diversity is distributed across scales, ecological resilience is expected to function across scales as well (Peterson, 1998). Ecosystems are not closed systems, but are responsive to external input, such as migration of individuals and species dispersal, and are connected through species that serve as "mobile links". Such forces are essential to maintain a wide range of functional traits within ecosystems on a local scale (Loreau et al., 2002). On regional and global scales, forces are at play that affect the range of functional traits in ecosystems on local scales. Such forces can be landscape configuration, species dispersal and migration. Through these, local functional traits are maintained in ecosystems, or new functional traits are added to ecosystems. An added complexity is that while regional and global biodiversity supports local ecosystem stability, ecosystems on a local scale in turn support regional and global biodiversity. Ecosystems on a local scale may function as source or sink locations for species populations that range over larger areas. Bird and fish species often feed in one area and breed in another. Forests may provide for the precipitation on agricultural areas. Or one area may provide for the pollination of plant species in another area. Biological control and pollination are ecosystem services especially vulnerable to changes in these forces (Bengtsson et al., 2002). In summary, local, regional and global biodiversity support each other.

The biological linkages between local, regional and global biodiversity are embedded in the concept of "mobile links" (see Fig. 3). Individual animal species can be labeled as mobile links that increase ecological resilience by connecting habitats through genetic exchange, food web linkages or chemical or physical processes (Lundberg and Moberg, 2003). Examples of genetic links are insects that contribute to pollination or seed dispersal in general, and so promote genetic exchange between plants of different areas. Grazers and predators are examples of food web links or trophic links that impact the populations and dispersal of other species. Species with long-distance migrations are seen as links between habitats. In addition to species that fulfill roles as spatial links, there are species that fulfill local resource links, such as scavengers as agents of decomposition, or organisms such as beavers, that function as links in physical processes through dam building. Through mobile links such as seed dispersers, a local loss of species can be replenished from the regional species pool. Thus, regional biodiversity functions as an external ecological memory that enables disturbed local sites to reorganize (Bengtsson et al., 2002; Lundberg and Moberg, 2003). As Loreau et al. (2003) put it, biodiversity on a regional scale provides spatial and temporal insurance against losses in local biodiversity. So while functional diversity supports ecosystem adaptivity, biodiversity on a larger scale supports the functional diversity on smaller scales.

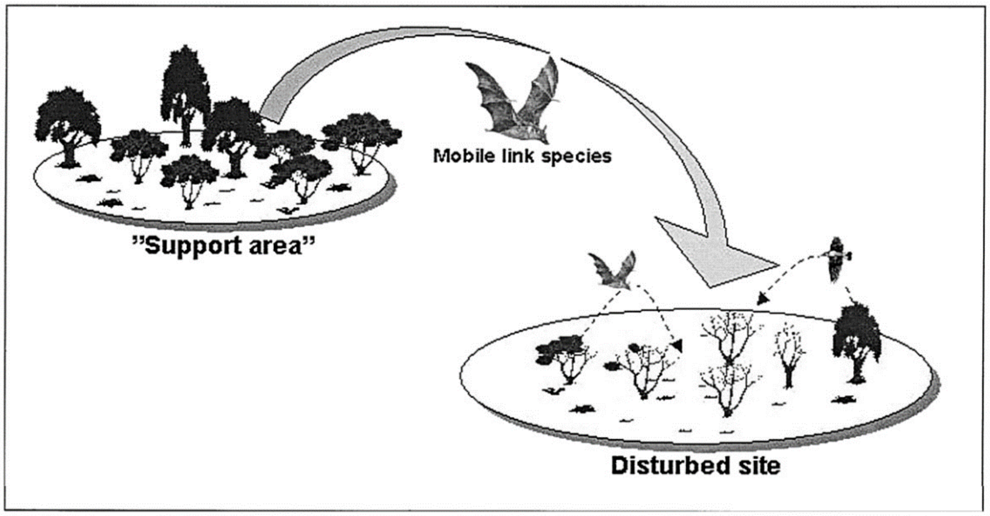


**Fig. 3**. Mobile link species connect sites and can replenish a local loss of species. This effect is known as external ecological memory. Adapted from Lundberg and Moberg (2003).

*2.4. In Summary*

This section described notions of ecosystem resilience that need to be added to Total Economic Value assessments to support decisions that foster sustainable use of ecosystem services. An overview was provided of insights from theoretical ecology on ecosystem resilience, the role of functional diversity in ecosystem resilience, and ecosystem resilience across scales through mobile link species. Theory of functional diversity and mobile links can help to inform management on how to support the resilience of ecosystems. Investing in functional diversity and mobile links can improve the adaptability of ecosystems and so prevent ecosystems from undergoing a regime shift to another valley of stability. A recurring theme in these theories is biodiversity as an insurance mechanism. Investing in functional diversity insures an ecosystem against approaching a stability threshold, and investing in biodiversity on a regional scale through supporting mobile link species can be seen as investing in the insurance mechanism of ecological memory, that can replace lost species from a regional species pool.

**3. How can Total Economic Value be combined with notions of ecosystem resilience?**

In the preceding section, we have expanded on the ecological theory that needs to be incorporated in economic valuation, so that the prescriptions following from it ensure sustainable use of ecosystems. Having first identified the information problem in economic valuation as a lack of information on ecosystem sustainability, and having identified ecosystem resilience, functional diversity and the workings of ecological memory through mobile links as the ecological theory that concerns itself with ecosystem sustainability, we now need to explore how these ecological theories can be combined with economic valuation to establish a new methodology.

*3.1. The Insurance Concept*

A general trend emerges from the ecological theories presented in section 2, namely that biodiversity acts as an insurance against state change (Baumgärtner, 2007; Swanson, 1992; Yachi and Loreau, 1999). This perspective helps to explain why preserving additional biodiversity has economic value. In the context of Holling Sustainability, biodiversity (in the manifestations of functional diversity and biodiversity across scales) has a value in insuring human society against loss of ecosystem services through maintaining the adaptability of an ecosystem to biotic and abiotic stresses imposed on it, to prevent it from shifting to another state. Insurance value of biodiversity has also been called the inherent value, contributory value, the indirect value, the primary value or the infrastructure value of biodiversity (Nunes and Van den Bergh, 2001), or has been described as a set of complementary relationships between species in a habitat, between biotic and abiotic components, and functions and services by Fromm (2000).

The insurance value of functional diversity is thought to lie within two parameters: a diversity of functional groups in an ecosystem and the number of species within these functional groups. A diversity of functional groups enables an ecosystem to respond in different ways to disturbances (Cadotte et al., 2011), while having multiple species within functional groups renders the loss of single species less harmful for continued ecosystem functioning. After a local loss of a single species, the species remaining in that same functional group can perform the same function in the ecosystem as the extinct species. Thus, having multiple species within functional groups is regarded as a redundancy of species. Redundancy has negative connotations such as superfluity, but in an ecological sense it is similar to valuable redundancy in software or in the human immune system to boost their reliability (Naeem, 1998; Naeem and Li, 1997). This is also known as the rivet model (Peterson, 1998). The insurance value of biodiversity across scales is thought to lie within the mechanism of ecological memory, where the local loss of a species can be replenished from the regional species pool. Such biological exchanges between regional and local biodiversity are facilitated through mobile link species. This insures ecosystems at local scales against functional diversity loss.

Given that the challenge is to maintain ecosystem service provision through time and space, the insurance value of biodiversity shows us that biodiversity (in the manifestations of functional diversity and mobile link species) has an economic value in maintaining ecosystem sustainability, and can (and should) therefore be invested in. Walker et al. (2010) describe the insurance value of biodiversity as a stock of resilience. These authors explain how ecosystem variables characterized by thresholds have a stock of resilience, and how a decline in ecosystem resilience can be considered a decline in wealth. Determining variables with thresholds are for example vegetation connectivity and depth to the water table. If the variable changes, a threshold may be reached that causes the ecosystem to change state. The insurance value of biodiversity refers to such controlling variables, such as "differential response of an ecosystem to disturbances”. The stock of resilience is defined as the distance of an ecosystem to the threshold of a state change in a stability landscape, for a particular variable (see Fig. 2). Walker et al. (2010) present an example of including changes in resilience in the estimation of wealth by its quantification for three controlling variables (ground water table, vegetation connectivity and the condition of irrigation infrastructure). To invest in the resilience stock of a variable such as "differential response of an ecosystem”, would mean to invest in biodiversity.

We aimed to find an answer to the question: can the concept of total economic value be combined with notions of ecosystem sustainability? We can now further refine that question to: how can we express the economic value of a resilience stock of biodiversity, so that it can be combined with traditional economic valuation? A resilience stock of biodiversity would often be comprised of a collection of species populations that would not all be considered needed for optimization of total economic value, because their insurance value is not recognized in total economic value. The benefit to humans, the ecosystem service, of a resilience stock of biodiversity is its capacity to maintain the adaptability of an ecosystem to stresses imposed on it. This capacity is expressed in functional diversity, so insurance value could ideally be expressed as a level of functional diversity, where more diversity equals a greater value.

A problem is that the locations of thresholds in ecosystems are often unknown and that means the size of the resilience stock of an ecosystem is often unknown. Here we run into the limits of ecology's predictive power, and to claim that ecology can predict the precise thresholds and thus the resilience stock in an ecosystem for any ecosystem service would be pretentious (Norgaard, 2010; Polasky et al., 2011). Walters and Maguire (1996) discuss the example of fishery collapses of Atlantic cod. Even in the context of fisheries scientists seeking sustainable harvest regimes, and a decision-making system placing confidence in their scientific models, the collapse of the cod stocks happened unexpectedly, illustrating that ecosystems can change suddenly, and greater caution is required when the location of thresholds in ecosystems are unknown. In ecosystem management, that would translate to making use of working hypotheses that can be revised (Fischer et al., 2010), and a diversification in use of ecological models (Peterson, 2003).

Even if quantification of a resilience stock of functional diversity remains out of reach in ecosystem management, investment in a resilience stock of functional diversity is warranted to prevent a regime shift in an ecosystem. Hence, a framework is required in which investment in traditional total economic value can be combined with investment in a resilience stock in such a way that a resilience stock is maintained in the face of optimization of total economic value. To argue for an investment in more biodiversity in order to invest in both total economic value and insurance value is to argue for a diversification in investment, and the economic sense of diversification in investment is explained through portfolio theory. Portfolio theory also allows us to select specific assemblies of biodiversity to take into account in ecosystem management.

### *3.2. Portfolio Theory can Combine Total Economic Value with Investment in a Resilience Stock of Biodiversity*

Analogous to financial capital management, sustainable ecosystem management aims to maximize the delivery of ecosystem services while ensuring that the state of ecosystems is maintained. If biodiversity is considered a portfolio of natural assets (Weitzman, 2000) the link with portfolio theory is obvious (e.g., Tilman et al., 1996; Koellner and Schmitz, 2006). More recently this insight has been extended towards its implications for ecosystem management (Figge, 2004). Portfolio theory came about in investment research, because a need for diversification in investment was recognized, but the value of diversification as of yet was still to be described. It was mathematically developed by Markowitz (1952; 1959). In ecosystem services management we observe a similar situation.

Economics has developed a rich literature on how to optimize the use of capital assets. The idea of diversifying one's assets in order to increase return and to manage risk is essential in this literature. Portfolio theory seeks to maximize returns while minimizing risk through the creation of a portfolio of investments that are not positively correlated with one another, thus seeking to assure that the investments held in an account do not all move in a similar pattern. The overall effect of this diversification is to minimize volatility in returns. In ecosystem management, that would translate to building a biodiversity portfolio of genes, species or ecosystems with different characteristics in order to maximize the economic value of ecosystem services, while managing variability or loss of ecosystem services provision (Figge, 2004). The underlying assumption of portfolio theory is that covariance among assets (biodiversity) influences the variance of the returns (services) at any given level of these returns provided by the assets. Portfolio approaches to management compare the tradeoffs between these variances and the level of returns for specific assets. When applied to biodiversity this means that the risk of variability or loss of ecosystem services provided by an ecosystem differs depending on the assembly of biodiversity that the ecosystem includes (Figge, 2004).

Examples of the application of portfolio theory in ecosystem management, e.g. Schläpfer et al. (2002) for hay cultivation and Perruso et al. (2005) for fisheries, construct a portfolio of biodiversity to successfully minimize volatility in ecosystem services provision. In these examples, the population assemblies chosen are selected on their ability to minimize volatility of the total economic value of the ecosystem services. We argue that in selecting species populations for a portfolio, the investment should be expanded to include a larger range of species populations comprising both total economic value and insurance value (see Fig. 4). These species populations overlap, as economically valuable species add to the total functional diversity of an ecosystem. Ecological theory predicts that higher levels of biodiversity lead to lower variability in services provision (Isbell et al., 2011; Tilman et al., 1996). More specifically, ecology predicts that small assemblies of species focused on maximizing total economic value risk regime shifts that lead to loss of services, while in larger assemblies of species, a resilience stock is maintained that increases an ecosystem's adaptability to external influences, and thus leads to lower variability of returns. The concepts of functional diversity and resilience across scales add theory on ecological resilience to the portfolio framework, and can guide us to a selection of species whose addition to the portfolio is a priority for keeping ecosystems resilient.

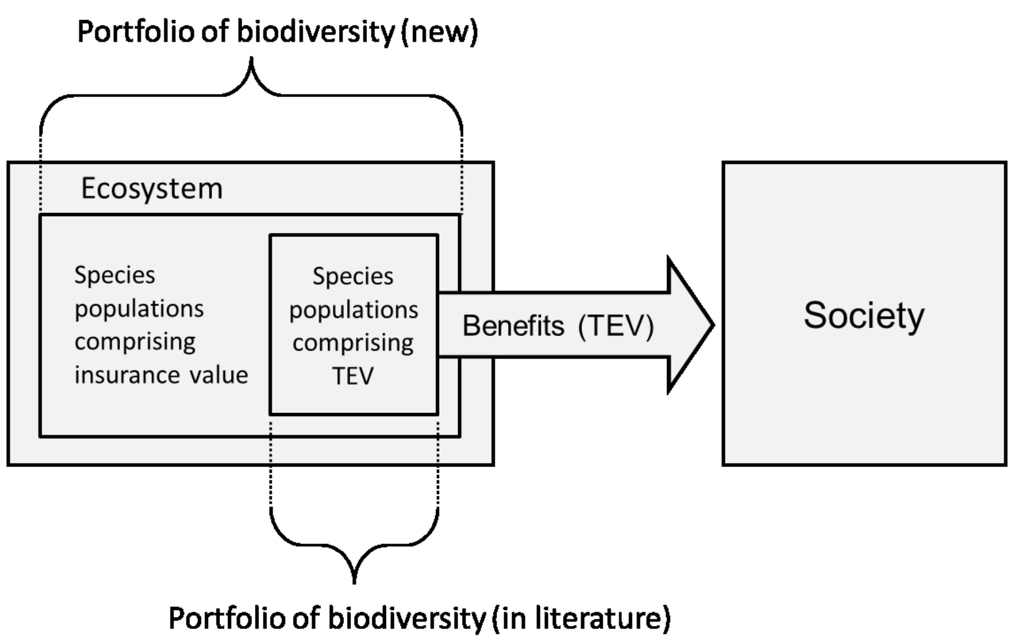


**Fig. 4**. In selecting species populations for a portfolio, investment can be expanded to include a larger range of species populations that comprise both total economic value (TEV) and insurance value. These species populations overlap, as economically valuable species add to the total functional diversity of an ecosystem.

While portfolio theory has so far been presented in the literature as a framework to manage risk, i.e. variability, of ecosystem service provision, we present it as a framework to maintain ecosystem sustainability. Whereas total economic value is a snapshot valuation of ecosystem services, portfolio theory introduces the elements of time and future revenue. Thus the basic idea is that the variance of the total economic value of an ecosystem can be reduced, and service provision kept sustainable, by investing in more functional biodiversity and mobile link species. Theoretically, management alternatives can then be compared based on the expected returns (total economic value) and the risk (variance or loss of the expected total economic value). The quantification of this tradeoff for (a) alternative ecosystems or for (b) alternative plans for one specific ecosystem would provide useful information to support management and species conservation decisions. The trade-offs offer two useful kinds of results in particular. First, for new ecosystem management plans mapping by these two criteria can show which plans are "efficient" in the sense of giving the best expected total economic value performance for a given level of accepted risk, or the least risky outcome at a given total economic value level. Second, trade-off analysis offers an evaluation of existing ecosystems management plans in terms of their relative performance compared to other potential species assemblies.

As noted before, the locations of thresholds and thus the level of functional diversity needed to maintain ecosystem sustainability is difficult to assess, yet investment in resilience stocks is warranted. Portfolio theory may not help us to assess the locations of thresholds, but it allows us to set a limit on the functional diversity in danger of being removed from an ecosystem through optimization of total economic value. As a level of sufficient functional diversity is set to prevent the ecosystem undergoing a regime shift, that level of functional diversity is a boundary condition for species assemblies, and limits the number of potential species assemblies under consideration as a portfolio to those that uphold that level of functional diversity. In addition, as a resilient ecosystem is expected to lead to lower variability of returns, the species assembly holding that level of functional diversity also sets the maximum level of accepted risk for other potential species assemblies. Making use of economic valuation in this methodology thus limits the optimization of total economic value by putting a boundary on the minimum level of functional diversity. This way, optimization of total economic value is performed in accordance with a species assembly in a biodiversity portfolio, assessed through guidance by ecological resilience theory, that maintains an ecosystem's sustainability.

## 4. Conclusion

The purpose of this paper was to clarify a lack in the concept of total economic value that renders it inadequate to maintain sustainable use of ecosystem services, what notions of ecosystem sustainability can be used to address this lack, and to offer suggestions on how such notions can be combined with total economic value. To do so, the paper has touched upon three different lines of research: (1) research on the limits of optimization of the economic value of ecosystem services, which clarifies the information problem in economic valuation, (2) research on ecosystem resilience, which clarifies the characteristics of ecosystems that must be maintained for sustainable use of ecosystem services, from which we concluded functional diversity and mobile link species are its most important characteristics, and (3) research on portfolio theory, which explains the economic sense of extending investment in biodiversity to combat risk of losing returns from ecosystem services.

We expand on earlier research by arguing that these three lines of research can be combined to put total economic value in a framework that would foster sustainable use of ecosystems. The concepts of insurance value and resilience stock are part of resilience thinking, which is a perspective for a sustainability analysis of systems, whereas economic valuation is a method for optimization. This distinction suggests that the two apply to different stages in a process and can therefore complement each other (Fischer et al., 2010). We present portfolio theory as a framework in which investment in total economic value can be combined with investment in ecological resilience. Theory on functional diversity and resilience across scales can provide guidelines for species assemblies that maintain ecological resilience. Such a portfolio of biodiversity will give an investment strategy that most effectively lowers the risk of an ecosystem undergoing a regime shift and thus losing ecosystem services. The species assembly invested in sets a limit on future optimization of total economic value, while stabilizing its variance through time and insuring society against its loss. In conclusion, to solve the information problem in total economic value, economic valuation and optimization of an ecosystem's services needs to be performed in accordance with a species assembly in a biodiversity portfolio, assembled through guidance by ecological resilience theory, that maintains an ecosystem's sustainability.

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# Chapter 5

# A stakeholders’ view on indicators of farmers’ biodiversity Performance

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**Abstract**

The last decades have seen an increasing pressure on biodiversity in agricultural lands. The farmer plays a crucial role in maintaining biodiversity. However, opinions on systems of rating or rewarding of farmers for their performance in biodiversity management are divided. A study was conducted to elucidate the opinions of stakeholders of agricultural production on what would be proper indicators with which to rate a farmer's performance in stimulating biodiversity on his property. Four different stakeholders were chosen to express their opinions: farmers' organizations, nature conservation organizations, governmental organizations and food companies. Thirty different indicators were presented to the stakeholders and these indicators were grouped in three different categories: "A farmer's effort in nature management", "The preconditions necessary to obtain an enhanced performance" and "The attained nature results". By grading the thirty indicators, we found the revealed preferences for these three categories. In addition, in a stated preferences test the chain parties were asked to rank the three categories in importance.

