Sustainable Landscapes in Central Romania

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SUSTAINABLE LANDSCAPES IN CENTRAL ROMANIA

A SOCIAL-ECOLOGICAL STUDY ON THE FUTURE OF SOUTHERN TRANSYLVANIA

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by

Jacqueline Loos, David J. Abson, Ine Dorresteijn,
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FOREWORD

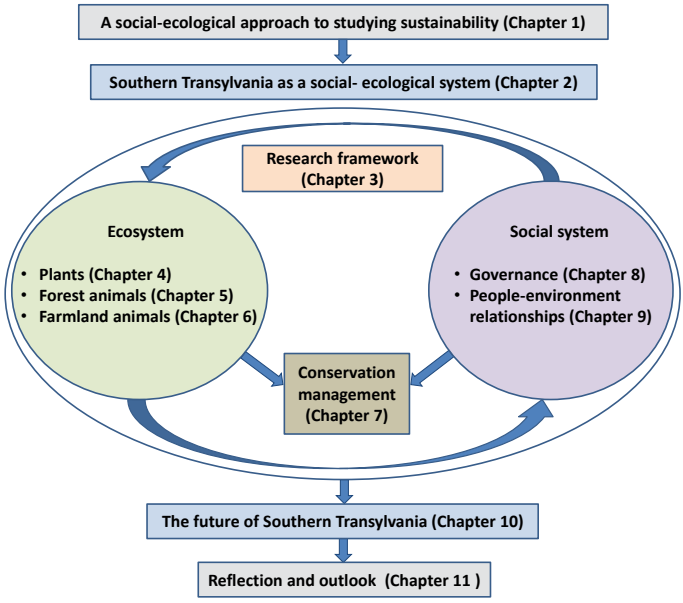
To have a meaningful impact, research findings need to be accessible to a broad audience – not only to researchers, but also to politicians, policy makers, civil society organisations and interested citizens. This is what motivated us to summarise our findings from five years of research in Southern Transylvania.

We hope to reach a wide audience with this book. Other researchers working on similar problems in other parts of the world may find our work useful, because it provides a one-stop-shop summarising the various research insights we gained over the last few years. As such, we hope this book might help inspire or inform similar types of research projects that combine ecological and social research in other parts of the world.

But more importantly, this book is addressed at people with a direct stake in the future of Southern Transylvania: at local and regional politicians, policy makers, non-government organisations, school teachers, and other engaged local people. Readers from these groups will differ in their formal training, and many will not be used to reading research reports. For this reason, this book is not a standard research report. To the best of our ability, we have taken care to avoid technical language, and have tried to share our findings in a way that is no more complicated than it needs to be. The technical terms we could not avoid are explained in a glossary at the end of the book. However, we also appreciate that some readers will be looking for more depth, or additional information related to our work. For this group of people, we have provided references to the original research papers on which this book is based at the end of every chapter, as well as a list of suggested further readings at the end of the book.

Our research addressed the interplay of social and ecological changes taking place in Southern Transylvania today. To that end, we explored local ecosystems in depth, and we spoke with many local people about the changes that are currently taking place. The goal of our research was to understand how the relationship between people and nature is changing, and what this, in turn, means for the future of the region.

Throughout the chapters of this book, we share our most important findings (see schematic overview of chapters below). Chapters 1-3 serve as an introductory section. Chapter 1 provides general background on regional-scale “social-ecological research”, explaining why such research is being done, and what its key features are. Chapter 2 provides background on the study region itself, Southern Transylvania. In Chapter 3, we more specifically explain how we applied the concept of social-ecological research to the region of Transylvania. Here, we outline some of the most important methods we used in our research.



Schematic overview of the chapters of this book.

Chapters 4-7 focus on the ecosystems of Southern Transylvania. Chapter 4 synthesises our analyses of plant diversity – in particular in grasslands, but also in the mosaic of arable fields, and in wood pastures. Animals are the focus of Chapters 5 and 6. Chapter 5 focuses on forest animals (including the Brown Bear), while Chapter 6 investigates farmland animals (and especially birds). Key challenges for the conservation of ecosystems in Southern Transylvania are discussed in Chapter 7.

From Chapter 8 onwards, we consider some of the most important social challenges, including their relationship with natural ecosystems. Chapter 8 addresses the topic of governance – that is, the processes and interactions of decision-making on a particular issue, which involve governmental bodies as well as other interest groups. In Chapter 9, we focus more specifically on local communities, exploring how people relate to the environment, and depend or benefit from it in different ways.

Chapter 10 presents four contrasting plausible futures for Southern Transylvania. These so-called "scenarios" were developed together with local stakeholders. They highlight that decisions made by local people right now could have a big effect on the well-being of local people in the future, as well as on the state of natural ecosystems. Finally, Chapter 11 is a personal reflection on our research, as well as an outlook for the region.

