Ministry of Science and Higher Education of the Russian Federation
Pskov State University

PRINCIPLES OF ENVIRONMENTAL POLICY: LOCAL, EUROPEAN AND GLOBAL PERSPECTIVES

Multi-authored monograph

Pskov,
Publishing house of Pskov State University,
2018

UDK 504.03, 506.06
BBK 20.18 + 81.2Англ
P92

The book is published by the decision of the Botany and Plant Ecology Department and PskovSU Editorial Board

The book is published in the frame of the projects
565367-EPP-1-2015-1-RU-EPPJMO-MODULE «Systems for monitoring and responses to early warnings — EU experience for Russia» / SMART (Erasmus+, Jean Monnet Modules);
587697-EPP-1-2017-1-RU-EPPJMO-PROJECT «EU governance of natural resources: geopolitics, regions and sectors» / GRaSs (Erasmus+, Jean Monnet projects)

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P92 **Principles of Environmental Policy: Local, European and Global Perspectives**. Multi-authored monograph. Edited by A. Shkaruba. Pskov, Publishing house of Pskov State University, 2018. 342 p.
ISBN 978-5-91116-761-5

The purpose of this textbook is to give an overview of environmental policy, starting from the history of environmental thought and growth of environmental awareness to the fundamental principles and the application. Wherever possible, we take the European policy context, and discuss local and regional environmental issues from the perspectives of EU-promoted policy developments. The target audience of the book are university students and teachers interested in the field, but also environmental professionals interested to have a better grasp on the tools and methodology, and to learn how policies are developed and work in a variety of contexts worldwide, and how they compare with European contexts.

Many examples and case studies analysed in the book are taken from the context of Central and Eastern Europe, so this book will be of a particular value to those interested in the region (in particular the former USSR).

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ISBN 978-5-91116-761-5

Co-funded by the
Erasmus+ Programme
of the European Union

The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein

Contents

Introduction

Anatoly Istomin, Olga Likhacheva

The degree of modern human impact on natural ecosystems and components exceeds the natural abilities of their self-restoration; as a result, environmental problems become global. The scale of human influence on the environment is currently comparable to geological, and therefore the concept of Anthropocene was introduced and widely popularized. The Anthropocene is an informal geochronological term for the era with the highest level of human activity that plays a significant role in the Earth's ecosystem and biogeochemical cycles (Stephen et al., 2011).

Catastrophic changes occurring in the natural environment under the influence of anthropogenic activities determine the development of a system of political, economic, legal, educational and other measures taken to manage the environmental situation and ensure rational use of natural resources, i. e. *environmental policy*.

In a broad sense, *environmental policy* is a set of actions launched by society and individual stakeholders (the interaction of various economic, political and social structures) with the aim to implement environmental management and nature conservation strategy. This is an activity through which society's attitude to nature is regulated to enhance its protection and development. The role of mediator in this process belongs to the state, public and political organizations and institutions.

In a narrow sense, environmental policy is a set of documents, programs and strategies developed and adopted at the international level of a group of countries (e. g. international environmental policy, environmental policy of the European Union), one country (e. g. national environmental policy of Russia), a region, a municipality (e. g. environmental policy of Krasnoyarsk Kray, a watershed management plan), or a particular enterprise (environmental policy of Gazprom, RusHydro, electric grid complex, etc.).

Although the state plays the main role in the implementation of environmental policy, at least in some countries, it is not the only implementer of environmental policy. The latter can be represented as an inter-level interaction of the state, environmental parties and movements of regional, national and international levels, individual enterprises and large corporations.

B. Williams and A. Matheny (1995) distinguish three main types of state environmental policy: *managerial*, *pluralist*, and *communitarian*.

In a *managerial environmental policy*, individuals who implement it focus on the technical aspects of making relevant decisions. The main role is played by experts who establish both the framework for the consideration of a particular issue and the degree of its significance (“top-down” approach).

In the *pluralistic type* of eco-policy not only experts, but also civil society representatives participate in the decision-making process. However, citizen participation is not carried out directly, but through some kind of civil society organizations. Eco-policy is implemented through the interaction of government agencies with non-governmental organizations (“bottom-up” approach).

The *collective type* of eco-politics is based on the concept of “rights of indigenous people”. In this case, the state employs the practice of transferring authority in making certain decisions to a group of citizens who are primarily affected by this decision. This way a collective participation in making decisions is insured. Such an approach has become quite common in a number of countries (see Hill et al., 2012; Pimbert, 2004; Notzke, 1995, etc.), in some other countries it is on the agenda (see Chunhabunyatip et al., 2018; Shukla et al., 2014, etc.).

It is possible to identify the most significant common trends that currently determine the vector of development of environmental policy (Morozova et al., 2014):

– *globalization* (integration to solve global environmental problems). The environment has become a key area of international concern, as the impacts of human activities threaten not only local ecosystems but also touch upon the Earth’s system, and emerging problems have been addressed on international scale in many multilateral forums and treaties;

– *glocalization* (local or regional response to global environmental changes, for one of the examples see the activities of Arctic Council (https://arctic-council.org/index.php/en/);

– *democratization* (expansion of the channels of civil society influence on the adoption of environmental policy decisions, the right to receive information on the state of the environment, the right to participate in the development of environmental policy);

– "*green economy*" — an economy that aims to reduce environmental risks, enhance resource efficiency, and promote social inclusiveness, in order to ensure sustainable development;

– *networking environmental policy* (increasing the role and importance of network structures with high potential for self-organization and mobilization and the emergence of various mechanisms for the influence of network activity on the development and reproduction of environmental policy);

– *internalization* of environmental values among the population as a result of the development of environmental awareness.

Another important trend is environmental policy integration, or sector integration (Persson, 2004). Preservation of the environment has now ceased to be a narrow departmental task, the execution of which is exclusively entrusted to environmental authorities. The causes and solutions of many environmental problems often lie in sectoral strategies, therefore environmental aspects and objectives of environmental policy are increasingly associated with various fields and sectors of economic activity, including energy, agriculture, transport, trade, industry, etc. The essence of environmental policy integration is in combining socio-economic development with the need to protect the environment (see also Mullally et al., 2018; van Osten et al., 2018; Jordan & Lenschow, 2010, etc.).

In the last decades, the European Union has played a significant role in solving environmental problems through the development and implementation of environmental policies. Advanced environmental protection measures have successfully been implemented there, a legal framework for the regulation and coordination of environmental activities of the member states has been created, new approaches to protecting and improving the quality of the environment have been developed and introduced (e.g. Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, Water Framework Directive 2000/60/EC, Council Directive 2009/147/EC on the conservation of wild birds). In particular, in the EU the legal basis for the system for collecting and processing environmental information, environmental monitoring, environmental certification, and environmental impact assessment and the mechanism for financing environmental activities were substantially updated. Regulations for environmental standardization and certification have been developed (e. g. Forest Stewardship Council, which functions at the international scale; Carbon Trust Standard; ISO 14001). The right of citizens to have access to environmental information, the right to participate in the discussion and adoption of legal acts of an environmental nature, the right to go to court on environmental issues, enshrined in the Aarhus Convention in 1998, has been implemented (since Water Framework Directive has entered into force). In addition, the EU is one of the world leaders in the field of international environmental cooperation, since many documents originally adopted in the EU were subsequently implemented outside of it. Thus, the EU, on the one hand, has experience in implementing environmental policies at the regional and local level, and on the other, it has an impact on global environmental policy.

Despite the progress achieved in the EU environmental policy, a number of issues remain unresolved, or even exacerbate, and the new ones emerge, setting new goals and promoting the search for more effective environmental actions and solutions.

This publication presents an overview of environmental policy, starting with the history of environmental thought and growth of environmental awareness to the fundamental concepts, principles and applications. We provide a detailed review of the main methodological tools used in the framework of existing concepts. Particular attention is paid to specific and diverse examples of the application of these concepts and tools in solving environmental management and planning problems in various territorial and socio-economic contexts.

Wherever possible, the authors take the European policy context, and discuss local and regional environmental issues from the perspectives of EU-promoted policy developments.

The target audience for this book is university students and teachers, interested in the field, but also environmental professionals interested to have a better grasp on the tools and methodology, and to learn how policies are developed and work in a variety of contexts worldwide, and how they compare with European contexts. The materials of the monograph can be useful to anyone who is interested in the issues discussed and in order to better understand the presented tools and methodology, to learn how policies are developed and how they work in different contexts in different regions of the globe, to what extent they correspond to the best world practices.

Many examples and case studies analysed in the book are taken from the context of Central and Eastern Europe, so this book will be of a particular value to those interested in the region (in particular the former USSR).

The materials in the book are divided into three sections:

– Section 1 covers the history, general principles and theoretical aspects of environmental policy. From a historical perspective, this chapter presents landmark documents and international conferences that have set the course for environmental policy at the global and European levels, gives insights into policy of science and scientific politics, and provides a detailed overview of the main instruments and institutions of environmental governance.

– Section 2 deals with learning and knowledge management for the design and implementation of environmental policies. Knowledge is the main and determining factor of environmental policy; this is recognized by the academic community and is demonstrated by the growing volume of publications on knowledge generation systems, dissemination and actual use of knowledge. First, in order to frame the discussion, it introduces the concepts of socio-ecological systems and adaptive governance (2.1). Next, it describes a wide range of issues related to the production and use of knowledge, and relates them to the structure of environmental policy and participants of environmental policy process (2.2). The section ends with concrete examples of knowledge production, such as social learning (2.3) and local knowledge (2.4), as well as a discussion of the problems of their integration into environmental management and governance.

– Section 3 presents an overview of cases that reveal a number of environmental problems in various sectors, socio-economic and biophysical conditions, and also demonstrates different approaches and tools (including management of knowledge systems) of implemented environmental policies, although the principles and mechanisms applied seem to have a lot in common. The chapter discusses four examples of environmental policy analysis from adaptive management of coastal zones (3.1), biodiversity conservation in mountain ecosystems (3.2), physical planning in urban context (3.3), the dilemmas between biodiversity management and the interests of local communities (3.4), stretching geographically across the whole Eurasian continent from Ireland (3.1) to Tajikistan (3.2) and Southern Siberia (3.3), and to South Africa (3.4).

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1. Environmental policy: origin, science and knowledge in global and European contexts

Rapidly increasing anthropogenic global environmental change in the second half of the 20th century led to the emergence and global spread of environmental problems, but also to the development of environmental protection agendas at different scales, and raising of international and European environmental institutions and policies.

This chapter introduces landmark documents and global conferences that have set the course for environmental policy at the global and European levels, gives insights into policy of science and scientific politics, and provides an overview of basic concepts of environmental governance and institutions of environmental governance.

1.1. Global and European Environmental Policy — Milestones and Concepts

Anton Shkaruba, Vladislav Donchenko, Ruben Zondervan

The "great acceleration" (Steffen et al., 2015) in global environmental change, largely anthropogenic caused, led to the emergence and global spread of environmental problems in the second half of the 20th century. The entire earth system now operates well outside the normal state exhibited over the past 500,000 years (Steffen et al., 2004) and risks exceeding planetary boundaries (Rockstrom et al., 2009).

Alongside the acceleration in frequency, complexity, and magnitude of global environmental change, new research challenges, issues, methods, and even entirely new scientific disciplines emerged to address these challenges. In parallel, and complementary to numerous local, national, and regional environmental protection policies, the environment and the more encompassing issue of sustainable development became items on the agenda of global governance.

This chapter introduces a set of landmark reports, global policy processes and conferences that have set the course for environmental policy at the global level and influenced concepts now featuring prominently in research and policy on the policy challenges of global environmental change.

1.1.1. Club of Rome — the Limits to Growth

The 1972 Report on Limits to Growth (Meadows et al., 1972) by the *Club of Rome* was an international bestseller and among first comprehensive studies on global environmental change. Using computer modeling of population, industrialization, pollution, food production and resources variables, and taking the assumption that these variables would grow exponentially, while assuming that the technology to increase availability or use-intensity of these resources would only grow linearly, the report pictured a bleak future.

The Limits to Growth Report by Donella Meadows, Dennis Meadows, Jørgen Randers and William W. Behrens III, presented on March 12, 1972 in the Smithsonian Institution (Washington DC) as the first report of the Club of Rome, was based on a mathematical model called WORLD3. This model build on previous work by Jay Forrester on WORLD1, and the next (refined) version WORLD2, published in a 1971 book titled *World Dynamics* (Forrester, 1971) which predicted major human-caused global environmental disaster by the 2020s.

The combination of a mathematical model to assess human impacts, tipping points and thresholds, was innovative for that time — and in hindsight quite accurate: comparison of model outputs with observed data for 1970–2000 show a close match for the *standard run* scenario of the report (though neither for the *comprehensive technology* scenario nor the *stabilized world* scenario) (Turner, 2008).

The Limits to Growth Report no doubt had a great impact not only on the academic community and policy-makers, but also on the general public. This, and subsequent further reports by the Club of Rome analyzed various aspects of global social and economic development, and formed the inspiration to and knowledge foundation of numerous international policies and initiatives (Meadows et al., 1972). It also provided momentum to emerging public discussions of and social movements around environmental problems and the future of the planet in the early 1970s. Eventually, environmental issues appeared in the international political discussions, and were taken up by the United Nations for the first time in 1972 at the Stockholm Conference (see below).

It is worthy to note here, that some aspects of the report seemingly had a lasting impact on global environmental change research. For example, the dominance of "apocalyptic narratives", the heavy reliance on computer based modelling, or the generally sceptical or even pessimist view on technological innovations and solutions.

1.1.2. The 1972 UN Conference on the Human Environment

Global UN Conference on the environment are widely understood as a major institutional innovation of the 1970s (Haas, 2002: 78) and started with the *UN Conference of Human Environment*, 5–16 June 1972 in Stockholm, Sweden. Representatives of 113 countries (The Soviet Union and most of its allies did not participate), 19 inter-governmental agencies, and more than 400 intergovernmental and non-governmental organizations discussed and negotiated a joint approach to the issues of environment and development. It defined two main reasons for global environmental change: (1) fast population growth in developing countries, and (2) industrialization in developed countries.

The outcomes of the meeting were the Declaration of the United Nations Conference on the Human Environment (UNEP, 1972), containing 26 principles concerning the environment and development, as well as an Action Plan with 109 recommendations, and a Resolution. The Stockholm Declaration consists of two parts. The first part summarizes the state of human-nature interactions (very much following the conclusions of the reports to the Club of Rome) in seven introductory proclamations. In particular, it recognizes the importance of the state of the environment for human well-being and therefore declares environmental protection as the duty of all Governments. In this context, it confirms the obligation of industrialized countries to help developing countries to reduce the gap in human development — thereby laying the foundations for what later in international climate change policies would become the paramount principle of Common but Differentiated Responsibility (CBDR). The declaration also notes that population growth presents the biggest challenge to the environment, and all the means of technological and research development should be used to reduce the human footprint and adapt to this growth; and finally it calls for inclusive and equitable policy-making and management actions. The second part of the Stockholm Declaration (UNEP, 1972) lists the 26 principles of human development and environmental protection (see Annex 1).

The Stockholm Action Plan included 109 recommendations focusing on (1) environmental assessment, (2) environmental management and (3) preventive measures. To address the objectives related to *environmental assessment*, the overall recommendation was to develop monitoring systems, so policies and decisions would be based on accurate and up-to-date information. The recommendations for achieving *environmental management* objectives related to the development of legislation and regulatory mechanisms, and the establishment of decision-making and management bodies. Development of *preventive measures* was seen as a revolutionary approach for replacing "end of pipe" solutions as the dominating paradigm of environmental protection at that time.

The 1972 Stockholm Conference gave rise to the development of national and international environmental programs, and to setting up the mechanisms and bodies for their implementation. Most significant, responding to the outcomes of the Stockholm Conference, the United Nations Environmental Program (UNEP) was established. The outcomes of the Stockholm Conference played a major role in raising environmental awareness, and not at least laid foundation to the international system of environmental protection with new institutions and negotiations of international environmental governance emerging and proliferating since then (Chasek & Wagner, 2012).

As another result of the Stockholm Conference, terms such as "international environmental relations", "environmental policy", "environmental legislations" not just emerged, but also started to gain importance in policy discussions at all levels, and became important fields of research. This generated an increasing demand for expertise related to environmental protection, and universities responded to it with opening new educational programs and updating the existing ones with new courses — and specialized sub-disciplines like international environmental governance (from international relations), environmental management (from public policy studies), and environmental economics (from macro-economics) developed. Even new scientific disciplines like earth system sciences and sustainability sciences emerged.

Resulting from the conference, many countries adopted national policy documents on environmental protection, and citizen rights to a healthy environment became recognised, in many instances even as a constitutional right (Gellers, 2015). In most countries, such national policies for environmental protection were first developed as a part of the national government, often in a very top-down manner. Such governance systems were (and in many countries still are) based on a rigid legislative framework, compulsory standards and rules, and dedicated implementation agencies integrated to national administrative systems.

1.1.3. Brundtland Commission — Our Common Future

In 1983, the UN General Assembly set up the World Commission on Environment and Development (WCED). Gro Harlem Brundtland, former (1981–82) and then future (1986–89, 1990–96) Norwegian primeminister and former minister for environment, was appointed to chair the Commission which soon became known as the Brundtland Commission. Its objectives were (WCED, 1987):

- to re-examine the critical issues of environment and development and to formulate innovative, concrete, and realistic action proposals to deal with them;
- to strengthen international cooperation on environment and development and to assess and propose new forms of cooperation that can break out of existing patterns and influence policies and events in the direction of needed change; and
- to raise the level of understanding and commitment to action on the part of individuals, voluntary organizations, businesses, institutes, and governments.

The thematic areas analyzed by the Commission included population, food security, the loss of species and genetic resources, energy, industry, and human settlements, all those areas viewed as interconnected and interdependent system. After publishing the report *Our Common Future* in 1987 the Commission was dissolved.

Our Common Future gave very specific examples demonstrating the critical state of the global ecological system. It broadly used predictions from the reports to the Club of Rome and outcomes of the 1972 Stockholm Conference, and it discussed environmental issues as a part of the overall political agenda by combining them with the issue of *development*. The Report linked the objectives of environmental conservation to the development of human resources (poverty reduction, gender and social equality) as components of the single development agenda, and although it did not identify specific activities leading to environmental degradation, and did not discussed economic principles and mechanisms responsible for quantitative and qualitative characteristics of economic growth, the Report paved an avenue for such discussions. The report recognized that many global crises are interlocking crises constituting the single global crisis, and that any global solutions are only possible if the active involvement of all sectors of human society in decision-making is secured.

One of the best known features in the *Our Common Future* is the definition of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

The concept of sustainable development, as defined in *Our Common Future*, was somewhat contradictory to the central idea of the Stockholm Declaration, although it was very much based on the outcomes of the Stockholm Conference. While the main narrative of the Stockholm discussions was that future generations would be living in polluted and uncomfortable environment, destroyed by economic growth, industrialization, and population growth, the Brundtland Report warned that the economic growth itself could be compromised by environmental degradation. *Our Common Future* further stresses that the dependency of states on the environment and resources will be growing in post-industrial societies, and environment and economy will be increasingly interdependent at all the scales. The Report argues that successful implementation of the principles of sustainable development shall be based on strict enforcement of environmental norms and standards that need to be developed for specific economic activities.

Once the Report has been approved by the UN General Assembly, the term *sustainable development* became established and politically accepted and was quickly picked up by policy and academic communities all over the globe. *Our Common Future* wrapped up the epoch of industrialization with its increasingly important interdependence of states, and suggested the idea of sustainable development for the post-industrial society.

1.1.4. The 1992 UN Conference on Environment and Development

The United Nations Conference on Environment and Development (also known as the Earth Summit) was held in Rio de Janeiro, Brazil, 5–14 June 1992. The conference was unprecedented for its scale: 172 governments sent their representatives, including 116 sending their heads of state or government; over 2,400 participants were representing NGOs. Some 17,000 participants attended the parallel NGO "Global Forum".

From the beginning, the Conference was designed not only as a venue for intergovernmental negotiations, where politicians would listen to expert opinions and take decisions, but also as a public event of global importance that would unleash new energy in environmental governance, engaging actors beyond the state and across scales, from local to global, from communities to large transnational networks (Andonova & Hoffmann, 2012). An important element of the message was that nothing but behavioral change would be crucial to get on a sustainable development trajectory. To convey and translate this message, over 10,000 journalists were accredited.

Preparations for the Earth Summit started in December 1989. They included discussions, planning sessions and negotiations between the UN member states resulting in a conference that achieved the adoption of the landmark Agenda 21 (United Nations, 1992), a comprehensive plan for achieving global sustainable development. As often in intergovernmental negotiations, Agenda 21 was a compromise. However, it remained for long the most important internationally negotiated and agreed document outlining principles and methods of sustainable development. In addition to Agenda 21, the conference also agreed on the Rio Declaration on Environment and Development, and a Statement of Forest Principles, and started the process of negotiations leading to the three so called *Rio Conventions*:

- the United Nations Framework Convention on Climate Change (UNFCCC);
- the United Nations Convention on Biological Diversity (CBD);
- the United Nations Convention to Combat Desertification (UNCCD).

UN member states could not agree on a similar convention on forests, hence the adaptation of the non-binding statement of forest principles as a direct conference output. However, in outcome and impact, this failure to institutionalize global forest governance in an intergovernmental setting, provided a space for private agency to emerge in form of the Forest Stewardship Council (Pattberg, 2005), and also illustrated the emergence of an era in global sustainable development governance in which increasingly non-state actors gained agency in global sustainable development governance (Dellas, Pattberg, & Betsill, 2011).

Other "institutionalizations" resulting from the conference, mainly aiming at facilitating the follow-up mechanisms agreed, included:

- the Commission on Sustainable Development (CSD);
- the Inter-agency Committee on Sustainable Development;
- the High-level Advisory Board on Sustainable Development.

Agenda 21 is a 300 page-document with status of a non-binding, voluntarily implemented action plan. It served as a framework for the development of many national and local agendas, most of which also have a non-binding status. Agenda 21 consists of 40 chapters that have been aggregated into four sections:

- Section I: Social and Economic Dimensions is directed toward combating poverty, especially in developing countries, changing consumption patterns, promoting health, achieving a more sustainable population, and sustainable settlement in decision making.
- Section II: Conservation and Management of Resources for Development includes atmospheric protection, combating deforestation, protecting fragile environments, conservation

of biological diversity (biodiversity), control of pollution and the management of biotechnology, and radioactive wastes.

- Section III: Strengthening the Role of Major Groups includes the roles of children and youth, women, NGOs, local authorities, business and industry, and workers; and strengthening the role of indigenous peoples, their communities, and farmers.
- Section IV: Means of Implementation: implementation includes science, technology transfer, education, international institutions and financial mechanisms.

The Rio Declaration on Environment and Development (1992) is a not binding document consisting of 27 principles that define responsibilities and rings of states regarding the implementation of Agenda 21 (Annex 2).

The decade after the 1992 Rio Conference, saw a mushrooming of multilateral environmental agreements (MEAs) — depending on definition and source up to 800 — as an important new mechanism in global environmental policies (Kanie, 2007) but also as the cause of the high level of fragmentation which currently characterizes the institutional landscape in global sustainable development governance. The issue of fragmentation also gained strong academic interest (Biermann et al., 2009) which more recently is turning from problematizing this, to understanding how this fragmented landscape could orchestrate sustainable development, especially within the 2030 Development Agenda and the Sustainable Development Goals (see below) (Abbott & Bernstein, 2015).

1.1.5. Millennium Development Goals and the World Summit on Sustainable Development

The Millennium Development Goals (MDGs) were initiated at the United Nations Millennium Summit in 2000, based on the United Nations Millennium Declaration negotiated and adopted on that meeting. The Millennium Declaration started a five-year process that formulated and revised the MDGs into the 8 Goals and 21 Targets that formed the final structure (Annex 3).

The goal-focused structure of the MDGs, signifying that outcomes were prioritized over implementation strategies, was not new as such — a few other goal-sets were already agreed upon in development policies — it was another innovation in global sustainable development policies. While such clear, time-bound, and quantified targets can provide clear benchmarks for policy makers, such results based management significantly leave implementation up to the other actors (Fukuda-Parr, 2008) — which aligns to the high level of fragmentation in sustainable development governance at the time of the conference. Content-wise, the MDGs did not really add new aspects on the global agenda but rather focused on encouraging adherence with existing international treaties (Fukuda-Parr & Greenstein, 2010).

While the MDGs are generally considered to having made a significant impact, it remains a question how much of the poverty reduction achieved in the period of the MDGs is the result from any implementation efforts that can be attributed to the MDGs. The no-MDG counterfactual condition (Hovi, Sprinz, & Underdal, 2003) may have seen similar progress. This is most clear in the case of poverty reduction in China where poverty reduction efforts were started before the MDGs and the MDGs had little impact on their actions and were responsible for three-quarters of the achievement.

Following the relative low-profile Millennium Conference, a next large UN conference on sustainable development was organized 26 August — 4 September 2002 in Johannesburg: *The World Summit on Sustainable Development*. The summit marked the 10th anniversary of the United Nations Conference on Environment and Development in Rio, and the 30th anniversary of the United Nations Conference on the Human Environment in Stockholm hence also became known as the "Rio+10 Summit".

The Summit had a mixed success: due to the absence of the United States (The George W. Bush government boycotted the Summit) its global legitimacy was somewhat compromised, and its discussions and outcomes also received less publicity than it was expected. Different from previous conferences, the intergovernmental outcomes were meager at best. The Johannesburg Declaration on Sustainable Development very much builds on the outcomes and follow-up experience of Stockholm (1972) and Rio (1992) conferences, and calls for further steps towards sustainable development. As such, the Declaration does not offer anything strikingly new in terms of concepts or methods for achieving sustainability, but it reaffirms the global commitment, calls for broader involvements of stakeholder groups beyond national governments, and brings to the attention issues of human security. Nevertheless, the conference was an important milestone in the history of global environmental governance because of its *type 2* (as different from the intergovernmental *type 1* outcomes). This was the endorsement of "partnership initiatives" between different sectors and actors to support Millennium Development Goals. Despite partnerships being hyped as a mechanism to reduce the implementation and regulation gaps, extensive research in the years following the conference, paints a different picture: Many partnerships never became operational, hardly any had discernible activity, and only few any impact (Pattberg et al., 2012).

Another remarkable aspect of the 2002 Conference was that for the first time in the UN, the importance of good governance "*within each country and at the international level*" was brought forward. The Implementation Plan calls for the development of institutional framework for sustainable development to promote the implementation through good and globally coordinated governance. An issue that became a core agenda item ten years later in the Rio+20 Conference.

1.1.6. Rio+20 and the Sustainable Development Goals

The 2012 United Nations Conference on Sustainable Development, know better as Rio+20 Conference, was held in Rio de Janeiro in June 2012. The conference with two agenda items, the Institutional Framework for Sustainable Development, and the Green Economy, resulted in a political outcome document entitled "The Future we Want" (UN General Assembly, 2012) which contains measures for implementing sustainable development.

The Rio+20 Summit resulted in a policy outcome that, according to most observers, did neither meet the requirements for a deep transformation of the current unsustainable practices nor the high expectations of the public, media, NGOs and scientists (Pattberg & Mert, 2013). A potentially important outcome of the Rio+20 Conference is the strengthening of the United Nations Environment Programme (UNEP). The conference also saw the establishment of a new body in the already fragmented landscape on sustainable development in the UN System, the High-Level Political Forum for Sustainable Development (HLPF).

The most important, if not even decisive result of the Rio+20 Conference, was the decision to launch a process to develop a set of Sustainable Development Goals (SDGs), which will build upon the Millennium Development Goals and converge with the Development Agenda for 2030. The terms and content of the SDGs were developed primarily in the outcome document of the Open Working Group on Sustainable Development Goals (SDGs) which was released in July 2014 (OWG, 2014). The OWG was an intergovernmental body in the UN, which met for over a year with inputs from scientists, civil society, and the private sector to develop a framework for the SDGs. Key issues about financing were handled in the Intergovernmental Committee of Experts on Sustainable Development Financing, which had a similar work program. Measurement and indicators discussions and the fit of the SDGs into the larger Post-2015 Development Agenda were major discussions for negotiations through 2015 with the goal to create a coherent structure for overall efforts. The OWG outcome document listed 17 separate goals and 169 targets and was agreed upon by the UN General Assembly in September 2015 (Annex 4).

The Sustainable Development Goals mark the most ambitious effort yet to place goal setting at the center of global governance and policy (Kanie & Biermann, 2017) and pose an enormous challenge to global sustainable development governance, but will require also tremendous efforts of the global research community in understanding governance through goals and providing the knowledge needed for a sustainable future.

1.1.7. From Incrementalism to Transformative Governance of Sustainable Development

The mega-conferences described in this chapter are important milestones in the development of international environmental governance, and have at times served as catalysts for new ideas and the generation of momentum behind certain environmental policy initiatives — from new global conventions like the UNFCCC to a mushrooming of local initiatives (see for comprehensive overview

(Chasek & Wagner, 2012). In addition, their near universal participation including substantial civil society involvement, have given them a lot of weight and legitimacy. However, students in this area should be cautious not to equal these conferences and their outcomes — often rather long bucket-lists of non-binding to-do's — with the overall dynamics and topics of international environmental governance or as reflecting the state-of-art in our knowledge about environmental change (Ely et al., 2013; Haas, 2002; Pattberg & Mert, 2013) but rather a lowest common denominator of political discourses and interests. Even some of the "success stories" like the establishment of so called Partnerships for Sustainable Development at the 2002 Johannesburg Conference, turned out to be more window dressing than actual progress (Mert, 2013). Most actual policies might be fostered by the momentum of the global conferences or inspired by their outcomes (for example the local Agenda 21 chapters, or focus of development policies along the MDGs), but are in essence developed, implemented and enforced on local, national and at best regional level (here mainly in the EU).

In conclusion, for the 21st century, when societies must now change course and steer away from critical tipping points in the Earth system that might lead to rapid and irreversible change, the incremental change enabled by the conferences and reports needs replacement by a transformative reorientation of national and international institutions toward more effective governance (Biermann et al., 2012).

1.1.8. Development and transition of the European system of environmental governance

The 1980s saw an exceptional number of man-made environmental disasters, including those associated with military conflicts. This brought forward the issues of environmental security, and stimulated interest in integrated approaches to environmental management. In the European Union this started with the Environmental Impact Assessment (EIA) Directive 85/337 EEC (in force since 1985).

The new perspective the Directive took on environmental responsibility was revolutionary for the time and greatly influenced environmental management and policy in the EU and beyond. The new definition suggested that instead of responsibility for environmental pollution and associate damage alone, the responsibility would rather move to timely preventive measures. To pursue this objective, the Directive decrees that any activities with potential significant impact on the environment are subject to the procedure of environmental assessment. The Directive specifies what kinds of activities shall be submitted to this procedure, and describes the procedure itself. It also pays attention to availability and open circulation of environmental information, and to stakeholder consultations. The Directive 85/337 was taken as good practice by many countries outside the EU, especially in Europe, and used for modernisation of national environmental legislation and implementation mechanisms.

A few years before the adoption of the EIA Directive, Directorate-General for the Environment was set-up in 1981 to coordinate and develop the EU environmental policy. To provide data and information on the state of European Environment, the European Environment Agency (EEA) was established in 1990 with headquarters in Copenhagen (Denmark) by the EEC Regulation 1210/1990; it became operational in 1994. Responsibilities of the Agency included development of environmental standards and indicators, coordination and further development of environmental monitoring and observation (in particular through the European environment information and observation network (Eionet) established at EEA), and circulation of best practices in environmental management. Non-EU countries can join the EEA as well, and in addition to all the EU member states, the agency includes five non-EU member countries, and six further countries have the status of cooperating countries.

Since 1973, EU environmental policy was steered and coordinated through Action Programmes for the Environment. The first one was adopted after the Stockholm Conference and based on its outcomes; the second (1977), third (1983) and fourth (1987) Programmes reflected most important trends in the development of international environmental policy and the needs to support the rapidly growing body of EU environmental legislation. The fifth and the sixth Programs have been developed for 10-year periods (with optional reviews every five years). Under the Fifth Program (1992–2000), the Community actions have been limited to the following actions:

- long-term management of natural resources: soil, water, countryside and coasts;
- an integrated approach to combating pollution, and acting to prevent waste;
- reducing the consumption of energy from non-renewable sources;
- improving the management of mobility by developing efficient and clean modes of transport;
- drawing up a coherent package of measures to improve the quality of the urban environment;
- improving health and safety, in particular in relation to the management of industrial hazards, nuclear safety and radiation protection.

Actions, included to the Sixth Program (2002–2012) feature:

- publishing a communication on the importance of integrating the environment into land-use planning and management;
- improving the implementation of the Environmental Impact Assessment Directive;
- spreading best practice and fostering the exchange of experience on sustainable development, including urban development;
- including sustainable development in Community regional policy;
- boosting agri-environmental measures within the Common Agricultural Policy;
- developing a partnership for the sustainable management of tourism.

The Seventh Environment Action Program will be guiding EU environmental policies till 2020. It entered in force in 2014, and its key objectives are:

- to protect, conserve and enhance the European Union’s natural capital;
- to turn the EU into a resource-efficient, green, and competitive low-carbon economy;
- to safeguard the Union's citizens from environment-related pressures and risks to health and wellbeing.

To deliver the objectives, four "enablers" were formulated:

- better implementation of legislation;
- better information by improving the knowledge base;
- more and wiser investment for environment and climate policy;
- full integration of environmental requirements and considerations into other policies.

By 1997, when the Treaty of Amsterdam was signed, the key principles of environmental policy were recognized as central to the EU governance, and therefore they were included to the Treaty:

- Sustainable development;
- Prevention approach;
- Precautionary principle;
- Polluter pays principle;
- Principle of integration of environmental requirements in other Community policies;
- Subsidiary principle;
- Principle of high level of environmental protection.

Some of these principles already featured in the First Action Programme for the Environment (1973) and in the previous editions of the Treaty, such as the Single European Act and the Maastricht Treaty, however it was only in 1997 that all of them were brought together with the addition of the principle of sustainable development, which was also set as the overall approach for EU environmental policy.

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Annex 1: Stockholm 1972 Principles (UNEP, 1972)

Principle 1 — Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being, and he bears a solemn responsibility to protect and improve the environment for present and future generations. In this respect, policies promoting or perpetuating apartheid, racial segregation, discrimination, colonial and other forms of oppression and foreign domination stand condemned and must be eliminated.

Principle 2 — The natural resources of the earth, including the air, water, land, flora and fauna and especially representative samples of natural ecosystems, must be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate.

Principle 3 — The capacity of the earth to produce vital renewable resources must be maintained and, wherever practicable, restored or improved.

Principle 4 — Man has a special responsibility to safeguard and wisely manage the heritage of wildlife and its habitat, which are now gravely imperilled by a combination of adverse factors. Nature conservation, including wildlife, must therefore receive importance in planning for economic development.

Principle 5 — The non-renewable resources of the earth must be employed in such a way as to guard against the danger of their future exhaustion and to ensure that benefits from such employment are shared by all mankind.

Principle 6 — The discharge of toxic substances or of other substances and the release of heat, in such quantities or concentrations as to exceed the capacity of the environment to render them harmless, must be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems. The just struggle of the peoples of ill countries against pollution should be supported.

Principle 7 — States shall take all possible steps to prevent pollution of the seas by substances that are liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.

Principle 8 — Economic and social development is essential for ensuring a favorable living and working environment for man and for creating conditions on earth that are necessary for the improvement of the quality of life.

Principle 9 — Environmental deficiencies generated by the conditions of under-development and natural disasters pose grave problems and can best be remedied by accelerated development through the transfer of substantial quantities of financial and technological assistance as a supplement to the domestic effort of the developing countries and such timely assistance as may be required.

Principle 10 — For the developing countries, stability of prices and adequate earnings for primary commodities and raw materials are essential to environmental management, since economic factors as well as ecological processes must be taken into account.

Principle 11 — The environmental policies of all States should enhance and not adversely affect the present or future development potential of developing countries, nor should they hamper the attainment of better living conditions for all, and appropriate steps should be taken by States and international organizations with a view to reaching agreement on meeting the possible national and international economic consequences resulting from the application of environmental measures.

Principle 12 — Resources should be made available to preserve and improve the environment, taking into account the circumstances and particular requirements of developing countries and any costs which may emanate- from their incorporating environmental safeguards into their development planning and the need for making available to them, upon their request, additional international technical and financial assistance for this purpose.

Principle 13 — In order to achieve a more rational management of resources and thus to improve the environment, States should adopt an integrated and coordinated approach to their development planning so as to ensure that development is compatible with the need to protect and improve environment for the benefit of their population.

Principle 14 — Rational planning constitutes an essential tool for reconciling any conflict between the needs of development and the need to protect and improve the environment.

Principle 15 — Planning must be applied to human settlements and urbanization with a view to avoiding adverse effects on the environment and obtaining maximum social, economic and environmental benefits for all. In this respect projects which are designed for colonialist and racist domination must be abandoned.

Principle 16 — Demographic policies which are without prejudice to basic human rights and which are deemed appropriate by Governments concerned should be applied in those regions where the rate of population growth or excessive population concentrations are likely to have adverse effects on the environment of the human environment and impede development.

Principle 17 — Appropriate national institutions must be entrusted with the task of planning, managing or controlling the 9 environmental resources of States with a view to enhancing environmental quality.

Principle 18 — Science and technology, as part of their contribution to economic and social development, must be applied to the identification, avoidance and control of environmental risks and the solution of environmental problems and for the common good of mankind.

Principle 19 — Education in environmental matters, for the younger generation as well as adults, giving due consideration to the underprivileged, is essential in order to broaden the basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in protecting and improving the environment in its full human dimension. It is also essential that mass media of communications avoid contributing to the deterioration of the environment, but, on the contrary, disseminates information of an educational nature on the need to project and improve the environment in order to enable mal to develop in every respect.

Principle 20 — Scientific research and development in the context of environmental problems, both national and multinational, must be promoted in all countries, especially the developing countries. In this connection, the free flow of up-to-date scientific information and transfer of experience must be supported and assisted, to facilitate the solution of environmental problems; environmental technologies should be made available to developing countries on terms which would encourage their wide dissemination without constituting an economic burden on the developing countries.

Principle 21 — States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Principle 22 — States shall cooperate to develop further the international law regarding liability and compensation for the victims of pollution and other environmental damage caused by activities within the jurisdiction or control of such States to areas beyond their jurisdiction.

Principle 23 — Without prejudice to such criteria as may be agreed upon by the international community, or to standards which will have to be determined nationally, it will be essential in all cases to consider the systems of values prevailing in each country, and the extent of the applicability of standards which are valid for the most advanced countries but which may be inappropriate and of unwarranted social cost for the developing countries.

Principle 24 — International matters concerning the protection and improvement of the environment should be handled in a cooperative spirit by all countries, big and small, on an equal footing. Cooperation through multilateral or bilateral arrangements or other appropriate means is essential to effectively control, prevent, reduce and eliminate adverse environmental effects resulting from activities conducted in all spheres, in such a way, that due account is taken of the sovereignty and interests of all States.

Principle 25 — States shall ensure that international organizations play a coordinated, efficient and dynamic role for the protection and improvement of the environment.

Principle 26 — Man and his environment must be spared the effects of nuclear weapons and all other means of mass destruction. States must strive to reach prompt agreement, in the relevant international organs, on the elimination and complete destruction of such weapons.

Annex 2: Rio 1992 Principles (Rio Declaration, 1992)

Principle 1 — Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Principle 2 — States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Principle 3 — The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations.

Principle 4 — In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

Principle 5 — All States and all people shall co-operate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world.

Principle 6 — The special situation and needs of developing countries, particularly the least developed and those most environmentally vulnerable, shall be given special priority. International actions in the field of environment and development should also address the interests and needs of all countries.

Principle 7 — States shall co-operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

Principle 8 — To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.

Principle 9 — States should co-operate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies.

Principle 10 — Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

Principle 11 — States shall enact effective environmental legislation. Environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply. Standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries.

Principle 12 — States should co-operate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. Unilateral actions to deal with environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing transboundary or global environmental problems should, as far as possible, be based on an international consensus.

Principle 13 — States shall develop national law regarding liability and compensation for the victims of pollution and other environmental damage. States shall also co-operate in an expeditious and more determined manner to develop further international law regarding liability and compensation for adverse effects of environmental damage caused by activities within their jurisdiction or control to areas beyond their jurisdiction.

Principle 14 — States should effectively co-operate to discourage or prevent the relocation and transfer to other States of any activities and substances that cause severe environmental degradation or are found to be harmful to human health.

Principle 15 — In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Principle 16 — National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

Principle 17 — Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

Principle 18 — States shall immediately notify other States of any natural disasters or other emergencies that are likely to produce sudden harmful effects on the environment of those States. Every effort shall be made by the international community to help States so afflicted.

Principle 19 — States shall provide prior and timely notification and relevant information to potentially affected States on activities that may have a significant adverse transboundary environmental effect and shall consult with those States at an early stage and in good faith.

Principle 20 — Women have a vital role in environmental management and development. Their full participation is therefore essential to achieve sustainable development.

Principle 21 — The creativity, ideals and courage of the youth of the world should be mobilized to forge a global partnership in order to achieve sustainable development and ensure a better future for all.

Principle 22 — Indigenous people and their communities, and other local communities, have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development.

Principle 23 — The environment and natural resources of people under oppression, domination and occupation shall be protected.

Principle 24 — Warfare is inherently destructive of sustainable development. States shall therefore respect international law providing protection for the environment in times of armed conflict and co-operate in its further development, as necessary.

Principle 25 — Peace, development and environmental protection are interdependent and indivisible.

Principle 26 — States shall resolve all their environmental disputes peacefully and by appropriate means in accordance with the Charter of the United Nations.

Principle 27 — States and people shall co-operate in good faith and in a spirit of partnership in the fulfilment of the principles embodied in this Declaration and in the further development of international law in the field of sustainable development.

Annex 3: Millennium Development Goals (UN MDGs, 2015)

Annex 4: Sustainable Development Goals (SDGs, 2018)

1.2. Science — Policy

Ruben Zondervan

1.2.1. What is science based policy and where does it come from?

"The dynamics of politics and power, like those of culture, seem impossible to tease apart from the broad currents of scientific and technological change (...) What we know about the world is intimately linked to the our sense of that we can do about it, as well as to the felt legitimacy of specific actors, instruments, and courses of action" (Jasanoff, 2004).

Science has become an increasingly integrated part of western society, politics and government during the last 50 years, initially rising to unprecedented importance and visibility in the context of the Cold War, the nuclear arms race and space technology. In 1957, the institutionalization of a Presidential Scientific Advisory Committee in the USA paved the way for similar arrangements in other countries, opening up a new era in the relationship between politics and science (Weingart, 1999).

Science- or evidence-based policy making serves as a political rhetoric to legitimize forms of decision-making that are different from ideological or faith-based policy making (Head, 2010). It is characterised by systematic investigation towards increasing knowledge for policy making, based on a rational or technocratic approach often accompanied by phenomena such as lobbying or consulting (Böhme, 2002). For this, government agencies draw on knowledge and advice produced in external research organizations such as universities, consultancy firms, private think-tanks and not-for-profit social welfare bodies. Additionally, they maintain substantial research units within the public sector to gather and process scientific information relevant to the policy making process (Head, 2010). Some argue that scientific advisors (either persons or in form of advisory bodies, more on this later) have become indispensable to the politics of nations, as modern democratic governments rely on the backing of experts to assure citizens that they are acting in a responsible manner (Jasanoff, 2005).

The concept of basing decision-making on scientific reason arose to importance and grandeur in 19th century Europe, embedded in the enlightenment ethos of human development arising from greater understanding and knowledge (Friedmann, 1987). Its relevance for policy making was institutionalized in western nations during the post-war era, when Keynesianism and welfare-oriented social planning were integrated in government policies during the 1940s and 1950s, followed by science-based educational reforms and urban renewal in the 1960s and 1970s (Wagner et al., 1991). This development not only signified a shift from ideological to evidence-based policy making, but, so the argument or Morgenthau, also in a way a shift of power from people to the government. Where democratically elected leaders had formally made decisions bound by the will of their electorate, scientific and military elites increasingly decided on the direction and style of policy making (Morgenthau, 1964). In recent years this critique is re-emerging in the context of the 'ecological crisis' (Hulme, 2012).

Similar arguments are made cautioning against prescriptive policy advise instead of descriptive (Cairney, 2014) and evidence-based policy making in turn is frequently criticised for relying on a technocratic, linear understanding of the policy making process and on a naïve empiricist understanding of the role of evidence hence unable to engage with the role of the underlying discursive frameworks and paradigms (du Toit, 2012).

During the 1960s, the increasing importance of science in policy making was accompanied by a demand for improving 'scientific standards', i. e. the increased use of quantitative data and experimental methods in the social sciences (Campbell, 1968). This was not without consequence, and several scholars at the time criticized the focus on quantitatively measurable results, warning that technocracy leads to arbitrary decision making and a restraint in policy options (Habermas, 1966; Offe, 1969). It reduced the human component from policy making, with government policy evaluations focusing on quantitative measures of pre-defined goals rather than assessing the value of the programme to the people affected by it. By the 1980s, qualitative evaluations by social scientists had virtually disappeared. Instead, governments spent large amounts on geographical information systems that rarely influenced change in programmes as they were not designed to understand end-users or the planning process (Innes, 2002).

In reaction to this excessively technocratic approach and its inadequacy to tackle complex or ‘wicked’ problems (especially concerning the global environment), attention was raised on the need for “post-normal” or “civic-science” in policy making, i.e. the inclusion of stakeholders and alternative types of knowledge alongside scientific assessment (Bäckstrand, 2003). In contrast to the former, linear relationship between science and policy, a more interactive approach was suggested where system uncertainties and high stakes are tackled through an ongoing dialogue between science, government and an extended peer community (Funtowicz & Ravetz, 1993).

TEXT BOX 1

Evidence-based policy making experienced a significant vogue of interest after 1997 in Great Britain, when the Labour Party replaced the conservatives in government. The term ‘evidence-based policy making’ was coined in this period, based on the governments mantra of ‘what works is what matters’ and ‘what gets measured gets managed’. The Labour Party’s agenda explicitly focused on the need for policy practice to be informed by scientific evidence, accompanied by large investments in research institutes focusing on the science of government policies (Solesbury, 2002; Clarence, 2002). *However, although the government of Great Britain may have coined the term, similar trends (under different names) have been visible in the United States and other EU countries since the 1960s* (Innes, 2002; Böhme, 2002).

Global change, is urgent and of high public and political concern entangled in values, and the science, especially the post-normal science is complex, incomplete and uncertain (Gluckman, 2014). Diverse meanings and understandings of risks and trade-offs dominate. At the European level, this change in methods was integrated in the 6th Framework Programme for Research and Technological Development (FP6), which called for ‘‘developing appropriate means for creating scientific references and channelling scientific advice to policymakers and equipping policy-makers with tools to assess and manage scientific uncertainty, risk and precaution''; for new consultations mechanisms in this regard; and for assessing the ''interaction between experts, industry, civil society and policy-makers'' (Council of the European Union, 2002). At an international level, the interactive approach is visible in the ongoing deliberations between governments and international research bodies such as the Intergovernmental Panel on Climate Change (IPCC) (Agrawala, 1997) or the new Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Görg, Neßhöver, & Paulsch, 2010).

1.2.2. Development of science policy for sustainability

Science-based natural resource management has been common at a local or national level for almost two centuries; "Since the origins of resource management in Europe, its elaboration in empires and colonies, and its application to resources in North America and elsewhere, decisions regarding forestry, fisheries, wildlife and other resources have been considered the domain of technical professionals" (Bocking, 2004). Often however, science was not primarily used to sustainably manage ecosystems, but rather to intensify extraction.

The awareness that humans are able to influence the environment at a global scale only arose in the early years of the cold war, when measurements of nuclear fallout were made far away from the corresponding testing sites. Since then, environmental research has increasingly shifted towards examining the globe as a single system, deepening knowledge through research on the cycling of elements, weather patterns and physical processes (Bocking, 2004).

In the course of this development, environmental research also changed its values and in the 1960s and 1970s started issuing warnings of the detrimental effects of human activity on the environment (Carson, 1962; Meadows et al., 1972). Some prominent examples for this are ozone depletion, the transport of contaminants across borders and hemispheres, and climate change. The recognition of these global issues at a scientific level sparked efforts to manage the global biosphere at an international level.

The 1969 UNESCO Intergovernmental Conference of Experts on the Scientific Basis for Rational Use and Conservation of the Resources of the Biosphere represented a milestone event for the environmental science-policy interface. It brought together more than 300 scientists and policymakers, recommending action to resolve environmental problems (UNESCO, 1969). Major environmental conferences such as the 1972 United Nations Conference on the Human Environment (UNCHE) in Stockholm or the 1992 United Nations Conference in Environment and Development (UNCED) in Rio de Janeiro, and international agreements such as the Montreal Protocol for the Protection of the Ozone Layer, the Convention on Long-Range Transboundary Air Pollution (LRTAP) and the Kyoto Protocol on Climate Change implemented these recommendations to some extent.

TEXT BOX 2

Historical Context

In the early days of global sustainable development policies, the 1972 UN Conference on the Human Environment stated that science and technology must be applied to the identification, avoidance and control of environmental risks, and the solution of environmental problems for the common good of mankind, as well as that of scientific research; development must be promoted and the free flow of up-to-date scientific information and transfer of the experience must be supported. In 1992, the UN Conference on Environment and Development in Rio de Janeiro repeated the call to states to cooperate to strengthen capacity building for sustainable development by: improving scientific understanding through exchanges of scientific and technological knowledge; making science more accessible; and contributing effectively to the decision-making processes concerning environment and development. A further twenty years later, Rio+20 repeated these calls and emphasised the need to strengthen the science-policy interface and for inclusive, evidence-based and transparent scientific assessments to be conducted.

More recently, the science policy interface in global environmental change and development is furthermore challenged to contribute to not only translate the massive amounts of scientific knowledge into the policy arena but also to foster its transformation into action (Bille Larsen, 2013), or as Mike Hulme (2012) puts it in regard to climate change "The science is clear. The politics is not. Knowing facts is not the same as enacting change."

However, using scientific knowledge to trigger action at the international level remains challenging. For one, the relationships between science and policy vary from country to country, and while science may have a major influence on government when ties between the two are close, these ties dissolve when funding and reporting responsibilities are diffused (Engels, 2005; Renn, 1995). Furthermore, the necessity for geographical balance in scientific input at international level makes it easy for political conflicts to be drawn into the assessment, blurring the lines between scientific result and national advocacy (Biermann, 2002; Karlsson, 2002) or ideology. Finally, the manner in which the scientific community goes about communicating uncertainties to policy makers as well as its emphasis of global effects rather than national or regional causes reduces feelings of responsibility and ownership, and opens space for argumentation on who should take action and whether action should be taken in the first place (Bocking, 2004). In this context, the outcome document of the Rio+20 conference of 2012 reiterates the need to improve the impact of science on policy making and to "strengthen the science-policy interface", emphasizing "inclusive, evidence-based and transparent scientific assessments" (UNCSD, 2012). Importantly however, the understanding of science in this document is limited and utilitarian (Zondervan, 2015b, 2017; Zondervan & Volt, 2018).

The more recent development in response to improving the impact of science on policy making at international level is the creation of a Scientific Advisory Board (SAB) to the Secretary-General of the United Nations. Created by Ban Ki-moon in September 2013, the SAB was composed of 26 scientists from different parts of the world and covers a broad spectrum of academic disciplines in order to work on the social, economic and ecological dimensions of sustainable development. The chosen scientists were responsible for advising the UN Secretary-General and the executive heads of UN organizations on scientific, technological and innovation matters, communicating up-to-date knowledge in a comprehensible manner and identifying knowledge gaps that could be addressed by research programs outside of the UN system

(German Commission for UNESCO 2014). Although these scientists have officially been selected for their scientific merits, it can be criticized that they do not represent the top class of their field. The requirements for geographic and gender balance ultimately make any official scientific body at UN level a political matter. Nevertheless, a significant strength of the SAB is that it tried to form a bridge between the UN and international research, which itself is undergoing major reform (Gaffney, 2014). The issue with all of these kind of advisory groups in the UN System however, is that they have no formal role or rights in the intergovernmental negotiation process, which in the end matters most. Their influence or even mere existence depends on the grace of the secretary-general or the willingness to listen by the UN system and member states (Zondervan, 2015a). Thus not surprisingly, the SAB was retired when the new UN Secretary General took office.

The 2030 Agenda for Sustainable Development emphasizes that the new Global Sustainable Development Report (GSDR) is one important component of the follow-up and review process for the 2030 Agenda for Sustainable Development. The GSDR is intended to inform the high-level political forum, and shall strengthen the science-policy interface and provide a strong evidence-based instrument to support policymakers in promoting poverty eradication and sustainable development. After some pilot versions, the first GSDR written by a group of 15 independent scientists will be released in 2019.

1.2.3. Why is science-based policy useful?

"*It is often said that knowledge is power, but more often than not relevant knowledge is not used when political decisions are made*" (Grundmann & Stehr, 2012).

Using scientific research for policy making can have two principle functions, being either instrumental or legitimating. Earlier discussions about science in policy making focused on its instrumental role only, i.e. its capacity to deliver useful solutions to policy problems. The legitimating role of science was only recognised and examined more closely in the 1990s, i.e. that policy makers use specific scientific results to legitimize pre-conceived decisions

(Weingart, 1999). These two distinct but rather general functions have been further subdivided into ten more specific functions, among them: legitimacy; persuasion; delaying or avoiding action; justification for unpopular policies; arbitrating disputes; and clarification of conflicting interests (Boehmer-Christiansen, 1995; Weiss, 1979).

Especially the latter two functions are important in the context of the European Union, where scientific evidence is one of the few means to harmonise conflicting national interests and create a common interest (Theys, 1995). Interestingly, in 2014 NGO's called for the abolishment of the EU's Chief Science Advisor position, created just 4 years earlier, and calling for variety of independent, multi-disciplinary sources instead. A call that underscores the important point that science policy can be and frequently is politicised (see with further examples (Pielke Jr., 2014)).

In the case of natural resources and environmental issues, science can serve to counter the tragedy of the commons. It is often perceived to provide a neutral perspective on sustainable resource management, unrelated to the self-interest of the resource users. Its instrumental role here is to provide an objective, rational view of the facts of nature, enabling management that is not swayed by local interests and political conditions. This view has of course been challenged, as 'cherry-picked' scientific evidence can of course also be used to legitimate interest-driven, pre-defined policies. However, the instrumental role remains an important element of the public image of scientific advisors (Bocking, 2004). Value and knowledge development in science can also cause innovation in resource management and problem solving. For example, the academic development towards fields sympathetic to the environment such as ecology and sustainability science has led to the integration of adaptive management and ecosystem management in the North American forestry sector (Bocking, 2004).

1.2.4. How can science influence policy?

The extent to which scientific results are relied on for policy making is largely determined by the type of policy problem at hand (Engels, 2005). More complex or cross-sectoral policy problems generally require more scientific input than others, as research is needed to determine the driving forces of a problem and the effects that a policy may have on the system in question (Engels, 2005). Furthermore, stakeholders often draw on scientific evidence when a policy is hotly contested to strengthen their position. In these cases, scientific evidence can be mobilised as “arrows in the battle of ideas” and sometimes used contrary to the authors intentions (Head, 2010). Although visible in many different policy areas, evidence-based policy making has been most prominent in healthcare, social services, education, criminal justice and environmental/resource management. So far, its adoption is most prevalent in advanced democratic nations which have invested in policy-relevant research, but its analytical techniques also being applied to some extent in several of the rapidly developing nations (Head, 2010).

The ways in which science can influence policy making specifically vary depending on the phase of the policy cycle and the intent of the scientific result. In the absence of public concern, scientific warnings can bring attention to a new risk and place it on the policy makers’ agenda. This process can be initiated either through findings of new data or new interpretations of existing data and is often connected to high uncertainty, making the issuing of a public warning risky.

Once a risk has been identified, science can help define the actual problem by delivering information on drivers, impacts, threats and reaction strategies. This process is usually contested and controversial, as it defines whose interests are being affected and whose behaviour must change. At the stage where policy makers decide on which policy instrument to use in order to tackle the problem, scientific ex-ante assessments can help in anticipating the possible impacts and results that a specific tool may have. Often this is done in the form of a monetary cost-benefit analysis or using an integrated impact assessment. Once a policy has been implemented, scientific ex-post assessment (often initiated by the opposing political party) is used to evaluate its effects. Although methodologically this type of evaluation contains the least uncertainty, it is rarely neutral as the justification or discreditation of policies inevitably involves taking sides. Finally, the implementation of a policy may need to be monitored on a regular basis if it is to yield the intended outcome. This phase is usually executed by the technical staff of governments rather than scientists per se, although neutral scientific monitoring may be needed in cases where policies are contested and the success of a policy is dependent on stakeholders with diverging interests (one of which may be the government itself) (Engels, 2005).