The results show clear differences between the revealed and stated preferences of stakeholders to indicator types. This indicates that the stakeholders have opinions about the indicator categories that do not conform to their stated preferences. Furthermore, the revealed preferences test shows consistently high ratings for the indicator groups "preconditions" and "nature results", with a significant difference between those indicators groups and the "effort" group. Both results should be taken into account in the design of rating systems. Our study suggests that a rating system based on the preconditions necessary to obtain an enhanced performance and the attained biodiversity results will be experienced as most acceptable throughout the chain of agricultural production.

**Key words**

Biodiversity, agricultural production

**Introduction**

The last decades have seen an increasing pressure on the environment through a wide range of trends, including a growing world population, growing wealth, industrial activities and food production. In the Netherlands, intensive use of agricultural land has resulted in a decline of environmental quality on many fronts in agricultural areas (Manhoudt & De Snoo, 2003). Agricultural landscapes have become more homogeneous because of agricultural expansion and removal of non-crop habitat. In addition, agricultural practices have been intensified. Together, both trends are seen as important causes of a rapid decline in farmland biodiversity (Stoate et al., 2009). The last vestiges of farmland biodiversity are concentrated in field edges (Bianchi et al, 2006). This is problematic, because a loss of biodiversity increases the vulnerability of ecosystems to disturbances, such as pests and human-induced pressures. Biodiversity also supports necessary services for crop production, such as pollination.

In response, environmental awareness increased in the Netherlands, and with it came a desire to preserve or improve biodiversity in agricultural lands. Over time, all parties in the chain of agricultural production were affected by the societal change in values. Governmental organizations set up requirements for landscape quality, and companies engaged in more environmentally friendly production methods. Involving agricultural production chains in environmental management is a market oriented approach, which in theory enables consumers, the end users in the production chain, to steer agricultural production to environmentally friendly methods through market competition. Alternatively, the production chain is steered by retailers in a business-to-business approach. In both cases, the strategy assumes that consumers or retailers have an accurate knowledge of just how environmentally friendly a production chain is. Insufficient knowledge would create a market failure, and undermines the market oriented approach of environmental management.

To provide consumers or retailers with sufficient information, many market-oriented initiatives have been formalized in a system of labels and certificates. Labels have criteria relating to production methods, and the chain parties that meet these criteria are awarded recognition and potentially competitive success in the market (De Snoo and Van de Ven, 1999). In this system, a matter that requires solving is where in the chain of production the responsibility should lie of maintaining environmentally friendly production. The agricultural production chain consists essentially of primary producers such as farmers, processing industries like dairy factories and slaughter houses, retailers and consumers. The option where all parties are required to have a certificate has proven to be too rigid in the past, and has been abandoned, but partnerships and covenants between companies exists, sometimes stimulated by governmental organizations (Udo de Haes and De Snoo, 1996).

A variety of labels for sustainable agriculture have been introduced in the Netherlands. These existing labels aim to address the environmental problems of acidification, eutrophication, climate change effects and eco-toxicity. Van Amstel et al. (2007) noted that there is a distinct lack of labels that address problems of biodiversity loss. Themes of habitat loss and landscape fragmentation are scarcely covered (De Snoo and Van de Ven, 1999), and as such the Dutch collection of labels is insufficient to depend on as part of a national policy to stimulate agrobiodiversity.

For setting up a label for stimulating agro biodiversity, an important role is recognized in the farmer, who is the primary producer working on agricultural land. An increase in biodiversity on agricultural land can therefore be seen as the farmer's "biodiversity performance", and stimulating the biodiversity management of farmers is seen as crucial in environmental management (Von Haaren et al., 2012). Indicators of this biodiversity performance can guide farmers to environmentally friendly management strategies (Gunningham, 2007). Yet a farmer cannot be simplified as a cog in the production machine. Farmers are also social beings, who are, at every moment, influenced by their social environment, work, culture, economics, politics, and the preconditions of soil and water. This web of drivers impacts their willingness and ability to work on biodiversity on their farm, and hence setting an indicator of a farmer's biodiversity performance is not a straightforward task (De Snoo et al., 2012). Also, multiple stakeholders are involved. Farmer's organizations and other stakeholders need to be in support of such performance indicators to make them accepted and used. Environmental management is a social exercise that receives its shape through the values of the actors involved. So too a search for suitable indicators of a farmer's biodiversity performance depends also on what stakeholders involved in the production value most.

A farmer's biodiversity performance is a nebulous concept and consequently, any systems of rating and rewarding farmers touch on different issues. In this paper we consider three different potential measures of rating a farmer's biodiversity performance: the effort of the farmer in nature management, the preconditions of soil, water, air and local biodiversity that present the environmental frame in which farmers operate, and the attained nature results irrespective of effort and preconditions (Von Haaren et al., 2012). Henceforth these measures are referred to "effort", "preconditions" and "nature results" respectively. Opinions on systems of rating or rewarding of farmers for their performance in biodiversity management are divided, and insight into the opinions of stakeholders involved in production towards such rating systems helps to set up future rating systems that will be experienced as acceptable throughout the production chains of agriculture.

This paper aims to illuminate the values held by different stakeholders involved in agricultural production with respect to a famer's biodiversity performance. It aims to answer the question of which type of indicator such stakeholders find most suitable to measure on-farm biodiversity performance, and how the stakeholders differ in their opinions.

## Materials and Methods

To illuminate the values held by different stakeholders with respect to a famer's biodiversity performance, stakeholders were asked to state their preferences on a given set of indicators. Four different parties were chosen for this study: (1) farmers organizations, (2) nature and landscape conservation organizations, (3) governmental organizations and (4) food companies. With the word "farmer" different kinds of agricultural entrepreneurs are addressed, such as cattle farmers, crop cultivators and horticulturists. These different kinds of entrepreneurs each have different types of product approach, and so each would probably have a different way of treating the environment in their company areas. As stakeholders were interviewed who work with all the different types of entrepreneurs, the results will also represent all these different sectors. In total, 42 interviewees contributed to this study.

Interviews were used to obtain two kinds of information from the respondent: a stated preference and revealed preferences. First, the respondents were asked to choose the best type of indicator on its suitability to determine a farmer's biodiversity performance, giving the respondents a choice between (1) effort in nature management, (2) preconditions and (3) the attained nature results. Secondly, thirty different indicators were presented to the stakeholders to be graded in preference on a scale of one to five. These thirty indicators can be grouped in the same three categories as presented in the first test (in short, effort, preconditions and nature results) (table 1). In the questionnaire, the sequence of the indicators to be rated was randomized. By grading the thirty indicators, the revealed preferences were found for the three categories of indicators, and the most preferred indicators were found for each stakeholder.

A Fisher's Exact test of independence was done on the results of the stated preference test, to test the hypothesis that the stakeholders chose each indicator group with equal frequency. The revealed preferences were analyzed with a linear mixed model (function lme () of the R package "nlme" in R version 2.15.1). The independent variable in the model was the scale of one to five on which the respondent had to rate the indicator, where one equals "very unimportant" and five equals "very important". The fixed factors in the model were the indicator groups and the stakeholders, the random factor was the respondent.

| Indicator category | Description indicator |
|---|---|
| Farmer's effort in nature management | 1. The farmer has a company nature plan<br>2. How long the farmer already takes nature friendly measures<br>3. The farmer is a member of an agricultural nature association<br>4. The farmer is active in nature education<br>5. The farmer accepts volunteers for nature management on his grounds<br>6. The time the farmer spends on nature management<br>7. The farmer is a certified nature manager<br>8. The farmer has received nature education<br>9. The farmer manages nature outside his own grounds<br>10. The farm/farming system is organic |
| The preconditions necessary to obtain an enhanced performance | 11. The connectivity of the nature elements to the surrounding nature<br>12. The air, soil and water on the farm are clean<br>13. Percentage of the company area with nature elements<br>14. Diversity of the nature elements present<br>15. Company area on which the farmer takes nature friendly measures |

| | |
|---|---|
| | 16. The nature on the farm is accessible for third parties (e.g. recreationist)<br>17. The measure of the farming intensity<br>18. Construction of artificial hiding and nesting places for animals<br>19. The presence of food for wild animals<br>20. Diversity of the crops and the livestock |
| The attained nature results | 21. The presence of regional landscape elements<br>22. The presence of regional plant and animal species<br>23. The total number of present plant species<br>24. The experience of the nature by third parties (e.g. recreationists)<br>25. The presence of useful plant and animal species<br>26. The total number of present animal species<br>27. The presence of rare and/or threatened species<br>28. The presence of rare and/or threatened landscape elements<br>29. A beautiful nature<br>30. The presence of old crops and livestock |

**Table 1**. Thirty different indicators that were presented to the stakeholders to be graded in preference on a scale of one to five.

**Results**

Looking at the stated preference for indicator group by stakeholder (figure 1), the Fisher's Exact test of independence showed no statistical contingency between the stakeholders and their choices for indicators ($p=0.6959$). Next, the revealed preferences of stakeholders was ascertained (figure 2). Where in the stated preference question the parties were asked to choose a specific indicator group, here thirty different indicators were presented that form the three groups of effort, preconditions and nature results. It was expected that the results of this test were similar to the test above. However, the results differ.

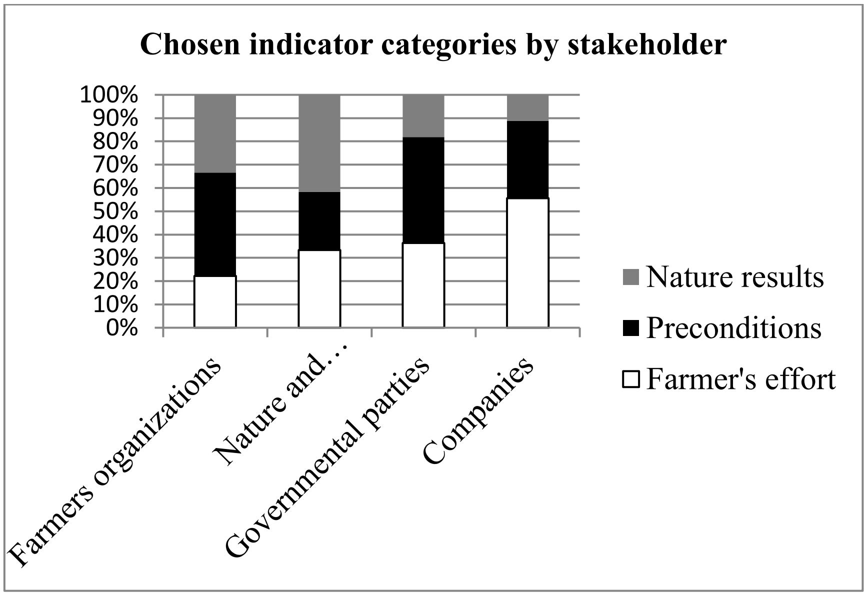


**Figure 1.** Stated preference for indicator group by stakeholder. The bars show the percentages of respondents per stakeholder that chose the indicator group. No statistical differences were found between stakeholders and between indicator groups within the stakeholder bars.

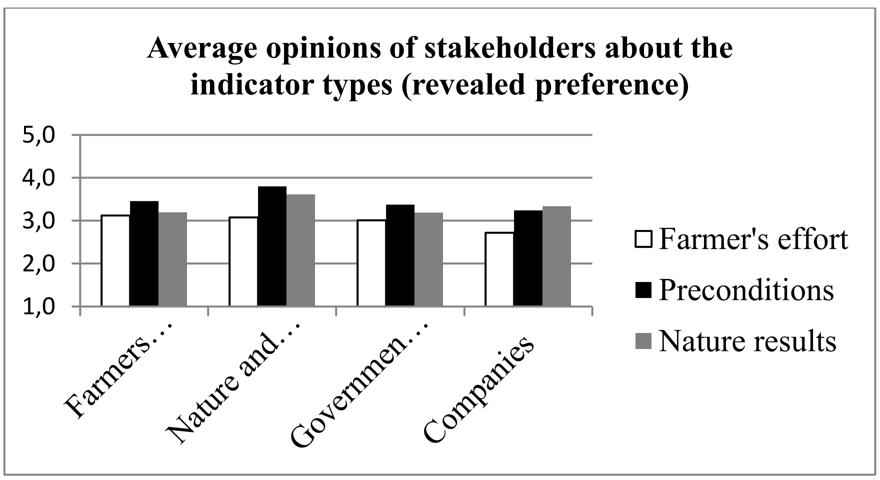


**Figure 2**. Revealed preferences of stakeholders about the types of indicators. The bars represent the average ratings.5=high rating, 1=low rating.

No statistical difference was found between the stakeholders (p=0.2024), meaning that all stakeholders rate the indicator groups with similar preferences. A statistical difference was found between the ratings of the indicator groups (p<0.0001) (table 2). This means that the three indicator types were rated differently by the stakeholders, with a clear overall preference for the "preconditions" type, and an overall dislike for the "farmer's effort" type (figure 3). No interaction effects were found.

| | numDF | denDF | F-value | p-value |
|---|---|---|---|---|
| (Intercept) | 1 | 1206 | 2417.40 | <0.0001 |
| Indicator groups | 2 | 1206 | 28.93 | <0.0001 |
| Stakeholders | 3 | 38 | 1.61 | 0.2029 |
| Indicator groups : stakeholders | 6 | 1206 | 1.72 | 0.1134 |
| | | | | |
| Random effects<br>Random factor: respondent | | | | |
| | (Intercept) | Residual | | |
| Standard deviation | 0.39 | 0.97 | | |

**Table 2**. Results from the linear mixed model. No statistical difference was found between the stakeholders. A statistical difference was found between the ratings of the indicator groups.

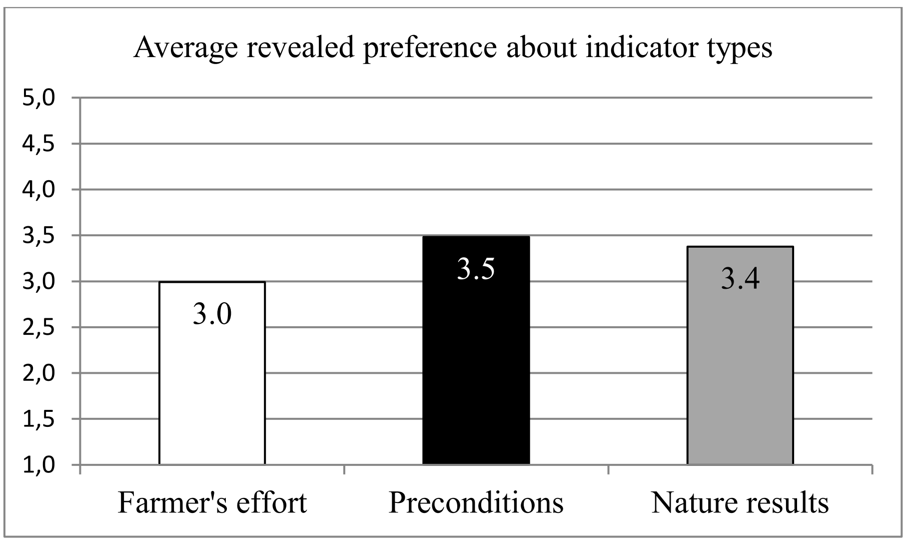


**Figure 3**. Average revealed preferences for the indicator groups. 5=high rating, 1=low rating.

A list is given of the thirty indicators and how they are rated by the stakeholders (table 3). There are noteworthy differences in how stakeholders rate certain indicators. In a few instances, nature and landscapes organizations have given high ratings to indicators that have been rated low by other stakeholders, or vice versa. The indicator “The farm/farming system is organic” was rated highly, but all other stakeholders gave a low rating. Conversely, the indicators “The presence of useful plant and animal species” was rated low, and “The farmer has a company nature plan” was rated moderately low, but all other stakeholders rated both indicators highly. Governmental organizations gave a low rating to “The presence of rare and/or threatened species”, while all other stakeholders rated it moderately high to high. All stakeholders taken together, indicators of connectivity of nature elements, clean air, soil and water, and indicators of regional plants, animals and landscape elements were rated highly. Low ratings were given to indicators of organic farming, for farmers managing nature outside his grounds, for a beautiful nature and for the presence of old crops and livestock.

| Indicator category | Description indicator | Farmer organisations n=10 | | Nature organisations n=12 | | Government n=11 | | Companies n=9 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average rating | Standard deviation | Average rating | Standard deviation | Average rating | Standard deviation | Average rating | Standard deviation |
| Farmer's effort into nature management | The farmer has a company nature plan | 3.5 | 1.3 | 3.0 | 1.2 | 3.7 | 0.9 | 3.6 | 0.9 |
| | How long the farmer already takes nature friendly measures | 3.3 | 0.9 | 3.2 | 1.2 | 3.1 | 0.8 | 2.9 | 0.8 |
| | The farmer is a member of an agricultural nature association | 3.7 | 0.8 | 3.0 | 1.2 | 3.4 | 0.8 | 2.4 | 1.3 |
| | The farmer is active in nature education | 3.3 | 0.7 | 3.2 | 0.6 | 3.0 | 0.8 | 2.8 | 1.2 |
| | The farmer accepts volunteers for nature management on his grounds | 3.0 | 1.2 | 3.1 | 1.0 | 3.5 | 1.0 | 2.6 | 0.7 |
| | The time the farmer spends on nature management | 2.8 | 1.2 | 3.3 | 1.0 | 3.1 | 1.2 | 3.1 | 0.8 |
| | The farmer is a certified nature manager | 3.2 | 1.1 | 3.3 | 1.1 | 2.8 | 1.2 | 2.3 | 1.3 |
| | The farmer has enjoyed nature education | 3.4 | 1.3 | 2.8 | 1.3 | 2.1 | 0.7 | 2.6 | 1.0 |
| | The farmer manages nature outside his own grounds | 2.6 | 1.2 | 2.8 | 1.1 | 2.8 | 1.2 | 2.7 | 0.9 |
| | The farm/farming system is organic | 2.4 | 1.0 | 3.3 | 1.2 | 2.6 | 0.9 | 2.3 | 1.1 |
| The preconditions necessary for nature results | The connectivity of the nature elements to the surrounding nature | 3.7 | 0.9 | 4.5 | 0.7 | 3.9 | 0.8 | 3.6 | 1.2 |
| | The air, soil and water on the farm are clean | 4.0 | 0.8 | 4.4 | 0.7 | 3.5 | 1.4 | 4.6 | 0.5 |
| | Percentage of the company area with nature elements | 3.5 | 0.8 | 3.7 | 0.9 | 3.7 | 0.8 | 3.1 | 1.1 |
| | Diversity of the nature elements present | 3.4 | 1.5 | 4.1 | 0.7 | 3.6 | 0.9 | 3.6 | 1.1 |
| | Company area on which the farmer takes nature friendly measures | 3.5 | 0.8 | 4.2 | 0.8 | 3.2 | 1.3 | 3.0 | 1.4 |
| | The nature on the farm is accessible for third parties (e.g. recreationist) | 3.2 | 1.2 | 3.5 | 1.1 | 3.1 | 1.0 | 2.2 | 1.0 |
| | The measure of the farming intensity | 3.2 | 0.4 | 3.7 | 1.0 | 3.4 | 1.2 | 3.0 | 1.1 |
| | Construction of artificial hiding and nesting places for animals | 3.8 | 0.4 | 2.9 | 1.1 | 3.3 | 1.0 | 3.3 | 0.9 |
| | The presence of food for wild animals | 3.3 | 1.1 | 3.8 | 0.7 | 3.3 | 0.8 | 2.8 | 1.0 |
| | Diversity of the crops and the livestock | 3.0 | 1.3 | 3.2 | 1.2 | 2.8 | 1.2 | 3.3 | 1.1 |
| The attained nature results | The presence of regional landscape elements | 3.7 | 0.9 | 3.9 | 1.0 | 3.8 | 0.6 | 3.8 | 0.8 |
| | The presence of regional plant and animal species | 3.7 | 0.9 | 3.9 | 0.7 | 3.7 | 0.9 | 3.8 | 0.4 |
| | The total number of present plant species | 3.2 | 1.0 | 4.1 | 0.7 | 3.4 | 0.9 | 3.3 | 0.7 |
| | The experience of the nature by third parties (e.g. recreationists) | 3.2 | 1.2 | 3.7 | 1.0 | 2.9 | 1.1 | 3.0 | 1.1 |
| | The presence of useful plant and animal species | 3.8 | 0.8 | 2.7 | 1.6 | 3.5 | 1.0 | 4.0 | 0.7 |
| | The total number of present animal species | 3.2 | 1.0 | 3.9 | 0.7 | 3.1 | 0.7 | 3.3 | 1.0 |
| | The presence of rare and/or threatened species | 3.5 | 1.3 | 4.4 | 0.5 | 2.8 | 1.0 | 3.2 | 1.2 |
| | The presence of rare and/or threatened landscape elements | 2.5 | 1.3 | 3.8 | 1.1 | 3.3 | 1.0 | 3.2 | 1.2 |
| | A beautiful nature | 2.7 | 1.1 | 2.9 | 1.2 | 2.9 | 1.2 | 3.2 | 1.3 |
| | The presence of old crops and livestock | 2.7 | 1.3 | 2.9 | 1.4 | 2.5 | 0.9 | 2.6 | 1.0 |

Table 3. *Average ratings for each indicator by the four stakeholder groups.*

**Discussion**

This paper aimed to illuminate the values held by different stakeholders involved in agricultural production with respect to a famer's biodiversity performance. It aimed to answer the question of which type of indicator the stakeholders find most suitable to measure on-farm biodiversity performance. The stated preferences test yielded no statistical differences between the stakeholders, nor between the indicator groups chosen.