Whichever group of reader you feel you belong to: we hope you get something out of this book – be it motivation, new information, or perhaps a new way of thinking about problems you have long known about.

The authors, January 2016

ABOUT THE AUTHORS

Joern Fischer is a Professor at Leuphana University Lueneburg's Faculty of Sustainability and the head of the project "Peisaje sustenabile" (Romanian for "Sustainable Landscapes"). His primary interests are biodiversity conservation and interdisciplinary sustainability science. He was responsible for the design and management of this research project, as well as for the supervision of other members of the research team.

Tibor Hartel is an Associate Professor at Sapientia Hungarian University of Transylvania, Romania. He works in the traditional rural landscapes of Southern Transylvania and is interested in amphibian ecology and conservation, wood pastures and social-ecological systems. As an Alexander von Humboldt postdoctoral fellow, he spent two years in the project team, studying wood pastures in Transylvania.

Jan Hanspach is a postdoctoral researcher in Joern Fischer's group. He has an ecological background and is interested in biodiversity conservation in farming landscapes. Jan was responsible for study design, statistics, mapping and scenario work.

Jacqueline Loos was a PhD student in the project "Peisaje sustenabile". She is an environmental scientist interested in landscape ecology, and especially in interactions between biodiversity and land use change. Jacqueline focused on the future of plants and butterflies in Transylvania, and is engaged in establishing a national butterfly monitoring scheme in Romania.

Andra Ioana Horcea-Milcu was a PhD student in the project. She worked on social science aspects, investigating the values locals attribute to nature and their relation to the landscape. She explored the diverse range of landscape preferences and values held by village residents. She also studied how and why different groups of local people benefit from local ecosystems in different ways.

Ine Dorresteijn was a PhD student in the project. She is interested in animal diversity and interactions, especially in the context of human-wildlife interactions. For this project, Ine was responsible for studies on bird and mammal distribution and diversity, human-predator interactions, and the effects of top predators in the ecosystem.

Friederike Mikulcak was a PhD student in the project. She has a background in European law and human geography and is especially interested in the role of institutions governing natural resource use. Friederike investigated the impact of EU agricultural policy on smallholder farming and biodiversity conservation in Central Romania, and the barriers to rural development.

Dave Abson is an interdisciplinary scientist with a background in geography, ecological economics and landscape ecology. His primary research interests are the integration of social and natural science perspectives on sustainability issues within the context of multifunctional agro-ecosystems. He works on social-ecological systems thinking and ecosystem services.

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CHAPTER 1: A SOCIAL-ECOLOGICAL APPROACH TO STUDYING SUSTAINABILIT Y

Our world is changing faster than ever before. Since the Industrial Revolution, there has been a tremendous acceleration in a vast range of social, economic, and environmental phenomena. For example, since 1900, the human population has grown from under 2 billion to more than 7 billion people, and is expected to reach well over 9 billion by the middle of this century. In the same period, global economic activity has multiplied several times, as has the amount of fossil fuels burned. Natural ecosystems have taken a heavy toll. Many plants and animals that evolved over thousands of years are now being lost forever – at a rate that is many times faster than what Earth experienced before people started to be a dominant force. This rapid loss of species is driven by human activities, and above all, by the increasingly widespread and intensive use of land for agriculture and livestock grazing. This period of human domination of the Earth is now so extensive that it is regarded by some scientists as a new geological epoch – the Anthropocene (from the greek word "anthropos", meaning human).

The current period poses formidable challenges to all of us. How can humanity thrive without undermining the natural environment – on which we ultimately depend for our survival? How can we make sure that people living in the future will still be able to benefit from the environment in the same way as we can today? These questions are central to sustainability science, an emerging arena of scientific enquiry devoted to understanding how human well-being can be ensured, equitably, and over long periods of time. Sustainability can be understood in many different ways. The way we approached sustainability in our project was to see it as a nested hierarchy: Without a healthy environment that provides food, fresh air and a stable climate, we cannot have healthy societies. Similarly, a healthy economy depends on the functioning of the society it is situated within (Fig. 1.1).

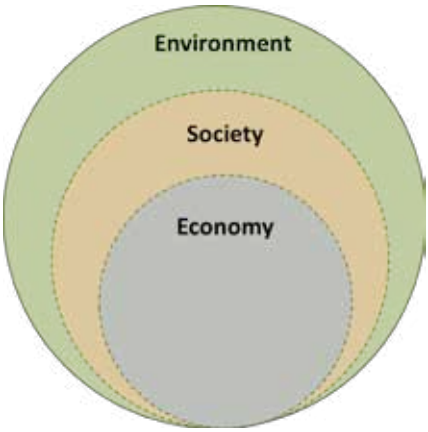

Figure 1.1. Illustration of the interdependencies between economy, society and the environment. Without an intact environment, there would be no society, and without a society, there would be no economy.