Across this policy cycle, science can have different types of impact depending on its intent. If research has been tailored to address a specific issue previously identified by policy makers, its findings may be adopted and implemented *directly*. Examples for this would be the ex-ante and ex-post assessments directly initiated by government bodies or opposition, which target the evaluation of a specific policy. Research that does not answer to a specific policy problem can influence policy more *indirectly* by enhancing the understanding of processes or providing new frameworks of thought. Any research may also influence policy *symbolically* if it is taken up as a weapon in a partisan debate (Weiss, 1979).

1.2.5. The Institutionalization of the Interface

"Linking science to policy (...) is home to a variety of diligent, smart, hard working and creative people. It is more akin to Plato's agora than a chasm of despair: a place where our most closely held ideas about knowledge and democracy are continually being tested, reworked and improved" (Paul, Ryan, & Peat, 2013).

Calls for the closer integration of science and policy are and have been made for decades. Sometimes these calls require scientists to be more policy relevant or 'usable' (Ford, Knight, & Pearce, 2013) or even to get involved in politics. But this is unrealistic (Sutherland, 2013). Scientists distance themselves from the muddy-waters of science policy, sometimes inadvertently, as they tend to pursue a research agenda they are passionate about, as they regard their job as finished when they report their results in a specialized research journal, or argue that advocating for a particular societal position compromises their scientific credibility, and because they feel that dealing with societal issues is some other profession's problem (Hadly et al., 2013).

Less frequently, these calls are addressed to politicians, suggesting to break their scientific-ignorance and to teach science to politicians. This is unrealistic likewise, although, as suggested by Sutherland et al., some interpretive scientific skills instead of fundamental science itself, could form part of the broad skill set of most politicians (Sutherland, 2013) as some policy and politics knowledge could be useful for scientists (Tyler, 2013). Related are proposals for standard-setting and auditing of research quality (beyond the established peer-review systems) to mitigate unreliability and bias in science, to provide policy officials and others with a reliable way of assessing evidence quality, and to drive up standards in scientific research (Boyd, 2013).

Politics and science are deeply intertwined. As such, the science-policy interface does not exist, at least not as a clearly identifiable space in the overlap of the two systems. It rather permeates throughout science and policy. However, as nevertheless the two systems have their own aims, rationales and logic, which is very hard to overcome by the efforts of getting scientists more engaged in policy making or policy makers more understandable of sciences, there is an increasing professionalization and institutionalization happening. Through so-called boundary organizations, much of the actual (as different from the scientific studies about) science-policy work is undertaken.

Boundary organizations are organizations whose central purpose is to create and sustain meaningful and mutually beneficial links between knowledge producers and users. Their roles include translation (between science and non-science, between long-term research and short-term policy needs, etc.); participation and co-production (including fostering the space-physical, temporal, institutional, political, etc. where co-production can occur); and dual accountability (Meyer & Knight, 2014). There are many such organisations. Prominent types of science policy boundary organisations include Chief Science Advisors to governments, and Scientific Advisory Bodies, and to some extend also the global scientific assessment institutions like the IPCC, IPBES, or GEO. However, the most innovative, creative and effective boundary organizations are often small to medium size private-sector companies, NGOs, and not at least individuals.

Acknowledgement

The author gratefully acknowledges the substantial research and writing support by Ina Möller, Department of Political Sciences, Lund University.

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1.3. Environmental governance and institutions of Environmental Governance

Anton Shkaruba, Viktar Kireyeu

In his analysis of institutions of environmental governance, Jouni Paavola (2007) rightly noticed ”*new institutional research on environmental governance has been phenomenally successful in terms of its volume growth and policy impact. Yet its potential is far from exhausted…*”. The key words here are *environmental governance* and *institutions of environmental governance*. Their promotion to buzz words of environmental policy literature occurred mostly because these concepts worked well for creating integrative perspectives. Furthemore, conceptualising nature-human interactions, including environmental conflicts, as interactions of institutions dealing with specific environmental issues or governing natural resources, is a relatively simple yet comprehensive way to understand the policy process and structure all the complexity of human-nature interactions. The success of *institutions* as a research concept can also be also attributed to the fact that it was very well elaborated in social science (or rather institutional economics) literature, and therefore it was easy to pick up and apply in environmental studies by social- and policy science-trained scholars increasingly dominating the field.

The objective of this chapter is to guide through the literature on institutions and environmental governance and through the related terminology and concepts, and to demonstrate the diversity of mainstream approaches to defining and researching them. We take a closer look on adaptive governance and institutions of adaptive governance as areas of possible application.

1.3.1. Institutions of environmental governance — ways of conceptualization, definitions and properties

In relation to social organizations and practices, the term ‘*institution*’ was used since at least the 14th century (Merriam-Webster, 2012). However, the origin of social institutions themselves is still a highly debated issue (e. g. Urpelainen, 2011). Some scholars (most notably, Hobbes, 1651; Locke, 1689) believed that their origin was in a social contract. Others (e. g. Smith, 1759; Hayek, 1960) explained it by the adaptive behaviour of individual agents. Although there is no complete agreement about what the concept of institution stands for, most scholars emphasise the role of constraints and rules in their definitions (Urpelainen, 2011).

In environmental literature, one of the most commonly cited definitions of institutions comes from Elinor Ostrom (1990), who defined *institutions* as "*working rules that are used to determine who is eligible to make decisions in some arena, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, what information must or must not be provided, and what payoffs will be assigned to individuals depending on their actions*". In her research of governing common-pool resources (CPR), she also suggested what characteristic of institutions would make them successful in governing such resources; these characteristics are also known as *institutional design principles*:

(i) clearly defined boundaries of resource systems;
(ii) fair appropriation and provision rules;
(iii) collective choice arrangements providing for participation in decision-making;
(iv) monitoring by monitors accountable to resource users;
(v) graduated sanctions for violators;
(vi) accessible mechanisms for conflict resolution;
(vii) a minimal recognition of rights to organize;
(viii) organisation in the form of nested enterprises.

A similar approach to defining *institutions* was taken by the Institutional Dimension of Global Environmental Change (IDGEC) Project. The main difference was in putting forward *social-practices* as a way to understand institutions (Young, 1999), which we therefore defined as "*systems of rules, decision-making procedures, and programs that give rise to social practices, assign roles to the participants in these practices, and guide interactions among the occupants of the relevant roles*" (Young, 2002).

Making a stronger emphasis on the role of *institutions* as objects creating interfaces of human-nature interactions, Folke et al. (1998) described them as humanly devised formal and informal constraints and their enforcement characteristics. Institutions, according to them, provide a link between human and natural systems allowing for a co-evolutionary development of the both systems, but at the same time, they are capable of suppressing adaptive responses and creating confusion in management. Adopting a similar perspective, Adger et al. (2003) argued that institutions can be instrumental in resolving environmental conflicts by finding a right balance between divergent interests by "*...either establishing, reaffirming or redefining entitlements in environmental resources*".

This standpoint (i. e. seeing the issues of nature recourse use as *environmental conflicts*) brings us from understanding environmental problems as an explicitly economic issue, to the dimension of *social justice*, where welfare-related incentives are interacting with *norms* and *values* (Paavola, 2007). *Norms* rule what solutions are legitimate (in a formal or informal sense), while "*...values influence what resolutions of environmental conflicts are considered just*" (Paavola, 2007). Introducing *norms* and *values* to a policy analysis framework helps to understand why and how decisions are taken, most of all in the situations when incentive-based logic fails to explain the decision-making process. The same author further argues that legitimate environmental decisions shall incorporate both *distributive* and *procedural* aspects of environmental justice, with implications that wealth incentives might be able in many situations to compensate for compromised values (i.e. fair distribution), and that "*…those whose interests are not endorsed by a particular environmental decision that their interests can count in other decisions*" (i.e. the procedure does not give a sense of being excluded from the decision-making process) (Paavola, 2007).

1.3.2. Environmental governance — properties and functions

Environmental governance, although it was mentioned quite a few times before, deserves to be introduced separately as one of the core (and increasingly popular) concepts of environmental discourse. *Governance* is often confused with *governing*; the key difference is that *governing* refers to those social activities which make a "*…purposeful effort to guide, steer, control, or manage (sectors or facets of) societies*", while governance concerns "*the patterns that emerge from the governing activities of social, political and administrative actors*" (Kooiman, 1993: 2), or in other words "*the ways and* *means in which the divergent preferences of citizens are translated into effective policy choices, about how the plurality of societal interests are transformed into unitary action and the compliance of social actors is achieved*" (Kohler-Koch, 1999: 14).

A universal and relatively concise definition of *environmental governance* was suggested by Jouni Paavola (2007), who described it as "*…the establishment, reaffirmation or change of institutions to resolve conflicts over environmental resources*"; Karl Folke with co-authors gave a somewhat broader view, where *environmental governance* concerned with "*…creating the conditions for ordered rule and collective action or institutions of social coordination; the structures and processes by which people in societies make decisions and share power*" (Folke et al., 2005).

In the context of these definitions it is important to see the difference between the governance by the state, which is the ability of a state to meet its governance objectives and governance in its broader sense, i. e. the system that functions even in a situation of a deregulated economy, where governmental actors or rules set by the government do not exist or have limited influence.

In policy analysis it can be important to understand the difference between *governance frameworks* and *governance regimes*. Governance frameworks are usually set by pieces of legislation (or other norms) created to establish or to modify policies. Examples include EU directives (e. g. EU water management policies regulated by the Water Framework Directive), UN conventions (e. g. Montreal Protocol providing a framework for global ozone policy) etc. Different frameworks may interfere, especially if they originate from different contexts (e. g. forestry, water management, biodiversity conservation), and their combined action, alongside with contribution by many more agents (both affected by the frameworks and acting/existing independently), create a new contexts and institutional environments that can be conceptualised as *governance regimes* (Paavola et al., 2009). Their scale may range from local (e. g. a regime emerged over governing a lake) to global (e. g. governance of the global climate change).

Interaction between the physical system and the society is often conceptualised through the analytical problems of *fit, interplay*, and *scale* in environmental governance.

The problem of *fit* emerges from the argument that the effectiveness of institutions is a function of match between institutions and biophysical systems, that is to say, the better the match the more effective the institution. However, the closest fit is not always the best one, as it is very case (time/place) specific. Changes in biophysical system may impact the performance of institutions (Young, 1999). According to Young (2002), institutional misfits (mismatch) occur through imperfect knowledge, institutional constraints, and rent-seeking behaviour. The fundamental assumption of the concept of fit is that the society and its institutions can achieve a very close match with the biophysical system; this assumption can be easily challenged, however it helps to explain how certain social constructs or management models can be inappropriate in specific ecosystem conditions.

Folke et al. (1998) recognise spatial, functional, and temporal misfits. *Spatial mismatches* occur where the boundaries of management do not coincide with the boundaries of the ecological entity. The nest discussed examples include mismatches between administrative borders and boundaries of ecosystems or river basins managed within these borders. *Functional mismatches* are mostly mismatches of scope, arising when users with very specific needs and narrowly defined management actions fail to take into account the complexity of managed systems, e. g. when a water management body is also assigned to manage biodiversity. *Temporal mismatches* may occur when environment is rapidly changing, but social systems are slow to respond and have cultural inertia and organizational rigidity. Very common instances of such mismatches occur in situations when an administrative procedure takes longer than a biophysical or social cycle it is dealing with, e. g. in many countries the management of national parks or biosphere reserves involves so many bureaucratic procedures that management responses to natural disasters or seasonal changes are often delayed and delivered not in a timely manner.

Institutions cannot be perceived as autonomous arrangements. They interact with other institutions both horizontally and vertically. *Horizontal interplay* features interactions occurring at the same level of social organization. *Vertical interplay* is a result of cross-scale interactions or links involving institutions located at different levels of society (Young, 2002).

The problem of *scale* refers to the transferability of generalizations and inferences from one level to another in spatial and temporal dimensions; it has to do with an ability to generalise knowledge about institutions (Young, 1999). In a very simplified form this problem can be summarised as following: "the scale of a problem and the scale of institutions set up to solve the problem shall be the same". In a reality most problems have a multi-scale nature that obviously requires multi-scale approaches for solving them.

1.3.3. Multilevel environmental governance

The discussion on the scale of problems is related to the notions of *multilevel* or sometimes also *polycentric governance*. They are based on the observation that environmental change and increasing complexity of societal interactions act as triggers for proliferating institutional arrangements dealing with environmental issues and also for their increased interconnectedness (Young, 2002). This ultimately leads to the dispersion of central government authority, which process is referred to by Hooghe and Marks (2001) as *multi-level governance*. Ostrom et al. (1961) described this process as *polycentric governance*, where many centers of decision-making that are formally independent of each co-exist and collectively deal with an environmental issue or natural resources (McGinnis, 1999).

Increasing prominence of non-state actors in political decision-making is commonly described as a core feature of *multilevel* (*polycentric*) *governance* (Bache & Flinders, 2005). For this reason *multilevel* (*polycentric*) *governance* is also argued to support flexible and competent decision-making (e. g. Bromley et al., 1992; Folke et al., 2002; Ostrom, 2005), which is, being fed by multiple centers of authority (including multiple sources of expertise), contribute to the solution of complex problems (McGinnis, 2000).

Multilevel environmental governance, however, became a reality only with proliferation of multilateral environmental agreements (MEAs) and development of a substantial body of EU directives on environmental matters (Paavola, 2008). Even in governance contexts where governance by the state is hierarchical and decision-making is very top-down, MEAs may play an important role in supporting alternative centers of governance.

Otto et al. (2011) show how in Belarus, where the national administrative culture is very top-down, NGOs carve their way to participation in policy discussions or in decision-making about management of national parks through appeals to international organisations, both governmental and inter-governmental (UNESCO, European Council) and non-governmental (such as WWF). This study further demonstrates that if the issue or the protected areas in question are not of a very high concern to international counter-parts, or if the national government does not value the material or symbolic benefits associated with cooperation with and appreciation by the international partners, then such appeals may not work. Such situations, although to a smaller extent, are also typical for many Western democracies, including EU member-states. Although cooperation of government bodies with multiple stakeholders, including local communities and NGOs is embedded in most environmental EU directives, the state actors are often unwilling to accept the emerging agency beyond the state.

1.3.4. Implementation deficits

A very special applied issue emerging in the context of multilevel governance is *transposition of environmental policies* from higher policy level to the action ground and related *implementation deficits*.

As such, the problem of *implementation deficits* is not new. The first comprehensive analysis of the issue came from Pressman and Wildavsky (1973), who set the objectives and boundaries of implementation studies as a research field, and offered a critical assessment of causal linkages between policy goals and the actual outcomes. They brought forward the notion of "*implementation chain*" consisting of interlinked implementing agencies. Their assessment framework is based on the assumption that the degree of cooperation between the agencies required to create the links should be close to one hundred percent, and if the percentage is considerably lower in many instances, the small deficits accumulate over the chain that results in compromised or unsuccessful policy outcomes. In other words, development of conditions for a coordinated *collective action* is essential in order for the policy to be effective.

To support this point, in their analysis of implementation and re-development perspectives of the Great Lakes Water Quality Agreement, McLaughlin and Krantzberg (2011) argue for the policy that is aware of the complexity of governance and biophysical systems and the deficiencies of traditional policy-making approaches (including the unwillingness to guess and experiment under large uncertainty and information deficiency — see section 2 for information on adaptive co-management and governance approaches) still dominating natural resource management agencies and based on a simplistic understanding of social-ecological systems and their management, while in the reality the society and its interactions with ecosystems is neither under control nor entirely predictable. Evans and Klinger (2008) demonstrate that even at the action ground the implementation process can be easily constrained by oversimplistic understanding of ecosystem management. They further identify two specific barriers preventing user groups from achieving ecosystem management objectives: (1) deficit of information (e. g. due to the lack of specific management expertise) and (2) inadequate investment to management activities (mostly due to underestimation of the complexity and size of the management action).

Problem framing (see more on the framing issues in the Section 2) is one of the key factors that determine the success of policies, or their "*tractability*". As Dupuis and Knoepfel (2013) show for adaptive policies in Switzerland and India, their efficiency varied depending on whether the problem was framed as "climate change adaptation", "climate variability adaptation" or "vulnerability-centred adaptation". They argue that the "climate change adaptation" track is more prone to tractability issues due to pre-required (and not available at all the decision-making and management levels) in-depth understanding of the atmospheric system and climate projections, while "vulnerability-centred adaptation" addresses specific issues and requires the expertise, which is broader available at all the levels (in particular the management level). The authors further argue that at the meso-scale the "climate change adaptation"-oriented policies are very likely to be compromised by conflicts of "intra-policy coordination" (here this is terminologically equal to the *institutional interplay* as discussed in 1.3.2) due to innovative, large-scale, or intense policy solutions they utilize and promote, the kind of solutions usually associated with most other vertically-integrated policies, such as sustainability policies. At the micro-level the authors find that in contrast to other framings, the globally formulated and coordinated "climate change adaptation" policy stream does not fit the local institutions of environmental governance, whereas "climate variability adaptation" and "vulnerability-centred adaptation" have a wider scope that is more likely to appeal to the needs and interest of implementation actors.

In complex administrative set-ups, such as federal states or the EU, where the same legislation can be offered to a diversity of federal subjects or even independent nations with different management cultures, institutional and biophysical contexts, the policy implementation process is challenged even more. Lampinen and Uusikylä (1998) show that even in the relatively homogeneous EU of 1995, the implementation success of EU directives in different member states significantly varied, with Denmark, Netherlands and the UK most successful, and Greece, Portugal and Italy failing to implement most of the directives. The study concluded with the assumptions that "*countries with effective and stable political institutions and a corporatist system that integrates interest organizations into political decision making, would have the best capability to implement EU directives*", and "*it is easier to implement EU directives in countries where the political system has high legitimacy, people are satisfied with democracy, the degree of social fragmentation is low, individual rights are highly respected, and attitudes towards the EU are positive*" (Lampinen & Uusikylä, 1998: 248).

With the EU accession of Central and eastern European countries, the European biophysical and governance landscapes became even more diverse, and so became the landscape of implementation deficits. Leventon and Antypas (2012) had demonstrated the difficulties Hungary faced with the implementation of the EU Drinking Water Directive. On one hand, local geological conditions cause high concentration of arsenic in groundwater in a significant part of the country. On the other hand, regional governments and local communities do not have institutions of joining resources for a common cause, and involving non-governmental actors in the matters related to municipal management, while the Directive is very much based on the assumption that such institutions might exist. As a result, the deficits occurred at all the administrative levels, and their cumulative effect led to the overall implementation failure. Apparently, some of the deficits were related to wrong (not suitable for this specific social-ecological system) assumptions laid in the Directive, while the others are rather related to actors' choices and behaviour.

Leventon and Antypas (2012) had identified the instances of implementation deficits and classified them in regard to the failures oriented either to policy goals (e.g. adoption of an EU Directive and all the necessary sub-laws for completing the formal implementation process) or policy problems (the extent to which the actual problem is solved), and to policy outputs (creation of policy infrastructure) or policy outcomes (specific management actions demanded by the outputs). In simplified form the classification used to describe the implementation of the Drinking Water Directive (DWD) in Hungary is set in the Table 1.1 (Leventon & Antypas, 2012: 255):

Table 1.1

Implementation deficits in the EU policy system in Hungary (Leventon & Antypas, 2012)

Failure	Impact	
	Policy output	Policy outcome
Orientation to policy goals	A. There is no Hungarian legislation to enact the EU drinking water directive	B. The actions outlined in Hungarian legislation cannot achieve the EU arsenic limits
Orientation to policy problem	C. The EU DWD is not the most effective option for managing arsenic in drinking water in Hungary	D. The arsenic limits set in EU legislation do not protect public health from the impacts of geogenic arsenic

1.3.5. Decomposing environmental governance

One of the ways for understanding a system's complexity is to decompose it on components that explain the system's dynamics as a combination of certain aspects. For such a complex system as environmental governance, such decomposition may, for instance, follow generic environmental governance functions identified by Paavola (2007):

1) exclusion of unauthorized users;

2) regulation of authorized resource uses and distribution of their benefits;

3) provisioning and the recovery of its costs;

4) monitoring;

5) enforcement;

6) conflict resolution;

7) collective choice.

The assumption is that for successful functioning of a governance system, all of these need to be checked through, so there are working governance solutions behind each of the functions. As such, this can be used as a template for an analytical framework, in particular for studying liveability of governance set-ups.

Earth System Governance global research alliance (http://www.earthsystemgovernance.org/) approached the problem of decomposition through *analytical problems of Earth System Governance* (ESG).

The concept of *Earth System Governance* (ESG) was formulated by Biermann (2007) to provide a platform for merging governance theories with earth system science. The concept of governance — often implying some form of self-regulation by actors, private-public cooperation, and multilevel policy approaches — was used instead of a narrower management concept to eliminate connotations to hierarchical steering, planning and controlling of social relations by the state (Biermann et al., 2009).

ESG is defined by Biermann et al. (2010) as "*the interrelated and increasingly integrated system of formal and informal rules, rule-making systems, and actor-networks at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating, and adapting to global and local environmental change and, in particular, earth system transformation, within the normative context of sustainable development*".

There are at least five *problem characteristics,* which make ESG a special and unprecedented governance challenge for both researchers, decision makers and justify it as broadly applicable way to analyse environmental governance systems (Biermann, 2007):

(i) persistent analytical and normative *uncertainties* associated with global environmental change and response options to it;
(ii) *intergenerational dependencies* resulting from the temporal separation of causes and effect of earth system transformation;
(iii) *functional interdependence* between policy domains linking response strategies in one problem area to a number of other areas;
(iv) *spatial interdependence* caused by the earth system potential to transform local environmental changes into changes that affect other localities and the ability of global social system to transform local environmental degradation into regional or global socioeconomic crises; and
(v) an *extraordinary degree of harm* existing governance systems are not entirely prepared for.

From these characteristics of earth system transformation, Biermann (2007) derives *governance principles* of credibility, stability, adaptiveness, and inclusiveness. Following these principles, the ESG Project (Biermann et al., 2009) put forward five interdependent *analytical problems* (these problems are often referred to as *5 As of ESG*):

(i) the overall *Architecture* of ESG,
(ii) *Agency* beyond the state and of the state,
(iii) the *Adaptiveness* of governance mechanisms and processes,
(iv) their *Accountability and legitimacy*, and
(v) modes of *Allocation and access* in ESG.

Biermann (2007) argues that the research efforts should be refocused from single institutions to the overall *Architecture* of ESG in order to account for stability, credibility, and inclusiveness. By governance architecture, he understands clusters of regimes, norms, principles, and other institutions in a problem area. Architecture can also be described as a meta-level of governance (Biermann et al., 2010).

Governance institutions increasingly tend to include non-state actors from different levels. These actors often acquire *Agency* by means of active participation and ability to set their own rules; which leads to a formal recognition of a difference between actors and agents. The actors are individuals, organizations, and networks involved in decision-making, while the agents are the authoritative actors. In this discussion the authority refers to a legitimacy and capacity to exercise power, and the power is a capacity to influence outcomes (Biermann et al., 2010).

The ESG Project (Biermann et al., 2009) uses *Adaptiveness* as an umbrella term for a number of concepts describing the changes society is making in response to environmental change. These concepts include adaptive capacity, resilience, adaptation, and vulnerability. Adaptiveness includes both adaptive governance to social-ecological change and the processes of adaptation taking place within governance systems.

Accountability and legitimacy are intervening variables determining overall effectiveness of institutions. With the emergence of international and subnational levels of governance, legitimacy and accountability are not concerns of national governments alone. Intergovernmental institutions and agents indirectly obtain their legitimacy through governments, which are accountable to their voters, while the legitimacy of private agents may come from accountability to their members and donors (Biermann et al., 2009).

An effective ESG is possible only if all the stakeholders perceive it as fair and equitable (Biermann, 2007). A fairness of *Allocation and Access* has to do with both the way their objectives are defined and the means selected to achieve them. The problem of access is directly linked to human rights and freedom of information. The allocation refers to the distribution of risks, responsibilities and benefits between actors.

Although ESG was designed as a global research plan, the 5 As also work fairly well for analysing social-ecological systems at a local scale, as an increasingly growing body of literature demonstrates (Werners et al., 2009; Shkaruba & Kireyeu, 2013).

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2. Knowledge and learning in environmental policy context

Knowledge is often held to be the main driver and framing power of environmental policy, which is also recognised and addressed by a growing body of literature on knowledge generation systems, and on the propagation and actual use of knowledge. The second part of the textbook explores the issues of learning and use of knowledge in the context of agenda setting, development and implementation of environmental policies. First, in order to frame the discussion, it introduces the concepts of *social-ecological systems* and *adaptive governance* (2.1). Next, it describes a broad range of issues related to *knowledge production and utilisation* and relates them to structure and participants of environmental policy process (2.2). After this, we explore such specific (albeit important) instances of knowledge production as *social learning* (2.3) and *local knowledge* (2.4), and discuss the problems of integrating them into environmental management and governance.

2.1. Governance of adaptation and adaptive governance

Viktar Kireyeu, Anton Shkaruba

Adaptation, adaptive management, adaptive governance, adaptive policies and other key words with "adaptive" in it, are increasingly populating international, EU, national and local policy documents, international treaties, agendas of strategy discussions and management plans. This is because global environmental change, in particular, climate change is a new reality for environmental management, and environmental managers are getting used to the idea that nothing is stable anymore, ecological, social and political contexts are highly dynamic, and that good management shall incorporate a significant *learning component,* evaluation of *uncertainties* and be ready for *experimentation*. This chapter will introduce the field of *vulnerability and adaptation* studies, in particular from a policy perspective.

Environmental policy is all about human-nature interactions. Concept of *social-ecological systems* (or SES) gave rise to a field of studies that looks at such interactions from an integrative perspective combining holistic approaches and issues of human well-being and social justice, i. e. provides a good fit to normative context of sustainable development. For this reason, and also because this concept is broadly employed in vulnerability and adaptation studies, the chapter opens with an introduction to social-ecological systems and their properties; then it continues with explaining the basic terminology of vulnerability and adaptation, introduces *adaptive management* and *co-management*, and to a broader concept of *adaptive governance*.

2.1.1. Social-Ecological Systems and their diagnostics

There is a number of concepts and approaches illustrating the coupled nature of human and biophysical systems, including socio-ecological systems (Gallopín, 1994), social-ecological systems (Berkes & Folke, 1998), human-environment systems (Turner et al., 2003), human-biophysical systems (Dietz et al., 2003) etc. These systems may exist at various levels, ranging from local to global.

Due to the strong theoretical base, the concept of *social-ecological systems* (SES) enjoys broad dissemination in the international literature, in particular on community-based management. It explains human-nature interactions in a relatively simple and coherent way, and works as a functional tool for visualisation of links and interdependencies within the system, including the spatial and historical patterns. It also can visualise how local institutions integrate into larger governance architectures, and the agency below the state develops taking advantage of polycentric nature of environmental governance.

The concept of SES was first proposed in order to explain and examine the complexity of interactions in a system that included humans interacting with a biophysical system and had an ability to sustain itself (Gallopín, 1989), and then it was further elaborated by many scholarly networks. The "social science cluster" of the global environmental research community usually sticks to definitions coming from the Elinor Ostrom's group (e. g. "…social systems in which some of the interdependent relationships among humans are mediated through interactions with biophysical and non-human biological units" (Anderies et al., 2004)). Scholars belonging to the Resilience Alliance (http://www.resalliance.org/) chose to emphasise the integrated character of the concept, and to stress that the delineation between social and ecological systems is artificial and arbitrary (Folke et al., 2005). They therefore offer definitions of SES, which are essentially very neutral and underlying the equal importance of social and biophysical components of social-ecological systems (e. g. “social-ecological systems are complex, integrated systems in which humans are part of nature” (Berkes et al., 1998)).

Depending on the position of institutional components, the literature describes SESs from the three perspectives: intersection (Fischer-Kowalski & Weisz, 1999), linked (Gallopín, 1994; Berkes & Folke, 1998), and those linked with a governance filter (Kotchen & Young, 2007).

SESs as intersections are discussed in the frame of *socio-metabolic approach* where society-nature interactions are conceptualised as interaction and co-evolution (Fischer-Kowalski & Weisz, 1999). The underlying idea is that human society is maintained by cultural (including interconnecting communication flows generated by political, economic, legal etc. subsystems of the society) and by biophysical modes of perpetuation. The biophysical mode is further decomposed as two interrelated processes — social metabolism (i. e. continuous flow of energy and materials from or to the natural environment) and colonization (deliberate interventions into the environment). The social-ecological systems here is the area where these two modes intersect and materialise in physical infrastructure, environmental impacts, management practices and policies, development agendas, educational and research programs, artistic reflections and so on, all interacting between each other, reinforcing, mitigating, destroying etc.

In the *linked SESs* discussed by Gallopín (1994), society and nature (or also ecological systems) interact through human actions coming from the society and ecological effects generated by the nature as a result of internal dynamics or external impacts (including the human actions). In this methodology an important part of the system analysis is related to the external environment (ecological and social) that interacts with actions coming from the societal system and modifies them (and this way influences the natural subsystem), but also may change feedback mechanisms of ecological systems or even cause their structural changes.

Kotchen and Young (2007) conceptualised the role of institutions as filters mediating between human actions and biophysical processes, rather than just providing a link between social and ecological systems (Folke et al., 1998). In this conceptualisation, governance system is seen as a combination of institutional filters working in both directions (see Fig. 2.1). The governance filter consists of the sets of rules, rights, and decision-making procedures that are created by humans to guide actions, including those that may have disruptive impacts on biophysical systems. It also provides mechanisms acting as a sort of "safety nets" against biophysical impacts on human welfare, such as insurance schemes and emergency assistance programs. The governance system should be capable of managing both of these relationships simultaneously (Kotchen & Young, 2007).

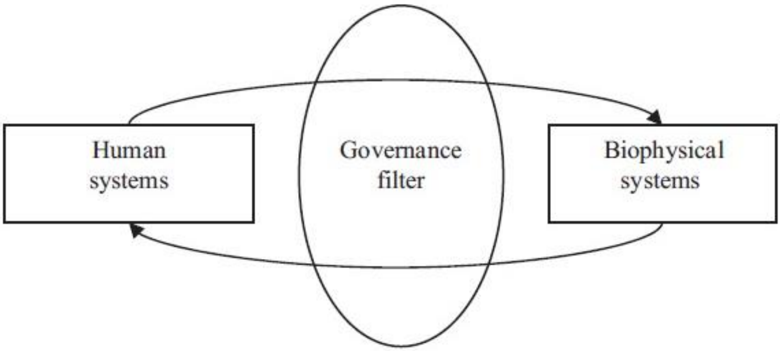

Fig. 2.1. Coupled human-biophysical systems.
Source: Kotchen & Young, 2007

The SES provides a conceptual base for a number of analytical and evaluation frameworks looking at the SES e.g. through glasses of stakeholder assessments, model explorations, historical profiling or case study comparison (Carpenter et al., 2005).

Elinor Ostrom (2009) developed a SES diagnostic framework, in which she recognised four dynamically interlinked subsystems: (1) resources systems, (2) resource units, (3) governance systems, and (4) users with their knowledge and understanding the resources. In order to fill this frame with details and link it to established methodological tools, Michael McGinnis (2010) offered a revision, which was very much based on the well standing Institutional Analysis and Development framework (IAD) (Kiser & Ostrom, 1982). He looked to address "*the criticism of the IAD framework as* *not taking concepts of relevance to ecologists as seriously as we were taking diverse levels of concepts related to institutions*" (McGinnis, 2010: 2). The integration of institutional and biophysical sides of SES's is mostly implemented through the analysis of *focal situations*, i.e. specific instances of managing the system or the sub-systems.

Some of the assessment approaches used within the Resilience Alliance are summarized e. g. in the series of workbooks available from http://www.resalliance.org offering tools and forms to fill in that can be used for more basic social-ecological inventories (SEI) as well as for the full resilience assessment. The workbooks provide guidance to a structural overview of SES, identification of vulnerabilities, driving forces and uncertainties, and call for an issue-based assessment and, where possible, for "collective" treatment of the issues. The workbooks also suggest to consider for the resilience assessment thresholds and their interactions and proximity (e. g. discussed by Kinzig et al. (2006), Briske et al. (2010) and assess both specified and general resilience (e. g. see Walker et al. (2009) for examples of a comprehensive analysis). Augerot and Smith (2010) offer a more straightforward SES assessment, which is structured according to the dimensions of the adaptive cycle: they ran a qualitative assessment of capital accumulation and connectedness at the regional scale. The methodology for valuation of ecosystem services proposed by Hein et al. (2006) does not specifically addresses SES, but it looks at biophysical properties of ecosystems as well as values and stakeholders' consent and therefore it is often used in the resilience assessment of SES.

2.1.2. Vulnerability and adaptation studies — introduction to the concept and terminology

To evaluate the governance of social-ecological systems, we need a conceptual framework, which would provide for integrative assessment of both human and biophysical components. The broadest and the most commonly used by climate change research community framework is *vulnerability* (Gallopín, 2006; IPCC, 2007).

Füssel and Klein (2006) distinguished risk-hazard, social constructivist, and integrated models to conceptualise and assess vulnerability. The *risk — hazard framework* is commonly used in technical research on disaster and risk management. Vulnerability in this model is a dose — response relationship between the hazard a system is exposed to and the range of adverse effects caused by the hazard. The *social constructivist framework* dominating in human geography and political economy defines vulnerability as an intrinsic characteristic of a community determined by socioeconomic and political settings. Vulnerability in this approach refers to socioeconomic causes of differential sensitivity and exposure. According to the *integrated framework*, vulnerability is a combination of possible impacts to a system triggered by external stressors. In this model, vulnerability has an *external dimension* — which refers to the 'exposure' of a system to an environmental change — and an *internal dimension* — which combines 'sensitivity' and 'adaptive capacity' to the environmental change.

The origin of the integrated framework is the hazards of place model (Cutter, 1996), which was developed to integrate biophysical and social determinants of vulnerability. This conceptual framework has an explicit focus on a locality. The overall hazard potential in this model is understood as a combination of risk and mitigation. It is filtered both through the social fabric and the geographic context, and results in a social or a biophysical vulnerability respectively. The vulnerability of places is defined as an intersection of these two vulnerabilities. There is a feedback loop from the place vulnerability to both the risk and mitigation. This relatively simple model is getting more complicated with all the parameters of the model constantly changing over time (see the bottom half of Fig. 2.2); furthermore, each of these parameters contains a number of nested elements.

The hazards of place model were further developed by IPCC. Their initial approach was to distinguish between *sensitivity* — how a sector is directly affected by global climate change (e. g., change in agronomic crop yield); *adaptability* — how a system could respond to global climate change (e. g., crop rotation); and *vulnerability* — the net effect after sensitivity and adaptability are evaluated (IPCC, 1996).

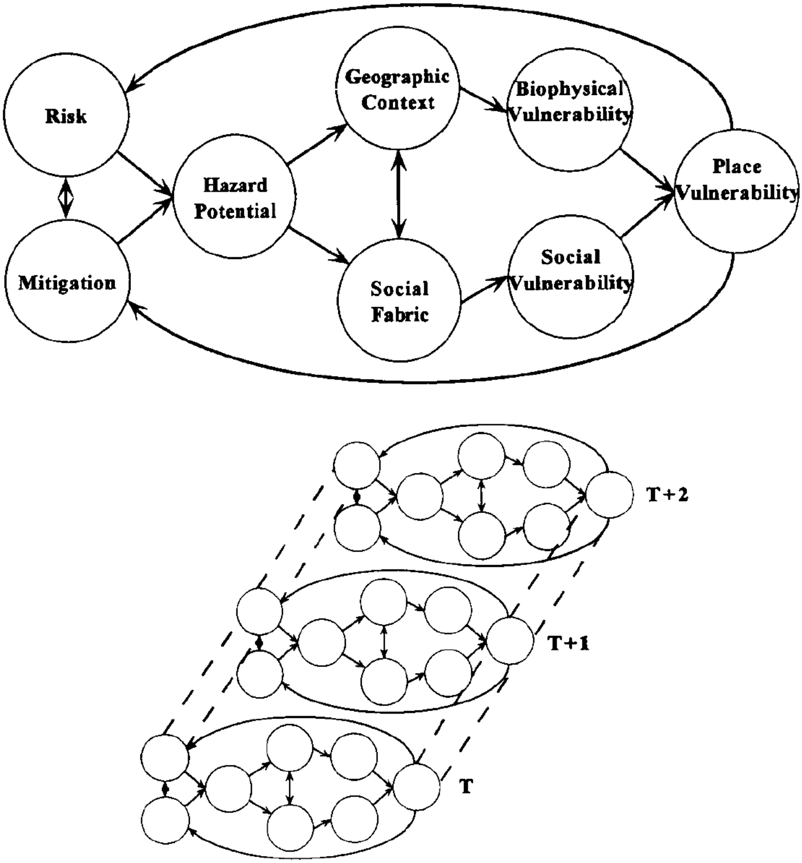

Fig. 2.2. The hazards of place model of Vulnerability.
Source: Cutter, 1996

However, in the synthesis chapter of the IPCC Third Assessment Report (TAR) Working Group II recognised the limitations of static impact assessments and challenged a shift towards dynamic assessments (based on functions of shifting climatic parameters, trends in economic and population growth, and the ability to innovate and adapt to changes), which finally led to the definition of vulnerability as "the extent to which a natural or social system is susceptible to sustaining damage from climate change" and the degree to which a system is unable to cope with “adverse effects of climate change”. Vulnerability thus could be measured as “a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity” (IPCC, 2001b).

In the Advanced Terrestrial Ecosystem Assessment and Modelling (ATEAM) project, the term ‘vulnerability’ was defined in a way to include both the traditional elements of impact assessments (i. e. sensitivities of a system to exposures) and adaptive capacity to cope with potential impacts of global change). ATEAM adjusted the IPCC definition of vulnerability to make it directly related to social-ecological systems and human sectors relying on ecosystem services: “Vulnerability is the degree to which an ecosystem service is sensitive to global change plus the degree to which the sector that relies on this service is unable to adapt to the changes” (Metzger et al., 2005).

Exposure is a nature and degree to which ecosystems are exposed to significant climatic variations, as IPCC (2001b) defines, or to environmental change, as a broader definition used in the ATEAM project (Metzger & Schröter, 2006) suggests. In IPCC (2001b), *sensitivity* is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e. g., a drop of crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e. g., damages caused by an increase in the frequency of coastal flooding due to sea level rise). *Sensitivity* used in ATEAM is the degree to which a social-ecological system is affected, either adversely or beneficially, by environmental change (Metzger & Schröter, 2006).

Knight and Staneva (2002) define *sensitivity* as the degree to which a system will respond to a change in climatic conditions (e. g., the extent of change in ecosystem composition, structure, and functioning, including primary productivity, resulting from a given change in temperature or precipitation).

The issue of *adaptation* to climate change and to its effects on human health and economic activities has received a considerable attention of researchers and policy makers (IPCC, 2001a, b). IPCC (2001b) defines *adaptation* as “any adjustment in natural or human systems in response to actual or expected climate change stimuli or their effects, which moderates harm or exploits beneficial opportunities". According to IPCC (2001b), adaptation can be autonomous or planned, anticipatory (proactive) or reactive (depending on whether the adaptation takes place before or after impacts of climate change have been observed), and also a private or a public. *Autonomous adaptation* is "triggered by ecological changes in natural systems and by market or welfare changes in human systems, but does not constitute a conscious response to environmental change". This type of adaptation changes the sensitivity of a system by changing its state. It is a part of the internal feedbacks in the social-ecological systems. *Planned adaptation* is "the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state". Examples of such adaptations include an introduction of drought resistant crops, establishing protected areas and ecological networks to sustain landscape and biological diversity, widening river channels to cope with peak flows, and constructing dams to preserve water for drier summers.

Knight and Staneva (2002) defined *adaptation* as adjustments of practices, processes, or structures in response to projected or actual climate changes. Adjustments can be either spontaneous or planned, reactive or anticipatory. In some instances (e. g. in case of many ecosystems), options for planned or anticipatory adaptation may not exist. Adaptations can reduce negative impacts or take advantage of new opportunities emerging with changing climate conditions.

Potential impacts are all impacts that may occur under a projected environmental change without considering planned adaptation (Metzger et al., 2005). Residual impacts are the impacts of global change that would occur with planned adaptation measures taken (Metzger et al., 2005). According to Füssel and Klein (2006), the exposure, sensitivity, and potential impacts are only relevant at the level of *exposure unit* (a sector, activity or location assessed for climate change impacts (Carter et al., 1994)) as opposed to GHG emissions, concentrations, and climate change which are relevant at the global level.

IPCC (2001b) defines *adaptive capacity* as the "potential, capability, or ability of a system to adapt to climate change stimuli or their effects or impacts". In Millennium Ecosystem Assessment (2005), it is the "general ability of institutions, systems, and individuals to adjust to potential damage, to take advantage of opportunities, or to cope with the consequences". Both definitions imply that, in principle, adaptive capacity has the potential to reduce the damages of climate change, or to increase its benefits.

In the Third Assessment Report of IPCC, they propose 6 broad classes of factors that determine the adaptive capacity, namely (i) economic wealth, (ii) technology, (iii) information and skills, (iv) infrastructure, (v) institutions, and (vi) equity (IPCC, 2001b). Methodologies for empirical measurement of adaptive capacity and establishing the relative importance of its determinants are still not sufficiently robust. Brooks et al. (2005) and WRI (2009) have made attempts to develop a framework for determining adaptive capacity at the national level. Metzger et al. (2008) developed a generic index of macro-scale adaptive capacity, which was based on socio-economic indicators, determinants and components of adaptive capacity, such as female activity rate, equity, GDP, number of patents, and age dependency ratio. This index was calculated for subnational regions (i. e. lands, provinces).

Links between adaptive capacity and multilevel governance of social-ecological systems were revealed by Plummer and Armitage (2010). They recognise that the adaptive capacity has an important social dimension, and there is a need to understand the role of formal and informal institutions, as well as a relationship between the dynamics of governance and biophysical systems.

Adaptive capacity is directly related to the concept of *resilience*. This concept is widely used by ecologists and engineers. According to Holling (1973: 17) "resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist." *Resilience* was the first concept to be used for the analysis of interactions between human and natural components. The concept is being continuously developed by the Resilience Alliance.

2.1.3. Adaptive governance

Addressing the issue of uncertainty associated with complex systems, Holling et al. (1978) found that the *resilience* (Holling, 1973) of a system is higher, when both management and natural components of the system are more variable. They proposed an *adaptive management* approach to increase the variability and, by extension, the resilience of management institutions. The essential parts of their approach were an explicit accounting for uncertainty, using an adaptive process for the design of management policies, and treating environmental assessment as an integral part of management. Depending on the way the policy design process takes place, Walters and Hilborn (1978) distinguished between *passive* and *active* adaptive managements. The former approach uses models based on prior knowledge and corrects them as mistakes occur, while the latter treats all management actions as experiments.

The adaptive management framework was further developed and applied for renewable resources by Walters (1986). He described traditional trial-and-error management as “unnecessary wasteful” and, in order to make adaptive management more intelligent, suggested to involve the structured synthesis and analysis of major processes and uncertainties, the development and implementation of improved monitoring programs, and formal optimization techniques to search for best possible policies accounting for both existing and future uncertainties.

The principles of adaptive management were applied to policy-making by Swanson et al. (2009). They proposed seven tools for devising adaptive policies, namely integrated and forward-looking analysis, built-in policy adjustments, formal policy review and continuous learning, multi-stakeholder deliberation, self-organization and social networking, decentralizing of decision-making, and promoting variation.

A broader concept of *adaptive governance* was introduced by Dietz et al. (2003). Adaptive governance, they argue, requires providing reliable information, dealing with conflicts, inducing rule compliance, providing infrastructure, and designing institutions prepared to a change. These requirements can be met by devising rules that are congruent with ecological conditions, clearly defining the boundaries of resources, devising accountability mechanisms for monitors, applying graduated sanctions for violations, establishing low-cost mechanisms for conflict resolution, encouraging analytical deliberation, nesting institutional arrangements, and promoting institutional variety.

To operationalise the concept of adaptive governance, Olsson et al. (2004) proposed *adaptive comanagement* approach that integrated the dynamic learning feature of adaptive management with the linkage attribute of collaborative management (Borrini-Feyerband, 1996). They argue that this approach, if combined with institutional support from higher levels, has a capacity to increase the robustness of social-ecological systems to the change. The essential requirements for the emergence of adaptive comanagement of ecosystems include legislation that creates social space for ecosystem management, funds for responding to environmental change, ability to monitor and address environmental feedbacks, information flow and social networks, integration of various sources of information, sensemaking of the integration results, and platforms for collaborative learning.

Adaptive governance of social-ecological systems in the periods of abrupt change was analysed by Folke et al (2005). In the systems of adaptive governance, according to them, actors and institutions are connected at multiple organizational levels; some actors provide leadership, vision, meaning, trust, and help to transform organizations into a learning environment. The authors highlight four interacting characteristics of adaptive governance of social-ecological systems: building knowledge on ecosystem dynamics; feeding ecological knowledge into adaptive management practices; supporting flexible institutions and multilevel governance systems; and dealing with uncertainties, surprises, and external perturbations. Further chapters specifically focus on knowledge generation, use and dissemination as core components of environmental policy process, in particular on such well discussed in vulnerability and adaptation literature issues as social learning and local knowledge.

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2.2. Knowledge in support of governing sustainability transitions

Matthijs Hisschemöller

The way governments and societal actors handle new knowledge and information is of major relevance for sustainability transitions (Loorbach 2010; Kemp, Loorbach & Rotmans, 2007). The objective of this chapter is to discuss the processes in which knowledge is used, not used or abused as a central component in environmental governance. It continues the discussion started in the previous chapter on the role of knowledge and learning in the dynamics of social-ecological systems, explains typologies of knowledge (e. g. scientific, practical and unwanted) and knowledge use, interactions between actors, and policy problems, explores the policy context of knowledge production and utilization, and introduces such concepts as advocacy coalition, agenda-building and barriers to agenda-building.

2.2.1. Conceptual and methodological questions

For several decades, policy scientists and sociologists have been struggling with the conceptualization of knowledge use in public policy. There have been quite some efforts to structure this issue in a manageable way, which have resulted in quite different frameworks for evaluation research. Notwithstanding all differences, we think it is fair to say that there is scientific consensus with respect to the following observation: Variables to be taken into account relate (1) to the type of knowledge, which may also include institutional factors such as culture and tradition with respect to academic disciplines and the institutionalization of academic research, (2) the institutional policy context, including values, practical knowledge, the policy process, characteristics of the policy subsystem including the interactions between knowledge providers and potential users and (3) different types of actual use.

Below we will bring some conceptual clarity with respect to both issues. The main purpose of this exercise is not so much to make a decisive claim with respect to the state-of-the-art in knowledge for policy research but to frame the complexity in such a way that it helps the environmental researcher to find a way in assessing the usefulness of different frameworks and methods.

2.2.2. Different types of knowledge

There are various classification systems for knowledge. These classifications may assist in assessing and, eventually, explaining as to whether and why certain knowledge is more relevant in a decision context than other.

Fundamental versus applied research. Although this distinction is quite common, there is no agreement among researchers about its usefulness. One important feature of applied research is that it is aimed to be used by policy-makers or other stakeholders. Therefore, the value context of applied research is probably more critical than for fundamental research. Knowledge from applied research may be more relevant for a specific decision context than knowledge from fundamental research. However, in both types the research quality is critical. Research quality is traditionally assessed using criteria such as reliability and validity. This is what Van de Vall (1987) has labelled the first quality parameter of applied research. The other parameters for assessing the quality of applied research are referred to as the 'strategic', and the 'feasibility' parameter. The strategic parameter relates to shared values between the producer and user of the knowledge, whereas the feasibility parameter relates to the issue as to whether policy advice can be implemented (Van de Vall, 1987). Dunn (1980) has tested several hypotheses on research quality in the eyes of the anticipated user, such as (i) the reliability of research findings, (ii) the validity of research findings, (iii) research using contextually grounded concepts, which the user may better relate to than formal social science concepts and (iv) the use of quantitative versus qualitative research methods. Only for reliability and validity, Dunn found a moderate to strong correlation with utilization.

Scientific knowledge versus practical knowledge. Researchers of knowledge use have become interested in the distinction between, on the one hand, expert, academic or scientific knowledge and, on the other, what has been labelled as tacit knowledge (Polanyi, 1958), theory in practice (Argyris & Schön, 1974), policy frame (Holzner & Marx, 1979), belief system (Lindblom & Cohen, 1979), theory in use (Zaltman, 1983) or policy theories (Leeuw, 1991). The relevance of this distinction is threefold. First, scientific studies suggest that potential users evaluate information from academic research within the perspective of their own knowledge and experience. Non-use of research can thus be explained by the fact that the knowledge provided does not fit in with the decision makers' own belief system. Factors that explain for the sharing of knowledge and trust of information among potential knowledge users are the information source, the way information is phrased as well as the novelty of the information (Cuppen, Hisschemöller & Midden, 2009). Second, academic knowledge is not necessarily better suited to local situations than practical knowledge (Schön, 1983). Each policy decision, how evidence based it may look, inevitably involves practical knowledge. For academic knowledge, it may take a while before it becomes embedded in actions. This is called knowledge creep (Weiss & Bucuvalas, 1980). Third, whereas scientific theories are written down in a more or less formalized way, theories in practice are (in part) implicit. They provide policies with a supporting argumentative framework, which includes insights from scientific reports as well as taken for granted assumptions (common sense knowledge). One well-known example of 'taken-for-granted' assumptions in environmental policy is that sustainable solutions are normally more expensive than unsustainable ones.

The dynamics of knowledge systems, boundary work and unwanted knowledge. Science is divided into different disciplines. It has been widely acknowledged that building bridges between disciplines is a key condition for increasing its usability in public policy. However, the disciplines themselves, with their specific conceptual and methodological frameworks, are among the primary *institutional* barriers that inhibit the sharing of knowledge among them or even among fields within a single discipline. In different countries there are different traditions with respect to the organization of knowledge production through academia and consultancy and knowledge use (e. g. Hisschemöller et al., 2009).

The institutionalisation of knowledge production in relation to its dissemination and use is referred to as 'knowledge system' (Holzner et al., 1987; Holzner & Marx, 1979; Machlup, 1980). Knowledge systems are specified in terms of mandating, producing, structuring, storing, distributing and utilizing scientific and practical knowledge (cited in Hisschemöller et al., 2001a: 7, 8). The concept of knowledge system points our attention to the relationship between specific institutional arrangements within the sphere of knowledge production for policy and their impact on knowledge uptake and use.

The term widely used to describe the interactions between science and policy is 'boundary work' (Gieryn, 1995). Boundary work refers to the negotiation processes that result in establishing the boundaries between policy and science. However, boundary work also produces an area where the boundaries between the realms of science and policy become fluid, especially by developing joint policy-research agendas and so-called 'boundary objects' (e. g. Hisschemöller et al., 2001a, Turnhout et al., 2008). An example of a boundary object is the notion of ecological indicators. These are not based on mere scientific research but framed and defined in a process of negotiation and compromise within a policy-science network (Turnhout et al., 2007, 2008). Another example of a boundary object is the Trias Energetica for the Netherlands or the energy hierarchy in the UK (Hisschemöller & Sioziou, 2013). This concept prescribes a course of action for diminishing the use of fossil energy through, first, investing the maximum in energy savings, second, investing in renewables and third, if there is money left, investing in energy efficiency. In consequence, policies aimed at saving energy strongly focus on building insulation rather than on integrated concepts for creating energy neutral buildings. Hence, boundary objects bring some focus into both the research and policy orientation, but at the same time they reduce the opportunities for competition. Although a knowledge system allows for competition between knowledge claims (Dunn, 2001), it also marginalizes knowledge, not because it is bad science, but because it belongs to the category Machlup (1980) has referred to as unwanted knowledge.

Unwanted knowledge does not fit in with dominant interests or beliefs. An example of unwanted knowledge is low temperature heating as an alternative for current high temperature heating systems based on fossil fuels. In the Netherlands and elsewhere, the dominant idea is that greenhouse gas emission reductions in the built environment must be realized by firm insulation of buildings (trias energetica). Technologies that focus on low value heat in combination with heat and cold storage are still in the very margins of the knowledge system related to climate neutral buildings (Hisschemöller & Cornelisse, 2008; Hisschemöller, 2016). An (in)famous example of government attempts to keep unwanted knowledge out of publicity is the evidence concerning BSE (Bovine spongiform encephalopathy, commonly known as mad cow disease) in the UK of the 1990s (Jasanoff, 2001). This case shows that disregarding scientific evidence may have serious consequences. The BSE scare in the 1990s UK led to huge societal unrest, mistrust in food safety and a paralysis on the side of British government.

What we learn is that critical knowledge in the margin of a knowledge system and unwanted for policy can nevertheless be very relevant in the long run. "*From the standpoint of communications theory and language, the information-content of a hypothesis tends to be negatively related to its relative frequency, or probability of occurrence. Hypotheses that are mentioned more frequently — those on which there is substantial consensus — have less probative value than rarely mentioned hypotheses, because highly probable or predictable hypotheses do not challenge accepted knowledge claims. The importance of challenging knowledge claims should be evident when we consider that the only process available for determining the plausibility of a knowledge claim, or for confirming or corroborating a scientific hypothesis, is one of testing and eliminating rival hypotheses*" (Dunn, 2001: 425, 426). One of the implications of this observation is that, next to usable knowledge, unwanted knowledge can also be considered 'usable ignorance', which can be detected by systematic research into rival hypothesis, often present in the margin of a knowledge system with stakeholders outside the dominant knowledge networks (Dunn, 1994).

What we can conclude so far is that utilization of knowledge for policy is very much dependent on research quality, but equally so on shared values among researchers and policy-makers. We, secondly, learn that the knowledge system itself imposes barriers on the production of useful research, e. g. if traditional cleavages between disciplines stand in the way of an integrated approach in policy research. Thirdly, we can conclude that, ironically, the most relevant research results often meet with the least acceptance among policy makers, as these results come from research that critically questions dominant knowledge claims. This also explains for the fact that it normally takes quite a while, before new insights break through the barriers imposed by the dominant knowledge system.

Methodological implications. Here, we discuss some methodological implications from the findings so far. How can we, in a systematic way, map out practical knowledge and assumptions that relate to knowledge produced in specific knowledge systems? One possibility is to compare practical knowledge or 'policy theories' with scientific knowledge available. Scientific knowledge is used to the extent the policy theory is congruent with the scientific state of the art. The steps to be taken in this method are roughly as follows (Leeuw, 1991, 2003):

1) Articulate or 'surface' the assumptions underlying a specific policy. This can happen by document analysis and interviewing key-policy makers. This exercise results in the articulated policy theory, i. e. the set of assumptions that underlie the policy in question.
2) The policy theory must be presented as if it were a scientific theory, including hypotheses with respect to cause-effect relationships, the expected impacts of means (actions, interventions, instruments) to reach goals as well as the relationships between the different values at stake.
3) Evaluate the quality of the policy theory. The analyst looks into scientific work and checks for each of the Hypotheses under 2 as to whether they are congruent with the notions from science.

The idea of articulating assumptions is a basic methodological device (see also Mason & Mitroff, 1980).

If the quality of the underlying policy theory is evaluated with reference to the latest scientific insights, one may very well find an underutilization of scientific knowledge. Underutilization can relate to notions with respect to behaviour, such as the persistent ideas about the effectiveness of environmental subsidies, whereas in fact the impacts are limited. An example of comparing public policy assumptions with findings from scientific research is provided by the Dutch General Accounting Office (Algemene Rekenkamer, 2008) study on sustainable fisheries. The study evaluates EU and Dutch policy aimed at preservation of flatfish and marine ecosystems through quota and other instruments. It cites the EC in stating that many fish species are at a level below biological minimum, which is partly due to the fact that the yearly restrictions for fisheries are lower than what has been advised by marine biologists. Total Allowable Catch (TAC) has been higher than what would be expected on the base of scientific advice. However, a complicating factor is that scientific advice by the International Council for the Exploration of the Sea (ICES) (biologists) uses a margin for uncertainty in the range of 30–40 %. Hence, it is concluded that, "*because of this large margin the scientific information does not provide a clear picture of the real conditions as regards commercial fish varieties and therefore provides a weak basis for policy*" (Algemene Rekenkamer, 2008: 40, 41).