The revealed preferences test shows consistently high ratings for the indicator types "preconditions" and "nature results". All respondents taken together, there is a significant difference between those indicators types and "farmer's effort". Our study suggests that a rating system based on the preconditions necessary to obtain an enhanced performance and the attained biodiversity results will be experienced as most acceptable throughout the stakeholders involved, and that a rating system based on indicators of farmer's effort will be experienced as less acceptable. These conclusions should be taken into account in the design of future rating systems for biodiversity performance.

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# Chapter 6

# Motivations for committed nature conservation action in Europe

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**Abstract**

Despite ongoing efforts to motivate politicians and publics in Europe for nature conservation, biodiversity continues to decline. Monetary valuation of ecosystem services sees popular usage to get people acting for nature, but appears to be insufficient to motivate people, suggesting that non-monetary values have a crucial role to play. In extant literature, there is insufficient information about the motivations of actors who have been instrumental in successful conservation projects. We investigated the motivations of these biodiversity actors for their work using a ranking of cards, and compared the results with the rankings of motivations of a second group of actors with more socially related interests. For both groups of actors, action for biodiversity is supported in general by two groups of motivations related to living a meaningful life and moral values. The social actors noted in addition that their action for biodiversity rested more on beauty, place attachment and intrinsic values in comparison with their main non-biodiversity interests. Our results have implications for environmental policy and biodiversity conservation in that the current tendency of focusing on economic valuation of biodiversity fails to address the motivations exhibited by successful actors, and thereby fails to motivate nature conservation on an individual level.

**Keywords**

Biodiversity conservation, ecosystem services, environmental policy, economic valuation

## 1. Introduction

As reported by the European Environmental Agency, biodiversity in Europe is in a crisis of continuous decline (EEA 2015). The Eurobarometer (EU 2015) investigation shows that biodiversity degradation is considered a serious topic by eight out of ten Europeans, yet this concern apparently is not translated into successful action (Pearce 2007). The rise of the ecosystem services concept (e.g. MEA 2005) and the economic valuation of these services can be seen as an attempt to adequately inform private and public decision making to address this problem; economic valuation is used to prove that biodiversity, with values approaching trillions of euros worldwide, is worth protecting (Costanza *et al.* 1997; TEEB 2013; Costanza *et al.* 2014). Ecosystem services as a concept attained a broader global institutionalization, as is visible for example in the global initiative TEEB (2013), the World Bank's WAVES partnership (WAVES 2015) and a large-scale research programmes such as IPBES (IPBES 2015) and the European Horizon 2020 (Admiraal *et al.* 2016), making ecosystem services the foremost way to express the value of biodiversity to society.

However, the ecosystem services approach appears to fail in its motivational objective to stimulate European governments and the general public to prevent further biodiversity degradation (Tittensor *et al.* 2014). Within the ecosystem services community, this failure has prompted reflections on its limitations (O'Neill 1997; Norgaard 2010) and calls for caution about its promises (Locatelli *et al.* 2013). Specifically, economic approaches may crowd out other, non-economic motivations (Rode *et al.* 2015; Luck *et al.* 2012; Gómez-Baggethun & Ruiz-Pérez 2011). This corresponds with research from outside the ecosystem services community, demonstrating that committed action for nature rests on grounds other than economic values, such as the development of trust between stakeholders and other moral standards (Hiedanpää & Borgström 2014; Flint *et al.* 2013; Sponarski *et al.* 2014) and room for autonomous action in conservation initiatives (Dedeurwaerdere *et al.* 2016).

Extant literature paints a complex picture of personal motivation to act for biodiversity. This picture must be understood more fully in order to grasp where current efforts to motivate people fall short. Environmental psychology has conducted a large number of studies about motivation for environmental action, but this research is often focused on single factors assumed to be pivotal for action. Examples include connectedness to nature (Mayer & Frantz 2004), egoistic, altruistic, and biospheric environmental concerns (Schultz 2001), place attachment (Williams & Vaske 2003), community (Asah & Blahna 2013), subjective norms (Fornara *et al.* 2011), empathy (Schultz 2000), time perspective (Corral-Verdugo *et al.* 2006), views on human-nature relationships (Van den Born *et al.* 2001) and emotions, habits and rational choices (Carrus *et al.* 2008). These studies almost invariably conclude that the factors of interest perform a role in environmental behavior.

What remains unknown is how these factors act in concert or in relation to each other. Gifford & Nilsson (2014) for example, recognize this diversity of factors in the literature and provide an overview of no less than 17 'categories of influence' on environmental behaviour, and conclude that research should focus on how these influences interact with each other. In search for theories of interaction, several studies depart from a relatively wide set of motivational factors. Kollmuss & Agyeman (2002), for example, attempted to incorporate multiple factors, including knowledge, values, attitudes, emotions and more. Clark *et al.* (2001) and Ryan & Deci (2000) distinguish between internal and external influences on behavior. Perkins (2010) combines several factors to measure people's emotional relationship with nature. The general findings of these studies are that these factors are in fact related to each other and that humans do not act for nature primarily to safeguard ecosystem services but for a complex combination of reasons that is very difficult to model.

What motivates individuals to protect the environment therefore remains a key issue of investigation, and an interdisciplinary approach is needed for a better understanding of this complex issue (Perkins 2010). The present paper stands in this tradition of interdisciplinary, 'multi-factor studies', with the added value of focusing on a group of highly committed individuals as so-called 'biodiversity activists'. This group forms an important yet underexplored source of information about motivations to act for biodiversity.

Conservation motivations of committed 'biodiversity activists' likely differ from people who engage in other causes such as urban social development or care for invalids. Such social or 'non-biodiversity activists' may engage in conservation activities only in the margin of their lives, e.g. when donating to a conservation charity. Regarding motivations, a life-time devotion to biodiversity conservation might be driven by moral values while a marginal action might be motivated by a felt obligation or a social norm. To clarify how the motivations for conservation of committed actors might differ from non-biodiversity focused actors, we compare our 'biodiversity activists' to 'activists committed to other causes'. Our research question was: how do committed actors for biodiversity and committed actors for non-biodiversity causes rank their motivations to act for nature, given a broad set of motivational options? Mapping the specific motivations that they rank themselves would provide clarity that could help to stimulate both committed conservationists already working in the field and people acting for nature in the margin of their lives.

## 2. Methods

### *2.1. Participant Selection*

The study was part of a greater European FP7 research project named BIOMOT (2011). Within this project, an interdisciplinary team of researchers from Belgium, Finland, Germany, Italy, the Netherlands, Slovenia and the United Kingdom investigated what motivates people to act for biodiversity and to explore alternative ways for valuing biodiversity. In each country, conservation leaders were interviewed using the same data collection methods to map their individual motivations for conservation action. The project recognized that motivation for biodiversity conservation can play out in many sectors of society, from managers making strategic decisions in business to elementary school teachers stimulating wonder of nature in children. Living up to this diversity, a list of three sectors with sub-categories was used as a criterion for selecting interviewees. These sectors were (*i*) the public domain (including local governments, city parks and projects part of Natura 2000 and UNESCO-MAB networks), (*ii*) business (including fishing, farming, forestry, food production, corporate land ownership and tourism) and (*iii*) civil society (including school teachers, NGOs, foundations, media professionals, civil activists).

For each sub-category in the list, a committed actor for biodiversity conservation was identified in each country. 'Committed actor' was defined as any person who spends much more time or energy for the cause of biodiversity conservation than could be expected from normal citizen or job duties. Examples of committed actions include founding a biodiversity NGO, radically greening a firm or spending tireless energy on nature education. For simplicity's sake, we call them 'biodiversity activists' here, but it should be kept in mind that this term includes many non-political actors, such as bureaucrats and school teachers. Then, a second committed actor was identified who worked in the same category (e.g. schools, government, media) but without a strong conservation commitment. For simplicity's sake again, we name them 'non-biodiversity activists' here, to which the same caveat applies as with the biodiversity activists. For example, in the sub-category 'food', in each country an actor was identified who pushed through a change in management in a company towards biodiversity-friendly methods. This would be the biodiversity activist. For selecting a non-biodiversity activist, a similar production company was identified in the same country that did not make a similar commitment to biodiversity conservation and an actor was interviewed from a similar occupational role as the biodiversity activist. In many cases, this actor worked committedly for another goal, such as poverty reduction, projects for disabled people, community building or any other goal not directly related to biodiversity.

*2.2. Interview Structure*

The interview consisted of a semi-structured life-history part, followed by a sorting of cards that displayed motivations. In the life-history part, the interviewees reflected on the history of their committed actions, in the context of their more general life story. For the cards sorting element that is the focus of the present paper, the life-story part acted as a 'primer', focusing the interviewees on the full extent of their actions and developing a 'feel' of how their actions were embedded in the context of their life (see Table S1 for the interview structure). On that basis built in the life-history part, the interviewees were given a set of twenty cards, with a motivation on one side and on the other side a brief explanation of the motivation. The full list is shown in Table 1. The interviewee was asked to rank the cards on a 6-step scale from most important (6) to least important (1), and was allowed to freely distribute the motivations over the 6 scales.

The procedure of the card rankings differed between the biodiversity activists and the non-biodiversity activists in that the latter were asked to rank the cards twice: once for their non-biodiversity cause, which was their main cause and defined by the interviewees themselves, and the second time for any biodiversity action they had engaged in. Their actions for biodiversity were usually fairly minor, e.g. making a small monthly donation to a conservancy or some hours of volunteer work. The resulting motivational rankings of both groups of actors allowed us to make three comparisons:

1. The difference in motivations to act for biodiversity between both groups of activists.
2. The difference in motivations of the biodiversity activists to act for biodiversity on the one hand, and the motivations of the non-biodiversity activists to act for their main causes on the other.

3. The difference in motivations within the group of non-biodiversity activists to act for their main cause and for biodiversity.

*2.3. Creating the Motivation List*

The list of twenty motivations for the card set has been grounded in a two-step, multi-disciplinary exploration that sought representation of fundamental motivational concepts found in philosophy, social psychology and governance science. The first step was a literature review carried out by researchers of these disciplines in the BIOMOT project, subsequently compiled into a reference document (BIOMOT 2013). The second step consisted of workshop discussions between all BIOMOT researchers, in which the scientific basis was enriched by a pragmatic reflexivity (Popa *et al.* 2014). These discussions were inspired by the professional experience and cultural diversity of the BIOMOT researchers, resulting in a list of 20 motivations that was considered 'saturated' (i.e. comprising all fundamental concepts).

The concepts from the various disciplines appeared to overlap well in meaning; examples are the items of 'hedonic' in Schwartz (1992) and 'instrumental' in Muraca (2011), and the items of 'power' in Schwartz (1992) and 'control' in Fiske (2014). Another example of an overlap of concepts is that the concept of 'connectedness' was found in the literature from different fields, including environmental psychology (Tam 2013) and philosophy (Nolt 2006). However, on the level of overarching concepts that authors tend to use in order to arrive at a structured classification, interdisciplinary convergence turned out to be impossible. For example, motivations can be grouped in classes such as intrinsic versus extrinsic, or individually based versus group-based, or hedonic versus moral, or economic versus non-economic, but these classes could not be molded into a single structured classification. This is corroborated by Kollmuss & Agyeman (2002) who encountered similar problems in combining models of environmental behavior. As a consequence, the 20 motivations represents values, emotional states and end goals, which can all be potential motivations. Also, as a result, they were presented as an *un*structured list (Table 1), open to be classified in follow-up studies depending on aim, research context or disciplinary tradition. The cards were translated and back-translated in the interviewee's local language.

| Motivation | Given description on the card |
|---|---|
| Anger | You are motivated by anger, disgust, contempt or other negative emotions towards individuals, groups or events. |
| Insecurity | You are motivated by a sense of insecurity or anxiety and your desire to reduce these feelings. |
| To end or prevent conflict | You are motivated by a desire to end or prevent a collision between people. |
| Duty | You are motivated by a sense of duty, responsibility and/or obligation. |
| Religion or spirituality | You are motivated by a religious or spiritual belief or practice. (You are allowed to choose between the two.) |
| Beauty | You are motivated by beauty or other aesthetic qualities. |
| Curiosity and learning | You are motivated by a fascination with complexity of things and the opportunities they provide for learning. |
| Value in itself | You are motivated by a belief that some things are valuable in themselves, regardless of their usefulness to you or others. |
| Connectedness | You are motivated by a feeling of connectedness to something larger than |

| | |
|---|---|
| | yourself and your feelings of care and affection for this larger whole. |
| Attachment to place | You are motivated by your attachment to a particular place or places. |
| My children/family | You are motivated by your care and concern for your children or family. |
| Future generations | You are motivated by your care and concern for, or feeling of solidarity with, future generations of humans. |
| Recognition | You are driven by the desire to gain positive recognition from those around you, because this makes your life more significant. |
| Control | You are motivated by a desire to have influence and to exercise that influence. |
| Living a worthwhile life | You are motivated by a desire to live a good, meaningful and worthwhile life. |
| Destiny | You are motivated by a belief that you have a calling. |
| Social benefit | You are motivated by a desire to promote a benefit for your community or wider society. |
| Personal benefit | You are motivated by a desire to promote a benefit for yourself. |
| Pleasure in doing what you are good at | You are motivated by the pleasure in doing things that you are good at. |
| Pleasure of doing things with others | You are motivated by the pleasure in joining in and collaborate with others. |

**Table 1**: the 20 motivations with a short description of each, as presented to the interviewees.

In total, 217 interviewees took part in the cards ranking. Roughly half of the 217 interviewees (109) were classified as “biodiversity activists” and 68 were classified as “non-biodiversity activists”; 40 interviewees were re-classified as not being part of either of the two groups, since it turned out in the interviews that they did not devote much more than their job requirements to any cause. For clarity of interpretations, they were not taken up in the analysis. Due to coordination difficulties between partners, in three countries (Belgium, Finland and the UK) the non-biodiversity activists were asked to rank the cards only for their main cause, but the total numbers of the rankings in the entire dataset were still considered sufficient for the three comparisons.

*2.4. Statistical Analysis*

We used R (R Core Team 2012) and *lme4* (Bates *et al.* 2015) to create a linear mixed-effects model to analyze the relationship between the scores (1-6) given to the 20 motivations, taking along variables for activist type (biodiversity or non-biodiversity), subject (biodiversity cause or non-biodiversity cause), gender and country as fixed factors. All the interactions between the fixed factors were included in the model. The scores of an individual interviewee may not be independent from each other because individual interviewees may rank motivations generally higher or lower than other interviewees. For this reason, individual interviewees were regarded as a random factor in the model. Since all our fixed factors were categorical, the linear mixed model used here estimated the differences in scores (1-6) per motivation between activist types and subjects. These estimates were standardized to t-values. Due to the random factor of the individual interviewees, the degrees of freedom are no longer well defined, which makes it impossible to properly estimate the p-values. However, we considered t-values lower than -2 and higher than 2 as critical values to indicate a significant difference between the scores, as these values correspond in probability with $p<0.05$.

The model also enabled us to test the difference between activist types by applying a Likelihood Ratio Test, i.e. testing the effect of removing activist type from the model on its data fit (likelihood). In the same way we tested the effect of subject, gender and country. The differences that activist type, subject, gender or country made on the model were estimated in p-values.

**3. Results**

In the ranking of motivations of biodiversity activists, the ten highest ranking motivations differ little in their score (Fig. 1a). This suggests that conservation action is founded on a broad selection of possible motivations. High ranking motivations are *curiosity and learning, value of nature in itself, living a worthwhile life* and *future generations.* Notably, motivations that point to instrumental values of biodiversity such as *personal benefit* and *self-significance* received a low rating. Other motivations that point to self-expression or self-assertion, such as *anger*, *control* and *insecurity*, also received a low rating, possibly because of negative connotations attached to them. *Religion or spirituality* and *destiny* also received a low rating on average.

