Governance of Biodiversity:
Bringing together society, policy and science

Four studies

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A Clothilde.

Celui qui vient au monde pour ne rien troubler, ne mérite ni égard ni patience.

René Char, Fureur et Mystère (1948)

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Abstract

This research is underpinned by two observations: despite man-made directives, laws and initiatives, biodiversity is still shrinking; and the very concept of biodiversity combines societal, political and scientific considerations. The challenge of biodiversity loss therefore requires us to consider a three-layered theoretical framework that contains social and ethical (what are the values of biodiversity?), political (what are the legitimate mechanisms by which biodiversity can be protected?) and epistemological questions (how can we understand biodiversity?). In this thesis I develop this three-layered understanding of biodiversity and of the general issue of *how we may best improve biodiversity governance* from these three viewpoints in order to highlight the social, political and scientific foundations that humanity must understand and support if it is to address the issue of biodiversity protection in an effective way.

To respond to this question, I focus on science-stakeholders interfaces in the field of European biodiversity research. I adopt a normative standpoint in which research that includes stakeholders was by definition more 'social', integrating human needs and the impact of human activity as fundamentals that should be considered if we are to meet the environmental challenges of the present and the future.

In this context, the objectives of this thesis are (i) to shift from an anthropocentric human needs-based approach to a more global and ecosystemic one, (ii) to highlight perspectives that acknowledge the redistribution of state functions towards non-state, and bottom up environmental governance process, (iii) to shift toward multi-faceted, multi-directional process of knowledge production and transfer, and (iv) to turn the tensions and challenges related to interdisciplinary and intercultural research for sustainable development into opportunities.

To reach these objectives, the thesis builds on four case studies that cover a critical assessment of (i) the extension of the Human-scale Development model to non-humans in analysing environmental conflict in South Europe, (ii) two mechanisms of governance: the participation of non-state actors and scenario-building for environmental planning in Western Europe, (iii) the level and modalities of stakeholder engagement in EU-funded FP6 biodiversity research projects and the impact of a more participatory approach, and (iv) the challenges and opportunities that arise when nine PhD students set out to write a doctoral dissertation within an interdisciplinary research project (GoverNat).

To improve biodiversity governance, I therefore propose a holistic view of human and non-human needs, recognizing the intrinsic value of the living world (i.e. the social dimension of the concept of biodiversity, chapter 1); strengthen community life present and future, encouraging bottom-to-top collective decision-making (i.e. political dimension of the concept of biodiversity, chapter 2); involve and share experiences of key stakeholders, creating local networks for the co-construction of common knowledge (i.e. scientific dimension of the concept of biodiversity, chapter 3); and enable interdisciplinary communication and networks that require time and patience (chapter 4).

This thesis offers arguments and tools to justify the protection of biodiversity in its social, political and scientific dimensions, and therefore also in an interdisciplinary context. It also feeds the debate on sustainable public policy-making. From now on, we need to support an integrative approach to governance in which the public are involved based on fundamental needs. This would enable an inclusive, permanent but dynamic reflexion on future environmental policy proposals.

Resumen

Esta investigación está motivada por dos observaciones. En primer lugar, la constatación de que, a pesar de la multiplicación de directivas, leyes e iniciativas, la biodiversidad continúa disminuyendo. En segundo lugar, el reconocimiento de que la biodiversidad articula consideraciones sociales, políticas y científicas. En este marco, la pérdida de biodiversidad requiere de un análisis teórico en tres dimensiones, teniendo en cuenta las cuestiones sociales y éticas (¿cuál es el valor de la biodiversidad?), políticas (¿cuáles son los mecanismos legítimos para proteger la biodiversidad?) y epistemológicas (¿cómo podemos entender la biodiversidad?). Esta tesis presenta una conceptualización de la biodiversidad teniendo en cuenta estos tres niveles. Se discute cómo podemos mejorar la gobernanza de la biodiversidad desde estas tres perspectivas, poniendo así en relieve las bases sociales, políticas y científicas que la humanidad necesita entender y apoyar si quiere tratar de forma efectiva la cuestión de la protección de la biodiversidad.

Para responder a esta pregunta, he enfocado mi investigación en las interfaces entre los actores clave de la investigación europea en biodiversidad. Adopto un punto de vista normativo según el cual las investigaciones que incluyen a las partes interesadas son por definición más 'sociales'. En este contexto, los objectivos de esta tesis son: (i) pasar de un enfoque antropocéntrico basado en las necesidades humanas hacia otro más global y ecosistémico, (ii) poner de relieve las perspectivas que reconocen los procesos politicos de gobernanza de abajo a arriba, (iii) avanzar hacia procesos poliédricos y multidireccionales de producción y transferencia de conocimientos, y (iv) convertir las tensiones y desafios relacionados con la investigación intercultural e interdisciplinaria en oportunidades.

Para cumplir estos objetivos, la tesis se apoya en cuatro estudios que valoran críticamente (i) la extensión del Modelo de Desarrollo de Escala Humana hacia lo no-humano como parte del análisis de los conflictos ambientales en el sur de Europa, (ii) dos mecanismos de gobernanza: la participación de los actores no gubernamentales y la producción de escenarios para la planificación ambiental en Europa occidental, (iii) los niveles y formas de involucramiento de los participantes en los proyectos europeos de investigación en biodiversidad (FP6) y el impacto de un enfoque más participativo, y (iv) los retos y oportunidades que surgen cuando

nueve estudiantes de Doctorado escriben sus tesis a partir de sus proyectos de investigación interdisciplinarios (GoverNat).

Para mejorar la gobernanza de la biodiversidad, propongo una visión holistica de las necesidades humanas y no humanas, reconociendo el valor intrínseco del mundo de los seres vivos (la dimensión social del concepto de biodiversidad, capítulo 1); fortalecer la vida comunitaria presente y futura promoviendo los procesos de toma de decisión colectivos de abajo a arriba (dimensión política del concepto de biodiversidad, capítulo 2); involucrar y compartir las experiencias de las partes interesadas claves, creando redes locales para la co-construcción de un conocimiento común (dimensión científica del concepto de biodiversidad, capítulo 3); y generar las condiciones para permitir la comunicación interdisciplinaria (capitulo 4).

Esta tesis ofrece argumentos y herramientas para justificar la protección de la biodiversidad en sus dimensiones social, política y científicas, en un contexto interdisciplinario. Tambièn alimenta el debate sobre el diseño de las políticas públicas. A partir de ahora, necesitamos apoyar un enfoque integrador de la gobernanza basado en las necesidades fundamentales y en el cual el público esté involucrado. Esto permetirá una reflexión inclusiva, permanente pero dinámica sobre las propuestas futuras de políticas ambientales.

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Preface

My first degree was in Cell Biology and Physiology, and I hold a Master's degree in Evolutionary Biology and Ecology. Before becoming a PhD fellow, I had experience as a coordinator and writer at the French Institute for the Environment, as a project manager on the study of the impact of the December 1999 storms at the French Ministry of the Environment, and as teacher of ecology in the field of natural habitat management and protection. I then became a PhD research fellow at the Institute of Environmental Science and Technology (ICTA), Autonomous University of Barcelona (UAB), where I worked in the Marie Curie Research Training network GoverNat, a FP6 project funded by the European Commission. The project was on Multi-level Governance of Natural Resources: Tools and Processes for water and biodiversity in Europe. GoverNat concentrated on participatory processes as a means to improving multi-level environmental governance, thereby empirically testing the hypothesis that certain participatory processes improve multi-level governance.

This thesis is composed of four articles, two published[1], one under review[2], and one a chapter of a book[3]. My Ph.D. offers an interdisciplinary analysis of how stakeholder engagement processes in EU-funded biodiversity research projects can help to reinforce the interface between science and society. In other words, how can these processes help us to consider the needs of policy-makers, scientists, civil society, business, the media, etc, but also non-human beings. The thesis analyses different aspects of governance, and supports an integrative approach to governance in which the fundamental needs of all stakeholders are considered. I feel that the process of working on my thesis has enabled me to think in a more global way, to improve my ability to write scholarly articles in English and to learn from the interdisciplinary collaboration with my co-authors.

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[1] Jolibert, C., Max-Neef, M., Rauschmayer, F., Paavola, J. 2011. Should We Care About the Needs of Non-humans? Needs Assessment: A Tool for Environmental Conflict Resolution and Sustainable Organization of Living Beings. Environmental Policy and Governance 21, 259–269. Best Student Paper of the 2009 ESEE Conference.
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[2] Jolibert, C., Paavola, J., Rauschmayer, F., Dendoncker, N., submitted 2012. Addressing needs in the search for sustainable development. A proposal for needs-based scenario building. Environmental Values.

[3] Santaoja, M., Treffny, R., Mertens, C. and Jolibert, C. with Farrell, K.N. 2012. Looking for a place to anchor: confusing thoughts along an interdisciplinary dissertation journey. Extract from the book 'Beyond reductionism: A passion for interdisciplinarity', Edited by Farrell, K.., Luzzati, T., van den Hove, S. Routledge Studies in Ecological Economics, Routledge, London.

1. Introduction

1.1. Motivations

1.1.1. The loss of biodiversity

Extinction is an integral part of the evolutionary process. As a rule, a given species will survive for 5 to 10 million years (excluding periods of bioecological crisis) (Newman, 1994). However, in parallel with the growth in the number and the spread of human beings, around 100,000 years ago, the extinction rate accelerated between 1,000 and 10,000 times (IUCN, 2011). This phenomenon is known as the Holocene extinction and represents the sixth documented wave of large-scale species extinction. Some experts, like Edward Osborne Wilson, estimate that more half of the species currently in existence may become extinct by 2100 (Wilson, 2002). The causes are well known: they are both direct (e.g. hunting) and indirect (e.g. destruction of the natural habitat, increased in the Human Appropriation of Net Primary Production – HANPP, introduction of foreign species) but in both cases are caused by man (Vitousek et al., 1986; Adsersen, 1989). I will illustrate this idea with an example: La Réunion, in the Indian Ocean. La Réunion can be categorized as a 'real' island because it is volcanic, which implies that it was colonised by living species slowly over time either by air or sea (Diamond, 1975). The island's 500 indigenous flowering plants therefore took root with, in theory, the arrival of a new founding population every 30,000 years (Cadet, 1977). Since humans first colonised the island four centuries ago, this rate suddenly increased with an average of 3 to 4 new plant species being introduced each year. Flore des Mascareignes describes more than 1,100 plant species introduced by man on La Réunion (Bosser et al., 1976), of which 460 have become naturalised (Thébaud, 1989). One could argue that biodiversity has increased, but in reality the distribution of species on Earth is becoming more homogenous, and some 12% of bird species, 23% of mammals, and 25% of conifers are currently threatened with extinction (MA, 2005).

These numbers are persuasive, but the data alone does not provide valid reasons for protecting biodiversity. We also need to understand the values allocated to biodiversity in order to determine what measures may be legitimately implemented to protect it. The scientific community has played a first crucial role here; by alerting the public to its decline, it has ensured that biodiversity is now valued the world over, and it has campaigned in favour of

protection on the ground, notably through public conservation programmes and biodiversity governance. By ‘value’, we do not understand only economic value. Valuing something can also mean attributing importance to it.

1.1.2. Governance of biodiversity

The term governance can be applied to a wide range of issues, relationships and institutions involved in the process of managing public and private affairs (UN, 2006). Among the various definitions, the United Nations Development Programme (UN, 1997) defined governance as ‘the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences’ (UN, 1997). According to Jon Pierre (2000), ‘governance refers to sustaining coordination and coherence among a wide variety of actors with different purposes and objectives’. Pierre’s definition of governance is society-centric, while Pierre and Peters (2000) offer a definition of the term that is more State-centric where ‘governance relates to changing relationships between State and society and a growing reliance on less coercive policy instruments’. In developing countries, there is a lack of spaces where citizens can exchange ideas and deliberate (Denhardt and Denhardt, 2003), and most crises, whatever their causes, are also crisis of bad governance (UN, 2006). In the current context of biodiversity and the environmental crisis in the broader sense, there is a breakdown in the process of articulation and communication between actors of civil society. Problems of governance may be expressed through unsatisfied fundamental human needs, e.g. the need for participation, and entail poverties, i.e. social conflict, violence, depression, biodiversity loss, landscape destruction and the over-use of natural resources (Max-Neef et al., 1989).

In this study, I focus on the sharing and co-production of knowledge composed of multiple hybrid social-ecological practices and configurations that can support sustainability learning and transformation (Tàbara and Chabay, 2012), thus facilitating good governance. Good governance implies a participative governing process that is responsible, accountable and transparent and that promotes not only the rights of individual citizens and the public interest (Munshi, 2004), but also the rights and interests of all living beings. My aim is to focus on the collective efforts to identify, understand or address biodiversity governance problems (Weiss, 2009), by studying the links to the concept of biodiversity.

1.1.3. Biodiversity: a concept blending societal, policy and scientific considerations

This research is underpinned by two observations. One, despite man-made directives, laws and initiatives, biodiversity defined as 'the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems' (Hawksworth, 1996), is still shrinking. And two, the very concept of biodiversity combines societal, political and scientific considerations. The challenge of biodiversity loss therefore projects us into a three-layered theoretical framework that contains social and ethical (what are the values of biodiversity?), political (what are the legitimate mechanisms by which biodiversity can be protected?) and epistemological questions (how can we understand biodiversity?).

I consider the problematisation of biodiversity from these three viewpoints in order to highlight the social, political and scientific foundations that humanity must understand and support if it is to address the issue of biodiversity protection in an effective way. This is no easy task, since it requires the blending of disciplines that have traditionally been kept apart: the natural sciences, the social sciences, the economic and political sciences, the so-called 'post-normal' sciences of risk assessment and uncertainty management, etc. Any attempt to embrace these diverse disciplines demands certain compromises, and I had to select carefully within each one in order to find the issues that relate directly to biodiversity conservation and governance, thus leaving some of the larger themes covered by these different areas untouched.

1.1.4. Specificity and objective of the thesis

This doctoral thesis will be presented in the form of a compendium of academic work. Each piece of work should be considered as independent, since each was written at a different stage of my research. As a consequence, the thesis might contain some repetitions, but I hope it will also show the evolution of my ideas, interests, knowledge and experience. I have organized the four articles into four chapters, in order to analyse the problematisation of biodiversity, and to attempt a response to the general question of *how we may best improve biodiversity governance*. Where governance is a process aiming to sustain co-ordination and coherence among a wide variety of actors with different purposes and objectives such as political actors and institutions, civil society, corporate interest and transnational organizations (Pierre and Peters, 2000), biodiversity governance deals with safeguarding conditions for sustainable life

on earth, but also has direct influences on the quality of life for those living here. In order to respond to this question, I focused on the science-stakeholders interface in the field of European biodiversity research. I adopted a normative standpoint in which research that includes stakeholders was by definition more 'social' and participative, integrating human needs and the impact of human activity as fundamentals that must be considered if we are to meet the environmental challenges of the present and the future.

1.2. Structure of the research

1.2.1. Social dimension of the concept of biodiversity

In the first chapter, I consider the first aspect of the problematisation of biodiversity by focusing on the social dimension. The biology of conservation is intimately linked with normative standards, because it presupposes that biodiversity has a value and must be protected. Scientific research is also influenced by contextual values, which can be considered as strategies, forms of organisation, social practices, norms, individual, social or collective attitudes that we call satisfiers (Max-Neef et al., 1989; Guillen-Royo, 2010; Jolibert et al., 2011). These contextual values or satisfiers act directly on constitutive values, by influencing scientific research from the inside. Here, the normative value (biodiversity must be protected) acts as a constitutive part of the objectives and methods of scientific discipline and converges with socially accepted values, notably because it presumably corresponds to the best interest of the greatest number of living beings. In this section, I will concentrate on the following question: *how are the needs of non-human living beings taken into account*?

The study of conflicts, particularly the environmental conflicts, highlights the pressure that human activity places on biodiversity and ecosystems, and the complexity of contextual values. I am therefore interested in the analysis of an environmental conflict where non-humans are at the centre of a conflict with humans. To illustrate this chapter, I use a case study (Jolibert et al., 2011) to discuss whether the Human-scale Development (HsD) methodology (Max-Neef et al., 1989) based on fundamental human needs is helpful in analysing environmental conflict. The analysis of this conflict proposes for the first time to go beyond the anthropocentric view restricted to human needs to include all stakeholders, which I define as all users (human and non-human) who are (directly and indirectly) affected or who are beneficiaries of biodiversity and ecosystems functions. Then, I focus on their needs and their satisfiers, which either promote or impede the satisfaction of needs. I identify the interdependencies between stakeholders' satisfiers, and in particular the extent to which

satisfiers for some entail poverties (i.e. unsatisfied needs) for others. These divergent and peaceful (convergent) satisfiers allow then to characterize a conflict in terms of needs. At the end of this chapter, I conclude that a conflict between humans is best understood by integrating non-humans, and that solutions that incorporate non-humans provide a better way to resolving conflicts between humans. Therefore, I propose to use the needs-based approach to ensure that local development strategies are more sustainable, improving interactions between all living beings, not just humans. By identifying and analysing a conflict in terms of needs, we shed light on the nature of social and contextual values to improve the political aspects of decision-making for biodiversity governance.

1.2.2. Policy dimension of the concept of biodiversity

In the second chapter, I consider the second aspect of the problematisation of biodiversity by focusing on the political dimension. The drawing up of conservation scenarios and the assessment of their comparative advantages are just two of the responsibilities allocated to conservation biologists[4], in order to inform and assist the decision-making processes of biodiversity governance. In this section, I consider legitimate approaches to protecting biodiversity; i.e. *to what extent can biodiversity governance through environmental planning be improved by the drawing up of sustainable scenario*?

I focus on environmental planning and implement the HsD method to build with stakeholders a sustainable scenario, which I refer to here as a sustainable needs-based planning scenario (Jolibert et al., submitted 2012). Scenario-building has been proposed as a way to overcome planning's limits and to take into account the role of values and needs, which were rarely mentioned in environmental planning literature (Lawrence, 2000). Applying scenarios that describe possible futures that reflect different perspectives on the past, the present and the future (van Notten and Rotmans, 2001) enables to take into account all fundamental human needs that must be met if we are to plan sustainability. I asked stakeholders to imagine their needs and satisfiers in 2050 (i.e. individual dimension), as part of a sustainable scenario. Then, I identified interdependencies between people's satisfiers for the same need (i.e. community dimension), calling these divergent satisfiers (unsustainable) and convergent satisfiers (sustainable). Finally, the interdependencies between satisfiers for all needs were also identified – I called these singular satisfiers, i.e. strategies that meet a single need – and those that meet several needs – what I called synergic satisfiers. This allowed identifying

[4] The two other missions being the assessment of biological diversity and the identification of threats to this diversity

collective satisfiers when seeking to promote sustainability. This level of analysis is called the governance dimension. During the needs-based scenario building, changes in stakeholders' values occurred, reducing unsustainable satisfiers, and leading to the selection of collective satisfiers for sustainable planning. To conclude, I propose to use the needs-based approach within scenario building as a means to reduce tensions and strengthen a sense of community, to encourage bottom-up collective decision-making, and ultimately to foster a climate more suited to sustainable development.

1.2.3. Scientific dimension of the concept of biodiversity

In the third chapter, I look at the third aspect of the problematisation of biodiversity by considering the scientific dimension. To quote Balmford, 'the key to increasing the future contribution of biologists to on-the-ground conservation interventions lies in accepting that reality – i.e. that conservation is primarily not about biology but about people and the choices they make and in working much more closely with experts from other disciplines, especially the social sciences' (Balmford and Cowling, 2006: 692). It is only fairly recently that researchers have begun to incorporate an assessment of biological diversity and the threats to that diversity into the social sciences and integrate the data on social acceptance, stakeholder participation, the level of stakeholder satisfaction, etc. In this chapter, I consider the commitment of stakeholders to biodiversity research, by asking *how the societal, the political, the scientific spheres is impacted by the co-production of knowledge?*

In this chapter, I assess the level and modalities of stakeholder engagement in the 38 EU-funded FP6 biodiversity research projects and the impact of a more participatory approach on research on policy, society and science (Jolibert and Wesselink, 2012). I look both at impacts on the 'research users' as well as on the 'producers' of research outcomes. In particular, I look at how and when scientists use stakeholders' input in the research process. Data indicate that half of the projects engaged stakeholders mainly during the dissemination stage and not at critical stages of problem definition and method selection. This reflects a vision of research that is largely disconnected from its social context, one in which if the public is consulted, it is the scientists who define the terms of the research.

Focussing on the other half of the projects – e.g. with stakeholder engagement before the dissemination stage – it appears that the type of communication between science and stakeholders (e.g. formal or informal, one-way or two-way) did not affect the co-production of knowledge: the existence of even the most basic form of communication appears to be the

main factor here. The study shows that productive stakeholder engagement was more frequent in certain stages of the research process. In addition, involving key stakeholders when they had a particular stake, experience, credibility or legitimacy at any stage of the research was most productive. I conclude that when fruitful interactions between science and society occur along the whole research process, this often results in the foundation of innovative research programmes and transdisciplinary networks to cluster around particular topics yielding improved assessment of environmental change, and effective policy option proposals. The observed complexity and failure to halt biodiversity loss in Europe calls then for a more holistic and inclusive model procedures of knowledge production at the science-society interface and specifically in research projects evaluation and results implementation.

1.2.4. Interdisciplinarity: an inherent dimension of the concept of biodiversity

At this point, I think it is important to come back to the different theoretical approaches that can be used in the problematisation of biodiversity and ecosystem loss, and to consider the original definition of ecology, as proposed by Haeckel.

By ecology, we mean the science of the relations of the organism to the environment, including, in the broad sense, all the 'conditions of existence' (Haeckel, 1866).

When we consider that human beings are not only an integral part of the natural world but that they also have a huge influence on the planet's ecosystems, it is strange that human activity and as an inherent consequence, social sciences, were excluded from the study of the relationships between organisms and their environment for so long. And that interdisciplinarity – i.e. the collaboration between human, social, and natural sciences – has been for so long ruled out, at best, homeopathically used. Interdisciplinarity, although called for by many in environmental research, remains difficult in practice for epistemological, conceptual, institutional and cultural reasons.

Based on my personal experience, I consider various questions triggered by the challenges and opportunities of interdisciplinarity in research on conservation and biodiversity governance. I use parts of a chapter[5] in the book 'Beyond reductionism: interdisciplinary research in Ecological Economics' (Farrell et al., 2012). The ideas presented in this chapter are inspired by the experiences of nine PhD students working in an interdisciplinary European

[5] Santaoja, M., Treffny, R., Mertens, C. and Jolibert, C. with Farrell, K.N. 2012. Looking for a place to anchor: confusing thoughts along an interdisciplinary dissertation journey. Extract from the book 'Beyond reductionism: A passion for interdisciplinarity', Edited by Farrell, K.., Luzzati, T., van den Hove, S. Routledge Studies in Ecological Economics, Routledge, London.

research project called GoverNat. GoverNat focused on multi-level governance of natural resources, with the aim to develop tools and processes for water and biodiversity governance in Europe. The project aimed to blend diverse academic backgrounds, attracting and accepting PhD candidates with various academic degrees and experiences in the social and/or the natural sciences. I present in this chapter a brief overview of four of us, our backgrounds and motivations, but also our disappointment upon realizing that being part of an interdisciplinary sustainability science network seemed to make the PhD process even more demanding. Therefore I propose to sketch out the situations that we encountered and to share the lessons learned in the course of facing these challenges.