An additional quality of this method is that, in evaluating policy effectiveness, it is also capable of identifying knowledge gaps. For example, in an evaluation of nature conservation policy, the Accounting Office found that policy instrumentation was fit to provide a gradual increase of natural areas, but also states that information on nature quality in these areas is only partially available, as research and monitoring are absent (Algemene Rekenkamer, 2006).

In short, we address two specific limitations related to this methodology. First, assumptions underlying public policy are not always easy to trace. Some of them are well explicated in policy papers, parliamentary records or by policy officials in personal interviews. However, some of them are implicit and hidden from first sight. There may be different causes for this. One cause may be that policy officials do not want to fully explain their policy goals or objectives — they may be secret. Yet, another cause, equally likely, is that policy officials are not aware of their assumptions. This is especially the case with so-called taken-for-granted assumptions that relate to common sense. An interview technique that may highlight this type of assumptions is to keep asking questions up to the point where the interviewee answers like: "*But isn't it common knowledge that...*", "*Don't we all know that...*". Another difficulty of tracing policy assumptions is that they may be contradictory. A difficulty with the articulation of policy assumptions is always that this activity is, in part, subjective. The product is the researcher's own understanding of what is being presented. One cannot avoid subjectivity, but one can only reduce its negative consequences by building the best argument for each case. This means that, in addition or instead of phrasing policy assumptions in terms of tentative hypotheses, one can use frameworks from argumentation analysis to present policy theories.

A second limitation is that this method relies very much on espoused scientific theories and findings. It does insufficiently into account the value of (tacit) personal and practical knowledge of policy-makers.

The limitations mentioned do not stand in the way of using the approach. An obvious advantage of this approach is that it enables government officials and other stakeholders to reflect upon the information provided and to agree or disagree with the findings. The technical complexity of the method is rather low and its use does not bring high costs.

2.2.3. Policy Context

We can think of quite some factors, linked to the policy context that may have an impact on use or non-use of knowledge in policy. Examples are (Dunn, 1980):

(1) the shorter the time span of problems, the greater the knowledge utilization,

(2) the more a policy issue involves an operational decision (rather than a strategic one), the greater the knowledge utilization,

(3) knowledge will be used more in private organizations with formal profit incentives than in public organizations, which lack these incentives,

(4) the presence of outside evaluators will enhance knowledge use rather than evaluators from inside,

(5) knowledge produced by change agents formally affiliated with the sponsoring organization will be utilized more than knowledge produced by unaffiliated change agents,

(6) knowledge utilization is positively influenced the more influence all stakeholders including the knowledge providers exercise during all stages of the policy process,

(7) the more the (social) scientists use a diffusion style that encourages feed-back, the greater knowledge utilization, and

(8) the more the products are stored in personal verbal reports rather than written documents, the greater the utilization.

By that time (end 1970s), positive correlations were only found for the hypotheses 3, 5, 6 and 8. H3 may imply that public agencies lack an incentive system for enhancing knowledge use or, to put it differently, that the incentive to use specific knowledge may be outweighed by stronger incentives to maintain the status quo. H5 suggests that knowledge is more likely to be used when the research agency or researchers are operating within or very close to the organization that commissions the research. We already referred to factors that explain for the sharing of knowledge and trust of information among potential knowledge users. The information source must be trusted, which is more likely when the source is part of the (immediate network of the) agency which commissions the research. If this information source is part of the immediate network of the knowledge user, then (s)he is more likely to phrase the knowledge in a way understandable for the customer. The novelty of information can be a problem, but the more a researcher is part of the customer's immediate network; the more unlikely it is that this researcher will drop information completely new to the user. As regards H6, the more the researchers are part of the network of the commissioning agency; the more likely they are to enact influence during all stages of the policy process. And this would also imply that the message of the research will not only be reported in a document, but will be stored in personal verbal reports on the side of the policy-makers who commissioned the research, as is hypothesized under H8.

There is evidence from theory and practice that policy agencies have a preference for working with research agencies they are familiar with for quite some time. Theoretical evidence is provided by economic theories of policy-making and bureaucracy, as developed by Antony Downs in his famous *Inside Burocracy* (1967). Being rational in their behaviour, bureaus and bureaucrats tend to conservatism and avoid risks, both in their personal interest and in the interest of the bureau. New insights provide risks of all kinds, so there is a great tendency not to follow up on these. As Downs put it: "*Officials who exhibit a great deal of initiative and innovative behavior are more likely to encounter frustration and failure in achieving their goals than those who seek merely to survive and retain the status quo.*" (p. 267). Rich (1991) argues that the use of research findings is largely dependent on the specific interests of the policy agency. Findings from empirical studies confirm the conservatism of policy agencies as it comes to effective policies for enhancing sustainability. A study into the lobbies of the renewable energy sector in Germany shows that policy-makers express a preference to have longstanding relationship with lobbyists rather than being lobbied by strangers on an incidental basis (Sühlsen & Hisschemöller, 2014). The implication from this is that larger companies have much better access to policy-makers in Germany, but probably in general, than smaller innovative companies who cannot afford to hire lobbyists on a daily basis. It also implies that the knowledge provided by vested interests is more likely to be accepted in policy-making circles, as this knowledge is cited more frequently and on which there is substantial consensus. Knowledge providing agencies, like sustainability consultants and universities, which are dependent on grants and subsidies for their work, tend to adapt their policy advice to the mainstream in the knowledge system, as they run the risks of missing contracts and, because of this, losing jobs.

Hence, the main challenge for independent environmental researchers is to get access to anticipated clients of their research findings and enter with them into a dialogue during the different stages of the policy process in order to convince them of the relevance of their research. Below we discuss three analytical models designed to systematically research into the utilization of knowledge and the way the policy context affects knowledge utilization. These models are (1) the Advocacy Coalition Framework (Fig. 2.3), (2) the agenda building approach and (3) problem structuring.

The *Advocacy Coalition Framework* (ACF) (Sabatier & Jenkins-Smith, 1993, 1999) underlies the observation that it takes a long period, a decade or more, for new knowledge to have an impact on policy-making. Policy change is a function of three sets of processes (Hisschemöller et al., 2009: 285):

1. The interaction of competing advocacy coalitions within a policy subsystem, e. g. the subsystem environmental policy. An advocacy coalition consists of actors from a variety of positions and institutions (elected and agency officials, interest group leaders, researchers, etc.) who share a particular belief system, and who show a nontrivial degree of parallel action over time. Coalition actors seek to translate their beliefs into public policies throughout the governmental system. The concept of an advocacy coalition assumes that it is shared beliefs that provide the principal 'glue' of politics.

2. Changes external to the subsystem in socio-economic conditions, public opinion, system-wide governing coalitions, and decisions from other policy subsystems.

3. The effects of changes in relatively stable system parameters: the basic attributes of the problem area, the basic distribution of natural resources, fundamental socio-cultural values and social structure, and the basic constitutional structure. For both the cause and solution of environmental issues, these parameters may be critical.

The ACF is visualized in Fig. 2.3.

As a method for policy analysis, the ACF focuses on articulating the policy belief systems of (competing) advocacy coalitions. In order to facilitate this analytical activity, the ACF proposes that the belief system of an advocacy coalition is structured into three categories, arranged in order of decreasing resistance to change:

- a Deep Core of fundamental normative and ontological axioms that define an actor's underlying personal philosophy;
- a Near Policy Core of basic strategies and policy positions for achieving deep core beliefs in the policy area or subsystem in question;
- a set of Secondary Aspects comprising a multitude of instrumental decisions and information searches necessary to implement the policy core in the specific policy area.

Policy change can be brought about by pressures external to the policy subsystem — environmental disasters or financial crises are examples of such pressures that may lead to policy change in the environmental subsystem. Yet, there is also the possibility of learning. The ACF distinguishes two types of policy-oriented learning: *within* a coalition's belief system, and *across* the belief systems of different coalitions. The first type of learning means that members of an advocacy coalition are seeking to improve their understanding of variable states and causal relationships consistent with their policy core ('puzzle-solving'). The second type of learning refers to a productive analytical debate between members of different advocacy coalitions. One or more coalitions are led to alter policy core aspects of their belief system (or at least very important secondary aspects) as a result of an observed dialogue rather than a change in external conditions. The ACF claims that learning across coalitions benefits from a moderate level of conflict, an issue that is analytically tractable (i. e. it has widely accepted theories and quantitative indicators), and the presence of a professionalized forum in which experts from competing coalitions must justify their claims. Experts may perform as knowledge brokers in order to promote political settlement.

Advocacy Coalition Framework

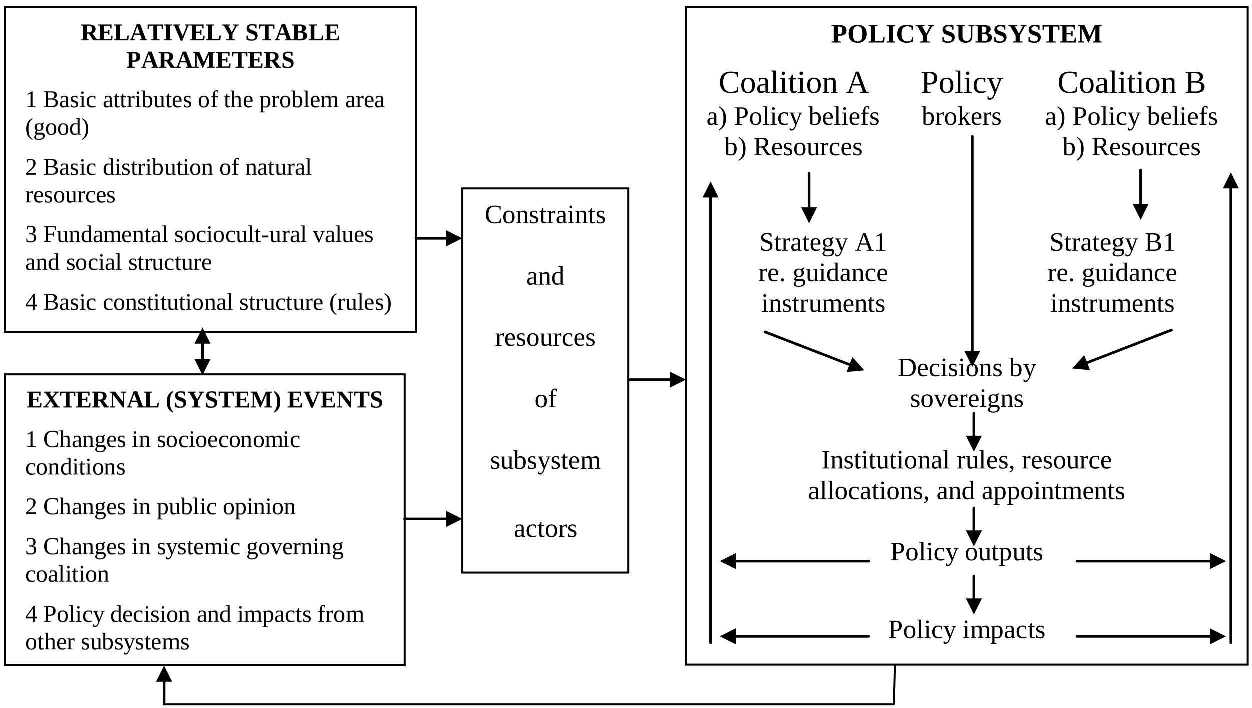

Fig. 2.3. The advocacy coalition framework. Source: Sabatier, 1998

The ACF has been used in numerous studies on environmental policy-making around the world. An example is a study into Poland's environmental policy during the transition from a state based to a market economy and from dictatorship to democracy (Andersson, 1999). In this study, advocacy coalitions were analyzed during the 1980s, before, and during the 1990s, after the transition. Next to national policy the study concentrates on sectoral environmental issues, i.e. air protection and salination water caused by mining. Andersson found quite some learning within and across advocacy coalitions in the air protection case. A special case was provided by research and debate about new environmental policy instruments, such as emission trading. Where the hard coal sector was concerned, Andersson found almost no interaction with the environmental sector and almost no learning. The hard coal sector was — and probably still is — considered as vital for the national economy, which has prevented necessary environmental measures from being taken.

Agenda building. A different approach in the analysis of (environmental) policy-making is political agenda building (Cobb & Elder, 1983). This approach was developed in the critical tradition in American political science during the 1970s. It is based on the work of the American political scientists Schattschneider (1960) and Bachrach and Baratz (1962). Central theme in Schattschneider's work is the observation that *"(a)ll forms of political organization have a bias in favor of the exploitation of some kinds of conflict and the suppression of others because organization is the mobilization of bias. Some issues are organized into politics while others are organized out."* (Schattschneider, 1960: 71). In line with this observation, Bachrach and Baratz (1962) conceptualized the notion that power has two faces. On the forefront, we witness political struggles about specific laws, regulations, measures and other policy interventions. Here we witness the power of winning coalitions in majority votes or compromise. Yet, at the background, we may witness a more hidden form of power with respect to the kind of problems that are allowed access to the political agenda and which issues are not. This is the power to decide on the framing of policy problems and thereby on the range of policy alternatives taken into consideration; in Schattschneider's expression this is "the supreme instrument of power" (1960: 66). This face of power has everything to do with the information and knowledge policy-makers want or do not want to consider. For the situation where actors ask to take specific information into account, and where this information is nonetheless disregarded in the decision-process, Bachrach and Baratz invented the notion of 'non-decision'.

For the agenda building approach, it is of critical importance to not only look at the attempts of actors involved in the decision-making process to exercise power and influence in shaping decisions, but also, and even more, to look at the behaviour of actors who try to get involved, but who do not or only partially succeed. Where (non)utilization of knowledge is concerned, it is of critical importance to analyze how policy problems are framed and how, in consequence, specific information and knowledge is denied access to the political agenda and why.

The policy process has traditionally been divided into stages such as agenda setting — policy formulation — policy adoption — policy implementation — policy assessment (Dunn, 1994: 17; also Lindblom, 1980: 3). From an environmental management perspective, Winsemius (1989) distinguishes between problem recognition — policy formulation — policy action — self-regulation. Winsemius makes clear that policy in the various stages of problem recognition and solving requires different kinds of knowledge. In the first stages, where the problem is found to be relevant and strategic choices are made, there is a need for as much knowledge as possible. Competing scenarios and trajectories must be explored in order to find out: Do we have a problem, how big is it and are we going to do something about it? In the later stages, the knowledge required is focused on effectiveness and efficiency with respect to regulation and control. This management scheme implicitly recognizes one of the major problems associated with knowledge uptake in (environmental) policy. Once strategic political decisions have been made and specific policies are implemented, it is quite inconvenient to be confronted with new insights that shed a different light on the policy problem and the political interventions required. Knowledge that may be seriously considered at an ‘early’ stage, maybe rejected as unwanted knowledge in a later stage.

For this section, we propose an analytical model distinguishing five stages (Fig. 2.4). We thereby focus on the situation, very common in the field of environmental policy, that environmental problems are first discovered outside the realm of policy-making, e. g. by environmental researchers, NGOs or citizens, who then try to bring these problems to the political agenda. First stage is raising a concern, for example, when some people get the idea that air or soil could be polluted. Second stage is that a person or group express a demand, for example: Do something about it! Or, we need independent information! In the third stage, the initial concern is transformed into a public issue. At this stage, the problem has made it to the public agenda. There will be media attention. Other organizations than the initial persons will get involved. The involvement of new actors, like (national) environmental NGOs or research agencies, may imply that the framing of the initial problem will be modified, which could either help or prevent the problem from reaching political agenda status. If successful, the issue will become a formal decision item on the political agenda. Eventually, a decision will be taken. It must be realized, that not each stage must be visible in every policy case. It happens that one or more stages overlap or are skipped. A demand can be directly transformed into a decision item or can become a public issue at the same time. It must also be realized, that the model proposed here can also be used to study policy implementation, because implementation also implies decisions and may lead to modifications of the initial problem. Critical in the model is the notion of barriers that may prevent information to pass from one analytical stage to another.

Over time, researchers have pointed to different types of barriers in the agenda building process. The major challenge for persons or groups to successfully bring a new message to the public or policy agenda is to be trustworthy and credible. An even bigger challenge is to keep attention for an issue over a longer period of time. According to Cobb and Elder (1983), barriers can either relate to the credibility of problem content or to credibility of the actors putting it forward. Strategies or mechanisms that affect the transition of a problem from one stage to another can be either direct or indirect. Examples are:

- *Direct issue (contents) oriented*. Concerns are completely unjustified, information provided is false. In today's terminology, we would say there is a spreads of fake news. Examples may include: “The idea of sea-level rise because of global warming cannot be true. When ice in the polar seas turns into water, the global sea level will remain equal.” Or: “Long-term assessments do not provide any empirical evidence of global warming.”

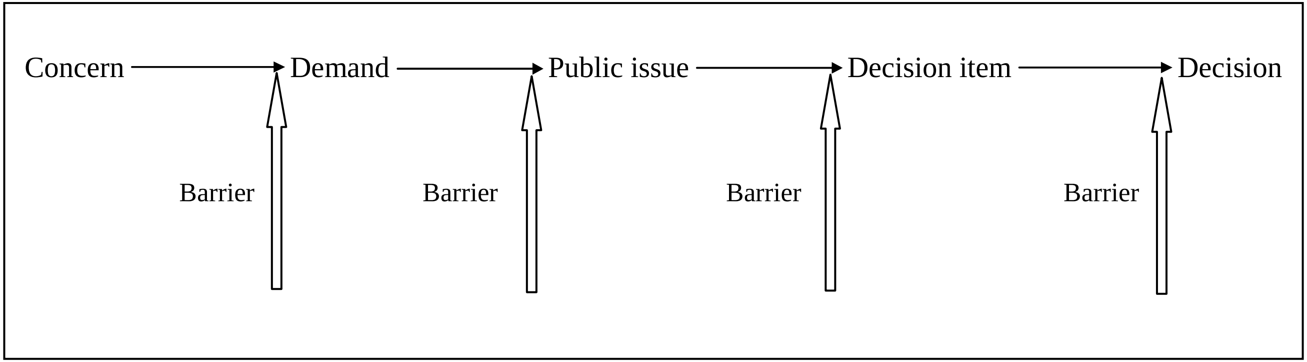

Fig. 2.4. An outside initiative model of political agenda building. Based on Hommes, Van der Heijden and Kok, 1986: 262

- Indirect issue oriented. Here, the alleged problem is not rejected, but all kinds of difficulties are raised to prevent taking action. Examples include: “There may be some truth in the theory on global warming. However, the problem is extremely complex and needs further investigation before taking action.” Or: “Unfortunately, there is lack of funding at the moment”, as other issues are competing for priority. This example is cited by Downs (1972), who points out that is a challenge to put an environmental problem on the policy agenda, but even more difficult to keep the attention. After some time, people will get bored with the issue and attention will shift to other pressing problems.
- Direct actor oriented. Here the strategy to prevent agenda status for a problem is targeted at the person(s) or group putting the issue forward. For example, the industrial in the US tried to manipulate public opinion in order to prevent measures for protecting the ozone layer, stating that the scientists who claim the depletion of the ozone layer have been bought by the Soviets in order to destabilize the US free economic system (Dotto & Schiff, 1978).
- Indirect actor oriented. Here, persons or groups who try to push a problem towards the policy agenda are involved in the policy process, but in such a way that they may become coresponsible for delay: "We invite critics to take part in a broad research commission”.
- It is important to note that also environmental NGOs have their specific interests that may contribute to undermining environmental issues. In the Netherlands during the 1990s, some important environmental NGOs have been in doubt as to whether they give priority to promoting the climate change issue. Their reluctance can be explained by their concern, that climate change would revitalize the nuclear option, which was just removed from the policy agenda because of Tsjernobyl (Dinkelman, 1995). When different actors take ownership of a problem, they add meaning to it or shape its connotations. A societal organization, such as an environmental NGO, a trade union or an academic institution, has its specific institutional bias including its ideology, belief system, working routines, coalitions with others, and history. This may, on the one hand, enable the transition of a problem to the national political agenda. However, on the other hand, it may change the initial meaning of the problem and so even become a barrier for its full consideration.

The barriers described so far imply more or less conscious strategies employed by actors. However, these can be added to the barriers cited in section 2.2.2. These are more of an institutional nature; they relate to longstanding ways of doing things, the way our political and knowledge institutions have been shaped over time and the culture that policy (sub)systems have developed. Institutional barriers are much harder recognize and to tackle than actor strategies alone. We can expect to always find combinations of actor strategies and institutional barriers. These all have an immediate impact on the dissemination and uptake of information, to the linking of facts and values and, simultaneously, to the exclusion of competing knowledge claims and information from political consideration.

Problem structuring

Policy-making and the role of experts therein can also be understood by pointing to different types of rationality. Diesing's (1962) typology of rationality, differentiating between technical, economic, legal, social and political rationality how different lines of reasoning, all embedded in decision-making, provide competing contexts for the contents of policies and policy problems, as well as the specific role envisioned for experts. Diesing's work is shows that there is a relationship between problem contents and policy process (see also the typologies developed by Thompson and Tuden (1959) and Lowi (1972)). The relationship between problem content and policy process is referred to as problem structure (Hisschemöller & Hoppe, 2001; Hisschemöller, 2005). In this approach, a social or policy problem is defined as a gap between (a) certain value(s) and an observed situation (e. g. Dunn, 1994). The relation between values and facts is what distinguishes a problem from a phenomenon. A problem is considered a social construct: what is a problem for one person is not necessarily a problem for another person (Hisschemöller & Hoppe, 2001).

For identifying problems with a different structure, two basic questions are addressed:

1. Is there consensus on what knowledge (including skills and methods) is relevant for addressing the policy problem? The word knowledge here refers to both academic and practical knowledge.

2. Is there consensus on the values relevant for the problem at stake?

Fig. 2.5 shows four different *types of policy problems* according to their *structure,* the relationship between contents and process. It should be noticed that the distinction between knowledge and values, the X and Y axes of Fig. 2.5, is ideal-typical. In actual policies knowledge and values always appear together, articulated in a specific way (Cell A–D). This typology highlights in a simplified fashion the biases that can be observed in policy processes and how these shape and limit the possibilities for scientists and other knowledge providers to make a contribution to policy.

Before discussing the different problem types in more detail, we need to point out one important element in the problem structuring approach. Methods appropriate for addressing one kind of problem are not appropriate for addressing problems with another structure. Each problem type fits a specific problem solving approach.

Consensus on relevant values? / **Consensus on relevant knowledge?**	***NO***	***YES***
NO	**UNSTRUCTURED PROBLEM** Policy as learning Science as problem finding **A**	**MODERATELY STRUCTURED PROBLEM** Policy as negotiation Science as advocate **B**
YES	**C** **BADLY STRUCTURED PROBLEM** Policy as accommodation Science as mediator	**D** **STRUCTURED PROBLEM** Policy as ruling Science as problem solver

Fig. 2.5. Four types of policy problems and policy styles and their bearing on the role of science in public policy.
Source: Hisschemöller et al. (2001b)

Dunn refers here to the principle of methodological congruence: "The appropriateness of a particular type of method is a function of its congruence with the type of problem under investigation." (Dunn, 1988: 724). Structured problems are for example successfully addressed by quantitative methods, such as cost-benefit analysis or risk analysis. In contrast, unstructured problems require methods for problem finding or structuring in order to assess the complex problem situation and develop a vision on goals and means for policy. Very basic in problem structuring is that people involved talk about the problem and share ideas and information. If a problem is addressed with a (research) method that does not fit in with the problem type, then the policy-maker or researcher is likely to overlook relevant information. As Dunn phrases it: "Yet critical elements of a problem situation may lie outside the boundaries of an individual's construction system; what is unrecognized and unknown cannot be understood or anticipated." (Dunn, 1988: 723). We must add to this that what is true for individuals is also true for institutions. In consequence, policy-makers may find correct solution however for the 'wrong' problem. This phenomenon is referred to as Type III error (Dunn, 1994).

Below we will discuss the four problem types, showing what policy process is considered adequate for addressing environmental problems of this type, as well as showing what happens if the 'wrong' problem is addressed.

Policy as Rule (Fig. 2.5, Cell D). Policy as Rule applies to structured problems, i.e. problems characterised by consensus on both relevant knowledge and values. In consensus situations, the problems are usually considered technical. Persons rely on expert judgment. Experts are known and trusted, as there is also consensus on who is an expert and who is not. In case a policy problem is considered to be structured, policy-makers rely on scientific and technical experts. This would not always imply that experts get formal decision-making status. Traditional boundaries between policy and expert advice are kept intact, science advises policy. The policy process, congruent with this problem type I refer to as Ruling. In policy as Ruling, scientific advice is *de facto* binding for policy decisions. Many routine policy decisions are based binding expert advice. We may think of safety precautions for buildings and the important role of for example the local fire departments in formal decisions concerning construction safety. Management by Ruling works well for the great amount of small, routine decisions and if conflicts arise, there are standard procedures to deal with them.

The decision maker in this type of policy is usually one monolithic actor. The advisors are part of a closed policy-science network, which is characterized by a rather straightforward and commonly accepted division of tasks, competences and responsibilities. The role of science is problem solving. Policy as Rule supposes expert consensus.

It may happen that consensus is not real, but imposed on affected citizens by government. Opposition is not recognized as legitimate in policy as Rule. Resistance to policies is normally considered to be based on uninformed, emotional response (fake news). In turn, resistance is based on a lack of trust, often because of secrecy on the side of decision-makers. An interesting case arises when scientists get divided amongst themselves, as has been the case in controversies around nuclear power or genetic modification. Critics maybe accused to be driven by political rather than by scientific motives. Historic experience with the nuclear energy debate and the debate on GMOs, illustrates that it is far from easy to accept information put forward by critics from the science community as science. Once this happens, the problem is no longer treated as structured and shifts to a more pluralist policy setting.

Policy as Negotiation (Fig. 2.5, Cell B). The moderately structured problem is characterised by consensus on the values at stake, i.e. some public good that needs protection, but uncertainty and conflict as regards the best way to realise common ends. Different interests are at stake. In contrast to the structured problem, these differences are considered legitimate. Moderately problems are often issues of distribution. The conflict is who gets what piece of the cake? The adversarial process for addressing problems of this type is called Negotiation. Even if actors do not really believe in the consensus on the goal, such as addressing climate change or reduction of fish-stocks, they have to play the game according to its rules in order to maximise gain and minimise losses. In this policy type, research-and-analysis becomes an intellectual ammunition in the pluralist group struggle. Processes of partisan mutual adjustment (Lindblom, 1965) work like a selection device for scientific arguments in support of previously determined policy stands. Each and every interest will mobilise its own science-based expertise to bolster its case. In this system, policy analysts are like lawyers, and their business is advocacy (Hisschemöller et al., 2001a). In the adversarial model, separate actors defend or strengthen their respective positions in the short run, while in the long run policy oriented learning may result (Sabatier & Jenkins-Smith, 1993). Needless to say, the conflict of interests seriously limits the opportunities for scientists to take a nuanced position, which may provide a 'third way' out of the conflict.

Jasanoff (2001) has convincingly argued that, what she refers to as an over politicization will hamper a proper use of scientific research. In case of over politicization, there will be deadlock rather than a constructive dialogue. Deadlock in fact happens when different stakeholders disagree not only on means, such as the amount of money to be allocated to what or the most effective policy instrument to be deployed, but on the policy goal or the values at stake. Common examples are health risks or external safety in case of polluting industries or airports, destruction of ecological values in case of the construction of highways or the planning of wind turbines.

Policy as Accommodation (Fig. 2.5, Cell C). The badly structured problem can be best understood as a conflict between irreconcilable values, a dilemma without a solution perspective. The best one can hope for is a compromise, which keeps the main conflicting parties on board. The type of interaction that matches with the search for compromise is situated somewhere in the middle between the technocratic, knowledge driven concept of Ruling and the politicized, adhocracy practices of Negotiation.

The strategy for working out a compromise is characterised by depoliticization of the value conflict, in other words by transforming the social and political issue into a technical one. The first step in this direction is to move away from a specific problem situation to a problem at a more general level, abstract and long-term. Politics and research concentrate on the invention and internalisation of concepts, such as 'sustainability' or 'precautionary principle' rather than rather than specific interventions. The politics of compromise are often symbolic but may enhance a process of policy learning, which may in the end result in specific interventions. Science in a mediatory role may flourish under this kind of policy; there is a need for multidisciplinary research and, to support the process of accommodation, interaction between scientists and policy makers. But still, the borders between science and policy are intact, as well as most of the disciplinary boundaries. In order to make the mediation between conflicting policy views succeed, scientific consensus is a must. This type of policy-science interaction can frequently be seen in national environmental policy, especially in countries with a strong consensus tradition. But it can be observed even more clearly at the level of international environmental regimes that need to accommodate states with divergent conceptions of their national interests. International relations scholars share the view that scientific consensus, or the existence of so-called epistemic communities (Haas, 1991) is a vital condition for the success of any environmental regime. The Intergovernmental Panel on Climate Change (IPCC) is frequently cited as a successful example.

Policy as Learning (Fig. 2.5, Cell A). Situations where there is uncertainty about what knowledge is relevant as well as dissent on the relevant values at stake are characterised by the unstructured nature of the underlying problem. Once this situation has been recognised, it may be possible to engage in a process of problem structuring, i.e. to identify, confront, compare and, where possible, integrate different views (Hisschemöller & Hoppe, 2001). The policy process called Learning supposes that parties reconsider their (vested) interests, which makes learning both a cognitive and an emotional experience. What policy learning produces, is a new vision on the policy problem, goals and alternatives. It implies dialogue and co-production with respect to concrete problems, e. g. at a local or regional scale (Botts et al., 2001). Science has traditionally played a significant role in the signalling and agenda setting of environmental problems. However, the more complex these problems are, the greater the need for scientists to work in an interdisciplinary manner, which implies the identification, confrontation, and where possible integration of different scientific perspectives. The boundaries between science and practical knowledge get diffuse and may even become obsolete, when practitioners and experts have valuable insights to offer. Therefore, experts are bound to cooperate in their very core business of knowledge production with non-experts or, to put it differently, experts in other fields. This requires specific qualities and may cost time. The difficulty with unstructured problems is that policy-makers usually try to avoid them, because they are so hard to manage and the outcome of the policy is far from certain.

Using this problem typology, Hisschemöller et al. (2001b) found from a comparative analysis of seven case studies of Dutch environmental policy making, the following barriers for knowledge dissemination and use:

1) knowledge from 'other' parties is disregarded,

2) there is a separation between knowledge needed for problem recognition and for problem solving,

3) certain academic disciplines (e. g. economics) are favoured over others; ethical issues get little attention in environmental research,

4) information on large scale level is preferred over information on small scale,

5) expert knowledge is favoured over lay knowledge.

These mechanisms in particular hamper the capacity of knowledge systems for environmental policy to explore and integrate competing knowledge claims.

Turnhout, Hisschemöller, and Eijsackers (2007, 2008) used the typology to analyse Dutch nature conservation policy, especially the development and use of ecological indicators. These and other studies illustrate the policy processes and the expert roles described here. They confirm that problem structure restricts the freedom of action for both knowledge providers and potential users. Policy-making may shift over time between Negotiation and Compromise in particular.

The most important lesson from problem structuring is probably that there are so many institutional barriers in both policy and knowledge systems that hinder learning among policy-makers, stakeholders and scientists though an open dialogue on conflicting perspectives. Policy-makers have a general inclination to be in control. Hence, they have a preference for more structured problems and dislike unstructured ones. They are normally unaware of mechanisms that exclude competing visions and knowledge claims from the policy agenda.

2.2.4. Types of actual knowledge use

The extent or degree to which knowledge is actually used in policy-making depends on how the concept 'use' is defined (Dunn, 1983; Rich, 1997). Dunn (1983: 121) states that "the variability of competing conceptions seems virtually endless." First, the definition must clarify as to whether the use is researched at the level of individuals or (a) collective(s). For example: could we say that 'enlightment' is to be reserved for individual decision-makers or for agencies, advocacy coalitions or even entire policy subsystems? Second, the definition must specify the expected effect of use. On this dimension two types of use can be distinguished, conceptual and instrumental use. Conceptual use relates to research influencing policy discourse, especially the phrasing of problems and interventions, whereas the latter relates to research influencing actual behaviour (changes in government actions). Third, one must consider the scope of use in terms of generality or specificity. Are we looking into the use of knowledge related to a policy instrument or a management concept in general or into the use of knowledge related to a specific program?

Most well-known are conceptual use, instrumental use and enlightment. Other concepts for classifying knowledge use are symbolic use, strategic use and abuse. We can link these distinctions to the different types of policy processes described above.

Slightly different from types of use is classifying the functions that knowledge may have in policy. Weiss and Bucovalas (1980) distinguish functions, or purposes' of knowledge use for the different stages in the political agenda process, such as (i) raising an issue, (ii) formulating new policies and programs, (iii) evaluating alternatives, (iv) improving existing programs, (v) mobilizing support, (vi) changing ways of thinking or (vii) planning new research.

In studying knowledge utilization in environmental policy, it is critical that the researcher in advance reflects on how (s)he operationalizes different notions of knowledge use.

2.2.5. Summary and conclusions

Sustainability transitions are long-term processes of systemic change, featured by the adoption of new ideas, knowledge and values together with the emergence of new actors, who become part of new regimes. This chapter discussed what we know about how knowledge becomes disseminated and eventually used by policy-makers and other societal actors. This chapter thereby focused on three critical aspects. First, we discussed different types of knowledge — including knowledge fundamental or applied science, and practical knowledge among policy stakeholders — and the relevance of knowledge systems — including the policy-science interface and boundary work. Second, we focused on the opportunities and constraints for knowledge utilization provided by policy contexts. We discussed three approaches from the policy sciences that point to specific issues related to the uptake of new knowledge, i.e. the Advocacy Coalition Framework, Agenda Building and Problem Structuring. Third, the chapter pointed to the difficulties we encounter in defining the notion of knowledge use.

The main conclusion from this chapter is that in studying knowledge utilization, we have to look into the short-term impact of knowledge but also the impact on the long term, knowledge use in different ways but also abuse, knowledge that is asked for by decision-makers but also unwanted knowledge, knowledge on the policy agenda and disregarded knowledge, as well as the biases that mould and shape information contents during policy processes over a longer period of time.

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2.3. Social learning for deliberative policy-making

Christian Albert, Maria Falaleeva

This chapter continues to explore the problems of knowledge generation and use in the context of environmental policy process. It discusses social learning as the central components of the learning process in social-ecological systems, and uses a case study of climate change adaptation in the Broads ecosystem in order to illustrate how social knowledge contributes to address policy-making and – implementation challenges, such as issues of mismatches, ignorance and plurality of scales and levels.

2.3.1. Social learning — the policy context

To successfully address the complexity of global environmental change and societal responses to it and diversity of perspectives, pluralism in ideas and approaches is required (cf. (Functowicz & Ravetz, 1993; Kates et al., 2001; Turner II et al., 2003). Through participation of various collective and individual actors, different types of knowledge and information can be integrated and the plurality addressed (Arnstein, 1969; Blackstock et al., 2007; Dryzek, 2000; Fischer, 2000; O'Neill, 2001; Rauschmayer & Wittmer, 2006; Renn et al., 1995; Stirling, 2004).

The concept of *social learning* arguably has large potential for analytical understanding the processes and driving forces behind the changes of policies and practices in society. At the operational level, social learning concepts is applied to advise upon the initiation and facilitation of collaborative processes for climate change adaptation amid complexity and uncertainty (cf. King & Jiggins, 2002; NRC, 1999; Pahl-Wostl et al., 2008). In general terms, social learning aimed to address the challenges of changing climate can be described as "processes of agent and institutional reconfiguration derived from a conscious awareness and willingness to act and deal with the common problem [of climate change]" (Tàbara et al., 2009). Over time, participants can develop and change mechanisms and procedures for overcoming the past, present and forthcoming challenges of climate governance e. g. effectively bridging scales and levels for climate change adaptation.

There is an increasing number of studies exploring social learning from both theoretical perspective (e. g. Ison et al., 2004; Pahl-Wostl et al., 2007a; Pahl-Wostl & Hare, 2004) or from operational point of view analyzing empirical evidences of learning in environmental decision-making (Pahl-Wostl, 2006; Pahl-Wostl et al., 2007b). A number of studies recently emerged that addressed the entangled issues of scales, information, and knowledge (e. g. Cash et al., 2006), and highlighted the need for social learning to span scales and levels.

2.3.2. Social learning for climate change adaptation

Numerous definitions exist of the meaning of learning. Here we draw on the work of Siebenhüner (2002a) who proposes to understand learning as "*a process of long-lasting change in the behavior or the general ability to behave in a certain way that is founded on changes of knowledge*". The knowledge gained in this process, according to Siebenhüner, can then be of either substantive or procedural nature. *Substantive knowledge* involves the actual problems considered, and the details and level of integration of the analysis. *Procedural knowledge* refers to how the process is designed, including which actors are involved, which methods of collaborative problem solving are employed, and how complexity and uncertainty is dealt with.

CAs long as adaptation requires processes of co-production and application of knowledge between various actors, learning must therefore not only occur at the level of individuals, but rather at the level of the collective body of individuals involved. The idea of collective, organizational, or social learning has being developed and explored in the social sciences since about three decades to describe changes at the level of collectives (e.g. organizations) and society at whole. Major advances in inquiry into social learning have been made in the fields of psychology (Bandura, 1977), organization theory (Argyris & Schön, 1978, 1996), and policy and development studies (Dunn, 1971; Hall, 1993; Heclo, 1974). In this literature, social learning is understood as going beyond the composition of individual learning processes in that it also includes alterations of processes and shared knowledge, based on the contributions of members of the collective body i. e. “society”(cf. Siebenhüner, 2002a).

Various scholars have pointed to the different kinds of social learning processes that can occur. Drawing upon earlier research on organization learning by Argyris and Schön (1978), recent studies (ADAM, 2007; Hall, 1993; Pahl-Wostl & Hare, 2004; Siebenhüner, 2002a, b) differentiate *single-loop*, *double-loop*, and, in several cases *deutero* (Argyris & Schön, 1978) or *triple-loop* (King & Jiggins, 2002) learning. Single loop learning refers to the simple adaptation of new knowledge to the existing knowledge base. Double-loop learning takes place when learning also leads to alterations of the underlying theory of action, including the objectives, values, norms, and belief structures. Deutero learning happens on a meta-level and considers the ability to learn itself. The upper levels of learning are believed to be most substantive but also most difficult to achieve that also explains relatively little evidences of double- and especially triple-loop learning (Hall, 1993; Siebenhüner, 2002a).

Recent studies by Mostert et al. (2007) and Pahl-Wostl and Hare (2004) conceptualized social learning as an open-ended, iterative process that may involve several cycles and stages. At its core is a *process* (1) of interaction and collaboration between multiple actors that is influenced by the specific *context* (2), and results in *outcomes* (3) in a form of practical action, policy responses or behavioral changes. The context may include internal (structural and cultural) and contextual or external factors (Siebenhüner, 2002a).

Assessing the outcomes of social learning is not easy. Some commentators consider changes in practices (i.e. actions, policies) and behaviors of the actors as indicators of social learning (Hall, 1993; Siebenhüner, 2002a). For example, Siebenhüner (2002a, b) proposes to look for “crucial learning events” in which past experiences are reflected and incorporated into changes of the design of collaborative assessment, planning, and implementation efforts. According to this view, successful social leaning means that a specific policy or management goal was achieved (Heclo, 1974; Siebenhüner, 2002a). Others stress the spontaneous character of learning processes (ADAM, 2007) and suggest the rather abstract notion of “enhanced capacity of the social-ecologic system to cope with sustainability challenges” should be seen as ultimate goal of a learning process

(Folke et al., 2003; Tompkins & Adger, 2004). Both positions, however, are complementing each other. For example, social learning can be successful if the actors achieved a specific goal of considering new information they possess. At the same time it also matters if this new knowledge was taken into account and had been used to enhance capacity of the actors to address sustainability challenges.

In this light, the concept of social learning is increasingly applied in the study of and consultancy for processes and dynamics of collaborative knowledge production and decision making of multiple actors on natural resources' management and sustainable development issues (cf. NRC, 1999; Pahl-Wostl, 2006; Pahl-Wostl et al., 2007a; Pahl-Wostl & Hare, 2004; Social Learning Group, 2001a, b). Extending the focus of learning processes from specific organizations or policy issues towards the evolution of complex social-environmental systems brings new challenges and opportunities to "learning societies". In this broader understanding, social learning cannot be reduced to mere transfer of information between the actors but should be seen as taking place in a wider environmental and social context (Folke et al., 2003; Mostert et al., 2007; Pahl-Wostl et al., 2007a; Tompkins & Adger, 2004).

Therefore, the focus of learning processes for sustainability should be on "developing adaptive cross-sectoral capacities and new types of knowledge" to address the problems which are persist rather due to our poor understanding of the structure of socio-environmental systems than in the mere lack of knowledge about ecosystems and their reaction to human intervention (Pahl-Wostl et al., 2008).

2.3.3. Conceptualizing Social Learning for Bridging Scales and Levels

The different but complimentary perspectives on sustainability decision-making reflected by the concept of scales and levels and the concept of social learning may supplement each other in grounding the efforts by society on climate adaptation. Looking at the history of action and decision-making through the prism of "social learning" helps to understand and, possibly, to facilitate dynamics of social processes towards more adaptive planning and actions. At the same time, reflecting on the problems, capacities and interests associated with different scales/levels sheds light on the structures of socio-environmental systems and related problems, therefore, helps to set up specific targets for social learning processes.

It can be argued that processes of social learning are needed to improve the cross-scalar and multi-level climate adaptation assessment and. First, bridging scales and levels is most often an unprecedented effort related to new challenges of complex decision-making in the field of environment and sustainable development. Society needs to accumulate knowledge on complexity of issues related to multi-level structures of social-environmental systems and experience on how to address this complexity. Through social learning, appropriate strategies can be identified, tested, and further developed over time. Second, our understanding of the complex cross-scalar and multi-level dynamics of many environmental issues is constantly evolving. Only continuous learning processes of all affected actors will allow to identify and to respond to changing conditions.

For the sake of simplicity in explanations, social learning can be considered as successful when the participants of the climate change adaptation process increase their joint capacities or general ability to integrate cross-scalar and multi-level interactions in their research and implementation activities. Along these lines, substantive knowledge involves information about the dynamics and interactions of phenomena at and across different levels and scale. Procedural knowledge deals with the way the process of integrating information is designed and the approach used to facilitate cross-scale and multilevel co-production of knowledge. Single loop learning occurs if information from another level or scale is integrated that has not been considered before. Double loop learning happens if the learning process has led to significant alterations of the processes and structures of integration.

To analyze in detail how social learning could help in bridging scales and levels in climate change adaptation, we can draw on Cash et al.'s (2006) three main challenges for bridging mentioned above. Table 2.1 describes how social learning could contribute to addressing each of the challenges. The table summarizes, first, how social learning may help to identify the problems and the gaps related to the particular challenge, and, second, how learning process may lead toward solutions to address these problems and gaps.

Table 2.1

Social learning for addressing challenges for cross-level and cross-scale interaction

Challenges	**Potential contributions of Social Learning (SL) for addressing the challenges**
Ignorance	– SL can help to identify levels and scales that was previously not considered (either because of lack of knowledge that they exist or reluctance to take them into account); – SL can help to identify the links between levels and scales that actors were not aware or might have ignored if they had acted individually; – during the process of SL actors may find out or develop ways to take into account levels and scales that have been previously ignored
Mismatch	– SL can help to identify mismatches in the way how the problem is addressed (e. g. lack of fit between biogeophysical system and social institutions, between long-term objectives and short terms of policy objectives, etc.) and possible risks associated with them for decision-making; – SL may help to identify mismatches between knowledge production (e. g. content and form it is presented) and type of knowledge needed for credible and legitimate decision-making; – SL can enhance developing the knowledge and know-how necessary to fit institutions to levels of problems (if we learn from previous failures or predicted problems)
Plurality	– SL can help identify the actors associated with different levels and scales, their interests and visions on the problem (e. g. identifying and transferring local visions into scenarios based on global environmental models and vice versa); – SL is explicitly attuned to facilitate discussion among various actors that may support informational exchange and communicate plurality of visions and interests and contribute to possible solutions

Following the argumentation of Cash and colleagues (2006), it can be suggested that social learning has great importance for developing responses to the problem of levels and scales i. e.: *institu-*

tional interplay, co-management and operation of *boundary organizations*. Remarkably, all three "responses" also play an important role in establishing and facilitation of the learning process in a society. Institutional interplay is necessarily for transfer of information, establishing communications and building trust between the actors (Pahl-Wostl et al., 2008); co-management supports the processes of learning by doing by "communities of practice" and also helps to avoid management overlaps (HarmoniCOP Team, 2005; Pahl-Wostl et al., 2008); and boundary organizations provide an independent platforms for actors' interaction, accumulation and transfer of knowledge and facilitation of the learning processes (Olsson et al., unpublished manuscript, cited by Borowski et al., 2008; Cash et al., 2006; Tàbara et al., 2009). Therefore, social learning processes may use institutional interplay, co-management and boundary organization as a platform for information transfer and communication. At the same time, it is a part of the social learning process to learn how these three responses can be employed more effectively e.g. to enhance cross-scale and cross-level interaction. Therefore we can suggest that institutional interplay, co-management and boundary organizations as such represent rather *potentials* than ready-to-use responses. These potentials may not be necessarily realized and used by society. It is a social leaning process in which society finds how to create, use and improve social responses (e.g. institutional interplay, co-management and boundary organization) for bridging levels and scales.

Evidence from empirical case studies suggests that social learning for cross-scale and multilevel integration is most feasible if it is place based (AAG GCLP Research Team, 2003; Kates et al., 2001; NRC, 1999; Wilbanks, 2003). Developing an understanding of the complex relationships among environmental, economic, and social dynamics seems to be only possible when conducting relatively focused and place-based assessments, integrating various types of knowledge from the global to local scale (NRC, 1999). For example, potentials for adapting to climate change most often strongly depend on locally specific contexts, options, and avenues for action while decisions are often taken at the upper levels of administrative and scientific hierarchy (Burch & Robinson, 2007; Wilbanks, 2007).

2.3.4. Case study: Climate Change Adaptation in The Broads Ecosystem

The Broads ecosystem is situated in the East Anglia, south-eastern United Kingdom, at the border of the Norfolk and Suffolk regions (Fig. 2.6). It includes the Broads National Park (about 301 km²) as well as adjacent river catchments and coastal zones (Broads Authority, 2004).

The Broads area features of fens, marshes, and shallow lakes (broads) drained by rivers and man-made canals. Due to the great diversity of landscapes and floristic and faunistic species, the ecosystem has been identified as a unique wetland and lowland complex of national and international importance (Natural England, 2008). The ecosystem further includes a mosaic of agricultural lands, industrial and housing areas (water-side villages and peripheral urban lands), and zones of recreational use (boatyards, holiday accommodations, etc.) (Broads Authority, 2004).

The region has a long history of economic development in water related sectors. Traditional economic and recreational activities include agriculture, fishing, tourism, and navigation. Intensive recreational activities and agricultural exploitation of The Broads' landscapes resulted in a notable decrease of environmental quality from the 1950s to the 1970s that threatened nature conservation and wild-life preservation as well as economic activities relying on healthy ecosystems (e. g. tourism). The subsequent implementation of policy measures and significant investments in nature conservation in the area helped to maintain and restore the ecosystem conditions and strengthened its status as one of the most popular recreational sites in UK.

The potential impacts of climate change are among the main current threats for the future of the Broads sensitive ecosystems. Temperature rises of about two to five degrees Celsius are predicted for the next 100 years (Broads Authority, 2004) that, in combination to the natural sinking of the coastline, are expected to cause sea level rise and derogate fresh-water ecosystems through salt-water intrusions.

A.

B.

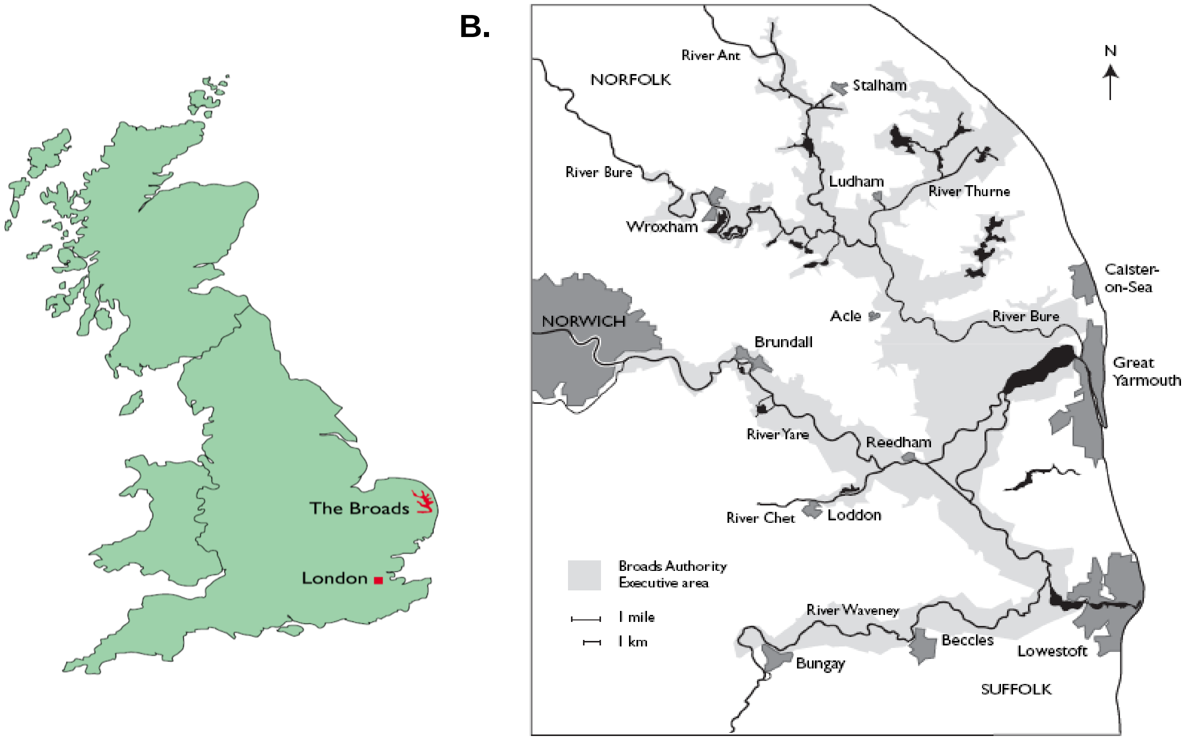

Fig. 2.6. The Broads area: A. The Broads in UK; B. The Broads National Park (Broads Authority, 2004)

Increased magnitude and lowered predictability of river and tidal floods and changing climate patterns will impact land-use and economic activities, including greater demand and lower quality of water for agriculture and tourism. At the same time, new climate conditions may bring opportunities for the area including lengthening of the growing season and wetland creation for biodiversity and recreation (Broads Authority, 2004).

The Broads' history of adaptation to natural disasters is almost as long as the history of human activity in the area (George, 1992). Public and policy awareness of risks of devastating floods was already raised after severe storms in the North Sea in 1937 and 1950. Today, climate change and its possible resulting impact on flood risks is recognized as one of the most important factors influencing economic development from the national to local levels.

The Broads Authority holds management and planning duties in the national park. Besides, management system in the area involves multiple interests and supporting institutions at different levels: EU policies; national legislation on planning and development, sectoral and climate policies and responsible governmental agencies; regional development plans; administrations of the bordering areas and multiple interest groups (wildlife conservation, navigation, business, tourism, land-owners and others) (Fig. 2.6).

In the remainder of this section, we employ the concept for social learning for climate change adaptation as described above to reflect on two decades of actions (e.g. knowledge generation, assessments, planning and implementations) towards more climate-proof development in The Broads. Local climate adaptation cannot be seen as a separate "domain" but only in the context of other planning and development decisions in the area. Therefore, "learning for adaptation" in The Broads can be hardly separated from broader "learning for better management". Fig. 2.7 represents a "road-map" of this process including factors and events at different levels that have had (or still have) an influence on decision-making on climate adaptation in the Broads. Based on official documents (Broads Authority, 2004, 2007, 2008; Communities and Local Government, 2007; DEFRA, 2005, 2007; EERA, 2004; EU, 2007) and interviews, we represent 20 years of "climate learning" in the Broads as two cycles including context, process and outcomes (Pahl-Wostl et al., 2007a; Tàbara et al., 2009) with several “key learning events” (Siebenhüner, 2002a) also reflecting on first- and second-order learning in the case study. Overview of these broader learning processes at different levels over time represents an important part of the case study description. It provides a clear view on a larger system of reference within which the local agents need to operate i.e. to build their responses and to establish learning activities. Detailed description of the cycles of multi-level social learning process grounds the analysis of social learning for bridging scales and levels at the local level represented in the next section.

Fist cycle: from The Broads Act (1998) to The Broads Plan (2004)

Context: In 1988, the UK Government Norfolk and Suffolk Broads Act established The Broads National Park and introduced the Broads Authority (BA) as the main management body responsible for navigation, tourism and nature conservation at both terrestrial and water spaces (Broads Authority, 2004). Important step had been made towards spatial and administrative integrity of management that was previously shared between Norfolk and Suffolk County Councils.

In the beginning of 1990s, increasing evidences of climate change and information campaigns at global and national levels stressed the importance of integrating adaptation measures in local development planning. The adaptation focus in The Broads started to shift from the traditional reliance on technical approaches to flood protection towards a long-term perspective that, among other factors, also considered the potentially emerging issues like salinization and loss of fresh-water ecosystems. Growing industrial and agricultural development pressures in close-by areas increased water pollution and eutrophication, resulting in negative effects not only for biodiversity but also for navigation.

Fig. 2.7. A road-map of the decision-making process on climate adaptation in The Broads: decisions, actions, institutions and factors of influence

At the same time, environmental policies at the national and EU level provided new, and often stricter, standards for environmental quality and safety. The EU Birds and Habitat directive applied within the boundaries of the national park and the new EU Water Framework Directive (WFD) established higher standards for water quality. River Basin Management Schemes (RBMS) introduced by the WFD expanded planning schemes beyond the borders of the national park, thereby increasing the complexity of management and, to some extent, limiting the capacity of the BA to plan adaptation responses within its borders. At the national level, the Flood Alleviation Program reduced possibilities for economic activity in the zones qualified as "flood-prone" — which form only part of the area — that further increased management fragmentation. Although significant financial support existed in the national park, the majority of funds are appropriated for ecosystem preservation while funding for adaptation measures is still limited.

Scientific research on The Broads ecosystem has been immense (cf. George, 1992). Starting form 1990s, new series of research in the area increasingly stressed social and economic aspects including considerations of risks of flooding and possible adaptation measures (Turner et al., 2003, 2004), climate change scenarios (Lorenzoni et al., 2000a, b) and schemes for complex environmental management (Turner et al., 2003, 2004). Several studies, supported by initiatives at national and EU levels, argued for more participatory approaches (Lorenzoni et al., 2000a, b; Turner et al., 2003).

Process: New conditions of management and increasing effects of climate change forced the Broads Authority to look for alternative management solutions. The development of a new management strategy spread over two years and included several phases: initial planning and design; identification of stakeholders; public consultations to identify key issues; preparation of a draft Plan and following consultations; and finalization of the new Broads Plan (Broads Authority, 2004). The process was organized by the BA and independent consultants were involved in the process to assess the design and facilitation of dialogues (Broads Authority, 2004).

Outcomes and key learning events: In 2004, the Authority adopted the new Broads Plan (BP), a guiding document providing management objectives for the four themes of ‘living landscapes’, ‘water, habitat and wildlife’, ‘tourism and recreation’, and ‘understanding the Broads’ (Broads Authority, 2004). Climate change was increasingly considered as one of the factors with most potential influence on The Broads development. The BP developed a five-year Actions Plan, considered visions of future developments within the next 20 years, and uses a one hundred year interval as reference line for evaluating possible consequences of global climate change (Broads Authority, 2004). The administrative structure of the BA was revised to implement a more pragmatic and problem-oriented approach which enhanced its position as a coordinating body. The Broads Authority further initiated the Broads Forum (BF) as a consultative stakeholder body, aiming at involving stakeholders’ knowledge and to share awareness of and responsibility for complex decisions. The Broadland Flood Alleviation Project, focused on flood protection in river section (e. g. constructing of banks) and based on 20-years public and private partnership funding scheme, started to operate.