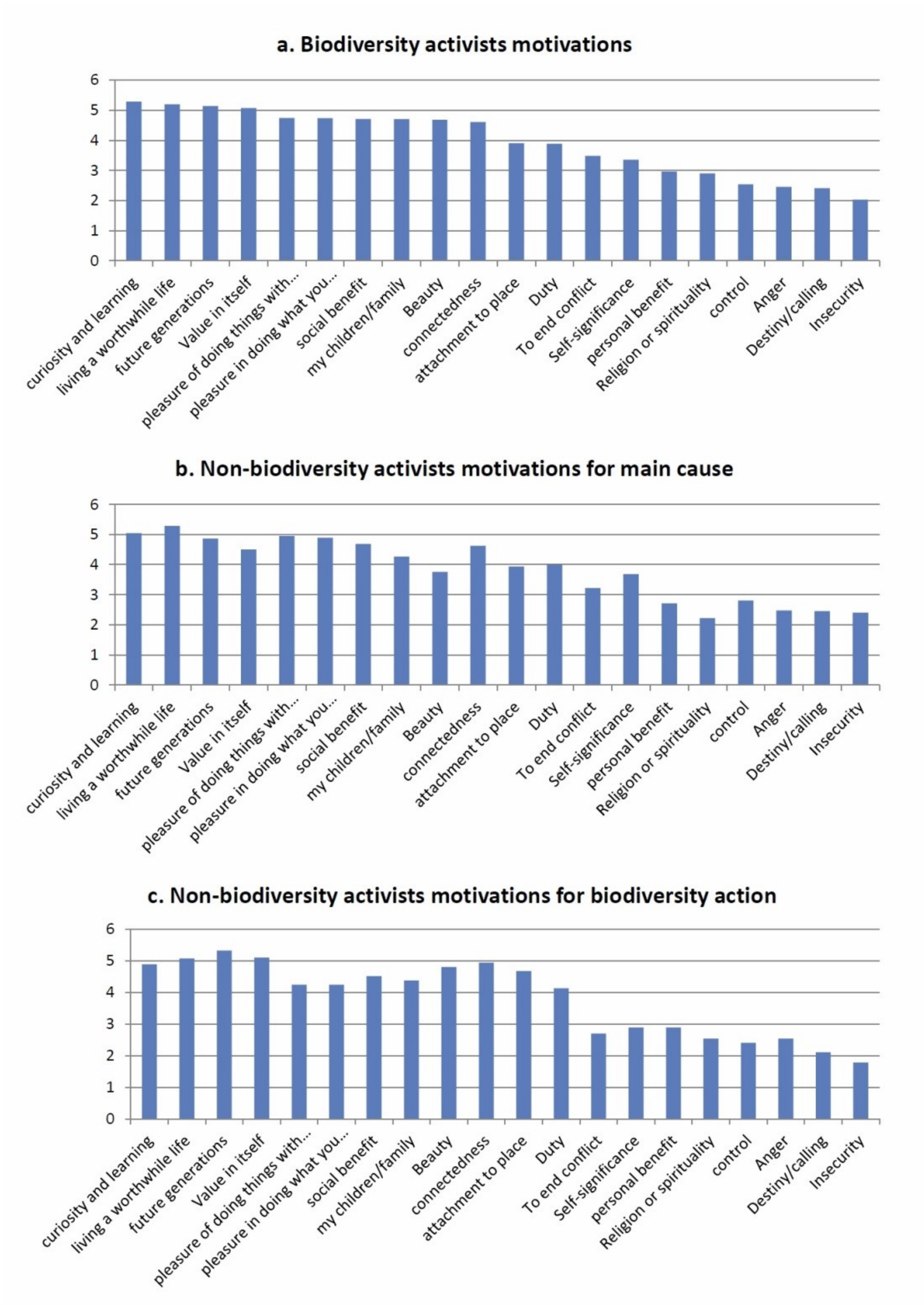


**Figure 1**. Motivations of biodiversity activists and non-biodiversity activists for their main interest and actions for biodiversity.

Significant differences exist between the rankings by biodiversity activists and non-biodiversity activists for their main interest (biodiversity cause or non-biodiversity cause) (Likelihood Ratio Test, $Chi^2$=54.996, Df=20, P< 0.001), although most motivations are ranked similarly high or low between the two groups (Fig. 1). More precisely, *value in itself, beauty* and *religion or spirituality* received significantly lower ratings by the non-biodiversity activists for their main cause than by the biodiversity activists for their biodiversity cause (Table 2). Nevertheless, *religion or spirituality*'s rating is low relative to the other motivations, indicating that it generally plays a small role.

| Motivation (as presented on card) | Biodiversity activists | Social activists (main interest) | | Social activists (biodiversity) | | |
|---|---|---|---|---|---|---|
| | | Average | T value vs Biodiversity activists | Average | T value vs Biodiversity activists | T value vs Social activists (main interest) |
| Curiosity and learning | 5.29 | 5.04 | **-0.885** | 4.89 | **-1.587** | **-0.533** |
| Living a worthwhile life | 5.20 | 5.28 | **0.223** | 5.08 | **-0.513** | **-0.656** |
| Future generations | 5.14 | 4.87 | **-0.902** | 5.32 | **0.334** | **0.978** |
| Value in itself | 5.07 | 4.50 | **-2.022*** | 5.11 | **-0.467** | **1.350** |
| Pleasure of doing things with others | 4.75 | 4.96 | **0.642** | 4.24 | **-1.749** | **-1.915** |
| Pleasure in doing what you are good at | 4.74 | 4.90 | **0.408** | 4.24 | **-1.721** | **-1.767** |
| Social benefit | 4.71 | 4.69 | **-0.14** | 4.51 | **-0.762** | **-0.583** |
| My children/family | 4.71 | 4.27 | **-1.473** | 4.38 | **-1.028** | **0.116** |
| Beauty | 4.68 | 3.76 | **-3.358*** | 4.81 | **-0.155** | **2.438*** |
| Connectedness | 4.61 | 4.63 | **-0.023** | 4.95 | **0.303** | **0.633** |
| Attachment to place | 3.91 | 3.94 | **-0.073** | 4.68 | **1.535** | **1.661** |
| Duty | 3.89 | 4.00 | **0.428** | 4.14 | **0.305** | **0.184** |
| To end conflict | 3.49 | 3.22 | **-0.995** | 2.70 | **-2.167*** | **-1.443** |
| Self-significance | 3.36 | 3.69 | **1.105** | 2.89 | **-1.674** | **-2.119*** |
| personal benefit | 2.96 | 2.71 | **-0.856** | 2.89 | **-0.533** | **0.278** |
| Religion or spirituality | 2.91 | 2.22 | **-2.371*** | 2.54 | **-1.249** | **0.627** |
| Control | 2.54 | 2.81 | **0.725** | 2.41 | **-0.78** | **-1.145** |
| Anger | 2.46 | 2.48 | **0.074** | 2.54 | **0.45** | **0.266** |
| Destiny/calling | 2.41 | 2.45 | **-0.053** | 2.11 | **-1.251** | **-1.005** |
| Insecurity | 2.04 | 2.40 | **1.154** | 1.78 | **-0.984** | **-1.685** |

**Table 2**. Motivation rankings, with t-values in bold. An asterisk (*) signifies a significant difference of a t-value <-2 and >2.

A follow-up question is then which motivations would be important for non-biodiversity activists to take up action for biodiversity conservation (Fig. 1c). For the ranking of motivations to act for biodiversity, significant differences appear to exist between the two groups of activists (Likelihood Ratio Test, $Chi^2$=33.694, Df=20, P=0.028). The pleasure motivations (*pleasure in doing what you are good at* and *pleasure of doing things with others*) are rated lower by the non-biodiversity activists than by the biodiversity activists, and so is the *to end conflict* motive (Fig. 2). This suggests that non-biodiversity activists find less pleasure in biodiversity conservation than in their main interest, might usually not work together with others to act for biodiversity, and feel less driven to deal with conflicts involving biodiversity conservation. Yet in comparison with their motivations for their main interest (Likelihood Ratio Test, $Chi^2$=60.945, Df=20, P<0.001), it becomes clear that *beauty* is an important motive to act for biodiversity for the non-biodiversity activists as well, as they rank it significantly higher for biodiversity conservation-related action than for their main interests (Table 2). No similar raise is seen in the ratings for *value in itself* and *religion or spirituality* for biodiversity conservation, suggesting that these motivations are less important for this group for biodiversity conservation. Action for biodiversity conservation also turns out to be less related to their sense of *self-significance*.

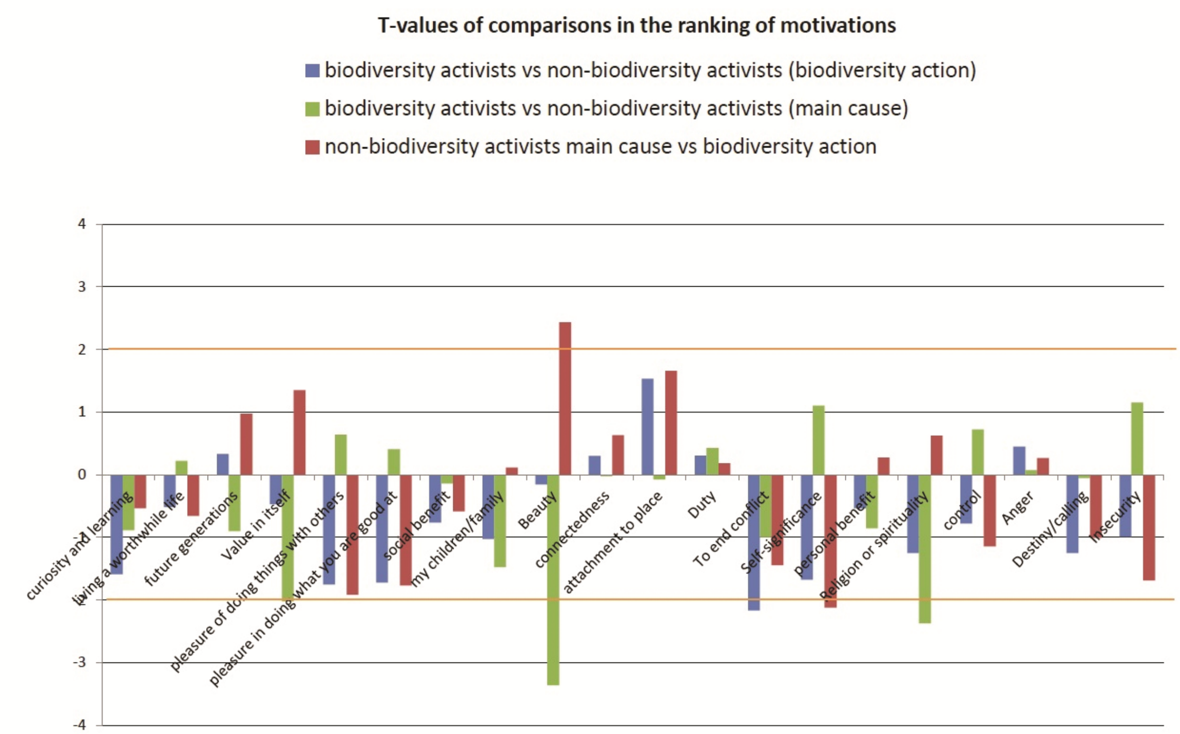


**Figure 2**. T-values of the comparisons of motivation rankings. Orange lines showing values >2 and <-2, which signify a significant difference.

The same three comparisons between biodiversity activists and non-biodiversity activists and their rankings of motivations were explored further for effects of gender and country. No significant effect of gender was found in the model for the comparison between the two groups of activists and their rankings of motivations for their main interest (P=0.2154), nor for biodiversity conservation (P=0.8811). Also, in the comparison within the non-biodiversity activists group between main interest and biodiversity conservation for, no significant effect for gender was found (P=0.1488).

In the comparison between biodiversity activists and non-biodiversity activists for their main interest, a significant effect was found for country of origin (Likelihood Ratio Test, $Chi^2$=423.95, Df=240, P<0.001). The greatest differences between the countries could be found in the rankings of Germany and the United Kingdom, whose non-biodiversity activists scored significantly higher for many motivations than the other countries. However, the motivations *value in itself, beauty* and *religion or spirituality,* which differed the most in the total comparison (Fig. 2), were ranked similarly among the countries, suggesting that although the average ranking between countries may differ, a common trend occurs in which the same motivations are rated differently between biodiversity activists and non-biodiversity activists in all countries. Further comparisons between the rankings for action for biodiversity were not possible, since this ranking was not performed by the non-biodiversity activists in three countries.

## 4. Discussion

### *4.1. Overview*

Although the rankings by biodiversity activists for their work in conservation differ significantly from the rankings by non-biodiversity activists for their main interests, a deeper investigation into the individual rankings of motivations clarifies that only a few specific motivations show a significant difference between these two groups, and the top and bottom motivations are very similar in both groups (figure 2). This suggest not only that biodiversity conservation is supported by a broad palette of motivations, but also that this palette of motivations for committed action is shared amongst people regardless of the topic of interest. The lack of significant gender differences and the similarities in ratings between the countries further underscore a universality of these motivations. The four top ranking motivations for biodiversity action could be interpreted as aggregating into two groups: (*i*) living a meaningful life (*living a worthwhile life* and *curiosity and learning*) and (*ii*) moral values (*future generations* and *value in itself*). Both value-groups have a crucial role to play in motivation for biodiversity conservation. We explore this broad palette more deeply underneath.

The motivations referring to living a meaningful life make a set of values explicit that have been called *eudaemonistic*, and differ from hedonic or moral values (Muraca 2011) and from the welfare maximization in neo-classical economics (O'Neill & Spash 2000). Ryan *et al.* (2008) define the meaningful life as self-realization, based on the fulfilment of three fundamental psychological needs: autonomy, competence, and relatedness. The notion of eudaemonistic value can be traced back to Socrates and Aristotle and originally referred to the obligation of every human being to "live in truth to his or her daemon" a kind of inner voice speaking about good or bad (Norton 1976). The concept is still used in literature on motivation (Ryff & Singer 2008) and also appears in the 'quest for significance' theory of Kruglanski *et al.* (2009). In environmental psychology, analogous concepts surface in environmental self-identity (Van der Werff *et al.* 2013) and ecological responsibility (Jagers & Matti 2010), which refers to how people regard themselves and their environmental behavior.

The highly rated motivations of *value in itself* and *future generations* refer to moral values, inciting people to act beyond self or group interest. The public perceptions of nature's value in itself, often called intrinsic value, have been investigated before in European countries (Buijs & Volker 1997; Grendstad & Wollebaek 1998; Widegren 1998; Butler & Acott 2007; Van den Born 2008), leading to the consensus that the great majority of people recognize the intrinsic value of nature. This is corroborated by research into human-nature relationships. As shown by Kempton *et al.* (1995), De Groot & Van den Born (2007) and De Groot & De Groot (2009), respondents show very high levels of adherence to ecocentric stewardship in which people are seen as part of nature, responsible for taking care of nature and for preserving nature for future generations.

For the non-biodiversity activists, motivations to be involved in biodiversity conservation are largely the same as for the biodiversity activists in that *future generations*, *value in itself* and *living a worthwhile life* are rated highly. However, the pleasure motivations of *working with others* and *doing what you are good at* have less importance for non-biodiversity actors for these activities, and so does the motivation of *self-significance*. These differences may be explained by that non-biodiversity activists already achieve their pleasure and self-significance motivations through their main non-biodiversity interest, an explanation corroborated by the higher scores of these motivations for the non-biodiversity action. In contrast, other motivations appear to be more important for non-biodiversity activists to act for biodiversity: nature's *beauty*, *attachment to place* and nature's *value in itself*. This finding suggests that the discovery of beauty and values in nature and landscapes, even though not prime motivations for devoted biodiversity activists, may be foundational in the motivations to act for nature by less committed actors. Richards (2001) has argued how beauty could support environmental awareness. Stimulating biodiversity actions amongst non-biodiversity activists may require a change of focus to underline these specific motivations.

*4.2. Limitations*

The study method used has some limitations. First, it is possible that the respondents interpreted the formulation of the motivations on the cards slightly differently. One example of this validity issue is the description of the connectedness card, which refers to "connectedness with a larger whole", which might have been too esoteric for respondents who do feel connected with nature but on a more singular level, e.g. connected with the local forest, with animals etc. This may explain why scores for *connectedness* are lower than expected. Connectedness has been introduced before as a key motivational drive (Tam 2013), and Nolt (2006) suggested that in order to act for a valuable thing, we need to feel connected to that thing. It is therefore possible that a feeling of connectedness with nature underlies many other motivations, but is considered less salient when put next to the other motivations. Another limitation of the method is that strictly speaking, some cards describe values, other cards describe emotional states and yet others emphasize end goals. Consequently, it is unclear how much this lack of homogeneity in the list influenced the ranking by the respondents (*cf.* Ryan *et al.* 2008). Also, social relations and conflicts of interest that may be very relevant in real-life situations are not covered in the card ranking method, which may explain the low ranking of the *personal benefit* and *control* motivations. Social desirability and positive or negative framing of motivations may influence the ranking of some cards, such as *living a worthwhile life* or *insecurity*. Finally, because our data was gathered only in European countries, it is unclear to what degree our data are generalizable to other regions.

*4.3. Policy Relevance*

Ecosystem services and economic values are increasingly communicated in policy as the main reasons to act for biodiversity. Although motivations such as *curiosity and learning*, *value in itself*, *living a worthwhile life* and *beauty* can be framed into the abstraction of 'cultural ecosystem services' in the form of education and spiritual services (MEA 2005), and groupings of ecosystem services appear to be connected with different values (Hicks *et al.* 2015), a back-translation from services to motivation appears to be problematic in environmental policy. The functionalistic outlook of the ecosystem services concept, in which biodiversity produces services for consumption by individuals, may be inappropriate to express and stimulate motivations to act, as human-nature relationships appear to be more complex than that (Flint *et al.* 2013).

Our results offer scope to address these motivational limitations of ecosystem services to stimulate motivation for biodiversity conservation. On the one hand, the highest ranking motivations driving biodiversity activists may be recognized and supported in order to stimulate their ongoing activities and the growth of new young conservation enthusiasts. Such motivations would be curiosity and learning about nature, seeing conservation as a part of living a meaningful life, caring for future generations, and nature's intrinsic value. On the other hand, to involve actors from other sectors, a slightly different set of motivations may be addressed, such as: a stronger focus on natural beauty, the inherent values of biodiversity and what biodiversity means for local development and identity. Space must be created for such non-monetary values to be expressed in participatory and deliberative valuation and decision making.

This study shows that people act for biodiversity mainly out of eudaimonistic values and moral values. Ecosystem services itself may provide an initial inspiration to get more people on board, but is limited in motivating conservation leaders and does not halt biodiversity loss on its own. Acknowledging the full gamut of motivations is necessary to inspire conservation leaders and get more people on board for nature conservation. An improved policy basis for biodiversity conservation would therefore consist of three elements: (*i*) nature is *meaningful* in the lives of people, (*ii*) nature is perceived as having *intrinsic* values and (*iii*) nature delivers economic *benefits*. Advertising only the economic benefits of nature offers a weak and possibly even counter-productive motivational basis for large-scale individual action for biodiversity.