The first challenge identified, within the GoverNat project, is that we did not find a common understanding of what is meant by the term '*interdisciplinarity*'. Various definitions exist, but no single definition has gained widespread acceptance. Second, it seems to us that all interdisciplinary researchers are working more or less in a sort of no-man's land, between disciplines, where a variety of *ontologies* coexist. We discovered through our experience that in research using natural and social sciences ideas, the most fundamental of all ontological questions remains wide open to debate: *to what extent, if at all, and in what respect are we, humans, part of nature?* The challenge of coping with all these different ontologies brings us to the third attribute of interdisciplinarity: *normativity*. This attribute is related to the reflective pressure that our debates on ontology have placed on us, forcing us to ask ourselves questions in a new and more penetrating way. Closely linked to these challenges, is the challenge of *epistemology*, and also of *methodology*. Natural and social scientists often have different expectations regarding how to reveal 'what is really going on' and indeed regarding the extent to which that is possible and how. Reflecting on our experiences, we suggested turning these challenges into opportunities, and offer some tips to find contentedness when struggling with interdisciplinary research.

To conclude this thesis, I propose some possible avenues to policy-making for biodiversity governance that I believe offer sound alternatives to traditional sustainable development norms, and that reconcile the diverse needs of all living beings both now and in the future.

2. Should We Care About the Needs of Non-humans? Needs Assessment: A Tool for Environmental Conflict Resolution and Sustainable Organization of Living Beings[6]

Catherine Jolibert, Manfred Max-Neef, Felix Rauschmayer, Jouni Paavola. Environmental Policy and Governance 21, 259–269 (2011).

2.1. Introduction

The organisation of modern human society reveals a growing imbalance in the way that human and non-human rights and needs are allocated and met. We automatically grant these rights to ourselves, but all too often only grant them to non-humans when we anticipate a potential benefit. This attitude has its share with the negative impact on millions of forms of life, to the degree that distinguished biologists such as E. O. Wilson, Niles Eldredge and Norman Myers consider that the magnitude of the present ecosystems devastation has not occurred on our planet since the Mesozoic era. The great breaking point and from which we have not recovered occurred during the 17th century, embodied, among others, in the work of Descartes who de-spirited the world through the division of reality between mind and extension. Everything non-human was reconceived as mere mechanical entities destined to be exploited and utilized exclusively for the benefit of human beings. As incredible as it may sound to us today, according to Descartes, animals suffered no pain because they were thought to have no consciousness. If they emitted some sound that might be indicative of pain, it was the equivalent of a chariot's wheel that needed lubrication. By the same token it was absurd to think of animal feelings. Today, with our immense and spectacular accumulation of knowledge, the de-spirited Cartesian tradition remains strong. The excessive value attached to human rights and needs hampers a good understanding of our place and our role in the structure and functioning of the rich and complex fabric of the natural world. This study proposes to go beyond the anthropocentric view restricted to human needs to include all stakeholder needs, i.e. both human and non-human 'actants' in the case of environmental conflict.

Analysis of environmental conflicts highlights the human pressures on forms of life and ecosystems, but also the complexity of economic, social and environmental relations.

[6] Best Student Paper of the 2009 ESEE Conference

Although conflicts are situations in which at least two actors pursue what each perceive to be incompatible goals (Sandole, 1993), in many cases, non-humans are at the centre of conflicts between humans. In some circumstances, conflicts appear at the governance level when policy initiatives seek to protect and/or eradicate non-humans. In the Sado River estuary of Portugal, on the one hand European policy-makers argue for strict protection of otters (Lutra lutra) through the Fauna, Flora and Habitat Directive (Council Directive, 1992), and on the other, regional policies seek to promote economic growth. This is a typical example of local conflict of interest in environmental governance: biodiversity conservation vs. economic activity.

Human needs theorists argue that human needs must be met in order to survive and in particular to attain well-being, but also that social conflicts arise from the failure to satisfy those needs (Lederer, 1980, Burton, 1990, 2001, Max-Neef, 1991, Rosenberg, 2003, Danielsen, 2005, Kök, 2007). This study uses the needs approach developed by Max-Neef (1989) in Human-scale Development (HsD) theory, broadened to cover environmental conflict including the needs of non-humans. We used data from the Sado estuary participatory conflict resolution process initiated by the research project FRAP[7]. We selected three key participants: reserve managers, fish-farmers and otters. We identified their needs, their satisfiers (strategies, forms of organization, values, social practices, norms, attitudes), which either promote or impede the satisfaction of needs in their lives (Guillen-Royo, 2010), and their poverties, i.e. any fundamental needs that are not adequately satisfied. We identified the interdependencies between these satisfiers and in particular the extent to which satisfiers for some might be perceived as poverties for others. We call these divergent satisfiers (i.e. conflicting satisfiers). This allows us to characterize a conflict in terms of needs. We also identified the means used in the conflict resolution process led by the FRAP project to show how divergent satisfiers have evolved into convergent (i.e. peaceful) satisfiers, allowing some to satisfy their needs without compromising the satisfaction of the needs of others. We analysed how these changes depend on the adoption of satisfiers that are less divergent for a given need, but also on the reduction of interdependencies so that existing satisfiers become less divergent.

[7] The FRAP project – Framework for biodiversity Reconciliation Action Plans – is an EU-funded project from the 5th FP (from February 2003 to April 2006). The goal was to develop policy instruments to reconcile the conflict between otter conservation and fish farming. The participatory process organized by the FRAP project led to many positive changes, including cooperation between the municipality, fish farmers and nature reserve administrators, but also outcomes such as the implementation of a sustainable fish labelling scheme, the promotion of a fish packaging unit, increased scientific and idiosyncratic knowledge (scientific survey on otters) and the implementation of legal measures adapted to combat otter predation. For more details see http://www.frap-project.ufz.de/.

First, we assess how the conflict resolution process provides sustainable solutions, i.e. solutions that have transformed divergent satisfiers into convergent ones, or even solutions that allow all actors to meet their needs. The second chapter of the study shows how the widening of the HsD method to include otters contributes to this result, and helps us to answer our research question: *should we consider the needs of otters?* Understanding and resolving the conflict between managers and fish-farmers requires an understanding of the role of otters in that conflict. Understanding otters' needs means understanding how otters' satisfiers create poverties among managers and fish-farmers. Changing how otters' satisfiers diverge from those of fish-farmers opens the way to a resolution of the conflict between fish-farmers and managers. We then conclude that a conflict between humans is best understood by integrating non-humans, and that solutions that incorporate non-humans provide a better way to resolving conflicts between humans.

Despite many references to the concepts of human needs and satisfiers in the literature and the empirical works mentioned in the third section, the needs approach has never been adapted to cover environmental conflict that involves non-humans as a key actor. The paper proposes to focus on the concept of needs and satisfiers to provide a theoretical frame and a justification for our chosen model. The third part presents the case study, the material and the method used. The analysis section offers a fresh needs-based approach to see whether HsD methodology can be extended to cover environmental conflict analysis and enable both sustainable resolution and the satisfaction of non-humans' needs.

2.2. The needs approach

2.2.1. Importance of needs

A number of academics have already discussed the importance of needs as a main motivation for human well-being, action and development. Rubenstein (2001) quoted Marx –'history is a preparation for 'man' to become the object of sense perception and for needs to be the needs of 'man' as man' – to highlight that this is not a new idea and how under socialism, the satisfaction of human needs was more important than economic wealth creation.

With its pyramid of needs, Abraham Maslow built the foundation for the human needs model. In his Theory of Human Motivation, Maslow (1943) proposed a hierarchy of human needs to explain human motivation. Gough and Doyal (1991) developed the idea that humans have needs in terms of health and autonomy, but also in the search to achieve optimal satisfaction.

Several authors focused on needs whose satisfaction was required to produce 'normal' (non-deviant, non-violent) individual behaviour. The unsatisfaction of needs would naturally explain social and political conflict (Sites, 1973; Lederer, 1980; Burton, 1990, 2001; Rosenberg, 2003; Danielsen, 2005; Kök, 2007).

The needs approach has been used in the context of decision-making, building on the fact that emotions are heightened when individual needs are satisfied or not satisfied (Rauschmayer, 2005, Omann and Rauschmayer, 2008), but also as a basis for working towards sustainable development (Rauschmayer et al., 2011). The definition of sustainable development has been formulated in terms of the future satisfaction of needs: 'sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (UN, 1987).

The needs approach was developed in detail by Max-Neef (1989) to assess quality of life using HsD theory, the basic idea of which is that development is about people and not about objects. Cruz (2009) proposed some methodological extensions and suggested enlarging the scope of HsD theory to incorporate a more systemic development approach for development-policy assessment, development planning and technology appraisal. More recently, Guillen-Royo (2010) opened out the HsD method to include the design and implementation of changes aimed at achieving increased well-being through a reduction in consumption (i.e. the 'well-being dividend'). HsD methodology was used as a framework to analyse human behaviour and improve people's quality of life in developing countries (Max-Neef, 1989). It considers that the improvement in people's quality of life depends on the possibilities they have to adequately satisfy their fundamental human needs. The theory focuses on three pillars: (1) the satisfaction of fundamental human needs, (2) the ability to increase levels of self-reliance and (3) the existence of organic interactions (e.g. between people, nature and technology, and between global processes and local activity). These pillars recognize social groups, make people the protagonists of their own future, foster active participation of people in small systems, and lead to decisions that flow from the bottom to the top.

This approach provides a framework to identify human behaviour, but also a bridge that helps to articulate entities too poorly connected because of, a priori, opposed objectives and interests. Its strength lies in its transdisciplinarity and applicability. Thus, the HsD model inspired scholars in many fields, including economics, sociology, psychology and anthropology, which offered many ways to understand the plurality of the different constituents of well-being (O'Neill, 2011). HsD theory offers a taxonomy of needs that can

serve as a framework for both policy and action. A two-day workshop is proposed to construct a matrix containing the destructive elements (negative satisfiers) affecting the participants' society but also the matrix of their Utopia (positive satisfiers). Once the two lists have been drawn up, it is possible to design the 'bridges' enabling the participants to cross from an undesirable situation to a desirable one (for more details, see Max-Neef, 1991).
Table 1 presents an example of needs and their main satisfiers.

Table 1: Matrix of Fundamental Human Needs (Max-Neef et al., 1989)

Fundamental Human Needs	Being (qualities)	Having (things)	Doing (actions)	Interacting (settings)
Subsistence	physical and mental health	food, shelter work	feed, clothe, rest, work	living environment, social setting
Protection	care, adaptability autonomy	social security, health systems, work	co-operate, plan, take care of, help	social environment, dwelling
Affection	respect, sense of humor, generosity, sensuality	friendships, family, relationships with nature	share, take care of, make love, express emotions	privacy, intimate spaces of togetherness
Understanding	critical capacity, curiosity, intuition	literature, teachers, policies educational	analyse, study, meditate investigate,	schools, family, communities,
Participation	receptiveness, dedication, sense of humor	responsibilities, duties, work, rights	cooperate, dissent, express opinions	associations, parties, churches, neighbourhoods
Idleness	imagination, tranquility spontaneity	games, parties, peace of mind	day-dream, remember, relax, have fun	landscapes, intimate spaces, places to be alone
Creation	imagination, inventiveness, curiosity	abilities, skills, work, techniques	invent, build, design, work, compose, interpret	spaces for expression, workshops
Identity	sense of belonging, self-esteem, consistency	language, religions, work, customs, values, norms	get to know oneself, grow, commit oneself	places one belongs to, everyday settings
Freedom	autonomy, passion, self-esteem, open-mindedness	equal rights	dissent, choose, run risks, develop awareness	anywhere

Table 1 shows a possible matrix of the nine fundamental human needs as proposed by HsD theory: Subsistence, Protection, Affection, Understanding, Participation, Idleness, Creation, Identity and Freedom. These needs are universal, i.e. constant over time and across geographical and cultural scales. On the other hand, satisfiers are the instruments for needs

satisfaction. They are expressions of the categories of Being, Having, Doing and Interacting (Table 1). Each economic, social and political system adopts different methods for the satisfaction of the same fundamental human need. Hence, satisfiers are non-universal; they change with time and geographical scales. Satisfiers are also culturally determined and there is no one-to-one correspondence between needs and satisfiers (i.e. a satisfier may contribute simultaneously to the satisfaction of different needs, and a need may require various satisfiers in order to be met). Max-Neef gives the example of breast-feeding a baby, which simultaneously satisfies the infant's needs for Subsistence, Protection, Affection and Identity.

Max-Neef also proposes to re-interpret the economic concept of poverty. For example: poverty of subsistence (due to insufficient income, food), of protection (due to bad health systems, violence), of affection (due to authoritarianism, exploitative relations with the natural environment), of understanding (due to poor quality of education), of participation (due to marginalization or discrimination of minorities) or of identity (due to imposition of alien values upon local and regional cultures). Unemployment, external debt, hyperinflation, violence and marginalization, but also conflict appears to be the aftermaths of unsatisfied needs. Max-Neef stresses that development should establish its priorities according to the observed poverties, a plural he finds more adequate. For instance, in the case of poverty of subsistence which is considered as a priority for social well-being, programmes of social assistance will be implemented as a mean of tackling this poverty.

2.2.2. Extension to non-human beings

Material resources and symbolic innovations related to language allow some people to have more power over others (Strum and Latour, 1987), but also more power over non-humans. For Latour (2004), the collective is made up of humans and non-humans capable of being treated as citizens. Otters should therefore be included as part of the collective. Furthermore, otters, like baboons and other mammals, are active interpreters of their societies. What differentiates them from humans are the 'practical ways' in which they have to impose their conception of society (Strum and Latour, 1987). In the frame of the needs approach, by 'practical ways', we understand satisfiers that are used by otters to meet their needs. Latour (2004) also suggested separate representation for humans and non-humans, which raises the question of who should represent otters in the participatory process using the matrix of needs? In the FRAP participatory process, biologists (with thorough knowledge of otters' predation and behaviour) represented otters.

In the present study, otters are considered as animal-subjects, as supported by Singer (1979), Strum and Latour (1987), O'Neill (2001), Lestel (2001) and Latour (1997, 2004, 2006), thus avoiding the idea that otters are merely objects of contention between fish-farmers and reserve managers. We do not attempt to show that otters are moral agents or responsible 'persons', making moral judgments and taking 'moral' actions. Rather, we consider that they have needs and satisfiers and thus should naturally be included in the HsD methodology. The inclusion of otters as stakeholders recreates a sense of collectivity as defended by Latour. Furthermore, otters have a direct stake (i.e. they are stakeholders) in the environmental conflict. For instance, otters play a key role in the Sado estuary ecosystem and in its stability (Green, 1977, Wayre, 1979, Beja, 1991, 1992, Trindade et al., 1998, Carss, 2003, Dallas, 2003, Santos et al., 2003, 2006a, 2006b). Otters are considered by humans to feel and express emotions such as suffering, pain and joy (Singer, 1979), and to have capacities of culture (Lestel, 2001).

As we attempt to show, otters have needs for Subsistence, Protection, Affection, Understanding, Participation, Recreation, Creation, Identity and Freedom and they also used satisfiers to meet their needs that are sometimes in conflict with other stakeholders' satisfiers (see Analysis section).

2.3. Study site, material and methods

2.3.1. The Sado estuary

The Sado estuary of south-west Portugal is a rural area that is nevertheless considered as a peri-urban sprawl because of its proximity to Lisbon. The region is considered to be depressed economically. In 2009, when the unemployment rate in Portugal reached 10% it was 12.5% in the Península de Setúbal sub-region to which the Nature Reserve belongs (OECD, 2010). This area also has below-average income. The minimum wage in Portugal, regulated by law, is €475 per month (Com, 2009), and the population has one of the lowest per-capita incomes in the European Union. In the Sado estuary, economic activities include fish farming and fishing, salt production, forestry and intensive agriculture.

Created in 1980, the Sado Nature Reserve (23971ha) is a Ramsar Site, a Special Protection Area for Birds and belongs to the European network of protected areas, i.e. Natura 2000. The reserve also benefits from legal protection through the Directive[8] on the Conservation of Natural Habitats and of Wild Plants and Animals (Council Directive, 1992). The presence of

[8] Directive 92/43/EEC [the Fauna, Flora, and Habitat (FFH) Directive], like all directives, is mandatory. In the case of non-compliance, sanctions can be decided by the European Court of Justice.

an otter population designated as a 'species of community interest' in the Directive (listed in Annexes II and IV) also justifies the high conservation value of the reserve, which is designated as a Special Conservation Area with special protection measures.

2.3.2. The conflict

The competition between fish-farmers and otters causes multiple conflicts between fisheries and the administration of the Nature Reserve (Rauschmayer et al., 2007). Otters use both saltwater and freshwater resources (fish) on the coastline and in the estuary that flows from the River Sado (Beja, 1991, 1992), resources that are also sought by fisheries. Before the FRAP project, the number of otters was unknown and visiting and predation rates were not uniform across all fish-farms (Trindade, 1998, Dallas et al., 2003). No estimation of the takes was established and it was difficult to assess the damage in terms of eaten fish and possible secondary losses (e.g. wounded fish, stress-disturbed fish), but also in terms of losses through disease and production hazards, as well as non-otter predation such as piscivorous birds (Carss, 2003).

This lack of knowledge fostered mistaken perceptions of the scale of otters' takes and of associated losses. In the winter of 2004/5, surveys were conducted to evaluate the number of otters visiting each fish-farm. For an average of 8 days, less than 18-hold spraints[9] were collected for molecular analyses, the most recent non-invasive technique for individual identification (Dallas et al., 2003). Overall, 15 individual otters were identified in a 100-km² area, indicating a high density of otters but irregular fish-farm visits. In parallel, the Nature Reserve Administration imposed restrictions on the use of mitigation measures, which were perceived by fish-farmers as poorly adapted regulation on fish-farming in the Reserve. Also, the weak justification of restrictions by the Reserve administration led fish-farmers to believe that decisions were being made on an ad hoc basis. In addition, a lack of understanding and cooperation among fish-farmers worsened the situation.

As a general pattern, conflicts intensify over time because as protected populations increase (i.e. otters), natural resources such as prey populations (i.e. wild fish and farm fish) become less available for wild animals and humans, which increases competition between predator species (Tasker et al., 2000). Also, no policy instruments were in place to mitigate the

[9] Spraint or scat is the dung of the otter.

erupting conflict, with a strong potential for escalation where supranational, national and regional governments were enmeshed in local policy networks (adapted from Marks, 1993). For Rui Santos (2006b, 2006c), the conflict went beyond otter protection or even predation in general. Issues such as licensing, operating practices or environmental management were also relevant.

2.3.3. Actors

The issue of otter predation on fish-farms in the Sado estuary involved three key actors. On the one hand, fish-farmers, mostly owners of small or medium-sized production facilities aware of the existence of otter predation, used all possible means to keep otters away, including illegal killing. On the other hand, managers of the Sado estuary nature reserve were also aware of otter predation and of the weakness of the monitoring system to control illegal killing, but were not allowed the use of any mitigation measures to prevent it (Santos et al., 2006a, 2006b). Finally are the otters (*Lutra lutra*), which are collecting fish from fish-farms and which are playing a key role in the ecosystem of the estuary and its functioning.

Otters are members of the subfamily Lutrinae, family Mustelidae, which also includes weasels, polecats and badgers. Otters need the presence of specific flora, itself associated with a specific fish area upon which the otter is dependent for its diet. Despite their worldwide distribution, otter populations are threatened by many dangers (e.g. chemical contamination, reduction of food supply due to nitrate-induced eutrophication from agricultural run-off, illegal hunting, road traffic accidents), which justifies a precautionary 'Near Threatened'[10] listing on IUCN's red list. For some, the otter is an indicator of a healthy environment whereas others see otters as a pest that should be controlled or even eradicated.

2.3.4. Material and method

The matrix of stakeholders' needs and satisfiers (Table 2) was made ex post, using all information provided by the coordinator of the FRAP project, two work-package leaders and four scientists following semi-structured interviews. All available FRAP documents were used: final deliverables (FRAP, 2006), periodic reports, regular written comments and feedback from the members of the Advisory Board of Stakeholders[11]. The social scientists

[10] IUCN, Otter Specialist Group: http://www.otterspecialistgroup.org/Species/Lutra_lutra.html

[11] The six members of the Advisory Board of Stakeholders (ABoS) included representatives of conservation managers, local stakeholders, scientists, fisheries managers, governmental administration and non-governmental organizations from regional, national and European levels. The ABoS had been designed to ensure connections between knowledge emerging from the case studies and higher levels of governance.

from the project conducted participatory conflict reconciliation between the different stakeholders for three years. They combined the use of formal participation techniques – consultation workshops – with an informal approach of information gathering and trust building based on individual meetings, but they did not use the needs approach. The participatory process consisted of a platform involving all actors[12] in the area. We therefore used reports and presentations (Santos et al., 2003, 2006a, 2006b) related to the participatory conflict reconciliation process between the different stakeholders. The FRAP project is now complete and policies at various levels of governance have changed. We are unsure as to whether it has enabled the long-term stabilization of the conflict. Also, some processes initiated during the project are still ongoing: the institutionalization of the participatory platform, the management plan of the Reserve, and the setting up of an Installing Commission inside the Reserve leading to the decentralization (from national to regional level) of the decision-making process.

Based on FRAP's data and limits, we propose the ex post identification of stakeholders' satisfiers, poverties and interdependencies between these satisfiers to understand the project's outcomes, i.e. what has worked and what has not, in order to clarify how a needs-based approach might help. In this manner, the paper proposes to use the matrix of needs and satisfiers as an operational tool to foster the analysis and sustainable resolution of environmental conflicts.

2.4. Analysis: needs and satisfiers

Here we propose to address the following issues: 'what kind of poverties does environmental conflict create?' and 'which needs are left unsatisfied as a result?'

2.4.1. The environmental conflict

According to human needs theorists (Lederer, 1980, Burton, 1990, 2001, Max-Neef, 1991, Rosenberg, 2003, Danielsen, 2005, Kök, 2007), social conflicts arise when needs for Subsistence, Protection, Affection, Understanding, Participation, Idleness, Creation, Identity and Freedom are unsatisfied. Are these needs satisfied in the environmental conflict between fish-farmers and reserve managers? Table 2 presents stakeholders' satisfiers identified ex post as specified above.

[12] Fish-farmers, Nature Reserve Administration, local municipality, IPIMAR (Portugal's public research organization in the area of fisheries) and GNR-SEPNA (National Institute for the Environment).

For each of the three actors, needs for Subsistence and Protection were unmet with un-favourable social setting (Square 3/S3), illegal killing of otters (S4), lack of knowledge on otter biology, and a lack of communication and cooperation (S7) that did not permit to foster fish-farming development (S1) nor otter protection (S2). Needs for Affection, Understanding, Participation, Identity and Freedom for both fish-farmers and managers were unsatisfied (see corresponding squares in Table 2). The needs for Idleness and Creation were filled. For instance, techniques of self-mitigation measures (e.g. otters' traps) for fish-farmers (S19) and self-interpretation of biodiversity protection measures for managers (S20) satisfied the need for Creation. But these satisfiers are also divergent (Max-Neef, 1989), i.e. ways to satisfy their needs are opposed and conflicting.