Second cycle: from the Broads Plan to the modern challenges

Context: From 2004 to 2008 several changes happened at the national and regional levels. To support a strategic move toward sustainable development at the local level (Turnpenny & O'Riordan, 2007) the UK government significantly revised planning standards. The Local Development Framework (LDF) supported an integral system of planning and management at the local level by combining different development objectives. Later on, Regional Spatial Strategies (RSS) had been introduced to set up development frameworks at the regional level. By introducing LDF and RSS, the UK government attempted to enhance the role of regions in planning and management (EERA, 2004).

Advances in climate policy development (UK Climate Impact Program, Adaptation Framework Program and Climate Bill (DEFRA, 2005, 2007) brought climate issues to a fore. Climate change became an important factor for strategic planning and was integrated into development policies and guidelines (Communities and Local Government, 2007; EERA, 2004). Nevertheless, the main policy focus remained on mitigation. The EU Green Paper on Adaptation (EU, 2007) aimed to balance adaptation objectives with the mitigation agenda at the EU level. At the local level, increasing evidences of disastrous events (e. g. storms of 2006 and 2007) raised public awareness and emphasized necessity to protect population from climate-related risks. However, alongside with the local development and adaptation, the BA needed to support the standards for water management and biodiversity conservation (EU WFD and Habitat Directives) controlled by, respectively, the Environmental Agency (EA) and Natural England (NE). Fragmentation of management was recognized as an important barrier: BA did not have control over flood protection at the coast (responsibility of the EA) and nearby areas.

Process: According to new planning regulations, the BA got full planning and management functions including responsibility for development and implantation of the LDF. To overcome fragmentation and meet the demands at upper levels, the BA revised its management structure and initiates institutional cooperation with the EA and NE. The BA also expects possible changes in planning structure according the new RSS — The East England Plan (EERA, 2004). In 2008, Natural England (NE) prepared a draft version of the Adaptation Strategy for the key natural character areas in UK, including the Broads (Natural England, 2008). The strategy suggested several scenarios of adaptation depending on the way the society will face climate change (i. e. from complete reluctance to accepting climate-related changes in ecosystems); the document had strong focus on ecosystem protection and less on other aspects of development in The Broads.

Several public consultations were organized in the area. River Management Basin Schemes (RBMS) were presented for public discussion according to the WFD requirements. Climate impact models developed by the EA were discussed at the BF; stakeholder consultations were organized on the adaptation strategy by the NE. At present, the Broads Forum looks for new ways to enhance capacity for stakeholder participation, e.g. to contribute to and to communicate possible climate change strategies.

Outcomes and key learning events: BA, EA and NE established the Committee for Coordinated Action for Adaptation, which subsequently became an important step towards more effective and less fragmented management. To address the complexity of addressing adaptation challenges and to support the standards of RBMS/WFD, the BA introduced new "whole valley" management schemes based on river catchments. A new Green Plan suggests climate action for the area, combining mitigation targets by the BA with adaptation strategies based on the objectives defined by the Broads Plan 2004.

At present, the balance of development objectives at the regional level and trade-off between long- and short-term priorities at the local level are among the most important challenges for climate policy and climate learning in the area. New planning regulations (RSS) shift responsibility for planning to Regional Development Agency (EERDA) that may give more priority to the economic development and less to environmental issues, that may "*make it a lot more a challenge to get climate change at the regional level"* (Interview 2). Continuing reliance on traditional technical measures for flood protection may preserve the areas from flooding and reduce the risk for the population in a short and medium perspective while accepting unavoidable natural changes in land-use structure may deliver effective solutions in a longer run.

2.3.5. Social Learning Processes in Climate Change Adaptation in the Broads Ecosystem

The above-described evolution of climate adaptation in the Broads ecosystem can be interpreted as a relatively successful social learning process, because evidences of changing practices, management policies, institutional structures, and actors' behavior can be identified. The changes can in many cases be directly linked to the availability of new information, the input of innovative knowledge by various actors, insights gained from scientific research, and changes in the decision making context. Many challenges remain before an effective mechanism of social learning for bridging scales and levels will be implemented in The Broads national park.

To assess in greater detail how social learning has contributed to building channels for cross-scale and multi-level integration in climate change adaptation in the case study, we will now shed some light on the question of if and how the problems of ignorance, mismatch, and plurality have been addressed, what type of social learning has occurred, and which factors seem to have been particularly important for the social learning to happen.

In this empirical analysis of the Broads case study, there are many examples illustrating both the challenges of bridging scales and levels in climate change adaptation and how social learning processes can help addressing them.

Social learning for addressing ignorance of scales and levels. The common problem of ignorance was and is prevalent in various aspects, including scientific information about scenarios and effects of climate change in the area, multi-level management and integration of local knowledge.

Before the 1990s when climate change was not yet on the agenda of sectoral planning agencies, ignorance of scientific information about possible long-term effects of climate change existed. At present, notwithstanding several advances and learning efforts in the field of climate scenario development at various levels, local development planning is still insufficiently attuned to the potential impacts of climate change. For example, local climate change data only starts to be scaled down to local impacts. Knowledge is rare of how exactly the different global IPCC scenarios would play out in terms of expected changes in precipitation patterns, average temperatures, and sea level rise and how this information can be integrated in local planning. At the same time, scenarios at global and national levels (which also ground guidelines for local development) as well as standards for environmental quality (e. g. the WFD and the Habitat Directive) usually do not take into account information about specific local effects, e. g. eutrophication and decreasing water quality as result of climate change in the Broads.

The later example of the EU directives can also indicate ignorance related to management. EA and NE as national-level agencies responsible for implementation of the WFD and Habitat Directives may ignore local objectives of more flexible climate-proof development. Ignorance is also apparent in that the WFD does not directly include the aspects of climate change adaptation. In absence of any guidance form the EU, member states and local watersheds are still lack information of how to include aspects of climate change adaptation in the plans (cf. Interview 2). Another persisting example of ignorance can be seen in the possible neglect of the potential impacts of climate change and need for adaptation measures in new regional development plans (Interview 2). Furthermore, platforms and procedures for integration of the local knowledge need to be further developed.

Nevertheless, several advances in overcoming ignorance have been made that can be attributed to effective social learning processes: better integration and more local assessments of potential climate change impacts are now available. Actors in regional and national instructions (e. g. EA) are collaborating with scientific counterparts and stakeholders at the local level (the Broads Forum) which increases the usefulness of the assessments and advices. The Broads Authority in its attempt to create alliances with the institutions as different spatial and administrative levels (e. g. EA and NE, and bordering authorities), experiments with ways to deliver the local information to the other levels and create “communities of practices” for co-managing the Broads area. Another example can be seen in the creation and current re-framing of the Broads Forum for better integrating local knowledge, which is a response to new political conditions and changes in management behavior of the Broads Authority.

Social learning for addressing mismatch of scales and levels. Mismatches in climate change adaptation can exist between the ecosystem boundaries, the administrative borders and management structures, the scales of scientific information and management requirements, and resources allocated at different levels and for different purposes. Such mismatches exhibit important barriers to the creation and implementation of complex adaptation strategies. If assessment and management do not address a phenomenon at the level at which it occurs, understanding of the system must remain incomplete and changes in the ecosystem behavior cannot be induced effectively.

The case of climate change adaptation in the Broads shows numerous examples of mismatch between the spatial and administrative scales. Particularly relevant is the mismatch between the ecosystem boundaries and the area administrated by the Broads Authority since the coastal zones, upstream parts of river catchments and other areas adjacent to the national park are still outside of the Authority's influence. Furthermore, the adaptation strategy prepared by Natural England delineates the Broads as a natural character area on the bases of its natural habitats while important interactions with local land use dynamics, economic activities and development in the broader ecosystem remain only vaguely considered. Another example can be seen in the national flood-protection regulations that are concentrated only on some designated "flood-prone areas" and thus increasing the fragmentation of management.

An example for the mismatch between scientific information and management objectives is apparent in that data on water availability and risk management are dispersed between assessments at different agencies responsible for the climate change scenarios at the national level (UK CIP) and evaluation of flood risk (DEFRA).

At odds are also the local stakeholders' long-term objectives of climate change adaptation and the rather short-term oriented financial investments from the national level. Local stakeholders perceive the resources provided by the national level as insufficient and rather ineffectively distributed.

In addition to these persisting problems, positive examples of social learning for overcoming issues of mismatch can be found. The Broads authority, after gaining the management responsibility over the area in 1989, has successfully increased its capacity to address climate change adaptation issues at the ecosystem scale. The last extension of the BA's control over the planning in the area may also be seen as an effect of learning processes at upper levels that finally led to the decision to empower local administrations as a condition for more sustainable planning. Besides, several re-framing of the BA structures e.g. toward more integral management of river catchments, indicate an effort to reflect on the management practices and to adapt to policy changes at the upper levels. Similar to the challenge of ignorance, the creation of the Committee for Coordinated Actions for Adaptation between the BA, the EA and the NE can be considered as a significant advance in learning for overcoming mismatch between spatial and administrative scales of management for climate adaptation. At the same time, the Broads case shows how the introduction of polices with good intentions may also have the side effect of further complicating the governance structures: new planning system introduced by the RSS may interfere with the established planning and management structures.

To address current mismatches between management objectives at different scales (i. e. meeting the standards for water quality as defined by the WFD), the Broads Authority currently applies at the national level to have the Broads National Park designated as an experimental area for local adaptation strategies in UK. The proposal, which for example includes the introduction of flexible water quality standards, is a highly innovative response to the management problem and can be interpreted as a result of successful learning.

The mismatch between scientific information and management targets is currently being addressed in involving local stakeholders in discussing the allocation of measures for coastal flood defense, evaluating risks related to sea level rise by the EA, and scenarios suggested in the Adaptation Strategy by the NE (Natural England, 2008). The stakeholder involvement can be seen as a result of learning at the local and upper levels, aimed at designing more effective practices of decision-making.

One of the most crucial factors for overcoming mismatch might be local leadership to facilitate better communication between scientific results and the people making decisions (Interview 2).

Social learning for addressing plurality of scales and levels. The challenge of plurality in cross-scale and multi-level climate change adaptation lies in the need to identify and consciously address the multiple perceptions of the impacts and potential mechanisms for effective adaptation. The Broads case exhibits two examples of plurality challenges: the multiple objectives of actors representing different scales and levels and the trade-offs between short- and long-term approaches to climate change adaptation.

Multiple objectives, interests, and future visions are advocated by actors at different levels and cross-scale. The various sectors involved such as navigation, tourism, agriculture, nature protection etc. all have independent and sometimes conflicting perspectives on climate change adaptation. Furthermore, actors from one sector but different levels in the hierarchy may have slightly different objectives as well. It is important to stress that these cross-scale and multi-level plurality relates to issues of power distribution and prioritization between objectives. For example, the objectives of ecosystem preservation lobbied at the national level obviously receive more priorities including financial support. At the same time, responsibility for complex strategy for local adaptation to greater extent remains at the local level with less resources and capacity to act.

Plurality also becomes apparent in valuing trade-offs between short- and long-term management solutions for adaptation. Flood protection (i. e. based on technical measures including holding a sea line as long as possible by banks) is seen as primary short-time goal and supported by number of actors. At the same time, other actors, including scientists and stakeholders at the upper levels (NE and, also, BA) may advocate for longer-term solutions, i. e. supporting scenarios, which imply unavoidable changes of ecosystem and land-use (see Text Box 2.1).

Social learning about approaches for addressing the issue of plurality is reflected in the advances made towards more complex planning. A salient example is the introduction of broad stakeholder consultation in the development of the Broads Plan, which can be seen as a major result of learning for better management.

TEXT BOX 2.1.

Let Nature to Take Its Course?: debates around adaptation measures.

One of the four scenarios the Adaptation Plan for the Broads Character Area by Natural England (NE) (Natural England, 2008) suggests to "Let Nature to Take Its Course". The scenario implies that the areas along the North Sea coast now protected from flooding e. g. by "beach feeding" for the cost of significant financial investments, will be let for gradual flooding by the sea as a result of climate change and sinking of the coast line. The option implied a loss of land now partly used for agriculture. Several villages along the coast would need to be relocated. As the benefits, this scenario suggested creating new wild life habitats in the abandoned areas and significant decrease of the climate change risks in the longer run. The draft version of the plan was discussed at the stakeholder workshop with the representatives of the Broads Authority, local communities, municipalities and scientific experts in February 2008. Shortly after the workshop BBC reported on public oppositions against the plan (http://news.bbc.co.uk/2/hi/uk_news/england/norfolk/7338079.stm) supported by the NGO Broads Society and local communities. The NE needed to provide explanation, i. e. that all the options had suggestive character and was developed by the Adaptation Plan alongside with the other strategies following more "business-us-usual" passes.

This example may illustrate how learning, triggered by a crisis in relations between the actors (Holling & Sanderson, 1996), revealed the challenge of "plurality" in cross-scale and cross-level interaction. The actors at different levels had different perceptions of the time-span of adaptation strategies (longer in case of NE and shorter for protesting public) and of at which level the decisions should be located. The case also stressed the importance of adequate and timely representation of information across the levels that can be also done thorough a boundary organization.

Additionally, a reframing has taken place in that climate issues are now one of the cross-cutting themes of regional development in the Broads plan. In this regard, climate change and the need for adaptation can be seen as a boundary object that allows multiple stakeholder perspective and helps integrating the formerly competing sectors of nature and landscape protection, industry, and recreation. It has been recognized among the actors that co-management is crucial for effective climate change adaptation (Interviews 1, 2, 3).

Social learning concerning plurality in the "time-frames" of the visions has also occurred through conducting wide stakeholder engagement (Interview 2). As a result of this learning, almost all actors involved are now at least aware about the existence of alternative strategies for future development.

However, reaching agreements on which pathway to choose is still an ambitious goal. From this perspective, consultation by the Natural England on the adaptation strategy for the Broads' valuable ecosystem became an important event that triggered a conflict but also helped to clarify positions of actors at different levels and scales. Other examples are the consultations conducted between the Environmental Agency and local stakeholders to discuss how to respond to the potential local effects of climate change and the remaining degree of uncertainty in the Broads. In this effort, internal and external communication has been identified as the main factor of success.

2.3.6. Types of social learning for addressing issues of scales and levels

Most social learning in the Broads represents single-loop learning or "adaptation of information" (cf. Siebenhüner, 2002a). For example, the introduction of the new "whole river valley management" system which resulted in better integration of spatial and administrative scales occurred rather in compliance with requirements of the WFD than as a result of changing management behavior of the Broads Authority. Single loop learning may also refer to new technological solutions and funding schemes to maintain the existing system of flood protection based on banks along the rivers and the coast. These solutions address the issues of cross-level and cross scale interaction but only aim for changes of management tasks (like seeking financial resources from institutions at levels that were previously not considered appropriate) rather than challenging existing power structures (e.g. convincing the Government to prioritize the issues of complex planning at the local level against sectoral interests of nature protection and water management).

However, there are also several learning events that can be interpreted as double loop learning. The Broads Plan 2004 is an innovative management approach that combines different development objectives and introduces new management structure to respond to the challenges of climate and other environmental changes (Interview 1). Remarkably, the Broads Plan combined previous academic research results with intensive stakeholder consultations, thus integrating information and visions from different scales and levels. An institutional response to overcome plurality, ignorance, and mismatch between spatial and management scales is the establishment of a joint committee on local adaptation that includes representative from the BA, EA, and NE. In this committee, the organizations aim at *"looking for adaptation strategies that all three agencies can agree on and can implement even though they have different implementation areas of responsibility"* (Interview 1). Another example of double loop learning was the shift in problem perception towards realizing and accepting the possible long-term impacts of unavoidable climate change. As one interviewee remarked, *"there have been a lot of people maintaining the Broads at their current states. But we have to understand that the Broads will [...] likely to become more saline in character. [...] That process will notably continue. I think we have to accept this when we starting to understand how we will manage the system"* (Interview 3). Although controversial, this vision indicates an attempt to match the current management objectives and responses to the temporal scales of the ecosystem dynamic under climate change. Currently implemented "substitute policy" (i.e. creating new artificial lakes further in land to replace the existing broads) and

Natural England's (2008) suggestion to replace areas with limited agricultural value with flooded wildlife habitats represent two possible examples of such "reframed" responses.

2.3.7. Promising strategies for effective social learning for addressing issues of scales and levels

The Broads case exhibits many examples in which the strategies of establishing structures of co-management, creating arrangements for institutional interplay, and implementing boundary organizations have led to the creation of effective mechanisms of social learning for bridging scales and levels. The Broads example also shows how society iteratively learns to use these structures more effectively for integration and use of the information and capacities at different levels and scales adapting to the current demands and situation. Whereas several solutions related to co-management and institutional interplay have been already mentioned, in our view the Broads Authority as boundary organization deserves particular attention.

Since its installation in 1989, the Broads Authority has increasingly served as a boundary organization for social learning and for enhancing capacities for bridging scales and levels in climate change adaptation. In many cases, the authority assumed a critical role in acquiring, transferring and applying information (e. g. scientific information and policy decisions), initiating cooperation between the actors and institutions at different levels and scales, raising awareness (both at the local and upper levels) about the effects of climate change for the Broads, and enhancing participation. Many actors in the region recognize and value the Broads Authority's function as a boundary organization. Despite some criticism, it is perceived as legitimate platform for communication and facilitation of information transfer, stakeholder dialogue and learning. In the nearest future, the role of the Authority may even increase due to increased awareness of the Authority's capacity as a boundary organization and support from national tendencies to empower local administrations.

Although the Broads Authority presents us with a case in which a local planning and management authority serves as a boundary organization for facilitating social learning, institutions of other governmental or non-governmental status can also successfully assume this role. For example, in the Helgeå River catchment in Sweden, a non-governmental institution (the Ecomuseum Kristianstads Vattenrike) helps facilitating communication and knowledge transfer for adaptive co-management (P. Olsson et al., unpublished manuscript referred by Cash et al., 2006). Since various kinds of institutions of different official status adopt boundary organization functions, flexible and locally adapted strategies for establishing and fostering such organizations seem appropriate, rather than prescriptions of certain institutional settings.

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2.4. Challenges and Opportunities of Integrating Local Knowledge into Environmental Management

Anne-Claire Loftus, Brandon Anthony

2.4.1. Introduction

A popular Christmas pastime for many 19th century North America hunters was a competition in which the hunter who shot the most birds and small mammals was declared the winner (National Audubon Society, 2011). The Audubon Society turned this tradition on its head and in 1900 organised the first bird census undertaken by laypersons, which has come to be known as the Christmas Bird Count. The Christmas Bird Count is one of the earliest examples of an organised effort to gather and make use of local knowledge held by individuals outside of the research community.

Such flora and fauna monitoring programmes have increased in popularity, as has academic interest in the value of local knowledge for natural resource management. Growing interest in local knowledge is in many ways linked to increased awareness of the shortcomings of scientific knowledge in explaining and solving environmental problems. There is however a dichotomy between the theoretical benefits of local knowledge use and integration into management and the actual practice linked to local knowledge capture. Indeed, most local knowledge capture takes place as part of "citizen science" projects, where laypersons gather data as part of studies designed, analysed and used by researchers. While such projects have undeniable benefits, not only in terms of data gathering but also in terms of increased environmental awareness on the part of participants, they do not involve local knowledge holders in all parts of the process, from research design to ultimate decision making.

This chapter will focus on one example of local knowledge — that held by a group of anglers who have fished the Motueka River catchment in New Zealand for many years (Fig. 2.8). The local knowledge held by these anglers was sought in the context of a study seeking to determine the causes of an observed decline in the river's brown trout (*Salmo trutta* L.) population. The case study revealed some characteristics of angler knowledge that make it useful for catchment management, while also highlighting some deficiencies of local knowledge that can partly be resolved through appropriate research design. The study also demonstrates that the Motueka River catchment management framework and institutions are structured in a way that allows for full integration of local knowledge into management. The integration of local knowledge therefore faces challenges both in terms of the ways in which it is produced and conceptualised, and in terms of how it can be utilised.

The chapter aims to draw lessons from the Motueka River catchment and draw broad conclusions about the integration of local knowledge into environmental management, both at the scale of the Motueka River catchment and more generally for other local knowledge use initiatives. We also summarise the current discourse concerning local knowledge, its definitions and integration into the research process.

Fig. 2.8. Fly fishing for trout (Source: David Eccleston)

The first section will clarify some of the many terms and definitions relating to local knowledge and provide an overview of the main options for local knowledge acquisition and analysis, and will also present the parameters of the Motueka angler case. The second section will provide the main results of this research, both in terms of the investigation on trout decline and sedimentation, and in terms of local knowledge use for catchment management. Finally, we discuss the opportunities and challenges of integrating local knowledge in natural resource management.

2.4.2. Local knowledge: its definition, capture and analysis

Some of the earliest *practical* examples of data collected utilizing local knowledge include published records kept by North American fish and game organizations, including hunters and fishermen who recorded species distributions and specimen size ranges (e. g. Gray, 1932; IGFA, 1941). Making use of the knowledge held by local people for the management of natural resources has been the subject of *academic* enquiry since at least the 1950s (Dove et al., 2007). There has, however, been a relatively recent surge in interest in acquiring local knowledge for environmental monitoring (Anthony, 2002; Anadon et al., 2009; Danielsen et al., 2007, 2009), developing conservation plans (Oscarson & Calhoun, 2007), and particularly for the management of resources facing over-exploitation and depletion, such as fisheries. Indeed, some perceive scientific knowledge as having failed to address many environmental problems, while pointing to other types of knowledge as possible complementary or even alternative solutions for improved natural resource management (Baird & Flaherty, 2005; Bergmann et al., 2004; Close & Hall, 2006; Mackinson & Nøttestad, 1998; Mathooko, 2005; Murray et al., 2006, 2008).

2.4.3. Defining local knowledge

The terminology used in relation to local knowledge is extensive and subject to overlap, and is also related to the ways in which local knowledge is proposed to be used. It is important to first clarify what is meant by both local knowledge and citizen science, two often-used terms in scientific literature.

Local knowledge as situated knowledge

The knowledge possessed by those whose are not professionally involved in knowledge-production institutions has been variously termed traditional knowledge, indigenous knowledge or local knowledge. Several terms are offshoots of these main branches, including Traditional Ecological Knowledge (TEK), Indigenous Technical Knowledge (ITK), Indigenous Ecological Knowledge (IEK) and Local Ecological Knowledge (LEK). Such knowledge can also be specific to a certain area of activity, such as Fishermen's Ecological Knowledge (FEK). The concept of indigenous knowledge is one that emerged from anthropological research upon contact with non-western cultures. Traditional knowledge is in some ways similar to indigenous knowledge, though it does widen the scope beyond non-western cultures. The concept is firmly rooted in time, and does not allow for changes, which affect all types of knowledge as a result of interactions with other people and places (Ingold, 2000; Sillitoe, 2002).

TEXT BOX 2.2

Local knowledge: a working definition

The local knowledge of an individual is unrelated to any institutional affiliation, and is the product of both the individual's cultural background and of a lifetime of interaction with his or her surroundings. A holder of local knowledge does not belong to any particular social group nor does he or she necessarily lead a traditional lifestyle.

If approached from Ingold’s (2000) ‘situated knowledge’ perspective, the term ‘local knowledge’ is the most valuable, as other concepts highlighting the indigenous or traditional origin of knowledge appear to marginalize the spatial component which Ingold favors (Strang, 2004). The concept of situated knowledge is one derived from Ingold’s (2000) anthropological work, where knowledge is shaped by an individual’s lifelong interactions within his or her environment, rather than transmitted genealogically at a single point in time. The situated knowledge concept gives rise to the idea of local knowledge integration being most valuable at the most site-specific scale of management, and decreasingly valuable and relevant as the management scale covers a larger and larger area, be it in terms of subject, spatial or temporal scales. A further aspect of local knowledge is its rooting in practical action, rather than in theory and documentation. This facet of situated knowledge has important implications for its conceptualization and incorporation into wider contexts; its acquisition through time spent in a particular location and as part of a particular set of activities is quite dissimilar from the more temporary and observational role of scientific research (Ingold, 2000; Sillitoe, 2007). Fig. 2.9 illustrates how the different types of knowledge fit in the situated knowledge spectrum of space, time and culture.

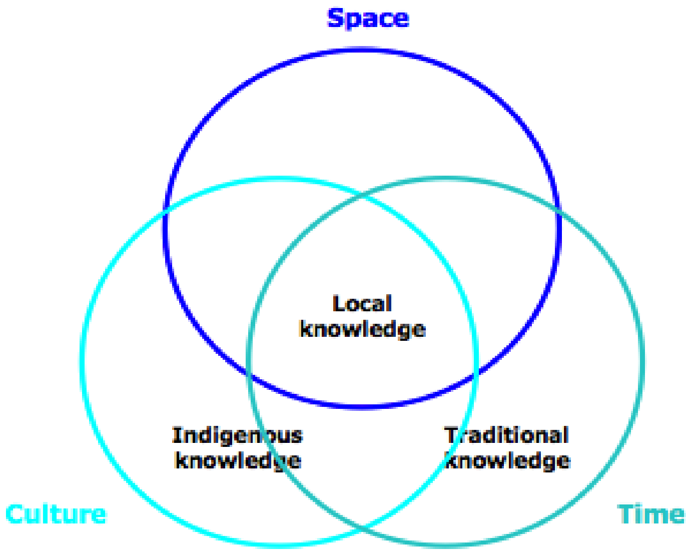

Fig. 2.9. Distribution of different local knowledge types in a situated knowledge spectrum

Local knowledge use: an academic perspective. Before explaining the concept of citizen science, it is worth reviewing the main arguments that have been put forward to justify the use of local knowledge. One category relates to increasing the validity of scientific research by supplementing it in areas where it is deficient, including the local relevance of research (Fischer, 2000; Sable et al., 2007; Williams & Bax, 2007). In the case of fisheries, replacement of traditional or local knowledge by centrally generated data has led to largely locally irrelevant policies, on which problems like overfishing can partially be blamed (Fischer, 2000). Lack of local relevance is particularly prominent in development studies, where examples of projects failing because of their failure to incorporate local knowledge abound; calls by donor agencies and researchers to break the top-down (often hegemonic) expert-driven transmission of knowledge for a more holistic and integrated approach are increasing (Agrawal, 1995; Siebers, 2004; Anthony et al., 2011).

A second argument promotes the benefits brought about by increasing the participatory and collaborative nature of scientific research. Local empowerment is seen as a means of increasing the quality and validity of scientific research, through participation in both formulation and implementation (Fischer, 2000; Mackinson & Nøttestad, 1998; Marzano, 2007; Sillitoe, 2002, 2007; Stanley & Rice, 2007). Fischer (2000) sees local involvement in environmental management as vital given the local origin of many environmental problems. A third category of arguments sees local knowledge as an essential component of scientific research; a good example of this is pharmaceutical research, where local indigenous knowledge of the medicinal properties of local flora and fauna is key to the development of new compounds (Maffi, 2001; Sillitoe, 2007). Often, local knowledge is also put forward as a first investigative step, which may save both time and money, by supplanting the need to conduct scientific research, or at least enabling a focus of research on certain priority areas (Sillitoe et al., 2004).

Citizen science or the practical application of local knowledge. Citizen science mainly relates to the third category of arguments outlined above: that local knowledge can become an integral part of scientific research. Citizen science is not synonymous to local knowledge but rather refers to ways in which this knowledge can be applied in practice. Very little recent research supports the wholesale substitution of scientific research by local knowledge; rather, local knowledge is seen, as a supplementary source of knowledge, to be tapped before, during or after scientific research has been undertaken, or sometimes at all stages (Fischer, 2000; Gilchrist et al., 2005; Sillitoe, 2007).

2.4.4. Capturing and analysing local knowledge

While the general consensus is that local knowledge has inherent value, views on how valuable this knowledge can be for environmental management and on how it can be integrated within it are much less unified. Some researchers see local knowledge as a data source like any other, which must be subjected to rigorous analysis in order to contribute to management in a meaningful way (Gilchrist et al., 2005). Others take the view that the inherent value of local knowledge is compromised by attempts to evaluate it based on comparisons with scientific knowledge, which they see as subject to its own set of biases and imperfections. A third view of local knowledge research does not necessarily promote its integration into management but rather sees the mere fact of gathering knowledge and interacting with the local knowledge holders as achieving a positive environmental outcome. Although there is a paucity of research which has evaluated the validity of local knowledge versus 'science-based' knowledge, there is indication that local knowledge can yield statistically similar results (Engel & Voshell, 2002), and may even be superior in some cases (Anadon et al., 2009).

Capturing local knowledge. Several research methods have been adapted for the purpose of capturing local knowledge; two of these are Geographical Information Systems (GIS) and interviews.

The spatial component of local knowledge means it lends itself particularly well to systematization using GIS. Although not limited to fisheries (Sillitoe et al., 2004), the spatial conceptualization of fish stocks and fishing zones in fishermen's minds means GIS can be used to clarify and record their observations (Anuchiracheeva et al., 2003; Close & Hall, 2006; Hall & Close, 2007; Schafer & Reis, 2008). Researchers may either gather positional information from local knowledge holders on printed maps and subsequently digitise this information using GIS software, or they may accompany local knowledge holders on the ground and record coordinates using GPS technology (Schafer & Reis, 2008). Also, a number of interview techniques have been devised to attempt to capture the richness of local knowledge while accounting for the fact that it may not come in the same format as scientific data. For example, some researchers use colour photographs of species (Silvano et al., 2006; Silvano & Valbo-Jorgensen, 2008; Valbo-Jørgensen & Poulsen, 2000) or actual specimens (Anthony & Bellinger, 2007) when going through questionnaires and interviews, while others use trend timelines made by the local knowledge holders themselves (Píriz, 2004).

The fact that levels of knowledge may not be equally distributed among members of a community or resource user group is one of the main limitations relating to local knowledge capture. For example, one study found that fishermen using larger equipment possessed less knowledge than those using smaller equipment (Wilson et al., 2006); differences can also be due to differences in age and/or diversity of fishing areas utilised. Hence, selecting the 'wrong' fishermen for data may skew the results (Close & Hall 2006; Davis & Wagner 2003; Drew, 2005; Murray et al., 2006, 2008; Silvano et al., 2006; Silver & Campbell, 2005; Wilson et al., 2006). Another limitation relates to the perceived sensitivity of some forms of knowledge. The knowledge held by commercial natural resource users is subject to some particular considerations; these may feel their knowledge is of commercial value and hence should remain confidential (Close & Hall, 2006; Drew, 2005; Maurstad, 2002). They may also feel that any use of their knowledge in the interest of environmental management is likely to lead to more restrictive regulations, and is therefore not in their commercial interest (Silver & Campbell, 2005; Williams & Bax, 2007). Research should be designed in order to assure the confidentiality of any information given — particularly if the results are to be publicized — if researchers want to ensure they get valid and reliable data from local knowledge holders.

Analysing local knowledge. Following its collection, local knowledge usually undergoes various stages of analyses, either through GIS software, statistical and modelling techniques, and/or qualitative analysis (Olson et al., 1995; Kelle, 2001; Campbell, 2002). The use of GIS also allows for the storage of information that cannot be spatially represented on maps in linked databases, text files or photographs (Hall & Close, 2007; Harmsworth, 1998). This approach is particularly valuable, as it captures the varied nature of local knowledge and comes at a relatively low cost. The data obtained from interviews and focus groups can also be entered into databases and statistically analyzed (Baird & Flaherty, 2005; Anthony & Bellinger, 2007).

The analysis of local knowledge can be hampered by the fact that it is not always valid or reliable. For example, some aspects of fish biology may take place outside of the sphere in which fishermen's knowledge is situated. For example, fishermen in Brazil do not have extensive knowledge on the reproduction of pelagic fish, simply because it takes place at sea, beyond the reach of their vessels (Silvano et al., 2006). Since local knowledge comes in different formats, it is neither easily made compatible with existing scientific structures, nor simply communicated to others in a fishery management setting (Mackinson & Nøttestad, 1998; Agrawal, 2002; Anuchiracheeva et al., 2003; Davis & Wagner, 2003; Píriz, 2004; Drew, 2005; Baird & Flaherty, 2005; Close & Hall, 2006; Wilson et al., 2006; Schafer & Reis, 2008). Since the analytical tools local knowledge is often repackaged into often have pre-existing requirements in terms of the type of data and information, which they can utilize, some data representing local knowledge must sometimes be discarded, regardless of its value or relevance.

Gathering and using local knowledge in developing countries. The chief difference between fisheries research in developing and developed countries is that research in developing countries tends to focus on artisanal-style fisheries, which use more traditional techniques, while that in developed countries (apart from some examples focusing on the fishing methods of aboriginal communities) tends to focus on small-scale fisheries which employ more modern techniques. While this may very well be a reflection of the reality on the ground, it has implication in terms of research methods used; a good example is the use of GIS. Research using GIS to systematise local knowledge in developed countries uses detailed maps, such as nautical charts, as well as advanced technologies, such as interactive GIS platforms (Murray et al., 2008) and GPS (Bergmann et al., 2004). The results of this research are likely to have little replicability in developing countries, where use and understanding of these methods is likely to be very low.

2.4.5. An example of local knowledge: brown trout fishermen of the Motueka River catchment

As a case study of the existence, capture, analysis and possible use of local knowledge, here we focus on the local knowledge held by a group of fishermen of the Motueka River catchment in New Zealand. A study of local angler knowledge was undertaken in 2009 as part of the Integrated Catchment Management Motueka Research Programme[1] and focused on the knowledge of environmental and sedimentary processes held by a group of long-term local anglers. This section will briefly explain the methodology followed in the study.

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[1] From 2000 to 2010, the Integrated Catchment Management programme took an integrated and multi-disciplinary perspective to the management of the catchment, researching social and economic issues as well as biophysical variables while seeking to involve affected stakeholders in environmental management decisions. For more information, see: [Electronic resource]: URL: http://icm.landcareresearch.co.nz/

TEXT BOX 2.3

The Motueka River catchment

Located in the north-west of the country's South Island, the Motueka River catchment drains an area of 2,180 km^2 and is composed of the Motueka River, whose main stem is 110 km in length, as well as a number of tributaries (Fig. 2.10). The catchment is predominantly rural and characterised by mountains and hills, making most of it ill-suited for arable cropping; land cover in the catchment is mostly a combination of native forest, planted exotic forest and pastoral grassland (Basher, 2003). The catchment is managed by the Tasman District Council (TDC), while the catchment's trout fishery is under the authority of Fish and Game New Zealand (FGNZ).

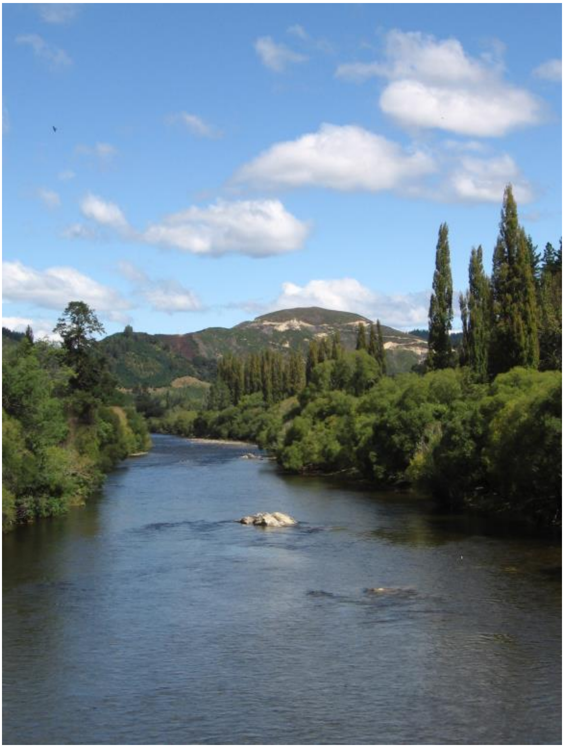


Fig. 2.10. The Motueka River catchment (Source: Anne-Claire Loftus)

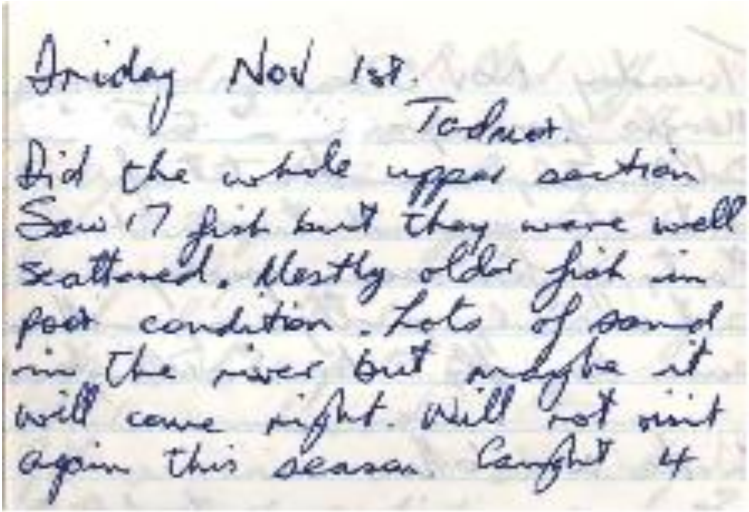
Some key challenges face the Motueka River catchment: competition for limited water supplies both between different water-consumptive land uses and between these and non-consumptive uses of water; the influence of sediment on river ecology and its relationship with land use; deteriorating water quality due to the cumulative input of nutrients and bacteria; and possible negative trends in riparian management affecting aquatic species (Basher, 2003). In the mid-1990s, brown trout (*Salmo trutta* L.) numbers were observed to decline in the catchment, with sedimentation identified as a possible causal factor. Anglers who have fished in the catchment over a long period of time were identified as potentially valuable sources of information about sedimentation events, the trout fishery and other environmental processes.

Methodology

Fieldwork for this study consisted of semi-structured interviews with long-time anglers of the Motueka River catchment. Interviewees were not selected randomly, but rather were chosen because of the breadth of their experience of the river. The lack of randomized sampling was justified by the need to obtain information covering a long historical period, from anglers who frequently use the catchment; lack of representativeness was therefore not seen as an issue. To understand if and how angler knowledge can be used for catchment management, a number of persons involved in management of the catchment and trout fishery were also interviewed.

The angler interviews had two objectives: first, to ascertain what knowledge the anglers possess and second, to identify the characteristics of the knowledge that could play a part in determining to what extent it can be integrated in catchment management. A number of aspects of the interviews were tailored to meet the specific features of local knowledge:

- Anglers were encouraged to bring any fishing diaries they might keep to the interviews (Fig. 2.11).
- In recognition of the strong visual component involved in fishing, the interview protocol involved asking anglers if



Friday Nov 1st.
Tadmor.
Did the whole upper section
Saw 17 fish but they were well
scattered. Mostly older fish in
poor condition. Lots of sand
in the river but maybe it
will come right. Will not visit
again this season. Caught 4

Fig. 2.11. Example of angler diary entry

they used any visual means of recording events during fishing trips, such as photographs.

- Interviewees were asked to identify from a series of photographs the severity of the sediment events, which they encountered. This visual support was established in an effort to facilitate comparison across interviews.
- A map showing the main bridges within the Motueka River catchment was used during the interviews to ensure clarity of communication and to aid with identification of the areas predominantly fished. Indeed, a pilot interview conducted showed that anglers primarily locate themselves according to the main access points to the river: its bridges.
- Confidentiality of interviews was ensured in recognition of the sensitivity of opinions given about current fishery and environmental management measures and of information about favoured fishing spots. Although such information would only be commercially valuable for the several fishing guides interviewed, it could be of value to the rest of the

anglers in other ways. Indeed, their enjoyment of fishing can depend on their ability to catch fish, as well as on the ability to spend time alone in a particular place, either of which might be jeopardized by an increase in the number of encounters with other anglers.

In the analysis of interview responses, the characteristics of local knowledge were also taken into account. Namely, validation was used in order to try and assess the validity and reliability of the largely anecdotal responses elicited by the questionnaire, using three main methods:

- Comparison of statements made during each interview to identify inconsistencies.
- Cross-checking of information within the angler sample; this particular method was used as much to identify any outlying opinions as to determine validity. Indeed, the expression of a view contrary to all others was not necessarily seen as evidence of its falsehood, particularly given the small size of the angler sample.
- Triangulation with other sources of data: statements made were compared, where possible, to existing information on the subject, from both scientific and non-scientific sources.

2.4.6. Local knowledge integration in environmental management

Although integration into management is not the aim of all local knowledge collection — some being geared more towards archiving of knowledge for posterity (Agrawal, 1995) — it is an important part of a number of local knowledge research projects. This section will focus on integration of local knowledge, taking both lessons from the Motueka River catchment case and from other examples.

Findings from the Motueka River catchment study relating to sedimentation and other environmental processes. The first objective of the interview process was to determine what knowledge the anglers possess. Through their extensive experience of the catchment, both in terms of distance covered and time spent on the river, anglers have accumulated a vast store of information about the trout fishery, and environmental processes in the catchment as a whole. Within the angler sample, there exist important differences in observations and opinions, some about specific events and issues, and others about more fundamental views on the state of the fishery and its relation to land use within the catchment. The interviews produced a large quantity of angler observations of sediment events and other environmental processes, as well as widely varying views concerning both the state of the fishery, and the possible driving forces behind it.

TEXT BOX 2.4

The angler sample

The 16 anglers interviewed for the study have been fishing in the Motueka River catchment for a mean of 36 years (min = 7, max = 71). The average number of days fished per year is 25, with some of the anglers fishing over 50 days per year — much more than average fishing license holders in the region. Their fishing habits vary, with some alternating fishing spots quite often and others choosing to fish in one area exclusively. The fact that some of the anglers change their privileged fishing spots in response to the number and size of fish has implications in terms of their familiarity with certain parts of the catchment.

Anglers were asked about the location, timing, duration, type and severity of any sediment events, which they may have noticed in the Motueka River and its tributaries, as well as about their opinion of the causes of these events. Anglers reported the occurrence of sediment in a wide variety of locations and over a range of timescales, and also broadly agreed that the aquatic habitats in the catchment have become more uniform over the years due to sedimentation and consequent in filling. Anglers primarily believed sediment affected trout at a localized level, by smothering the riverbed and creating unsuitable habitat for the trout’s main source of food: invertebrates. Most anglers blamed forestry and its associated roading, preparation of land for planting and finally harvesting for the sedimentation observed in the catchment. Apart from observations about sedimentation, most anglers also observed a change in the population distribution of trout, which transitioned from housing large numbers of small fish to hosting small numbers of large fish. However, there was wide variation in opinions regarding the magnitude of change undergone by the trout fishery through time, some seeing it as having deteriorated severely and others as responding to more cyclical patterns. Although a large number of possible causes for the perceived decline in trout numbers were mentioned by anglers, sedimentation and the failure of juvenile recruitment were the most frequently cited.

Findings from the Motueka River catchment study relating to local knowledge in general. The second objective of the interviews was to determine what aspects of angler knowledge affect its integration in catchment management. Overall, the aspects identified seem to negatively affect the possibility of integrating the local knowledge into the management of the catchment, though the influence of the study design must be highlighted.

The fishing experience of the interviewed anglers varied quite widely: some had both wide spatial and temporal experience, while others had shorter-term experience in more limited parts of the catchment. However, these differences did not necessarily correspond to the degree of recollection of events in the catchment; indeed, the extent to which fishermen record events in written form appeared to play a more important role. Many of the anglers keep or kept fishing diaries, though the level of detail and the consistency of diary-keeping varied widely. Most of the information recorded related to fish catches, with few diarists noting information about habitat or insect life. Overall, the fishing diaries provided little useful information regarding sediment, but were useful to help understand the ways in which anglers conceptualise and present information relating to the catchment.

TEXT BOX 2.5

Brown trout in New Zealand

Brown trout (Salmo trutta L.) (Fig. 2.12) was introduced to New Zealand during the 18th century for sport fishing purposes and can now be found in most of the country's rivers. Although the introduction of brown trout appears to have had an overall relatively less detrimental impact on New Zealand's ecosystems than other introduced species (Wilding & Rowe, 2008), brown trout nonetheless negatively impacts freshwater ecosystems (Townsend & Simon, 2006). However, because the negative impact of trout on ecosystems is less pronounced — or at least less visible — than that of introduced land mammals, and since trout is the centre of a lucrative sport fishing industry, no organised control measures for trout populations exist.

Fig. 2.12. Brown trout (Salmo trutta L.). Copyright Eric Engbretson, US Fish and Wildlife Service

The degree to which statements were an individual's memory or recall was hard to establish. Also, the degree to which the knowledge obtained from fishermen is purely local is nearly impossible to determine. Indeed, each individual's thoughts and opinions are continually formed by interactions with other individuals, organizations, and philosophies, and through exposure to different discourses (Long, 1992). Anglers interact with one another through their participation in angling clubs and through friendships formed with other anglers.

In attempting to validate the responses given by interviewees, the study came across some difficulties. Cross-checking of statements within the angler sample was particularly challenging given the wide variety of opinions put forward by interviewees. Interestingly, while some general views were held by the majority of anglers within the sample, this did not necessarily give them greater weight; indeed, contradictory views held by a smaller number of anglers (in some cases only one) were sometimes more strongly supported by other sources of information. Furthermore, the validation of responses using other sources of information such as scientific research was not only hampered by the lack of research on particular topics but also gave rise to a wider ethical question regarding the need for validation of local knowledge by science.

The following section will show how these findings can be embedded into the larger debate concerning local knowledge integration in environmental management by highlighting the opportunities and challenges of local knowledge utilisation in natural resource management.

2.4.7. Opportunities for local knowledge integration

Observations and opinions varied widely amongst Motueka River catchment anglers, but some overall trends that may be useful for further research were identified. Angler knowledge and local knowledge in general presents characteristics, which make it highly suitable for integration into management.

Observation skills. The Motueka River catchment anglers spent a considerable amount of time on the river over their lifetimes. Apart from the sheer amount of time their angling trips translated into, the observation habits of the anglers were also of benefit to catchment research. Similar to hunters, fishermen must pay particular attention to their surroundings and to the habitat conditions of their prey, in order to improve fishing success. A relevant example is observing the abundance and composition of invertebrates, which is a favoured food source for trout.

This combination of observational skills and time spent on the river is a potentially powerful tool for management; angler knowledge can for instance help serve as an early warning system. Anglers are currently able to act as environmental watchdogs and contribute to fishery management by voluntarily contacting FGNZ to report potential threats to the river. Moreover, the anglers also demonstrated their ability and desire to record visual information about the catchment, not only through the diaries they keep (we return to this later) but also because many fishermen routinely take photographs during their fishing trips, meaning that they may be willing to make use of this technology for management purposes. Such capacity for observation combined with a significant amount of time spent in the natural environment is not unique to anglers, but can also apply to hunters, bird watchers as well as other outdoor enthusiasts.

Capacity for sampling. Given that anglers, or certainly experienced anglers such as the ones we interviewed, spend a significant amount of time on the river, they would be ideally placed to participate in an initiative requiring regular monitoring of habitat indicators. An example of measurement tools which have been designed to be used by non-scientists are Stream Health Monitoring and Assessment Kits (SHMAK), intended as a supplement to more formal monitoring of stream health, and enabling the involvement of community volunteers — particularly farmers. The kits collect data about land use, stream habitat and indicator organisms and consist of a measurement kit and a manual (Biggs et al., 2002). Given the apparent willingness of some anglers to undertake simple monitoring steps as part of their fishing diary records, there may be scope for the implementation of a simplified version of the kit amongst local fishermen who use the river often and regularly.

Systematic thought. As well as being observant and capable of sampling, the anglers showed evidence of a systematic approach being taken in their relations with the trout fishery and the environment as a whole. This approach can be seen in the choice of fishing location and in the diary keeping of some anglers. Some anglers made comments demonstrating the ability to formulate hypotheses and prove or disprove them through observation or experimentation, as would be done in scientific research. A systematic approach is also evident in the way some anglers learn through experience and in the refusal of some interviewees to make categorical statements, acknowledging their uncertainty about certain phenomena.

2.4.8. Challenges to local knowledge integration

Many of the deficiencies of angler knowledge in this study could be remedied through modified research methods, for example by gathering data in a timely fashion rather than as part of a historical analysis. Some problems with local knowledge however lead to more all-encompassing questions about the role of local knowledge as compared to scientific knowledge.

Problems with sampling and data capture. Fishing diaries were identified in the study as a potentially valuable source of information, as long as the information collected was standardised and made more systematic. However, diary schemes can also suffer from low participation rates, because of lack of time or interest or other reasons, which would affect the quality and quantity of data collected, a fact particularly problematic for schemes relying on a high level of detail and commitment. Moreover, if the motivating factor behind the choice of fishing location for an angler is the quality (success) of fishing, this location is subject to change, which may predispose him or her to be less able to observe long-term changes in any given area.

Lack of consistency of observation goes against the principles of scientific monitoring, one of the main tenets of which is to maintain fixed monitoring points over the period of study, in order to accurately capture changes (Spellerberg, 1991). This factor has a particular impact on studies such as this one, which seeks to capture information about historical trends, but may also play a role in the success of habitat diary schemes or other initiatives. Indeed, fishermen may be unwilling to participate in initiatives, which dictate fixed monitoring points, a recognised drawback in other volunteer monitoring programs (Shirose et al., 1997; Mossman et al., 2002).

Also, sampling done by non-scientists can, unless the parameters of the study are set in a very precise fashion, suffer from a lack of accuracy. For example, a bird-spotting study might lead to the over-representation of particular species because of factors like personal preference, ease of spotting or choice of spotting location. A study comparing bird population data gathered from voluntary reporting with data from a standardised survey in Sweden found that volunteers tended to under-report common bird species, that their search effort varied over the years and that they did not choose bird spotting locations randomly but rather based on the likelihood of observation and ease of access. To limit these problems, the authors suggest that the use of full checklists (i.e. asking volunteers to record both presence and absence of species) might increase the validity of such studies, while acknowledging that the citizen science input could be particularly valuable for targeted studies of less common species and could therefore act as a complement to standardised scientific surveys (Snäll et al., 2011).

Observation, hearsay and drivers of perception. Several comments made in the angler interviews revealed a high level of interaction between fishermen and also with fishery managers. Moreover, anglers also showed evidence of having read or been made aware of scientific research results from the catchment, which, although a positive sign from the point of view of stakeholder interaction in catchment management, also made the distinction between pure observation and hearsay more challenging.

Furthermore, the angler study revealed the downsides of involvement of local knowledge holders in all aspects of research (including hypothesis formulation). For example, anglers tended to equate the quality of the fishery with the numbers of fish found in the river rather than their size, while in reality a shift to fewer bigger fish might not reflect reduced water quality. Anglers were also more likely to ascribe greater importance to visually perceptible factors such as forest harvesting rather than more concealed factors such as the damage inflicted upon trout redds[2] by wading anglers, which can cause a significant percentage of egg mortality (Hayes & Hill, 2005). The possible mistaken identification of causal factors is not limited to local knowledge, and it should not prevent its incorporation into management, but it must be taken into account prior to implementation of management measures.

Knowledge extinction. The concept of Shifting Baseline Syndrome, first coined by Pauly (1995), defines a process by which humans change their perception of biological systems as knowledge of past conditions is lost. It was first identified to describe a trend in fisheries science, where scientists used data from the beginning of their career as the baseline with which to evaluate any changes in fish stocks, unmindful of any pre-existing trends, and therefore under-reported fishery depletion. In the study of Motueka River catchment anglers, problems were encountered in terms of angler recollections, the most important of which was lack of precision in terms of descriptions and dating of events. However, while this particular study — because of the need to gather data from the past — relied heavily on personal memory, it is likely and advisable that future studies should focus on recently collected data or on data recorded through diaries, smartphones or other means.

Bias. Since fishermen's knowledge is intimately linked to their livelihoods, it could be regarded as a biased source of information. Surprisingly, few academic articles mention this potentially large bias as a limitation of their research (Mackinson & Nøttestad,

[2] spawning area

1998; Silver & Campbell, 2005; Wilson et al., 2006). Of these three articles, Silver & Campbell (2005) is the most detailed and outspoken on the topic; however, their work is rarely cited. It is possible that the limitation is overlooked because it affects the very core of the research done. Although bias is certainly not limited to local knowledge holders, it should be taken into account when seeking to gather knowledge for the management of natural resources, since many of these natural resources form either the basis of livelihoods or have a direct connection to the hobbies of the local knowledge holders addressed.

2.4.9. Synthesis: appropriate use of local knowledge for environmental management

Given the challenges and opportunities outlined above, it is possible to identify two principal ways in which local knowledge can be integrated into environmental management. The first is to view local knowledge holders as playing an active role in a part of the research process, that which involves data collection, while hoping to create additional benefits linked to awareness-raising — the "citizen scientist" view. The second is to view local knowledge holders as vital to the entire research process, from design through to analysis and implementation, as well as to the eventual use of this research for management purposes.

Local knowledge holders as citizen scientists. The potential of non-scientists to act as an extended sampling force is one of the central tenets of citizen science, whose practical application often involves people making observations according to set instructions from scientists so that more data can be obtained than if relying on their own sampling. For example, the Zooniverse portal run by the University of Oxford asks regular citizens to contribute to scientific understanding through a variety of projects, one of which is the Milky Way Project. This project seeks to increase scientific understanding of star formation, and asks laypersons to, using a simple bubble-drawing interface, identify the bubbles that characterise the life cycle of stars from a series of satellite photographs. With around 12,000 images to inspect, the project leaders hope that citizen scientists will help reduce the analysis burden (Adler Planetarium & the Zooniverse, n. d.). A wide variety of notable programs have utilized volunteers to monitor wetland habitats (http://www.ec.gc.ca/tho-wlo/default.asp?lang=En&n=B6B30A86), bees (University of Illinois, n.d.; Center for Biodiversity and Conservation at the American Museum of Natural History and the Greenbelt Native Plant Center, n. d.), and amphibians (http://www.pwrc.usgs.gov/naamp/) in North America. In Hungary, an interactive website and national map is also used to monitor flora and fauna based on uploading volunteer data (http://www.vadonleso.hu/fajok/terkep/). Other notable examples of using local knowledge to inform management is the observations of inter alia Arctic sea ice change, narwhal tusks and meteorological conditions by the Inuit in Canada (http://www.eloka-arctic.org/data/). Such initiatives typically provide training or basic instructions for volunteers to follow, and citizen scientists normally return data in the form of filled-in data sheets or photographs. As well as providing valuable information to scientists, these citizen science schemes have the added advantage of often being simple enough for children to participate in and help raise awareness about the natural environment.

Such a citizen science system could be put in place in the Motueka River catchment, where the incident reporting system currently in place could be improved and expanded upon. One possibility could be an online information repository, perhaps similar to biological recording websites currently in place, such as the New Zealand Biodiversity Recording Network, where any registered user can enter observations about flora and fauna (New Zealand Biodiversity Recording Network, n. d.). The New Zealand website mainly records observations of a species' occurrence, and is modelled on a similar system in Sweden — Artportalen (Swedish Species Information Centre, n. d.). It would be technologically feasible to extend this system of observation to include not only information about a given species, but also photographic and other records relating to its habitat. Moreover, although anglers could play a central contributing role, the website could be open to anyone else making observations in the catchment and verified by experts. Such data recording websites are an ideal way to gather and ultimately analyse local knowledge in countries where internet access is widespread.

Through such media as web portals, modern technology is making it increasingly easier to take advantage of the sampling power offered by non-scientists. Smartphone applications will make it easier for users to enter information, record sounds and images and transmit the data back to central locations. With GPS soon to be integrated into smartphones, sampling initiatives will be made much more relevant and accurate. Many smartphone applications already exist in the field of citizen science, for example those enabling data collection about waterways (http://www.ibm.com/smarterplanet/us/en/water_management/article/creek_watch.html), birds (http://thewildlab.org/) and other species (www.inaturalist.org/).

Local knowledge holders as integral to the research process. Danielsen et al. (2009) identify five different categories of environmental monitoring, ranging from research undertaken exclusively by professional researchers (category 1) to monitoring conducted exclusively by local people (category 5). Fig. 2.13 summarises the characteristics of each monitoring category.