**Supplementary Material**

For supplementary material accompanying this paper, visit http://www.journals.cambridge.org/ENC

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**Supplementary Material**

**Table S1.** Interview structure.

<table>
<tr><td colspan="2">Thank you for your willingness to participate in our research.<br><br>We are interested in your drives to do something for nature or for society, something you do with your heart and conviction. In this interview we want to talk with you about this endeavor, this main thing, and your passion to do so, whether this main thing is nature or something else and whether it is big or small. Together we want to try to identify your motivations and inspirations.<br><br>This interview consists of three parts. First, we want to briefly talk about the things you consider to be important for you to do for society or nature. After that we want to investigate, together with you, how these ideas and motivations came about, and how they are connected with your life course. Finally we would like to explore some of these motivations, to deepen our insight.<br><br>I ask permission to record this conversation. This is for methodological reasons. It makes it easier to work out the interview, guarantees punctuality and prevents misquoting. It also enables me to write less during the interview, although I will make some notes. Is that all right with you?<br><br>All data will be dealt with in confidence.</td></tr>
<tr><td colspan="2">PART 1 main thing</td></tr>
<tr><td>Main questions</td><td>Probes/checklist</td></tr>
<tr><td>For the interviewers: choose an introduction you feel comfortable with. If you already know something about what the person is doing (can be the reason that he/she is selected for this interview) you can start with that.</td><td></td></tr>
<tr><td>What would you describe as the main thing you do in society?</td><td>Main thing can be nature; can be something else<br>Main thing can be something in work; can be something else</td></tr>
<tr><td>We will take a more detailed look later, but could you already tell me now roughly what you think are the major drivers for [main thing]?</td><td></td></tr>
<tr><td>What is the role of [main thing] in your work?</td><td>Try to get a broad idea of the work he/she does and the connectedness of work with [main thing]</td></tr>
<tr><td colspan="2">PART 2: life course<br>We are looking for the connections between the main thing you do with the history, the course of your life. Life experiences and the place where you grew up, for instance. . That is why we want to go back with you to some periods in your life and see whether we can detect a few of those connections.</td></tr>
<tr><td>Main questions</td><td>Probes/checklist</td></tr>
<tr><td colspan="2"><u>Period till 15th year</u></td></tr>
<tr><td>Did this [main thing] emerge in early youth ? (till 15$^{th}$ year)</td><td>If yes, ask for more details. For instance frequency of actions; important persons; feelings etc.</td></tr>
<tr><td>We have some questions to go a little bit deeper into that period and we would like to talk about the physical and the social environment of your childhood.</td><td></td></tr>
</table>

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| **Physical:**<br>- where did you grow up? | *To get a main picture of the physical place of growing up*<br>-is this a city, a village, or the countryside<br>-can you describe the house wherein you grew up?<br>- in case of the countryside; is it a farmhouse<br>-was there a garden by the house; if so, can you describe it? |
| -in what kind of neighbourhood did you live? | Busy/quiet; many/less buildings; places to play; |
| **Social:**<br>**Family & role of parents**<br>-how was the composition of the family in which you were raised? | |
| did your parents work? | Both?<br>-What kind of work did he/she/they do?<br>-What did your parents really like to do in their free time? (hobbies) |
| -did the family undertake a lot of activities? | -what kind of activities<br>-Were they active in some sort of club? |
| Do you think your parents played an important role in the emergence of [main thing] | If yes, how? What was it ?<br>*action/attention/encounter?* |
| Are there, besides your parents, other significant people playing a major role in your early childhood?<br>Did these people play an important role in the emergence of [main thing]? | If so, who and why was he/she important and what role did this person played in your life<br>If so, how? |
| **School**<br>Do you think that this[main thing] also emerged at school? Are there any important experiences or persons at school that are of influence on your enthusiasm for [main thing]? | |
| **Peak experiences**<br>Are there in your early youth any peak experiences of which you think were of importance for you? Were they of influence on your enthusiasm for [main thing]? | *Can be positive or negative experiences; can be nature or social (e.g. confrontation with poverty)*<br>Supervised or not? |
| *If main thing is not nature: skip this section*<br>**Role of nature**<br>How would you describe the role of nature in your childhood, and how did you relate to nature?<br><br>-did you play in nature ? | - Was nature important or not (why)<br>- What was nature for you? What did you consider as nature (nature-image) (wild versus cultivated etc.)<br><br>- a lot?<br>- what did you do in nature (level of activity: playing in nature versus playing with nature) action/encounter<br>- did you also do things for nature? (help, protect, ….)<br>- did nature play any role at for instance school, in your peak experiences or in the things you did with your parents? |

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| <u>Period between 15th and 25th year</u> | |
| Did this [main thing] emerge in later youth ? (between 15$^{th}$ and 25$^{th}$ year) | If yes, ask for more details. For instance frequency of actions; important persons; feelings etc. |
| - can you tell us something about the place or places you lived between your 15th and 25th year? | -moved for study or living on their own or starting a family?<br>- were these cities/villages/countryside |
| - what were your main activities in this period? | (*get an idea of the main life course activities*)<br>-work? What kind of work<br>-study? What kind of study |
| -what did you do most in your free time?<br>Were you active in some sort of clubs? | -alone or in groups<br>What kind of clubs/ how active |
| What were the most important people for you in this period? | -why were they important<br>-What role did they play in your life<br>-What did kind of influence did they have on you? |
| Did these people played an important role in the emergence of [main thing]? | If yes, how? |
| **Peak experiences**<br>Are there in your later youth any peak experiences of which you think were of importance for you? Were they of influence on your enthusiasm for [main thing]? | *Can be positive or negative experiences* |
| *If main thing is not nature; skip this section*<br>**Role of nature**<br>- In a more general way: how would you describe the role of nature in this period of your life, and how did you relate to nature? | - Was nature important or not (why)<br>- What was nature for you? What did you consider as nature (nature-image) (wild versus cultivated etc.*)( is image of nature changed*?)<br>- did you do things *in* or (also) *for* nature? Level of activity<br>- did nature play any role at for instance school, in your peak experiences or in the things you did with your parents?<br>- How much free time did you spend on these activities? (approximate hours/week) |
| <u>Period from 25 till today</u> | |
| As a last period in your life course we want to look at the time from you were 25 till now. It is too long a time to go through all the details of what happened in your life. So, we want to ask you if you want to tell about the most important events that connect to your [main thing]<br><br>Did this [main thing] emerge in adulthood ? (after 25$^{th}$ year) | If so how? Ask more details. |
| - What do you regard as the most important events in your work life? | |
| - Did [main thing] or motivation for [main thing] play a role in this events? How? | Big changes? Or not.<br>If big change or event: was it a choice or something that happened to you without you having a lot of influence on it? |

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| - What do you regard as the most important events in your private life? | Big changes? Or not.<br>If big change or event: was it a choice or something that happened to you without you having a lot of influence on it? |
| - Did [main thing] or motivation for [main thing] play a role in this events? How? | |
| - How much free time did you spend on [main thing] in the peak period of your enthusiasm? (approx. hours/week) | |
| *If main thing is not nature; skip this section*<br>**Role of nature**<br>- In a more general way: how would you describe the role of nature in this period of your life, and how did you relate to nature? | - Was nature important or not (why)<br>- What was nature for you? What did you consider as nature (nature-image) (wild versus cultivated etc.*)( is image of nature changed*?)<br>- did nature play any role in your work or private life?<br>- did you do things *in* or *for* nature? Level of activity.<br>- what was the role of other people or organisations in this? |
| Up till now we talked about your work, your life course and your motivations for [main thing]. Can you say something about what you think are your main motivations? And when and where did these motivations come from?<br>Do you see a main path?<br>Do you see any patterns or tensions?<br><br>One of the patterns we can look for is whether someone is motivated mainly for oneself and immediate family, or for being a good member of groups, or for making a difference in the wider world. Could you say something about this? | *First open question, then discuss patterns when you see them* |
| **PART 3: cards and reflection**<br>In this last part of the interview we want to go deeper into what motivates you. We will do this with the help of cards . | |
| *(For the interviewers: show the category cards, while explaining).*<br>We have twenty cards representing different motivations . It is possible for you to lay these the cards, ranging from motivations, which are not at all important for you (to do your main thing), to motivations that are very important, to do so. We have six categories. You can place more cards in each category. | |
| When looking at the cards like you choose to lay them in the figure, do you see any relations or patterns between the things we discussed about your life course and these cards? | Do you see any relations or patterns between your current work/projects and these cards? |
| *Is there something I did not ask for, of which you think it is important? Or is there anything else you want to tell me?* | |

**SECOND PART OF THE INTERVIEW ABOUT NATURE**

*Only when main thing is not nature*

Intro: We talked about your motivations for[main thing]. However, because our project focus on nature, we want to ask you to tell us something about your relation with nature. We will follow the same structure as in the first part of the interview.

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| **PART 1: life course**<br>We are looking for the connections between acting for nature with the history, the course of your life. Life experiences and the place where you grew up, for instance. . That is why we want to go back with you to some periods in your life and see whether we can detect a few of those connections. | |
|---|---|
| *Main questions* | *Probes/checklist* |
| <u>Period till 15th year</u> | |
| **Role of nature**<br>How would you describe the role of nature in your childhood, and how did you relate to nature?<br><br><br>-did you play in nature ? | - Was nature important or not (why)<br>- What was nature for you? What did you consider as nature (nature-image) (wild versus cultivated etc.)<br><br>- a lot?<br>- what did you do in nature (level of activity: playing in nature versus playing with nature) action/encounter<br>- did you also do things for nature? (help, protect, ….)<br>- did nature play any role at for instance school, in your peak experiences or in the things you did with your parents? |
| <u>Period between 15th and 25th year</u> | |
| **Role of nature**<br>- In a more general way: how would you describe the role of nature in this period of your life, and how did you relate to nature? | - Was nature important or not (why)<br>- What was nature for you? What did you consider as nature (nature-image) (wild versus cultivated etc*.)( is image of nature changed*?)<br>- did you do things *in* or (also) *for* nature? level of activity<br>- did nature play any role at for instance school, in your peak experiences or in the things you did with your parents?<br>- How much free time did you spend on these activities? (approximate hours/week) |
| <u>Period from 25 till today</u> | |
| **Role of nature**<br>- In a more general way: how would you describe the role of nature in this period of your life, and how did you relate to nature? | - Was nature important or not (why)<br>- What was nature for you? What did you consider as nature (nature-image) (wild versus cultivated etc*.)( is image of nature changed*?)<br>- did nature play any role in your work or private life?<br>- did you do things *in* or *for* nature? level of activity.<br>- what was the role of other people or organisations in this? |
| You told me your actions for nature are…..<br>[*or get clarity about the thing he/she does for nature]*<br>Can you say something about what you think are your | |

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| main motivations to do this for nature? And when and where did these motivations come from? | Are they different or comparable to motivations for main thing? |
| **PART 3: cards and reflection** | |
| Finally, we will like to know if the things you do for nature show the same pattern as the things you do for [main thing] or a different one. We do it again with the cards.<br><br>*How would you lay the cards for this?*<br><br>When looking at the cards like you choose to lay them in the figure, do you see any relations or patterns between the things we discussed about your life course and these cards? | *If things done for nature is so insignificant that respondent protest, skip the cards.*<br><br>Do you see any relations or patterns between your current work/projects and these cards? |
| *Is there something about your relationship with nature I did not ask for, of which you think it is important? Or is there anything else you want to tell me?* | |

# Chapter 7

# General discussion

## 1. Introduction

The aim of this thesis is to investigate what would constitute an appropriate role for economic valuation of nature for nature conservation. This valuation approach rests on the earlier introduced paradigm of ecosystem services, where nature provides services to society. The ecosystem services idea has been integrated and taken up both by nature conservationists and various governmental and non-governmental organizations for various reasons, with either good or bad prospects for nature conservation. This thesis contributes to the identification of challenges for nature conservation in a world where the ecosystem services and economic valuation of nature paradigm is popular. In particular, it puts a focus on some of those challenges where the goals of nature conservation themselves are in danger of being lost due to the economic value approach, and it contributes to solving these issues by reassessing the role of this approach.

The topics dealt with in this thesis cover a broad range of topics. One chapter may deal with economics, while the next one investigates ecology, environmental policy or human psychology. The objective behind this variety is that the topic of economic valuation for nature conservation gets illuminated from many different angles, so that we might discover aspects of it that remained unknown beforehand. At the same time, it becomes challenging to tie the studies together in a comprehensive discussion. Nevertheless, there are themes that emerge that can be found in more than one of the studies, such as the worry that economic valuation ignores certain human values. Also, one study may comment upon the next one. For example, the study on discourses shows that a great debate exists about the consequences of using economic valuation, and the study on the expression of values in policy documents shows evidence that one of the debated fears may be well-founded.

This is then how the discussion is built up: with a focus on the themes that are shared between the various studies, and on how the chapters comment upon each other. The first study on the discourses opens up the debate and in effect introduces the various themes that are connected to ecosystem services and economic valuation, and the hopes and fears about its use in environmental policy. The next study on policy documents comments on one of those fears: namely that economic values crowd out other values. The two studies following that offer two different solutions to the fear that conservation values and conservation goals will be lost sight of. The final study opens up the discussion further by regarding the values that underlie human motivation for nature conservation, and hence we can investigate how economic valuation connects to those motivations, and what we might expect from it in terms of stimulating conservation actions.

The limits of the scope of the thesis become clear as well, now. The studies address a small part of the debate surrounding ecosystem services and economic valuation. There are many topics that do not return in this thesis, such as the fear that economic valuation has negative consequences for the poor, or the consequences of biodiversity offsetting, or the virtues or limits of alternative methods such as deliberative economics, or how economic valuation is regarded from the perspective of institutional economics. Yet, all these topics have important messages as well and are essential to form a clearer judgment about economic valuation. It is hence not the ambition of this thesis to regard economic valuation from all possible angles and neither will it come to a final judgment about the conflicts between economic valuation and nature conservation. The discussion in this thesis will lead to recommendations for scientists and policy makers, but those recommendations will be based only on the studies that form part of this thesis.

With these caveats kept in mind, we return to the research questions and the answer that the studies produced for them.

**2. Answers to the research questions**

**Q1**: **What do practitioners think about economic valuation?**

The first study aimed to provide insights into the opinions of EU economic experts and practitioners, as well as critics, on economic valuation of ecosystem services relative to alternative or complementary valuation methods. The method used in this study generated 'discourses', coherent viewpoints that would reduce the complexity of the debate.

The conclusions are that four coherent viewpoints could be identified concerning economic valuation of ecosystem services: *enthusiasm*, *value pluralism*, *social justice concerns* and *eco-deliberation*. Some of the same arguments for or against economic valuation form part of different discourses. Furthermore, the sequence of salience of the four identified discourses illustrates a polarization of opinions. Only one discourse is in clear agreement with economic valuation of ecosystems and biodiversity and it is the most salient one. The three discourses besides *enthusiasm* express different forms of disagreement with economic valuation, and are nevertheless strongly expressed in the debate.

**Q2**: **How do EU research subsidy documents communicate the importance of biodiversity conservation?**

The second study analyzed the visibility of biodiversity and its conservation in the wording of open call research subsidy documents of the EU. It is a content analysis, which allowed us to trace trends in word use and make inferences based on those trends on thematic shifts underlying biodiversity conservation in the EU research programmes. The documents are the open call descriptions on the topic of biodiversity conservation in the documents of the environment theme in the EU Seventh Framework Research Programme (FP7) from 2007-2013 and the EU Framework Programme for Research and Innovation - Horizon 2020 of 2014-2015. The focus of the content analysis was on the prevalence of 'conservation' of biodiversity, and how this differs in prevalence from to other mentioned keywords related to biodiversity, such as 'ecosystem services'.

The conclusions are that a clear shift in word use is visible in the environment themes of the FP7 and Horizon 2020 work programs towards using 'ecosystem services' as the foremost way to express the value of biodiversity. There is little explicit referral to economic valuation of biodiversity in the documents. Coupled with a simultaneous decrease of other expressions of values and goals such as ‘conservation’ and ‘sustainability’, ‘ecosystem services’ substitutes other expressions of value in the work programs.

**Q3**: **How can we combine economic valuation with notions of sustainable use of ecosystems?**

This chapter addressed the research question of how economic valuation of nature could be combined with notions of sustainable use of ecosystems in economic models of nature conservation. Two sub-questions were asked:
1. What notions of ecosystem resilience need to be added to Total Economic Value assessments in decision making to foster a sustainable use of ecosystem services?
2. How can the concept of Total Economic Value be combined with notions of ecosystem resilience?

The main conclusions of this paper are that ecological theory of resilience has an important role to play to arrive at a sustainable use of ecosystems. To connect the theory of ecological resilience to the methods of economic valuation, we need to regard the diversity of genes, species and ecosystems as providing humanity with an insurance against the collapse of ecosystems. Then, to safeguard the future provision of ecosystem services, maintaining a high level of biodiversity is a way to invest in security for future revenue of services and to insure us against a loss of production. From the perspective of economics, the value of diversifying your investments has been worked out in portfolio theory, and investing in the diversity of genes, species and ecosystems can be regarded in the same way. From the perspective of ecologists, the theory about functional diversity and how that relates to stability and resilience is what is useful in this framework, because it relates to sustained ecosystem functioning.

**Q4**: **What are stakeholders’ ideas about good indicators for conservation action success by farmers?**

This chapter measured the preferences of agricultural chain parties on different indicators for rating a farmer’s biodiversity performance. We consider three different potential metrics of rating a farmer’s biodiversity performance: the effort of the farmer in nature management, the preconditions of soil, water, air and local biodiversity that present the environmental frame in which farmers operate, and the attained nature results irrespective of effort and preconditions. We ask different agricultural chain parties their opinions towards such rating systems: farmers’ organizations, nature conservation organizations, governmental organizations and food companies.

The conclusions are that there are no clear differences in preference between the agricultural chain parties. However, the potential metrics did receive significantly different scores, suggesting that a rating system, such as a score card, based on a combination of the preconditions on the farm and the attained biodiversity results will be experienced as most acceptable throughout the chain of agricultural production.

**Q5**: **What are the motivations underlying committed conservation action?**

The final study aimed to answer the following research question: How do highly committed actors for biodiversity and highly committed actors for other, non-biodiversity causes rank their motivations to act for nature, given a broad set of motivational options that include hedonic, moral and eudemonic values? The knowledge gaps that this research question aimed to fill were the unknown but suspected specific roles of hedonic, moral and eudemonic values in conservation action in committed actors, and how these motivations differed between biodiversity and non-biodiversity actors.

The conclusions are that a basic palette of motivations appears to exist for committed action in general, and this palette is broad, including the motivations *curiosity and learning*, *living a worthwhile life*, *future generations* and *value in itself*. Secondly, small specific differences are found between biodiversity and non-biodiversity actors. The findings suggest that the discovery of beauty in nature, even though not prime motivations for devoted biodiversity activists, may play a more important role for the non-biodiversity actors in their motivation to act for nature.

## 3. Reflections

### 3.1 The economic valuation discussion within the community of practitioners and experts is mostly about hypothetical consequences instead of empirical evidence.

The first study strictly identified discourses. But in addition to that, we can interpret the discourses as an excellent summary of the topics that are deemed important by the community of practitioners and experts about economic valuation. We can make this interpretation because the discourses arose from the data as emergent constructs that are ultimately based on the available literature on the topic. What is interesting in this interpretation is that successful nature conservation is not a prominent topic of discussion in this debate. Instead, the discussion is mostly about hypothetical consequences of economic valuation on social issues and on the crowding out of values.

Looking at the four discourses, the *enthusiasm* discourse sees economic valuation as a useful approach for a variety of topics: for protection of nature, for issues of sustainable development and for political decision making. In general, the end goal, what economic valuation might be good for, isn't well specified in the debate. Underlying the discourse seems to be a feeling that economic valuation has a general usefulness that supports good decision-making about the environment, without specifying any clear goal. The reason for this could be that economic valuation has a variety of uses for policy makers (Laurans *et al.* 2013). The three other discourses are largely negative reactions to this approach, and the two strongest negative reactions are the discourses of value pluralism and social justice. These both embody concerns about values that humans uphold, recognition of personal values and the treatment of humans in the economic system. Personal values, the values perhaps on which nature conservation is built, are seen as under attack. It was hypothesized in this study that a discourse of pragmatism would emerge from this study, but because the end goals such as nature conservation are apparently so undefined in the debate as it exists now, pragmatism didn't emerge as a discourse.

This result could be a consequence of that the effectiveness of economic valuation to protect nature is still unknown. Different setups of PES schemes have different efficacy (Wunder *et al.* 2008) and may or may not cause a crowding out of intrinsic motivation (Rode *et al.* 2015). The debate is hence largely about hypotheticals. It could be that, as empirical evidence mounts for or against economic valuation approaches for the goal of nature conservation, then the debate on this topic might shift from imagined applicability and side-effects to more clearly defined limits and usefulness. Another reason for the focus on hypothetical consequences could be that economic valuation so misrepresents certain types of relationships between humans and nature (van den Born 2008) and issues of identities and perceived rights (O'Neill & Walsh 2000) that the resultant discussion is largely focused on good expression of personal values instead of its effectiveness in nature conservation.

From the point of view of nature conservation, this result begs the question whether the ethical and social issues connected with economic valuation of nature are relevant at this moment for reaching conservation goals. Are these issues raised by the discourses not simply questions for politicians and ethicists, but not for conservationists? For nature conservation, would it not be enough to keep a focus on the effectiveness of economic valuation for conservation goals? Fisher and Young (2007) argue that these ethical and socio-economic issues are relevant for nature conservation in the sense that they are connected to the motivations and justifications behind nature conservation. The individual's relationship with nature, that is seen as attacked by economic valuation in the discourse *value pluralism*, is a personal motivator to act for nature conservation. This is supported by a rich literature of environmental psychology which identified factors such as connectedness to nature (Mayer & Frantz 2004), place attachment (Williams & Vaske 2003) and many others as having an important role in environmentally friendly behavior. Also, the social justice debate about economic valuation drags nature conservation deeper into the web of socio-economic issues. As Rose (2014) argues, this provides an opportunity for stronger policy-relevant, socio-economic reasons in favor of nature conservation.