This brings us to the second comment: in the case of conflict, for the same need, satisfiers between stakeholders diverged. Thus, concerning the need for Protection, fish-farmers were aiming to develop their farms including mitigation measures against predation by otters (S5) (i.e. divergent from managers' satisfiers), managers were applying strict protection measures (S6) (i.e. divergent from fish-farmers' satisfiers), otters were fishing in fish-farms (S8) (i.e. divergent from fish-farmers' satisfiers) and they were also being killed (S8) (i.e. divergent from managers' satisfiers). The existence of divergent satisfiers for the same need explains how, at local level, stakeholders can gradually come into conflict and find themselves in a climate in which there is poor communication, little respect for others and no openness to other viewpoints.

The Table 2 regroups the four axiological categories (Max-Neef, 1989) of Being (qualities), Having (things), Doing (actions), and Interacting (settings) into one group (e.g. the category 'satisfiers' for each stakeholder), to focus on the comparison between stakeholders.

Table 2: Examples of stakeholders' satisfiers in the Sado estuary conflict

<table>
<tr><th>Needs</th><th>Fish-farmers' satisfiers</th><th>Reserve managers' satisfiers</th><th>Otters' satisfiers</th></tr>
<tr><td rowspan="2">Subsistence</td><td>1/ Developing fish-farming.</td><td>2/ Otters conservation.</td><td rowspan="2">4/ Killed by fish-farmers. Large space, clear water for fishing and reproduction. Cleaning time against parasites and pneumonia. Vocalizes.</td></tr>
<tr><td colspan="2">3/ Social setting un-favourable because of conflict between fish-farmers and reserve managers.</td></tr>
<tr><td rowspan="2">Protection</td><td>5/ Mitigation measures against otter predation, including illegal killing.</td><td>6/ Biodiversity protection (evolution to biodiversity management).</td><td rowspan="2">8/ Killed by fish-farmers. Bank vegetation necessary (i.e. shelter). Fishing in fish-farms. Regular vocalizing (i.e. alarm, threat call).</td></tr>
<tr><td colspan="2">7/ Lack of knowledge, of communication, of cooperation.</td></tr>
<tr><td>Affection</td><td colspan="2">9/ Lack of respect for each other, lack of sharing.</td><td>10/ Contacts and vocalizes between individuals.</td></tr>
<tr><td rowspan="2">Understanding</td><td>11/ No group representation.</td><td>12/ Strong representation (EU policies support).</td><td rowspan="2">14/ Vocalizes, spraints and secretion for communication, recognition, reproduction. Hierarchical construction of society (e.g. various status).</td></tr>
<tr><td colspan="2">13/ Lack of communication, recognition, willingness for mediation. Lack of adaptability. Lack of knowledge on otters.</td></tr>
<tr><td>Participation</td><td colspan="2">15/ Lack of exchange, receptiveness, openness. Strategies of cooperation and willingness for justification appear progressively.</td><td>16/ Exchanges with vocalizes (i.e. contact call, learning process).</td></tr>
<tr><td>Idleness</td><td colspan="2">17/ Rest time, personal activities (e.g. sports, games), dream, imagination.</td><td>18/ Games, cleaning time, relaxation.</td></tr>
<tr><td>Creation</td><td>19/ Self-mitigation measures (e.g. otter traps).</td><td>20/ Self interpretation of protection measures.</td><td>21/ Build shelter, curiosity for discovering new territory.</td></tr>
<tr><td>Identity</td><td>22/ Strong feeling of legitimacy (i.e. old community).</td><td>23/ Recent presence of managers (i.e. 1980), small but growing legitimacy.</td><td>24/ Roles of games, vocalizes and spraints in identification and recognition.</td></tr>
<tr><td>Freedom</td><td colspan="2">25/ Lack of open-mindedness and self-esteem. Both of stakeholders are passionate. Strong institutional setting (from top to bottom).</td><td>26/ Choice of food, territory (inc. size). Restriction of choice in fish-farms.</td></tr>
</table>

In the context of the Sado conflict resolution, the expression of certain satisfiers either increased or decreased. For instance, the satisfiers for share (Affection/S9), communication and cooperation (Understanding/S13, Participation/S15) appeared gradually. However, the satisfier 'biodiversity protection' also became a satisfier of 'biodiversity management' (S6), including economic and social development. These results suggest a general policy shift, from strict population protection towards population management (Rauschmayer et al., 2007) of the endangered predating species. A single species protection approach is found to be inadequate (Varjopuro et al., 2008), and the resulting conflict indicate its limitations. The adoption of

satisfiers that are less divergent for a given need leads to the reduction of interdependencies, which in turn makes the existing satisfiers less divergent.

2.4.2. Needs of otters

Several poverties such as that of subsistence or that of protection, source of the environmental conflict, have been highlighted for humans. What about non-humans?

Based on data from the FRAP project and other studies used in the framework of the project (Green, 1977, Wayre, 1979, Beja, 1991, 1992, Trindade, 1998, Carss, 2003, Dallas et al., 2003, Santos et al., 2006a, 2006b, 2006c), Table 2 shows that the matrix of human needs can be filled with non-human satisfiers. For instance, otters use vocal communication as satisfiers to warm of danger (S4, S8) or reproduction (S4, S10) or assist in learning (S16). In much the same way as human communication tools, otters use 'vocalizations'; to meet their needs for Subsistence, Protection, Affection, Understanding, Participation and Identity. Other needs for Affection, Idleness, Creation or Freedom, usually restricted to humans, may also be found in otters. Thus, the need for Affection is met through contact with other otters (S10). The need for Idleness is met with games and cleaning time (S18). The need for Freedom is met when otters are free to eat what they want or choose their territory and its size (S26). Also, and in the Sado conflict, some otters' needs were unsatisfied, such as those for Subsistence (S4) and Protection (S8) as they were killed, highlighting two poverties.

Otters have needs and use satisfiers to meet these needs. But they also have divergent satisfiers from other stakeholders that feed the conflict (i.e. they eat fish produced in fish-farms) and create poverties among other stakeholders. By integrating otters' needs into the conflict resolution process, we can share the idiosyncratic knowledge with key actors, reducing poverties (e.g. poverty of understanding, S13), but also reducing, for the same need (e.g. subsistence), divergences and interdependencies of satisfiers between stakeholders.

The matrix of needs allows us to make a comparative analysis of stakeholders' strategies, organizational structures, values, social practices, norms and attitudes (i.e. satisfiers), and it is an efficient tool to focus on how satisfiers can diverge, a key source of conflict. It is also a means to identify poverties, i.e. those of subsistence, protection, affection, understanding, participation, identity and freedom, generating the environmental conflict in the Sado estuary.

2.5. Conclusion

This paper argues that the identification of stakeholders' needs and satisfiers allows us to analyse and increase our understanding of a conflict that has been triggered by different forms of resource appropriation. It highlights which needs are unmet and which satisfiers are involved. It also focuses on the divergence of satisfiers, a factor that fuels conflict. The study also proposes the inclusion of otters, as they have their own specific needs and satisfiers. By widening the matrix to include non-humans, we shift from a more anthropocentric human needs-based approach to a more global and ecosystemic one, thus creating not only a better understanding of conflicts between humans but also easing the task of resolving them. It also provides an adequate starting point for the acknowledgment of forms of human dependence and vulnerability that informs basic concerns with sustainability (O'Neill, 2011: 39).

Adapting the matrix of needs for conflict resolution into a common matrix describing stakeholders' satisfiers would make people active protagonists in their own futures and foster active participation in small systems. Also, humans find it easier to understand a situation, to accept a decision and to implement it when they take part in the decision-making process. The needs approach helps to rebuild organic interactions between the personal and the social, between global processes and local activity, between planning and autonomy, and between civil society and the state. Thus, this approach restores vertical and horizontal exchanges that strengthen community life and bottom-to-top collective decision-making.

By integrating otters into the matrix of needs in a way that enables us to compare the needs and satisfiers of people and otters, we can rebuild the articulations between people, nature and technology. We believe that the way in which idiosyncratic knowledge is shared, and the defence of otters' satisfiers are fundamental to fostering changes in sustainable human organization and behaviour. The well-being of each party depends on the level of convergence and dependency between the satisfiers. An agreed-upon matrix that formalizes these at times conflicting interests symbolizes the moral commitment of humans to respect non-humans in their everyday lives. Moreover, policy-makers have a series of specific needs from science. They need knowledge on the issue itself and options for action. This knowledge is in constant evolution and must be continually shared between scientists, policy-makers and other stakeholders (van den Hove and Sharman, 2006). Integrating non-humans through the matrix aims to integrate into policy decision-making common issues of uncertainty,

indeterminacy, ambiguity and ignorance (Funtowicz and Ravetz, 1993; Stirling, 1999; van den Hove and Sharman, 2006).

The needs approach helps to establish ‘primary objectives’ based on personal and direct needs, and ‘global objectives’ that are shared. These are then used to identify and resolve the conflict of interest, including the interests of otters. The matrix of needs allows both horizontal and vertical exchanges of knowledge that strengthen the links between the stakeholders involved in a specific issue, and improve the coordination of strategies designed to resolve it.

Needs assessment allows us to take a holistic approach to conflict resolution and to articulate policy based on a shared goal of sustainability by creating a balance between nature and culture, humans and non-humans, scientists and non-scientists. Achieving sustainability is dependent on adapting policies and science to the needs of living beings, but also on adopting convergent satisfiers to satisfy our own needs, without compromising the ability to satisfy the needs of others.

3. Addressing needs in the search for sustainable planning. A proposal for needs-based scenario building.

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3.1. Introduction

This chapter explores a sustainable, needs-based approach to policy-making. In order to do this, we built a needs-based planning scenario in which the notion of 'needs' is central to understanding individual and collective values, as well as causal connections between conflicts and regional planning. Conflicts related to ecological distribution are more likely when economic growth leads to an increased use of the environment, and involves different languages of valuation and a complexity of points of view and powers (Martinez-Alier, 2003). This study emphasizes Hards' idea that values[13] and actions are co-constructive (Hards, 2011) and that people are constituted relationally and collectively (Tay and Diener, 2011). This implies that an individual's action cannot be treated as independent of others (Hourdequin, 2010). Therefore, the exploration of our fundamental human needs and actions leads us to identify our underlying social commitments and values (Redclift, 1993). In this work, we achieved a societal consensus (Loorbach, 2010) or collective agreement (Johnson, 2003) and improved the early phase of the planning process, by taking into account local stakeholders' needs and values in a sustainable planning scenario.

In order to find ways to become active citizens (Benton, 2008), planning requires that we put ourselves in the position of informed and empowered citizens rather than of mere consumers. However, while planning processes are swathed in value judgements – what development is permitted, who should be involved in the decision-making process, what criteria should be given priority status in the decision (Davies, 2001) – the planning 'tradition' is silent on how these values are assessed in development plans (Hillier, 1999). Likewise, planners struggle to articulate conflicting stakeholder needs, short-term governmental concerns and long-term thinking in planning (EEA, 2009), elements that form the basis of sustainable development[14].

[13] Defined as 'the really important concepts in human experience' (Foster, 1997: 3)

[14] Sustainable development is understood here as a development that meets the needs of the present without compromising the ability of future generations to meet their own needs (UN, 1987)

To address these limitations of planning and to take into account the role of values and needs, which are rarely mentioned in planning literature (Lawrence, 2000), we build a sustainable needs-based scenario for regional planning. While scenarios describe possible futures and mirror different perspectives on the past, the present and the future of a society (van Notten and Rotmans, 2001), the needs-based approach highlights not only society's fundamental sameness but also the conflicts that arise between competing strategies that can be staged through a scenario.

This work proposes a dynamic and ontological definition of fundamental human needs that stems from the condition of being human where fundamental human needs are understood as a system, i.e. as being interrelated and interactive. In this system, there is no hierarchy of needs (apart from the basic need for subsistence). Rather, simultaneity, complementarity and trade-offs are features of the process by which needs are satisfied.

Despite many references to the concepts of human needs and satisfiers in the literature, the needs-based approach has not yet been used to construct scenarios for planning. This work requires the creation of a list of human needs and satisfiers that is based on a deeply qualitative view of a sustainable future. We also propose to move beyond the individual level of needs satisfaction (Max-Neef et al., 1989) by exploring the community and governance dimensions of fundamental human needs. The study finally proposes an answer to the question, *how can needs and values be used to achieve sustainable development?*

Eight key stakeholders of an EcoChange[15] project in Central Belgium were selected to participate in this case study. The stakeholders were selected from a broad range of socio-professional categories with their own values and satisfiers that were identified and used to elaborate a sustainable scenario for the 2050s. The needs-based process allowed the identification of individual values and practices that we call individual satisfiers. We call this level of analysis the *individual dimension*. We then identified the interdependencies between people's satisfiers for the same need, calling these divergent (conflicting, unsustainable) satisfiers and convergent (peaceful, sustainable) satisfiers. This allowed us to identify to what extent some satisfiers impede the satisfaction of others' needs. We call this level of analysis the *community dimension*. Finally, we identified the interdependencies between satisfiers for any need. We distinguish 'singular satisfiers' that meet a single need from 'synergic satisfiers' that meet several. This allowed us to focus on synergic satisfiers (which are by definition

[15] Eco-Change was an EU-funded biodiversity research project from the 6th FP: "Challenges in assessing and forecasting biodiversity and ecosystem changes in Europe" (http://www.ecochange-project.eu/).

therefore sustainable) when seeking to promote sustainable human development. We call this level of analysis the *governance dimension.*

The first section of the paper presents the theoretical framework and offers a justification for selecting our model. We chose Max-Neef's HsD model, which we propose to test within our case study. The second section develops the context and the scenario method employed. The third section reports the results, and the last section discusses whether HsD methodology can be extended to cover community and governance dimensions of needs in order to achieve sustainable planning.

3.2. Theoretical framework

3.2.1. Why a needs-based approach?

The concept of sustainability rests on the idea that human development can be sustained. Therefore, human development that is not sustainable cannot be considered as genuine development (Neumayer, 2010). The UN Development Program defines the concept according to the capability approach (Sen, 1993; Alkire, 2010) as follows: 'human development is about expanding people's choices, building on shared natural resources' (HDR, 2011: 1). In this definition, the word 'needs' does not appear, even though it is at the heart of Brundtland's definition of sustainable development (UN, 1987). We propose to insert the word 'needs' in to the human development definition as follows: 'human development is about expanding people's choices to satisfy their fundamental human needs, building on shared natural resources', and to apply this definition in our study.

The 'capability approach', developed by Sen (1993), Nussbaum (2003, 2004), Alkire (2010), and others, and the 'needs approach' developed by Maslow (1954), Max-Neef et al (1989), Tay and Diener (2011), etc., all seek to develop an alternative to the monetary and utilitarian well-being assessment framework of neoclassical economics. However, their respective analytical frameworks differ substantially. While Max-Neef bases the evaluation of well-being on how it is achieved, i.e satisfiers, Sen bases the evaluation of well-being on freedom of achievement i.e. freedom of choice. The purpose of this chapter is not to compare these two approaches, nor to develop a new one, but rather to use an existing framework where the concept of needs is central. Therefore, our theoretical choice focused on the Human-scale Development model developed by Max-Neef and his colleague (1989), which examines human behaviour and ways to improve the quality of life in developing countries.

3.2.2. Human-scale Development model

Psychologist Abraham Maslow (1943) proposed a hierarchy of human needs to explain human motivation: earthly needs, such as food and safety, are considered essential, since they act as the groundwork that makes it possible to pursue needs that are higher in the hierarchy, such as love, respect, and self-actualization (the realization of one's full potential). Recently, Tay and Diener (2011) helped design and analyse a landmark survey on well-being with 60,865 participants from 123 countries. The survey was conducted from 2005 to 2010. Its results corroborated Maslow's views that there are human needs that apply regardless of culture, but his ordering of needs was not right on target: you do not need to fulfil basic needs in order to get benefits from the other needs satisfiers (Tay and Diener, 2011). Several other authors have focused on fundamental human needs to explain social and political conflicts (Sites, 1973; Lederer, 1980; Burton, 1990, 2001; Rosenberg, 2003; Danielsen, 2005; Kök, 2007), or health and autonomy (Gough and Doyal, 1991). Needs have also been used to explain variables in the context of decision-making (Rauschmayer, 2005; Cruz et al., 2009), quality of life and sustainable development (Rauschmayer et al., 2011) and well-being achieved by reducing consumption (Guillen-Royo, 2010). And lately, fundamental human needs were applied to non-humans as a way to better understand human beings conflicts (Jolibert et al., 2011).

Based on Maslow's work, economist Manfred Max-Neef used fundamental human needs in the HsD framework. The framework develops a taxonomy of nine fundamental human needs for subsistence, protection, affection, understanding, participation, idleness, creation, identity and freedom (axiological categories). Some scholars (e.g. Rauschmayer, 2011, following Max-Neef's suggestion; Max-Neef et al. 1991: 27) added the need for transcendence (e.g. dreams). The satisfiers then become not only the instruments for need satisfaction, but also expressions of the existential categories being, having, doing, and interacting (Max-Neef et al., 1989): being depends on individual attributes for its implementation; having concerns norms, institutions, laws and mechanisms that must be implemented to support satisfiers (not in a material sense); doing refers to personal actions that are expressed as verbs; and interacting refers to places in the sense of time and space (Max-Neef et al., 1989:40). The above-discussed existential and axiological categories were combined and displayed in a 36-cell matrix that can be filled with satisfiers for those needs (Table 1).

The main contribution that Max-Neef made to the understanding of needs is the distinction between needs and satisfiers. While needs are finite, few, identical in all cultures and in all historical periods, satisfiers are not. Realising needs can involve several satisfiers at the same time and they can be complementary or incompatible. Max-Neef and his colleagues also defined several types of satisfiers: synergic satisfiers such as breast-feeding, which contribute simultaneously to the satisfaction of different needs; singular satisfiers such as being opportunistic, which contribute to meeting only one particular need (valid in some contexts); or inhibiting satisfiers such as the arms race, which reduce the possibility of satisfying other needs.

This study uses the fundamental human needs approach developed by Max-Neef and his colleagues (1989) to explain 'needs' in the context of sustainable human development. We propose to demonstrate that a framework such as HsD helps to identify the situations of individual actors in society and to act as a catalyst for social change that enables more positive social action. Such a framework also helps to create more sustainable ways to meet the needs of current and future generations. This implies the following questions: *how can people satisfy their fundamental needs without endangering either the health of the ecosystems we depend on, or the rights of other beings? What role can individuals play in creating this future?*

3.2.3. Planning scenario and planning theories

In order to adopt the language used in futurist studies, we focus on planning scenarios that explore potential contributions to regional development strategies (Mulvihill and Kramkowski, 2010). A scenario is a description of how the future might unfold that encourages users to think beyond conventional wisdom (UN, 2007), to address possible changes to factors affecting a given issue (e.g. in ecosystem services and their implications for human well-being) (Carpenter et al., 2006)), and that informs the main issues of a policy debate (EEA, 2009). Scenarios have exploratory and educational functions. They have been used for learning and communication to orient decisions for military-strategic planning, private organisations and public policy in land-use management and planning or environmental assessment.

We chose a scenario typology developed by van Notten et al. (2003)[16] to capture the diversity of contemporary social, economic and environmental issues, to allow us to explore local interactions and to construct a coherent structured speculation (van Notten, 2005). Van Notten's typology is based on three key themes: the project goal, the process design, and the scenario content. These are divided into scenario characteristics. We used this methodology to define the goal, i.e. to build a sustainable development scenario with local citizens, taking into account the fundamental human needs that must be met for a sustainable future. The second (the design) and the third (the content) dimensions of the methodological aspects of scenario development are integrated into the methodological and findings sections below.

According to van Notten's (2005) typology, the needs-based planning scenario may be characterised as 1) an explorative scenario that leads to learning, awareness-raising, stimulation of creative thinking, and an investigation of the interaction of societal processes; 2) a pre-policy research scenario that produces paths to the future and offers implicit policy recommendations; and 3) a normative or 'back-casting' scenario that considers the development needed to reach a particular, desirable sustainable future for the year 2050[17].

Of the five planning theories[18] described by Lawrence (2000), this study has its theoretical roots in the most recent: communication and collaboration planning theory. This theory involves two overlapping components – one that focuses on the act of communication, and another that concentrates on consensus building and collaborative visioning (Helling, 1998), i.e. the collective search for common ground (Innes, 1996, 1998). This rational approach to planning implies that knowledge may be used to achieve positive change and public good in society (Sandercock, 1998). Therefore, this conception acknowledges the diversity of knowledge, which stems from the presence and participation of a variety of local actors. Participation is then about finding consensus in diversity, reflecting a normative shift towards multiple-use values, and recognising that regional planning should blend multiple objectives into a coherent set of practices (Appelstrand, 2002). The core of any planning process should give all stakeholders a voice (Bulkeley and Mol, 2003) and seek to achieve a planning consensus (Rydin, 2007) through negotiation and mediation between interests (Innes and Booher, 2003).

[16] See also Van Notten et al., 2005; Börjeson et al., 2006; Bradfield, 2005; Carpenter, 2006; Cork et al., 2006; UN, 2007; EEA, 2009; Mulvihill and Kramkowski, 2010

[17] for more details see van Notten et al., 2005

[18] rationalism, pragmatism, socio-ecological idealism, political-economic mobilization, and communication and collaboration

However regional planning has its limits: at the individual level – the difficult transfer from environmental values to sustainable actions (Benton, 2008; Hards, 2011); at the community level – the weak conflict resolution linked with the hijacking of participatory outputs, the lack of communication and knowledge transfer (Olson, 1982; Tullock, 1993; Ostrom, 1990; Lawrence, 2000; Dietz and Stern, 2008); and at the governance level – the mismatch between the different levels of institutions that leads to inadequate governance of local problems (Max-Neef et al., 1989; Ostrom 1990, 1996).

This study seeks to address these weaknesses by implementing for the first time the Human-scale Development model in the elaboration of a needs-based sustainable planning scenario. We aim to identify and take into account the fundamental human needs in the early phase of the planning process, and to test it in a local context.

3.3. Context and method

The EU EcoChange project assessed the capacity of ecosystems to supply humans with required goods and services, in order to describe possible mitigation and adaptation strategies against climate and land-use changes (EcoChange, 2007). In a case-study-based approach, the project focused on improved modelling of complex socio-ecological systems facing socio-economic and land-use changes (EcoChange, 2009). We chose to focus on the Belgian case study to co-construct a needs-based scenario with eight stakeholders.

The province of Brabant-Wallon, located in the centre of Belgium, south of Brussels, is facing rapid urban sprawl. With an area of 1,091 km² for 364,000 inhabitants, Brabant-Wallon is also Belgium's smallest province. Its population density is high (334 persons/km2) and the province has a strong peri-urban character, with a large part of the population working in Brussels. Table 3 shows characteristics of the province and key issues for land-use changes.

Table 3: Characteristics of the province and potential drivers of land use change[19]

Population	Population has grown fast (+45% between 1971 and 1996) and is still increasing. There is a lack of housing availability for lower or even medium range incomes; house prices are high.
Economy	The unemployment rate is low. The tertiary sector is in constant growth (e.g. commerce, education) while the first and second sectors are in decline. The province is attractive to investors and activities are mainly clustered in industrial and scientific parks. Farmers are largely dependent on European subsidies, including agri-environmental measures for their income.
Tourism	The main tourist attraction is an entertainment park (over 1 million visitors per year). Numbers of visitors staying overnight have almost doubled between 1991 and 2001.
Natural Environment	Protected areas are represented by 14 Natura 2000 sites for a total of 5,000 ha (less than 5% of the total area). Aquatic/wetland fauna and flora, together with some broadleaved acidic woodlands are the main habitats and species protected.