Category 2 — citizen science — where data is collected by local people but where the research design and analysis is done by professional researchers has been discussed in previous sections. An example of category 3, where local people participate in data collection and analysis, comes from south-eastern Australia. Because of the paucity of data regarding the region, local fishermen were recruited to help with ecological mapping (Williams & Bax, 2007). The fishermen were used not only as data collectors, with the aid of vessels' track-plotters, but also as data interpreters, by being asked to give their opinion of the seabed habitats, something which they would assess for example by gauging the degree of wear on fishing gear (Williams & Bax, 2007). Category 4 and 5 involve local people to a higher degree, in process design, data collection and analysis but also decision making. Such schemes represent the highest level of local knowledge use and integration into resource management (Danielsen et al., 2009).

	Characteristic[a]							
Monitoring category[b]	*cost to local stakeholders*	*cost to others (outsiders)*	*requirement for local expertise*	*requirement for external expertise*	*accuracy and precision*	*promptness of decision making*	*potential for enhancing local stakeholder capacity*	*capacity to inform national and international monitoring schemes*
Category 1	*	***	*	***	***[c]	*[d]	*	***
Category 2	**	**	**	***	***	*	*	***
Category 3	**	**	**	***	***	*	**	***
Category 4	***	*–***[e]	***	**–***[f]	**	***	***	**
Category 5	***	*	***	*	*	***	***	*

[a] *Key: *, low; **, intermediate; ***, high.*

[b] *Monitoring categories are defined in the text.*

[c] *Especially in developing countries, local people may be needed for locating and identifying (e.g., tracks of) wildlife species.*

[d] *An exception is remote-sensing schemes that detect, for example, forest fire in near real time and potentially may allow for almost immediate decision making.*

[e] *Recurrent costs to nonlocals low, set-up and training costs to nonlocals high.*

[f] *Recurrent requirement for nonlocal expertise intermediate; during set up/training requirement for nonlocal expertise high.*

Fig. 2.13. Variation in 8 characteristics across the 5 different categories of natural resource monitoring schemes (Source: Danielsen et al., 2009)

Citizen science projects essentially follow classic research methods (category 1), with researchers designing studies, providing volunteers with set instructions and ultimately being responsible for data analysis and making links to natural resource management. Conversely, local knowledge projects which involve citizens in steps outside of pure data collection — and particularly when it comes to decision making — require greater adaptability within natural resource management institutions. Angler knowledge is not currently incorporated to any large extent into management of the Motueka catchment, partly because catchment managers currently lack the time to be able to take local knowledge observations or comments into account to a greater extent. The information given by anglers is not yet an accepted and trusted source, and a local policy planner expressed the view that local knowledge would need to be substantiated and assessed prior to consideration for management. In order to force policy change, any angler concerns about the potential effect of TDC's policies on the fishery would first have to be substantiated by FGNZ and then by scientists; the policy change itself may take months or years to come into effect. Tasman District Council perceives angler knowledge as belonging rather to the area of public participation, which is both a means of feeding more knowledge into the decision making process, thereby increasing its quality, and of increasing buy-in to Council policies, thereby increasing their effectiveness (Baker, 2009, pers. comm.).

2.4.10. Conclusion on the case study

The case study of angler knowledge of sedimentary and other environmental processes within the Motueka River catchment produced inconclusive results. From the point of view of angler knowledge itself, interviews with the expert anglers produced results that varied widely amongst interviewees and between the anglers' views and available scientific and other records. Indeed, a forthcoming scientific study done within the Motueka River catchment has concluded that the trout decline was mainly due to above-average river flows over a period of a few years coinciding with the emergence of juvenile trout (Young et al., unpubl.), while the interviewed anglers had rather pointed to sedimentation (mostly due to forestry) as the primary cause of trout decline. However, many of the inconsistencies can be related to the design of the study itself, which relied for the most part on angler recollections unsupported by any means of recording. Better design of local knowledge studies, for example supported by data gathering means such as spreadsheets, photographs or GPS coordinates, can for the most part help overcome the deficiencies of local knowledge.

From the point of view of the integration of local knowledge within natural resource management, the Motueka angler case showed that perhaps the greatest barrier to the use of angler knowledge rests in the way ‘integration’ is often approached: as incorporation into pre-existing management structures, regardless of the capacity of these structures to conceptualise it or take its particular characteristics into account. Indeed, unless natural resource management structures perceive the value of local knowledge and are willing to adapt in order to be able to make full use of it, local knowledge use is likely to remain largely limited to citizen science projects. Although the value of these — as long as they follow certain parameters — is widely acknowledged, it does limit the involvement of non-scientists in natural resource management. One of the most exciting developments in local knowledge research has been the emergence of tailored ITC technologies such as smartphone applications, which show great promise in terms of supporting citizen science projects. Such software is becoming increasingly adapted for citizen science use; for example, one application provides images and sound bites of bird species to enable correct identification. The design of these technologies, which helps reduce some of the deficiencies of local knowledge, combined with their ease of use and ever-increasing technology penetration, indicates that citizen science initiatives will likely grow in popularity and use. These factors may, in concert with policy pushes for increased public participation in decision making, organically lead to more in-depth involvement of local knowledge holders in natural resource management.

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3. Environmental policy analysis for sectoral issues

The diversity of environmental policies and their tools (including the management of knowledge systems) across various sectors and locations is outstanding, although the general principles and mechanisms are basically the same. This section of the textbook gives examples of policy analysis from *adaptive management of coastal zones* (3.1), *biodiversity conservation in mountainous ecosystems* (3.2), *physical planning in urban context* (3.3) and dilemmas between *biodiversity management and interests of indigenous communities* (3.4), stretching geographically across the whole Eurasia, from Ireland (3.1) to Tadjikistan (3.2) and Southern Siberia (3.3), and to South Africa (3.4).

3.1. Coastal Environments — Challenges for Integrated Management in Multi-use Settings

Cathal O'Mahony, Anne Marie O'Hagan, Jeremy Gault, Maria Falaleeva

This chapter examines a range of contemporary issues relating to coastal management, and the challenge of delivering sustainable development of coastal and marine resources. While the geographic focus is European, literature from other regions of the globe is incorporated within the chapter sections. Indeed, many of the coastal issues addressed in this chapter are not specific to Europe's coastal domain; therefore, the content is applicable to many coastal locations outside of Europe. Within this chapter, coastal environments (including the marine component) are presented in terms of their socio-environmental character, how they are managed, salient issues and challenges, and associated management responses, and finally an examination of the outlook for the management of coastal environments is provided. Case study material is used to communicate contemporary approaches to integrated management of coastal environments.

3.1.1. Character of Coasts

Coasts reflect the transition between terrestrial and marine ecosystems (Burke et al., 2001; Carter, 2002; He, 2010), typically represent areas where change can be sometimes sudden and dramatic, but is virtually always constant (Carter, 2002), for example — changes to coastlines due to physical processes such as erosion, movement of goods and people through ports, (re)development of coastal land for settlement, sites of inward and outward migration for many forms of animal and sea-life, hubs for traditional (fishing) and emerging enterprises (offshore energy). Coastal areas support a significant portion of the world's population (Martinez et al., 2007; Horstman et al., 2009), through the provision of ecosystem goods and services, and as a location for livelihoods (Weinstein et al., 2007). Coastal regions can represent high concentrations of human activity (e. g. recreation and tourism, energy, commerce and trade, fisheries, energy — hydrocarbons and offshore renewables, and aquaculture (Miller & Hadley, 2005; Martinez et al., 2007; Weinstein et al., 2007) and settlement, resulting in a range of development pressures and associated impacts, often to the detriment of the ecological integrity of coastal and marine environments (see *3.1.3 — Issues and Challenges Relating to Coastal Management*).

The value of coastal areas is evidenced by the levels of use they support, goods and services they provide, and by the range of policy, legislative and management instruments designed with coastal environments in mind. However, providing a comprehensive economic valuation of our coastal ecosystems is a difficult task due to data limitations (Turner, 2000), and ability to capture non-market evaluation of coastal resources (Morrissey et al., 2011); with estimates ranging from over US$12 trillion annually to US$25 billion (Martinez et al., 2007). Needless to say, coastal ecosystems and all that they support are valuable to the continued welfare of human populations, and efforts should be employed to ensure this value is safeguarded in the long-term.

3.1.2. Background to Management of Coasts

While the challenges facing coastal ecosystems are apparent, the management response is complicated by the complex nature of coasts and by a series of shortcomings in the design and application of management approaches (Shipman & Stojanovic, 2007), which have not always yielded the outcomes and improvements necessary to simultaneously sustain human use and ecological quality. Understanding and communicating what is meant by "the coast" presents a management challenge in its own right (see *3.1.3. — Issues and Challenges Relating to Coastal Management*). The multi-use nature of coastal environments has led to management structures that are intricate and multi-layered; which in many cases are sector-specific, reflect a strong terrestrial — marine divide, reactive, or introduce potential disagreement between stakeholders, despite common management objectives existing across sectors and spatial units (e.g. sustainable development and growth). The aforementioned criteria are key drivers for policy-makers advocating a more integrated or holistic approach to coastal management — defined as Integrated Coastal Zone Management (ICZM) or derivatives of, for example Integrated Coastal Management (ICM), Integrated Coastal Area Management (ICAM); Integrated Marine and Coastal Area Management (IMCAM). For the purposes of this chapter, the term Integrated Zone Coastal Management (ICZM) is used throughout, as much of the literature, legislation and policy cited, particularly in a European context, contain references to ICZM. ICZM as a management process is covered in further detail within the section entitled *3.1.4 — Coastal Management and Planning Reponses and Processes.*

One of the earliest moves towards management specific to the coasts emerged in the United States of America during the 1970s with the introduction of the Coastal Act, since then other members of the global community have initiated and advanced management relating to the coast. For example, in 2006 a national implementation plan for ICZM was introduced in Australia to support an integrated and strategic approach to coastal planning and environmental management (Lazarow et al., 2006) for its coastline spanning over 35,000 km in length. Canada — which has the longest coastline of any country in the world — embarked from the late 1990s onwards on a path to incorporate integrated coastal management efforts within a strategic approach to ocean and coastal planning (Ricketts & Harrison, 2007). Similarly, integrated approaches to coastal management have become more mainstream in countries such as New Zealand (Kay & Alder, 1999), Norway (Tiller et al., 2012) and across regions (e. g. Mediterranean Basin; House, 2010), see Nobre (2011) for an overview of major ICZM initiatives worldwide.

In Europe, coastal management came to the fore from the 1980s onwards; a European Coastal Charter was adopted by the Conference of Peripheral Maritime Regions of the European Community in 1981, whilst in 1986 the European Commission prepared a Communication to the Council of Ministers on integrated planning of coastal areas. A European Coastal Strategy proposed in 1991 which was followed by a series of policy and legislative tools focused on improved coastal and marine management, as well as a Demonstration Programme, which ran from 1996–1999, "*to show the practical conditions that must be met if sustainable development is to be achieved in the European coastal zones in all their diversity*." The Demonstration Programme consisted of 35 projects across Europe and six thematic studies, and was intended to lead to a consensus regarding the measures necessary in order to stimulate ICZM in Europe. The experiences of the Demonstration Programme (Capobianco 2003; Doody, 2003; Humphrey & Burbridge, 2003; King, 2003;) contributed to the shaping of EU ICZM policy and following the publication of the outcomes of the Demonstration Programme, the European Commission subsequently adopted two key documents advocating and supporting a more integrated approach to coastal planning and management:

1. A Communication from the Commission to the Council and the European Parliament on "Integrated Coastal Zone Management: A Strategy for Europe" (COM/00/547 of 17th September 2000).
2. A proposal for a European Parliament and Council Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe (COM/00/545 of 8th September 2000). This Recommendation was adopted by Council and Parliament on 30th May 2002.

The latter explained how the Commission intended to promote ICZM through the use of Community instruments and programmes. The Recommendation outlined steps, which the Member States should take to develop national strategies for ICZM, which the majority of Member States went on to complete and submit. It should be noted that, in general, competency for coastal areas remains with the Member State and not with the EU. This is one of the reasons, along with the variety of legal systems in operation, why the Commission has not considered the formulation of a Directive specific to ICZM to date. During 2006 and the beginning of 2007 the Commission reviewed the experience with the implementation of the EC ICZM Recommendation. The Commission Communication of 7th June 2007, COM(2007)308 final presented the conclusions of this evaluation exercise and set out the main policy directions for further promotion of ICZM implementation in Europe. A range of more recent policy and legislative instruments from Europe have re-iterated the need for a more integrated approach to coastal planning and management culminating in the recent EU Integrated Maritime Policy (COM(2007) 575 final), and Marine Strategy Framework Directive (2008/56/EC). At the regional level, the Protocol on ICZM to the Barcelona Convention heralds a significant step in advancing ICZM on a legislative footing at the international level, as the protocol ensures that ICZM is compulsory for all coastal Member States in Mediterranean who are signatories to the Barcelona Convention.

3.1.3. Issues and Challenges Relating to Coastal Management

Due to fact that coastal environments are the location for such a range of human activities (Weinstein et al., 2007), it is unsurprising that a number of issues have emerged as challenges to those tasked with managing the coast in a sustainable manner (Olsen et al., 1997; Barker, 2005), and whose livelihoods are associated with the coast. Evidence of pressures and impacts exerted on the natural environment as a consequence of human activities is reflected by degraded ecological states (e. g. Sherman & Duda, 1999), loss of productivity (e.g. Waycott et al., 2009), introduction of invasive species (e. g. Williams & Grosholz, 2008), and reduced water quality (Beatley et al., 2002; Suarez de Vivero & Rodriguez Mateos, 2005). Coastal and marine areas are particularly vulnerable to effects associated with climate change which drive changes in environmental and social systems (Gibbs, 2009; Falaleeva et al., 2011), for example, sea level rise, changing weather patterns, increasing intensity of storms and precipitation, and the occurrence of coastal squeeze (Doody, 2004; Fletcher & Pike, 2007).

In addition, the value of coastal environments can result in competition for space, and access to use common resources by multi-stakeholders can often result in negative interactions (Rockloff & Lockie, 2004), particularly where participatory structures are weak or absent, or where inappropriate management intervention has taken place (Barker, 2005). A key differentiation to make at this point is those impacts that are considered harmful or undesirable but are natural processes (e.g. erosion) to those which are human induced (e. g. pollution by heavy metals) — in other words, people are often the key catalyst in the changing state of coastal environments — it is people who will drive an issue and who will insist on a response, and it is management of people (including education, training, communication and capacity building activities) within the environment, rather than just environmental management that is essential to the sustainable development of coastal resources.

Defining the spatial extent, or delineating what is categorised as the coast, as a start point for intervention can itself present an issue to coastal management and planning practitioners (Nichols, 1999). The terms 'coast' and 'coastal zone' have many different definitions. For the purposes of the Demonstration Programme on ICZM (1996–1999), for example, the coastal zone was defined as "*a strip of land and sea of varying width depending on the nature of the environment and management needs. It seldom corresponds to existing administrative or planning units. The natural coastal systems and the areas in which human activities involve the use of coastal resources may therefore extend well beyond the limit of territorial waters, and many kilometres inland*". The US Coastal Zone Management Act 1972 defines the coastal zone as "*the coastal waters (including the land therein and there under) and the adjacent shorelands (including the waters therein and there under), strongly influenced by each and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands and beaches*." Depending on how the coastal zone is defined for any particular location or purpose, coastal managers may encounter situations where their management effort can be undermined by influences that lie outside their geographical boundary and/or jurisdictional remit, and due consideration has to be given to this issue in the context of ensuring effective integrated management. For additional information on defining the spatial extent of the coastal zone, see for example, Beatley et al. (2002) and Sas et al. (2010) for further discussion.

It can be said that the coast is delineated by various actors in accordance with their use of the coast and the legal framework that applies to particular use(s). For example, at a pan-European scale, delineation of coastal areas in the context of conservation of areas and species of ecological importance is set out under the Habitats and Birds Directives. At Member State level, the Water Framework Directive requires River Basin Districts to be delineated according to hydrographic units. At a national level, areas will be delineated for the licensing of activities such as aquaculture and other commercial uses; while at local levels, bye-laws and similar instruments can be applied to routine or seasonal uses (e. g. recreation activities) of the coast (e. g. O'Mahony et al., 2012). As a result while the term coast may have a common understanding within specific sectors, this may not be true across different sectors leading to a lack of cohesion between various actors in the same geographic area.

Similarly, at sector level, different delineations and methodologies for these are used. In relation to shipping for example, shipping lanes historically derived from an analysis of the prevailing winds — trade winds allowed ships to sail towards the west quickly while westerlies allowed ships to travel to the east quickly. Now ship routeing is the responsibility of the International Maritime Organisation which is enshrined in the Law of the Sea Convention and Chapter V of the Safety of Life at Sea (SOLAS) Convention, which recognises the IMO as the only international body for establishing such systems. In contrast, fishing areas of the coast are delineated by the EU if outside the territorial seas or national Government if fisheries are within the 12M zone (O'Hagan & O'Mahony, *unpublished*).

Attempts to harmonise the differing approaches for delineation of the coast are ongoing, and at a European level it is recognised that overlap between key policies, and the resultant effect this has on management and use of the coast, requires consideration. For example, the Water Framework Directive covers freshwater bodies and coastal waters (1 nm), (exceptions exist, e.g. for chemical status) whereas the Marine Strategy Framework Directive includes the ”*seaward side of the baseline from which the extent of territorial waters is measured extending to the outmost reach of the area where a Member State has and/or exercises jurisdictional rights*.”

Another issue facing coastal managers is that of climate change and how to deal with the associated impacts on coastal locations (e. g. Nicholls, 1995; Nicholls & Klien, 2005; Schlacher et al., 2008; Jones & Phillips 2011). Coastal and marine areas are particularly vulnerable to effects associated with climate change which drive socio-environmental changes (Gibbs, 2009; Falaleeva et al., 2011), for example, sea level rise (Bosello et al., 2007; Nicholls & Cazenave, 2010), flooding (Nicholls, 2004; Diez et al., 2011), changing weather patterns, increasing intensity of storms and precipitation, coastal squeeze (Doody, 2004; Fletcher & Pike, 2007). Each of the impacts will vary in magnitude for different locations and sectors of the coastal economy. However, vulnerability to climate change is increasingly associated with the preparedness of society to adapt (e.g. by means of planning and management, policy and behaviour), rather than mere exposure to its effects (Green & McFadden, 2007; Moser, 2008). Coastal locations are no different in this regard and increasingly climate change adaptation is becoming a factor within coastal management processes, as those seeking to formulate planning and management responses to the impacts of climate change look to lessons and capacity to emerge from the implementation of ICZM (Tobey et al., 2010; Falaleeva et al., 2011). ICZM and climate adaptation have common elements, both stipulate the integration of sectoral, administrative and geographical governance (Few et al., 2004), advocate subsidiarity and participatory decision making, while also positing an adaptive governance approach and ecosystems-based problem framing as essential ingredients for long-term sustainability. Both processes also necessitate engagement by common constituents, particularly local government organisation, community-based groupings and civil-society bodies.

Participation is a critical element of integrated coastal zone management, as reflected in the literature (Agrawal & Gibson, 1999;

Davos et al., 2002; King, 2003; Ernoul et al., 2009; Cliquet et al. 2010). However, ensuring participation is incorporated into the ICZM process in an appropriate manner, and choosing the optimal participatory process can present issues for practitioners; for example, effectiveness (McKenna et al., 2008), input to planning (Milligan et al., 2009; Green, 2010), balancing multiple viewpoints (Treby & Clarke, 2004; Imeson & Van den Bergh, 2006), legitimacy (Cliquet et al., 2010), and maintaining credibility and representation (Fletcher, 2003, 2007) are all factors that require consideration within the ICZM process. The incorporation of stakeholder input into the ICZM process is critical but it should not be the sole metric for measuring progress; similarly win-win solutions and a consensus based approach are desirable but are often extremely difficult to achieve (e.g. McShane et al., 2011) and in certain circumstances may not be attainable, and ultimately should not hinder the aims of a process designed to assist informed decision-making and promote sustainability (McFadden, 2007).

Other salient issues relevant to coastal management include: bridging the science and policy interface (Cooper & Cummins, 2009; O'Connor et al., 2009; Stojanovic et al., 2009; Diedrich et al., 2010); an over-reliance on a project-based model of implementation (McKenna & Cooper, 2006), and a non-statutory basis for the implementation ICZM (McGlashan, 2003; O'Hagan & Ballinger, 2010; O'Connor et al., 2010; Falaleeva et al., 2011).

3.1.4. Coastal Management and Planning Responses and Processes

Bearing in mind the issues and challenges identified, the following section presents a case study involving numerous sites within five European countries that successfully overcame many of the aforementioned issues (e. g. partnership working, bridging science and policy, working in a policy vacuum); this is preceded by a short introductory section on what is considered to constitute effective ICZM and represents good practice.

Following the completion of the Demonstration Programme on ICZM, a set of principles was developed to communicate key elements of good practice in delivering effective coastal management (European Parliament and Council, 2002):

- Principle 1 — A broad overall perspective (thematic and geographic) which will take into account the interdependence and disparity of natural systems and human activities with an impact on coastal areas.
- Principle 2 — A long-term perspective which will take into account the precautionary principle and the needs of present and future generations.
- Principle 3 — Adaptive management during a gradual process which will facilitate adjustment as problems and knowledge develop. This implies the need for a sound scientific basis concerning the evolution of the coastal zone.
- Principle 4 — Local specificity and the great diversity of European coastal zones, which will make it possible to respond to their practical needs with specific solutions and flexible measures.
- Principle 5 — Working with natural processes and respecting the carrying capacity of ecosystems, which will make human activities more environmentally friendly, socially responsible and economically sound.
- Principle 6 — Involving all the parties concerned (economic and social partners, the organisations representing coastal zone residents, non-governmental organisations and the business sector) in the management process, for example by means of agreements and based on shared responsibility.
- Principle 7 — Support and involvement of relevant administrative bodies at national, regional and local level between which appropriate links should be established or maintained with the aim of improved coordination of the various existing policies. Partnership with and between regional and local authorities should apply when appropriate.
- Principle 8 — Use of a combination of instruments designed to facilitate coherence between sectoral policy objectives and coherence between planning and management.

The principles are to be implemented within an ICZM process (Ballinger et al., 2010) that typically follows a number of iterative stages, which form part of a policy or strategy development cycle: 1. Issue identification; 2. Plan preparation; 3. Formal adoption and funding; 4. Implementation; and, 5. Monitoring and evaluation (see Olsen et al., 1997). Mature ICZM programmes are those that have completed a sequence of management cycles to achieve improvements in coast management and ultimately in integrating coastal management across key sectors and administrative levels (Cummins et al., 2004). The concept of ICZM as a process has since been further elaborated (e. g. Varghese et al., 2008) and proposals introduced means of evaluating the ICZM process for the purposes of improved outcomes (Baarse et al., 2001; Olsen, 2003; Pickaver et al., 2004; Stojanovic et al., 2004; Billé, 2008; Jones et al., 2008; Pickaver, 2009).

The principles as stated above provide coastal planners and managers a series of objectives against which to develop their ICZM response, but in essence they reflect what can be broadly considered as elements of good governance in natural resource management (e. g. working with stakeholders (Walker et al., 2002; Lebel et al., 2006), taking an ecosystem-based approach (Folke et al., 2005; Douvere, 2008), thinking strategically). The principles have attracted a degree of criticism owing to the fact that they offer a mix of strategic and local focused principles, without prioritisation within or between these groupings (McKenna et al., 2008). A further consideration when evaluating ICZM progress is the role of external factors (e. g. policy vacuum), often leading to a lack of adequate resource (financial and human) and political support which can undermine success even in situations where the principles have been almost fully applied (Falaleeva et al., 2011). Early successes in the implementation of ICZM across Europe yielded examples of good practice and valuable experience, but which subsequently failed due to external factors (e. g. Bantry Bay Charter, Ireland). The emphasis on a project-based approach to deliver ICZM is only likely to work if the project fits within an institutional structure or governance model geared towards long-term sustainable development and management of coastal resources. Otherwise, the risk is one of promoting sustainability through an unsustainable approach. This challenge facing coastal practitioners perhaps forced a rethink in terms of how ICZM should work, and how best to communicate the added value of the concept, and how to better embed ICZM within the coastal planning and management structures of Member States. The following section illustrates one such example of a model of partnership designed to deliver effective ICZM at a number of sites across Europe.

3.1.5. The Expert Couplet Node Approach to Coastal Management

While partnership working is a key feature of ICZM (Hildebrand et al., 2002; Stojanovic et al., 2004; Stojanovic & Barker, 2008;), and coastal partnerships and fora have been used as a means of progressing ICZM with good effect, particularly in the United Kingdom (Hewett & Fletcher, 2009; Stojanovic & Ballinger, 2009), the Expert Couplet Node (ECN) represents an approach that has demonstrated progress in a range of geographical and institutional settings. The ECN model of partnership typically entails the research centres and local authorities working in close collaboration throughout a process devised to respond to a particular issue(s), and marks a departure from the traditional client / provider relationship that tended to exist between research community and administrative bodies (Cooper & Cummins, 2009; O'Mahony et al., 2009; Gault et al., 2011). It could also be argued that the ECN model brings together two of the most active and essential groupings in relation to coastal management: 1) the research and academic community who have actively contributed to the theory and concepts behind ICZM in Europe; and, 2) local government who are often the primary body tasked with operationalising and implementing ICZM plans and strategies; thus, a working relationship that facilitates joint-working between these two groups has potential for advancing coastal management and sustainability.

The ECN collaborative approach, was piloted at a nine locations in five European countries (Ireland, UK, France, Belgium and the Netherlands; Fig. 3.1, Table 3.1) as part of the Coastal Research and Policy Integration (COREPOINT) project (Cooper & Cummins, 2009; http://corepoint.ucc.ie); with the couplets continuing to operate under the Innovative Management for Europe's Changing Coastal Resource (IMCORE) project (Gault et al., 2011; http://www.imcore.eu; http://coastaladaptation.eu). Whilst some of the ECN participants at certain sites had an existing relationship prior to piloting of the approach, the COREPOINT and IMCORE projects provided a platform that enabled them to cement their working relationship, while for others the projects were the catalyst for initiating an ECN; however, in all cases the IMCORE project afforded the opportunity for ECN partners to effectively employ their combined knowledge and skill-sets in the face of challenging coastal management issues (Gault et al., 2011).

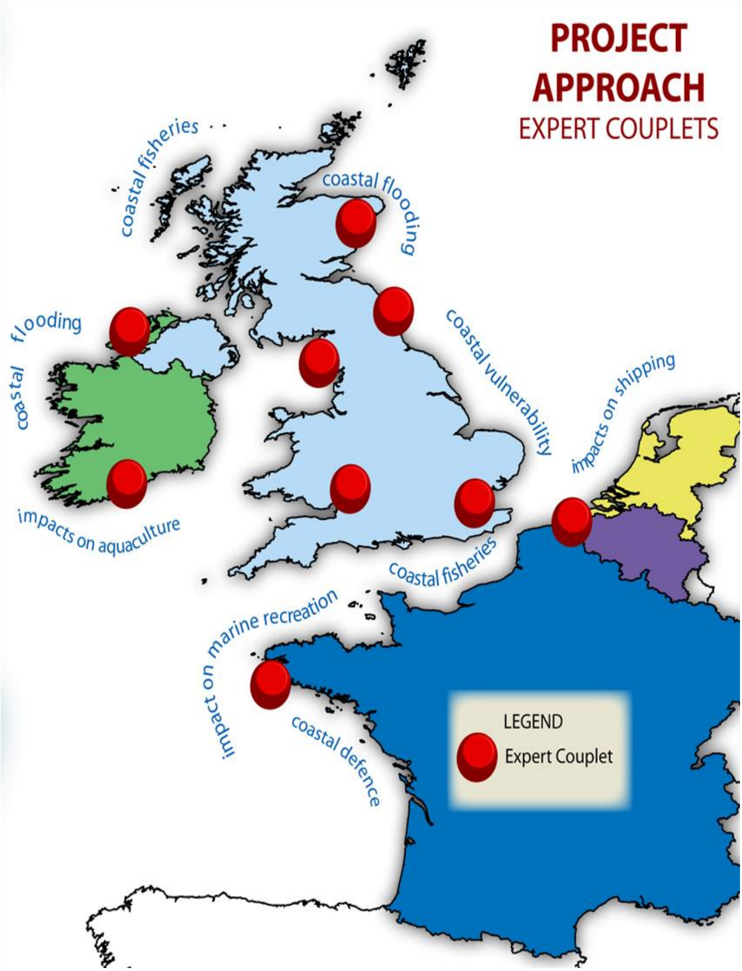

Fig. 3.1. Location of the nine Expert Couplet Nodes established in NW Europe and selection of coastal management issues addressed by the partnership approach

Table 3.1

Key coastal issues and impacts identified at each ECN study location during the COREPOINT and IMCORE projects (modified from Gault et al., 2011).

ECN Location	Country	Key Coastal Issues and Impacts Identified
Severn Estuary	**UK**	– Impact on communities, – Strain on emergency services – Development at risk
NW England — Sefton Coast	**UK**	– Loss of habitats/designations – Change in groundwater affecting habitats
NE England — Durham Coast	**UK**	– Port and harbour functioning – Threat to industrial infrastructure and urban areas – Threat to coastal paths — Marine and Coastal Access Bill – Coastal squeeze and impact on designations – Salination of agricultural land
E England	**UK**	– Erosion and pressure on flood defences – Loss of protected intertidal habitat – Higher defence costs
Aberdeen	**UK**	– Flooding of low lying towns and drainage concerns – Loss of habitats – Damage to harbour and shipping infrastructure – Decreased tourism due to increased precipitation

ECN Location	Country	Key Coastal Issues and Impacts Identified
Lough Swilly	**IRELAND**	– Flooding of low lying towns – Erosion of infrastructure and property – Changes/loss of biodiversity – Damage to aquaculture sites – Safety for water activities – Reduction of access to piers and harbours
Cork Harbour	**IRELAND**	– Threat to tourist attractions/infrastructure – Access for coastal recreation – Re-use of brownfield sites – Access to port and impact on shipping – Potential loss of tourist liner trade/livelihoods – Loss of housing/commercial property – Loss of habitats and / or coastal heritage – Impact on future land-use patterns
Belgium Coast	**BELGIUM**	– Loss of beach/dunes and protected areas – Loss of employment in flooded area – Safety/protection of harbours – Loss of property/infrastructure – Loss of human lives – Damage to ports
Gulf of Morbihan	**FRANCE**	– Sea level rise – Loss of islands – Coastal erosion – Threats to housing and tourism infrastructure

Case Study 1: Development of Integrated Coastal Management Strategy in Cork Harbour, Ireland

Site Description: Cork Harbour is one of the largest coastal water bodies in Ireland, the large estuary comprises a mixture of land uses, e. g. agriculture, industrialised areas (primarily pharmaceutical), and rural and urban settlement patterns, e. g. ranging from ~200,000 in the metropolitan area of Cork city to smaller towns and villages with populations between 1,500 and 6,500 (O'Mahony et al., 2009). Cork Harbour is analogous with many other coastal locations in that it is a multi-resource and multi-use environment. The level and diversity of activities operating within the confines of the Harbour are exemplified by the presence of numerous sectors (of regional and national importance) and their associated infrastructure, and by the fact that areas within the Harbour are recognised as being of international ecological importance, as evidenced through the presence of Natura 2000 and Ramsar designated sites. (O'Mahony et al., 2009).

Policy Context: Despite references to the value of integrated coastal management in numerous policy documents (e. g. Marine Institute, 1996; Brady Shipman Martin, 1997; Department of Agriculture and Food, 1999; Department of the Environment and Local Government, 2002; Department of Communications, Marine and Natural Resources, 2005; Heritage Council, 2006; Cawley et al., 2006) no national strategy or plan exists for ICZM in Ireland. Approaches to coastal management in Ireland remain sectoral, with numerous statutory bodies having a management and/or planning remit in the Irish coastal environment (MacLeod et al., 2000; O'Mahony et al., 2009).

Despite the plethora of organisations with a coastal management and/or planning remit, it is the local authorities, as the principal planning consent body, which have a significant influence on coastal management and planning (O'Mahony et al., 2012). Therefore, engagement with coastal local authorities is critical to efforts to advance coastal management. Until recently management of Ireland's coastal environment was characterised by a strong marine — terrestrial divide (O'Mahony et al., 2009). Two separate planning regimes, which set out differing systems for planning applications, decisions and appeals, existed for the foreshore and terrestrial environments.

In 2010, the Department of the Environment, Heritage and Local Government assumed the majority of foreshore responsibilities; with the result that, for the first time in the history of the State, responsibility for terrestrial planning (including Environmental Impact Assessment), coastal management, conservation management and designations, heritage, Water Framework Directive implementation and foreshore licensing all come within the same Government department (Note: the department is currently titled the Department of the Environment, Community and Local Government).

Case Study 2: Development of Integrated Coastal Management Strategy in Cork Harbour, Ireland

Approach and Process: The process that underpinned the development of the Strategy was undertaken as part of the COREPOINT project (2004–2008) — Cork Harbour was one of the initial ECN study sites — and subsequently implemented under the IMCORE project. The approach involved a leadership and facilitation role by the local COREPOINT project partners (Coastal and Marine Research Centre and Planning Policy Unit of Cork County Council). A process of stakeholder identification and engagement was initiated by the project partners to ascertain the need and desire for an integrated approach to management in the Harbour area. This led to the establishment of the Cork Harbour Forum (comprising local stakeholders) and a Strategic Advisory Group (representatives of organisations with key management / regulatory roles in the Harbour). Consultation with all stakeholders over the course of a series of workshops and meetings formed the basis for the development and content of the Strategy.

The aim of the Strategy is to bring together all those involved in the development, management and use of Cork Harbour in a framework, which encourages the integration of their interests and responsibilities to achieve common objectives in a sustainable manner. Following completion of the Strategy development phase of the process, the Strategic Advisory Group was expanded to form the Harbour Management Focus Group; the body tasked with implementation of the Strategy.

Key Outcomes: An integrated management strategy (Cork Harbour Integrated Management Strategy) was developed for the

Harbour, and is currently being implemented on a voluntary basis (at present no statutory basis exists for ICZM in Ireland). The development and subsequent implementation of the Harbour Strategy represents the fruition of the local scale activities of the COREPOINT and IMCORE projects, and involved extensive stakeholder consultation, fostering of partnership working between various sectors and administrative / regulatory bodies, and effective use of science to underpin coastal planning and management.

The Cork Harbour strategy process represents the only example of contemporary ICZM at work in Ireland on this scale, and has yielded significant outputs in the context of good practice examples (e. g. Expert Couplet Node model of partnership) and capacity building relevant to national and international arenas. Similarly, the value and strength of the partnership approach and capacity building associated with the strategy process is perhaps best evidenced by the fact that the stakeholder group continues to meet and collaborate for 1) sharing of information and optimising resources for coastal management; and, 2) purposes of tackling emerging management challenges facing Cork Harbour, e. g. climate change and adaptation planning.

3.1.6. Outlook and Recommendations

How we manage our coastal environments and ensure sustainable use of coastal resources will continue to be a challenging undertaking for coastal management practitioners and policy-makers. The natural complexity of coasts coupled with the multiplicity of management and institutional structures suggests that achieving sustainable development of coasts will necessitate the involvement of many stakeholders; thus, pointing to the value of a joined-up approach, the ICZM process and the adoption of transdisciplinary methods and approaches (see Torkar & McGregor (2012) for application of transdisciplinarity in the case of nature conservation). Although coastal regions are diverse in terms of their physical characteristics, quite often the management issues that arise are similar (e.g. working with multi-users and an array of interest groups, having sufficient data on hand to support decision-making, having adequate legal and policy supports in place) and there is significant potential for knowledge exchange and continued co-learning between coastal managers from different regions.

In Europe, the findings of the Demonstration Programme of 1996–1999 provided a set of management principles, which identified the key elements required within the ICZM process, and subsequently led to advances in participatory approaches, co-management models and collation of extensive information on Europe's coastal zones at national and regional scales. Despite these advances, the regulatory and legislative basis for ICZM has remained largely unchanged (with the exception of the 2011 Protocol on ICZM to the Barcelona Convention which makes ICZM compulsory for Mediterranean coastal Member States), and examples of management issues (e.g. poor coastal planning, habitat degradation, loss of species and economic pressures on coastal communities) remain evident.

In light of the continued importance of coasts to the socio-economic well-being of large populations, and the sustainability challenge associated with this relationship, there is a need to continue broadening the good practice base from which coastal managers can extract key lessons, share experiences (e.g. Steijn et al., 2012; OURCOAST: http://ec.europa.eu/environment/iczm/ ourcoast.htm) and assist with institutional capacity building and learning. The activities of the COREPOINT and IMCORE projects provide examples of where innovative partnership arrangements can be applied to address a range of coastal issues (Table 3.1) in different physical environments, policy settings, and institutional arrangements. Consolidating the key outcomes and lessons from investment in ICZM is essential to ensure optimum use is made of our learning to date; this will ensure coastal management practitioners have at their disposal a wealth of experience to draw upon, which in turn will yield cost savings in terms of lessons learned, avoidance of overlaps and repetition of failed interventions. Exchange of experiences and good practices in coastal management is all the more relevant when one considers the pivotal role of ICZM in the delivery of objectives for related policy areas of EU importance, primarily maritime spatial planning (MSP), marine environmental protection (i.e. Marine Strategy Framework Directive), conservation of biodiversity, green infrastructure, and climate adaptation.

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3.2. Impacts of climate change on biodiversity and its implications for protected areas management

Anastasiya Idrisova, Brandon P. Anthony

This chapter focuses on Tajikistan, a mountainous country with unique biodiversity, and explores climate change impacts on the biodiversity of one of the most vulnerable reserves rich in biodiversity — *Dashtidjum Zakaznik*. The current and potential impacts of climate change on the biodiversity of the *zakaznik* have been analyzed following the DPSIR approach and based on current knowledge, experts' assumptions and observations.

3.2.1. Case study context

Climate change is an unequivocal global issue that has been confirmed by observations of an increase in global mean sea and air temperatures, ice melting and sea level rise (IPCC, 2007). In its fourth assessment report, the Intergovernmental Panel on Climate Change (IPCC) stated that the global mean surface temperature has increased by 0.76 °C from 1850 to 2000, with a linear warming trend of 0.13 °C per decade (last 50 years), which is twice that recorded for the last 100 years (IPCC, 2007). Scenarios developed by the IPCC predict that increase of global mean temperature by 2099 may reach 6.4 °C if greenhouse gases emissions and other anthropogenic changes, for instance land use change, continue at or above current rates. This would be among the highest temperature shifts experienced in the past 740,000 years (Fischlin et al., 2007).

Such rapid rate of temperature increase has many negative consequences and can become the dominant direct driver for the loss of valuable ecosystems and their services at a global level (Root et al., 2003; Guariguata, 2008). Change in temperature and precipitation regimes, along with associated disturbances, like flooding, wildfire and drought, increases ecosystems vulnerability leading to their disruption and loss of biodiversity (Rosenzweig et al., 2007). According to the IPCC report, if the increase of global mean surface temperature exceeds 2 °C, many species will be at a greater risk than in recent geological past and up to 20–30 % of species could become extinct (Thomas et al., 2004; Fischlin et al., 2007). Climate change has already been blamed for the extinction of 14 vertebrate species, including the golden toad (*Bufo periglenes*) that inhabited the cloud forests of Costa Rica (IUCN, 2010a).

Species responses to climate change impacts include physiological adaptations as a result of their capacity to tolerate some degree of change and migration (behavioral) to a more suitable location in response to the changes, both of which are expressions of phenotypic plasticity (Auld & Keith, 2009; Omann et al., 2009). Adaptation mechanisms are mainly demonstrated by the temporal shifts of life-cycle events, including leaf unfolding, flowering, migration arrival, egg laying and breeding (Crick, 2004; Araujo et al., 2006; Lepetz et al., 2009; SCBD, 2009; Vitt et al., 2010). In spite of the adaptative nature of these changes, climate change poses a number of threats to species and could lead to population declines due to changes in species interactions, particular predator-prey interactions and mutualisms (Leech & Crick, 2007; Rosenzweig et al., 2007; SCBD, 2009). Another notable point is that the capacity of organisms for adaptation is limited and could be slower than the pace of climate change, which may lead to decreasing populations and eventually species extinctions (Parmesan & Yohe, 2003; Thomas et al., 2004; Brook et al., 2008).

Posing a critical threat to biodiversity and ecosystems, climate change represents a real challenge for protected areas management, questioning the adequacy of current protected areas in the conservation of representative ecosystems and endangered species (Scott, 2004). The main challenges are related to species' tendency to move poleward and to higher altitudes for suitable climatic conditions and thus landscape-level shifts in ecosystem structure and distribution (Lemieux & Scott, 2005; Willis et al., 2009). Existing protected area networks have largely been developed to protect static patterns of biodiversity, and thereby may not adequately respond to the dynamic changes in ecosystem composition and distribution triggered by climate change impacts (Burns et al., 2003; Heller & Zavaleta, 2009; Mawdsley et al., 2009). New management approaches and climate change adaptation measures must be developed and integrated into protected areas planning and management to ensure biodiversity conservation, as well as mitigation of climate change impacts.

This chapter focuses on climate change impacts on biodiversity of Tajikistan — a country that despite its small land area is characterised by a rich and unique biodiversity, with a high degree of endemism (Safarov et al., 2003). Specific mountain climatic conditions and isolation have enabled the formation of a considerable number of species of global significance represented by endemic, relic species and wild relatives of cultivated plants (NBBC, 2009). The latter occur in Tajikistan on a scale found nowhere else in the world (Krever et al., 1998). Tajikistan is home for nearly 10,000 flora species, including nearly 1000 species of wild relatives of cultivated plants, 1132 endemic plants, and 20 vegetation types represented by plant communities that range from broadleaf forests and boreal meadows to subtropical and tropical deserts (NBBC, 2003, 2009). The diversity of ecosystems and plant communities promoted the development of a rich fauna, which is represented by more than 13,000 species, including 800 endemic species (NBBC, 2003; Safarov et al., 2003).

Similar to other countries, the biodiversity of Tajikistan is experiencing different pressures, resulting mainly from anthropogenic activities, including unsustainable use of natural resources, habitat modification and fragmentation, and environmental pollution (NBBC, 2003; Safarov et al., 2003). As a result, ecosystems are degrading and losing their diversity and functionality, and species are threatened by population decline and extinction. Due to habitat destruction and poaching, 3 faunal and 16 floral species have already been extirpated from Tajikistan (Safarov et al., 2003). Species negatively affected by anthropogenic activities may also become even more vulnerable to climate change due to synergistic effects, and will have diminished capacity for successful adaptation to its impacts (Millsap et al., 1990; Mkanda, 1996).

Climate change has already been observed in most areas of Tajikistan, including high altitude zones (Makhmadaliev et al., 2008). The surface mean temperature has increased by 0.3–1.2 °C for the last sixty years, with a linear warming trend of 0.1–0.2 °C per decade. There are also changes in precipitation patterns, and in the intensity and frequency of extreme weather events and associated natural disasters (Makhmadaliev et al., 2003; 2008). A further increase of temperature could be 3.7 °C on average by the end of 2099 (0.3–0.4 °C per decade) according to IPCC models (Christensen et al., 2007), or by 0.2–0.4 °C by 2030 (0.1–0.2 °C per decade), according to the projections of the State Administration for Hydrometeorology (SAH) (Makhmadaliev et al., 2008). Taking into account these projections, the probability of ecosystem degradation and loss of species, in particular rare and endangered species, is quite high (Makhmadaliev et al., 2003).

Mountain ecosystems of Tajikistan are exceptionally sensitive to climate change due to their low adaptive capacity (Makhmadaliev et al., 2003); and have already been affected by climate change. In particular, increase of mean temperature and melting of snow patches were reasons for the extinction of the endemic Menzber's marmot (*Marmota menzbieri*) that inhabited the high altitude meadows in northern Tajikistan until 1990 (Makhmadaliev et al., 2008). Experts also claimed declining populations of several fish species due to the warming of water in reservoirs that created unfavorable conditions. Other impacts include the spread of invasive species and an increased number of pest infestations (Makhmadaliev et al., 2008).

The Government of Tajikistan has undertaken a number of measures towards biodiversity conservation, including the development of a protected areas network that covers 22 % of the country's territory and represents almost all ecosystems and rare species (Safarov et al., 2003). In addition, a number of national strategies and programs have been developed to enhance biodiversity conservation and protected areas management. At the same time, none of these documents considers climate change impacts on biodiversity, though they have unquestionable implications for protected areas. There is a lack of research on the potential impacts of climate change on species occurring in Tajikistan. A few available studies focus on general issues of biodiversity vulnerability to climate change, rather than vulnerability of specific species within particular areas.

Meanwhile, the importance of assessing climate change impacts on biodiversity is highlighted in the National Action Plan for the Mitigation of Climate Change (Makhmadaliev et al., 2003). The document also stipulates as a priority measure a need to enhance the scientific understanding of climate change impact on ecosystems with a special focus on protected areas. Here, we report on research, which analyzes climate change impacts on protected areas in Tajikistan. This chapter seeks to inform policy development geared towards the mitigation of negative consequences of climate change on Tajikistan's biodiversity, and fills an important research gap by investigating climate change impacts on one of the most vulnerable reserves rich in biodiversity — Dashtidjum Zakaznik.

The following objectives were developed for the research: (i) analyze meteorological data and identify climate change trends on the territory of Dashtidjum Zakaznik; (ii) assess vulnerability of different components of biodiversity of Dashtidjum Zakaznik, including fauna, flora and ecosystems, to climate change impacts and identify potential changes in their state under an altered climate; (iii) analyze relevant national policies and programs and identify prerequisites for implementation of adaptation measures, and (iv) identify implications for protected areas management and develop recommendations for adaptation measures to climate change.

The results of the research contributed to the implementation of national strategies on biodiversity conservation and climate change mitigation in Tajikistan. Therefore, they may be of interest not only to scientists and protected areas managers, but also to policy and decision makers. Though the research was focused on Dashtidjum Zakaznik, the results of its vulnerability assessment may be relevant for other protected areas of Tajikistan with similar species and ecosystems. Meanwhile, the results of the analysis of national policies and programs and identified prerequisites for adaptation measures are applicable for all protected areas in Tajikistan, and other areas with similar conditions.

3.2.2. Research methodology

In the absence of long-term ecological monitoring in the *zakaznik*, we employed a combination of complementary methods, including archival reviews and expert interviews, quantitative methods for analyses of meteorological data and qualitative vulnerability assessment. A case study approach was chosen to address the research problem and ensure its comprehensive exploration with a variety of data collection and analysis procedures. The study site selection was based on a number of criteria, including sensitivity to climate change, data availability and site significance for biodiversity conservation. Archival reviews involved review of publications and materials from various sources, such as academic, government, intergovernmental, international and non-governmental organisations.

Interviews with experts were an essential part of the research due to the lack of studies and published materials on observed and potential impacts of climate change on biodiversity of Tajikistan. In total, 18 experts with various backgrounds and from different institutions, including academic and governmental, were interviewed. A majority of interviews was conducted face-to-face; three interviews were conducted by phone. The interviews were held in a semi-structured form, with most of the questions prepared in advance. In addition to formal interviews, a number of consultations with experts in relevant fields were held to assist in selection of target species, as well as to discuss results of the research and suggested recommendations.

The current and potential impacts of climate change on biodiversity have been analyzed following the simplified Driver-Pressure-State-Impact-Response (DPSIR) assessment framework that allowed focusing on several aspects of biodiversity vulnerability to climate change and addressing the research problem from various angles. The framework was developed by European Environment Agency (EEA) in 1995, adopted by many organisations worldwide as a tool for environmental assessments (EEA, 1998; Maxim et al., 2009), and has proved to be helpful in identifying and illustrating different elements, their references to each other, and implications for policy tools (Omann et al., 2009). Here, we utilise the DPSIR approach to (i) assess the vulnerability of the biodiversity of *Dashtidjum Zakaznik* to climate change impacts, (ii) identify implications for its management, and (iii) develop recommendations on adaptation measures to mitigate climate change impacts on the biodiversity of the *zakaznik*.

Quantitative methods have been employed to analyze and characterise climate change on the territory of *Dashtidjum Zakaznik*. The modern climate has been identified using meteorological data from the Yol meteorological station, which is located on the territory of *Dashtidjum Zakaznik* at 1283 masl and represents the climate of most territory of the *zakaznik* (Asanova, 2010b), for the baseline period 1961–1990 as recommended by the World Meteorological Organisation (WMO) (McCarthy et al., 2001). The analysis of climate change on the territory of *Dashtidjum Zakaznik* for the period from 1991 to 2008 has been conducted employing data from mid-mountain meteorological stations that are representative for the study area through a comparative analysis of temperature and precipitation trends, as well as Pearson's R correlation analysis. A need to use the representative dataset was implied by nascent meteorological data from the study area.

3.2.3. Case study area

Dashtidjum Zakaznik[3] was established in 1972 with the objective of the conservation of the rare population of endangered markhor (*Capra falconeri heptneri*), as well as other endangered species, including urial (*Ovis vignei bocharensis*), snow leopard (*Uncia uncia*) and Tien-Shan brown bear (*Ursus arctos isabellinus*), and unique mid-mountain forests (NBBC, 2003; Safarov et al., 2003). The total area of the *zakaznik* is 51,300 ha (Safarov et al., 2008), and is located on the southeast slopes of the Khazratisho mountain range in southern Tajikistan (Fig. 3.2). The borders of *Dashtidjum Zakaznik* mainly pass along natural boundaries. In the north it is bordered by the Khodjidara river valley and on the south by the cam of Khazratisho range (Safarov et al., 2008). In the south, *Dashtidjum Zakaznik* borders with the state reserve (*zapovednik*) of the same name. South-eastern and eastern borders of the *zakaznik* coincide with the state border of Tajikistan and Afghanistan along the Pyanj river (see Fig. 3.2) (Safarov et al., 2008).

The territory of the *zakaznik* comprises diverse elevations ranging from 700 to 2911 masl (Safarov et al., 2008). The main orographic element of *Dashtidjum Zakaznik* is the Khazratisho range, with the highest peaks of Imam-Askari and Alanyzrak mountains: 2911 and 2843 masl, respectively. The territory of *Dashtidjum*

[3] National legislation classifies protected areas in four categories depending on the protection regime and land management: 1) state strict nature reserves or *zapovedniks* (IUCN category I), 2) state natural parks or national parks (IUCN category II), 3) state natural monuments (IUCN category III), and 4) state nature reserves, species management sites or *zakazniks* (IUCN category IV) (IUCN, 1994; *Law on Protected Areas*, 1996). For the purposes of this chapter, we use 'reserve' or '*zapovednik*' for category 1 and '*zakaznik*' for category 4.

Zakaznik is characterised by a contrast relief and a dense hydrological network. An interesting feature of the *zakaznik* is the unique rocky conglomerate formations located in all vertical zones, from foothills to high mountains. They have diverse shapes and constitute one of the main elements that form the landscape of the *zakaznik* (Fig. 3.3). These formations represent the main attractions for tourists, as well as provide shelter for many rare and endemic animal species (Safarov et al., 2008).

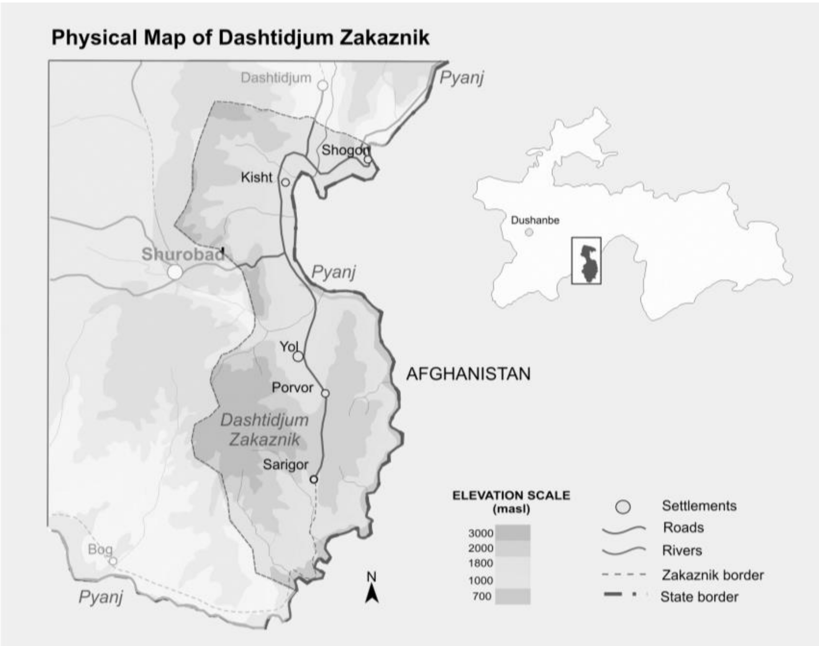

Fig. 3.2. Location and physical map of Dashtidjum Zakaznik
Source: Adapted from Noosfera, 2008

Fig. 3.3. Diverse landscapes of Dashtidjum Zakaznik

3.2.4. Outcomes of the vulnerability assessment

Driver: Climate change in Dashtidjum area

Climate change on the territory of *Dashtidjum Zakaznik* is confirmed by the analysis of data from meteorological stations located at altitudes of 1000 to 2500 masl. According to data processed, there are significant changes in air temperatures during the period analyzed, which resulted in expected fluctuations in mean temperatures (Fig. 3.4). At the same time, there is a clear trend of increase in annual mean temperatures, which can already be observed during the baseline period of 1961–1990, i. e. an increase of 0.5 °C or by 0.02 °C per year. This increase is caused by observed increases in mean monthly temperatures through the year, except February and March (Asanova, 2010a). The analysis of seasonal changes in mean temperatures has revealed their increase during the winter (by 0.4 °C), summer (by 0.3 °C), and especially autumn (by 0.8 °C). Spring, on the contrary, is characterised by a slight decrease, which constitutes –0.1 °C.

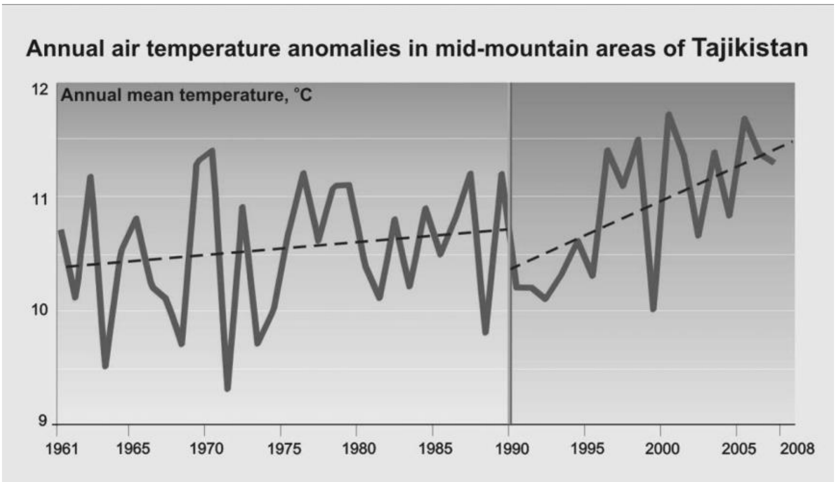

Fig. 3.4. Annual air temperature anomalies in mid-mountain areas. Data source: SAH, 2010

Climate change from 1991–2008 is characterised by a further increase of 1.3 °C (Fig. 3.4). This increase is 0.07 °C per year, which is over three times higher than for the baseline period. Similar to the baseline period, increase of annual mean temperatures is caused by increases in mean monthly temperatures. Analysis of seasonal anomalies has shown significant changes in spring mean temperatures, which have increased by 3.2 °C. While the summer temperatures have also considerably increased (by 0.9 °C), the autumn and winter temperatures have shown insignificant decrease if compared with the baseline period: by 0.7 °C and 0.3 °C, respectively. In general, the change of annual mean temperatures for the period 1961 to 2008 is 0.8 °C or 0.02 °C per year. This is significantly higher than the 0.5 °C trend observed in the majority of the country's regions for the same period.

Climate change on the territory of *Dashtidjum Zakaznik* is also confirmed by changes in precipitation. Analysis of annual and monthly variation has revealed significant differences between the baseline period and the following 18 years. As illustrated in Fig. 3.5, the baseline period is characterised by an insignificant increase of annual precipitation, which is 12 % of the average precipitation rate for 1961–1990. In a monthly analysis, the increase in precipitation has been observed in eight of twelve months. From 1991–2008, anomalies in precipitation patterns are characterised by a significant decrease of 32 % (Fig. 3.5), evident in all months except February, October and November. The most significant decreases in precipitation were observed in September, May and December.