### 3.2 Framing nature conservation as ecosystem services protection replaces clear nature conservation goals.

As the first study on discourses concluded that empirical evidence is lacking about the consequences of economic valuation of ecosystem services, the second study aimed to fill part of that lack. The research question about how the value of biodiversity was communicated in EU subsidy documents was concluded with the finding that referrals to ecosystem services gained in popularity, whilst more direct referrals to nature conservation went down through time. In other words, the frame of ecosystem services is not simply used in tandem with other frames for nature conservation, but it replaces the previous calls for nature conservation.

Related to issues of framing nature conservation are the ethical questions of where responsibility should lie for stating clear conservation goals, and how much either policy makers or scientists should adapt their language to each other. Sutherland *et al.* (2013) lament that policy makers fail to interpret and use scientific data, and lists 20 concepts about the process of science that policy makers could take into account. On the other side of this debate, Adams & Sandbrook (2013) and Rose (2014) argue that scientists should communicate science through evidence-informed narratives and so adapt their communication more to the messy process of policy making. Coupling nature conservation to ecosystem services protection is one such strategy and, according to Rose (2014), could be used in tandem with arguments of the intrinsic value of nature. Our research shows however that fears about ecosystem services replacing other arguments for nature conservation is well founded.

The study was limited in scope, considering seven years and a limited number of documents. It remains unknown whether these observations are part of a broader trend in policy documents about environmental themes, but it could prove to be indicative of such a trend. Additional research could clarify whether the term ecosystem services replaces nature conservation in other documents. Here it would be interesting to investigate whether such a trend occurs top-down, from global to national to regional and local levels, and whether concrete goals for nature conservation are only maintained in the research goals of scientists, local conservation projects and local government. Investigations that delve deeper in time could shed more light on how shifts in word use might change over time.

It also remains unknown how this shift in word use is related to the intentions of policy makers behind the framing of environmental issues. Ecosystem services could be taken up because it presents a useful concept to policy makers (Daily *et al*. 2009). We can conjecture that since ecosystem services promises to take economic and social needs into account, it is easier to justify the protection of ecosystem services than precise nature conservation goals based on ecological indicators, but the motivations behind framings remain obscure. In addition, as expanded upon by Mace (2014), ecosystem services are part of a framing of nature conservation that in scientific literature is currently being subsumed by a new framing that focuses on social-ecological resilience. It remains unknown whether this new frame is in turn being adopted in policy language.

### 3.3 Difficult to reconcile economic valuation with ecological measures of successful conservation.

So far in this discussion, economic valuation of ecosystem services is seen as a potential threat to nature conservation in the first study, and the second study showed that some of those fears may be warranted. The third study investigates how ecological science could still play an important role in maintaining a focus on nature conservation in the case that economic valuation informs management practices. There is perhaps no better illustration that economic valuation of nature may not be in service of nature conservation by showing the tortuous theoretical route one must go down to reconnect economic valuation with ecological notions of resilient ecosystems. Ecological knowledge is essential for effective nature conservation, but economic valuation complicates taking action on this knowledge. Nature conservation based on ecological science must now be defended and justified in a new arena of argumentation that economic valuation has brought up.

The third study is very much connected to the debate of how biodiversity relates to ecosystem services (Mace *et al* 2012). Building on a lot of background theory, the whole idea of a biodiversity portfolio can be likened to a bridge connecting two shaky towers of theoretical ideas that can both be attacked at their very foundations. One tower represents the approach of economic valuation of ecosystem services in its current disguise as Total Economic Value (Dziegielewska, 2009), and the other tower the idea of an insurance value of biodiversity (Baumgärtner, 2007; Loreau *et al.* 2002) that is directly connected to a debate within conservation biology about ecological resilience and stability (McCann, 2000). In a way, the chapter looks at these two towers as two ways of thinking and climbs the stairs, to see where they might be bridged. The portfolio idea is such an bridge between ecology and economics and therefore holds merit for both conservationists and economists (Figge, 2004). The greatest merit of this investigation is that it introduces a call for precaution about using or optimizing the ecosystem services idea for production, so that the resilience of ecosystems is not undermined.

From the perspective of welfare economists, a lack of ecological knowledge is an information problem for informing and satisfying consumers of ecosystem services (Chee, 2004; Ludwig, 2000), and the bio-portfolio idea could address this. From the perspective of nature conservation however, a lack of ecological knowledge is a danger to successful conservation (Sutherland *et al.* 2009), and the portfolio approach is a tortured, roundabout way of arguing for conservation. This study posits biodiversity as a supporting ecosystem service (*cf.* MEA, 2005): an insurance service for safeguarding the provision of ecosystem services (Perrings et al. 2009; Naeem, 1998). However, the value of doing so still refers to economic values and to desired ecosystem functions from an anthropological point of view. Jax and Heink (2015) see different motives for treating biodiversity as an ecosystem service or not: from the perspective of a resource protection motive it is sensible, but from a conservation motive it might not be. It creates a necessity to talk about resilience and insurance value and functional diversity for conservation motives. Even as you do this, you lose focus of the protection of rare species that don’t offer much benefit (Ridder 2008). The selection of diversity that you would choose for your bio-portfolio as a necessary baseline in the end depends on what kind of services you desire from the ecosystem. It will be the particular desires from stakeholders that drives how much diversity and stability is required, much like the introduction of plant diversity in agriculture to maintain profitable production (Isbell et al. 2011), and not out of any other ethical consideration. The portfolio approach remains a highly anthropocentric approach.

### 3.4 A biodiversity label to uphold ecological goals in market oriented approaches.

The fourth study investigates a second approach how ecological science could still play an important role in maintaining a focus on nature conservation in a market-based approach. In this study, the research question concerning biodiversity indicators for farmer’s performance in biodiversity conservation is essentially addressing the question of quality control in an environmental management scheme that could be considered a payment-for-ecosystem-services (PES) scheme, following the definition by Wunder (2005). The search for biodiversity indicators is meant for the potential creation of a biodiversity-related label, which provides information to consumers or retailers, so that they act on this information and hence that the market stimulates environmentally-friendly production methods. The study concludes that all stakeholders in the production chain agree about the content of this label and which indicators should be partof it: environmental preconditions for biodiversity and biodiversity results.

There are two important aspects about these conclusions to expand on. The first aspect is the agreement among the stakeholders, which shows that all parties in the production chain can enter a PES scheme with the same environmental goals in mind. This is a promising conclusion for the establishment of PES schemes in general. Wunder *et al.* (2008) gives an inventory of PES scheme experiences and notes that a frequent weak spot, especially among government-run PES schemes, is that the link between stimulated land use changes and the desired ecosystem services can be very weak and scientifically unfounded, and that biodiversity conservation itself is seen only as an implicit positive side-effect in these schemes. Agreements among the indicators of success could strengthen these weak spots. The second aspect to note is that the indicators that are regarded as most important are those informed by ecological science. Not only could ecological science make indicators scientifically rigorous, but it also gives ecological indicators themselves an important role in a financial scheme. A biodiversity label based on accepted ecological indicators would therefore be a promising way to combine economic valuation of nature with ecological knowledge for biodiversity conservation.

For conservationists, a recurring debate concerns the values behind economic valuation of nature and hence a feared ‘selling out’ on nature (McCauley 2006). One underlying fear in these cases is that economic imperatives would override the values behind biodiversity conservation. It is therefore promising that all stakeholders seem to consider ecological indicators as the most valuable to judge conservation performance. This suggests that a biodiversity label based on ecological indicators would be a promising way to maintain a strong presence of ecological knowledge and ultimately conservation values in PES schemes. In the previous study about combining ecology with economic valuation of nature, one solution was proposed to give ecological knowledge a stronger presence in PES schemes: the portfolio theory applied to biodiversity. A biodiversity label based on ecological indicators would be an alternative or supplementary solution to this. Where portfolios of biodiversity are meant to protect ecosystems from regime shifts and uphold ecological resilience, biodiversity labels give an indication whether the ecological goals for protecting ecosystems are actually upheld. Both solutions could help to give voice to values underlying biodiversity conservation.

### 3.5 About personal motivations versus institutional motivation

The final study explores the motivations of successful biodiversity activists to act for nature conservation. The results help us understand why the debate surrounding economic valuation is focused so strongly on personal values, as is seen in chapter 2 on the discourses.

As the final study shows, biodiversity conservation seems intimately connected with committed actors seeking meaning in their lives, and with how their work in nature conservation plays a role in that quest for meaning. The approach of ecosystem services can theoretically conceptualize these meanings and statements of morality as so-called cultural ecosystem services (MEA 2005). Services such as spiritual services or cultural identity services seem to touch on the meaningful life element. However, the results of the study suggest that ecosystem services misrepresent the relationship between humans and nature, which can be characterized in multiple ways (van den Born 2008). According to Flint et al. (2013), ecosystem services only touches upon a subset of human-nature relationships. Values of biodiversity in the form of services are expressed as a kind of object or flow that is separate from the actual source. Economic valuation then goes a step beyond and presents a further abstraction of that connection, and further solidifies the relationship between humans and nature as that of a consumer and a producer. As is seen in chapter 2 in the study on discourses, a main critique is that certain values are not represented well in this relationship, and the strong emergence of the element of a meaningful life in chapter 6 helps us understand why. It seems that in the transformation of this element of a meaningful life to the abstract level of a service, the motivation that people ascribe to the meaningful life for their conservation work is somehow not acknowledged anymore when it is described as a service.

It is important to make a distinction here between personal motivation that says something about why an individual person chooses to act for something, and institutional motivation that says something about humans working in groups. When discussing how economic valuation of ecosystem services relates to personal motivation, it should also be mentioned that the techniques used to value nature in this way, such as contingent valuation, hedonic pricing etc., (see Gatto & De Leo (2000) for an overview) are not meant to motivate people personally. Instead, they are used to 'elicit' the values that people hold about nature and express these in a monetary way, working from the assumption that human welfare from experiencing nature can adequately be expressed in money (Bockstael et al., 2000). And these monetary numbers are then a decision support tool for policy makers. The numbers, supposedly roughly reflecting what should be the preferences of people as consumers of ecosystem services, assist policy makers in a couple of ways, such as making a list of stakeholders and envisioning alternative plans for the future of certain areas (Laurans et al., 2013). In other words, economic valuation as a decision support tool is meant to motivate decisions made on an institutional or governance level. Research into payment for ecosystem services schemes, such as by Midler *et al.* (2015), suggests that economic rewards can stabilize collective action. Also, Dedeurwaerdere et al. (2016) showed that in biodiversity conservation projects, internal and non-economic motivations of participants in the projects are compatible with the involvement of private parties and with goals of economic benefits for society. Chapter 5 on biodiversity performance indications also shows that a market-based approach can fulfill a motivating role by aligning stakeholders when it comes to indicators and judgments of performance.

However, a danger remains that those personal values and motivations on which nature conservation rests are then only expressed on the personal level of practitioners, without receiving recognition or legitimacy in policy and social constructions. The argumentation for nature conservation in policy will then not match with personal values and motivation, creating a situation of cognitive dissonance which may not benefit or might even endanger successful nature conservation. An institutionalized demotivation for nature conservation may be a consequence.

**4. Conclusions**

Using the answers to the research questions, we come to a deeper understanding of the role economic valuation of ecosystem services could play in nature conservation and where it creates problems.

1. To lay out the debate, the first study illuminates that within the ecosystem services community, the debate about economic valuation is polarized into one discourse of enthusiasm and a couple of negative discourses whose concerns refer to personal and societal values that are perceived as ignored or under threat. The arguments for and against economic valuation refer to different understandings of hypothetical consequences, while empirical evidence is lacking.
2. One perceived danger of economic valuation of ecosystem services is the crowding-out issue, which describes a fear that non-anthropocentric reasons for nature conservation and the personal values underlying these reasons will be crowded out by economic values and therefore will not be acknowledged. This danger becomes more tangible as chapter 3 on EU research programmes shows that nature conservation as a goal itself disappears from higher policy levels while during the same period the ecosystem services idea becomes the foremost way to express the value of biodiversity.
3. If nature conservation goals are henceforth repackaged as ecosystem services provision goals and economic value goals, can ecological knowledge still inform environmental policy? The third study shows that economic valuation of nature can still be combined with notions of ecosystem resilience. The proposed solution of portfolio theory is however only a partial solution in the grand scheme of ignored values, because it still refers to economic values and to desired ecosystem functions from an anthropological point of view.
4. The fourth study shows a second route to combine ecological knowledge with market schemes. Within a market-based approach, stakeholders can come to agreements such as over the right indicators for biodiversity success. Indicators based on ecological indicators offer a promising way to strengthen the ecological knowledge in financial schemes and its focus on ecological values is supported by all stakeholders.
5. Concerning personal values that are seen as under threat by economic valuation, the strongest motivations for nature conservation refer to values that are either difficult to describe and to value as services, such as care for future generations and intrinsic value, or not part of a services framework, such as living a worthwhile life. Consequentially, using economic valuation to come to a decision will not reflect the personal values and motivations of people working for nature conservation. The argumentation for nature conservation in policy will then not match with personal values and motivation, creating a situation of cognitive dissonance which may not successfully motivate nature conservation.

Based on these conclusions, economic valuation of ecosystem services should be embedded in a social context where both clear nature conservation goals and personal motivations for nature conservation are given a stronger acknowledgment. The recommendations in section 5 offer suggestions from literature to shape this context.

## 5. Recommendations

### 5.1 Recommendations for researchers

The conclusions to the research questions invite a couple of recommendations for future research. In the search for a proper role for economic valuation of ecosystem services in nature conservation, knowledge gaps remain.

First of all, empirical evidence is lacking about either the dangers or the effectiveness of economic valuation and Payment for Ecosystem Services (PES) schemes. This lack currently leads to a polarization of opinion, dividing opinions into enthusiasm or different flavors of criticism. Underlying this polarization are a number of assumptions about the long-term consequences of using economic values for nature conservation. There is an assumption made that the use of economic valuation leads to financial schemes such as biodiversity offsetting. A common argument is that ecosystem services thinking is a slippery slope towards economic valuation (Gomez-Baggethun & Ruiz-Perez, 2011) and economic valuation a slippery slope towards financial mechanisms such as biodiversity offsetting (Silvertown 2015). It is hard not to draw this conclusion when organizations such as the Nature Conservancy advocate the use of biodiversity offsets (Kaveira *et al*. 2012), whatever the reasons this organization may have for this strategy and whatever the underlying motivations. According to critics, this is highly undesirable, but what remains unknown is how often economic valuation leads to these practices and under what conditions, and what the precise consequences are of offsetting schemes. Payment for Ecosystem Services schemes' effectiveness in conservation also remains unclear and so does its impact on the intrinsic motivations of stakeholders. Further research could either resolve some of the worries of critics or support the validity of their critiques.

A core issue of the debate around ecosystem services revolves around the long-term consequences of using the anthropocentric values and so 'selling out on nature' (McCauley 2006) or 'selling' nature as a policy-relevant topic (Armsworth *et al.* 2007; Rose 2014). Since our investigation into word use discovered that the ecosystem services framing replaces other frames that could stand alongside it, then ecosystem services could no longer be seen as just an extra tool in a toolbox of strategies for nature conservationists. Further investigation into whether this trend is replicated in other policy documents would be very important to investigate the usefulness or danger of ecosystem services as a frame for nature conservation. Such an investigation could give more empirical evidence that intrinsic values and concrete conservation goals need protection against a crowding-out effect by ecosystem services.

Secondly, the two solutions proposed in this thesis to give ecological knowledge an important role in PES schemes, namely the portfolio approach and the use of ecological indicators for a biodiversity label, also lack empirical evidence about their feasibility. In a sense, portfolio techniques are already applied in agriculture when monocultures are replaced by a slightly larger set of species for sustainable harvests (Schläpfer *et al.* 2002). The same approach is applied to fisheries (Perruso *et al.* 2005). The challenge remains whether this technique can be expanded to PES schemes for goals of biodiversity conservation. Research is currently expanding about spatial overlap between biodiversity and ecosystems, and about whether ecosystem management can focus on bundles of ecosystem services. Conceivably,, payment for ecosystem services schemes may be set up to provide multiple ecosystem services simultaneously. To manage a stable and resilient provision of bundles of ecosystem services, the portfolio approach may inform the management of such schemes, but its usefulness and applicability remains unknown. In addition, a successful application of portfolio approaches rests on ecological knowledge; especially on the relationships between biodiversity and ecosystem functioning. A deeper understanding of these relationships remains essential.

The efficacy of a biodiversity label in practice is also unknown. Biodiversity labels could function as a quality control within PES schemes, but it remains unknown in what kind of schemes they are most effective. We can hypothesize that farmers would feel more motivated to protect biodiversity on their land once such a label is in place, because a label for judging performance speaks to motivations of reputation within a community and of financial benefits. On the other hand, such motivations were not rated highly in chapter 6 on motivations for nature conservation. Research on farmers' willingness to work on biodiversity could instead investigate ways to speak to values of living a worthwhile life and intrinsic values in addition to financial values.

The great pressing question remains how to motivate society to protect nature. The economic valuation of ecosystem services promises a solution, but simultaneously creates complications. The research question about the motivations that underlie successful biodiversity conservation concluded that economic values tell only a small part of the story when it comes to motivating people. Morals based on intrinsic values and especially the concept of living a worthwhile life, also known as eudaimonia, appear to play a much more important role. But will stressing the eudaimonia concept for nature conservation lead to more effective action? It might be the case that eudaimonistic values are effective to motivate people on an individual level, but will be less effective than economic values when it comes to motivating organizations to cooperate in nature conservation. People's sensitivity to different values of nature may differ according to the environment in which they receive them, for instance at work in a role of policy maker or at home as a member of a family. Also, if eudaimonistic values are communicated alongside economic values, will those economic values crowd out the eudaimonistic ones?

## 5.2 Recommendations for policy makers

### *5.2.1. In search for an appropriate role for economic valuation of nature*

Laurans et al. (2013) created a topology of uses for economic valuation of ecosystem services, and identify three categories and eight subcategories (see Table 1 for a complete overview). First, the valuation could be incorporated in a cost-benefit analysis, on which basis an informed choice can be made between alternative visions. Secondly, economic valuation could be used after such a choice is already made, for instance for the design of a financial instrument for ecosystem services provision. Finally, economic valuation could play a broader role in informing and awareness-raising about the value of nature. This possible use is most frequently communicated in influential papers by Costanza et al. (1997) and Daily et al. (2009).

| Category | Subcategory | Recommendation |
|---|---|---|
| 1. Decisive EV, used in a CBA, for | *EV for trade-offs.* Using EV for making an informed choice between alternative visions of environmental management. | Replace by alternative methods. |

| | | |
|---|---|---|
| *ex ante* decisions. | *Participative EV.* EV as a negotiating language, where the valuation forms the basis for discussion. Discussing the parameters and assumptions behind the valuation exercise forms a negotiation between stakeholders. | Replace by alternative methods. |
| | *EV as a criterion within environmental management.* It could be used to prioritize certain conservation efforts within an organization when budgets are increasingly limited. | Replace by alternative methods. |
| 2. Technical EV, for designing an economic instrument. | *EV used for establishing levels of damage compensation* that a project is expected to cause. This could guide administrative decisions and court rulings. | Partly useful while safeguarding conservation goals. |
| | *EV for price-setting*. On the basis of willingness-to-pay or willingness-to-accept arrangements between stakeholders, EV can make the calculations. | Partly useful while safeguarding conservation goals. |
| 3. Informative EV, for broader communication. | *EV for awareness-raising*. Communicating the calculations may influence support for conservation initiatives, even if the specific numbers are not used in those initiatives | Partly useful if made part of a more inclusive message of values. |
| | *EV for justification*. The calculation could demonstrate an economic rationality behind a choice. Alternatively, it could verify whether a made decision is effective. | Replace by alternative methods. |
| | *EV for green accounting*. For keeping decision makers informed about the state of natural capital | Partly useful while safeguarding conservation goals. |

**Table 1**: categories of use of economic valuation of nature for policy makers. Categories and subcategories are taken from Laurans et al. (2013).