Competition between land uses is likely to remain high in the future with urban land use (e.g. residential, infrastructure, commercial, industrial) pressuring semi-natural land uses (e.g. agriculture, woodlands and Natura 2000 sites). One of the challenges for the province will be to retain its relatively rural character and high quality of life while still being able to absorb the high demand for housing and services.

3.3.1. Stakeholders involved in the participatory process

To identify citizens' values and interests related to land-use changes, we brought eight key local stakeholders together – deliberately chosen so that a wide range of socio-professional categories was represented – in an afternoon workshop and asked them to imagine how they would like to satisfy their needs in a sustainable scenario for Brabant-Wallon. We asked them to think as representatives of their activity, while obviously taking into account their personal emotions as citizens.

[19] Source: www.brabantwallon.be

Table 4: Stakeholders involved in the workshop and their corresponding activities

Stakeholders	Main activities
Manager of natural areas	In charge of the coordination of the river contract for the two main rivers of the province.
Representative of tourism sector	Promoting and developing tourism in the province.
Manager of economic development	Manager of an inter-communal group of municipalities: managing waste, infrastructure, water and business parks. In charge of economic development.
Farmer	Crop cultivation and implementation of agri-environmental measures.
Policy-maker	Provincial representative of the green party.
Forester	Managing the province's public forests.
Sustainability promoter	In charge of awareness raising and information.
Resident	A job seeker (at the time of the workshop). Background in the tourism sector.

The eight stakeholders were: a manager of natural areas, a representative of the tourism sector, a manager in charge of economic development, a farmer, a policy-maker, a forester, a sustainable development promoter, and a private resident (Table 4). It is important to note that this is a small-scale study; the possibility of generalizing the methodological findings could be confirmed by further studies using different numbers of participants, different moderation settings, etc. Prior to the scenario workshop, participants who were considered key stakeholders in terms of decision-making related to land use and management were selected during the scoping phase of an Integrated Sustainability Assessment (ISA) performed in Ecochange. An ISA[20] is a cyclical, participatory process of scoping, envisioning, experimenting, and learning which, in this case, discusses the projected changes of land uses and biodiversity with regional stakeholders. It provides a shared interpretation of sustainability as a framework that allows the search for possible solutions to persistent problems of unsustainability (Bohunovsky et al., 2011). It is through the envisioning step of the ISA that the needs-based scenario elaboration took place. Table 1 presents the stakeholders who engaged in the scenario building process, and below that the section on 'methodology' explains what happened during the workshop.

3.3.2. Methodology used for the needs-based scenario elaboration

The scenario-building process was held on one afternoon and was divided into four steps, as proposed for the construction of the scenario by van Notten (2005). Step one consisted of the presentation of stakeholders, the EcoChange project and the needs-based scenario's

[20] For more details, see Bohunovsky et al., 2011

objectives. During step two, each stakeholder completed a table with their desired satisfiers for sustainable environment in Brabant-Wallon in 2050. A discussion was necessary to agree on definitions of needs and satisfiers. In step three, stakeholders selected and presented two or three of their satisfiers to the other participants. Through this sharing, the group became aware of the present and future satisfiers of each individual participant (Table 3). During the fourth step, we asked them to reformulate their satisfiers if some diverged from those of other members of the group (although few satisfiers were actually divergent). For instance, singular, pseudo, and inhibiting satisfiers belong to the category of divergent, conflicting or unsustainable satisfiers when they impede the satisfaction of others' needs. We then used these reformulated satisfiers as collective satisfiers to design a needs-based scenario (Table 4). During this step, we became aware of synergic satisfiers acting as collective, peaceful, sustainable satisfiers.

We also asked stakeholders to assess the needs-based scenario building process in a plenary session. Feedback from participants: the mix of participants' was interesting and complementary; the needs-based approach is a helpful planning tool for setting goals; the exercise could be applied to other areas; for most participants, the exercise revealed new truths; it was a shame not to have time to work on two contrasting scenarios; the exercise was difficult; and, they expressed a desire to be informed of the findings of the study.

3.4. Findings

The identification of stakeholders' satisfiers allowed us to draw a picture of future socio-economic trends in a matrix of satisfiers (Table 5), and the corresponding sustainable scenario (Table 4) for a future Brabant-Wallon.

3.4.1. Needs and satisfiers of local citizens in 2050

During the scenario-building, each stakeholder proposed ways to satisfy their needs that were the expressions of the existential categories being, having, doing, and interacting, described by Max-Neef and his colleagues (1989). In Table 5, the existential categories appear in one column to facilitate the comparison between stakeholders' satisfiers.

In our matrix (Table 5), several satisfiers belong to the category of being; e.g. to communicate (Square 36/ S36), be opportunistic (S26), be active (S9) and dynamic (S19), etc. Satisfiers of the having category – e.g. 'protect air quality, water and soil' (S5), 'keep AEMs' (S12) or 'encourage public transportation' (S66) – require laws and mechanisms. Participants also

proposed ‘to engage with local associations’ (S33) or ‘to implement participatory projects’ (S37) that characterize the dimension of doing. Satisfiers like ‘closer relationships with humans and nature’ (S17) and ‘adult training’ (S28) are the expression of interacting satisfiers.

In this sustainable context, four types of synergic satisfiers emerge: ‘participation and networking’ (e.g. squares S22, 29, 36, 42, 54, 62, 69), ‘protect nature and environment’ (S1, 14, 22, 30, 54, 62), ‘promote local development’ (S1, 2, 4 to 8, 13, 33, 48, 64, 71), and ‘communication’ (S17, 18, 32, 36, 58, 66). All these satisfiers correspond to human values, an important concept in human experience (Foster, 1997). These values are synergic satisfiers because they meet several needs at the same time (Table 5). In this case, these four synergic satisfiers are convergent because all satisfy fundamental human needs without impeding the satisfaction of others’ needs. In other words, they are sustainable.

We also identified satisfiers that meet the needs of some but not others. For instance, ‘develop local shops’ (S8) meets the subsistence need of the resident but it does not meet the same need of the manager responsible for economic development who will ‘focus on value-added businesses and external enterprises’ (S3). This means that these satisfiers are divergent and unsustainable; they might lead to conflict (i.e. unsatisfied needs) as they impede the well-being of citizens (Max-Neef et al., 1989). ‘Make the forest productive’ (S6) is a singular satisfier (it meets the need for subsistence of the forester), but it may also be – in a badly-conceived forestry system – a pseudo satisfier (meeting the need for subsistence in the short term but destroying soil in the longer term, thus reducing productivity), and an inhibiting satisfier because it prevents others’ needs from being met (e.g. need for protection, S14; and freedom, S70).

Table 5: Matrix of stakeholders' satisfiers projected onto a sustainable living environment in the year 2050.

	Manager of natural areas	Tourism sector	Manager of economic development	Farmer	Policy-maker	Forester	SD promoter	Resident
Subsistence	**S1/** Develop Natura 2000 areas and local activities.	**S2/** Develop local tourism and integrate it at regional level.	**S3/** Focus on external, value-added businesses.	**S4/** Measures against farmland fragmentation. Develop local agriculture.	**S5/** Protect air, water, soil quality, local values.	**S6/** Conservation of Natura 2000 areas, make forests productive.	**S7/** Production of a local, renewable energy, and distribution.	**S8/** Develop local shops.
Protection	**S9/** Be active. Preserving rivers, streams.	**S10/** Establish green tourism, qualitative labels.	**S11/** Invest in large business to pay greenhouse gas emissions.	**S12/** Keep AEM and ecological networks.	**S13/** Support local networks.	**S14/** Increase, restore natural territories.	**S15/** Reduce waste production.	**S16/** Maintain social protection.
Affection	**S17/** New relationship with nature with simple pleasure.	**S18/** Increase interactions between tourism actors.	**S19/** Be positive and dynamic.	**S20/** Developing connections to the territory (emotional).	**S21/** Increase interactions between generations	**S22/** Active participation of the population in landscape planning.	**S23/** Participation of local actors. Create green spaces in cities.	**S24/** Develop exchange between citizens.
Understanding	**S25/** Improve sustainable technologies.	**S26/** Be opportunistic in tourism. Roundtables for new practices.	**S27/** Invest in information, participation, education, be curious.	**S28/** Develop training, support to farmers.	**S29/** Develop adult training, networks of information	**S30/** Develop environmental network.	**S31/** Train local citizens to sustainable development.	**S32/** Create spaces for exchanges.
Participation	**S33/** Local associations to manage their surroundings.	**S34/** Participation of citizen to develop tourism.	**S35/** Learn several languages at school, adult training.	**S36/** Invest in local life, local information panels to communicate.	**S37/** Implement participatory projects.	**S38/** Participation of citizens in management of natural areas.	**S39/** Imagine and build eco-villages.	**S40/** Develop tools to be aware of local activities.
Idleness	**S41/** Recharge individually in nature.	**S42/** Networking and rural tourism.	**S43/** Rural collective work, get closer to nature.	**S44/** Open farms to pick own fruit / vegetables.	**S45/** Develop curiosity for nature.	**S46/** Create ecological network, playing sports in nature.	**S47/** Give meaning to nature, avoid mass tourism.	**S48/** Develop local skills (ceramic courses).
Creation	**S49/** Local decision-making participative.	**S50/** Be dynamic (local products).	**S51/** Creation of hospital, fire station.	**S52/** Development of local, organic agriculture.	**S53/** Be dynamic, open to changes.	**S54/** Create ecological networks.	**S55/** Restore, rebuild green spaces, closer living spaces.	**S56/** Create spaces for recreation.
Identity	**S57/** Innovate, dare, be proactive.	**S58/** Communicate at national international levels.	**S59/** Develop economic activities of the province.	**S60** Maintain farmers as key players in the landscape structure.	**S61/** Feeling part of a community	**S62/**Create an ecological network.	**S63/** Give meaning to local / regional life	**S64/** Apply labels of quality e.g. AOC.
Freedom	**S65/** Respect for privacy. Be responsible.	**S66/** Inform the public, develop public transportation	**S67/** Be as free as possible.	**S68/** Be satisfied with our actions, live in harmony.	**S69/** Create networks of trade with other EU regions.	**S70/** Wild recolonization of abandoned areas.	**S71/** Develop local mobility e.g. cycling, railway lines	**S72/** Develop local mobility.

The matrix of Table 5 was then used to construct a needs-based scenario (Table 6) that provides collective, consensual, convergent and sustainable satisfiers.

3.4.2. The needs-based scenario

The needs-based approach provides a 'polaroid of the future', based on heterogeneous factors, including demography, economic, social, cultural, environmental, and political variables (van Notten, 2005). Collective satisfiers of the co-constructed scenario were obtained after an open discussion in which stakeholders were asked to reformulate their individual satisfiers so that they were less divergent with those of other members of the group (i.e. step 4 of the method). The resulting collective satisfiers were used to design a sustainable future for Brabant-Wallon. These satisfiers were classified and synthesized into eight categories[21]: population and lifestyle, economic development, energy, tourism, spatial development, environment, transport and mobility, agriculture and forest (Table 6).

According to van Notten's typology (2005), this scenario is explorative, enabling learning, awareness-raising, creative thinking, and an investigation of how societal processes interact. The scenario is also normative, because it took the participants closer to a desirable sustainable future for the year 2050 (van Notten, 2005). Using the needs-based approach to elaborate an explorative and normative scenario leads to a complex sustainable scenario with causal-related and synergic satisfiers in which sustainable values are central. An example is the 'Transport and Mobility' category (Tables 5, 6), where we see a desire for the development of public transport networks (S66), construction of cycle lanes (S71) and reduced distances between homes and workplaces (S55).

[21] Already pre-defined in the draft versions of the scenarios prepared by the Sustainable Europe Research Institute (SERI) (in charge of socio-economic issues and scenario-building in the EcoChange project).

Table 6: Collective satisfiers of a sustainable needs-based planning scenario for Brabant-Wallon in 2050

	Sustainable scenario	
Population and Lifestyle	(1) social and environmental consciousness (2) non-materialistic, holistic, collective concept (3) justice within and between generations	(4) voluntary community work (5) maintain social protection
Economic development	(1) focus on quality rather than quantity (2) high value companies[22] (3) focus on international co-operations	(4) production and consumption of local products (5) higher recycling rates
Energy	(1) local renewable energy initiatives (2) no nuclear energy production	(3) systematic thermal insulation of houses
Tourism	(1) development of local, integrated tourism (2) development of "green tourism"	(3) agro-tourism as new income for farmers (4) citizen panels
Spatial development	(1) sealing and urban sprawl reduction (2) management of existing urban areas	(3) development of green spaces and parks (4) restoration of landscapes for aesthetic value
Environment	(1) priority on nature and biodiversity (2) reinforce climate policy (3) local reduction of greenhouse gas emissions	(4) participation of citizens to decision-making (5) expansion of Natura 2000 sites
Transport and Mobility	(1) development of public transport network (2) construction of cycle lanes	(3) reduced distances between living places
Agriculture and Forest	(1) shorter production and sales chains (2) banning of GMOs, pesticides (3) defence of AEMs, and organic agriculture	(4) restoration of extinct fruits and vegetables (5) sustainable timber production (6) natural tree species re-colonisation

The changes addressed in the needs-based sustainable scenario concern the evolutionary development of actual values and satisfiers, which open paths to the future and offer implicit policy recommendations (van Notten, 2005), such as for the category 'Population and Lifestyle' (maintain social protection) or for the 'Economic development' of Brabant-Wallon (focus on international co-operations) (Table 6).

In the next section, we consider individual values as satisfiers to meet individuals' needs (individual dimension), their interactions (community dimension), and their responses to policy-making processes (governance dimension), in order to assess whether a needs-based approach brings the pattern of environmental values closer to sustainable regional planning.

[22] Brabant-Wallon wants to engage with companies that provide high value-added in small spaces such as pharmaceutical laboratories

3.5. Discussion: three dimensions to sustainable planning

3.5.1. The individual dimension

One of the limitations of regional planning relates to the articulation between personal values and actions (Benton, 2008; Hards, 2011). This is because planning does not take people's values into account and until now, societal values have been deduced to feed the policy process (Davies, 2001). The needs-based approach helps to identify and to share participants' values and sustainable practices for everyday living (Table 5). Eco-regulatory practices (Benton, 2008) have been listed, such as 'playing sports in nature' (S46), 'create ecological networks' (S46, 54, 62) or 'develop rural tourism' (S42) for the forester and the representative of the tourism sector. We observed that the participants' sharing of personal information also creates a climate of trust (Ostrom, 1990, 1996) that facilitates the modification of individual satisfiers when we asked stakeholders to reformulate those satisfiers that diverged from those of other members of the group (the fourth step of the scenario elaboration). Also, awareness of neighbours' values is increased, which stimulates expectations and obligations with regard to each other and encourages positive actions (Ostrom, 1990, 1996; Rydin and Pennington, 2000).

The creation of the needs-based scenario provides personal information that enables us to identify individual values and practices. In this case, the scenario elaboration process fostered transparency, trust, legitimacy and reputation, which are the foundation for social structures or social capital as defined by Ostrom (1990, 1996). And, social capital also implies local action (Ostrom, 1990, 1996). A longer-term program of collaboration between researchers and local stakeholders would be required in order to prove that this process could foster future sustainable local actions.

3.5.2. The community dimension

Another limitation of regional planning concerns the weak conflict resolution process (Ostrom, 1996; Lawrence, 2000). One reason for this is the lack of communication and lack of incentive to participate within the wider community, which often lead to the hijacking of the planning outputs (Olson, 1982; Tullock, 1993). The needs-based approach helps to identify and to share community's social practices and spaces (Table 5). Thus, the comparison of stakeholders' satisfiers for the same need shows convergent, peaceful satisfiers but also conflicting or divergent ones. It highlights actual agreements and consensus, but also tensions

and potential conflicts between stakeholders such as between the manager of economic development and the resident (Table 5, e.g. S3 and S8 are divergent).
By involving a network of key local actors in the drawing up of the sustainable needs-based planning scenario, we allow a shared vision and priorities to emerge, thus avoiding issues of power, control and nimbyism (van Tatenhove and Leroy, 2003; Rydin and Pennington, 2000). The issue is not about collective interests overriding individual interests, but, as Johnson (2003, 2011) argues, the need to communicate clearly one's concern to ameliorate common problems and to share different types of knowledge – local, experiential, contextualized knowledge – but also indigenous, political, moral and institutional knowledge (e.g. Wynne, 1992; van den Hove, 2007; Rydin, 2007; Ostrom, 1996; Rauschmayer et al., 2009).

The community dimension of needs highlights issues of collective actions, and reveals the capacity of a local community to discuss collective initiatives within a dynamic participatory framework (Ostrom, 1996). The needs-based scenario is a consensual process which enables a collective search for common ground in a shared space (Lawrence, 2000), and sustainable planning through deliberation, discussion and negotiation.

3.5.3. The governance dimension

The last identified limitation of planning is the mismatch between the different levels of institutions which often results in inadequate governance of local environmental problems (Max-Neef et al., 1989; Ostrom 1990, 1996). The concept and practice of environmental governance – defined as the establishment, reaffirmation or change of institutions in order to resolve conflicts over environmental resources (Adger et al., 2003; Bromley, 1991) – has seen a shift from a system that functions within a centralised government-based nation-state towards one that operates within liberalised, market-based and decentralised decision-making structures (Paavola, 2007). This means that governance deals with the question of how to arrange the tensions between individuals and communities, using political systems, norms and arrangements that, in HsD terminology, are considered as satisfiers.
In a first step, the comparison of stakeholders' satisfiers for all needs identifies synergic satisfiers. The synergic satisfiers mentioned above – participation and networking, protect nature and environment, promote local development and communication – satisfy all nine fundamental human needs (Table 5). At the opposite end of the scale, the satisfier 'to be opportunistic in tourism institutions' (S26) is singular because it mainly meets the need for subsistence. Thus, 'to be opportunistic' implies adopting selfish behaviour aimed at taking

advantage of circumstances, with little regard for principles or for others. But as long as singular satisfiers are not detrimental to others or other needs, singular satisfiers are not necessarily unsustainable. It is only when they inhibit satisfaction of other needs that they become unsustainable. The needs-based scenario process is therefore a dynamic tool that allows the identification of and adaptation to evolving interdependent satisfiers whether they are sustainable or not.

In a second step, a scenario built around the needs approach highlights issues related to the environment, employment, energy, development and consumption (Table 6) for several levels of governance. At a local level, citizens proposed the development of green tourism (S10), public transport (S66), organic agriculture (S52). At a national level, they proposed to implement Natura 2000 areas (S1, 6). And at a European level, they seek to maintain agri-environmental measures (AEMs) (S12). These are concrete satisfiers, measures proposed and supported by local citizens that might act as clear guidelines for policy-making decisions.

The sustainable needs-based planning scenario considers long-term choices to define convergent, sustainable satisfiers that are in the interest of the majority of actors, thereby fostering more environmentally-friendly governance. But it also builds trust, thereby changing the nature of collective action, and fostering the building of social capital.

3.6. Conclusion

This study on the experimental creation of a sustainable needs-based planning scenario suggests that participants intuitively construct and reconstruct their individual representations, values, and therefore practices in the light of personal experience, relationships and events. This process enables us to face, share, and build identities, worldviews and moral discourses towards less conflicting relationships (Hards, 2011).

Second, by using the Human-scale Development model for planning, we enable a very personal form of communication between key local actors. This enables us to identify and regroup participants' satisfiers in order to bring the values constructed within the interactions of individuals and the socio-institutional context closer to the policy process (Rydin and Pennington, 2000; Davies, 2001). The process of building collective sustainable satisfiers and values helps to reorganize interactions between the personal, the societal and the state level, and to restore exchanges of knowledge to strengthen community life (Max-Neef and al., 1989).

Third, the co-construction of scenarios offers a ‘practice which is essentially a shared understanding of a way of thinking and acting’ (Hards, 2011:24) on environmental, social, economic and political issues. Practices such as the construction of a needs-based scenario, mediate the framework of social structures that are shaped by and lead to individual actions, as suggested by the theory of structuration (Giddens, 1984). In the Human-scale Development model, ‘social and physical spaces (e.g. family, group and community spaces) are fundamental to the generation of synergic satisfiers that combine personal growth with social development’ (Max-Neef et al., 1989:51). Constructing a sustainable needs-based planning scenario recreates ‘practice for social construction recognising the contextual, relational nature of thought and action’ (Hards, 2011:24). It also stimulates human beings’ ‘sensitivity, imagination, volition and intellectual talent in an effort that extends itself from personal development to social development, and, thereby generates a process of integration of the individual and the collective’ (Max-Neef et al., 1989:69).

Owens pointed to the need for an ideological shift amongst the wider planning policy community and general structures of governance, to ‘rediscover the value of judgement and the judgement of value’ (Owens, 2000: 576). The needs-based approach gives new meaning to the Brundtland report’s definition of sustainable development in which needs are central to consensus, and where we have to recognise and accept our shared values but also accept the judgement of our actions by future generations.

4. Research impacts and impact on research: the influence of stakeholder engagement.

Jolibert, C. and Wesselink, A. 2012. Research impacts and impact on research in biodiversity conservation: Influence of Stakeholder Engagement. Env. Science & Pol. 22:100–111.

4.1. Introduction

Global environmental issues such as biodiversity loss pose a major societal challenge. Much scientific research is on-going to provide knowledge for improving society's response to such problems, but it is a major challenge to ensure that knowledge on global environmental issues is translated into societal solutions.

The EU research policy links research agendas with societal challenges, and increasingly emphasises the need for exchange of knowledge between researchers and non-research actors in order to enhance the quality, relevance and legitimacy of research and its impact (Diedrich et al., 2011; Oreskes, 2004). We define the non-research actors or *stakeholders* as all users of, and those (directly and indirectly) affected by or benefitting from, research projects. These potentially include citizens, businesses, consumer groups, NGOs, public institutions, policy-makers from government and agencies, scientists, the media and other potential beneficiaries (EC, 2009). We then define *stakeholder engagement* as active involvement where these actors have brought inputs (financially, materially, opinions, knowledge or sharing of facilities, exchange of personnel) at one or several stages of the research process e.g. research proposal/design, planning, coordination, execution, dissemination, and/or follow-up.

The evidence from different disciplinary domains indicates that this interaction between science and society is not a simple matter of linear knowledge transfer from research to policy and practice but rather a multi-faceted, multi-directional process. Recent research on science-stakeholder interfaces[23] has identified various forms of knowledge transfer and exchange, such as translation of knowledge from one community to the other(s) by knowledge brokers (Pielke, 2007), through participatory platforms (Fischer, 1993; Renn, 2006) or by some means of knowledge co-production between users and producers. This knowledge production is socially distributed, application-oriented, trans-disciplinary, and subject to multiple

[23] defined as social processes that encompasses relations between scientists and stakeholders in and around the research process which enable exchanges of information, knowledge, experience and views, co-evolution and co-construction of knowledge (van den Hove, 2007),

accountabilities. It has been labelled variously as mode-2 science (Gibbons et al., 1994), post-normal science (Funtowicz and Ravetz, 1993) or transdisciplinary science (Klein et al., 2001). Importantly for our research, these approaches imply a two-way process of stakeholders having an *impact on research*, as well as the more familiar research having an impact on stakeholders and wider society (*research impacts*).