Climate change on the territory of *Dashtidjum Zakaznik* has also been observed by its inhabitants who cite hotter and drier summers in the last decade, as well as a decrease in winter snow cover in valleys and mid-mountain areas, and its increase in high mountain areas (Boboev pers. comm.; Faizov pers. comm.). Inhabitants also noticed more frequent extreme weather events, in particular heavy rains, which very often lead to mudflows and unusual extremely cold temperatures during recent winters (Boboev pers. comm.; Faizov pers. comm.). Experts also highlight desiccation of 30–50 % of springs, especially in the southern area of *Dashtidjum Zakaznik* and melting of snowfields on the top of the mountain ranges due to higher air temperatures (Safarov pers. comm.; Zagrebelnyi pers. comm.).

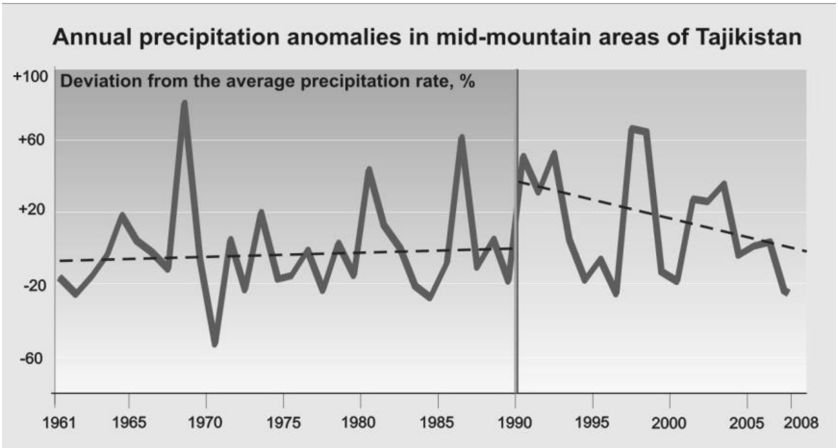

Fig. 3.5. Annual precipitation anomalies in mid-mountain areas. The trends for both periods (1961–1990, 1990–2008) are compared to the average mean precipitation for 1961–1990.
Data source: SAH, 2010

The identified climate change anomalies may have a significant negative impact on the biodiversity of *Dashtidjum Zakaznik*. The most adverse effect may be exerted by the decrease in spring precipitation important for vegetation, as well as a significant increase in spring air temperatures, which may lead to considerable changes in species phenology. A further climate warming, which is projected to continue at the currently observed rate (Makhmadaliev et al., 2008; Asanova, 2010a), may aggravate the consequences for biodiversity of the *zakaznik*. According to SAH projections, an increase of annual mean temperature by the end of 2050 may be 1.8 to 2.9 °C, while a decrease of annual precipitation may reach 20 % for the next 100 years (Asanova, 2010a).

Pressure and State: vulnerability of biodiversity — fauna

The unique geographical location of *Dashtidjum Zakaznik* between the large mountain systems of Pamir-Alai and Hindu Kush, and their proximity to the Himalayas and Tibet, has promoted the development of diverse fauna, which possesses characteristics of various mountainous regions (Safarov et al., 2008). A second factor, which contributes to species diversity is the location of the *zakaznik* on the southern branches of the Khazratisho range, which pass through the Tajik-Afghan Depression and constitute a part of the large migration corridor that connects this region with the Central Asian mountain-desert region. All these, combined with the variability of landscapes and climates, have resulted in the formation of rich fauna represented by nearly 4,000 species, with a considerable amount of endemic and rare species, as well as relics of the Tertiary period (Safarov et al., 2008).

Dashtidjum Zakaznik provides habitat for many rare, vulnerable and endangered species of fauna. Seven vertebrate species are classified as threatened in the IUCN Red List; four are 'endangered' and three are 'vulnerable' (IUCN, 2010b). Forty species of the *zakaznik* are included in the Red Data Book of Tajikistan (Safarov et al., 2008), with nine listed as 'endangered' and one as 'critically endangered' (Abdusaljamov et al., 1988). *Dashtidjum Zakaznik* is a zoological reserve and its priority measures are focused on the conservation of key species of global and regional importance, including markhor, urial, and snow leopard (Safarov et al., 2008). Despite the protection regime established on the territory, its biodiversity experiences anthropogenic pressure, which leads to its decline. The main direct factors that affect fauna species include poaching and expansion of urban and agricultural areas. Among indirect factors are forest cutting for fuel wood and livestock grazing that lead to the degradation of suitable habitats (Safarov et al., 2008).

Climate change is yet another threat for the animal world of *Dashtidjum Zakaznik.* It not only exacerbates habitat degradation, but also directly affects animals leading to changes in their phenology, population size and distribution range. The main factors of climate change impact include changes in food abundance and availability of suitable habitats, desynchronisation of species interaction, as well as spread of invasive species. Species that are already endangered by anthropogenic factors, as well as rare and endemic species with narrow and scattered distribution ranges, are among the most vulnerable to climate change (Millsap et al,. 1990; Mkanda, 1996; Malcolm, 1998). Species' responses to climate change have already been observed for several faunal taxa of the *zakaznik*. They are mainly represented by shifts in species' distribution ranges, as the paucity of regular monitoring does not allow identifying other changes, including phenological.

Climate change impact on animal species of *Dashtidjum Zakaznik* varies from positive to negative. Some species may benefit from climate warming and increase their populations. This mainly refers to pest insects that have already significantly expanded their distribution and increased populations (Safarov et al., 2008; Muminov pers. comm.; Saidov pers. comm.). One factor that provides favorable conditions for pest distribution is increases in air temperature. Reduced precipitation affects the composition of pest insects causing a prevalence of xeric species (Sangov pers. comm.). Other species that benefit from climate change are birds inhabiting high-mountain areas. The decrease of snow cover and melting of snowfields increases area of suitable habitats, making them available for species of birds from lower elevations (Murodov pers. comm.). The increase of populations of some high-mountains species of birds has already been observed in the last decade (Murodov pers. comm.). Another group of animals that may experience positive effects from climate change is reptiles, mainly snakes. They may benefit from the warmer climate, as well as increased prey populations of pest insects and some rodents (Nadjmidinov pers. comm.). One of the positive effects of climate change that may be beneficial for the majority of non-hibernating species is the warmer air temperature during some winters that may increase survival rates of animals and their offspring (Zaumyslova, 2006).

At the same time, a majority of the fauna of *Dashtidjum Zakaznik* experience negative (mainly indirect) effects of climate change that may result in the decline of their populations. These effects include reductions of suitable habitats due to changes in ecosystem composition and distribution. In this situation, species that occur in various habitats and are able to migrate upwards or to higher latitudes are less vulnerable than species with specific habitat requirements and limited migration capacity. The former mainly refers to birds and large mammals, including carnivores and ungulates. Climate warming has already forced them to shift their distribution ranges (Saidov pers. comm.; Zagrebelnyi pers. comm.). Some species, including Siberian ibex (*Capra sibirica*), snow leopard, ring dove (*Columba palumbus casiotis*), and paradise flycatcher (*Terpsiphone paradise leucogaster*) will most probably move northwards and disappear from the territory of the *zakaznik* due to the lack of suitable habitats (Saidov pers. comm.; Zagrebelnyi pers. comm.; Murodov pers. comm.). One representative bird, the black kite (*Milvus korschun*), has already left the territory (Murodov pers. comm.).

Another indirect impact that adversely affects populations is any decrease of forage resources due to changes in ecosystem productivity and prey abundance. The least vulnerable to this impact are polytrophic species that feed on diverse groups of plants and/or animals, and are able to switch their nutritive base. In contrast, the most vulnerable species are specialist species that feed on specific type of plants or prey and can experience difficulties in shifting to alternative prey. These include markhor, urial, Turkestan rat (*Rattus turkestanicus*), juniper vole (*Microtus carruthersi*), lammergeyer (*Gypaetus barbatus hemachalanus*), ashen hawk moth (*Dolbinopsis grisea*), large-headed mantis (*Mantis macrocephala*), and several species of endangered insects (*Dalpada pavlovskii*, *Mustha baranovi, Porphyrophora odorata*) (Saidov, 2006; Safarov et al., 2008; Valdez, 2008a; Muminov pers. comm.; Murodov pers. comm.; Saidov pers. comm.). In general, a considerable number of species are affected by the combination of both factors — decreasing suitable habitats and forage abundance, which exacerbates the impact of climate change and may lead to significant population declines.

In addition to indirect factors, some species may be directly affected by anomalies in temperature and precipitation. Increase of ambient temperature affects the hibernation process of several species, including *inter alia* long-eared hedgehog (*Hemiechinus auritus*), Central Asian steppe tortoise (*Agreonomys horsfieldi*), red marmot (*Marmota caudata*), and may disrupt their life activity, including reproduction (Dustov pers. comm.; Saidov pers.comm.). Higher air temperatures also negatively affect psychrophilic species of high mountain nival zones, including Siberian ibex and some insect species (Muminov pers. comm.; Saidov pers. comm.).

Harsh winters with heavy snow cover have negative consequences on species with limited capacity to walk on snow cover, including urial, snow leopard and chukar (*Alectoris kakelik kakelik)*, and may lead to their death from starvation (Kokorin et al., 2001;

Valdez, 2008b; Saidov pers. comm.; Murodov pers. comm.). They also affect tolai hare (*Lepus tolai*), constraining its access to fodder (Saidov pers. comm.). Increased number of days with heavy rains has a negative effect on eggs and tadpoles of the green toad (*Bufo viridis*), and may affect population and abundance (Bickford et al., 2010). Indirect effects of increasing temperature increase may also be experienced by fish species, resulting from increased water temperatures in small watercourses and associated declines in dissolved oxygen, complicating reproduction and survival rates (Saidov, 2006; Saidov pers. comm.). Indirect effects of heavy rains can also threaten the blind snake (*Typhlops vermicularis*), by reducing its avoidance capabilities against predators (Nadjmidinov pers. comm.).

Despite the positive impact of climate change on some species of animals, mainly insects and reptiles, it is evident that the majority of the species of *Dashtidjum Zakaznik* may be adversely affected. While few species with high migration capacities may migrate northwards and disappear from the territory of *zakaznik*, other species would be threatened by the risk of extirpation. A combination of climate change impacts with anthropogenic pressures would most likely have devastating synergetic effects on the animals of *Dashtidjum Zakaznik*, culminating in significant biodiversity loss.

Pressure and State: vulnerability of biodiversity — flora

Favorable and various climatic and soils conditions have promoted the formation of abundant and diverse flora, including forest vegetation (Safarov et al., 2008). A combination of elements, and sometimes entire complexes, of subtropical and temperate botanical-geographical zones can be observed at the relatively small area of the *zakaznik*. The flora species of *Dashtidjum Zakaznik* are represented by those from such mountainous regions as Tien-Shan, Himalaya, Pamir-Alai and Hindu Kush, and from desert regions of Kara Kum and Kyzyl Kum. It consists of many endemic and rare species, as well as wild relatives of cultural plants that represent valuable genetic resources (Safarov et al., 2008).

The flora of *Dashtidjum Zakaznik* comprises various endemic, rare and endangered species of regional and global significance. Endemic species are represented by 115 species, including rare and relic magnificent ostrowskia (*Ostrowskia magnifica*) (Safarov et al., 2008). Seven floral species are listed in the IUCN Red List (IUCN, 2010b), including the ‘critically endangered’ Darvaz hawthorn (*Crataegus darvasica*), Korjinskyi’s pear (*Pyrus korshinskyi*), and Darvaz swida (*Swida darvasica*). Of 43 species of plants of the *zakaznik* included in the Red Data Book of Tajikistan, eight are listed as ‘endangered’ (Abdusaljamov et al., 1988; Safarov et al., 2008).

Another important group of floral species are wild relatives of cultural crops, which represent unique genetic resources (Safarov et al., 2008). They comprise more than 200 species including 40 species of wild-growing ligneous species. The latter consist of fruit and nut trees, such as apples, pears, cherry-plums, plums, walnuts, pistachio, and almonds. Species that form forests on the *zakaznik* are represented by 19 ligneous species, including walnut (*Juglans regia*), maples (*Acer* spp.), pistachio (*Pistacia vera*), and almonds (*Amygdalus* spp.), as well as eight herbaceous species that form communities of light forests. Furthermore the flora of *Dashtidjum Zakaznik* comprise more than 200 species of plants that have value as medicine, food, oils, tannins and dyes (Safarov et al., 2008).

Similar to fauna, the plant species of *Dashtidjum Zakaznik* are significantly affected by a number of anthropogenic stressors, in particular livestock grazing and tree cutting for fuel wood (Safarov et al., 2008). The most threatened are species located in low- and mid-mountain zones. Tree cutting leads to the shrinking of forest area and associated disturbances in ecosystems’ composition and services, while livestock grazing can degrade vegetation cover and promote the distribution of invasive species. Combined, these processes lead to the replacement of valuable communities by weed species and a general loss of biodiversity (Safarov et al., 2008).

Climate change impact on the flora of *Dashtidjum Zakaznik* also varies from negative to positive. The main factors that directly affect plant species include anomalies in air temperature and precipitation; the indirect factors include spread of invasive species under an altered climate, as well as the disturbance of the fire regime. Adaptive responses of species are mainly represented by temporal shifts of phenological events, including the advancement of the vegetation period and its shortening, and shifts in distribution ranges. The latter has already been observed for some species, while the observation of phenological shifts is complicated due to the lack of long-term monitoring programs.

The most vulnerable to climate change is a group of hydrophilous and mesophilous species, which are sensitive to high air temperature and lack of precipitation (Safarov pers. comm.; Karimov pers. comm.). Among them are mesophilous trees, such as Tien-Shan birch (*Betula tianschanica*), Turkestan maple (*Acer turkestanicum*) and walnut, which may significantly reduce their distribution, even to the point of extinction, which is most probable for birch (Safarov pers. comm.; Ustjan pers. comm.). Herbaceous species, especially annual grasses, though less vulnerable than ligneous species, may also experience shrinking of distribution ranges and a decline in population sizes (Karimov pers. comm.). It is likely that mesophilous communities would lose a majority of valuable species, including meadow-grass (*Poa* spp.) and Tajik goutweed (*Aegopodium tadshicorum*), which will be replaced by weed species with higher adaptive and migration capacities (Safarov pers. comm.; Sattorov pers. comm.; Ustjan pers. comm.; Zagrebelnyi pers. comm.). Perennial grasses with short vegetation periods can also suffer from the climatic anomalies and suffer diversity loss (Karimov pers. comm.).

Species that may benefit from climate change mainly include xerophilous and xerophyte species, as well as invasive species (Ustjan pers. comm.; Safarov pers. comm.). The latter include such species as couch grass (*Elytrigia trichophora*), sagebrush (*Artemisia* spp.), sedge (*Carex* spp.), small-flowered origanum (*Origanum tyttanthum*) (Zagrebelnyi pers. comm.). Under an altered climate, and in combination with anthropogenic pressure, they may outcompete valuable native species and become dominant in the majority of herbaceous and shrub communities (Safarov pers. comm.; Karimov pers. comm.; Zagrebelnyi pers. comm.). Other species that may benefit from a warmer climate include species of alpine and sub-alpine zones, in particular those with high migration and adaptive capacities, which may expand their distribution ranges and occupy the nival zone of the *zakaznik* (Safarov pers. comm.; Sattorov pers. comm.).

It is likely that climate change will contribute to the extinction of a considerable proportion of rare, endemic and endangered species. Among the most vulnerable are those that grow within communities of mid-mountain mesophylic and juniper forests, including Eduard’s fritillary (*Petilium eduardii*), magnificent ostrovskia (*Ostrowskia magnifica*), and Goncharov’s skullcap (*Scutelaria gontscharovii*); as well as prevernal species and ephemeroids such as Korolkov’s crocus (*Crocus korolkovii*), Darvas iris (*Iris darvasica*), Nickolai juno (*Juno nicolai*), superior tulip (*Tulipa praestans*), and Maximovich’s tulip (*Tulipa maximowiczii*) (Karimov pers. comm.; Safarov pers. comm.; Sattorov pers. comm; Zagrebelnyi pers. comm.). Many endangered species may experience significant declines in their populations, including the xerophyte shrub — keyserlingia (*Keyserlingia mollis*), and mesophylic species of onion, including endemic Rozenbah’s onion (*Allium rosenbachianum*) and stalked onion (*Allium stipitatum*) (Safarov pers. comm.; Sattorov pers. comm.). The least vulnerable species of rare and endangered plants to climate change include black cumin (*Bunium persicum*) and tanner’s sumac (*Rhus coriaria*) (Safarov pers. comm.; Sattorov pers. comm.; Zagrebelnyi pers. comm.), which may even benefit from a warmer climate and expand their current distribution.

A majority of wild relatives of cultural crops, including rare and endangered species, has relatively low vulnerability to climate change (Sattorov pers. comm.; Sattorov pers. comm.). They are mainly represented by xerophyte species, including common pomegranate (*Punica granatum*), almond species, pistachio and fig species (*Ficus spp*). It is likely that they may expand their distribution ranges and occupy higher elevations of *Dashtidjum Zakaznik* (Safarov pers. comm.; Sattorov pers. comm.; Zagrebelnyi pers. comm.). The negative impact of climate change on these xerophyte species, except the cherry-plums (*Prunus* spp.), can be caused by the spread of invasive species, which may lead to the loss of single trees, in particular in the lower zone of their distributions (Safarov pers. comm.; Sattorov pers. comm.). Among the most vulnerable species of this group are those that occur within mid-mountain mesophylic forests, including Cayon pear (*Pyrus cayon*) and Korjinskyi’s pear, Siver’s apple (*Malus sieversii*) and walnut (Safarov pers. comm.). They may suffer population declines due to higher air temperature and anomalies in precipitation, which may lead to soil desiccation and death of single trees.

Pressure and State: vulnerability of biodiversity — ecosystems

Climatic and landscape variability of *Dashtidjum Zakaznik* have promoted formation of numerous ecosystems on a relatively small area and their diversity both in horizontal and vertical dimensions (Safarov et al., 2008). Ecosystems of the *zakaznik* comprise seven of twelve ecosystems types occurring in Tajikistan. They are represented by six natural ecosystems, including valuable mid-mountain mesophylic forests that provide habitats for rare, endemic and endangered species, and an anthropogenic ecosystem represented by agricultural areas occurring around human settlements. The most wide-spread ecosystem are mid-mountain xerophytic ecosystems that cover nearly 50 % of the territory of *Dashtidjum Zakaznik* and comprise wild relatives of cultural crops of global significance (Safarov et al., 2008).

Despite the nature protection regime established on the territory of *Dashtidjum Zakaznik*, it should be noted that the majority of its natural ecosystems are affected by various anthropogenic factors, including illegal wood cutting, poaching, and livestock grazing (Safarov et al., 2008). This results in the degradation of ecosystems especially those located at elevations < 1500 masl and represents a significant threat to the ecological balance in the region (Safarov et al., 2008). It also decreases the ability of ecosystems to adapt to climate change, worsening its impacts. Climate change already affects the ecosystems of *Dashtidjum Zakaznik* leading to various changes in their structure and distribution ranges. Further interaction of these factors will cause significant disruption of the ecosystems' self-recovery capacity and irreversible changes in their current structure with catastrophic consequences for biodiversity conservation. A brief overview of the ecosystems and their adaptive responses to climate change is presented below.

A major part of the ecosystems of *Dashtidjum Zakaznik* is vulnerable to climate change impacts and is already affected to varying degrees. The most vulnerable are high mountain meadows and mid-mountain mesophylic ecosystems that possess considerable numbers of hydrophilous species with limited adaptive capacities to climate change impacts. The main climatic factors that affect these and other ecosystems are increasing mean temperatures, precipitation anomalies, melting of snowfields and reduction of snow cover (Safarov pers. comm.; Zagrebelnyi pers. comm.). The least vulnerable are mid-low-mountain savannoid ecosystems as well as mid-mountain xerophytic light forests that consist of significant amount of xeric species, including sub-tropical (Safarov pers. comm.; Sattorov pers. comm.).

Climate change impacts on the ecosystems of the *zakaznik* can mainly be observed in changing compositions, shifting of distribution ranges, as well as modified population sizes of the composite plant and animal species. In particular, in all zones except nival, there is a general decrease in species diversity due to the loss of hydrophilous plants, as well as rare, endemic and endangered species. The structures of ecosystems are changing, with the replacement of mesophylic species by more xeric species as well as by weedy plants. A higher prevalence of invasive species decreases the productivity of the ecosystems leading to cascading effects on animal species diversity and population size, and their migration to other territories (Safarov pers. comm.; Zagrebelnyi pers. comm.). In general, changes in ecosystems of *Dashtidjum Zakaznik* can be characterised by the loss of species diversity, xerophytisation, and homogenisation due to the replacement of valuable native communities by weed species (Safarov pers. comm.; Sattorov pers. comm.; Zagrebelnyi pers. comm.). Climate change impacts also promote expansion of upper zones of the ecosystems, which indicates vertical migration of species in search of suitable climates (Safarov pers. comm.; Sattorov pers. comm.).

One of the positive consequences of climate change is the increased number of plant species in the nival zone caused by the shrinking of areas covered by snow and migration of species from the lower alpine zone (Safarov pers. comm.; Zagrebelnyi pers. comm.). However, in a long-term perspective, it is likely that this ecosystem will lose its “short-term” diversity due to the replacement of native species by incoming weed species. Reduction in snow cover also has negative consequences for the ecosystems as it affects water provision of the lower zone of sub-alpine meadows (Safarov pers. comm.). A loss of the poor-studied psychrophilic insects is yet another threat for the nival ecosystems (Muminov pers. comm.). The positive effects of climate change can be experienced by some insects, but this mainly refers to pest insects, which already affect a considerable part of forest resources and fruit trees (Muminov pers. comm.; Safarov pers. comm.). A theoretical increase of population size of some reptiles of mid-mountain xerophytic forests, such as cobra (*Naja oxiana*) and lebetina viper (*Vipera lebetina turanica*), is unlikely due to anthropogenic pressures and extermination of these species by the local human population (Nadjmidinov pers. comm.).

Impacts and implications for management

The main goal of *Dashtidjum Zakaznik* is to protect biodiversity and specific natural features, threatened by anthropogenic activities (see Study area). Thus its effectiveness (and conservation success) is measured by persistence of species and ecosystems selected for conservation. Posing a critical threat to biodiversity of the *zakaznik*, climate change affects its management, questioning its adequacy in the conservation of representative ecosystems and endangered species. The main challenges are associated with various characteristics of this *zakaznik*, as well as other protected areas, such as fixed borders and protection of particular species assemblages and ecosystems within these borders. The majority of *zakazniks* in Tajikistan have very narrow conservation targets and focus on the protection of only a few endangered species (Safarov et al., 2006), which makes protected areas effectiveness even more vulnerable to climate change impacts.

It is evident from the vulnerability assessment that a number of species, including key species for biodiversity conservation, may vacate the territory of the *zakaznik* and migrate northwards to unprotected territories. Many species under protection may suffer population decline and, eventually, become extinct. In addition, some new species may migrate to the *zakaznik* from southern areas in a search of suitable climate. The composition of ecosystems is also changing with a prevalence of xerophytic shrubs communities and loss of valuable mesophylic and hydrophilous species. Climate change therefore affects achievement of the *zakaznik's* conservation goals and requires development and implementation of adaptation measures, as well as a revision of its conservation goals.

The Government of Tajikistan has undertaken a number of measures towards biodiversity conservation, which includes development of national strategies, such as a National Strategy on Conservation and Sustainable Use of Biological Diversity (NBSAP) and

National Environmental Action Plan (NEAP), the development of an ecological network for the country (Econet) and adoption of the State Program on Protected Areas Development in 2005–2015. At the same time, none of these documents addresses climate change impacts on biodiversity. This will inevitably slow down development and implementation of measures needed to adjust current conservation practices to changing conditions. Nevertheless, these documents do provide a number of possibilities for implementation of adaptation measures, which are described in the next section.

Adaptive capacity

Dashtidjum Zakaznik possesses several positive characteristics that contribute to the adaptation of its biodiversity to climate change. One such feature is the altitudinal diversity of its habitats, with elevations ranging from 700 to 2911 masl (Safarov et al., 2008). This facilitates a wide spectrum of habitats with different climatic and landscape conditions and allows a number of species to shift their distribution range upwards. In comparison with latitudinal shifts, the altitudinal shift allows adjustment to climate change by minor shifts due to significant temperature gradients in montane areas (Mackinnon, 2008). The main species that are constrained in adaptations by vertical shifts are immobile species of the nival zone that may suffer extinction. In case of *Dashtidjum Zakaznik*, vertical shifts may bring additional benefits, as territories located upwards, to some extent, experience less anthropogenic pressure due to their remoteness from human settlements. At the same time, it should be noted that despite the climatic and landscape conditions many species would still suffer a reduction in population size due to their limited migration capacities, as well as specific habitat requirements.

Another positive characteristic of *Dashtidjum Zakaznik* is its long north-south axis (Fig. 3.2) that allows latitudinal shifts within its territory. Similar to the wide range of altitudes, the north-south elongation creates a variety of climatic conditions (Mackinnon, 2008), providing the possibility for northward migration of species. The north-south orientation of the main mountain ranges — Khazratisho and Darvaz ranges (Fig. 3.2) also creates favorable conditions for latitudinal shifts in distribution ranges, therefore contributing to species adaptation to climate change. The physical complexity of the landscape of *Dashtidjum Zakaznik*, including the combination of valleys, gorges and mountain peaks, contributes to the variety of habitats with different climatic conditions, increasing opportunities for species adaptation, but at the same time may create barriers for species migration. Mountain ranges also serve as a moisture trap preventing the site, and in particular high-mountain areas, from desiccation (Safarov pers. comm.).

Though the area of *Dashtidjum Zakaznik* is not large, it can be characterised by good connectivity with surrounding natural landscapes that may provide suitable habitats for migrating animals. In particular, it is connected to *Dashtidjum Zapovednik* (strict nature reserve) and serves as a migratory corridor for many mammal species that can be observed on the territory of both protected areas, including urial, markhor, and Tien-Shan brown bear (Safarov et al., 2008). Areas located to the north of the *zakaznik*, along the Khazratisho and Darvaz ranges, also possess natural ecosystems similar to those of *Dashtidjum Zakaznik* and can serve as suitable habitats for animals shifting their ranges northwards. Many bird species, as well as large mammals such as Siberian ibex, snow leopard, and markhor, already inhabit the surrounding areas of the *zakaznik* (Safarov et al., 2008). The latter constituted the basis for the recommendation on extension of the area of the *zakaznik* within the Econet document developed in 2006 (GRT, 2006). It should be highlighted that despite relatively good connectivity with the surrounding areas, many migration routes, as well as natural landscapes, have been disrupted by the construction of the Kulyab-Kalaikhumb road, as well as by expansion of human settlements (Safarov et al., 2008).

Despite the natural features of *Dashtidjum Zakaznik*, which create favorable conditions for species adaptation to climate change, there are a number of negative factors that constrain this adaptation and undermine species' likelihood to persist. They are represented by anthropogenic activities, in particular poaching, tree cutting and livestock grazing (Safarov et al., 2008). While the first two activities lead to the direct destruction of animal and plant species, livestock grazing is the main cause of habitat degradation, as well as facilitating the spread of invasive species. Livestock disrupts the reproduction of valuable plant species by trampling and grazing young sprouts, as well as reducing the forage abundance for wild ungulates, which ultimately influences their population size. Tree cutting results not only in a loss of valuable tree species, which have global importance as genetic resources, but also reduces the population size of animals and plants associated with mid-mountain forests. Poaching reduces the conservation efforts as well as species natural adaptation to climate change. Many anthropogenic activities not only prevent species adaptation, but also contribute to global warming. Reduction of forest cover and degradation of pastures affect the ecosystems' capacity for carbon sequestration, as well as contribute to the increase of local air temperature due to the higher heat flux from surfaces that have lost their vegetation cover. It is therefore important to minimise anthropogenic pressure on the *zakaznik* to ensure the implementation of conservation measures as well as adaptation strategies aimed to minimise climate change impacts.

Adaptation measures and conditions for their implementation

Responses of species to climate change impact are mainly observed in phenological changes, as well as in shifts in species distribution ranges poleward or to higher elevations. The latter has constituted the basis for a number of recommendations on adaptation measures that are aimed to ensure the availability of suitable habitats for species shifting their distribution ranges. These measures, among others, include the expanding of existing protected areas networks, increasing connectivity among natural habitats, as well as development of matrix and buffer zones around protected areas to minimise anthropogenic pressure on wildlife.

Options for expansion

Expansion of protected areas networks has been proposed as a tool to address the problem of species loss and ecosystems representation within current reserves and national parks (Hannah et al., 2002; Hagerman et al., 2010). It is believed that existing protected areas should be supplemented with additional coverage to ensure fulfilment of their conservation objectives and maintaining biodiversity representation targets in the face of range shifts (Hannah et al., 2002; Hannah, 2008; Hodgson et al., 2009). Territories adjacent to protected areas, as well as other areas with low human impact, should be secured for species to ensure the presence of sufficient habitats and increase connectivity (Heino et al., 2009; Hodgson et al., 2009; Hagerman et al., 2010). It is also important to revise existing networks to identify shifts in species distributions and ecosystems composition, rethink conservation goals and adjust them to new population dynamics (Hannah et al., 2002). Although expansion of the network is not a panacea for climate change, and there are a number of challenges including availability of viable climatic ranges, there is sufficient evidence that it will substantially reduce climate change impacts on biodiversity (Hannah, 2008).

Analyses of legislation and strategic documents of the Republic of Tajikistan aimed at biodiversity conservation and enhanced management of protected areas shows that there are many prerequisites for the development and implementation of climate change adaptation strategies both at the national and local level. According to the *Law on Protected Areas* (1996), protected areas are owned only by the state and are managed by competent national authorities designated for this purpose. It envisages the establishment of new protected areas, which can be created based on the decision of the Government of the Republic of Tajikistan (Article 4) (Law on Protected Areas, 1996). Article 24 of the Law stipulates the procedures for the establishment of *zakazniks,* which can be done by the government following a request from designated national authorities. It is permitted to declare the territory as a state *zakaznik*, without withdrawal of land from the current land owners (leased by the state) (Law on Protected Areas, 1996).

Unlike the provisions regarding reserves, which stipulate procedures not only for the establishment of new reserves, but also for the expansion of existing ones (Article 16) (Law on Protected Areas, 1996), there are no provisions for the expansion of state *zakazniks*. At the same time, it is evident that the extension of *zakazniks* does not contradict the Law, which is confirmed by a number of recent documents approved by the Government, including the State Program on Protected Areas Development in 2005–2015, adopted in 2005. Though the program does not directly stipulate any adaptation measures to climate change, a majority of the envisaged measures has a direct relation to climate change adaptation strategies suggested worldwide. In particular, the program provides measures on the establishment of new *zakazniks,* as well as expanding the territory of existing *zakazniks* (SCEPF, 2005). Although the Action Plan, which constitutes an integral part of the program, does not stipulate any measures related to the extension of *Dashtidjum Zakaznik*, one of the main goals of the program itself is “the extension of the area of protected areas” (Article 2) (SCEPF, 2005).

Other national documents that envisage an extension of existing protected areas are the State Ecological Program of the Republic of Tajikistan for 2009–2019 adopted in 2009 (CEP, 2009), NEAP adopted in 2006, and NBSAP adopted in 2003. Similar to the State Program on Protected Areas Development, these documents do not stipulate concrete actions for the extension of *Dashtidjum Zakaznik*, but provide a general basis for such actions. One of the strategic documents that provide specific measures on the extension of *Dashtidjum Zakaznik*, as well as its reorganisation into *Obiniou National Nature Park*, is the Econet document (GRT, 2006). The total area of planned extension constitutes 15,000 ha, which is almost 30% of the current area of the *zakaznik* (Safarov et al., 2008). The suggested extension and incorporation of areas located at higher latitudes (see Fig. 3.6) provide a significant contribution to mitigation of climate change impacts on the *zakaznik*.

Following the Econet provisions, the necessity to expand *Dashtidjum Zakaznik*, as well as to raise its protection status, has been emphasised within the *Dashtidjum Zakaznik* Management Plan. This official document has been agreed by various stakeholders and defines the strategy and action plan on the conservation and sustainable use of biodiversity of the *zakaznik* for the near future (Safarov et al., 2008). It also provides the detailed nature conservation zoning of the current territory of the *zakaznik*, as well as the area suggested for its extension based on a comprehensive analysis of the current distribution of rare and endangered species, as well as socio-economic activities in the region (Fig. 3.6). In addition to buffer zones and ecological corridors, the nature conservation zones are represented by a number of core areas of the first and second order. They encompass relatively intact areas and ecosystems with habitats of rare and endangered species (core areas of the first order), as well as valuable ecosystems and wild relatives of cultural crops (core areas of the second order), and are excluded from any economic activity (Safarov et al., 2008; Shermatov pers. comm.).

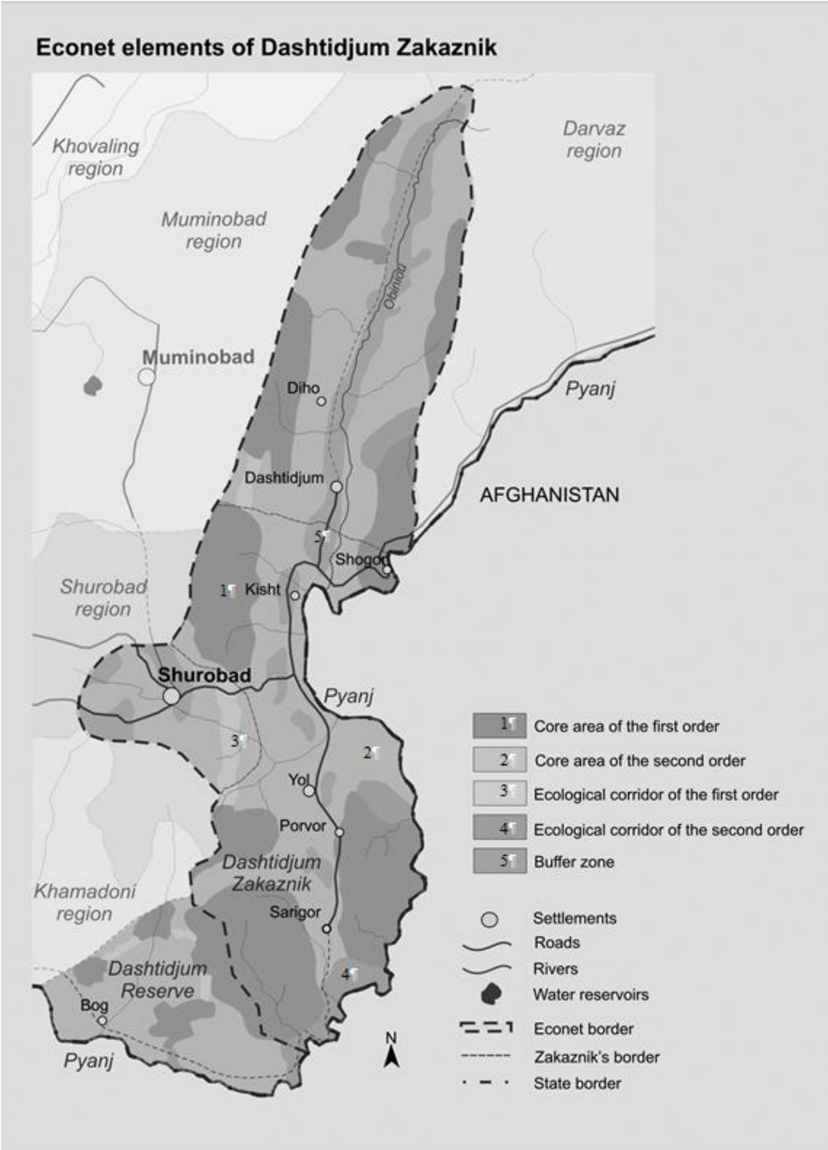

Fig. 3.6. Econet elements of Dashtidjum Zakaznik
Source: Adapted from Noosfera, 2008

Despite the documents mentioned above, no official decision on the extension of *Dashtidjum Zakaznik* has yet been made by the Government. At the same time, it is probable that such decision will be taken, as territories of some protected areas, for instance *Tigrovaya Balka Reserve*, have been recently expanded in accordance with the Econet document (GRT, 2006; WWF, 2008). While the extension of the *zakaznik* may considerably contribute to adaptation of biodiversity to climate change impacts, it can also trigger tensions over land use and consequent violations of the protection regime. On one hand, national legislation allows establishment of *zakazniks* without withdrawal of land from current land users (see above) which can minimise conflicts with local communities. On the other hand, such shifts in conservation regime imply certain limitations on the use of natural resources, which can affect the livelihoods of local resource-dependent communities. Taking into account the current poor socio-economic conditions in the country and associated frequency of protection regime violations (Safarov et al., 2008), the extension of the *zakaznik* itself cannot ensure effective biodiversity conservation if implemented in isolation from other measures.

Increasing connectivity

The concept of connectivity is conceived from the assumption that organisms require safe pathways between protected areas to facilitate dispersal in response to climate change (Hannah, 2008). The main idea is to create and maintain dispersal corridors that will connect suitable environments and will enable species to move towards suitable climatic conditions (Mackinnon, 2008; Heino et al., 2009; Hodgson et al., 2009). Opponents of the concept believe that its importance is being overemphasised, and there are many uncertainties in the quantification of the benefits. Implementation of such measures requires large investments and is not cost-efficient, as better results could be achieved by expanding the protected areas network and enhancing habitat quality, rather than solely creating corridors (Hodgson et al., 2009).

Unlike extension measures, the national documents that emphasise the need to increase connectivity among protected areas are quite limited. There are no such provisions in NBSAP and NEAP documents, or in the State Program on the Development of Protected Areas. At the same time, migration or ecological corridors constitute one of the key elements of the developed Econet of Tajikistan (Pereladova et al., 2006). These corridors have been identified along with core areas and buffer zones, and aim to link core areas to ensure sustainable links between species populations and habitats of sufficient size (Pereladova et al., 2006). Meanwhile, corridors are usually located within or in close proximity to existing and/or proposed protected areas, and do not connect reserves located in different parts of the country, which is rational considering its mountainous landscape. Though the idea of connectivity in this case is a bit different from the more extensive concept described above, the designated corridors can contribute to the adaptation to climate change impacts by providing pathways for migration to the northern parts of those protected areas that do not prohibit economic activities.

An approach similar to Econet has been employed for the development of the Management Plan of *Dashtidjum Zakaznik*, in particular its nature conservation zoning. Several migration corridors were suggested to connect core areas located within the current area, as well as in the territory of *Dashtidjum Zapovednik*, and the area proposed for *zakaznik* extension (Fig. 3.6). The corridors of the first order aim to ensure connection between core areas of the first order; and the corridors of the second order connect core areas of first order with core areas of second order (Safarov et al., 2008). The corridors also do not extend beyond the proposed protected area border and aim to provide reliable pathways to wild animals by limiting economic activities on their territories. If implemented, it would contribute to biodiversity conservation on the territory of *Dashtidjum Zakaznik*, as well as species' adaptation to climate change.

At the same time, the country is quite far from the actual establishment and management of migration corridors. There are no guidelines or procedures that can help responsible authorities to enforce such provisions, and thus there is a high probability that they will remain on paper only at least within the current decade. Moreover, taking into account various challenges that are being faced by nature protection authorities, including lack of funds, personnel and equipment, as well as lack of enforcement of the already established protection regime (Safarov et al., 2003), management of the migration corridors within protected areas may not receive priority. Nevertheless, considering the approach taken during the development of both documents, in particular designation of corridors based on information about current pathways for animal migrations as well as economic activities in the region, maintaining these corridors may not require significant additional efforts and funding.

Management of matrix area

This concept also focuses on increasing connectivity of the landscape outside of protected areas networks (Mawdsley et al., 2009). The idea is to manage areas surrounding protected areas in a way to enhance the mobility of species under suitable climatic conditions through the adjacent landscapes (IUCN, 2004; Heino et al., 2009; Hagerman et al., 2010). Development of matrix areas combine diverse existing management techniques, including agroforestry, dam removals, and has already been implemented in a number of countries in Europe and in the USA (Hannah, 2008; Mawdsley et al., 2009). It allows enhancing the quality of the landscape, making it permeable and suitable for various species, rather than facilitating the movement of specific species or ecosystem types (Hannah et al., 2002).

Inappropriate management of the matrix area could make the landscape also highly permeable for invasive species and damage vegetation on the edges of protected areas (Hannah, 2008). The drawback of the approach is that it does not focus on rare and endangered species, and species with narrow habitat requirements, which could lead to their extinction if not combined with other conservation strategies (Mawdsley et al., 2009). Nevertheless, in changing conditions, the matrix is playing an increasingly important role in supporting species shifts and may contain the only habitat available for species (Hannah, 2008; Willis & Bhagwat, 2009).

Although management of matrix areas *per se* is not reflected in any national legislation or strategic documents, there are a number of provisions concerning buffer zones. The main purpose of the buffer zone is to minimise the negative effect of economic activities on natural objects and complexes of reserves (Law on Nature Protection, 1993; Law on Protected Areas, 1996). Thus, economic activity within buffer zones is restricted, and in some cases prohibited. At the same time, the documents stipulate the establishment of buffer zones only for *zapovedniks*, and not for *zakazniks* (Law on Nature Protection, 1993; Law on Protected Areas, 1996; SCEPF, 2005). Similarly, the NEAP, as well as NBSAP, lists only the rehabilitation of buffer zones of some reserves as a priority measure for biodiversity conservation (Safarov et al., 2003, 2006). Further, the NBSAP also emphasises the need to develop regulations on buffer zones for the entire national network of protected areas (Safarov et al., 2003).

The document on Econet development is probably the first to envisage the creation of buffer zones not only for reserves. The proposed ecological network comprises a number of buffer zones that are aimed to protect both core areas and migration corridors from negative outside interference (GRT, 2006; Pereladova et al., 2006). As core areas are located not only on the territory of reserves, but also *zakazniks* and other categories of protected areas, the proposed network has a direct relation to the establishment of buffer zones for *zakazniks*. According to the Econet document, specific land use regulations with limited socio-economic activity should be established for all buffer zones (GRT, 2006). The same approach has been employed for the nature conservation zoning of *Dashtidjum Zakaznik* and surrounding areas (Safarov et al., 2008). In addition to internal buffer zones, the Management Plan highlights the need for designated buffer zones along the boundary of the *zakaznik* with adjacent areas. The latter, however, is difficult due to the complex administration of the area that is divided between four administrative regions: Khamadoni, Shurobad, Muminobad and Darvaz (Fig. 3.6).

Other measures

Other activities that are highly relevant to the development of adaptation measures to climate change include the implementation of monitoring and research activities on the territory of protected areas. These activities constitute the main elements of biodiversity conservation as well as protected areas management and are stipulated in related legislative acts. The need for systematic monitoring of biodiversity components, in particular on the territory of protected areas is emphasised in the related national strategies and programs. Moreover, the NBSAP and National Action Plan for Climate Change Mitigation list the research and assessment of climate change impact on biodiversity as one of the priority activities (Makhmadaliev et al., 2003; Safarov et al., 2003). The Management Plan of *Dashtidjum Zakaznik* provides a detailed Monitoring Plan which, if implemented, would significantly contribute to the understanding of species' responses to climate change on its territory (Safarov et al., 2008).

It should be noted that despite overall political support to the development of monitoring and research program, their implementation remains at a very low level due to the poor economic situation in the country, as well as the lack of professional human resources. In such conditions, support of international organisations and donor agencies plays an important role in overcoming the challenges of, and building capacity for, biodiversity conservation and adaptation to climate change impacts. The situation has already been slowly improving as a result of several projects implemented (and being implemented) with the support of Global Environment Facility, United Nations Development Programme, United Nations Environment Programme, World Bank and other international organisations. Although a number of monitoring programs have been developed with this support, including for *Dashtidjum Zakaznik*, their long-term implementation requires not only sustained funding, but also integration into other sectoral programs and policies.

3.2.5. Conclusions on the case study

Driver: Analyses of meteorological data confirmed a warming trend of annual mean temperature, which constitutes 0.8 °C from 1961–2008 and has a tendency for further increase. Combined with anomalies in precipitation, in particular the decrease in spring precipitation and projections of up to 20 % precipitation decrease by the end of 2050, climate warming poses a real threat for the unique biodiversity of *Dashtidjum Zakaznik* represented by many rare and endemic species and wild relatives of cultural plants.

Pressure: Climate change affects the biodiversity of the *zakaznik* both directly and indirectly. The latter mainly refers to faunal species and is represented by a decrease of suitable habitats due to changes in ecosystem composition and distribution, as well as a decrease of forage resources due to changes in ecosystem productivity and prey abundance. An increase of mean air temperature also directly affects a considerable number of species leading to phenological changes and species' migrations. Other factors include anomalies in snow cover, water temperature, and frequency of extreme weather events that affects populations of some species.

State: Climate change impact on the biodiversity of the *zakaznik* varies. A majority of species, in particular rare and endangered species, may experience population declines and some even extinction. The most vulnerable are mammals, and hydrophilous and mesophylic plant species. Species that may benefit from climate warming include xerophilous and subtropical species of plants, weed species, pest insects and some reptiles, as well as species inhabiting high mountain meadows and steppes. Responses of plants to climate change are mainly represented by temporal shifts of phenological events, including the advancement of the vegetation period and its shortening, and shifts in distribution ranges. Responses of animal species include changes in distribution ranges and population sizes, as well as phenological changes, including disruption of hibernation and aestivation.

Impact: Climate change impacts on biodiversity of *Dashtidjum Zakaznik* have direct implications for its management. In particular, a number of key species for biodiversity conservation, i.e. markhor, snow leopard and Turkestan lynx may vacate the territory of the *zakaznik* and migrate northwards. Many species under protection may suffer a population decline and become extinct. The composition of mid-mountain forests is shifting with an increasing prevalence of xerophytic shrub communities, and loss of valuable mesophylic and hydrophilous species. Climate change therefore affects achievement of the *zakaznik's* conservation goals and requires the development and implementation of adaptation measures.

Response: Analyses of relevant national legislation and strategic documents aimed at biodiversity conservation and enhanced management of protected areas indicates that there are many prerequisites for the development and implementation of climate change adaptation strategies both at the national and local level. They include provisions on the expansion of the protected areas network, development of buffer zones and migration corridors. Implementation of these measures will allow securing suitable habitats and protecting species that migrate northwards. Other activities that are highly relevant to the development of adaptation measures to climate change include the implementation of monitoring and research activities on the territory of protected areas, which, if implemented, would significantly contribute to the understanding of species' responses to climate change on its territory.

3.2.6. Recommendations to policy-makers

Taking into account the adverse effects of climate change on the biodiversity of *Dashtidjum Zakaznik*, it is important to implement adaptation measures as soon as possible. It is therefore recommended to expand the territory of the *zakaznik* as envisaged in the document on Econet development and Management Plan of *Dashtidjum Zakaznik*, and in accordance with the State Program on Protected Areas Development and National Action Plan on Climate Change Mitigation. The incorporation of adjacent areas will contribute to the protection of rare and endangered species and increase the abundance of suitable climates and habitats. It is also recommended not to limit the expansion to the top of the mountain range, but to also incorporate the northern slopes of the Khazratisho range.

It is also vital to implement provisions on the designation of buffer zones and migration corridors envisaged by the Econet document and the *Dashtidjum Zakaznik* Management Plan, as they will minimise the negative impact on species and ecosystems from anthropogenic activities and enhance conditions for species' migrations both altitudinally and northward. It is also essential to raise the status of the *zakaznik* as it will help to reduce the negative impacts from human activities. In general, it is highly critical to minimise the anthropogenic pressure on the ecosystems and species of *Dashtidjum Zakaznik*, in particular livestock grazing, tree cutting and poaching, as it constrains species adaptation to climate change and considerably aggravates its consequences. This can be accomplished, *inter alia*, by implementing programs to raise awareness and by involvement of local communities in biodiversity conservation activities.

Other conservation measures can include a provision of forage resources for a number of species, including urial and markhor, especially in the winter. To avoid the irreversible loss of rare and endangered species, it is recommended to ensure the collection of seed material for plant species and growing some species in nurseries, for instance wild fruit trees of global importance. Similar measures for animals may include keeping of the most vulnerable species, for instance urial, markhor, Siberian ibex, falcons and others, in animal breeding and caring centers to increase the reproduction rate with a further release into nature.

It is also recommended to implement monitoring measures, in particular those stipulated in the *Dashtidjum Zakaznik* Management Plan, including phenological observations. Appropriate indicator species on the territory of the *zakaznik* include species highly sensitive to changes in climatic parameters, such as urial, Siberian ibex, ring dove, steppe tortoise, as well as birch and Turkestan maple that may provide valuable information on species response to e. g. distribution shifts. The majority of these species are already identified in the Management Plan as indicator species. Monitoring observations will allow a better understanding of climate change impacts and identifying trends in species' populations and distribution. In general, it is also recommended to expand this study and assess the climate change impacts on biodiversity of other protected areas of the country to identify priority conservation and adaptation measures.

Last, but not least, it is important to incorporate the issue of climate change impact on biodiversity and its implications for protected areas management into all relevant national policies and programs, in particular those on protected areas management and biodiversity conservation. This includes emphasising the importance of implementing adaptation measures to mitigate climate change impacts and to envisage concrete action plans for such measures, including within existing management plans of protected areas where climate change impacts are not considered.

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3.3. Urban planning in the context of environmental governance: actors, conflicts, effectiveness

Hanna Skryhan, Viktar Kireyeu

Taking the city of Krasnoyarsk in Russia as a case study, this chapter provides an example of an environmental policy analysis in the context of spatial planning. In particular, the chapter explores such analytical tools as *STEEPL*- and *SWOT-analysis*, identification and analysis of *stakeholder groups* and mapping of the actors involved in spatial planning. The chapter contents and all the examples are taken from a research done in the city of Krasnoyarsk in 2013 and follow-ups from 2014–2015.

3.3.1. Historical background and legacies

In the course of its history, the city of Krasnoyarsk performed a variety of socio-economic functions in Russia and Soviet Union, and each of its "functional phases" was leaving series of impacts on spatial planning and institutions responsible for city development. In terms of the phases and the governance institutions, the history of Krasnoyarsk can be divided into 4 periods:

(1) *Krasnoyarsk City as a fortress on the outskirts of Moscow Tsardom*. City was founded in 1628 "on the frontier" as a military outpost between forest and steppe zones (Tsarev, 2002). In the first half of the 18th century, the city was a wooden fortress with 800–2500 inhabitants and some 200–350 houses (KrasSU Internet Center, 2008). The city functions included the protection of the surroundings, trade with indigenous people and nomads, and maintenance of the flow of goods from and to the "metropolis". The fortress of Krasnoyarsk was eventually burned down in 1773. In the cityscape this period is reminded by the Church of the Intercession, which is the oldest stone building in the city (Tsarev, 2002).

(2) *Krasnoyarsk as the capital of Yenisei Province in the Russian Empire*. Krasnoyarsk became the administrative centre of the province in 1822. The mid-19th century was marked in Eastern Siberia by the "gold rush". It was then that the public infrastructure started to emerge (e. g. wooden pavements, pavilions in Chinese

style, fountains); in parallel, commercial and public (theatres, casinos, etc.) housing was built, and the first Master Plan was developed following the Saint-Petersburg model, i. e. regular spatial planning (Tsarev, 2002). Trans-Siberian railway had reached the city in 1895, and became its ultimate connection with the European part of Russia. New city functions therefore included: support to railway maintenance as well as cargo and passenger services, controlling trade and resource extraction over the huge area, keeping the flow of goods and money to the "metropolis", and supporting administrative management and control over the territory. Major footprint of this time is spatial planning structure in the city center and in the historical "core" of the city.

(3) *Krasnoyarsk City as a Soviet Union "city-factory"*. Following the outbreak of the World War II, 23 industrial enterprises from the European part of the USSR were relocated to Krasnoyarsk. Sizeable industrial sites were established in the city on the both sides of Yenisei River (along the Trans-Siberian railway). To provide workers and their families with a place to live, temporary wooden houses were quickly constructed in a close proximity to the industrial areas (Shevchenko, 2005). Later on, utility infrastructure started to develop in these areas as well. Main city functions were, therefore, production of military equipment and management of cargo operations in the interest of the defence. Major footprints this period left on the city are (1) mixed industrial and housing areas in the downtown, (2) a lot of outdated wooden housing, and (3) poorly executed engineering infrastructure, especially on the right bank of the Yenisei.

(4) Krasnoyarsk City as a Soviet Union top-secret mega-factory. After World War II, most of industrial enterprises, once moved to Krasnoyarsk, remained there. Most of their production (as well as the production of some newly established enterprises) had to do with the national defence, and as a result, it was not until 1989 that it was allowed for foreigners to visit the city. The present spatial structure was shaped according to the mainstream Soviet city planning — the city was divided into so called "industrial villages" (Chief City Architect, interview) consisting of a major industrial site and housing areas around it (i.e. mono-functional zoning). This resulted in high levels of environmental pollution in many residential areas. Main city functions included controlling and supporting large-

scale projects of natural resource extraction in the region, providing the flow of resources and industrial goods to other regions of the country, and supporting administrative management and control over Krasnoyarsk Krai. This period left the following footprints in present city planning structure: (1) "friable" and low-density spatial structure, (2) underdeveloped social infrastructure, (3) traffic problems, (4) high levels of environmental pollution, (5) "khrushchyovki" — the 5-storey blocks of flats built in the 1960s and 1970s designed as a temporary solution to the acute housing shortage.

3.3.2. Urban sprawl: opportunities and constraints

We used STEEPLE (Bowman, 1998) and SWOT (Humphrey, 2005) methods to analyse the decision-making environment and available spatial planning options. Results are set in the Tables 3.2 and 3.3. Success in the implementation of a city development strategy strongly depends on the ability to solve the problems of environmental quality, social equity, legacies of soviet city planning, as well as on financial flows, lobbying by major business players, and levels of corruption. The risks and threat levels essentially depend on the effectiveness of negotiations between actors, solving conflicts, and finding satisfactory solutions for all the stakeholder groups.

Table 3.2

STEEPL-analysis of urban sprawl in Krasnoyarsk

Social aspects	**Technological aspects**	**Political aspects**	**Economic aspects**	**Environmental aspects**	**Legislative aspects**
- positive growth of population ("developing city"); - high employability; - segregation of population based on incomes, social status, nationality and etc.; - "boom" of housing construction; - underdevelopment of social infrastructure; - absence of social equity; - growth of social /	- outdated technologies and approaches in construction industry; - low level of energy efficiency in housing sector; - old systems of water supplying, sewerage, heating and other infrastructural elements; - narrow streets and problems with traffic; - mix of industrial and housing built-up areas;	- capital of Krasnoyarsk Krai; - good relations between Krai and municipal political powers; - political stability; - city self-governmental bodies are not a part of state government; - city officials are accountable to local people, they are elected	- investment attractiveness; - economic growth as the main goal of city development; - huge industrial potential; - natural resources (including energy resources); - low costs of energy resources; - sale and lease of municipal lands, local taxes are main financial	- high level of air pollution; - soil contamination with oil and point river pollution; - municipal solid waste; - location of industrial enterprises in the center of the city, lack of buffer zones between industries and housing in the center of Krasnoyarsk; - poor greenery in the center of Krasnoyarsk	- sales and leases of municipal lands are regulated by the Land Code of RF and the rules of land use and urban development of Krasnoyarsk City; - urban development is regulated by Urban development Code of RF, rules of for land use and urban development in Krasnoyarsk City, norms for

public involvement in societal processes, active citizenship in regard to city development; - corruption	- a lot of old housing (baraki, khrushchyovki, brezhnevki); - geomorphological conditions and relief of the city, the Yenisei River	every five years; - results of decision-making process and some legislative documents are accessible on the official web-page; - lobby of transnational companies and oligarchs in Krai government and parliament	source for the city budget; - outflow of financial resources (profit of industrial enterprises) to the transnational companies located in European part of Russia		urban development of Krasnoyarsk City, and Master plan; - building construction and infrastructure construction are regulated by construction standards; - environmental protection in the city is regulated by environmental legislation of RF

Table 3.3

SWOT-analysis: constraints and opportunities for urban sprawl in Krasnoyarsk

Strengths	**Weaknesses**
– Krasnoyarsk is a large industrial center in Siberia with large industrial potential, high investment attractiveness, and different opportunities for employability. – City has significant potential for development, increasing of livability and competitiveness. “Boom” of housing construction attracts new residents and gives more opportunities for further development. – Local officials are accountable to citizens, results of decision-making process and some legislative documents are accessible from the official web-page. During the last years, a growth of social / public involvement in societal processes, active citizenship in regard to city development could be observed. These factors insure openness and transparency of decision-making in city planning process.	– As a soviet industrial city, Krasnoyarsk is characterized by underdevelopment of social infrastructure, limiting city development in future. In spite of the “boom” of housing construction, construction industry often uses outdated technologies and approaches. There is a low level of energy efficiency in housing sector. These issues may decrease adaptiveness and liveability of the housing sector in the future. – Main infrastructural elements (systems of water supplying, sewerage, heating system, roads and streets) were built about 30–40 years ago. At present time, these factors have a negative impact on urban planning and development. – There are forest parks and city parks in Krasnoyarsk, but the central part of the city does not have a sufficient amount of green areas.