Using the conclusions of this thesis, we can now reflect on these various uses of economic valuation and narrow the list down to a possibly appropriate role for the method. Considering the first category of decisive uses, the three subcategories of decisive uses all suffer from the complication that the personal values of stakeholders are not adequately expressed in valuation methods, while we conclude that practitioners themselves note this lack (conclusion 1). Therefore, in making trade-offs, in negotiating between stakeholders and in making strategic decisions about environmental management, the economic valuation approach seems better replaced by an alternative method that creates space for these values.

From the perspective of decision makers, economic valuation of nature is useful if it can bring rationality to the process of coming to a decision, and whether it has power in the procedure to be influential for advocating or justifying decisions (Laurans and Mermet, 2013). Alternative valuation methods such as multi-criteria decision analysis, participatory methods and deliberative mapping arguably fill the same criteria (Knights et al, 2013). Deliberative mapping, for example, is an option appraisal process that brings citizens and specialists together for a method that combines a variety of participatory techniques to explore options. It has been used before for the topics of organ transplantation (Davies et. al. 2003), nuclear waste disposal (Burgess et. al. 2004) and climate change mitigation (Bellamy et. al. 2014). The critiques about economic valuation on the other hand undermine economic valuation’s power of justification in the decision process.

The second category of technical uses shows more promise, while concerns remain. Financial instruments may still crowd out the intrinsic values and motivations of people to engage in conservation activities. Also, the valuation methods such as willingness-to-pay or willingness-to-accept leave no space for the expression of intrinsic values. Technical uses in the form of financial instruments may however lead to cooperation on an institutional level, but the sustainable use of ecosystems and conservation goals will need safeguarding (conclusions 3 and 4).

The final category of informative uses also shows promise, while concerns remain. Using economic valuation for awareness-raising and general motivation is a truncated method that is better used in combination with two other messages: that of intrinsic value of nature and the role of nature in a meaningful life (conclusion 5). However, if the economic metaphor crowds out the other two messages, as is visible for example in the EU research programmes (conclusion 2), motivating people may only be partially successful. Economic valuation to justify decisions or verify them for their effectiveness seems misguided when a wider social context is needed to appraise decisions for their appropriateness (conclusion 1). Finally, in the case of green accounting of natural capital, again conservation goals will need safeguarding so that they are not replaced by the ecosystem services provision goals in higher policy levels (conclusion 2).

In conclusion, it is recommended to policy makers that the use of economic valuation of nature is restricted to two instances. First, as a facilitation for financial schemes for nature conservation, but only if clear conservation goals are set and respected, for example about the protection of rare but economically hard to value species, and if both those goals and the personal values of participants are clearly expressed and at the foundation of the scheme. Second, as a communication of the value of nature, but only if it is framed in a combination with other values that reflect human-nature relationships in which nature has intrinsic values and plays a role in living a meaningful life.

### *5.2.2. Maintain a strong focus on nature conservation goals in environmental policy.*

Ecosystem services will probably be here to stay as a piece of the puzzle in environmental management for its usefulness to address the social and economic aspects of environmental policy. However, embracing ecosystem services in environmental policy as a replacement concept for nature conservation may not necessarily help to support that nature conservation. Chapter 3 shows that the Horizon 2020 documents, for example, do not mention economic valuation in their environmental research plans, but their embrace of ecosystem services has nevertheless replaced direct calls for nature conservation to vaguer anthropocentric goals. Therefore, a detachment seems to be in order, detaching nature conservation goals from ecosystem services goals. As Schröter and Van Oudenhoven (2016) and Wilson and Law (2016) argue, ecosystem services has a lot to offer to modern nature conservation, but ecosystem services as a concept is so broadly useful that any pretense of using it for nature conservation, or indeed any other goal such as equitable management of services, should be regarded with scrutiny.

Wilson and Law (2016) argue that nature conservation practitioners should be on the lookout for so-called perverse outcomes if they operate within an ecosystem services framework for conservation, and suggest six steps to safeguard a positive outcome for biodiversity objectives. Spash and Aslaksen (2014) as well call for a stronger ecological rhetoric in environmental policy, in which ecological indicators inform our environmental management. It is a call back to earlier times in which the goals of nature conservation itself were not yet obscured by ecosystem services and economic language.

In addition, a growing body of literature now aims to reframe or reposition ecosystem services in such a way that its positive aspects are maintained, while human-nature relationships are given a stronger expression. For example, Laurila-Pant *et al.* (2015) suggests an ecosystem-based management framework, in which socio-cultural preferences and ecological indicators are both given a clear and present role, and economic valuation is only used to make understandable comparisons of values on a global level. According to Mace (2014), this literature is part of a new trend of framing conservation in a narrative that links nature to cultural structures and resilient societies. In a similar vein, Folke *et al.* (2010) explore how to think about resilient social-ecological systems. Part of this new trend is the recognition that ecosystem services is just one metaphor and should find its place among multiple metaphors about human-nature relationships, and that each metaphor could be granted space in ecosystem management. Following Raymond et al. (2013), the *economic* metaphor contributes to cost-benefit analyses, the *stewardship* metaphor identifies non-monetary behavior that enables conservation, the *web of life* metaphor identifies important natural drivers of change and the *ecocultural community* metaphor describes cultural connections with landscapes and local narratives. As argued by Spash and Aslaksen (2014), in using only the *economic* metaphor, we may lose sight of structural causes of environmental degradation in our political and economic systems, and ecosystem services should therefore be embedded in a new social-ecological economics approach that gives voice to both various human-nature relationships and illuminates structural causes of environmental degradation.

**5.4 Final word**

A sign of current trends in nature conservation is that the research topic for this thesis might become rare in the future. The research was done as a part of a European FP7 research project, BIOMOT, and this same project lit up as a data point in chapter 6, which was about the word use in FP7 research programmes. As chapter 6 clarified, the thematic emphasis of the BIOMOT project away from ecosystem services and towards other expressions of value has proven to be unique among the accepted research projects in FP7 and Horizon 2020. In the years following the start of BIOMOT, the open call descriptions of FP7 and the objectives of accepted research projects have fully embraced ecosystem services as a working and adequate expression of the value of biodiversity. Scrutinizing this development, as BIOMOT attempted, seems a final effort of a bygone era in this particular policy circle. If this thesis raised your interest or your concerns about whether we are on the right path on higher policy levels, then this is an unsettling realization.

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# Summary

**Summary**

The general topic of this thesis is how a strong focus on nature conservation can be maintained in a situation where economic valuation of nature has become a dominant but troubled approach in the governance and management of the environment. This valuation approach rests on an earlier introduced paradigm of ecosystem services, in which nature is seen as a source that provides services to society. The ecosystem services and economic valuation of nature approach has created both opportunities and challenges for nature conservation. Both its effectiveness in nature conservation and the moral and ethical consequences are heavily debated. This thesis puts a focus on some of those challenges where the goals of nature conservation themselves are in danger of being lost, and provides a contribution towards solving these issues.

The goals of nature conservation are formed by the way we see the relationship between humans and nature. Ecosystem services is the current popular approach to express this relationship and causes friction with earlier frames, because it involves human well-being as a measure of conservation success, while the frame of protection of nature against human pressures sees humanity increasing its wellbeing as a threat to conservation. Many nature conservationists viewed the ecosystem services concept and the additional step of monetization of services as a promising development in the battle to prevent biodiversity loss. From the perspective of economics, the concept was very useful, because it allowed economists to incorporate the effects of environmental damages and benefits from nature into an updated view of human welfare. The applicability and flexibility of ecosystem services is broad, and the potential use of the concept partly depends on the institutional context. In the vaguest sense, it can be a buzzword to mean that we take into account nature conservation, human happiness and economic development in one package.

A large number of critiques appeared in scientific literature about ecosystem services and economic valuation. From the perspective of nature conservation, the main problem that the ecosystem services frame poses, is that the justification of nature conservation changes to a strongly anthropocentric outlook. What ecosystem services does, is specifically naming the function and use of nature for humans as the justification for conservation. This makes it considerably more difficult to justify the protection of rare species, and diversity itself. Economic valuation of ecosystem services further narrows the justification of nature conservation, and rare species hardly ever carry the greatest monetary values. Nature conservation itself may even be in direct conflict with maintaining ecosystem services and may be in competition for space and resources.

It is argued further that human-nature relationships, which motivate the goals of nature conservation, cannot be adequately expressed through economic valuation. A commodification of nature would see ecosystems and individual species as exchangeable with other commodities and land uses, which devalues nature, may create fragmentation of landscapes, and disregards certain values that humans attribute to nature. There is accumulating evidence that an imposition of monetary rewards as an incentive to get people motivated to act has limits and undesirable consequences. There is also a danger that economic valuation and commodification of nature will further disenfranchise the poor and

empower the rich, and it doesn't change the institutional context enough to solve the environmental problems.

From the point of view of a policy maker, the criticism exhibits a layered complexity, in which it is unknown how to deal properly with these concerns. One way forward is to channel these critiques into practical adjustments of the way ecosystem services and economic valuation are implemented now. This thesis works towards that aim, leading to the following research questions.

1. **What do practitioners think about economic valuation?**
   This chapter takes all the available information about the virtues and limits of economic valuation of biodiversity and its alternatives and investigates the current opinions about these concepts among people who are involved in the field and carry out such economic valuation in projects.
2. **How do EU research subsidy documents communicate the importance of biodiversity conservation?**
   This chapter investigates how the value of biodiversity is communicated within European policy networks, and whether there are any trends visible through the years in how this value is communicated to European scientists.
3. **How can we combine economic valuation with notions of sustainable use of ecosystems?**
   This chapter looks into the economic methods that are used to value ecosystem services and to explore whether these methods could be augmented with ecological knowledge.
4. **What are stakeholders' ideas about good indicators for conservation action success by farmers?**
   This chapter investigates stakeholders' ideas about ecological indicators in how farmers are judged in their performance in biodiversity conservation, and whether such indicators are a viable way to use ecological knowledge in market-based approaches.
5. **What are the motivations underlying committed conservation action?**
   In the final chapter, the aim was to find people who already are passionate about protecting nature, and ask them what makes them motivated to do their work. This information informs us of the values of nature that need to be given freedom of expression in biodiversity conservation to trigger motivation.

**Answers to the Research Questions**

**Q1**: **What do practitioners think about economic valuation?**
Four coherent viewpoints could be identified concerning economic valuation of biodiversity and ecosystems: *enthusiasm*, *value pluralism*, *social justice concerns* and *eco-deliberation*. The discourses show that the same arguments for or against economic valuation may be used for different collections of ideas. Furthermore, the sequence of salience of the four identified discourses illustrates a polarization of opinions. Only one discourse is in clear agreement with economic valuation of ecosystems and biodiversity and it is the most salient one. The three discourses besides *enthusiasm* express different forms of disagreement with economic valuation, and are nevertheless strongly expressed in the debate.

**Q2**: **How do EU research subsidy documents communicate the importance of biodiversity conservation?**
A clear shift in word use is visible in the environment themes of the FP7 and Horizon 2020 work programs towards using 'ecosystem services' as the foremost way to express the value of biodiversity. There is little explicit referral to economic valuation of biodiversity in the documents. Coupled with a simultaneous decrease of other expressions of values and goals such as 'conservation' and 'sustainability', 'ecosystem services' substitutes other expressions of value in the work programs.

**Q3**: **How can we combine economic valuation with notions of sustainable use of ecosystems?**
Ecological theory of resilience has a role to play in sustainable use of ecosystems, and this can be connected to the approach of economic valuation via the metaphor of biodiversity having an insurance value for future provision of ecosystem services. The specific biodiversity-related ideas about functional diversity and how that relates to stability and resilience is what is useful in this framework, because it relates to sustained ecosystem functioning. Portfolio theory in turn justifies an investment in diversity.

**Q4**: **What are stakeholders' ideas about good indicators for conservation action success by farmers?**
The three types of ecological indicators received significantly different scores, suggesting that a rating system based on (1) the preconditions necessary to obtain biodiversity success and (2) the attained biodiversity results will be experienced as most acceptable throughout the chain of agricultural production. The third type, being "the farmer's effort in nature management" will be experienced as less acceptable. There are no clear differences in opinion between the chain parties. Within a market-based approach, stakeholders can come to agreements such as over the right indicators for biodiversity success.

**Q5**: **What are the motivations underlying committed conservation action?**
A basic palette of motivations appears to exist for committed action in general, but small specific differences are found between biodiversity and non-biodiversity actors. The basic palette is broad, including *curiosity and learning*, *living a worthwhile life*, *future generations* and *value in itself*. Especially *living a worthwhile life* is a motivation curiously absent from the current communication about the value of nature conservation.

**Discussion**

Using the answers to the research questions, we come to a deeper understanding of the roles ecosystem services and economic valuation of nature could play in nature conservation and where it creates problems.

To lay out the debate, the first study (chapter 2) illuminates that within the ecosystem services community, the debate about economic valuation is polarized into one discourse of enthusiasm and a couple of negative discourses whose concerns refer to personal and societal values that are perceived as ignored or under threat. The arguments for and against economic valuation refer to different understandings of hypothetical consequences. This result could be a consequence of that the effectiveness of economic valuation to protect nature is still unknown. As empirical evidence for or against economic valuation approaches for the goal of nature conservation mounts, the debate on this topic might shift from imagined applicability and side-effects to more clearly defined limits and usefulness.

One perceived danger of economic valuation of ecosystem services is that non-anthropocentric reasons for nature conservation and the personal values underlying these reasons will be discarded. This danger becomes more tangible when the study on word use in EU research programmes shows that nature conservation as a goal itself disappears from higher policy levels, while the ecosystem services idea becomes the foremost way to express the value of biodiversity. It is argued that arguments based on ecosystem services could be used in tandem with arguments from the intrinsic value of nature, but the results suggest that that may not be the case.

If nature conservation goals are repackaged as ecosystem services provision and economic value goals, can ecological knowledge still inform environmental policy? The third study shows that economic valuation of nature can still be combined with notions of sustainable use of ecosystems. The proposed solution of portfolio theory is however only a partial solution in the grand scheme of ignored values, because it still refers to economic values and to desired ecosystem functions from an anthropological point of view. From the perspective of nature conservation however, the portfolio approach is a tortured, roundabout way of arguing for conservation.

A biodiversity label based on accepted ecological indicators would be a second way to combine economic valuation of nature with ecological knowledge for biodiversity conservation. The indicators that are regarded as most important are those informed by ecological science. Within a market-based approach, stakeholders can come to agreements such as over the right indicators for biodiversity success. Where portfolios of biodiversity are meant to protect ecosystems from regime shifts and uphold ecological resilience, biodiversity labels give an indication whether the ecological goals for protecting ecosystems are actually upheld. Both solutions could help to give voice to values underlying biodiversity conservation.

The question remains how to motivate society to protect nature. When discussing how economic valuation of nature relates to personal motivation, it should first be mentioned that the techniques used to value nature in this way, such as contingent valuation, hedonic pricing etc., are not meant to motivate people personally. However, since personal values are seen as under threat by economic valuation in the identified discourses, the relationship between motivation and economic valuation bears scrutiny. The strongest motivations for nature conservation refer to values that are either difficult to describe and to value as services, such as care for future generations and intrinsic value, or not part of a services framework, such as living a worthwhile life. Our study suggests that ecosystem services fails to motivate because it is too abstract and misrepresents the relationship between humans and nature.

**Recommendations for future research**

First of all, empirical evidence is lacking about either the dangers or the effectiveness of economic valuation and Payment for Ecosystem Services (PES) schemes. A common argument is that ecosystem services thinking is a slippery slope towards economic valuation, and economic valuation a slippery slope towards financial mechanisms such as biodiversity offsetting. What remains unknown is how often economic valuation leads to these practices and under what conditions, and what the precise consequences are of offsetting schemes. Payment for Ecosystem Services schemes' effectiveness in conservation also remains unclear and so does its impact on the intrinsic motivations of stakeholders. Since our investigation into word use discovered that the ecosystem services framing replaces other frames that could stand alongside it, ecosystem services could no longer be seen as just a tool in a toolbox of strategies for nature conservationists. Further investigation into whether this trend is replicated in other policy documents would be very important to investigate the usefulness or danger of ecosystem services as a frame for nature conservation. Further research could either resolve some of the worries of critics or support the validity of their critiques.

Secondly, the two solutions proposed in this thesis to give ecological knowledge an important role in PES schemes, namely the portfolio approach and the use of ecological indicators for a biodiversity label, also lack empirical evidence about their feasibility. In addition, a successful application of these approaches rests on ecological knowledge; especially on the relationships between biodiversity and ecosystem functioning. A deeper understanding of these relationships remains essential.

Finally, the great pressing question remains how to motivate society to protect nature. The economic valuation of ecosystem services promises a solution, but simultaneously creates complications. The research question about the motivations that underlie successful biodiversity conservation concluded that economic values tell only a part of the story when it comes to motivating people. Morals based on intrinsic values and especially the concept of a worthwhile life appear to play an important role. But will stressing the worthwhile life concept for nature conservation lead to more effective action?

**Recommendations for policy makers**

It is recommended to policy makers that the use of economic valuation of nature is restricted to two instances. First, as a facilitation for financial schemes for nature conservation, but only if clear conservation goals are respected. Secondly, as a communication of the value of nature, but only if it is framed in a combination with other values that reflect human-nature relationships.

Conservation goals will need safeguarding so that vaguer notions of nature conservation do not become the status quo in higher policy levels. Technical uses in the form of financial instruments may however lead to cooperation on an institutional level, but the sustainable use of ecosystems and conservation goals will need safeguarding in that case against perverse outcomes.

In making trade-offs in environmental management, in negotiating between stakeholders and in making strategic management decisions, the economic valuation approach seems better replaced by an alternative method that creates space for unaddressed personal values. To bring rationality to the process of coming to a decision, alternative valuation methods arguably fill the same criteria. Also, using economic valuation for awareness-raising and general motivation is a truncated method that is better used in combination with two other messages: that of intrinsic value of nature and the role of nature in a meaningful life.

Reframe or reposition ecosystem services in such a way that its positive aspects are maintained, while human-nature relationships are given a stronger expression and structural causes of environmental degradation are illuminated. Ecosystem services is just one metaphor and should find its place among multiple metaphors about human-nature relationships, so that each metaphor could be granted space in ecosystem management.

# Samenvatting

**Samenvatting**

Het algemene onderwerp van deze dissertatie is hoe een sterke focus op natuurbescherming in stand kan worden gehouden in een situatie waarin de economische waardering van de natuur een dominante maar problematische aanpak is geworden in het natuurbeleid. Deze waarderingsaanpak rust op het eerder geïntroduceerde paradigma van de ecosysteemdiensten, waarin de natuur wordt gezien als een bron van diensten voor de samenleving. Deze aanpak van ecosysteemdiensten en economische waardering van de natuur heeft gezorgd voor kansen en uitdagingen voor de natuurbescherming. Zowel de effectiviteit ervan in natuurbescherming als de morele en ethische consequenties worden in alle hevigheid betwist. Deze dissertatie richt zich op sommige van deze uitdagingen, met name op de gevaren voor de natuurbescherming, en maakt een stap richting het oplossen van de problemen.