While a new language has therefore been invented – a language of application, relevance, contextualization, reach-out, technology transfer, and knowledge management – these models have not provided a deeper analysis of how knowledge is produced, validated, and disseminated (Nowotny et al., 2003:185), nor of what the real impacts are of stakeholder engagement on policy, society and on research itself. The general argument for stakeholder engagement in research is thus well established but it is much less clear whether the stated benefits actually occur in practice and under which conditions. Most research on science-society interactions has focused on the 'user' side of the equation, i.e. how and when policy makers and practitioners may or may not use research outcomes. Less attention has been paid to the 'producer' side: how and when do scientists use stakeholders' input in their research, and what barriers and enablers do they experience (see also Nutley et al., 2007: 67).

In this work we want to help remedy this gap in knowledge. We start from a normative position that stakeholder engagement in biodiversity and ecosystems research can support sustainability learning in society, and that an open knowledge system is part of a chain of reasoning, interaction and action for sustainable practices (Cornell et al., 2012; Tàbara and Chabay, 2012; Roelofsen et al. 2011). We explore inductively the EU landscape of stakeholder engagement in all 38 biodiversity research projects in the sixth research Framework Programme (FP6)[24] (Annex) in order to answer to the following question: *how does stakeholder engagement in biodiversity research foster its impacts to support learning on sustainability?* First, we present theories of research impacts and impact on research and develop a heuristic to analyse these in our material. We then describe stakeholder engagement in these projects by typifying the key actors involved, the types of communication between scientists and stakeholders, and the kind of stakeholder contributions. In the last section we assess whether and how stakeholder engagement influences the impact of the research on policy and the wider society and how stakeholder engagement impacts on the research itself.

[24] These projects are financed by the European Commission in the priority area of "Global change and ecosystems" and sub-priority "Biodiversity and Ecosystems".

Finally, we suggest directions for the design of knowledge production that increases these impacts.

While we therefore believe that stakeholder engagement can support sustainability learning in society, including potentially increasing sustainability of policies, we do acknowledge that stakeholder involvement in scientific research may also undermine the perceived strength of the research, both in policy making and in scientific peer review. Analysing the successes and failures of so-called post-normal science (Funtowicz and Ravetz 1993), Wesselink and Hoppe (2011) argue that in the view of many politicians extended peer review (i.e. stakeholder engagement) in research means less rather than more authority and credibility. The scientists who vehemently protested at climate scientist Mike Hulme's assertion that climate change science is post-normal (i.e. it involves stakeholders) have understood that this claim diminishes their authority[25]. Lovbrand (2011) furthermore shows how a tight coupling between stakeholder needs and research enhances the immediate usefulness of the research but blocks more critical and reflexive research that would ultimately lead to more innovation. Keeping this in mind, we now assess successes and failures in the processes of stakeholder engagement with the aim to inform their future conduct.

4.2. Models of research impact and of impact on research

A major difficulty when trying to analyse the impact of stakeholder engagement in European research projects is to establish a terminology able to adequately characterize the complexity of research projects that relate to biodiversity conservation. Given the richness of engagement processes, the types of stakeholder engaged in these projects, the roles they play and when, and the type of impacts derived from such involvement are hard to classify. Furthermore, to separate conceptually or practically stakeholder engagement activities and their impacts from the overall research process and its impact encounters the 'complex issues of attribution [..] and additionality' (Nutley et al. 2007: 289). This is added to the widely recognised difficulties of identifying and assessing research impacts in general, 'given all the complexity, diversity and messiness of research use' (Nutley et al. 2007: 271). Although many models of research impacts exist, most of them focus on science-policy interfaces only and assume linear transmission of research results to a societal use. From the 'incremental policy' model

[25] See the article (Hulme, 2007) and the subsequent exchange: http://www.guardian.co.uk/society/2007/mar/14/scienceofclimatechange.climatechange.

(Lindblom, 1968) to the 'context evidence and links' model (Crewe and Young, 2002) and the 'linkage and exchange' model (Lomas, 2000), policy-makers are considered as the main target for engagement in research. Also, labels such as 'knowledge transfer', 'knowledge dissemination' and 'research use' imply that research is complete before the impact process starts, while this is clearly not the case in the projects studied. Kingdon's 'policy streams' model is one example: this looks at routes through which research enters policy through policy-entrepreneurs (Kingdon, 1984). These linear models do not capture the richness of engagement processes nor the multiplicity of the interfaces that we observed (see Figure 1). For example, engagement of stakeholders can have a more diffuse effect, labelled 'process use' (Shulha and Cousins, 1997) or 'enlightenment' (Weiss, 1979): it leads to general changes in ways of thinking and behaving among stakeholders. Impacts are then not uni-directional but reciprocal, take many guises, and maybe amplified by e.g. media, cultural groups, interpersonal networks (Kasperson et al., 1988).

To circumvent these problems of typology of research impact we developed a heuristic based on van den Hove (2003). She analyses the impact of participatory processes in relation to their potential procedural, contextual and substantive effects. We adapted this typology to describe the effects of stakeholder engagement on different dimensions of the research process. *Procedural effects* consider how the policy process has been affected. They include improvement of the quality and complementarity of the informational basis for the policy decision process, better information use and dissemination, and dynamic exchanges. *Contextual effects* consider the social context in which the research process is embedded. And the *substantive effects* consider the relevance and quality of the research results, as judged in reference to the research objectives and the standard of scientific excellence. We named these, respectively, the impacts of stakeholder engagement in research on *policy*, *society*, and *science*.

4.3. Research methodology

To develop an understanding of stakeholder engagement in EU-funded research, we first conducted exploratory semi-structured interviews with selected project coordinators and partners[26] in all 38 biodiversity research projects in the sixth research Framework Programme

[26] Partners are those who are included at the funding proposal stage and participate actively throughout the project, but it was sometimes difficult to differentiate between partners and stakeholders from their respective degrees of active engagement,

(FP6) (Annex)[27], but also with members of the European Platform for Biodiversity Research Strategy (EPBRS)[28]. It was clear that the difficulties they experienced with stakeholder engagement are wide-ranging. These can be summarised as: identifying stakeholders who can contribute, managing the process of engagement, sustaining it over time, and linking stakeholders' contributions with research objectives.

We then systematically compared the processes of stakeholder engagement in all 38 FP6 biodiversity research projects using a combination of methods. We used data from the Cordis[29] and the Biota cluster[30] websites, which bring together information on European Union-funded research, including details on project research calls, news and results. We visited the 38 projects websites and examined all relevant publicly-available information: description of work, workshop reports, meetings and final conference reports, publications, newsletters and briefing sheets[31]. However, the nature and extent of stakeholder engagement in research cannot be fully assessed by looking at official project documents so we collected verbal or written input from project coordinators and partners in 32 projects, but also from members of the EPBRS[32] on the following questions: who were the stakeholders involved in the projects, what were their contributions and how were they involved?

With this way of working, we offer an overview on the practices of stakeholder engagement in European biodiversity research projects. We do not pretend to provide exhaustive knowledge of stakeholder engagement in these projects, as details of the engagement and local or informal engagement processes are not included in this way.

4.4. Science-stakeholder interfaces

After briefly presenting the standpoint held by European Commission on stakeholder engagement, in the following section we describe the science-stakeholder interfaces which evolved in the EU landscape of biodiversity research projects.

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particularly between scientists invited as stakeholders and scientists involved as partners. We therefore decided to include all project partners as stakeholders in order to get around the practical difficulties.

[27] These projects are financed by the European Commission in the priority area of "Global change and ecosystems" and sub-priority "Biodiversity and Ecosystems".

[28] The EPBRS is a forum at which natural and social scientists, policy-makers and other stakeholders meet twice a year under successive EU Presidencies to discuss and give recommendations on strategic research priorities for biodiversity. Members of the EPBRS were also involved in several FP6 projects in biodiversity (http://www.epbrs.org/).

29 http://cordis.europa.eu/home_en.html

30 http://www.edinburgh.ceh.ac.uk/biota/

[31] A briefing sheet is a very concise summary of a subject or document, intended to provide easily accessible information for professionals and interested laypeople.

[32] We were also invited at several EPBRS meeting; e.g. in 2008, the EPBRS meeting was on "Biodiversity and the industry" (Paris); in 2009, the EPBRS focused on a 'Network of Knowledge for biodiversity governance' (Barcelona); in 2010, the EPBRS meeting was held on 'Positive visions for biodiversity' (Brussels); etc.

4.4.1. EU policy on stakeholder engagement in research

Until the late 1970s, European research policy mainly consisted of sectoral initiatives in areas such as nuclear energy, coal, steel and agriculture. The shift from this ad hoc approach towards an integrated vision for research was reflected e.g. in the FP6 thematic priority "Global Change and Ecosystems" (EC, 2002). This theme addresses topics including biodiversity and ecosystems, desertification and natural disasters, sustainable land management, forecasting and modelling (EC, 2009). The FP6 used five different types of funding instruments which differ in terms of purpose, target audience for funding, activities covered, funding mechanisms, duration, flexibility, etc. (EC, 2006b). Integrated projects (IP) and Specific Targeted Research Projects (STREP) are research projects *per se*, aimed only at generating new knowledge, while Networks of Excellence (NoE) aim to establish long-term integration of the participants' activities and capacities. Specific Support Actions (SSA) and Coordination Actions (CA) support collaboration and coordination (EC, 2004a). The overall aim of the FP6 is strengthening and structuring of the European Research Area by bringing together European research communities (EC, 2009).

In the EU context, it is asserted that stakeholder engagement in research would help to both shape and deliver EU policy (EC, 2001), build a common EU research agenda for the future (EPBRS, 2005), increase the effectiveness of research dissemination into policy implementation processes (e.g. SEPA, 2008, SoBio, 2006), increase stakeholder knowledge as a key aspect of action and sound public governance (BiodivERsA, 2008; Cornell et al., 2012), and improve governance and conservation of biodiversity overall (e.g. EC, 2003; Furman et al., 2006; van den Hove., 2007; Holmes and Clark., 2008).

In the EU Framework Programmes, stakeholder engagement in research was promoted from the beginning but particularly since the FP3 where scientists, political decision-makers, industrialists and citizens were 'encouraged' to be involved in multidisciplinary projects, but no concrete procedures were specified (EC, 2002). In the FP6 guidelines[33], stakeholder engagement is raised in the sub-section 'Target audience' where it is stated that 'any legal entity may participate, [..] and organisations that have specific competence in management, dissemination and transfer of knowledge, as well as potential users and stakeholders' (EC, 2006a:16), but again no concrete procedures were specified. After the Commission's 2004

[33] for thematic priority 'Sustainable Development, Global Change and Ecosystems'

stakeholder consultation on the future of European research (EC, 2004b, 2004c), the issue of stakeholder engagement has evolved in the FP7 with the 'Cooperation programme' which aims to support cooperation between universities, industry, research centres and public authorities (EC, 2007). It introduces some new elements intended to facilitate European research cooperation such as the Joint Technology Initiatives (JTIs) intended to facilitate European public-private partnerships. It is however too early to assess what impacts on policy, society, and science these changes have, since these projects are still on-going. We therefore focus on stakeholder engagement in FP6 research projects on biodiversity.

4.4.2. Stakeholders involved in biodiversity research projects

The stakeholders who engaged in the FP6 biodiversity research projects were very diverse (see Figure 1). They had specific stakes or were directly and indirectly affected by the process or the outcomes of the research. To describe different categories of stakeholders, Nutley and al. (2007:37) distinguish practitioners and policy-makers. Another classification distinguishes researchers, policy-makers, practitioners, knowledge-brokers and research funders (CHSRF, 2000 in Nutley and al., 2007:105). We found that these categories could not be applied unambiguously in our projects: all stakeholders could play the role of knowledge-broker, and they could all fund research or 'use' research outputs. Our classification uses the main status of a stakeholder in society, yielding nine categories (Figure 1):

- scientists: from public research institutes, universities, consultants, experts;
- policy-makers: European institutions, environment agencies, ministries from sub-National to European levels;
- NGOs: local to international non-profit organizations;
- managers (public and private): nature and forest managers, water managers, land-managers, veterinarians, etc.;
- private sector: businesses including SMEs, private research institutes;
- citizens: members of the public, representatives of consumer groups, European Landowners Associations, Federation of European Hunting Associations, amateurs naturalists;
- students: from school children to post-doctoral students;
- facilitators: within the projects, they worked at the intersection between scientific research and practical concerns of users, represented by social scientists who played roles of mediator in environmental conflicts, coordinator in participatory processes, etc;
- media: representatives of TV, radio, newspapers.

Figure 1: Categories of stakeholders (in percentage) presents on the totality of the biodiversity research projects

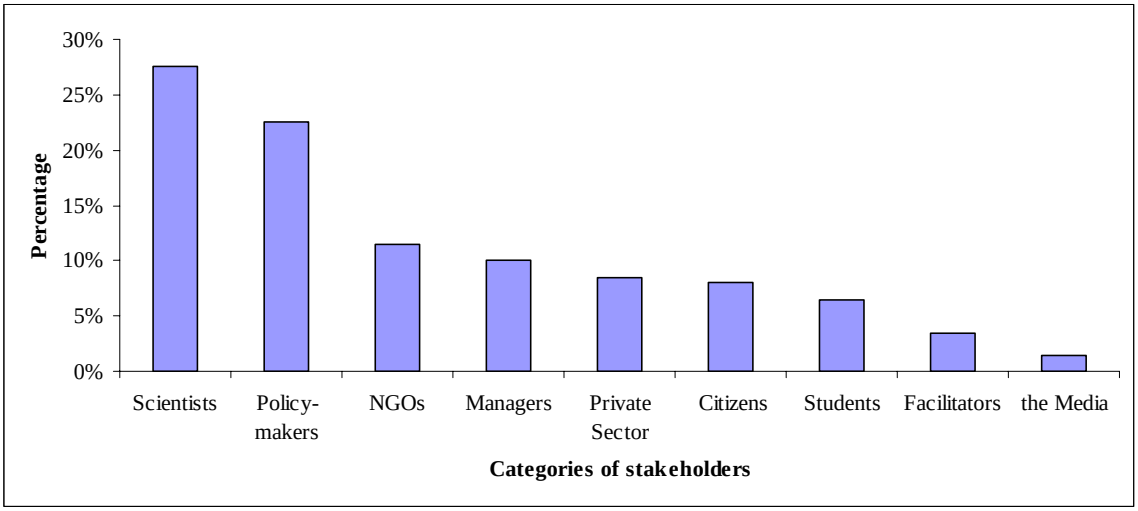

Figure 1 indicates that the stakeholders most involved in all projects combined are scientists (27,5%) and policy-makers (22,5%). Of the totality of the 38 projects studied, 36 projects engaged at least two categories of stakeholders, with a maximum of six. Of these projects, fourteen projects engaged mainly during the dissemination stage, through scientific publications and/or during final conferences and the presentation of results. These late-in-the-day stakeholder engagement processes are typical of 'end-of-pipe' interfaces. This reflects a vision of research as an activity largely disconnected from its social context in which public is only consulted and communicated the results to problems chosen only by scientists themselves. We counted twelve projects who engaged several categories of stakeholders at one or more stages of the research process before the dissemination stage.

4.4.3. Types of communication between research projects and stakeholders

We distinguish two dimensions in the communication between stakeholders and research projects: directionality and formality. One-way communication, e.g. through publications, posters, databases, newsletters, flyers, e-News, videos, brochures, guidelines, websites, are disconnected exchanges in space and time, and lead to mono-directional flow of information between scientists and stakeholders. Two-way communication, e.g. during workshops, meetings, conferences, including e-conferences, are dynamic interactions between scientists and stakeholders, connected in 'space' and time. Opportunities for dialogue exist that promote direct and reciprocal exchanges and joint construction of knowledge. Formal communication leads to explicitly expressed and recorded commitments e.g. a Description of Work, or expressed in Steering Committees, Stakeholder Advisory Boards, etc. Informal

communication take place outside these official settings and often leave no written document. They are important in establishing tacit and implicit rules of interaction, and also information exchanges.

In the 38 research projects 37% of projects engaged formally (with occasional and local informal engagement), and 58% engaged informally (5% of projects did not engage at all). Most of the projects had several types of communication processes on-going at the same time with the same stakeholder. When formal engagement took place, it was mainly in a two-way communication process (67%) but also both two-way and one-way communications process (23%). When informal engagement took place, it was mainly a mixture between both two-way and one-way communications process (70%) but also only one-way communication process (26%). For example, the formal Evoltree Stakeholder Group participated in a one-way process by offering their perspective on activities and outcomes of the NoE Evoltree project through the website. They also participated in a two-way process through Stakeholder Group meetings with oral presentations by stakeholders (Evoltree, 2008, 2009). In the Rubicode project informal involvement for the private sector, NGOs, European institutions, scientists, international institutions, and biodiversity managers through workshops was two-way, and aimed at evaluating the concepts and methods developed within the project and identifying gaps in knowledge (Rubicode, 2008).

Overall it appears that the types of communication between science and stakeholders did not influence the impacts of the science-stakeholders interactions. In the following sub-section, we extend our analysis by identifying the outputs of these interactions (i.e. stakeholder contributions).

4.4.4. Stakeholder contributions to EU-funded biodiversity research projects

Although biased towards the dissemination stage of the research as explained above, we observed that stakeholders contributed to any one of the different project phases and activities: *research design*, *prediction/modelling*, *data collection*, *implementation and commercialisation*, *networking*, *training*, and *dissemination*.

In the *research design stage*, stakeholders helped to define research priorities, the strategic orientation of research, or the methodology followed. For instance, in the BASIN project, scientists, policy-makers and businesses engaged informally in the development of the BASIN science plan, with input from the EC representative emphasizing EC priorities on

ecosystem based resource and maritime management (BASIN, 2007). In the BioScore project, the formal steering committee composed of policy-makers, NGOs and scientists advised the project team on the strategic orientation of its research, ensuring linkages with other initiatives (BioScore, 2009). Methodological inputs, opinions, knowledge, experience provided by stakeholders oriented the research process toward issue-driven research and practical concerns of users, matching with policy agendas, but also strengthened collaboration between stakeholders usually poorly connected.

In their contribution to *prediction/modelling*, stakeholders provided inputs for the development of scenarios and models, or they participate in the analysis of data. For instance, the Euro-limpacs project, through its informal network of end-users, key stakeholders developed a decision support system for use by managers to restore habitats (Euro-limpacs, 2009), and users added their experience and knowledge to the models developed to manage specific issues such as pollution disaster, forest fires, and landscape management.

Stakeholders often contributed to *collecting of data and information*. For example, 1628 experts engaged formally and informally in the DAISIE project, creating together an inventory of invasive species to provide the basis for prevention and control of biological invasions. The formal policy expert advisory board consisting of policy-makers, NGOs and scientists provided the COCONUT project input of data and knowledge throughout the life time of the project which helped to construct policy recommendations for mitigation of adverse impacts of land use change on biodiversity (COCONUT, 2009). Workshops in the GEM-CON-BIO project run informally by policy-makers (e.g. European policy makers), NGO (e.g. IUCN) and managers, experts on biodiversity governance, made a direct contribution to the project's objectives, e.g. WP4[34]. Stakeholders furthermore developed policy recommendations to meet the objectives of WP6 'Development of Policy Guidelines' (GEM-CON-BIO, 2008). Also, when the MACIS[35] project engaged with policy makers (e.g. representatives of different EU DGs and EEA[36], European Topic Centres), NGOs (e.g. Bird Life International) as well as scientists (partners in the project), they help to summarise current knowledge about the impacts of climate change on biodiversity, and to develop methods to assess the potential impacts in the future.

[34] WP4 'Case studies', Deliverable 4.4 (D4.4.) 'Third Countries Workshop'
[35] For details on EU-funded biodiversity research project from the 6th FP, see Annex 1.
[36] Europen Commission Directorate General and European Environment Agency

Stakeholders' *implementation/commercialisation* of research results are illustrated by the activities of the formal Evoltree Stakeholder Group, composed of policy makers, forest managers, nature conservation agencies, associations of forest owners, forest industry associations, non-governmental organizations and universities. They exchanged information, views and experiences through the project website to support and implement new conservation strategies. They also tried out the strategies that the project had developed. Also, the FACEIT project worked informally with various SMEs[37] to evaluate new methodologies for monitoring biological pollutants. These business partners in turn convinced their customers and contacts to incorporate FACEIT methods in their commercial programmes.

Networking is a project activity that contributes to project goals, but it was often also a goal in itself. The EPBRS network allowed the formal linking of policy agendas, research and stakeholder needs through the joint construction of recommendations for policy-makers, researchers, industrials and end-users (EPBRS, 2005). The NoE MarBEF was a platform to integrate and disseminate knowledge and expertise on marine biodiversity, linking researchers, the general public, industries e.g. petroleum companies, fish-farmers, and the tourism sector. The MarBEF project facilitated opportunities for cooperation between research groups at several scales e.g. research, training, sharing of facilities, exchange of personnel. The project set up two coexisting formal strategies to reap the benefits of this complementarity between small and large teams: a core of a well-structured research programme and a more open 'call for proposal'-like procedure to allow new approaches, especially from smaller teams (EC, 2009). A transversal network between different EU-funded biodiversity research projects has also been established, e.g. between MACIS, Alarm, COCONUT, EuMon, etc.

In some projects where the deliverables included *training* students, stakeholders were actively involved in this activity. During Alter-Net summer schools, lectures are given by stakeholders to students coming from a wide range of states and disciplines. For instance, in 2009, 44% of lecturers in the Alter-Net school were stakeholders (e.g. facilitators, managers, NGOs, policy-makers, scientists), and the others were partners (e.g. scientists). The EDIT project also offered fellowship for students as a way for them to learn as well as to provide input. Apart

[37] such as Cybersense Ltd from UK, Biodetection Systems BV and Bioclear from The Netherlands

from this, we did not generally observe stakeholder participation in training scientists, nor did we see scientists training stakeholders.

Finally, the *dissemination* of project outcomes by stakeholders is illustrated by the Integrated Project HERMES which engaged with more than 50 partners including key policy-makers, industry (SMEs), NGOs, the media, international institutions, and leading scientists (HERMES, 2009). Dissemination occurred through four mechanisms: the formal Science-Policy Panel, the formal Science Implementation Panel, informal *ad hoc* meetings with policy makers and stakeholders on specific topics, and informal national/regional scientist/stakeholder partnerships that stakeholders were actively involved at different stages of the research process. The objective of these mechanisms was, among others, to provide a primary interactive channel for dissemination of results towards policy circles and other users (HERMES, 2008, 2009). Across all projects, internet websites and written academic materials were a major way of dissemination. All projects produced research reports and peer-reviewed literature, but fewer produced newsletters, books, briefing sheets, and guidelines. In very few cases, dissemination took place using the media (newspapers, radio and television), while these could also be involved in designing dissemination (Table 7).

Except for dissemination, the examples of each type of contribution are small in number amongst the projects. For instance, few projects engaged with stakeholders in the research design stage or in the training of students. Nevertheless, in the examples where projects did engage with stakeholders at earlier stages, this induced real policy-oriented and user-engaged research (Cornell et al, 2012). Now, as our final step to analyse the interactions between science and stakeholders, we address the question of who was involved in what activity.