Table 3.3

Ending

Opportunities	Threats
– growing population (“developing city”); – capital of the region (Krasnoyarsk Krai); – good interrelations between Krai and municipal political powers; – political stability; – city self-government bodies are not a part of state government; – economic growth as the main goal of city development; – natural resources (including energy resources); – low costs of energy resources.	– segregation of population based on incomes, social status, nationality, etc.; – absence of social equity; – mixture of industrial and housing built-up areas; – a lot of old housing (baraki, khrushchyovki, brezhnevki); – lobby of transnational companies and oligarchs in Krai government and parliament; – corruption; – sale and rent of municipal lands, local taxes are main financial source for city budget; – outflow of finance (profit of industrial enterprises) to the transnational companies located in European part of Russia; – high level of air pollution; – soil contamination with oil and point river pollution; – municipal solid wastes; – location of industrial enterprises in the center of the city, lack of buffer zones between industrial and residential areas in the center of Krasnoyarsk.

3.3.3. Stakeholders' interactions in urban development

In Russia, there are three decision-making levels in urban development: local (city), regional (*krai* in case of Krasnoyarsk) and federal. At the local level, we have identified such actors as local self-governing bodies, architects and designers, developers and investors, and general public. The regional level of stakeholders includes regional executive and legislative authorities, (the Legislative Assembly and Government of Krasnoyarsk Krai). The federal level in decision-making process consists of: (1) Territorial representations of Federal governmental bodies located in Krasnoyarsk city, but subordinated directly to Moscow offices, (2) Legislative bodies of Russian Federation located outside the Krasnoyarsk Krai. The stakeholder groups operating at all decision-making levels are Business bodies and Non-governmental organizations.

The analysis of the significance of an actor group in the decision-making process was performed using the approach suggested by Mitchell, Agle and Wood (1997). The key concepts they explore in the study are *power*, *legitimacy* and *urgency*. The *power* is the extent to which a party has or can gain access to coercive (physical means), utilitarian (material means) or normative (prestige, esteem and social) means to impose their will. The *legitimacy* is understood as a set of formal established instruments and procedures insuring participation of actor group in city planning and urban development. The *urgency* is defined as the degree to which stakeholder claims call for immediate attention in accordance with declared principles of legislative documents.

Power, legitimacy and urgency are interrelated and the three variables often overlap giving us seven groups of stakeholders:

– *definitive group* enjoys legitimacy in decision-making process, huge power and considerable degree of urgency;

– *dominant group* has legitimacy and power for promoting own interests in urban development;

– *dangerous group* has huge power and urgency, but does not have legitimacy for promoting its goals and interests;

– *dependent group* has legitimacy and large urgency, but does not have enough power for promoting interests;

– *demanding group* has only urgency;

– *discretionary group* has only legitimacy;

– *dormant group* has only power.

Fig. 3.7 illustrates the typology of stakeholder groups, participating in city planning and urban development. Currently, the most influential actor group in urban development is a local authority (*defining group*), architects and planners, as well as developers and investors (*dominant groups*). These groups develop, approve and implement all urban development solutions.

The next level in decision-making process belongs to regional governmental structures as well as non-governmental organizations (*dangerous group*) and public (*dependent group*). A dangerous group does not have a legitimate mechanism to promote own interests, but can block the adoption of projects (e. g. the conflict over construction of Manganese Ferroalloy Plant (Krasnoyarsk Being Against Manganese Ferroalloy Plant, 2011)), at the same time, instrument of conflict resolution at the local level is missing. A dependent group needs someone else (e.g. NGOs) to promote their demands and claims.

The next level is represented by the federal authorities and business bodies unrelated to the construction (*demanding groups*). They have urgency but a little power and legitimacy at the local level to promote own ambitions. *Discretionary group* in Krasnoyarsk is represented by marginalized and vulnerable social strata. They have legitimate right to participate in decision-making process, but do not have power and urgency. *Dormant group* includes e. g. the Architects' Union. Many members of the Union participate in Urban Development Board and can have an influence on urban development policy, but at the same time this group does not have legitimacy and urgency.

Fig. 3.8 illustrates the interactions between stakeholder groups. Development of land use planning documents is the prerogative of local authorities, planners and developers who work closely together (Krasnoyarsk City Statute, 1997; Federal Law № 131-FZ, 2003; Urban Planning Code, 2004). The central figure of urban policy in the city is the Mayor. His leadership and personal qualities strongly influence the procedures and practices of policy implementation, as well as the involvement of all stakeholders in the decision-making process.

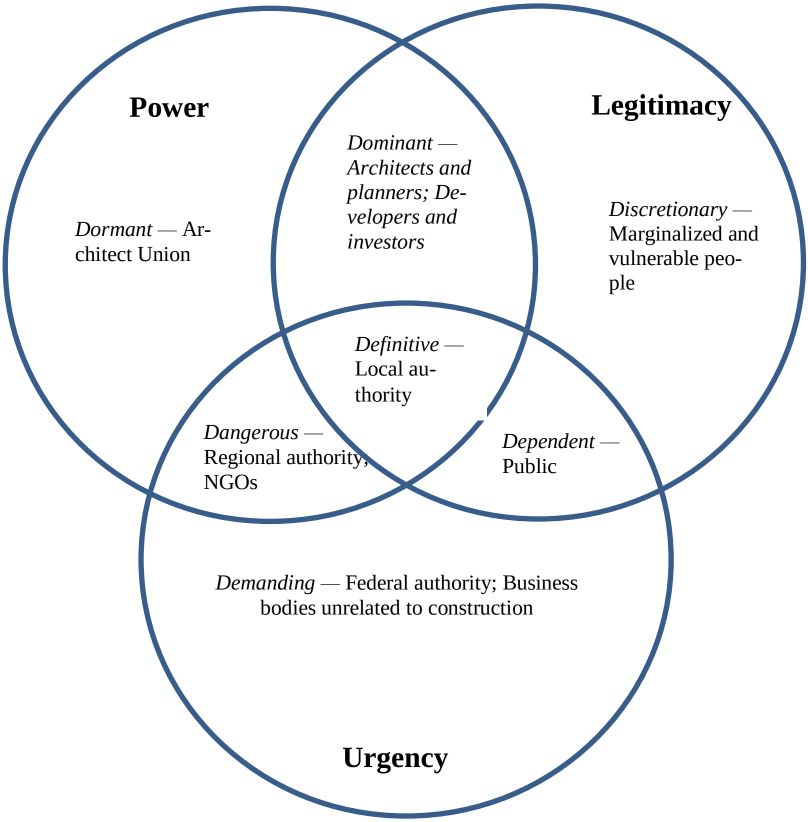

Fig. 3.7. The typology of stakeholder groups participating in the city planning and urban development of Krasnoyarsk city

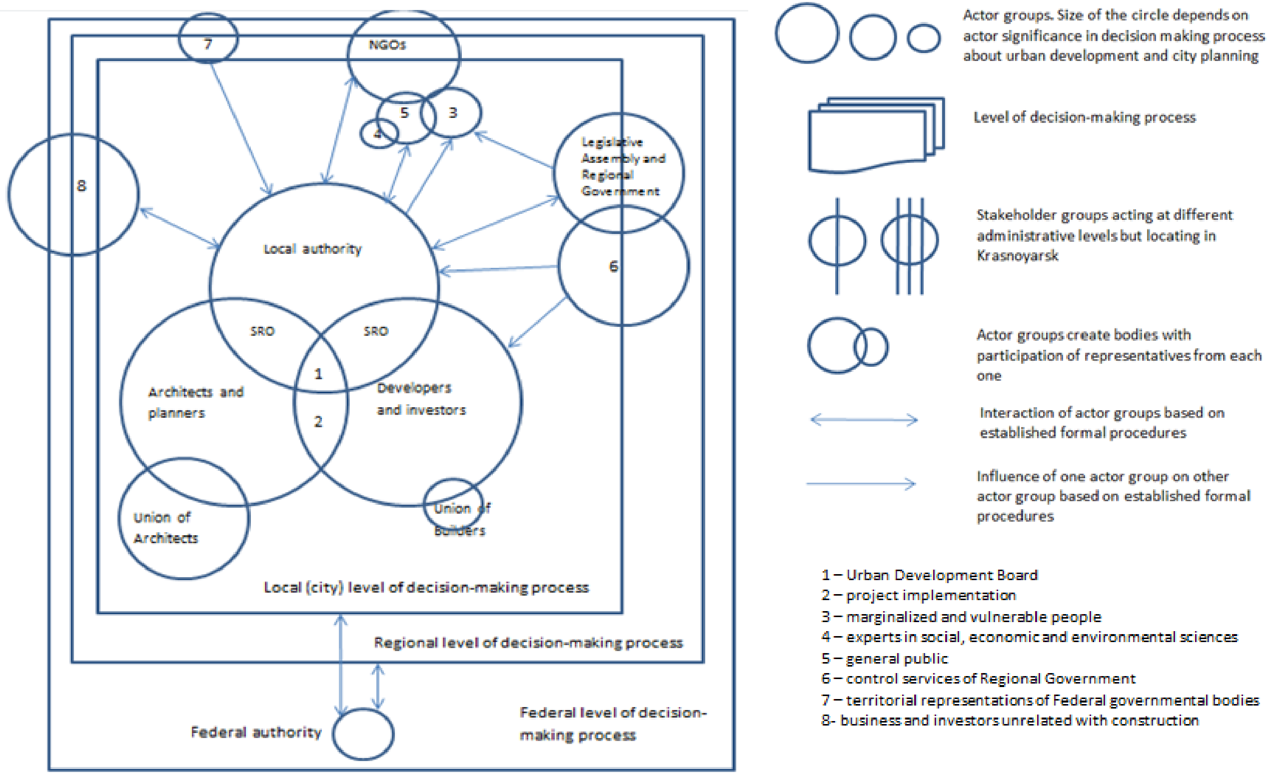

Fig. 3.8. Vienne diagram of stakeholders' interactions in Krasnoyarsk city

Representatives of all the three groups participate in the City Planning Board. List of Board members is established by the City Administration and approved by the Mayor. In accordance with the Statement of the City Planning Board (Krasnoyarsk City Administration, 2013), Board may include architects, builders, local authorities and other professionals whose work is related to the development of the city. Thus, the City Planning Board is a body consisting of city planning professionals, and it does not have a goal to take into account opinions of any other stakeholder groups, such as the lay public. As a result, the Board tends to approve the decisions perceived as right by a rather narrow professional group without proper consideration of the interests of other groups (e. g. the project of Orthodox Cathedral on the Strelka that was well received by the city authorities and the architects, but disliked by nearly everyone else (Zadereev, 2013)).

Functions of city administration bodies often overlap or duplicate in regard to the management of urban development. For example, construction of residential and public buildings is overseen by the Architecture Department (permitting), but also by the Department of Municipal Property and Land Relations. Each administrative body designs its plan for the city development in the relevant field; potentially, this requires involvement of the specialists from other departments, but such practices as exchange of information and involvement of peers are still poorly developed in the city administration bodies.

Designers and developers closely cooperate on their project designs and construction works. Self-regulatory organizations (SROs) were set up for improving cooperation and management in the construction sector (Federal Law № 315-FZ, 2007). SROs act in the sphere of interaction between professional communities and local authority. Business bodies have shared objectives with local authorities in regard to the implementation of their investment policies. The City administration is also working on improving the city’s attractiveness for investors. Investors, at the same time, need land plots, public and administrative buildings, warehouses and engineering infrastructure. Master plan reflects the policy goals of city administration, needs of business and investors communities, requirements of building and construction regulative documents. As observed from 2013 to 2015, the level of participation of non-experts and the public in the development of urban policies was extremely low. City planning is still essentially an expert-led process. Public is almost excluded from the decision-making and could interact with planners only through mechanisms of public hearings. The latter are ineffective due to poor attendance, while those who attend often are not aware about the purpose, procedure and possible outcomes of hearings. In case of conflicts related to new development plans, poor social infrastructure or shrinking green areas, residents preferred to write individual or collective complaints to the City Administration. Such complaints were processed and considered through the established procedure. In the case of unfavourable outcomes, citizens sometimes joined protest movements. The most successful "Krasnoyarsk Being Against Manganese Ferroalloy Plant" movement has managed to bring together a significant number of citizens, who participated in different types of protest campaigns. Potentially, the locals have also a right to initiate a referendum; however, this instrument had never been used to question planning policies.

The observed informal ways of interaction between actor groups included: lobby of corporative interests in the City Council and City Administration, coalition making between business bodies and local governments, shadow schemes of sale / lease transfer of land plots, and bribes (interviews with locals, representatives of spatial planning office, architects and developers), information campaigns in the mass-media, protest movements, social networks. Such informal procedures and practices apparently led to the development of mistrust between actor groups, as our interviewees suggested.

3.3.4. Institutions of urban development policy

Municipal, regional and federal authorities are key landowners in the city. There are many land plots with unrecognized or disputed property rights, while some of them are shared by the owners from various administrative levels. For example, city park *Berezovaya Roshcha* includes the plots owned by federal, regional and local authorities, as well as plots with mixed property rights. The management of such plots is a challenging task for city planners and municipal authorities.

Land market is regulated by the Land Code of Russian Federation (2001). According to its Chapter 30, land plots are allocated to developers through land tenders or auctions. Land tenders were on hold in Krasnoyarsk for a few years, and this procedure was renewed after the new Mayor was elected in 2012. According to the Land Code (2001), provision of land plots without tenders is possible only in a limited number of cases, e. g. conservation and restoration projects, which are governed by direct contracts between a developing company and the City Administration. Nevertheless, this mechanism had been broadly used in recent years, and this triggered speculations in local media and social networks about corruption schemes and lobbying by developers.

The fundamental problem of spatial planning and development in Krasnoyarsk over the centuries can be framed as a "syndrome of a visitor". Apparently, many people settling in the city, including its key decision-makers, had not considered it a place to live, but rather a place to leave. This resulted in many planning compromises (especially where green and public spaces, cultural heritage, walkability were concerned) and low-quality planning and architectural solutions, even if significant investments were involved. Most of such problems are still here, in particular short planning horizon, ad-hoc planning decisions, and acceptance of solutions, which are not socially or economically sustainable. One of the outcomes is a low respect for formally approved strategic planning documents.

The strategic development documents at the city level include:

1) *The City Master Plan.* The current Master Plan was approved in 2002 and largely followed the previous 1973 Master Plan as regards the overall architectural concept and planning approach. The Master plan had lost its strategic role, as it did not account for the latest economic and social developments, as well as new city planning practices.

2) *Urban Development Norms*. Current urban development norms were developed and approved in 2002. According to local architects, planners and developers, these norms do not satisfy demands of citizens and companies in regards to the comfort city environment, especially where parking places, green spaces, density of built-up areas etc. are concerned.

3) *Urban Development and Land Use Rules* were approved in 2008. Rules (1) establish requirements to functional zoning and to city planning regulations, (2) determine the procedure of permission applying of land plots and their use, (3) define the procedure of consideration and approving of deviations from the limit parameters of permitted construction, (4) describe requirements to planning, construction and reconstruction of built-up areas. Corrections and modifications of standards and limits set by the Rules occurred over the recent decade on a regular, rather than on an exceptional basis. E. g. in 2013, the City Administration approved 3–4 exceptions monthly. Thus, the legitimacy of urban policies and city planning documents was seriously compromised and questioned. This resulted in numerous conflicts between stakeholder groups.

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3.4. Community Fora as Vehicles of Change? The Hlanganani Forum and Kruger National Park, South Africa

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This chapter examines the relationship between the Kruger National Park (KNP), South Africa, and rural Tsonga communities located adjacent to its western border. Some of these communities are represented on the Hlanganani Forum, which liaises with the Park and was established in 1994 when South Africa became a new democracy. The historical background of these communities is characterized by a perceived inadequacy of compensation for their loss of access to resources within the KNP and to damage caused by wildlife escaping from the park (Cock & Fig, 2000; Freitag-Ronaldson & Foxcroft, 2003). These historical conflicts continued to occur through the dynamic economic and political transformations within South Africa since 1994. Post-Apartheid changes have witnessed a transformation in KNP policies, which are now more socially inclusive and seek to integrate its core biodiversity conservation objectives with socio-economic ones, designed to assimilate the park into the broader socio-economic landscape and improve relations with its neighboring communities. We highlight some of the challenges to the process of integrating biodiversity conservation and rural development in the communal areas of South Africa. This objective is part of a more general problem concerning participation in resource management by rural communities living in the neighborhoods of national parks and other protected areas. Although the focus here is on interactions between South Africa's KNP and its neighboring communities, the findings have relevance and resonance beyond Africa as they raise key questions that can be considered in similar contexts.

3.4.1. Conceptual Framework

People whose livelihoods[§] chiefly involve the direct exploitation of local natural resources often come into conflict with the institu-

[§] Following Ellis (2000; 10), *livelihood* is defined as that which comprises: "…the assets (natural, physical, human, financial, and social capital), the activities, and the access to these (mediated by institutional and social tions of protected areas (PAs), which are dedicated to natural resource conservation or preservation. Many scholars and managers now question the traditional top-down approach of excluding local participation and ignoring local interests in PA establishment and management (Kiss, 1990; Rihoy, 1995). More participatory planning is believed to enhance local support for biodiversity conservation goals of PAs (MacKinnon et al., 1986; Happold, 1995; Heinen, 1996). It is also believed that sustainable utilization of certain PA resources and/or PA outreach programs will contribute to rural development, especially in underdeveloped countries, and decrease conflicts between local people and park authorities. However, efforts in different parts of the world to integrate objectives of biodiversity conservation and rural development have had mixed results (Alpert, 1996; Brandon et al., 1998; Newmark & Hough, 2000; Hughes & Flintan, 2001; Barrett et al., 2005). These evaluative studies have shown that synergies between the two do not always occur, they are not a panacea, and must more fully incorporate local conditions and expectations in their design and implementation if they ever hope to succeed (Anthony et al., 2011).

In our research, involvement of local stakeholders in the management of KNP may be seen as an evolving social democratic process by which citizens are acquiring increasing rights and power to influence government decisions that directly affect their livelihoods. Related to this, participatory management in conservation refers to situations that substantially involve all or some of the stakeholders in a PA in management activities, especially when access to natural resources are essential to local livelihoods and cultural survival (Borrini-Feyerabend, 1996). Because participatory management implies a partnership between the agency with jurisdiction over a PA and other relevant stakeholders, and because decisions are shared between all involved to some extent, the case for participation is further strengthened by the reality that most situations are complex and would benefit from multiple interpretations.

Based on Firey (1960), conventional discourse on sustainability asserts that PA management needs to simultaneously be biologically sound, economically feasible, and socially acceptable.

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relations) that together determine the living gained by the individual or household."

Moreover, PAs cannot be divorced from people, either as direct users of their resources, or as beneficiaries of the goods and services they provide. Even when a PA's resources are not directly used, its management includes that of the relationship between people and the area's resources, as well as human interactions that are produced. Therefore, the best way for resource planning to proceed is to seek avenues of balancing the criteria used in optimizing each of the three categories of knowledge pertinent to natural resource use (ecological, economic, and ethnological/cultural), i. e. articulating, mediating, and negotiating trade-offs.

In defining which people are impacted by a PA, the concept of local community can facilitate focusing on the needs and rights of resource users who have in the past been marginalized by conservation efforts. However, this might engender a limited understanding of the place of people in complex natural resource use systems, because it suggests a homogeneity that may not exist at all levels, and ignores those who cannot be identified with a local, geographic community. The concept of stakeholder, guided by social democratic influences, has gained prominence in conservation and development circles because of its usefulness in identifying and defining those who have influence on, or can be affected by, the management process. The rationale for stakeholder participation is that it can lead to legitimacy, and in planning includes a) the quality of management decisions that integrate the knowledge, needs and aspirations of all parties; b) the feasibility of management decisions that are accepted and owned by stakeholders; and c) the empowerment and democratization that result from the involvement of people and their organizations in formulating and implementing policy and management decisions.

Relationships among and between stakeholders and their interaction with natural resources are partly governed by embedded beliefs and attitudes (Rokeach, 1976). PA management involves transforming these beliefs and attitudes through integration to meet defined goals. Increasingly, in addition to environmental sustainability and biodiversity conservation, these also include social and economic goals, such as the provision of human needs, poverty reduction, social justice, and equity (Luckham et al., 2000). The process of transforming must recognize the complexity and coherence of existing institutions[**] and the diversity and interests of the various stakeholders. It therefore must give stakeholders the opportunity to participate in the design of new arrangements, instead of providing external and technocratic answers. It should also embrace the range of development and natural resource management issues, instead of confining itself to narrow conservation objectives.

Within this framework, the challenge for PA planners and managers, including the KNP, is to design and implement planning processes and institutional arrangements that use the tools of participation to achieve objectives as diverse as environmental sustainability and biodiversity conservation, poverty reduction and provision of basic human needs, and equity and social justice. Moreover, by employing this conceptual framework, it is critical to understand under what conditions social interventions vis-à-vis community fora are operating, and to evaluate how obstacles can be overcome in ensuring their success.

Changes in global development thinking represent fundamental shifts away from the technology-dominated paradigm developed in the 1960s toward a less technocratic and more people-centered approach to sustainable growth (Cernea, 1991; Kottak, 1991; Roe, 1991). Much of this shift arose by reassessing key assumptions regarding the relationship between people and the environment. Central discourses rested on defining poverty (Gray & Moseley, 2005), and the extent to which there is a direct causal relationship between poverty and environmental degradation. Forsyth et al. (1998) refer to the orthodox or mainstream view of this linkage where 'poverty and environmental damage are inextricably linked, and are self-reinforcing' (1998: 2). Underlying this view are specific assumptions as to the way in which people manage their environment in the face of poverty or environmental degradation. It is assumed, for example, that the poor will always degrade their environment in

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[**] Institutions are humanly developed constraints that shape human interaction and the way societies evolve through time (North, 1990). Institutions are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behavior, conventions and self-imposed codes of conduct), and their enforcement characteristics. Institutions, such as property rights are mechanisms people use to control their use of the environment and behavior toward each other (Bromley, 1991).

response to population growth, economic marginalization and existing environmental degradation, and that the only way to avoid further environmental degradation is to alleviate poverty. In some cases, there may well appear to be a direct, causal relationship between poverty and environment, which would support the orthodox view of this linkage. Frankenberger and Goldstein (1992) cite examples of households that resorted to over-harvesting wild foods, overgrazing pasture, and increased planting in marginal areas when faced with food insecurity. Such examples postulate straightforward causal relationships between poverty and the environment where land degradation is seen as a *result* of food insecurity, or food insecurity as a *result* of faulty natural resource management, neglecting possible feedback loops, and other social, economic, cultural processes that may contribute to these relationships.

Forsyth et al. (1998), however, question the universality of such causal relationships between poverty and resource degradation, offering an alternative view of the social processes involved in resource management. Basing their claims on a growing body of empirical studies, they proposed that the relationship between poverty and environment is complex rather than directly causal in either direction. They argue that local responses to change are socially and environmentally specific, shaped by institutions and that depending on the situation, may actually lessen impacts and promote sustainable livelihoods. For example, Batterbury and Forsyth (1999) demonstrated how local adaptation processes have been utilized by local communities in the face of environmental threats to both improve livelihoods *and* reduce environmental degradation. How individuals relate to their environment cannot therefore be automatically generalized to all people and all environmental situations, as was the development policy based on the orthodox view (Leach et al., 1999). Local institutions, including community fora, are seen as central, and an acknowledgement of the diversity of local contexts is seen as imperative in understanding people-environment relationships. According to Forsyth's alternative view, a re-conceptualization of the relationship between people and their environment must occur not only at the policy level, but at a deeper level, which questions how, why, and under which circumstances such processes might occur.

This systematic search for development has also been accompanied by increasing concern for biological diversity[††] loss (Wilson, 1988; Ehrlich & Ehrlich, 1992; Reaka-Kudla et al., 1997; Myers et al., 2000). In many developing countries, severe financial constraints and inadequate resources for protecting sensitive areas has resulted in the merging of biodiversity management with more participatory forms of development planning and organization, giving rise to community-based conservation[‡‡] (CBC) or community-based natural resources management[§§] (CBNRM). Community participation, in principle, should enable communities to regain control over natural resources and, at the same time, strengthen decision-making capabilities, increase empowerment and involvement, and improve social and economic well-being (Uphoff, 1991). While these terms have been used extensively in both political and research fora, the concepts underlying these expressions and the conceptual links between them are often ambiguous and based on very different assumptions and interpretations of how individuals within communities experience daily life and interact with the environment. Further, although CBNRM projects have been broadly praised as activities, which seek to bridge the gap between the needs of wildlife and of local human populations, they can only be considered successful if they improve *both* the well-being of local communities *and* maintain, if not increase, biodiversity.

This chapter, which focuses in part on control of, and access to, resources will be examined more holistically in light of social processes embedded in both the conservation and development spheres,

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[††] 'Biological diversity', according to the Convention on Biological Diversity, means 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.

[‡‡] 'Conservation' in this study is defined as more than an *intentional* practice leading to the maintenance of biodiversity, ecological processes and life-support systems. It also encompasses practices that *result* in the above regardless of their stated or non-stated intention.

[§§] 'CBNRM' means any utilization of indigenous biological resources by a community for sustainable harvesting, traditional use or commercial purposes.

exploring how issues of power, participation, legitimacy, and costs and benefits are integral parts of people's relationships with nature, each other, and PAs, not only locally, but in relation to wider societal processes. These are themes that have only been touched on briefly in southern Africa, and are particularly little understood in the former homelands of South Africa. By taking such an approach, we offer for the first time community perspectives and internal perspectives of the Hlanganani Forum in South Africa. Despite being in existence for more than a decade, no evaluation had been conducted on the effectiveness of the HF, its influence, nor its perception by neighboring communities. Research findings here are crucial in understanding the role of KNP's interaction with community fora including the HF, and hopefully will be utilized to guide further engagement with community groups. Moreover, findings on attitudes of local communities towards both the KNP and HF and the factors that influence them, are valuable in determining priorities for more targeted policy action in resolving conflicts and improving relationships.

3.4.2. Context: Kruger National Park

Bio-physical Characteristics

The KNP, situated in the northeastern section of the Republic of South Africa, is approximately 350 km from north to south, averaging 60 km in width, and covers nearly two million hectares (Mabunda et al., 2003), i.e. about the size of Israel or Slovenia (see Fig. 3.9). Second only to Table Mountain National Park, annual visitor numbers to KNP surpassed 1.4 million in 2008/2009 (SANParks, 2010). It is unrivalled among South Africa's 20 national parks, being home to an unparalleled diversity of wildlife and maintained by one of the world's most sophisticated management systems (Braack, 2000). Furthermore, more than 254 cultural heritage sites have been identified within the Park's borders (SANParks, 2000a).

According to Jacana Education Ltd. (2000), 16 ecozones exist within the KNP. Three of these ecozones are represented along the western border from the Punda Maria gate south to the Klein Letaba River, namely the Mopane/Bushwillow Woodlands, Sandveld, and Riverine. The KNP also comprises eight main river catchments, including the Shingwedzi and Letaba in our study area. Annual precipitation ranges from 500–700 mm in the area, and thus is classified as 'semi-arid' (Jacana Education Ltd., 2000).

Land use adjacent to the western border of the KNP is characterized by slightly undulating plains containing villages with built-up land, surrounded by areas for subsistence farming. However, there still remain relatively sizeable vacant, bushland areas with biodiversity largely intact, especially between the Shingwedzi and Klein Letaba Rivers (DWAF et al., 2001). Adjacent areas are demarcated from the KNP by way of a boundary fence originally intended to control the spread of foot-and-mouth disease. However, many sections of the fence are dismantled and/or need repair (Bigalke, 2000; SANParks, 2000a). A combination of factors contributes to the poor condition of the border fence: extensive damage during flooding in 2000; elephant breakages; poor maintenance; and actions of persons illegally crossing into South Africa from Mozambique (Anthony, 2006).

Social Ecology

In 1994, the then National Parks Board, driven by national policy changes and the need to improve its image, issued a directive that parks cannot exist in isolation from their neighbors and thus, dialogue should begin. According to early Social Ecology Unit (transformed to People and Conservation Department in 2003) staff, with this directive, and without a framework nor any planning or objectives, rangers began to use black subordinates to initiate discussions with neighboring traditional authorities[***] (TAs). The focus was to increase the 'sense of ownership' of parks by local communities and, concurrently, create fora that could establish communication regarding park-people issues and alleviate conflicts. At that time, there was much friction between the KNP and communities as the KNP was still very much dominated by whites and followed Apartheid practices. According to the former Chief Warden of KNP (1994–1998), fora were initiated with communities within the 'red line'[†††] (which was

[***] The terms 'traditional authorities' and 'traditional leaders' are all encompassing terms to refer to 'chiefs' of various ranks. As the usage in this review refers to both people and structures, both terms are used.

[†††] The 'red line' is a veterinary demarcation, which runs approx. 15–20 km from the KNP's western border. It is currently managed by the national Department of Agriculture to control foot and mouth disease in terms of the Animal Disease and Parasite Act (No. 13 of 1956).

an arbitrary choice) and were partly modeled after community representative frameworks from the Richtersveld National Park.

Concomitant with these changes, the KNP established its own Social Ecology Program, which facilitates participatory communication structures with the Park's neighbors and affected communities[‡‡‡]. It consists of about 120 villages and private game farms with an estimated total human population of 1.5 million (SANParks, 2000a). The first duty of the Program was to break down barriers of ambiguity and antagonism and address real issues affecting the daily lives of their neighbors. As of 1999, this program was working with 88 communities bordering the Park and by March 2000, twenty-four permanent social ecology staff (~0.8 % of total) were employed by KNP (SANParks, 2000b). Seven multi-village fora have been organized and meet monthly to discuss issues of concern to the communities such as wildlife depredation on crops and livestock, foot-and-mouth disease, and land claims. In addition, ways to bring about socio-economic development in the communities are discussed, including the establishment of joint ecotourism ventures with local communities; developing markets within the Park for the sale of local crafts; providing funding for self-help projects; and negotiating with neighboring market gardeners to provide the Park with fresh produce.

[‡‡‡] According to Braack et al. (n.d.), 'Neighbors and Affected Communities' refer to 'any person or grouping of persons which within reasonable limits is deemed to be directly affected by the presence of the Park or the activities present therein'. This includes not only those persons living in close proximity to the Park who may occasionally be subject to damage inflicted by animals escaping from the Park, but also those living some distance away who may reasonably expect to use the Park as an offset area for saleable commodities, or live near main access roads to the Park which offer business opportunities, or who through historic displacement may currently be geographically well removed but have reasonable claim to access for ancestral worship or other purposes. The above description refers largely to black communities living along the western boundary of the KNP, but other stakeholders include many private nature reserves, hotels, mining and agricultural industries.

3.4.3. Context: Hlanganani Forum

The Hlanganani Forum (HF) was initiated by white KNP rangers at a meeting in Punda Maria on 24 February 1994 in which all TAs within the red line were approached and invited. Originally, it was named the 'KNP-Giyani/Malamulele Forum' and was formed to have three major actors 'come together', i. e. KNP, The Northern (now Limpopo) Province, and neighboring communities. According to minutes of that meeting, a KNP representative described the relationship between KNP and its neighboring villages stating that 'KNP has not had a mandate to work in these communities'. Emphasis was placed on 'the changing political and economic circumstances within the country, and the recognition that a good working relationship between KNP and its neighbors is essential for both parties'. According to a KNP Social Ecology staff member from that period, there was a conscious decision to exclude any white communities, vis-à-vis mining operations, out of the forum even if they fell within the red line and experienced DCA (damage-causing animal) problems. The reason for this was simple: the focus would be on black, previously disadvantaged communities.

The overall aim of the HF, according to its first constitution (approved 9 March 1995) was to: '*...build a relationship between Kruger National Park, the Northern Transvaal Department of Environmental Affairs (NTDEA), and the communities bordering on the Park within Giyani and Malamulele regions so as to enhance development and environmental education opportunities within these organizations and villages'*.

More specifically, its primary goals were:

1. To build trust and friendship between the KNP, neighboring villages, and the NTDEA.
2. To resolve mutual problems.
3. To facilitate the establishment of small business development and to support existing business in the communities bordering on the Park by using the infrastructure and economy of the Park.
4. To promote environmental education within the communities.

5. To facilitate development and capacity-building within the region with the support of sponsors and developers not directly involved in the region.

Original membership in the HF consisted of (a) 26 villages with 2 representatives each, (b) KNP with 5 official members: 3 local rangers plus 2 head office staff, (c) NTDEA with 5 official members, and (d) South African Police Service (SAPS) with 5 officers (SAPS are no longer members in the Forum). According to the HF Chairman, the HF gained Section 21 status (not-for-profit) in 2001, and represents 27 villages; although an additional 15 villages lie in our study area, which are not represented on the HF. The main issues that were central to discussion of the HF were damage-causing animals that were escaping from the KNP and the resulting lack of compensation to damage caused by these animals, the poor condition of the Park's border fence, the proposition of installing a new public entrance (Shangoni Gate) to the KNP, and a proposed buffer zone which would comprise both community and KNP land (Mariyeta Park). The HF is considered by both KNP Social Ecology staff and its chairperson to be the most active KNP forum, due primarily to the long history of conflicts in the area.

As the HF matured, it developed a new Constitution in 2000 with an expanded primary goal to more accurately reflect its priorities: *'To build a healthy working relationship between Kruger National Park (Park), the Limpopo Province Department of Agriculture, Land and Environmental Affairs (Government), and the communities bordering on the Park within the Mopani and Thulamela municipality (Forum) so as to enhance development, employment opportunities, environmental education opportunities, care of problem animals and compensation on livestock that belong to members communities.'*

HF objectives were also extended and encompass both primary and secondary objectives:

A. Primary objectives:

1. Deepen and strengthen a healthy relationship between the Forum, the Park, and the Government.
2. To work toward development of the previously disadvantaged communities.

3. To create employment opportunities either in the Park, the Government, or even in the Forum.
4. To help educate member communities about conservation and other environmental matters.
5. To help take care of problem animals either by employing professionals or by participating in the tendering process of the Government and of which the money generated thereof shall be made available for the use that will benefit the Forum.
6. To look at compensation of the members who have lost their livestock.

B. Secondary objectives:

7. Managing different environmental and conservation related projects that are beneficial to the community members (aimed at community development and empowering the community socially and economically).
8. Creating employment opportunities.
9. Establishing a support center that will look at training of professional hunters, compensation of people who have lost their livestock and also giving information to the relevant law enforcement officers in the Park and the Government about people who transgress the law according to the Nature Conservation Act.

3.4.4. Methods

This research studies the ongoing interaction of the KNP with its neighboring communities and so is limited by lack of baseline data on communities, including those represented on the HF, before its establishment. Therefore, a post-test only control group design was chosen which has virtually all the experimental rigour of a pre-test/post-test control group approach. Since data were collected at approximately the same time, problems of maturation, history, test effects and regression towards the mean have been minimised. Although it is impossible to be certain that the experimental and control groups were equivalent to begin with, by employing randomization techniques and ensuring a relatively large sample size in each group, researchers can safely use this design type (Bless & Higson-Smith, 2000).

This research involved a one-month pilot study, followed by a longer field component from February to November 2004. The techniques employed in this research included a protocol for securing access to local stakeholders, archival analysis of KNP and Limpopo Province reports and HF meetings minutes, a face-to-face questionnaire administered to randomly selected village households, written questionnaires for HF members, and semi-structured interviews.

Household Face-to-face Questionnaire

Based on theoretical and conceptual considerations, face-to-face questionnaires were formulated to elicit primary data from respondents. Questionnaires contained factual questions (e. g. age, gender, level of education, resources used), ranking questions (e. g. community needs), and contingency questions (e. g. whether respondent knew of HF). The questionnaire incorporated both closed-ended questions with a combination of different measurement scales (nominal, ordinal, scale) and open-ended questions. Open-ended questions were primarily used to allow respondents to express their beliefs in their own words or determine attitude strength, and were manifest (content) coded using a contextual method based on positive/negative or topical classifications, trying to preserve as much detail as possible (Weisberg et al., 1996). Likert-type questions, which use a rating scale to measure *inter alia* attitudes (Anderson et al., 1983), were limited to 3-point only as this form is most frequently used in African contexts (Bless & Higson-Smith, 2000). Questionnaire length and order of questions/topics were constructed to maximise the comfort of the respondent and to reduce consistency bias. These questionnaires helped to determine the role that independent variables (e. g. involvement in the Forum, age, gender, level of education, household income, Traditional Authority affiliation, proximity to the KNP) play in attitudes towards the HF.

Community questionnaires were first written in English, and then translated into Tsonga-Shangaan (local language) by a linguistic teacher. The Tsonga-Shangaan version was then translated back into English. Inconsistencies and/or clarifications in the text were then discussed and modified in a joint meeting between the two translators and the author. Questionnaires were pre-tested on the research assistants, as well as a sample of 20 people from rural villages adjacent to the study area (Sudman, 1983). As a result of the pre-testing and discussions, some questions were deleted and others modified to improve clarity.

Sampling Procedure

In order to ensure an accurate representation of the target population, especially in cases where populations are non-homogenous, it is important to obtain a representative sample in order that results can be generalised to the larger population (Weisberg et al., 1996). Thus, simple random sampling was chosen from the target population (18,339 households). A sample size of 240 households was used which ensures a maximum sampling error of +/–6.28 at a confidence level of 95 %. Although the fraction of total households sampled is only 1.3 % when N = 240, this has little effect on the margin of error and many studies have typically less than 1 % sampling fraction (Weisberg et al., 1996). In order to minimise sampling error, when possible, the researcher team attempted to sample at least one village within a day. The questionnaire was administered within 32 days in May-June 2004 extending from north to south through the study area.

As far as possible, household heads[§§§] were surveyed at each selected household and the time of sampling was optimised i. e., when household heads were likely to be home (e. g. during daylight hours, weekdays only). In cases where the household head was not home, the household occupants were allowed to determine who would respond to the questionnaire. Moreover, by utilising two mature, male field assistants, both cultural inhibitions and non-sampling error was minimised, and data disclosure from the respondents maximised. Research assistants were instructed, if possible, to ensure an equal representation of male and female respondents, and avoid gatherings of neighbors or other household members when individuals were being interviewed.

[§§§] In keeping with Statistics South Africa practice, a ‘head of household can either be male or female, and is the person who assumes responsibility for the household’ (Budlender, 1997). In this research the respondent was allowed to decide who the household head is.

Research Focus

In keeping with KNP's commitment to involve villages within 15 km of its border in community fora, and to include all those within the jurisdiction of the HF, the sampling frame consisted of all village households located within that area, extending from the Punda Maria gate, south of the Luvuvhu River to the Klein Letaba River (Fig. 3.9a, b), excluding four villages in the southern section which were moved to the Phalaborwa Forum (Mbawula, Palawubeni, Makuva, Savulani). In addition, two communities (Lambani, Mushiro) which are currently represented on the HF, were also excluded, as they joined the HF later and were not original members. The final sampling frame consisted of households within 38 villages (23 HF-represented villages; 15 non-HF villages) from seven *de jure* TAs.

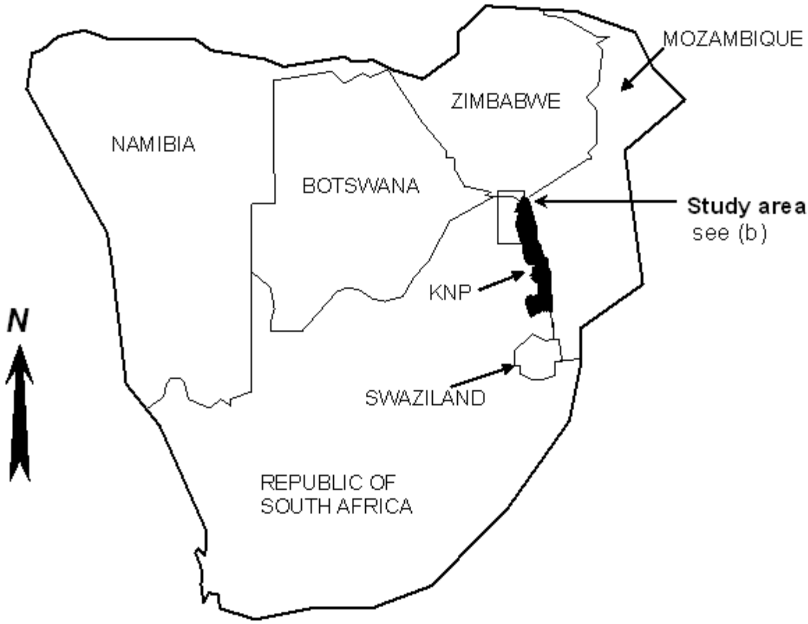

Fig. 3.9a. Location of Kruger National Park in Southern Africa

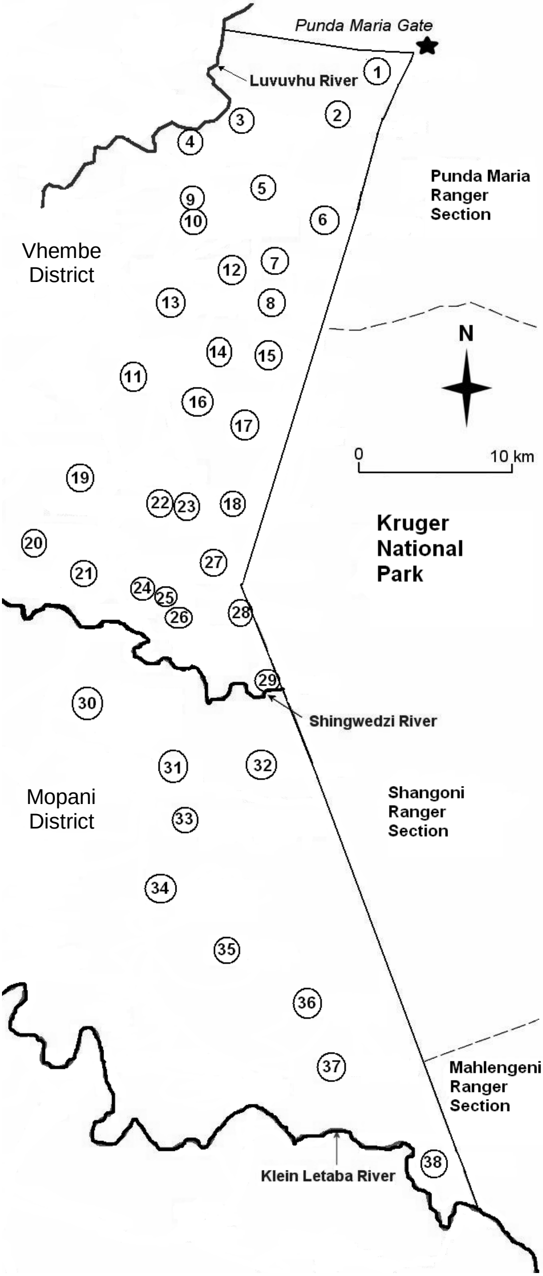

Fig. 3.9b. Study area with villages (listed below with associated de jure Traditional Authorities; Hlanganani Forum-represented villages in *italics*, non-Forum villages in normal font) **Mhinga TA**: *Matiyani* (1), *Josepha* (2), *Mhinga* (3), *Botsoleni* (4), *Maphophe* (5), *Maviligwe* (6), *Makuleke* (7), *Makahlule* (8); **Shikundu TA**: Ximixoni (9), Saselemani (10), Nkovani (11); **Bevhula TA**: Ntlhaveni D (12), Nkavela (13), Makhubele (14), *Bevhula* (15); **Magona TA**: *Nghomunghomu* (16), *Mashobye* (17), *Magona* (18); **Madonsi TA**: Gijamhandzeni (19), Matsakali (20), Halahala (21), *Peninghotsa* (22), *Govhu* (23), Merwe A (24), Shisasi (25), Jilongo (26); **Mtititi TA**: *Lombaard* (27), *Plange* (28), *Altein* (29); **Xiviti TA**: Mininginisi Block 3 (30), *Mininginisi Block 2* (31), *Muyexe* (32), Shitshamayoshe (33), Khakhala (34), *Gawula* (35), *Mahlathi* (36), *Ndindani* (37), *Hlomela* (38)
Source: Anthony (2007); reproduced with permission from Cambridge University Press.

Forum Representatives Questionnaires

Two separate written questionnaires were prepared for members of the HF: one in Tsonga-Shangaan for village representatives; the other in English for institutional representatives. Many of the questions within these questionnaires were similar to those of the household survey allowing for statistical comparisons, although specific questions were added to target respondents' personal involvement in the Forum. The questionnaires were distributed over a period of 3 months at regular HF meetings with the provision that they be returned before November 2004. Total returned questionnaires were N = 15 (village representatives) and N = 4 (institutional representatives).

Interviews

In order to capture and better understand the perspectives of relevant actors, interviews were also utilized. Interviews involve direct, personal contact with research subjects who are asked to answer questions relating to the research problem (Bless & Higson-Smith, 2000). In order to better understand social phenomenon from the actor's perspective, Mkabela (2005) emphasizes the need for researchers to empathize and identify with the people being studied within African indigenous communities. Although indigenous knowledge systems are often situated knowledge, the researcher does not necessarily have to be indigenous to understand them, including in this research where the researcher [BA] was considered a 'white, northerner' (Mutema, 2003). By allowing interviewees to freely explain terms and issues from their own perspective, these interactive interviews helped to construct a 'picture' of the nature of the relationship between the communities, the HF and the KNP, including how they value each other, and approach and resolve conflicts. Where necessary, follow-up interviews were carried out to clarify issues and explore further avenues of interest related to the research, as it unfolded.

Data Analyses and Interpretation

Using the Miles and Huberman (1994) interactive structure, and assisted by Atlas.ti (ver. 5.0) software, qualitative data was analyzed in three main components:

1. Data reduction

- editing, segmenting and summarizing data;
- coding and memoing, finding themes, clusters and patterns;
- conceptualizing and explaining.

2. Data display: organizing, compressing and assembling information.

3. Drawing and verifying conclusions (includes linkages with quantitative data).

Quantitative data was first compiled in Microsoft ® Excel 2002, then transferred to and analyzed using SPSS (ver. 13) software to:

- study trends and variation (mean, medium, variance, etc.),
- study associations (correlation, regression analyses, non-parametric tests) between basic socio-economic and demographic data/factors and attitudes/perceptions,
- produce ‘classifications’ or groupings of households according to social and demographic factors, and attitudes and beliefs.

3.4.5. Results

Significant Achievements

Reduced Costs for Park Entry. Since its commencement, the HF has been involved in a number of activities related to its Constitution’s objectives. As part of its more significant achievement, since 2000, the following persons have reduced entry fees to enter KNP, after first applying to KNP’s Department of People and Conservation:

- HF Executive receives free entrance to KNP for business-related trips.
- When HF meetings in KNP, all members receive free entrance.
- Elderly people and their children receive free entrance to visit heritage sites.
- School groups receive free entrance if they are from neighboring communities (first negotiated by HF). Currently, this privilege extends to all school groups within South Africa who participate in the KNP’s Environmental Education program.

- Further, chiefs accompanied by up to 10 people had free entry and Forum village members a 50 % discount on entry to KNP until 31 Dec 2004, but *not* on school or public holidays. This last caveat raised much opposition from Forum members as they felt that these are the times when families would normally go.

Socio-economic Development. The HF has also been instrumental in promoting socio-economic development in the region where it operates. Some of the most noteworthy achievements include:

- In 1998, HF compensated farmers who lost cattle to lions (1500 ZAR [~210 €]/animal). The meat from the lions also went to the communities (to *tindhuna* [village headmen] for distribution).
- HF has 11 people from neighboring communities who are being trained as professional hunters. In time, they hope to form an 'Outfitter', which can deal with DCA themselves and gain other employment.
- The HF assisted in developing a tourism link for the region through the 'Hlanganani Route' initiative.
- HF secured 175,000 ZAR (~21,000 €) in 2001–2002 through the community-based and government-supported 'Land-Care' program to stabilize streambanks in Matiyani village. This money was partly used for 'unskilled labor' from the community.
- Any KNP tenders must now stipulate that winning tenders source at least their 'unskilled labor' from local communities.
- Community dance groups are paid to do occasional performances within the KNP.
- The HF, in partnership with KNP and the Dept. of Welfare, secured 393,000 ZAR (~47,000 €) from Development Bank South Africa to build a new Art & Craft Centre at the Punda Maria gate.
- Organizing soccer and handball teams from neighboring villages to participate in KNP-sponsored tournaments.
- Employment has been secured for community members in the Working for Water Program[****], and in KNP border fence construction/maintenance.

[****] This national program was launched in 1995 to fight alien species and is administered through the Department of Water Affairs and Forestry. It provides employment in its partnerships with local communities.

Complaints and Constraints

Notwithstanding these achievements, the HF has had a rocky road since 1994. Not only have they encountered challenges beyond their control, but also perceptions and beliefs of the organization by other institutions (e. g. TAs, KNP, Limpopo Province) have not all been affirmative and, in some cases, are extremely critical. Of major concern have been issues of HF meeting absenteeism, management, and representation. Environments where broken promises are not uncommon and the competence of the KNP Social Ecologist questioned (discussed later) exacerbate these concerns.

Meeting Absenteeism

Assuming that HF has convened monthly since its inception in February 1994, there have been approximately 152 meetings to September 2004. Of these, meeting minutes from both the HF secretariat and KNP Social Ecology combined are available for only 44 (29 %) meetings (Fig. 3.10). Moreover, only 27 of these 44 (61.4 %) had an attendance record, although this has improved somewhat in recent years.

HF members and the Limpopo Province have identified meeting absenteeism as a problematic constraint for the operation of the HF. Meeting absenteeism has been of such magnitude that, in some cases, meetings have had to be cancelled (02/1996; 02/2000). Analysis of attendance records at HF meetings since 1994 reveal that only 15 of 27 villages have been represented at a minimum of 50 % of meetings, and only 8 have attended 67 % of the meetings or more (Table 3.4). If one looks only at 2003–2004, however, 13 villages have had attendees at > 66 % of the meetings. If village attendance at HF meetings can be an indicator of representation, there appears to be a growing trend in representation for some villages since 2003, although many villages are under-represented and five have simply not been represented at all. Further, aside from Mininginisi Block 2 and Gawula, all other villages south of the Shingwedzi River have attended ≤ 17 % of HF meetings in the last two years. Despite this high absenteeism rate, the HF’s 2000 constitution and its secretariat both maintain that these villages are indeed full-fledged members.

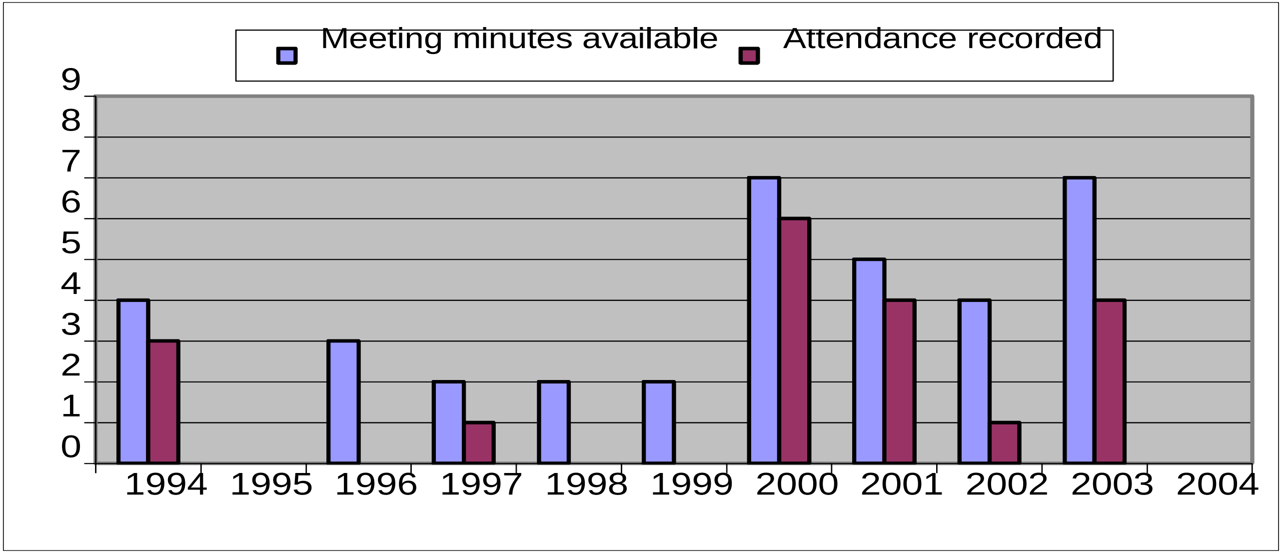

Fig. 3.10. Available HF meeting minutes and recorded attendance: Feb 1994 — Sept 2004

Table 3.4

Village representation at HF meetings 1994–2004

Village name	**Meetings attended**	**As % of minutes with recorded attendance (1994–2004)**	**As % of minutes with recorded attendance (2003–2004)**
Mhinga (Nkhavi)	27	100	100
Maviligwe*	24	89	92
Mushiro	22	81	92
Mahlathi	20	74	75
Mashobye‡	19	70	75
Peninghotsa‡	19	70	67
Plange (Mtititi) ‡	19	70	92
Makuleke*	18	67	83
Altein‡	16	59	75
Govhu‡	16	59	83
Botsoleni	15	56	75
Lombaard‡	15	56	58
Mininginisi Block 2	15	56	83
Muyexe†	15	56	17
Maphophe	14	52	58
Josepha	11	41	75
Magona (Gidjana) ‡	9	33	0
*Makahlule**	9	33	17
Bevhula‡	6	22	8
Lambani	6	22	17
Matiyani	6	22	17
Nghomunghomu‡	6	22	8
Sawulani	5	19	0
Gawula	3	11	8
Ndindani†	3	11	0
Hlomela (Macene) †	2	7	0
Vuyani	1	3	0

Notes: villages in *italics* have been absent from HF for ≥ 3consecutive meetings in last 12 months

† TA from these villages formed Nghunghunyani Trust

‡ TA from these villages formed Gazan Trust

* villages also represented on Makuleke C.P.A.

Even at the time of this research, confusion as to the number and identity of member villages actually in the HF remains. According to the 1995 HF Constitution, 26 villages are members. In contrast, the revised 2000 Constitution states 27 villages, and in a letter from the HF Chair to KNP Technical Services (10 April 2003), 29 communities are stated as belonging to the HF. When asked which villages are actually members, there is uncertainty amongst the HF Executive. This uncertainty was addressed at a forum meeting held on 25 July 2003, when the KNP Social Ecologist was mandated to write down HF village membership. The Chair instructed him to 'ignore villages which are claiming that they are no longer members of the forum because they didn't do it in writing as the [2000] Constitution of the Forum states in Article 4.3.' To date, this list has not been produced.

In addition to HF village representatives, complaints within the HF were raised about absence of KNP staff at meetings, including those within Social Ecology. Available attendance records show that the KNP Social Ecologist mandated to liaison with the HF has attended only 68 % of HF meetings since 2000, and only 50 % in 2004. According to HF questionnaires, village representatives attended a mean of 7.4 meetings in 2003 (median = 9, range = 11, N = 14), while institutional representatives averaged 6.8 meetings (median=6, range = 7, N = 4). Reasons for absence by village representatives included transport problems (6), attending funerals (2), attending other meetings (2), leaving the HF, and time conflicts with employment. Institutional representatives cited pointless discussions with no progress (2), and other work-related commitments (2) as reasons for their absence.

Meeting absence is also affected by years of participation in the HF. Questionnaire results indicate that HF village representatives have only participated in the HF for an average of 4.8 yrs (median = 3, N = 13), and institutional representatives slightly longer (median = 5.5, N = 4). Based on interviews conducted with former and current HF village representatives, disappointment with the HF, and changes in personal and employment commitments all contribute to reduction in HF participation. Similarly, institutional representatives state that high employee turnover and changing positions affect years of participation. Time taken to refill these positions has meant lack of institutional representation at HF meetings during these periods.