De doelen van natuurbescherming worden gevormd door de manier waarop wij de relatie zien tussen de mens en natuur. Ecosysteemdiensten zijn de huidige populaire manier om deze relatie te beschrijven, maar conflicteren met eerdere raamwerken die deze relatie op een andere manier weergeven. Ecosysteemdiensten zien het welzijn van mensen als een maatstaf voor succes in de natuurbescherming, terwijl het raamwerk van het beschermen van de natuur tegen de druk van mensen het vergroten van het menselijke welzijn ten kostte van de natuur juist ziet als het probleem. Vele natuurbeschermers zien het ecosysteemdiensten-concept en de vervolgstap van het monetariseren van deze diensten als een kansrijke ontwikkeling in de strijd om biodiversiteit te beschermen. Vanuit het perspectief van de economie is het concept goed bruikbaar, omdat het economen in staat stelt om de effecten van milieuschade en de voordelen van de natuur te incorporeren in een nieuwe berekening van menselijk welzijn. De bruikbaarheid en flexibiliteit van het ecosysteemdiensten concept is breed, en op welke manier het wordt gebruikt hangt af van de institutionele context. In de breedste zin kan het een populair woord zijn, waarmee we aangeven dat we natuurbescherming, menselijk welzijn en economische ontwikkeling allemaal tegelijkertijd ondersteunen.

In de wetenschappelijke literatuur is er veel kritiek verschenen over ecosysteemdiensten en economische waardering. Vanuit het perspectief van de natuurbescherming is het grootste probleem van het ecosysteemdiensten raamwerk dat de verantwoording van natuurbescherming een sterk antropocentrische grondslag krijgt. Wat ecosysteemdiensten specifiek betekenen voor de verantwoording van natuurbescherming, is dat de functies en het gebruik van de natuur voor het welzijn van mensen de hoofdredenen worden voor bescherming. Dit maakt het moeilijker om de bescherming van zeldzame soorten te verantwoorden, en diversiteit *an sich*. De economische waardering schuift de verantwoording van natuurbescherming nog meer richting geldwaarden, en zeldzame soorten dragen zelden de grootste monetaire waarden met zich mee. Natuurbescherming zou zelfs in direct conflict kunnen komen met het beheren van ecosysteemdiensten.

Daarbij wordt er beargumenteerd dat de relaties tussen mens en natuur, die de menselijke motivatie vormen voor natuurbescherming, niet goed tot uiting komen in een economische waardering. Het zien van de natuur als een consumptiegoed zou kunnen leiden tot het zien van ecosystemen en afzonderlijke soorten als inwisselbaar met andere goederen en landgebruiken. Het zou ook een fragmentatie van het

landschap in gang kunnen zetten, en negeert bepaalde waarden die mensen toekennen aan de natuur. Er is toenemend bewijs dat het gebruik van monetaire stimulansen om mensen te motiveren om te handelen zijn beperkingen heeft en zelfs ongewenste gevolgen kan hebben. Er bestaat tevens het gevaar dat economische waardering en het veranderen van de natuur naar koopwaar een armere bevolking achterstelt en rijkere mensen machtiger maakt. Ten slotte zou een economische waardering niet tot de gewenste veranderingen leiden op het beleidsniveau om milieuproblemen werkelijk op te lossen.

Vanuit het perspectief van een beleidsmaker is al deze kritiek erg complex, waardoor oplossingen uit het zicht blijven. Een manier vooruit is om de kritiek te kanaliseren naar praktische aanpassingen van de manier waarop ecosysteemdiensten en economische waardering nu wordt toegepast. Deze dissertatie werkt naar dit doel, en stelt daarvoor de volgende onderzoeksvragen.

1. **Wat vinden de beoefenaars van economische waardering van de aanpak?**
   Dit hoofdstuk verzamelt alle beschikbare informatie over de voor- en nadelen van de economische waardering van biodiversiteit en de alternatieven, en onderzoekt de huidige opvattingen over deze concepten onder mensen die betrokken zijn met de toepassing van economische waardering in projecten.
2. **Op welke manieren communiceren de EU onderzoekssubsidies-documenten het belang van het behoud van de biodiversiteit?**
   Dit hoofdstuk onderzoekt hoe de waarde van biodiversiteit wordt gecommuniceerd binnen de Europese beleidsnetwerken, en of er trends zichtbaar zijn door de jaren heen in de manier waarop deze waarde wordt gecommuniceerd naar Europese wetenschappers.
3. **Hoe kunnen we economische waardering combineren met noties van duurzaam gebruik van ecosystemen?**
   Dit hoofdstuk kijkt naar de economische methoden die worden gebruikt om de waarde van ecosysteemdiensten te bepalen of deze methoden kunnen worden uitgebreid met ecologische kennis.
4. **Wat zijn de opvattingen van belanghebbenden over goede indicatoren voor natuurbeschermings-succes van boeren?**
   Dit hoofdstuk onderzoekt ideeën van belanghebbenden in de agrarische sector over ecologische indicatoren van succes in natuurbescherming door boeren. De uitkomst van dit onderzoek zal duidelijk maken of dergelijke indicatoren een goede manier zijn om ecologische kennis een grotere rol te geven in markt-gebaseerde strategieën van natuurbehoud.
5. **Wat zijn de motivaties die ten grondslag liggen aan geëngageerde actie voor natuurbescherming?**
   In het laatste hoofdstuk is het doel om mensen te vinden die al gepassioneerd zijn over de bescherming van de natuur, en om hen te vragen wat hen gemotiveerd maakt om hun werk te doen. Dit geeft ons informatie over de waarden van de natuur die een stem moeten worden gegeven om zo natuurbescherming te stimuleren.

**Antwoorden op de onderzoeksvragen**

**V1**: **Wat vinden de beoefenaars van economische waardering van de aanpak?**

Vier coherente standpunten ("discoursen") konden worden geïdentificeerd met betrekking tot de economische waardering van biodiversiteit en ecosystemen: *enthousiasme*, *moreel pluralisme*, *sociale rechtvaardigheid* en *eco-overleg*. De discoursen gebruiken soms dezelfde argumenten voor of tegen economische waardering. Bovendien toont de volgorde van zichtbaarheid van de vier geïdentificeerde standpunten in de data een polarisatie. Slechts één discours, *enthousiasme*, is duidelijk in overeenstemming met de economische waardering van ecosystemen en biodiversiteit en het is de meest opvallende in de data. De drie andere standpunten uiten verschillende vormen van kritiek op economische waardering en zijn ook sterk aanwezig in het debat.

**V2: Op welke manieren communiceren de EU onderzoekssubsidies-documenten het belang van het behoud van de biodiversiteit?**

Een duidelijke verschuiving in woordgebruik is zichtbaar in de milieuthema's van de FP7 en Horizon 2020 werkprogramma's. In een periode van 7 jaar verschuift de bewoording van het behoud van biodiversiteit van doelen zoals *'conservation'* naar het gebruik van 'ecosysteemdiensten' als de belangrijkste manier om de waarde van biodiversiteit uit te drukken. Er is weinig expliciete verwijzing naar de economische waarde van de biodiversiteit in de documenten. In combinatie met een gelijktijdige daling van de andere uitingen van waarden en doelstellingen, zoals 'behoud' en 'duurzaamheid', vervangt 'ecosysteemdiensten' andere uitingen van waarde in de werkprogramma's.

**V3: Hoe kunnen we economische waardering combineren met noties van duurzaam gebruik van ecosystemen?**

Ecologische theorie over veerkracht heeft een rol te spelen bij een duurzaam gebruik van ecosystemen, en deze kan worden gebruikt bij de aanpak van de economische waardering. Dit is mogelijk via de metafoor van de biodiversiteit als een verzekeringswaarde voor de toekomstige levering van ecosysteemdiensten. De specifieke ecologische theorieën over functionele diversiteit en hoe deze betrekking hebben op de stabiliteit en veerkracht van ecosystemen is wat nuttig is in dit kader, omdat deze theorieën gaan over het duurzame functioneren van een ecosysteem. Economische portfolio theorie op zijn beurt rechtvaardigt een investering in deze biodiversiteit.

**V4: Wat zijn de opvattingen van belanghebbenden over goede indicatoren voor natuurbeschermings-succes van boeren?**

De drie onderzochte typen van ecologische indicatoren ontvangen significant verschillende scores. Een beoordelingssysteem gebaseerd op (1) de *randvoorwaarden* die nodig zijn voor het succes van de biodiversiteit en (2) de *bereikte resultaten* van biodiversiteit zullen worden ervaren als acceptabel in de gehele keten van agrarische productie. De derde indicator van de *moeite* die een boer steekt in natuurbescherming bleek minder acceptabel. Er zijn geen duidelijke verschillen in opvatting tussen de ketenpartijen. Het onderzoek geeft aan dat binnen een marktgerichte aanpak de belanghebbenden tot gelijkgestemdheid kunnen komen over de juiste indicatoren voor het succes van de biodiversiteit.

**V5: Wat zijn de motivaties die ten grondslag liggen aan geëngageerde actie voor natuurbescherming?**

Een basis palet van motivaties lijkt te bestaan voor toegewijd handelen in het algemeen. Dit basis palet van motivaties is breed, waarbij de hoogste scores zijn gegeven aan *nieuwsgierigheid en leren*, een *waardevol leven leiden*, zorg voor *toekomstige generaties* en natuur als *waarde op zich*. Er zijn kleine specifieke verschillen voor toegewijde actie tussen biodiversiteits- en niet-biodiversiteitsactoren. Zo lijkt schoonheid een belangrijkere rol te spelen voor niet-biodiversiteitsactoren voor hun activiteiten in de natuurbescherming. Een waardevol leven leiden is een motivatie die merkwaardig afwezig is in de huidige communicatie over de waarde van de natuur.

**Discussie**

Met behulp van de antwoorden op de onderzoeksvragen, komen we tot een dieper begrip van de rollen die ecosysteemdiensten en economische waardering van de natuur zou kunnen spelen bij natuurbehoud en waar zij problemen scheppen.

De eerste studie (hoofdstuk 2) opent het debat en belicht dat er binnen de gemeenschap van gebruikers, een tweesplitsing is in de meningen over economische waardering. De bestaande meningen zijn gepolariseerd in een discours van enthousiasme en een drietal negatieve discoursen waarin bezorgdheid wordt geuit over persoonlijke en maatschappelijke waarden die worden gezien als genegeerd of bedreigd. De argumenten voor en tegen economische waardering verwijzen naar verschillende opvattingen over de hypothetische gevolgen van het gebruik in de praktijk. Deze uitkomst van de studie komt wellicht omdat de effectiviteit van economische waardering voor natuurbescherming nog onbekend is. Als empirisch bewijs zich opstapelt voor of tegen economische waardering, dan zou het debat kunnen verschuiven van ingebeelde toepasbaarheid en gevolgen naar duidelijker afgebakende grenzen en effectiviteit.

Een vermeend gevaar van de economische waardering van ecosysteemdiensten is dat niet-antropocentrische redenen voor het behoud van de natuur zullen worden genegeerd, en dat daarmee de persoonlijke waarden worden genegeerd die ten grondslag liggen van natuurbehoud. De angst voor deze consequentie krijgt een onderbouwing in hoofdstuk 3, waarin het onderzoek op het woordgebruik in de EU-onderzoeksprogramma's aantoont dat natuurbescherming als een doel op zich verdwijnt uit hogere beleidsniveaus, terwijl ecosysteemdiensten de belangrijkste argumenten worden om de waarde van de biodiversiteit uit te drukken. Er wordt in de literatuur wel betoogd dat argumenten op basis van ecosysteemdiensten zouden kunnen worden gebruikt in combinatie met de argumenten van de intrinsieke waarde van de natuur, maar de resultaten van hoofdstuk 3 suggereren dat dat niet zo hoeft te zijn.

Als de doelen van natuurbehoud worden omgezet naar doelen voor het behoud van ecosysteemdiensten en economische waarde, kan ecologische kennis dan nog steeds een belangrijke rol spelen in het milieubeleid? De derde studie (hoofdstuk 4) toont aan dat de economische waardering van de natuur nog steeds kan worden gecombineerd met noties van een duurzaam gebruik van ecosystemen. De voorgestelde oplossing van de portfolio-theorie is echter slechts een gedeeltelijke oplossing als het gaat over genegeerde waarden, omdat het nog steeds verwijst naar de economische waarden en de gewenste functies van een ecosysteem vanuit een antropologisch perspectief. Vanuit het oogpunt van natuurbescherming is de portfolio aanpak een omslachtige weg om te pleiten voor natuurbehoud.

Een biodiversiteits-label op basis van aanvaarde ecologische indicatoren zou een tweede manier zijn om de economische waardering van de natuur te combineren met ecologische kennis voor het behoud van biodiversiteit. De indicatoren die als de belangrijkste worden beschouwd, zijn degenen die gebaseerd zijn op ecologische kennis. Binnen een marktgerichte aanpak zoals de keten in de landbouw van boeren naar consumenten, kunnen de belanghebbenden gelijkgestemd zijn over de juiste indicatoren voor het succes van biodiversiteit maatregelen. Als we de portfolio's van biodiversiteit zien als een methode om ecosystemen te beschermen tegen regimeverschuivingen en voor het verdedigen van ecologische veerkracht, dan geven biodiversiteits-labels een indicatie of de ecologische doelstellingen voor de bescherming van ecosystemen daadwerkelijk worden gehaald. Beide oplossingen kunnen helpen om ecologische kennis en duurzaam gebruik van ecosystemen een sterkere rol te geven in de praktijk van het biodiversiteit beleid.

De vraag blijft hoe de samenleving te motiveren valt om de natuur te beschermen. Bij het bespreken van het effect van economische waardering op persoonlijke motivatie, moet allereerst worden opgemerkt dat de technieken die worden gebruikt om de natuur op deze manier te waarderen, zoals *contingent valuation*, hedonistische prijzen etc., niet bedoeld zijn om mensen persoonlijk te motiveren. Echter, aangezien persoonlijke waarden worden gezien als bedreigd door de economische waardering in de geïdentificeerde discoursen in de 2$^{e}$ studie, moet de relatie tussen motivatie en de economische waardering dieper onderzocht worden. De sterkste motivaties voor natuurbehoud verwijzen naar waarden die ofwel moeilijk te beschrijven zijn als diensten, zoals de zorg voor toekomstige generaties en de intrinsieke waarde van de natuur, ofwel geen deel uitmaken van een raamwerk van ecosysteemdiensten, zoals een waardevol leven leiden. Onze studie suggereert dat ecosysteemdiensten niet motiveren omdat ze te abstract zijn en een verkeerde voorstelling geven van de relatie tussen mens en natuur, en dat de bovengenoemde motivaties een sterkere erkenning dienen te krijgen in het natuurbehoud.

**Aanbevelingen voor toekomstig onderzoek**

Allereerst ontbreekt er empirisch bewijs over zowel de gevaren als de effectiviteit van economische waardering voor natuurbehoud, en hetzelfde geldt voor regelingen van betaling voor ecosysteemdiensten (PES). Een veelgehoord argument is dat de ecosysteemdiensten is een hellend vlak zijn in de richting van economische waardering, en economische waardering op zijn beurt een hellend vlak is in de richting van financiële mechanismen zoals biodiversiteit compensaties. Het blijft onbekend hoe vaak economische waardering leidt tot deze praktijken en onder welke voorwaarden, en wat de precieze gevolgen zijn van compensatieregelingen. De effectiviteit van PES-regelingen in het natuurbehoud blijft ook onduidelijk en dat geldt ook voor de impact op de intrinsieke motivatie van de belanghebbenden in de praktijk. Omdat ons onderzoek naar woordgebruik ontdekt heeft dat de ecosysteemdiensten andere raamwerken van waarden vervangt, kunnen ecosysteemdiensten niet langer worden gezien als slechts een hulpmiddel in een gereedschapskist van strategieën voor de natuurbeschermers. Nader onderzoek naar de vraag of deze trend wordt overgenomen in andere beleidsdocumenten zou zeer belangrijk zijn om het nut of het gevaar te onderzoeken van ecosysteemdiensten als kader voor het behoud van de natuur. Verder onderzoek kan een deel van de zorgen van de critici oplossen of juist hun kritiek verder onderbouwen.

Ten tweede, de twee in dit proefschrift voorgestelde oplossingen om ecologische kennis te een belangrijke rol te geven in economische of markt-gebaseerde strategieën, de portfolio aanpak en de ecologische labels aanpak, lijden ook aan het gebrek aan empirische gegevens over hun haalbaarheid in de praktijk. Bovendien, een succesvolle toepassing van deze benaderingen berust op diepere ecologische kennis; vooral op de relatie tussen biodiversiteit en het functioneren van ecosystemen. Een dieper begrip van deze relaties blijft essentieel.

Ten slotte blijft de prangende vraag hoe de samenleving gemotiveerd kan worden om de natuur te beschermen. De economische waardering van ecosysteemdiensten belooft een oplossing, maar zorgt tegelijkertijd voor complicaties. De onderzoeksvraag over de motivaties voor het behoud van de biodiversiteit komt tot de conclusie dat de economische waarden slechts een deel van het verhaal vertellen als het gaat om het motiveren van mensen. De morele basis van intrinsieke waarde en vooral het begrip van een waardevol leven leiden blijken een belangrijke rol te spelen. Maar zal het stimuleren van het idee van een waardevol leven leiden ook leiden tot meer doeltreffende actie voor natuurbescherming?

**Aanbevelingen voor beleidsmakers**

Het wordt aanbevolen om het gebruik van economische waardering van de natuur te beperken tot twee instanties. Ten eerste, voor het gebruik van de financiële regelingen ten behoud van de natuur, maar alleen als er duidelijke ecologische beschermingsdoelen worden gesteld en gerespecteerd. Ten tweede, als communicatiemiddel van de waarde van de natuur, maar alleen als het wordt ingelijfd in een combinatie met andere waarden die de relaties tussen mensen en natuur breder weerspiegelen.

Natuurbeschermingsdoelen moeten duidelijk en helder opgesteld blijven, gebaseerd op ecologische doelen, zodat vagere noties van natuurbescherming niet de status quo worden op hogere beleidsniveaus. Praktische oplossingen in de vorm van financiële instrumenten kunnen leiden tot samenwerking op institutioneel niveau, maar in dat geval hebben het duurzaam gebruik van ecosystemen en de natuurbehoudsdoelen bescherming nodig.

De economische waardering kan beter vervangen worden door alternatieve methodes bij het maken van afwegingen in milieubeheer, bij de onderhandelingen tussen de belanghebbenden en bij het maken van strategische beslissingen van het management. Om op een rationele manier in een proces tot een besluit te komen, vervullen alternatieve waarderingsmethoden dezelfde criteria, en creëren meer ruimte voor persoonlijke waarden. Voor het verhogen van motivatie is economische waardering een te beperkte methode die beter kan wordt gebruikt in combinatie met twee andere boodschappen: die van de intrinsieke waarde van de natuur en de rol van de natuur in een waardevol leven.

Gebruik ecosysteemdiensten op een zodanige wijze dat de impact van de natuur op de economie zichtbaar blijft, terwijl de relaties tussen mens en natuur een sterkere expressie krijgen en de structurele oorzaken van biodiversiteitverlies helder worden. Het idee van ecosysteemdiensten is slechts een metafoor en moet zijn plaats vinden tussen meerdere metaforen over de relaties tussen mens en natuur, zodat andere metaforen ruimte houden of krijgen in het beheer van ecosystemen.

## Curriculum vitae

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|---|---|
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### Undergraduate studies

Master Environment and Resource Management at the VU University, 2010-2011.
Master Biology & Communication at Leiden University, 2006-2009.
Bachelor Biology at Leiden University, 2002-2005
VWO, Natuur & Gezondheid at Kennemer College in Beverwijk, 1997-2002

### Internships

Research internship ARCADIS (2011). Water management and climate change. Developing a damage model for inundation of the harbor industries of Rotterdam.

Internship science communication on the Filippines (2009). Writing an illustrated manual on nature conservation for Philippine officials. (Local ISBN nr. Print 500+ in 2 languages).

Internship zoology (2008). Solving the puzzle of the evolution of fangs in snakes. Result: 2 publications. *Nature*. (2008 Jul 31;454(7204):630-3); *Biol. Rev*. (2010 Feb;85(1):1-33)

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