4.4.5. Contributions by type of stakeholder

For each project, we identified the stakeholders involved and the types of their contributions (Table 7).

Table 7: Categories of stakeholder involved by type of contribution

	Scientist	Policy-maker	NGO	Citizen	Manager	Student	Private Sector	Facili-tator	The Media
Research design	++++	++++	+++	++	++	++	++	+	0
Prediction/ Modelling	++	++	+	+	+	+	?	0	0
Data collection	+	?	+	+	+	?	0	0	0
Implementation/ Commercialising	++	++	+	+	+	+	++	0	0
Networking	+++	++	++	++	++	++	+	+	?
Training	++	++	+	+	+	+	+	+	0
Dissemination	+++	++	++	++	++	+	+	+	+

Legend:
++++: [25-35] stakeholders; +++: [15-24] stakeholders; ++: [5-14] stakeholders; +: [1-4] stakeholders; 0: no involvement of stakeholders; ?: no information for this contribution

Table 7 shows that representatives from science, policy and NGOs were most likely to contribute to the design of research projects, while citizens, land-managers, students, the private sector and the media did so to a lesser extent. It also shows that stakeholders can play multiple roles simultaneously. Thus, scientists, NGOs representatives, citizens and managers were involved in all types of contributions. Maybe most importantly, Table 7 shows that some types of stakeholders were hardly involved at all, such as facilitators and the media.

Projects that engaged facilitators typically organised science-stakeholder interfaces at several levels, from local case study within the project, to the interactions with regional or European stakeholders (e.g. MARBEF, EcoChange, EDIT, GEM-CON-BIO, HERMES). However, these reflexive social sciences are still little involved compared to traditional disciplinary science. Also, while the media have much expertise in information diffusion, e.g. the new information systems and technologies, and could provide advice on production, diffusion and use of knowledge in societal and political contexts (Cornell et al., 2012), their involvement was low. Exceptions are ALARM and EXOCET/D who used TV channels, video, public events, website, newspaper, etc.

In the next section, we identify the impacts of the interactions between science and stakeholders. We assess whether and how stakeholder engagement influences impacts of the research on policy and the wider society, and how it impacts on the research itself.

4.5. Research impacts and impact on research

Below we assess impacts of stakeholder contributions on policy, society and science based on, respectively the procedural, contextual and substantive effects proposed by van den Hove (2003).

4.5.1. Impact on policies

To assess procedural effects we consider the extent to which projects that engaged with stakeholders contributed to the formulation or implementation of relevant European policies and the dissemination of policy-related knowledge.

One example is the SSA BioStrat project which was tasked with supporting the development of the EU biodiversity research strategy. They associated with the European Platform for Biodiversity Research Strategy (EPBRS) to link policy agendas, research and stakeholders' needs (BioStrat, 2008). Another project, ALARM, was of considerable international importance, especially for the United Nations Convention on Climate Change and the Convention on Biological Diversity (EC, 2009), in part because of the large number of stakeholders (68 from over 30 countries, including 12 non-EU partners). As mentioned above, the HERMES project is another example of well-established dialogue between science and stakeholders. Over four years, HERMES investigated Europe's deep marine ecosystems and engaged with key policy-makers in workshops and meetings (HERMES, 2008, 2009). HERMES contributed to supporting the formulation by EU Member States of Natura 2000 implementation strategies in the offshore area and also to the debate on the future EU maritime policy in the Maritime Policy Green Paper (HERMES, 2008). In these projects the science-policy interface mechanisms ensured policy-relevance of the research throughout the entire lifetime of the project.

The study thus found only a small number of projects which engaged extensively with stakeholders to do policy-oriented research, but in these cases research impacts on policies are evident, real and productive. Conversely, according to the EC's own assessment (EC, 2009) many projects missed opportunities to support policy making because of poor communication to the policy sphere.

4.5.2. Impact on society

To assess contextual effects we consider whether the projects that engaged with stakeholders contributed to the establishment of interpersonal connections (Cornell et al., 2012), the dissemination of knowledge related to society, or had economic impacts.

Through networking, the development of interpersonal connections occurred, e.g. in MarBEF, MACIS, EuMon. They networked principally through the European Platform for Biodiversity Research Strategy (EPBRS). In preparation for each EPBRS meeting, e-conferences have been held twice a year since 1999[38], with several types of stakeholders who contributed on specific issues. This dynamic process over time built trust, credibility and legitimacy between stakeholders who had little face-to-face contact. According to Tàbara and Chabay (2012) these interpersonal connections that develop over time enable the exchange of worldviews, and generate diverse patterns of hybrid social-ecological practices and configurations suitable for supporting sustainability learning and transformation, especially in the arenas of environmental EU policy-decision making, regional biodiversity conservation and environmental management.

With respect to the dissemination of knowledge toward society in general, as already mentioned, few projects engaged with the media to communicate about biodiversity to the public. Main exceptions are ALARM, Exocet/D, SESAME and Alter-Net. These large projects tended to have more activities dedicated especially towards dissemination towards the general public and involving the media. Furthermore, several stakeholders in these projects were also involved in projects to train students, and others projects offered fellowship such as doctoral or post-doctoral posts[39]. The EDIT project engaged with a large variety of professional and amateur users of taxonomy e.g. national parks, conservation managers, NGOs, farmers, environmental assessment industry, cosmetic and pharmaceutical industry and national governments to provide advice on the dissemination of taxonomic knowledge to influence how stakeholders within and outside the project view taxonomy.

Our analysis shows that out of 12 projects[40] that involved the private sector only two projects used it to facilitate the transfer of technologies developed during the research process. FACEIT involved SMEs[41] to help commercialize tests for monitoring biological pollutants. The project Probioprise created a European platform for SMEs and others stakeholders to

[38] http://www.epbrs.org/static/show/documents
[39] This occurred in Alarm, Alter-Net, EDIT, EcoChange, Eur-Oceans, FACEIT, SESAME
[40] These are BASIN, BioStrat, EvolTree, FACEIT, HABIT, HERMES, MarBef, Modelkey, Probioprise, RIOS, Rubicode, SoilCritZone
[41] Biodetection Systems BV (The Netherlands), Cybersense Ltd (UK), Bioclear (The Netherlands)

develop a research programme for pro-biodiversity business. While these activities hint at possible direct economic impacts, it is difficult to prove these, one reason being that the transfer and development process is still on-going. Indirect economic impacts are potentially much larger but even more difficult to assess. For example, the monitoring of biodiversity can result in the avoidance of biological invasions or biodiversity loss, both of which can produce significant economic losses. Since many of the other projects contributed to the assessment of biodiversity loss, they potentially have similar indirect impacts on the economy[42].

The study also shows that several projects engaged with stakeholders to do society-oriented research, specifically networking. The potential impacts on society are evident, i.e. in establishing interpersonal connections for exchanging experiences and worldviews, and for developing shared visions for behaviour change (Cornell et al., 2012). Also, it is easier to understand a situation, to accept a decision and to implement it when people take part in the decision-making process (Jolibert et al., 2011). Resolving the environmental crisis means bridging the gap between knowledge and action, means acting together that also means agreeing collectively on the knowledge and solutions.

4.5.3. Impact of stakeholder engagement in projects on science

To assess impacts on science, we considered issues of interdisciplinarity, the dissemination of knowledge to the scientific community, and opportunities for further projects.

The challenges of interdisciplinarity and dissemination of knowledge to the scientific community were overcome by several projects. For instance, ALARM led to an important interdisciplinary network, involving a large panel of scientists, coming from different disciplines. The project also produced more than 620 publications in academic journals in several disciplines[43]. Through its numerous publications and wide dissemination of results, ALARM had a very significant impact on the work of the European scientific community (EC, 2009). HERMES also recognised the importance of interdisciplinary research because the scale of the subject required this: the aim was to understand the deep ocean and to inform the governance of the offshore environment.

The extent to which networks and research communities will survive beyond the duration of the projects in the absence of dedicated initiative (and therefore of specific financing) is

[42] for further information about the costs of biodiversity loss and ecosystem degradation, see the Economics of Ecosystems and Biodiversity (TEEB) study (http://www.teebweb.org/)

[43] Science (6 publications), Nature (8), but also in Environmental Science & Policy (3), Journal of Biogeography (8), Atmospheric Environment (2), American Journal of Botany (2), etc.

unclear (EC, 2009). According to our data, seven projects continued their activity both with and without dedicated financing, driven by researchers' and stakeholders' motivation, but often in a different format[44]. For example, originally composed of 24 partners, the Alter-Net project now continues as a consortium, with a core group that has signed a memorandum of understanding which involves the set up of a joint activity programme and a small secretariat. MARBEF has given birth to a virtual centre for durable integration: the European Marine Biodiversity and Ecosystems Functioning (EMBEF). EMBEF is conceived as a tool for executing project activities in the long term. In order to provide a legal structure to EMBEF, the MARBEF project joined the existing UNESCO-MAB network of marine research stations (MARS).

These projects have built the foundation for future projects. They also contributed to the European Research Area by enabling networking among scientists from many different disciplines (EC, 2009), and between scientists and stakeholders. By addressing this full range of research areas and types of stakeholders, it is clear these projects enhanced the interdisciplinary structure of the European scientific community, but also the social learning that is more oriented towards sustainability in the face of accelerating global socio-environmental change (Cornell and al., 2012:2).

4.6. Conclusions

Weiss (1979), in her empirical study of policy-makers' use of research, started a line of enquiry that assumed linear transfer of scientific knowledge to policy-making which is still flourishing today. Within this uni-directional conceptualisation it has been recognised that one of the best predictors of research use is the strength of linkages between researchers and users, and that development and maintenance of strong interpersonal connections throughout a research project further enhances research use (e.g. Lomas 2000; Landry et al. 2001, 2003, Cornell and al., 2012). Our study confirms these insights. However, the interactions and knowledge flows are not linear. Some of the complexity of the interactions we observed is captured by Huberman (1987, 1994) who understands the use of research as a 'sustained interactivity' with ongoing, interpersonal and two-way links between researchers and research users that take place across the whole duration of a research project and not simply at its end.

[44] These are Alter-Net (now consortium), BASIN (now EU and US-BASIN), ELME (now Knowseas), EuMon (now SCALES), Eur-Oceans (now consortium), Euro-Limpacs (now Refresh), and Evoltree (now consortium), MARBEF (now EMBEF).

‘Sustained interactivity’ leads to reciprocal effects and to a ‘relative symmetry’ between the two communities of researchers and research users (Huberman, 1994). Consequently, the categorisation of stakeholders can then not be binary (i.e. separating researcher providers and research users) since the research process is a co-production of knowledge where research users sometimes play the role of researchers, and researchers are sometimes using the research. In the context of the multi-stakeholder engagements analysed in this study, the impact process becomes an open, complex, multi-directional and multi-level process of knowledge exchange and transformation. Instrumental, conceptual, strategic, and process uses of research merge into a single integrated use with reciprocal effects between policy, society and science.

Amongst all this complexity, how then to advise scientists who are organising stakeholder engagement? Firstly, we observe that only about half of the projects engaged with stakeholders before the dissemination stage. In these projects it appears that the choice of type of communication between science and stakeholders (e.g. formal or informal, one-way or two-way) did not affect the processes of co-production of knowledge: the main factor appears to be the existence of any kind of 'real' communication at all. Furthermore, our study shows that productive stakeholder engagement was more frequent in certain stages of the research process, e.g. prediction/modelling, data collection, networking. In addition, at any stage of the research to involve key stakeholders when they had a particular stake, experience, credibility or legitimacy was most productive, e.g. for facilitators to design the research process and organize a network; for SMEs to commercialize research results; for managers to train students or to provide operational data; for media to disseminate findings to the public.
Secondly, we return to the problem of recruitment and retention of stakeholders raised by the scientists interviewed at the beginning of our research. We conclude from our study that recruitment should be purposeful and have mutual benefit. Thus, it needs to be clear what role(s) stakeholders could play, what they could contribute and how this could be organised. At any stage of the project mutual expectations need to be made clear, including considerations of costs (e.g. time, effort) and benefits (e.g. influence, access to results). What should be avoided is an ill-defined process where stakeholders are engaged without specific purpose, either because it is thought that this in itself would ensure uptake in policy or practice (Wesselink and Hoppe, 2011) or simply because the funding agency requires it. All actions need to be ‘made to measure’. Linking stakeholders’ contributions with specific research project objectives or deliverables helps to clarify when to engage, in what manner,

with which stakeholders: for example, involvement in data collection requires different planning and different stakeholders than help with dissemination efforts. The involvement of key actors at early stages of the research process, e.g. for planning the research, should also be considered in timing the engagement.

The problematization of the loss of biodiversity is recent, as are the associated scientific disciplines whose mission is to produce scientific expertise necessary for its protection. Because biodiversity conservation is a transdisciplinary problem that includes scientific, societal and political aspects, the scientific knowledge production needs to include stakeholders from these areas. To meet the challenges of sustainability, there needs to be a profound, detailed exchange of knowledge and understanding between society, policy-makers and the scientific community (Diedrich et al., 2011). We have seen this principle being applied in several of the FP6 projects for biodiversity research. A narrow uni-linear model to assess or design research impact is then inappropriate and it should not be used to inform practices of stakeholder engagement. What we need instead is a much more reflective learning process, combined with an exchange of experiences, which is grounded in a holistic conceptualisation of science-society interactions (Angyal, 1939).

5. Challenges and opportunities of interdisciplinarity research

From the chapter ‘Looking for a place to anchor: Confusing thoughts along an interdisciplinary dissertation journey’, Minna Santaoja, Raphael Treffny, Cordula Mertens and Catherine Jolibert with Katharine N. Farrell; extract from the book ‘Beyond reductionism: A passion for interdisciplinarity’ (Farrell et al., 2012).

5.1. Introduction

Writing a doctoral dissertation is always a challenge. There is probably no PhD candidate who has not struggled with formulating a good research question, writing a convincing research proposal, managing time and research design, coming up with a neat literature review, collecting suitable data, developing analysis and writing up results. There is a multitude of books in which authors have made it their business to lend a hand to the confused minds of PhD students. This text here is about another kind of struggle, one that is growing increasingly common, as more and more PhD candidates are working on interdisciplinary or multidisciplinary research projects, particularly in the context of doing science for sustainable development (Kates et al, 2001; Farrell et al., 2005; Meadowcroft et al., 2005). The ideas presented in this chapter are inspired by the experiences of nine PhD students working in an interdisciplinary European research project called GoverNat, in which we were struggling with the additional hurdles associated with creating an inter-, trans-, or multidisciplinary dissertation that stays true to its own objectives while still attracting the benevolence of traditional academic institutions and peer reviewers. Our aim was to sketch out the situations that we have encountered and to share the lessons that we have learned in the course of facing these challenges, in the hope that other students and their supervisors can benefit from our experience.

We begin with a short introduction to the GoverNat research network and some background on our place within it, which we provide by noting our respective points of entry into the research network. Our varied backgrounds (biologist, ecologist, geographer, engineer turned social scientist) brought us to this shared research context from very different directions and that alone has already created a lot of creative confusion among us. This diversity of backgrounds, we think, was a challenge special to sustainability science and one that others setting sail into these waters were also likely to encounter. In the main part of this chapter we

discuss the challenges and opportunities that we have encountered. In addition to discussing the challenges of interdisciplinarity, we also talk, at times, about challenges associated with conducting intercultural research. We do this for two reasons. First, because it was part of our experience, since the research field for GoverNat covers all of Europe and each of us was conducting case study research in a country that was not our own. And second, because we understand cultural diversity to be a basic characteristic of the complex, international regions that are the subjects of environmental governance. At times it has been hard for us to tell if some troubles we have encountered were caused by the interdisciplinarity of our work or by doing research in another country, so we talk about both challenges as parts of the more general challenge of conducting interdisciplinary environmental science research.

At the close of this part we present a typology of some major challenges arising from interdisciplinary sustainability science work and, reflecting on our experiences, we make some suggestions about how they can be managed and even turned into opportunities.

5.2. Interdisciplinarity within the GoverNat project

GoverNat was a four year research and training project funded as a Marie Curie Research Training Network under the 6th Framework Program of the European Commission's Directorate General for Research. GoverNat focused on multi-level governance of natural resources, with the concrete aim to develop tools and processes for water and biodiversity governance in Europe. The project work was focused mainly on investigating progress and proceedings in the implementation of the European Union (EU) Water Framework Directive, Habitats and Birds Directives in various EU Member States. In the call for PhD applications, it was announced that the early stage researchers wanting to join the project should ideally have an interdisciplinary background in social sciences. The project aimed to achieve a mix of academic upbringings, attracting and accepting as PhD candidates people with degrees and backgrounds from social and / or natural sciences.

A brief overview of our own backgrounds and motivations illustrates the mix. Minna Santaoja (M.S.) likes to describe herself as an environmental social scientist, who was in her 'previous life' an environmental engineer. Raphael Treffny (R.T.) decided to specialize in Geography, wanting to learn more about the relationship between humans and the natural environment. Cordula Mertens (C.M.) studied Biology, focusing on Zoology and Plant Ecology; since the Biology courses alone were a bit too one-sided for her, she took several language courses and chose History of Science as an extra minor. And Catherine Jolibert (C.J.) has a background in

Cell Biology and Physiology and a Master's degree in Evolutionary Biology and Ecology. Following rather different paths to the GoverNat project, all four of us thought of ourselves as rather a good match with the project aims. We were excited of doing a PhD as a part of a project with common aims, unaware of the turbulent discussions ahead within the project regarding those aims. What followed was an initial disappointment upon realizing that being part of an interdisciplinary network seemed to make the PhD process even more demanding.

In the following we describe the challenges we faced in the beginning of the project, which encouraged our transformation from passive participants to owners of the process leaving us feeling empowered in the end.

5.3. Objectives, challenges and opportunities in the Project

Coordinated by the Helmholtz-Centre for Environmental Research (UFZ) in Leipzig, GoverNat was comprised of ten partner institutes throughout Europe and several affiliated praxis partners. Besides the lead scientists at the partner institutes there were nine early stage researchers (PhD students) and three post doctoral researchers (Post Docs) in the program. The nine early stage researchers were contributing work to the project at large but were also focused on their individual PhDs.

The overall objective of GoverNat was to develop new solutions for multi-level environmental governance challenges and to facilitate their use by decision makers in an enlarged EU. Specifically the project aimed to contribute toward the design of new and improved environmental governance. Since it was a research and training network, GoverNat aimed to achieve this overall objective both by carrying out research and by training the GoverNat fellows in how to design legitimate and effective procedures and practices for environmental governance participation and communication between policy makers, scientists and the general public. The topics that the fellows were investigating needed to fit into the overall GoverNat research plan and the work needed to serve the project’s overarching research objectives. Finally, the environmental governance systems in the various case study countries and in the EU as a whole have been studied not only individually but also in comparison with each other. Additionally to the many challenges that we were facing in our work that were just part and parcel of doing a PhD, we think there were several challenges that were directly related to the fact that we were working on sustainability science research

topics that concern relationships between social and ecological systems. In the remainder of this section, we discuss some of them in detail.

5.3.1. Working away from home: challenges in multicultural interdisciplinary environmental research

Marie Curie funding aims to support mobility of young researchers, which means that the GoverNat fellows had to move to another country. Doing research in a country other than one's own is becoming more and more common, especially in sustainability science. After all, the issues in sustainability science are often inherently international (e.g. pollution does not respect borders) and therefore the research needs to be conducted in a way that takes global and international issues into account.

In keeping with this international focus, we found cultural differences arising as obstacles to empirical research, so that we were not always free to choose comparisons on purely scientific grounds. We were also limited by what was possible: what languages we can speak; where we can gain access to the people and information needed to carry out the study, etc. Time concerns also pop up here; three years is a tight schedule for any PhD, but it is especially short in a multicultural, interdisciplinary setting. For example, GoverNat fellows who did not speak the language of their host country well enough to conduct research in that language have had to dedicate a lot of time to language training. While these examples from our experiences as GoverNat scholars were very specific to our situation, they highlight a more general set of social and physical challenges that come along with any interdisciplinary environmental and social science research work that sets out to compare and look at the relationships between different countries and cultures: taking cultural diversity into account is a practical as well as a conceptual matter.

As tricky as acquiring the data required for our multi-cultural and interdisciplinary GoverNat case studies was, interpreting it and generating results and conclusions from data covering multiple disciplines, often gathered within a foreign setting, posed even more significant challenges. Can we actually trust our data, or with the responsibility of interpreting them? Being an outsider to the country, its culture and the local setting may be an advantage: we may see things from a different perspective than the locals, which does allow for new and innovative ways of interpreting what is going on. But at the same time we felt a need to stay true to the context in which we collected the data and we were obliged to fit our findings into the bigger European environmental governance picture. This means that, alongside our basic

research data, the country's history, its particular institutional regimes and political culture must also be taken into consideration. How much time does a researcher need to devote to background study in order to be able to interpret cross country comparative interdisciplinary social-ecological research data correctly or at least intelligibly and within its context(s)? How long do we have to live in a country in order to gain a basic understanding about what is going on?

Due to the cross-border nature of environmental problems, international cooperation has been everyday reality to many environmental scientists for a while now. But as our example illustrates, it does not work by simply packing your bags and starting as usual in the new place. A due consideration of the new cultural context is necessary.

5.3.2. Finding a common framework: learning interdisciplinary communication

The original idea of the GoverNat project was to focus on governance processes, but many of the fellows felt that evaluating governance processes has no meaning unless we also look at the ecological outcomes of these processes. Here, the different ontologies behind the many different disciplinary perspectives that we brought to the project started to reveal themselves. The question of how ‘nature’ is conceptualized turned out to have a huge impact on the focus taken within each of our individual PhD projects and on our decisions about what methods would be necessary and adequate for obtaining the suitable empirical data.

Looking back, in confronting this question, we were faced with a fundamental environmental policy problem: trying to determine whether we are evaluating natural resource governance from a process point of view (e.g. assessing the quality of different types and instances of participation), or from an outcome point of view (e.g. assessing the effectiveness of protection measures developed in participative settings). This raised a first ontological question, i.e. ‘whether we can attribute ecological outcomes to governance processes?’, and we thought that this was usually impossible. A second methodological question was raised, i.e. ‘whether any ecological outcomes would be observable at such short time after the governance processes that were studied?’ In the end, we could not find clear grounds within the GoverNat project plan for choosing one or the other approach, so we chose based on our interests and abilities, often unwilling to choose and looking at both the processes and their outcomes. Looking back, it seems that the need to simplify such complexity is something that every student interested in interdisciplinary problems must face in order to make a manageable PhD.

The fellows with natural science background felt that they could make a considerable contribution on this issue and pushed the second proposition. People with backgrounds in social sciences felt that close study of the ecological outcomes of these processes would possibly fall outside the scope of the project and might require natural science research. However, this situation also revealed the confusion that can arise when people are working from different ontologies, since the fellows with natural scientific background were clear about the social scientific nature of the project and did not expect to conduct empirical natural scientific research but make use of the results from research done by other scientists. Being four fellows with varying degrees of natural science training, we view our role in the GoverNat project as one of bridging the social/natural science gap, interpreting natural scientific data and results for social science purposes. This is a point that required considerable effort to communicate and convince.