Regarding village attendance at HF meetings, the Chair stated that the Constitution stipulates that if there are three consecutive meetings in which a village is not represented, the Executive Committee should request the KNP Social Ecologist to go to the villages 'and see what's happening.' This occurred in November 2003 with Ndindani, Hlomela, Muyexe and Gawula villages, but so far, there has been no report back from the KNP Social Ecologist. On closer examination of the Constitution (Article 4.3.4.a.), however, it states: 'if a representative does not attend three consecutive meetings, the *Management Committee* of the forum will decide upon the termination of such a membership.' The HF Executive gave no explanation for the transfer of responsibility to investigate village absenteeism from the Management Committee to the KNP Social Ecologist, or for why no village memberships in the HF have been terminated to date, despite high absenteeism.

Meeting and Forum Management. Sub-standard financial accounting, quality of meeting management, and organizational structure have been cited by KNP, Limpopo Province and HF village representatives as hampering HF effectiveness. As early as 1998, both the Province and KNP staff were frustrated at the lack of HF responsibility in producing authentic audited financial annual reports. In 2000, the HF Executive acknowledged this deficiency and received training in 2001, but this was discontinued due to high costs. More recently, however, some HF members attended a KNP-sponsored THETA Leadership Training Course, which included project management and leadership, tourism, communication, and conflict management. It is hoped that capacity building like this will improve HF's ability to manage its financial affairs.

Similarly, much discourse regarding HF capacity revolves around meeting management style and its effects. Efficiency of the HF has been obstructed by:

- meetings being cancelled without notification;
- short notices for meetings;
- meeting venue changes without notice;
- lateness by meeting chair;
- insufficient number of meeting minutes being produced;

- meeting minutes not being accepted/approved because of incompleteness;
- letters mandated by HF to be written and forwarded by HF Executive not undertaken.

HF village and institution representatives alike have declared hindrances of this sort to be debilitating and conducive to promoting meeting absenteeism. Some current and past members go as far as to proclaim that the apparent *raison d'etre* of monthly HF meetings are 'only an excuse to eat meat' during the lunch provided afterwards because 'KNP basically covers all catering'.

Both lack of communication and miscommunication are further constraints on the effectiveness of the HF. Although HF meetings are to be held in both Tsonga and English, in reality the languages are often switched, with little or no translation. Although many members are fluent in both languages, some are not. This aspect of communication became especially problematic when the KNP Social Ecologist was absent, and KNP was being represented only by section rangers, who have limited understanding of Tsonga. This generated much misunderstanding among HF members regarding issues during meetings, exacerbated by reporting of and acting on second-hand information, and lack of clarity when discussing topics. Given that meeting minutes and other written correspondence are sometimes incomplete, and produced in English only (often poor), the flow and quality of information between the KNP, Limpopo Province, and HF is in dire need of improvement.

Other criticism of the HF has focused on how well it adheres to its Constitution with respect to organizational structure. Firstly, by Constitutional definition, the HF Executive Committee should be elected annually by secret ballot. According to most institutional and some village representatives, however, the current Chair and Executive have been in their positions for 'as long as they can remember' and condemn HF election practices. Secondly, of the three bodies that steer and govern the Forum, the Management Committee is to be composed of eight members, including one each from the KNP and Limpopo Province. Currently, the Management Committee consists solely of Executive Committee members and no institutional representatives. Finally, gender inequality has been quoted as a sign of poor representation in HF, with only 2 of 54 (3.7 %) village representatives being female.

Community Representation and Reporting. Linked with meeting absenteeism, representation of communities and reporting by HF members to their villages has been a contentious issue for the HF for many years. From the community questionnaire only 19 respondents (7.9 %) of the sample in the entire study area (12.4 % within HF villages) indicated that they had even heard of the HF, let alone knew of its activities (N = 240). This low frequency significantly limits the ability of this research's attempt to compare HF to non-HF villages, and is reflected in subsequent analyses. Further, all 19 respondents were from villages purported to be villages with HF membership, although only 11 of these respondents believed their village was actually represented on the HF. When asked the question, '*If you know of the Hlanganani Forum, how did you hear about it?*', 13 indicated 'interpersonal', 5 'KNP staff', and one had attended an early HF meeting.

Statistical tests were conducted to identify variables affecting knowledge of the HF by community members (Table 3.5). Responses were analyzed using Pearson's χ^2 tests to discern if two variables were independent of each other. Households within particular villages was found to be very highly significant ($p < 0.001$, df = 37, N = 240) with Bevhula, Govhu, Mashobye, Maviligwe, and Mininginisi Block 2 all having higher observed than expected frequencies. Both being male and from villages represented by the HF were also found to be highly significant in association with knowledge of the HF ($p < 0.01$, df = 1, N = 240). Although not significant ($p < 0.067$, df = 61, N = 240), those who knew of HF also tended to be younger. These data suggest that knowledge of the HF is very poor in the study area and, where it does exist, is influenced largely by village association and gender, and to some extent by age.

Table 3.5
Association between selected variables and knowledge of Hlanganani Forum

Variable	**Pearson $\chi 2$**	**continuity correction**[1]	***N***	**df**	**Asym. sig. (2-tailed)**
village represented on HF	11.733	10.091	240	1	0.001**
village	74.806		240	37	0.000***
age	78.335		240	61	0.067
number in household	14.182		240	15	0.512
years in village	38.706		225	43	0.658
gender [male]	7.447	6.138	240	1	0.006**
de jure TA	5.169		240	6	0.522
de facto TA	17.781		240	19	0.537
education	7.918		240	5	0.161
household income	1.815		240	3	0.612

[1] for 2x2 tables only

*** $p < 0.001$

** $p < 0.01$

HF village members are to be appointed by their respective community and ideally representatives must report back to their villages via monthly meetings. On the one hand, spokespersons for the Mhinga TA are pleased with the representation their villages have on the HF, and acknowledge that the TA was part of that decision-making process. In contrast, however, representatives from Makuleke, Magona, Mtititi, Ndindani, Hlomela, and Gawula TAs all expressed concern about the representation of their villages on the HF, and the individuals claiming to represent these areas, many of whom do not report back to the villages on HF activities. One *Hosi* [chief], with three villages in the HF area, stated that originally, the community chose the Forum representatives with the co-operation of the *Hosi*. However, the representatives currently '*never report the activities of the Forum to the Hosi*', and '*we have no idea what's going on and this shouldn't be so. The communities are under the* Hosi's *control and it's incorrect to not involve or consult the* Hosi *on these matters*.' Although many TAs have discontinued their association with the HF, a number of representatives from these communities still attend HF meetings and exacerbate tensions between TAs and the HF. As maintained by another *Hosi*, "*the HF representatives for villages in my area are illegitimate and only out for their own gain*". In April 2004, even the HF Chair acknowledged publicly at a HF meeting the fact that '*some HF members were not elected by communities, nor give reports to their communities nor* ndhuna [village headman]*'*. Due to allegations of questionable representation and non-reporting, it was agreed that the forum steering committee should inform all the villages individually '*that it is very important that representatives report back and that they be democratically elected by the communities*' (6 July 2004 HF minutes). This issue has been rectified in recent years as a system of nomination forms has been developed whereby a *Hosi* or *ndhuna* stipulates in the form that a member has indeed been nominated by the village to sit on the forum.

Many TA representatives accuse the HF of gross nepotism, especially when it comes to equity and benefit-sharing in employment opportunities and DCA compensation. For example, one *Hosi*'s own daughter was denied an application when she approached the HF about applying for a job, and was told 'to go get a job from your father.' A second case mentioned was the selection of people for employment opportunities only from villages favored by the KNP Social Ecologist. Thirdly, when people were compensated for livestock losses through the HF in 1998, it is alleged that the only people compensated were actually HF members. Finally, some *Hosi* claim that the HF is dominated by KNP objectives only. Given these conflicts, many TAs have polarized themselves from the HF and formed their own institutions to deal with land-use issues, negotiate with provincial administrations regarding DCA compensation, and the KNP for potential CBC partnerships. These include a number of TAs who subsequently decided to pull out of the Forum in mid-2001, and became involved with the Mariyeta Buffer Zone. When they discovered that Mariyeta was much like the HF and not representing the communities, a number of TAs then formed the Gazan Trust (Mtititi, Magona, Madonsi, Bevhula) and the Nghunghunyani Trust (Ndindani, Muyexe, Hlomela).

This disenchantment may also explain why HF members do not report back to their respective villages and thus, why knowledge of the HF and its activities is so poor in many communities. For those community members who know of the HF, 42.1 % stated that HF village representatives report to their respective communities at least once a month (Fig. 3.11), although, not surprisingly, a higher proportion of village representatives claim this frequency. It must be kept in mind, however, that due to poor knowledge of the HF in its member villages (12.4 %, n = 183), this translates into only 5.2 % of community members learning of HF activities on a monthly basis.

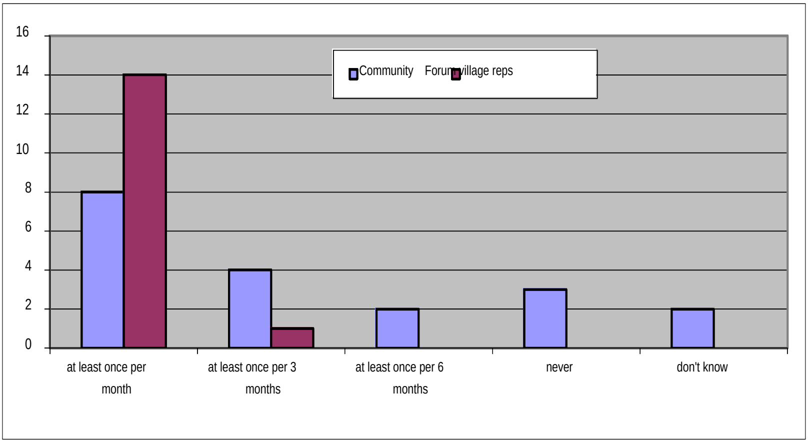

Fig. 3.11. Frequency of reporting of HF village representatives to communities

When asked '*How well does HF represent its communities' interests*?', 63.2 % of community members with knowledge of the HF stated 'much'. Reasons for saying so included:

- because they call regular meetings,
- they respond quickly to our complaints,
- they are discussing compensation with the KNP,
- they are trying to create harmony,
- when there's a problem, they quickly inform us,
- jobs are being created and they inform us when there are job vacancies.

HF village representatives who similarly believe that they represent their communities to this extent cite co-operation between the HF and its communities, education of children, improvement of the environment, reductions in poaching, and the fact that 'community cries of DCA damage are now reaching the government and KNP' as reasons for this high level of representation.

In contrast, 31.6 % of community respondents claimed 'not at all', citing the following reasons for their response: '*it does nothing for us and has never reached our expectations'; 'we are not being compensated'; 'because in July this year over 8 cattle were killed and no help was given'; 'we have no knowledge of recent developments'; and 'they were busy fixing the fence but didn't employ our people*'.

Issues of representation and management capacity, especially financial, have had repercussions on the extent to which the HF can fulfil its goal in securing DCA compensation. According to the HF Chair, the HF had approached the Province before obtaining its Section 21 status in order to request that it be the main mechanism responsible to disburse DCA compensation to affected parties in its area. At that time, the Province informed the HF Executive that it must first obtain Section 21 status (or be registered as a 'Trust'[††††]). After attaining Section 21 status in 2001, the HF, as part of a delegation with Limpopo Province staff and the Deputy Director, Limpopo Province Tourism & Parks Board, met the Limpopo Department of Finance and Economic Development (DFED) Member of Executive Council in Polokwane in October 2003 to issue a statement regarding their Section 21 status and the request for withheld funds. They received a verbal promise that all funds would be given by the end of the fiscal year (31 March 2004). However, to date they've received no word or any monies. In response, DFED and Department of Land Affairs officials cite ambiguity of HF representation, reflected partly by high meeting absenteeism, and questions of financial management competence as principal reasons why funds are being withheld from the HF. A Limpo-

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[††††] According to the Financial Institutions (Protection of Funds) Act № 28 of 2001, which repealed the Financial Institutions (Investment of Funds) Act № 39 of 1984 and associated amendments.

po Province high level manager stated that the province is unlikely to forward money to the HF as it "*has serious concerns about the Forum's legitimacy and representativeness, and there are other institutions vis-à-vis Trusts wanting the same money*".

Local Social Ecologist

In the study area, interaction between the KNP, local communities and the HF is primarily the responsibility of a social ecologist based in Punda Maria. This position can be described as the KNP's 'face' or 'front-line' liaison person, whose responsibility is to attend HF meetings, build trust with local communities, informing them of KNP policies, benefits including employment and training opportunities, and community-related events. Regarding this relationship, a number of transgressions and complaints surfaced in interviews with village members, HF representatives, and both Limpopo Province and KNP staff. These include:

- lateness and/or unexpected absence from HF meetings and a belief by fellow workers that he 'disappears without a valid explanation';
- miscommunication to KNP Conservation Services staff;
- lack of oversight and response to contractors contravening KNP policy by sourcing employment from outside HF member villages for local projects;
- repeated complaints of unreliability and being difficult to contact;
- unilateral decision-making regarding employment opportunities in which the HF was not informed, causing confusion to HF members who were asked to recruit people;
- unfulfilled promises of DCA compensation to village members;
- discrediting the trustworthiness of TA administrations;
- denying job applications to village members based on their TA affiliation; and
- failing to facilitate community elders from Muyexe village wishing to visit ancestral burial sites in KNP.

One can argue that because the social ecologist was also a member of a village within the HF, potential conflicts of interest would inevitably arise, and should have been expected. However, his superiors believe that "*he allowed his position as a community member to override his position as a SANParks employee*." In early 2005, the social ecologist was called before a disciplinary hearing on allegations of embezzlement of funds raised by selling curios made by artisans from rural villages. He was found guilty and subsequently dismissed from his KNP position. According to the Head of People and Conservation (PaC), the ex-social ecologist is "*appealing this decision legally and, therefore, we cannot replace him until a final decision is reached*." This has meant that KNP Corporate PaC staff have had to attend HF meetings during this interim period. Despite the positive role that social ecologists can have in acting as a liaison, incidents and experiences of this nature only serve to further break down trust between the KNP, local communities and the HF, and tarnish the reputation of the KNP in its neighboring villages.

Broken Promises

The HF has existed in a climate of broken promises almost since the day of its inception. Sadly, where promises have been made by KNP to its neighboring villages via the HF, and later been unfulfilled, it has resulted in mistrust and a loss of legitimacy of both the KNP and the HF. Examples summarized below include promises related to support in attending KNP functions, employment processes, opening of the Shangoni Gate, DCA compensation, and thatch grass collection within KNP.

KNP Functions

In a letter dated 15 April 1998, Headman Nkhavi strongly criticized KNP Director, complaining of the way that representatives from 6 villages waited throughout the night for promised transport to Skukuza for the KNP Centenary Celebrations. They feel that they were '*left out on purpose because we are taken as not very important to the KNP'*. In response to an unsatisfactory apology letter sent by the KNP Director (14 April 1998), it reads, '*This shows that you do not care about us and this makes us take you as people who want to benefit from us and return nothing to us*.' (15 April 1998). A second example involves one hundred people who were to attend the 10 year Democracy Celebration in KNP. KNP informed the HF later that the

Limpopo Province promised funding, but later reneged, and therefore only a handful of children actually attended (5 March 2004).

Employment Processes

In minutes of a meeting between KNP Director and HF Executive (22 June 1998), the HF stated that they are dissatisfied with the employment process of the KNP as they were promised advertisements would be distributed to community fora areas but that has stopped. This occurred a second time in which KNP promised to send job advertisement to HF, but didn't (21 Oct 1999). Finally, in a letter from HF to KNP Social Ecology, a complaint was launched about the unfair allocation of employment opportunities regarding the Working for Water program for HF villages. The HF believes that other communities (e. g. Bushbuckridge) are favored over them. The letter states, '*What we see as our cognitive perception as a Forum, is that the HF are utilized as a road for friends' enhancements because people are called to an interview for certain posts, but it is a strategy for corruption as friends are earmarked ... those who are connected to the authority get opportunities for better employment, but not in a transparent, efficient, and equitable way...*' (30 October 2000).

Shangoni Gate

The Shangoni Gate was to serve as an incentive for economic development in the area, which would alleviate high unemployment, high dependency ratio and the low human development index. This gate would make KNP more accessible to neighboring communities who currently need to travel to Punda Maria or Phalaborwa to gain entrance to the Park, and would prove to be a gesture of goodwill to KNP's neighbors and, thus, improve their relationship. The request for the gate was from the communities themselves west of Shangoni (adjacent to Altein village; see Figure 3.9b). The HF had written a formal request on this issue on 30 October 1995. The KNP responded positively in the Park Warden's letter dated 13 December 1995, in which it advocated that the opening would be as early as April 1996. Subsequently, on-site investigations were conducted in May 1996. In the first draft of an initial ecological impact report by KNP Scientific Services (October 1996), three route options were prescribed. It was also recommended that the Northern Province improve existing roads outside KNP, which lead to the Shangoni Gate (October 1996). However, in a KNP letter to HF (dated 1 April 1999), the KNP Director apologized for prior commitments made by KNP to the forum regarding opening of Shangoni Gate. They state that the KNP Management Committee has agreed in principal to the opening of the gate subject to a completed feasibility study, full EIA, and that the project be subject to the development of infrastructure outside the park. Finally, the Park Management stated that the gate might not open 'due to cost' (19 August 1999). To date, the Shangoni Gate remains a private gate for KNP staff, and is not open to the public.

DCA Compensation

A detailed description of the DCA issue has been provided by Anthony et al. (2010), however two cases of broken promises are worth mentioning here. Firstly, before the new electric border fence was erected in 2000, the communities were promised that once it is in place, an insurance policy would be taken out in order that communities would be compensated for livestock/crop loss due to problem animals. It was remarked later that KNP couldn't take an insurance policy out on something it didn't legally own (21 January 2000). Secondly, the HF claimed that it had been promised 6 million ZAR (~600,000 €) from Limpopo Province for livestock compensation after it had registered as a Section 21 company (16 August 2002), and that this was to take place before March 2004. The funds never materialized.

Thatch Grass Collection Program

In July 2004, the Shangoni Section Ranger was asked by his superiors within Conservation Services to commence a thatch grass harvesting program within KNP for neighboring communities. After initiating the program, it ran successfully for two weeks with members of Mtititi, Altein and Muyexe villages. Then, without any reason or explanation, he was ordered to terminate the program. He was given no idea as to the rationale for such a decision, and feels "*it is indicative of how KNP works, i. e. with either no communication or miscommunication*." Understandably, affected communities became disgruntled, as they were also not given any explanation for the termination of the program. It was later discovered that the program was forced to be terminated prematurely by KNP after it received a letter from the Department of Animal Health (DAH) stating that the program was actually in contravention to the Animal Health Act No. 7 of 2002 (Government Gazette No. 1023), i.e. 'no fodder material can be removed from an infected area [KNP buffalo (*Syncerus caffer*) are maintenance hosts of both bovine tuberculosis or 'BTB' (*Mycobacterium bovis*) and the SAT group of foot-and-mouth-disease (FMD) viruses (R. Bengis, pers. comm.)] and transported to an area where livestock exists' (c.f. section 4(a) under 'Detention and disposal of imported animal or thing, and animal or thing conveyed in transit'). In the DAH letter, it was recognized that there was some complaint by communities that the grass collected was for roofing material, but it was also noted that 'there could be no guarantee that it would not also be used for feeding domestic livestock'.

Broken promises and their consequences to relationships have been identified and publicly acknowledged in HF meetings, where it was noted that the 'KNP and Forum's relationship is poor' (21 October 1999), and 'communication between the Northern Province, its rangers, and the communities should improve' (21 January 2000). It must be understood, however, that broken promises are not unique to the HF and its interaction with conservation agencies. Informal interviews with community members revealed that corruption, broken promises, and unfulfilled expectations are widespread, especially between government and people. They have come to expect these types of constraints as commonplace. Despite this culture of broken promises, many questionnaire respondents believe that the HF is improving relationships between the KNP, Limpopo Province and local communities (Fig. 3.12). Justification for these responses include increased environmental awareness in some rural areas, the fact that the HF is '*the only mouthpiece between the three parties'*, and that it provides a forum by which the parties can meet together, share experiences, and begin to co-operate especially on DCA-related issues.

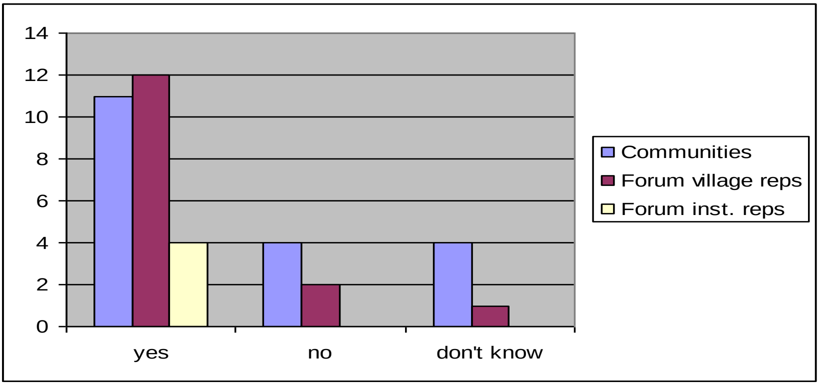

Fig. 3.12. Responses to 'Is the HF improving relationships between KNP, Limpopo Province Environmental Affairs and communities?'

Damage-causing Animals

Problems of DCAs and the lack of compensation for damages inflicted on neighboring communities were raised at the very first HF meeting, and continue to be a source of contention today (Anthony et al., 2010). Implications for the HF specifically are dealt with here.

At the second HF meeting (23 March 1994) it was decided that the following actions should be adhered to regarding DCA and their control:

- Communities, along with the then Gazankulu Nature Conservation (GNC) will assign people in communal areas bordering KNP to deal with problem animals. GNC will train and assist these people and, possibly, KNP on request.
- TAs are to try and make phones available 24 hours a day.
- GNC will man a radio 24 hours a day to take DCA reports.
- GNC will assess situation, and will either handle DCA themselves, or ask KNP personnel for assistance, but with GNC staff member present.
- GNC and KNP will write letters to officially invite each other to work in their respective regions upon request.
- KNP proposed that any meat or monetary compensation generated from the DCA should be channeled back to the communities troubled.

These actions and proposed responsibilities formed the basis by which communities, informed via the HF, believed DCAs would be controlled in their areas. Subsequently, however, organizational and policy changes within the GNC led to corruption and inefficiency in carrying out its duties. A meeting was held between KNP and GNC on 19 July 1994 to discuss DCA control and co-operation between the two institutions. In this meeting, it was noted that KNP had already written a letter inviting GNC staff to assist KNP staff in the park with DCA control, but a reciprocal letter was still expected. The GNC representative stated that due to GNC law enforcement activities they could not attend to every DCA report, and therefore 'the GNC are not popular among some of the local communities'. He also pointed out that current GNC rules don't make provision for compensation; however, they are investigating the possibility of diverting some funds generated by trophy hunting to people that have experienced losses. He further noted that hunting permits previously given out to certain Gazankulu officials have now 'changed hands and are currently being used for illegal hunting'. Finally, he remarked that 'with the current constitutional changes, many people think the old laws are no longer valid and that this is creating problems.' Most of these policy changes were not communicated to communities, who continued to experience DCA damage and build resentment towards the GNC and KNP.

Later, in 1997, the process was changed in that community members should now contact Northern Province Department of Environmental Affairs (replaced the GNC) for assistance. The Province, if necessary, would request the help of KNP in controlling the animal(s). However, inaction and corruption on the part of provincial rangers was again raised at a HF meeting in March 1998, where HF members stated that community members are complaining because the province only attends to DCA incidents when they are buffaloes and not lions[‡‡‡‡]. This was confirmed by *Hosi* Muyexe who stated that the province '*only brought him a hind leg and the rest of the meat was taken by provincial rangers*'. Unhappy with animals escaping from the KNP and perceived inadequacy in controlling DCA once outside the Park, a

‡‡‡‡ Buffalo meat is generally preferred to that of lion. It is also believed that there is a higher success rate in tracking and shooting buffalo, which tend to be more gregarious than lion.

number of communities in this period felt that KNP was ‘reluctant and uncaring’ and ‘not committed to its undertakings.’

Within this backdrop, the HF has had limited experience in being able to compensate DCA victims in its member villages. From May 1997 HF meeting minutes, the Deputy Chair informed the HF that a farmer from Matiyani village was compensated 4500 ZAR (~850 €) from the HF for cattle killed by lions. A second case occurred in 1998 when the HF was able to compensate 24,000 ZAR (~3360 €) from the sale of two lion skins by the KNP to eight farmers from four villages for livestock loss. Concern at this time was raised, however, that this compensation scheme by HF of 1500 ZAR (~210 €)/head of cattle was not market related as cattle were worth at least 2500 ZAR (~350 €). Aside from these two cases, there is no further record to date of communities receiving compensation for DCA damage, contributing to the belief by many community members and a number of TAs that the HF has been incompetent in its ability to fulfill its goals. In its defense, minutes of an HF meeting in June 2001 state that the government had promised to deposit 6 million ZAR (~600,000 €) generated from trophy hunting into the HF’s bank account for compensating affected farmers, but only after it was registered as a Section 21 company (discussed earlier). Raised expectations from the HF and community members alike were dashed, however, as even after attaining Section 21 status, this money has never materialized. This partially contributed to increasing tension between TAs and the HF, and the decision by many to circumvent the HF, form their own Trusts and seek compensation monies directly from the Province. At the July 2004 HF meeting, the representative of Maviligwe village emphasized this tension, and strongly urged the HF to ‘*gain credibility by addressing the problem of compensation for DCAs immediately*.’

Despite being unsuccessful in compensating most of its member villages for DCA damage, the HF does, however, have a role in reporting DCAs to the Limpopo Province and KNP in the rural areas. This fact is well known by HF village representatives and those with knowledge of the HF. Although there are mixed questionnaire responses to how well the HF functions in this regard (Fig. 3.13), it is acknowledged by a majority of community respondents who know of the HF that it indeed does little in getting compensation to affected farmers. Those who did believe HF assists in this respect were primarily those who knew of the compensation received from the HF to farmers in 1998.

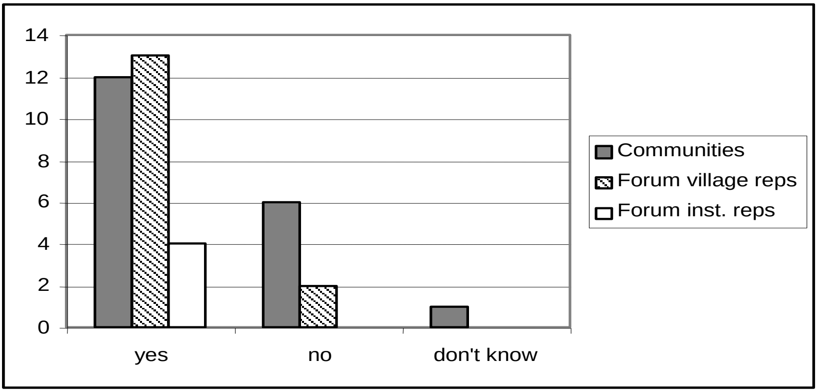

Fig. 3.13. Responses to 'Do you think HF helps in controlling DCAs?'

Juxtaposed with continuing questions of the HF's representation and legitimacy, the ambiguous role of various institutions also continues to cloud the DCA control issue and affect perceptions of the HF outside its control (Anthony et al., 2010). After almost two years of planning, a high level meeting with SANParks, KNP, Department of Veterinary Services, and Limpopo Province was convened in March 2005 regarding the issue. In this meeting, the actual ownership and maintenance of the KNP border fence was debated, as well as strategies of DCA compensation. According to the KNP District Ranger, in this meeting SANParks/KNP offered to assist with DCA control outside the Park but was denied. Instead, the Limpopo Province agreed that, if they feel its necessary, they would request KNP assistance. As institutions continue to debate over their roles and responsibilities, DCA problems persist, as do perceptions of ineffectiveness of the HF in helping community members with DCA compensation. Currently, the HF is meeting with community trusts (Nghunghunyani, Gazan) in order to take a more united front to Limpopo Province to receive DCA compensation funds. It waits to be seen how this co-operation will be received.

3.4.6. Evaluation of Effectiveness of Hlanganani Forum

Effectiveness of the HF regarding representation, reporting, building relationships, and DCA problems have been outlined above. This section will summarize perceptions by community members and HF members alike on how successful the HF has been in its other objectives, namely conservation projects, environmental education, development and employment, and overall functioning.

The HF was successful in securing funds through the government's LandCare program to stabilize streambanks, utilizing gabion baskets, in Matiyani village (Fig. 3.14). This project is a relatively high-profile initiative as the work was done adjacent to the paved road, and clearly visible to all that enter the KNP at the Punda Maria gate. More recently, there has been a proposal by the KNP to provide trees, which will be planted by HF members along the KNP border fence near Altein village to create a small buffer between the Park (and its elephant population) and neighboring maize crops. Aside from these two conservation projects, available HF meeting minutes and interviews conducted in this research indicated no other 'hands-on' conservation projects undertaken by the HF.

However, when asked for reasons behind responses to the question, '*Does the HF do good conservation work?*' in the three separate questionnaires utilized in this study, respondents indicated that in addition to soil erosion reduction projects, reporting DCAs, and KNP border fence maintenance, they believe education to be part of 'conservation work'. Education here was defined as a) discouraging people from cutting trees and poaching within the KNP, b) encouraging nature conservation, and c) educating people on the importance and dangers of wild animals. Negative responses to this question cite poor conservation work on behalf of the HF being evidenced by severe illegal activities and increased threats to biodiversity adjacent to KNP, e. g. illegal hunting, timber removal, erosion, litter, overgrazing, extraction of river sand, and developments undertaken without any EIA.

Fig. 3.14. Streambank stabilization project near Matiyani village

A similar pattern of responses resulted from a related question on the role of the HF in environmental education in its member villages. Responses by HF village representatives were more positive than community members and HF institutional representatives. Responses to open-ended questions on these opinions revealed that HF village representatives claimed that they conduct environmental training and workshops in most member villages, often by cooperating with TAs and inviting KNP staff. In contrast, some community members who know of the HF have never heard about these workshops and doubt they've ever been held in their village. Respondents believing that the HF performs poorly in environmental education again refer to increasing environmental threats in the neighboring areas as support for their opinions.

Questionnaire respondents were also asked their opinion on the effectiveness of the HF with respect to enhancing employment and development in the region. Again, HF village representatives responded more positively compared to the other two groups (Fig. 3.15). They mention the fact that the KNP is creating jobs for people in the area as evidence of this contribution, as well as discounted KNP entrance fees, limited DCA compensation, and quicker responses to DCA reports. In contrast, community members and HF institutional representatives are more divided on this question, with similar reasons to HF village representatives for positive responses. Those who do not share this belief argue reduced employment in some villages and the fact that '*money is not trickling through to village members*' as reasons for weak performance of the HF.

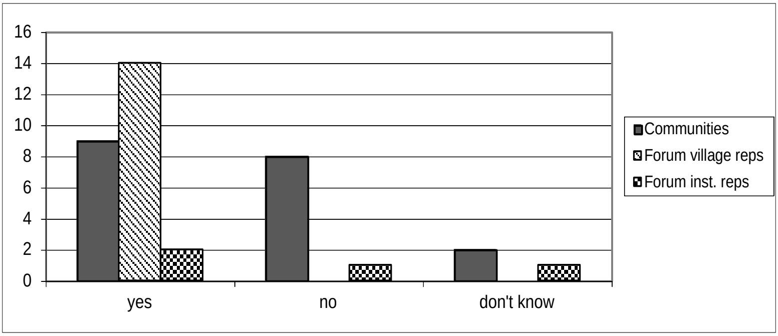

Fig. 3.15. Responses to 'Do you think the living standards of HF villages has improved because of its activities?'

In a related question, respondents were asked their opinion as to whether they were satisfied or not with community development programs delivered by KNP through HF (Fig. 3.16). Those with positive responses stated co-operation in DCA control, employment, reduced KNP entry fees, free environmental education by KNP, and the thatch grass program as rationale for their choice. Those who think otherwise and are dissatisfied with the programs indicated that their experience with nepotism by HF members in employment practices, broken promises by the HF, and because 'currently no one is benefiting from this partnership' all contribute to this belief. One respondent from Bevhula village emphasized lack of communication as particularly problematic, noting "*although the Hlanganani Forum is said to be encouraging KNP to employ our people, unfortunately, there is no information flowing between the Forum and our village*."

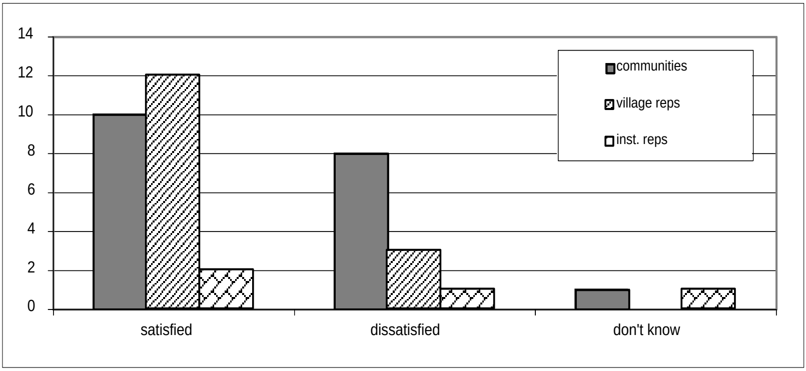

Fig. 3.16. Responses to ‘To what extent are you dis/satisfied with community development programs delivered by KNP through HF?’

Effectiveness of the HF was further investigated by addressing whether respondents believed that the HF functioned well or not. Again, responses by community members who knew of the HF were varied, with a slightly higher number of positive responses. Reasons for their belief included:

- it is democratic in its activities,
- because they usually give a report back of their activities,
- they effectively consult with KNP and the community,
- they are encouraging people to behave responsibly,
- ithout it, we couldn't manage what they are doing.

Community members who, on the other hand, believe that it fails to function well, justify their position with the following reasons:

- they are unsuccessful in their activities,
- we don't even know their representative here,
- we are not informed of its activities enough,
- we never received the promised compensation. This is a failure on their part.

HF village representative respondents were primarily positive in their responses, indicating high community representation, providing feedback and communicating with their villages, being an active voice to the KNP and Limpopo Province, and the delivery of KNP jobs to the communities as primary reasons for their belief. The single negative HF village representative response believed the HF fails to function well '*because it is not working with the chief*'. Finally, HF institutional representatives claim that although the HF is recognized, and has raised some money for DCA compensation, it could improve greatly because '*there are no decisions at meetings and no deadlines for their activities*'.

In order to understand the current impact of the HF in the neighboring areas, an open-ended question was also included in the questionnaires regarding expected consequences if the HF were to cease to exist. Responses that indicated negative consequences to such an incident centered on concepts of relationships between communities and the KNP, DCA problems, and benefit flows from the KNP (Table 3.6). In contrast, some respondents felt that nothing would change or that the activities of community Trusts would expand.

To explore perceptions by community members and HF representatives as to whether the HF should be changed and if so, how, was also addressed in the questionnaires. Responses to the question of whether the HF activities should, in fact, be changed are provided in Fig. 3.17.

For those who responded in the affirmative, an open-ended question allowed them to offer their views on how the HF should be changed. These suggestions, ordered in decreasing frequency, are listed below. The HF should change by:

- better representing communities' interests;
- being replaced by another organization;
- working harder on the DCA problem;
- being more equitable in its benefit-sharing;
- being more transparent;
- providing transport for members to attend meetings;
- keeping their promises;

Table 3.6

Responses to 'If HF stopped tomorrow, what would happen?'

Expected consequence	**Commu-nity** (N = 19)	**Forum village reps** (N = 15)	**Forum inst. reps** (N = 4)
Relationships with KNP would deteriorate	6	2	0
DCA problems would worsen	1	4	1
Employment & development opportunities would decrease	0	4	1
People would destroy nature in and out of KNP	0	4	0
Loss of knowledge of KNP activities	2	0	1
Representation would decrease to service providers	1	0	1
Gazan and Nghunghunyani Trusts would expand activities	0	1	1
It would be replaced by another forum	1	0	0
Nothing, because it bears no fruit	4	0	0
It would be better	0	1	0
Don't know	2	0	0

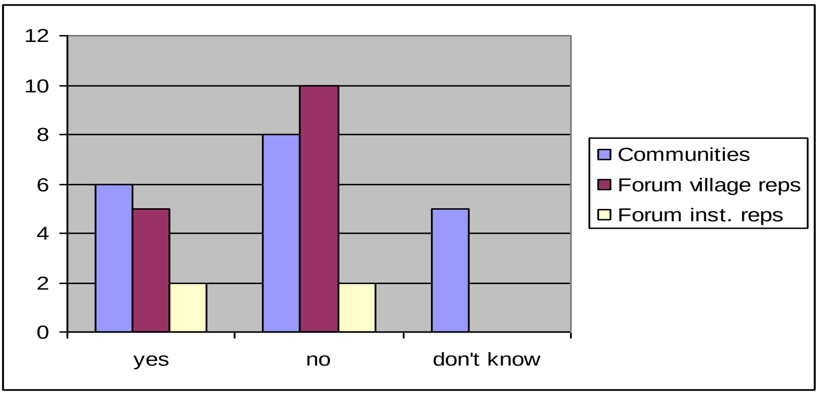

Fig. 3.17. Responses to 'Should HF's activities be changed?'

- involving more people familiar with law;
- having more representatives per village;
- having representatives selected by the community;
- increasing the number of women in its membership.

3.4.7. Discussion

Since its foundation in 1994, HF activities have revolved around DCA control and compensation, relationship building, development and employment opportunities, conservation projects and environmental education. With minimal capacity and experience in working with KNP, HF has forged ahead into relatively uncharted territory in realizing a number of significant achievements in relation to its stated objectives. However, a number of constraints outside their control including shifting government policies and questionable competence of KNP Social Ecology staff have affected HF's ability in meeting some objectives. In addition to these constraints, internal weaknesses including meeting absenteeism and management, representation, reporting, and accountability in benefit-sharing has led to the questioning of the legitimacy of the HF by TA, KNP, and Limpopo Province staff.

The relational links between interacting stakeholders is conceptualized in Fig. 3.18. Understanding the circumstances under which these stakeholders are operating is crucial in making any evaluations in intervention success. After dramatic policy changes and the belief that KNP could not exist in isolation from its neighbors in 1994, the KNP sought to develop links with its neighboring communities and initiated a number of community fora, including the HF. It has cultivated its relationship with the HF over the last decade through monthly meetings and co-operating with the HF in establishing a number of benefit-sharing arrangements in terms of reduced entry fees, employment, and training. In addition, the HF has played a critical role in DCA reporting to KNP and Limpopo Province.

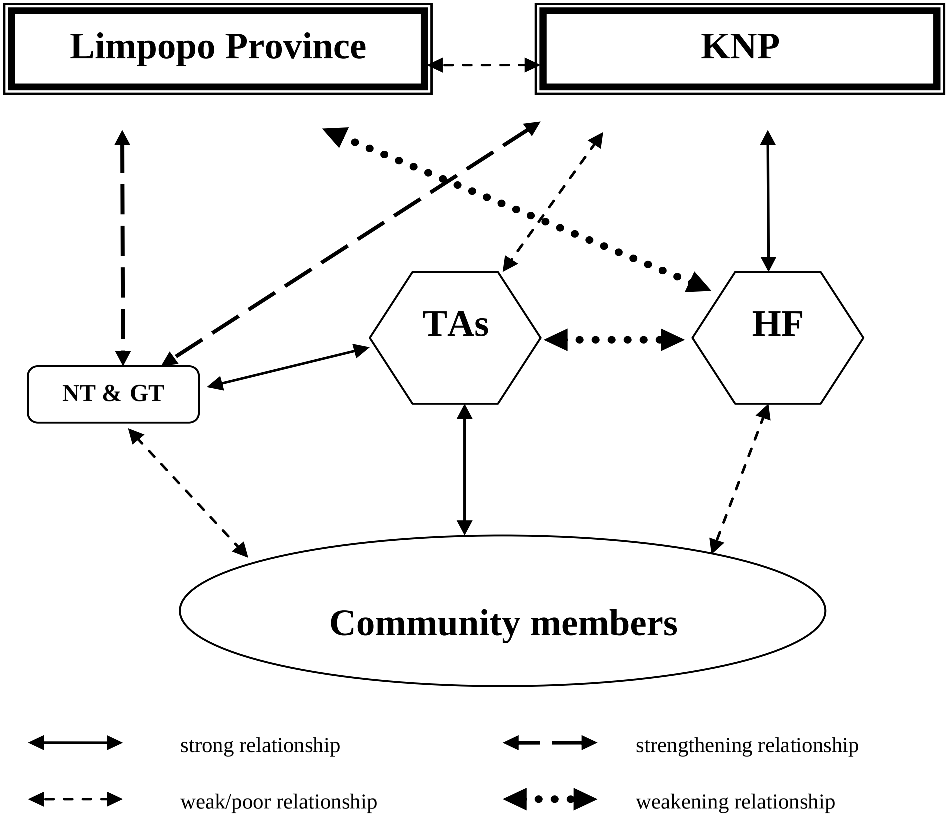

Fig. 3.18. Diagram showing temporal changes in relational links between stakeholders

However, due to perceived inaction of the HF with respect to DCA control, lack of promised compensation for DCA damage, nepotism, and poor representation and reporting, resentment toward the HF developed amongst a number of TAs. These TAs, which traditionally have had strong ties with community members in the rural areas, subsequently formed their own community trusts, namely the Ngunghunyani Trust (NT) and the Gazan Trust (GT). Complex and dynamic struggles between TAs and local government have also influenced the way in which TAs interact with 'democratic' organizations such as the HF. Concurrently, increased dissatisfaction by Limpopo Province staff with the practices of the HF coupled with new relationships being established with Trusts led to confusion as to the validity of claims of village representation within the rural areas. This confusion has contributed to the apprehension of the Limpopo Province in distributing DCA compensation monies, which were originally promised to the HF in 2003.

Although not wanting to sever its long-standing investment in its relationship with the HF, yet recognizing shifting power struggles between the HF and community Trusts, the KNP began to work more with TAs and recognize these registered Trusts both of which are planning CBC activities in conjunction with the private sector that could affect the KNP both directly and indirectly. However, lack of capacity within the PaC affects these relationships. Meaningfully addressing these shortcomings in a timely and sensitive manner with all actors is a must for KNP.

Complicating these relational dynamics has been the relatively weak relationship between the KNP and the Limpopo Province, especially regarding DCAs and their control (Anthony, 2007; Anthony et al., 2010). Despite both being conservation agencies with similar goals in environmental protection, this lack of co-operation has contributed to an increasing belief amongst rural villagers that these institutions do not care about their needs, nor are willing to accept responsibility for damage caused by wild animals that originate both within and outside the KNP, continuing to fuel a historic point of conflict (Cock & Fig, 2000; Freitag-Ronaldson & Foxcroft, 2003).

Evaluation of the effectiveness of the HF and the interaction described in this research between the HF, TAs, provincial government, KNP, and community members thoroughly dismisses the mythical concept of cohesive, homogeneous communities that function according to shared norms. Village of residence, e.g., significantly influences knowledge of the HF. KNP's neighboring communities *are* socially stratified, and do not necessarily constitute a community of interests in which all members willingly want to participate in the development of their community through the HF. The simplistic model of community and its representation has been challenged by Agrawal and Gibson (1999: 629) who argue that the focus should rather be on the 'multiple interests and actors within communities, on how these actors influence decision-making, and on the internal and external institutions that shape the decision-making process'.

Tsonga Proverb: *Mhunti va yi bela endhawini. / The duiker must be hit where it lies.*
Meaning: Deal with a problem at its beginning, and not when it is too late.

Far from a simple exercise, PA outreach to neighbors via community fora is a very complex and dynamic undertaking. In 1994, this was exacerbated by the dramatic socio-political changes in South Africa and expectations were high regarding future outcomes of proposed initiatives, including that of the HF. Grandiose objectives were drafted, evidently without much of a framework or planning, and activities began. However, shifting policies, new legislation and power struggles in the rural communal areas brought challenges to the HF that were unexpected, resulting in a loss of legitimacy. Of course, it is impossible to predict all that might occur, but programs of this nature should be conceptualized clearly and in great detail by the full range of stakeholders to anticipate and plan for potential impacts of any new developments before they are implemented. Naturally, this approach is time-consuming and must be based on adaptive management, but is necessary in dealing with such complex relationships.

3.4.8. Conclusions & Recommendations

The process of creating and defining community-based organizations and developing competent institutions, that both represent diverse local interests and are sensitive to community dynamics and power relations, is often arduous and time-consuming (Shackleton & Campbell, 2001). Any attempt to speed up this process can derail the initiative by ignoring important social processes and recognizing the time needed to develop a common language, and an appreciation that people do not all learn easily. Donors and government agencies need to recognize that such processes do not happen overnight and require long-term commitment and on-going support. After a decade of investment by both KNP and the HF, it would be wise not to 'throw out the baby with the bathwater', but rather, to investigate ways of improving existing structures that build relationships between the KNP and its neighbors. In this framework, we outline recommendations below regarding the HF which center on membership, accountability, capacity-building, and adaptive management.

Membership

All too frequently, externally derived techniques are applied indiscriminately in poor communities, usually with negative results. Inappropriate public participation methods and practices can be extremely harmful, often either intimidating or alienating the very communities they are attempting to involve. In their evaluation of statutory Local Boards which were instituted in KwaZulu-Natal, South Africa, to involve communities in protected area management, Luckett et al. (2003) stressed the importance of continuously involving TAs in decision-making processes, especially where these institutions are strong. In the case of the HF, although a bottom-up approach was originally taken in inviting communities and garnering support for community fora through TAs, a 'hands-off' approach to conflicts and power struggles with TAs was subsequently taken by KNP. Although one can argue that KNP was not mandated or equipped to mediate these conflicts, the direct consequences have meant that the HF, initiated and supported by the KNP, has suffered in terms of legitimacy and *de facto* membership. In some respects, by relying too heavily on the HF, the KNP has ignored local norms of behavior with respect to traditional leadership, and as a result now faces additional challenges in terms of initiating dialogue with new structures vis-à-vis community trusts.

The potential representation area of the HF covers approximately 1320 km^2, encompassing 38 villages. There are no less than seven *de jure* TAs in this area, but upwards of 20 *de facto* TAs recognized. These highly stratified and differentiated communities with multiple interests pose a particular challenge in that such situations create varying incentives and disincentives for participating in CBC or other forms of park–people interaction. Here, the role played by external facilitators is critical. All local actors, regardless of socio-economic background, need to be brought into *and continuously involved* in the process through equitable and collaborative negotiations ensuring broadly representative involvement of the local populace, including women. Similar to the more diverse Local Boards in Kwa-Zulu-Natal (Luckett et al., 2003), the KNP should investigate whether current HF members are truly representing communities and if including other local actors (e. g. local councilors, business, mining enterprises, farmer groups) might accommodate a wider degree of interests. This would involve re-thinking the KNP's original decision to include only black, previously disadvantaged communities in its community fora, excluding all other stakeholders. The hands-off approach by KNP in identifying and tracking HF membership, and relative unresponsiveness to local conditions may have contributed to the current confusion being experienced by the parties involved. In light of these developments and the current state of uncertainty over HF membership:

- In consultation with community members, TAs and staff from KNP and Limpopo Province, *village membership and representatives of HF should be identified, agreed upon, and documented by all parties.*
- If necessary, the HF should *broaden its membership base to include a wider spectrum of people and/or activities.*
- As TAs have traditionally had strong ties with their rural constituencies, and can mobilize communities for the conservation and sustainable use of natural resources (Campbell and Shackleton 2001), it is vital that *closer links be devel-*

oped between TAs, KNP and Limpopo Province. However, due to questionable legitimacy of some TAs, it is important that community members collectively decide on whom they want represented.

- Current differences in *objectives and conflicts of interest between HF, and Gazan and Nghunghunyani Trusts should be clarified and resolved* through discussion, mediation, and unbiased support by external institutions.

Furthermore, local level cooperation is believed to increase with women's participation (Molinas, 1998). Moreover, Westermann et al. (2005) found in their analysis of rural programs from America, Asia, and Africa that collaboration, solidarity, and conflict resolution all increase in groups where women are present, as do norms of reciprocity and the capacity for self-sustaining collective action. In our study, gender inequality has been cited as a sign of poor representation in HF, with only two female village representatives. Knowledge of the HF was also shown to be significantly influenced by gender, with women less likely to know of the HF and its activities. Considering these findings and gender differences in accessing and using resources, *women representation should be enhanced on the HF*.

Accountability

Tsonga Proverb: *U nga vuri, u ku 'N'wananga, ndzi ta ku lavela nyama!' / Don't say, 'Child, I'll get meat!'*
Meaning: Do not promise that which you do not have.

It is believed that if participants are not accountable, not only will communication falter, but they will often reach conclusions or make decisions which are not financially or physically feasible, thus rendering the process futile (Allen, 1998). Accusations of poor representation and reporting, inequity in employment and other benefit distribution by HF members, and lack of adherence to its Constitution are serious accountability matters that the HF must tackle in order to regain legitimacy and support from both community members and other institutions with which it interacts.

Knowledge of the HF is poor in the study area, including within villages it claims to represent. Further, of the residents interviewed who claimed to know of the HF, about half held a neutral or negative opinion on the effectiveness of the HF. This suggests that (i) the HF has not effectively conveyed its aims to its member villages, (ii) failed in meeting these objectives, and/or (iii) its recipients see its purpose and objectives as having little relevance. Recommendations regarding accountability include:

- *Build stronger accountability structures/mechanisms into HF*, which incorporate local forms and understanding of accountability, especially in benefit-sharing arrangements, which should have stricter and more democratic guidelines. These mechanisms can also include TAs as structures through which HF representatives can communicate to their respective communities.
- *Provide more clearly constructed policies or procedures* for appointments, reporting, and project management.
- *Follow through on Constitutional policies* for meeting absenteeism.

Capacity-building

'Capacity' is often described as a chicken and egg problem (Ribot, 2002). There is often reluctance on the part of governments to devolve powers before capacity has been demonstrated, but without powers there is no basis on which local institutions can gain the experience needed to build capacity. Hence, without the necessary capacity to improve its ability to manage funds to the satisfaction of the Limpopo Province, the HF will not receive monies to compensate victims of DCA damage, undermining a central goal of its existence. Here the KNP has an important role to play. If it is serious about empowering communities through community fora, then it must actively recognize constraints in capacity, including managerial and communication, and seek ways and/or support to remove them either directly or involving partnerships with other agencies. However, KNP must allocate more resources to its People and Conservation Department to achieve this objective. Without it, the HF is largely left to fend for itself and, like experiences elsewhere, will likely result in project failure and unmet conservation objectives (Pimbert, 2003).

Historically there has been a tendency for outside law to prescribe the structure of local organizations and the rules by which they operate. This is perverse, since one assumption of CBC management is that it is best to build upon local institutions that is rooted in local values and practices. If law tries to mold these institutions into forms too complex and alien to a local situation, and then standardizes that form across many different social settings, the result could be to create institutions that have little legitimacy among their members (Lindsay, 1998). On the other hand, it has been realized in other contexts that social stratification can affect participation in project meetings in that some people can influence opinions based on *inter alia* their relationship with tribal chiefs (Meister, 1972; Wasserman, 2001). Indeed, Meister (1972) argues that consensus often reached at rural meetings is not based on mutual agreement, but rather on the balance of social forces. Although everyone is encouraged to air their own opinions at HF meetings, not all do. Thus, it is worthwhile in this research context, to *explore and, if necessary, integrate more local types and forms of accountability into HF practices*, including the communication of opinions and ideas. Moreover, *provision and/or facilitation of on-going training for HF membership should be made*, especially those in financial management positions.

Khan (1998) found that a vital factor in success for community health projects in South Africa was that meeting times and language were suited to local conditions. Moreover, Soeftestad (2004) has emphasized the need to assess the impact that English is having on biodiversity conservation discourse, especially given the cross-cultural variability in perceiving, classifying, and naming the environment and its relationships. Language constraints identified in this research call for the need for *HF meetings to be conducted in a manner, which enables those present to express themselves in their mother tongue*. For those village or institutional members who are not fluent in both languages, language training and/or translation should be investigated. HF meeting minutes should similarly be produced in both languages.

Since 1997 the neighbor relations strategy in KwaZulu-Natal involves both the Local Boards and a Community Levy Fund, which is generated from levies charged to visitors to protected areas (Luckett et al., 2003). In addition to funding community development projects, these funds have been used to provide compensation for the expenses of Board members in attending meetings. Thus far, no such service exists for HF members and has been identified in this research as a constraint to meeting attendance. Therefore:

- avenues should be sought *to provide funding specifically for transport to HF meetings* for village representatives.
- training HF members already involved in customary approaches in *improved personal communication and negotiation skills.*
- training HF members already involved in customary approaches to *more effectively facilitate/mediate conflicts, both at micro-micro and micro-macro levels.*
- *develop partnerships with other development agencies and government departments* (agriculture, education, etc.) in building individual and institutional capacity within HF.

Adaptive Management

Tsonga Proverb: *La vutisaka ndlela, a nga lahleki. / The one who asks his way will not get lost.*

It has been argued by a number of respondents that the HF has 'lost sight of its original objectives' and 'side-stepped primary issues.' Given its history, and the fact that no systematic evaluation of its effectiveness has been made until this research (nor of any other KNP fora), the time is ripe to re-evaluate the mission of the HF, and realign its activities accordingly. Recommendations of this nature include:

- in intensive consultation with community members, the HF should *revise its mission, if necessary, and associated objectives***.** This should subsequently be conducted at regular intervals.
- in consultation with KNP staff, the HF should *identify its central issues and place problems and information in their wider context.*
- many projects have failed to develop adequate monitoring and evaluation systems for measuring both the biological or developmental impacts of implementation. Although re-

search and monitoring is identified as a pillar upon which social ecology functions, this has been the most neglected component within KNP activities (cf Swemmer and Taljaard, 2011). Thus, it is important to *institutionalize rigorous monitoring and evaluation systems into the activities of the HF*, using appropriate indicators and to respond in a flexible manner to these systems. A procedure whereby data collected can be independently verified would help institute greater transparency.

In summary, the case of the HF should give serious cause for KNP policy makers, and other PAs interested in reaching out to neighbors and shaping CBC schemes, to rethink their strategies. Approaches must be carefully designed to accommodate both internal and external characteristics of communities that it seeks to interact with, and how these evolve and are redefined over time. It is essential for governments, both within South Africa and elsewhere, to recognize these attributes and identify appropriate strategies such as local level mediation services, adherence to locally made rules and their enforcement, engaging in collaborative research with local communities, and adopting adaptive management approaches, characterized by regular monitoring. To do otherwise would continue to position the cart before the horse.

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Conclusions

The complexity of environmental challenges is growing. Many solutions, which were in use for decades, appear to be simplistic panaceas that do not work anymore. In order to address the emerging challenges, they need to be replaced with new ones, which would support the context-sensitive governance of the new environmental reality. Higher education plays a pivotal role in the transformation of management and policy paradigms. Environmental graduates entering the world of profession shall be expected to act under high uncertainty or even no sufficient knowledge available, to be capable to keep their options open, to be inclusive as regards sources of knowledge and stakeholder recognition, and to be aware of multiple management options and approaches. This was also the guiding assumption for the development of this textbook that offers an introduction to environmental policies and their European context, an overview of the methods and principles of environmental policies relevant for management actions, and examples from different sectors and environmental contexts.

Scientific publication

PRINCIPLES OF ENVIRONMENTAL POLICY: LOCAL, EUROPEAN AND GLOBAL PERSPECTIVES

Multi-authored monograph

ISBN 978-5-91116-761-5

Layout Anatoly Istomin, Olga Likhacheva
Proofreader S. N. Emel'yanova
Cover picture Bazyl Kamarou, 2013

Signed to print 25.12.2018. Size 60×90/16
Times New Roman, Cambria. 21,375 printers sheets
Printing run 200. Order № 5637.

Printed on Versant 2100.

Printing Publishing house of Pskov State University
L. Tolstogo st., house 4A, building 3, 180000 Pskov, Russia