In order to ensure that comparable data was available for the project wide European level environmental governance analysis, the GoverNat research applies a common conceptual framework to all the individual research projects, through which all the case studies in the various EU member states were to be analysed. Once we overcame the initial confusion about whether or not natural science research would be conducted, each fellow set out to develop their own research approach and plan, with their own unique interdisciplinary take and their own ontology of the relationships between nature, policy, civil society and economy. However, even with this framework as a reference, there was still a lot of confusion about how all the individual projects would fit together within it, in order to produce the interdisciplinary and cross country comparative analysis results. Not everybody felt able to place their own work within the framework, and not everybody felt comfortable with the assumption that our research would judge the quality of participatory governance processes or with the aim of conducting policy experiments.

In short, we found that our diversity of ontological perspectives on the GoverNat topic was accompanied by a diversity of epistemological perspectives regarding how the topic could be best understood and a diversity of methodological perspectives regarding how the research into the topic should itself be carried out.

5.3.3. ‘Nature’ in social sciences

We raise this point here because we think our struggle with understanding the place of ‘nature’ in studies of environmental governance reflects a challenge that must be faced by any researchers concerned with interdisciplinary study of complex social-ecological systems.

While there seemed to be an agreement within the project regarding the importance of biophysical systems and of understanding natural processes, since this is the vital basis for all human activities, natural scientific knowledge about the resources to be managed was not viewed as necessary for doing the research. In our view this led to a degree of imbalance in the interdisciplinary training that was taking place within the project, with natural science trained fellows being expected to learn about social science but social science fellows not being expected to increase their natural scientific knowledge regarding the objects of natural resource governance. While the social science orientation of GoverNat was more or less clear from the beginning, this perceived imbalance in the ontology of the project seems to us to have somewhat undermined the interdisciplinarity potential of the project, with the interdisciplinary crew of GoverNat being somewhat split in two: between social and natural scientists. So we found that in our attempt to problematise the topic of how social and physical scientific contributions were combined within GoverNat research, we again bumped into the consequences of this diversity of ontologies, the diversity of conceptualisations of human-nature relationships, which seem to us to be a key part of the GoverNat and indeed of the sustainability science adventure. The fundamental question here seems to be a philosophical one: *whether there is a separate nature outside society, or vice versa, a separate society outside nature*. Mostly, we have adopted ecosocial or hybrid views, where the two can not be seen as separate, and this led us unavoidably to interdisciplinary research, where we were discovering to be fundamental theoretical as well as methodological problems that were still very far from being resolved.

The role of natural scientific knowledge within biodiversity governance was a primary point of interest for two of us: C.J. was looking at how European biodiversity research projects engage with stakeholders and was exploring what were the consequences of these engagements for biodiversity governance; M.S. was interested in the practices of the biodiversity knowledge networks and the role of amateur naturalists therein. In both contexts, special challenges associated with collecting the required data have arisen, both with respect to the specification of what data was required and regarding how to gain access to it. From our perspective, it seems that, in social scientific research of natural resource management, the natural scientific knowledge being referenced was often assumed to be complete and

correct. Viewed critically, it was dominant in relation to other types of knowledge, for example because it was seen to be crowding out non-science knowledge but also in relation to social science knowledge.

It seems to us that an informed and critical understanding of available knowledge about the objects of environmental governance, about both the social and the natural processes involved, was required, if one is to evaluate the quality of a given governance approach, since the governance tool needs to be appropriate for governing the objects that it targets (Farrell, 2007: 15). To our thinking, the 'local' in multi-level governance does not only include the people involved in local governance but also local nature. Therefore it would seem necessary to conceptualize nature here as also being an actor in the governance processes. In suggesting this, we were departing from mainstream disciplinary social sciences but we were not without companions. We found that the route opened up by e.g. Latour (2004, 2005) gave us a lot of options that were not available to us through more discipline specific social science approaches. Our decision to treat 'nature' as an actor was a reflection of the interdisciplinary ontology that we have chosen to adopt in our research, where human-nature relationships are understood as complex, intertwined and reciprocal relationships, and we proposed that this ontology was important for analysing the human/nature interactions that lie at the heart of environmental governance.

Overcoming the strict limits of disciplinary distinctions would seem to allow for recognizing that constant change is not only an inherent characteristic within nature and within human relationships but also within relationships between humans and their environments. For us, one way to capture this was to conceptualize nature as an actor within a set of complex human nature relationship processes. It seemed to us that understanding natural resource management challenges requires that we acknowledge and try to make sense of the blurry boundary between nature and human society, rather than avoiding it.

5.4. Interdisciplinary, transdisciplinary or out of discipline?

Within the GoverNat project, as in the wider sustainability science community, there seem to be a number of different interpretations of what interdisciplinarity actually means. For our purposes here, we suggested a working distinction between wide (between natural and social sciences) and narrow (within natural or within social sciences) interdisciplinarity. Such a separation allowed us to make clearer the original aim of GoverNat, which was to conduct a

form of narrow social science interdisciplinarity while drawing information input from natural sciences. Early confusion in the project highlighted an ambition, mainly stimulated by fellows with natural science backgrounds, towards wide interdisciplinarity. After the impossibility of fulfilling this ambition within GoverNat was accepted, the discussion has instead focused on reconciling different interpretations of how social science works with 'input from natural sciences', reflecting a narrow understanding of interdisciplinarity. Within the project there also seem to be differing levels of enthusiasm for embarking on interdisciplinary endeavours, and different views regarding what their aims should be. A guide to developing interdisciplinary research proposals distinguishes between two types of interdisciplinary research (Tait and Lyall, 2007), one aiming to further the expertise and competence of academic disciplines themselves, for example through developments in methodology which enable new issues to be addressed or new disciplines or sub-disciplines to be formed, and the other being problem focused and addressing issues of social, technical and/or policy relevance, with less emphasis on discipline-related academic outcomes (see also Aram, 2004). GoverNat, as a project, would seem to correspond to the latter, being designed to be policy-relevant research. For many of the fellows, this problem orientation was a source of motivation for our involvement in GoverNat, but we were still at a stage of our research careers where we needed to prove ourselves, and for that, discipline-related outcomes were also important to us. On a day- to-day basis, as we are preparing our PhD work, we are working within discipline-specific scholarly departments at universities and our research will eventually have to pass through a university review process. This raised a lot of uncertainties for us, because the criteria for evaluating problem-oriented and purely academic works are not always the same.

In science, two developments seem to be going on in parallel: research is becoming more and more specialized, but at the same time there are calls for interdisciplinarity and a holistic understanding. The need for highly specific knowledge regarding detailed technical problems is ever more pertinent and must still be drawn from disciplinary research (Farrell et al. 2007). This was a source of inherent insecurity that seems to accompany the carrying out of interdisciplinary PhD work. As GoverNat PhDs, we asked ourselves questions like: even though working in an interdisciplinary project, should I still do a disciplinary PhD? How do I go about it, then, if my background is interdisciplinary or in another field? Is it even possible to be interdisciplinary on a single researcher level? It would mean that one would need to be deeply familiar with several disciplines and then combine them. Should I become a specialist, or a generalist – 'Jack of all trades, master of none'?

The central challenge in interdisciplinary work to us seems to be that we needed to get out of our comfort zones and work on a turf that was new to us. For a PhD candidate it feels a bit like shopping in the big supermarket of social scientific theories and having bits and pieces from here and there. It is easy to get lost when everything seems to relate to everything, and one seems to have all the disciplines, theories and literature of social science available. How then to choose and proceed in one's work? It seems that even in interdisciplinary work you still need an academic home, and you are expected to demonstrate knowledge of the important thinkers in your field. In making our first crucial decisions about how to begin sorting through all the available recipes and ingredients, we find that in the end we have only our basic research questions and perhaps a hunch based on preliminary empirical work to guide us.

5.5. A typology of interdisciplinary challenges encountered

Farrell et al. (2007) suggest that in interdisciplinary projects some discipline with core knowledge and skills concerning the core research problem may become the dominant frame for the study because that discipline has a gate-keeper status, controlling access to key information that persons with a particular disciplinary background are able to interpret correctly. In a project where the multi-level governance of natural resources is the core focus, one might expect that the dominant disciplines are those that can be used to identify the potential irreversible losses of biological diversity (Heywood, 1995), and the depletion of natural resources, including water. At this basic level the expertise is coming from the natural sciences: from disciplines such as conservation biology, and strands of hydrology and ecology. But, for the assessment of the human impacts of biodiversity loss and resource depletion, and for interpreting their consequences for the human system, insights from economics might be considered core, and economics might be understood as a dominant discipline. For the study of the management of resources and design of policies for the abatement of biodiversity loss, political sciences should be considered the dominant discipline. In GoverNat the dominant disciplines were the social science disciplines of economics, political science and sociology, because the research focus was on the interlinkages between economic, political and social processes. However, there were additional roles for social science in this project. For example, Farrell et al. (2007) attribute to social science a special role in the design and implementation of interdisciplinary research projects, noting that as soon as we begin to formally consider how science should be related

to policy, the social scientist becomes at the same time the observer and the observed, a target of external as well as internal inquiry. Similarly, Aram (2004) talks about exogenous (created by the 'real' problems of the community) and endogenous (concerned with the production of new knowledge) interdisciplinary knowledge, and a similar distinction between internal and external orientations is also discussed sometimes in terms of Mode 2 science knowledge (Gibbons et al. 1994). In our thinking, the whole GoverNat project can be described as an experiment in post-normal science (Funtowicz and Ravetz, 1991) or a big, complex action research project (e.g. Hall, 1985), depending upon which set of frames one chooses to use to describe it.

In summing up the challenges we have so far encountered in this interdisciplinary project, we came up with the following typology (Table 8), in which we identify core challenges and opportunities associated with what we find to be some of the key attributes of interdisciplinary research.

Table 8: A typology of challenges and opportunities in interdisciplinary sustainability science work

Attribute	Challenges	Opportunities
Definition of inter-disciplinarity	Various definitions; no single definition available and, with the GoverNat project, no common understanding of what is meant by the term	Careful clarification of a single definition or agreement to work from multiple definitions can provide a good starting point for collaboration
Different ontologies	Incommensurable ontologies, where differences are so great that the researchers can not even understand each other lead to disagreements and confusion about research objectives	Discussion about the inevitability of ontological diversity can provide an opportunity to reflect on one's own assumptions and on their implications for one's research
Normativity	Choices made in the course of sustainability science research come with normative baggage regardless of whether or not the researcher is aware of this	Mature reflection on one's own normative positions and their implications for the work can lead to better quality research and reporting
Different epistemologies	In the GoverNat project, even though there is a lot of good will, we have regularly encountered an inability to communicate across the disciplines, which seem to be linked to fundamentally different ideas how to construe the truth about a research topic	Recognising the relationship between one's epistemology and one's observations opens up a whole new area for discussion, regarding the presumptions that we make and the ethical and moral implications of our propositions
Different methodologies	Often there was no off-the-shelf method available for conducting the kind of empirical interdisciplinary research work that we were doing in the GoverNat project	Triangulation, the use of multiple methods, and taking the opportunity to build one's own methods by drawing from various disciplines can increase the robustness of the work
Lack of a disciplinary home	We have often had difficulty justifying our interdisciplinary research approaches to our more discipline oriented peers	Not fitting into any one academic box brings a freedom to explore and to come up with something genuinely new

The first challenge would seem to be the definition of *interdisciplinarity*. Is a project interdisciplinary when it just throws together people with different backgrounds and different interests, or should the interdisciplinarity be something more worked-through? Aram (2004), for example, distinguishes between instrumental, conceptual and epistemological interdisciplinarity, and transdisciplinarity, based on the depth of integration, but there are a wide variety of overlapping and sometimes contradicting definitions in use at the moment. What is clear is that the 'correct' definition, if there is indeed one, is not clear. And since PhD students are not in a position to decide which definition, if any, should eventually take the proverbial throne, we suggest that a careful clarification of the definition or definitions that one chooses to use, including a clear explanation for why one has chosen them, will need to be one of the first jobs in any interdisciplinary sustainability science.

Second, it seems to us that all interdisciplinary researchers are working more or less in a sort of no-man's land, between disciplines, where a variety of different *ontologies* are all more or less valid. Clear and valid assumptions regarding how the world behind the research topic works, regarding the nature of reality, are vitally important for conducting good research and the ontological ambiguity that seems to accompany interdisciplinary research is a challenge that needs to be explicitly addressed. For example, over time, we have discovered that there was a certain social science ontology behind the GoverNat framework, which was not made explicit and was not clear to many of the fellows at the start of the project. We have since learned that debates about ontology have been central to the so called science wars (Latour, 1999) and that our difficulties with the difference between social and natural science ideas of how the world works were not so unique. From this perspective it is no wonder that we, as PhD candidates, felt slightly lost with the task of defining our own interdisciplinary research ontologies. The question of finding a shared ontology is solved perhaps more easily in narrow interdisciplinary projects, but as we have seen in the case of our GoverNat project, in research that bridges the study of the natural and social worlds, the most fundamental of all ontological questions remains wide open to debate: *to what extent, if at all, and in what respect are we, humans, part of nature?* Furthermore, it seems that the differences in ontology may not in the end be only between natural and social scientists, but also between different disciplines, within disciplines, between different schools of though, and between different individuals' perceptions of the world. That is to say they may come all the way down to matters of individual style. We believe one way forward here could be to acknowledge the inevitable

ontological diversity of interdisciplinary research and to try to appreciate the existence of a range of ontologies within the project. In our case, that means that we had to accept that a single GoverNat ontology may not emerge during the project.

The challenge of coping with all these different ontologies brings us to the third attribute of interdisciplinarity included in our typology: *normativity*. Our appreciation for this attribute of interdisciplinary sustainability science research is related to the reflective pressure that our debates over ontology have brought upon us, making it necessary to ask ourselves questions in a more penetrating way. Any PhD student needs to ask themselves, why do I want to do a PhD? Why am I interested in this topic? Why did I set out on this quest? What do I want to achieve? But for a sustainability science PhD student these questions take on an additional weight, in part because they are responsible for helping to justify one's ontological, epistemological and eventually also one's methodological choices. Even when working within a discipline, one still needs to have a clear ontology upon which to base a research design, but one is rarely required to give a clear argument defending the presumptions and giving justifications to support its appropriateness. However, in research contexts like the GoverNat project, it has been our experience that we were very often expected to justify our ontologies, and we have found that these justifications were fundamentally related to our choices regarding what question we were trying to answer with the research: that is to say, with our own normative agendas.

There are always values behind choices made in research, be they more or less explicit. However, our experience suggests that, in interdisciplinary research generally, and especially when dealing with environmental governance problems, where the research aims to impact on policy, there is a great deal to be gained from being explicit about the normative choices that one makes. A researcher may not always be aware of the value choices s/he is making, since they might come pre-packed within disciplinary approaches or theories. But when debates about ontology take centre stage, these presumptions and prejudgements can be evaluated, adjusted or accepted, on the grounds that they serve the purpose of the research. This is not the same as being free from normativity. We view it rather as a mature way of handling the inevitability of normativity in sustainability science.

Closely linked to the challenges of different ontologies and normativity are the challenges of different *epistemologies*. With epistemology we understand here the theory regarding how one can go about knowing a subject of observation. Do we assume that there is only one truth

or several valid ways of knowing what is true, and how do we justify our methodological choices for revealing what ever kind of truth it is that we presume exists? The decision for using interviews in gathering data for the research may include an epistemological presumption that reliable answers to the research questions can be found by analysing oral testimonies of those involved. However, interview methods also presume that data content is partly controlled by the subjects (people being interviewed), so the epistemological presumption is that accuracy of the data is not only down to good data collection procedures but also to the good will of those being interviewed, and the interpretation of the researcher. Natural and social scientists often have different expectations regarding how to reveal 'what is really going on' and indeed regarding the extent to which that is possible.

Different *methodologies* result from the different ontologies and epistemologies. One needs to choose, for example, between inductive and deductive research designs and to decide on the roles that theory and method will play in the work. It seems to us that methodology in interdisciplinary work is not something off-the-shelf but needs to be carefully selected and also custom designed, according to the circumstances of each individual research setting and the investigative aims of the researcher(s). While this means that a lot of time and effort may need to be invested in the methods planning for an interdisciplinary sustainability science research project, combining various research methodologies offers students the possibility to explore the issue from several different perspectives.

In our experience, all these challenges contribute toward making the PhD candidate, at least the ones writing this chapter, feel somewhat insecure and lost, with a feeling that they lack a disciplinary home. We find ourselves needing to work harder to legitimate our choices and we were regularly faced with the need to balance between proving ourselves to our peers and teachers at the university and doing the issue-driven research on complex environmental governance phenomena, which is the ultimate aim of our sustainability science PhDs.

5.6. Conclusion

Looking back over our typology, among the various lessons we have learned, a golden piece of advice that we were offered along the way stands out: make sure you have your research question very clear. Of course, this is important for any PhD student, but based on our experience, we believe that for an interdisciplinary sustainability science PhD this is a matter

of survival. It is not possible to know all the theories relating to any one discipline, but when one is doing an interdisciplinary PhD, the problem is compounded, since one is faced with a feeling that s/he should read all the available information from all the relevant disciplines before proceeding with the empirical work. One has to somehow be confident that for all its breadth, the research can still provide something valuable to science. E.O. Wilson's dream of a reconciliation (Wilson, 1998) – with an all-encompassing explanation of the world and a unity of knowledge – has to be quickly discarded as an aim of a PhD, even if it is still kept in mind as an ideal.

Two main themes seem to emerge in our typology, and they are very much interrelated. One has to do with the quality of interdisciplinary scientific work, and the other is about dominance: what ontological and epistemological assumptions are taken as a basis of a research project proposal. What we think can be drawn out of the typology presented above is that interdisciplinarity should not be used as a catchword but it is necessary to be clear about where everybody is standing in an interdisciplinary research project. We find it important to keep an open mind towards different ontologies and to be tolerant towards new ways of seeing things, keeping in mind that with complex problems there is no one right way of conceptualising them. An interdisciplinary PhD student should keep wary of different epistemologies and always remember to ask oneself how and why any data has been created to see the underlying assumptions. Regarding methodology, it would seem wise not to put all the eggs in one basket but to examine the object of study with different lenses, using various methods. This is one of the upsides of lacking a disciplinary home: no-one can tell you exactly how you should carry out your dissertation work.

Interdisciplinarity gives a lot of freedom to be creative and to be true to one's own motivations, or to put it in more catchy words: it gives you the chance to follow your guts.

Keys to happiness

Happily, some clarity has now started to appear for us amidst the confusion, and we have begun to realize that we were not the only ones who were confused about the challenges we have discussed above. Debates on scientific methodology have been going on for as long as there has been scientific method, and there seems to be no one definition of what constitutes a discipline. Instead, there are a number of ways to approach interdisciplinary work (e.g. Aram 2004). Lyall et al. (2008) suggest that perhaps 'disciplines have survived for so long in the

academic world in part because they serve the very useful function of constraining what the researcher has to think about'.

For the students and supervisors who might be reading this chapter, we would like to leave you with one thought that we bring with us, as we get back to the basic practical work of turning our research plans into PhDs – when it all seems to be too much, keep this in mind: your research question is your best friend. It does not have to be written in stone from the beginning. Part of its beauty and its value to you is that it is allowed to grow and change. Its imperfections are part of what make it lovable. If you're stuck, and you don't know where to turn or what to do next, your research question will be there for you when everyone else seem to have left you on your own to navigate across the troubled waters of your interdisciplinary, intercultural dissertation voyage.

6. Conclusions

This study progressed as I wrote and submitted articles and book chapters on different aspects of biodiversity governance. I study the social, political and scientific dimensions of biodiversity governance, and ways in which they might be improved. I also discuss the concept of interdisciplinarity as an inherent dimension of biodiversity governance, where I propose to create opportunities out of some of the challenges found in interdisciplinary sustainability science. In the following conclusions, I outline the achievements of the thesis, but also possible ways to better integrate biodiversity and sustainability in to policy-making for biodiversity governance.

6.1. Achievements of the thesis

6.1.1. Extension of the Human-scale Development model to non-humans

To think about the ecological crisis in terms of resource distribution is to persist in a conception of the natural world that radically separates human beings from their environment. There is humankind on one side, in the present and the future, who are rational beings and moral agents, and on the other, is the natural world, a provider of natural resources and environmental services. Traditionally, environmental ethics called this moral stance anthropocentric, in that it places man at the heart of moral deliberation, making him the only subject of direct moral consideration. In other words, only humans have intrinsic value. Everything else can be considered to have indirect value, by contributing to the advancement of human values by providing for people's needs and aspirations.

We now need to rethink the status and moral character of humankind in the light of our current understanding of the world and how it is governed. This is what I propose in the first chapter; to consider the 'collective' made up of humans and non-humans who are capable of being treated as citizens (Latour, 2004). Based on the needs[45] and satisfiers used in the Human-scale Development (HsD) model proposed by Max-Neef (Max-Neef et al, 1989), I propose to include otters (*Lutra lutra*) as part of the collective in the decision-making process in a particular case in Portugal. I show that the matrix of human needs can be filled in with non-human satisfiers. Thus, otters use vocal communication as satisfiers to warn of danger or in reproduction or to assist in learning. In much the same way as human communication tools,

[45] for *subsistence, protection, affection, understanding, participation, idleness, creation, identity and freedom*

otters use ‘vocalizations’ to meet their needs for Subsistence, Protection, Affection, Understanding, Participation and Identity. Other needs for Affection, Idleness, Creation or Freedom, usually restricted to humans, may also be found in otters. Thus, the need for Affection is met through contact with other otters. The need for Idleness is met with games and cleaning time. The need for Freedom is met when otters are free to eat what they want, choose their territory and its size.

In this chapter, I show that otters have needs and use satisfiers to meet these needs. They also have satisfiers that diverge from those of other stakeholders (i.e. otters eat fishes produced in fish-farms). These divergences feed the conflict and create poverties (i.e. unsatisfied needs) among other stakeholders. By integrating otters’ needs into the conflict resolution process, we can share the idiosyncratic knowledge with key actors, thereby reducing poverties, but also reducing divergences and interdependencies of satisfiers between stakeholders. The matrix of needs allows us to make a comparative analysis of stakeholders’ strategies, organizational structures, values, social practices, norms and attitudes (i.e. satisfiers). It is an efficient tool to assess how satisfiers can diverge, which is a key source of conflict. Changing how otters’ satisfiers diverge from those of fish-farmers opens the way to a resolution of the conflict between fish-farmers and managers. We then conclude that a conflict between humans is best understood by integrating non-humans, and that solutions that incorporate non-humans provide a better way to resolving conflicts between humans, and can thus improve environmental governance.

Despite many references to the concepts of human needs and satisfiers in the literature, the needs approach has never been adapted to cover environmental conflict in which non-humans are key actors. By widening the matrix to include non-humans, we shift from a more anthropocentric human needs-based approach to a more global and ecosystemic one, thus creating not only a better understanding of conflicts between humans but also easing the task of resolving them. My approach, however, is difficult to apply to elements of abiotic nature. It is easier to empathise with an otter than as Aldo Leopold wrote ‘to think like a mountain’ (Leopold, 1949).

6.1.2. Contributions to sustainability planning

While there are various interpretations of the concept of governance, they all focus on systems of governing as new forms of governmentality with a positive resolution of environmental problems (Paterson et al., 2003), in which non-state actors are significant

participants. We are beginning to see challenges to the influence of domestic politics on international relations and vice versa by ‘knowledge-based’ or ‘constructivist’ approaches (Bulkeley, 2005), which view international regimes as a means through which cognitive and normative aspects of environmental issues are constructed and learnt, in turn shaping the ways in which states perceive their interests (Hasenclever et al., 1997; Newell, 2000; Paterson, 1996; Payne, 2001). For Dewey (1927), the public is concerned by the consequences of collective behaviour on individuals, and policy stems from public opinion. The roles played by non-state actors in the process of regime formation and policy implementation are fundamental, and lie in the extent to which they shape, facilitate and change the behaviour of nation-states (Auer, 2000).

In the second chapter, I highlight perspectives that acknowledge the redistribution of state functions towards non-state actors, but also the growing view that the governance of environmental issues might emanate from the bottom up. I focused on two mechanisms of governance: the participation of non-state actors and scenario-building for environmental planning. I used the Human-scale Development model (Max-Neef et al., 1989), based on a taxonomy of nine fundamental human needs, and on satisfiers. We asked eight key local stakeholders – a manager of natural areas, a representative of the tourism sector, a manager in charge of economic development, a farmer, a policy-maker, a forester, a sustainable development promoter, and a private resident – to imagine how they would like to meet their needs – i.e. their satisfiers – in a sustainable future. After several rounds of discussion, mixing individual expression and group discussions, a needs-based planning scenario in support of sustainability was built with local citizens in a case study in Belgium. Eco-regulatory practices (Benton, 2008) such as ‘playing sports in nature,’ ‘developing rural tourism’ emerged, but also less divergent satisfiers. We called these synergic satisfiers as they meet several needs at the same time, but also sustainable satisfiers as they do not impede the satisfaction of others’ needs.

The expression and sharing of individual satisfiers by and between individuals, provided personal information that helps us to understand local values and practices. From there, the comparison of collective satisfiers highlighted actual agreements and consensus (sustainable satisfiers), but also tensions and potential conflicts between stakeholders (unsustainable satisfiers). The participation of key local actors in the construction of the needs-based scenario enabled us to determine shared satisfiers that are sustainable or synergic, and that benefit the majority of actors, thereby fostering more environmentally-friendly governance.

For the first time we used the needs-based approach to provide a 'polaroid of the present, but also of the future', based on heterogeneous factors, including demography, economic, social, cultural, environmental, and political variables. By co-constructing a needs-based planning scenario, we proposed to strengthen community life, and to encourage bottom-to-top collective decision-making, thereby facilitating the adoption of more sustainable planning policies.

6.1.3. Options to improve impact of research and impact on research

The assessment of biological diversity and the identification of threats to this diversity is the work of the international scientific community. The scientific community has developed a common language around biodiversity that transcends cultural and societal differences. Interdependance between actors of society in face of today's challenges leads to common societal responses to problems of unsustainability, and requires open knowledge systems (Cornell et al., 2012). The need for exchange of knowledge between research and non-research actors in order to enhance the quality, relevance and legitimacy of the research and its impact is increasing (Diedrich et al., 2011; Oreskes, 2004). But knowledge utilization is faced with major methodological problems. While the uptake of scientific research by 'research users' has been modeled by several scholars[46], there is not yet an integrated conceptual model used by experts in the field of knowledge utilization (Landry et al., 2003). A large-scale quantitative study on knowledge utilization in Canadian and provincial administrations has shown that the uptake of university research depends on users' acquisition efforts, scholars' adaptation to research products, the closeness of the links between scholars and users, and on users' organizational factors (Landry et al., 2003). The evidence from different disciplinary domains indicates that the interaction between science and society is not a simple matter of linear knowledge transfer from research to policy to practice, but rather a multi-faceted, multi-directional process.

The third chapter focuses on the relation between 'producers' and 'users' of knowledge. We address qualitative aspects of a broader stakeholder engagement in European biodiversity research projects, i.e. who are the stakeholders involved, how and when do scientists use stakeholders' input in the research process and what are the impacts of stakeholders' contributions? We define stakeholder engagement as an active involvement where these actors have provided input (financial, material, opinions, knowledge or sharing of facilities,

[46] Huberman, 1987; Webber, 1987; Lester, 1993; Landry et al., 2001

exchange of personnel) at one or several levels of the research process: e.g. research proposal/design, planning, coordination, execution, dissemination, and/or follow-up stages. Data indicates that a stakeholder may play several roles in the same project, e.g. a 'producer' and a 'user' of knowledge. Thus, we propose a clear and practical classification of nine categories of stakeholders, according to their roles in society rather than their roles in the research process. We also show that the type of communication between science and stakeholders did not affect the process of co-producing knowledge: the main factor appears to be the existence of any kind of 'real' communication at all. The study highlights that 'productive' stakeholder engagement was more frequent in certain stages of the research process, like prediction/modelling, data collection and networking. In addition, the best results were obtained when key stakeholders had a specific interest, experience, credibility or legitimacy. Data also indicates that when fruitful interactions between science and society occur throughout the research process – rather than just at the final stage – it often results in the foundation of innovative research programmes, transdisciplinary networks, and effective policy proposals.

In an innovative way, the research focuses not only on the 'user' side of the equation – i.e. how and when policy makers and practitioners may or may not use research outcomes – but also on the 'producer' side: how and when do scientists use stakeholders' input in their research, and what barriers and enablers do they experience? Based on empirical data, this is the first study to show how stakeholder engagement in research can offer real practical benefits, under what conditions and to whom.

6.1.4. The challenges of interdisciplinarity

Biodiversity governance requires interdisciplinarity, but interdisciplinarity fits poorly in the traditional models of training and research, often characterized by a strong disciplinary segregation, and less valued than publication in disciplinary journals (Daily & Ehrlich, 1999). On one hand, there is a certain disdain within the disciplines, which sometimes see interdisciplinarity as a popularization of science, making discussion of the issues or the results of interdisciplinary research accessible to non-specialists. But on the other, we need a more integrated and interdisciplinary understanding of the issues related to global change (Cornell et al., 2012). The youth of this new mode of scientific investigation leads to tensions between protagonists of the different academic disciplines. These tensions should however be seen as

challenges that can be turned into opportunities, as a new set of rules that can help us move closer to creating a sustainable world.

In the last chapter of this dissertation, I share the challenges and opportunities that arise when nine PhD students set out to write nine doctoral dissertations within an interdisciplinary research project, with a specific focus on the area of science for sustainable development. I begin with a brief overview of the GoverNat research project, on which we were all working as PhD students, and discuss some of the basic challenges of conducting interdisciplinary and intercultural research for sustainable development. I then discuss how the process of developing a common conceptual framework for the project evolved, in an effort to establish a platform for interdisciplinary communication, revealing not only points of common understanding but also points of profound misunderstanding between the social and physical scientists in the project group. The causes and consequences of these misunderstandings are fundamentally related to basic ontological and epistemological research questions regarding how nature´s role is conceptualised in social scientific analysis of natural resource management. I suggest that the failure to formally consider the role of natural processes within such analysis is an oversight that leaves out important data about the policy object and propose that considering nature as an actor that influences both the content and progression of social interactions may be a way to correct it. Finally, based on our experiences within GoverNat and our reflections, I sketch out a typology of major challenges that arise when doing interdisciplinary sustainability science research and I propose some strategies for meeting them. To conclude, I summarise what we learned and leave our readers with a few final tips gleaned from the research process, the most important of which is: in the troubled waters of interdisciplinary dissertation work your research question is your best friend – keep it close to you and treat it well.

This last part explores and illustrates what nine PhD students have learned about conducting policy-relevant research in a challenging but exciting interdisciplinary context. The aim is to offer some advice to other students and academics who wish to or have already embarked upon this path. Our experience suggests that a more deliberative process is required when dealing with the plurality of perspectives in interdisciplinary research. But time and patience are also needed to enable interdisciplinary communication.

6.2. Towards an integrated approach to biodiversity and sustainability

6.2.1. From biodiversity protection to conservation

In 1948, the International Union for Protection of Nature (IUPN) was founded. At this occasion, the Secretary General of the organization, Jean-Paul Harroy, said in the Preamble to the Constitution that: 'the time is past when conservationists spoke only on behalf of morality and aesthetics. […] these two human values among the purest and highest, however, have a power of determining his behavior unquestionably low. Now the time has come to rely […] on a set of anthropocentric arguments, so convincing to the masses' (Harroy, 1949 in Blandin, 2005: 13).

He referred explicitly to the need for pragmatism in arguments for sustainability in order to convince the opponents of conservation. The call for sustainability became a normative issue in an effort to promote conservation. Because the moral and aesthetic arguments are not enough, we must speak the language of the opponents. Evoking the risks posed by the overuse of natural resources for human welfare and economic growth therefore becomes a good strategy to convince the public and policymakers of the merits of conservation (Maris, 2006).

In 1956, at its fifth general assembly, the IUPN change its name to the International Union for Conservation of Nature and Natural Resources (IUCN), also becoming the world's largest professional conservation network. The name change is indicative of a shift in the world of conservation, which realizes that the preservation of nature can not and must not be at the expense of human well-being.

6.2.2. From conservation to sustainable development

The term 'sustainable development' was explicitly proposed in 1980 with the publication of the World Conservation Strategy, subtitled 'The conservation of living resources in the service of sustainable development' and published jointly by IUCN, the United Nations Environment Programme (UNEP) and the World Wildlife Foundation (WWF). We read in the preamble to the text that the goal of conservation is 'the maintenance of the earth's capacity to promote both sustainable development of mankind and sustainability of all life'. It is only in the famous Brundtland report of 1987 that the term 'sustainable development' escapes from the conservation community and enters the wider spheres of politics and civil society. The United Nations World Commission on Environment and Development, presided by Gro Harlem Brundtland, defined sustainable development as 'a development that meets the needs

of the present without compromising the ability of future generations to meet their own needs' (UN, 1987).

Sustainable development is then a normative principle that aims to regulate the distribution of goods between individuals and between generations. But the normative status of this principle has evolved over time. First applied for strategic reasons, it has gradually become an independent argument in favor of conservation. Thus, this principle was used as the basis in the United Nations Conference on Environment and Development in 1992, also called the Earth Summit, in Rio de Janeiro. This conference saw the signing of the Convention on Biological Diversity (CBD), which aims to protect biodiversity; and Agenda 21, a global action plan which aims to integrate development issues and environmental protection. This Agenda is described as 'the birth of a new global partnership for sustainable development' (UN, 1992, Chap.1, Art.1).

The Johannesburg Summit in 2002 was called the World Summit on Sustainable Development. In the Johannesburg Declaration, the protection of the environment had become the third pillar of sustainable development, alongside economic and social development.

6.2.3. Failures of sustainable development

At the dawn of the twenty-first century, there is a change in how the international community views its obligations to the environmental crisis. Economic and social development has become the driver for environmental protection, which is now valued in relation to the benefits it can give to humans (Maris, 2006). This slow, global shift from an unambiguous respect for biodiversity towards the promotion of human interests, present and future, raises issues related to the current effects of the environmental crisis – damage to human and non-human health, human and environmental conflicts, etc – but remains blind to their causes, which include human population growth and the increasing use of finite resources.

The failure of sustainable development is partly due to the fact that the causes and consequences of the environmental crisis are complex. There is a confusion about the causes and consequences of the environmental crisis (e.g. increasing consumption is a consequence of human population growth, but a cause of carbon emissions and habitat destruction) which reflects the complexity of connections inside and between systems, and frightens decision-making politicians who are wary of what are often unknown repercussions. The solution must not only be found in the 'resolution of scientific complexity', but also in the courage of

policymakers to openly declare their environmental values and to implement policy that will benefit present and future generations, and also other species. Sustainable development has also failed because although it is widely sought after in principle, it is usually only partially achieved and many human activities remain unsustainable, leading to poverties, i.e. unsatisfied needs (Max-Neef et al., 1989) of both humans and non-humans. Thus, people are brought up with the idea that the world has an unlimited supply of resources to feed the never-ending growth of the consumer society. But the world is not a fixed entity whose composition can be determined, but rather a dynamic body in constant evolution.

The concept of sustainable development, which arises in the context of biodiversity conservation, has gradually swallowed up all the moral issues that the environmental crisis raises. Thus, concern about biodiversity protection has gradually been annexed to human desire to maintain ecological services and genetic resources. And the anthropocentric posture in which man can consider the rest of life as a resource for his disposal is reinforced. The Economics of Ecosystems and Biodiversity (TEEB, 2010) study, hosted by UNEP, follows this trend. TEEB aims to increase the importance of biodiversity by giving monetary values on environmental services.

6.2.4. Toward an integrated approach

Finally, the principle of sustainable development is not specific to the biodiversity crisis and environmental concerns. The second and third pillars of the CBD, which include more justice between present and future generations (CBD, 1992), are independent concepts of the biodiversity crisis. There are the common-sense principles of community life that are included in the constitutions of most nations.

Switching from a concept of sustainable development that has lost touch with its original purpose, towards an integrated approach where biodiversity and sustainability are central, requires a re-focusing on the conservation of biological diversity (first pillar of the CBD). To improve biodiversity governance, we have to include it in a holistic view of human and non-human needs, recognizing the intrinsic value of the living world (chapter 1); strengthen community life present and future, encouraging bottom-to-top collective decision-making (chapter 2); involve and share experiences of key stakeholders, creating local networks for the co-construction of common knowledge (chapter 3); and enable interdisciplinary communication and networks that require time and patience (chapter 4).

This thesis offers arguments and tools to justify the protection of biodiversity in its social, political and scientific dimensions, and therefore also in an interdisciplinary context. But it also feeds the debate on sustainable public policy-making. From now on, we need to support an integrative approach to governance in which the public are involved based on fundamental needs. This would enable a permanent and dynamic reflection on future environmental policy proposals.

7. References

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8. Annex:

Annex 1: List of the 38 EU-funded biodiversity research projects from the 6th FP

Project Acronym	EU Tool[1]	Project title	Web site
ALARM	IP	Assessing Large Scale Risks for Biodiversity with Tested Methods	http://www.alarmproject.net/alarm/
ALTER-Net	NoE	A Long-Term biodiversity, Ecosystem and awareness Research network	http://www.alter-net.info/
BASIN	SSA	Basin-scale Analysis, Synthesis, and Integration	http://www.euro-basin.eu/ http://na-basin.org/
BioScore	STRP	Biodiversity impact assessment using species sensitivity scores	http://www.bioscore.eu/
BioStrat	SSA	Developing the EU Biodiversity Research Strategy	http://www.biostrat.org/
COBO	STRP	Integrating new technologies for the study of benthic ecosystem response to human activity: towards a Coastal Ocean Benthic Observatory	http://www.cobo.org.uk/overview.htm
COCONUT	STRP	Understanding effects of land use changes on ecosystems to halt loss of biodiversity due to habitat destruction, fragmentation and degradation	http://www.coconut-project.net/
DAISIE	STRP	Delivering Alien Invasive Species Inventories for Europe	http://www.europe-aliens.org/
ECOCHANGE	IP	Challenges in assessing and forecasting biodiversity and ecosystem changes in Europe	http://www.ecochange-project.eu/
ECODIS	STRP	Dynamic Sensing of Chemical Pollution Disasters and Predictive Modelling of Their Spread and Ecological Impact	http://www.fenk.wau.nl/ecodis/
EDIT	NoE	European Distributed Institute of Taxonomy	http://www.e-taxonomy.eu/
ELME	STRP	European Lifestyles and Marine Ecosystems	http://www.elme-eu.org/
EPRECOT	SSA	Effects of precipitation change on terrestrial ecosystems – a workshop and networking activity.	http://www.climaite.dk/eprecot/eprecot.html
ESTTAL	STRP	Expressed Sequence Tag (EST) Analysis of Toxic Algae	http://genome.imb-jena.de/ESTTAL/cgi-bin/Index.pl
EuMon	STRP	EU-wide monitoring methods and systems of surveillance for species and habitats of Community interest	http://eumon.ckff.si/
EUR-OCEANS	NoE	European network of excellence for ocean ecosystems analysis	http://www.eur-oceans.eu/
Euro-limpacs	IP	Integrated project to evaluate impacts of global change on European freshwater ecosystems	http://www.refresh.ucl.ac.uk/
EVOLTREE	NoE	Evolution of trees as drivers of terrestrial biodiversity	http://www.evoltree.org/ http://www.efi.int/portal/
EXOCET/D	STRP	EXtreme ecosystem studies in the deep OCEan: Technological Developments	http://www.ifremer.fr/exocetd/
FACEIT	STRP	Fast Advanced Cellular and Ecosystems Information Technologies	http://www.unil.ch/face-it
FISH & CHIPS	STRP	Towards DNA chip technology as a standard analytical tool for the identification of marine organisms in biodiversity and ecosystem science	http://www.fish-and-chips.uni-bremen.de/PostNuke/html/
GEM-CON-BIO	STRP	Governance and ecosystems management for the conservation of biodiversity	http://www.gemconbio.eu/
GLOCHAMORE	SSA	Global Change in Mountain Regions	http://mri.scnatweb.ch/projects/glochamore/
HABIT	STRP	Harmful Algal Bloom species in Thin Layers	http://www.geohab.info/index.php?option=com_content&view=article&id=95:projects&catid=49&Itemid=143
HERMES	IP	Hotspot Ecosystem Research on the Margins of European Seas	http://www.eu-hermes.net/
INTRABIODIV	STRP	Tracking surrogates for intraspecific biodiversity: towards efficient selection strategies for the conservation of natural genetic resources using comparative mapping and modelling approaches	http://intrabiodiv.vitamib.com/
MACIS	STRP	Minimisation of and Adaptation to Climate change: Impacts on biodiverSity	http://www.macis-project.net/
MarBEF	NoE	Marine Biodiversity and Ecosystem Functioning	http://www.marbef.org/index.php
Marine Genomics Europe	NoE	Implementation of high-throughput genomic approaches to investigate the functionning of marine ecosystems and the biology of marine organisms	http://www.ist-world.org/ProjectDetails.aspx?ProjectId=33adb3bab95c4b9684b4dc316bbab57b
MODELKEY	IP	Models for assessing and forecasting the impact of environmental key pollutants on marine and freshwater ecosystems and biodiversity	http://www.modelkey.org/
PROBIOPRISE	SSA	Creating a European Platform for SMEs and other stakeholders to develop a research programme for pro-biodiversity business	http://www.efmd.org/index.php?option=com_content&view=article&id=101&Itemid=661
RIOS	SSA	Reducing the impact of oil spills	http://www.nordeconsult.com/RIOS/
RUBICODE	CA	Rationalising biodiversity conservation in dynamic ecosystems	http://www.rubicode.net/rubicode/index.html
SEED	STRP	Life history transformations among HAB species, and the environmental and physiological factors that regulate them	http://www.icm.csic.es/bio/projects/seed/
SESAME	IP	Southern European Seas: Assessing and Modelling Ecosystem Changes	http://www.sesame-ip.eu/
SHARING	SSA	International Conference on "Integrative Approaches Towards Sustainability"	http://www.lu.lv/Sharing
SoBio	CA	Mobilising the European social research potential in support of biodiversity and ecosystem management	http://www.ist-world.net/ProjectDetails.aspx?ProjectId=134921ac23414159ab277da43c84e418
SoilCritZone	SSA	Soil sustainability in Europe as deduced from investigation of the Critical Zone	http://sustainability.gly.bris.ac.uk/soilcritzone/

[1]Legend: Integrated Projects (IP), Specific Targeted Research Projects (STREPs), Networks of Excellence (NoE), Coordination Actions (CA), and Specific Support Actions (SSA)

9. Appendix: Statements of co-author's consent

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II. As a **DOCTOR COAUTHOR,** I am informed that Mr/Mrs **Jolibert Catherine** .....
will apply for authorization to the Doctoral Committee of the Universitat Autònoma de Barcelona for presenting his/her doctoral thesis as a compendium of works

TES37

And, for this reason

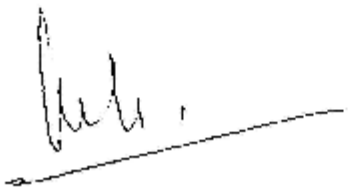
I STATE

That accept the use of the following works:

Should We Care About the Needs of Non-humans? Needs Assessment: A Tool for Environmental Conflict Resolution and Sustainable Organization of Living Beings.
Environmental Policy and Governance 21, 259–269 (2011)

in his/her doctoral thesis at the Universitat Autònoma de Barcelona, in the form of compendium of works.

Signed



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And, for this reason

I STATE

That accept the use of the following works:

TES37

Jolibert, C., Paavola, J., Rauschmayer, F. & Dendoncker, N. (submitted in 2011) Addressing needs in the search for sustainable development - A proposal for needs-based scenario building, Environmental Values.

Jolibert, C., Max-Neef, M., Rauschmayer, F., Paavola, J., 2011. Should we care about the needs of nonhumans? Needs assessment: a tool for environmental conflict resolution and sustainable organization of living beings. Environmental Policy and Governance **21**, 259-269, doi: 10.1002/eet.578.

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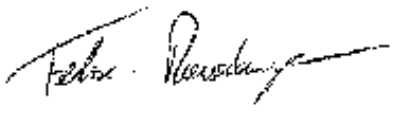

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That accept the use of the following works:

Should We Care About the Needs of Non-humans? Needs Assessment: A Tool for Environmental Conflict Resolution and Sustainable Organization of Living Beings.
Environmental Policy and Governance 21, 259–269 (2011)

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Paper submitted for publication to the Journal of Environmental Values the 11/10/2011

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I STATE

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Looking for a place to anchor. Confusing thoughts along an interdisciplinary dissertation journey. Santaoja Minna, Treffny Raphael, Mertens Cordula and Jolibert Catherine. *Teoksessa: Farrell, Katharine N., van den Hove, Sybille and Luzzati, Tommaso (2012; forthcoming). Beyond reductionism: interdisciplinary research in Ecological Economics.*

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will apply for authorization to the Doctoral Committee of the Universitat Autònoma de Barcelona for presenting his/her doctoral thesis as compendium of works, and I decline to use these works as a part of another doctoral thesis

II. As a **DOCTOR COAUTHOR**, I am informed that Mr/Mrs
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And, for this reason

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That accept the use of the following works:

Looking for a place to anchor. Confusing thoughts along an interdisciplinary dissertation journey. Santaoja Minna, Treffny Raphael, Mertens Cordula and Jolibert Catherine. *Teoksessa: Farrell, Katharine N., van den Hove, Sybille and Luzzati, Tommaso (2012: forthcoming). Beyond reductionism: interdisciplinary research in Ecological Economics.*

(please, list all the works where you appear as a coauthor)
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Signed Tampere 27.12.2011

MINNA SANTAOJA

Mr. Delegat del Rectora per al Doctorat

Bellaterra (Cerdanyola del Vallès),.....of ..... of 20...

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Signed Budapest, May 3, 2012
Cordula Mertens

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That I accept the use of the following works:

- Jolibert,C and Wesselink A (submitted) 'Research impacts and impact on research in biodiversity conservation: the influence of stakeholder engagement' *Environmental Science and Policy*

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in his/her doctoral thesis at the Universitat Autònoma de Barcelona, in the form of compendium of works

Signed

Leeds, 1 May 2012

Mr. Delegat del Rectora per al Doctorat

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....
(please, list all the works where you appear as a coauthor)
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Signed

Mr Delegat del Rectora per al Doctorat

Bellaterra (Cerdanyola del Vallès), 05 of May of 2012