An interest in sustainability requires a different kind of science from what has traditionally been taught at schools and universities. For hundreds of years, Western education systems divided knowledge into different categories, separating the natural sciences, social

sciences and humanities; and further sub-dividing each of these into a number of specific disciplines such as biology, physics, economics, and history. Dealing with sustainability demands that these different ways of understanding the world are re-integrated. The research we report on here therefore cannot be neatly placed within any single traditional discipline – it is interdisciplinary, meaning that we actively sought to transcend traditional disciplinary boundaries. Some parts of our work (especially Chapter 10) went even further, and actively involved local people in the research process, and thus in the generation of knowledge – an approach known as transdisciplinary research.

Throughout our work, we recognised that socio-economic and environmental phenomena are intricately linked. A useful way of thinking about such interlinkages is to consider a particular landscape as a social-ecological system – that is, a set of interlinked social and ecological components that interact to shape the landscape. For such a research approach it is necessary to identify a specific study region. In our case, we focused on Southern Transylvania for our research. Traditionally, the social-ecological system of Southern Transylvania was characterised by direct relationships between people and ecosystems. People modified the land for their purposes, and in turn, reaped a series of benefits (or ecosystem services) from the environment (Fig. 1.2). These traditional links, however, are becoming increasingly loose. Many people no longer directly depend on the environment, but instead make a living in other ways (e.g. working in town, or in a factory), and use goods that are imported to Transylvania from elsewhere (e.g. non-local foods, cars, or furniture). Even farmers have a different relationship to the environment than in the past, because they depend not only on what they produce, but often also on subsidies, such as those available under the EU Common Agricultural Policy (CAP). In short, the people of Transylvania are becoming increasingly disconnected from the natural environment – a process that is also taking place in many other parts of the world.

Given the changing relationship between people and their environment in Southern Transylvania, we were interested in understanding what these changes mean for sustainability – both in terms of the natural environment, as well as in terms of the region's social structures. To that end, our research examined some very practical issues, such as particular management approaches and their effects on the natural environment, or to what extent bears pose problems for local shepherds. But equally, we were also interested in examining some of the

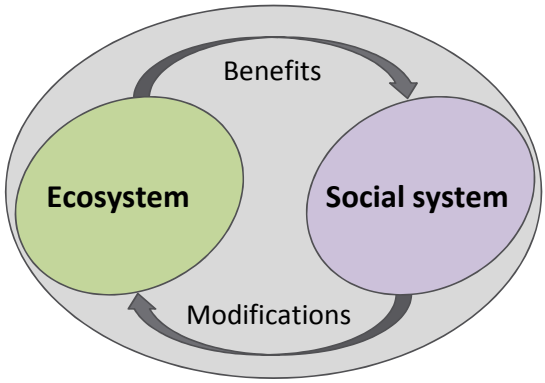

Figure 1.2. Landscapes can be thought of as social-ecological systems. Human activities and social structures are shaped and limited by the natural environment, which in turn is modified by human activities.

underlying challenges of sustainable development, which are less widely recognised. For example, what are the aspirations of local people regarding the natural environment? Are people longing for modernisation, or would they prefer to maintain local customs and traditions? How have the social and political changes of the last 30 years affected what people hope for in the future?

Our study plays out against a dynamic background of ideas, often proposed by scientists, and implemented to varying extents by policy makers and landscape managers in different parts of the world. One interesting discussion currently taking place among scientists at the international level is how we should best meet the increasing demand for agricultural products of a growing (and increasingly wealthy) global population of people. Some scientists argue that agricultural intensification (i.e. producing more food on the same amount of land) is needed to meet this rising demand. Proponents of agricultural intensification highlight that such intensification needs to be carefully managed with respect to its environmental impacts, and often argue for new protected areas to ensure there are some locations where nature is not being impacted by people. Other scientists are vehemently against the intensification of agriculture. They argue that low-intensity farming methods (such as those in Transylvania) have maintained a unique set of valuable biodiversity, and hence, that ways should be found to encourage the continuation of traditional practices.

Looking at Southern Transylvania, is there a "right" answer to this dilemma? What would be the consequences of agricultural intensification for birds, plants, or butterflies? What kinds of sustainable development options are there, and do they differ between villages? Put differently, what kinds of barriers might stand in the way of sustainable development? These are just some of the questions that we addressed in our research, and to which we summarise our findings in Chapters 4-10. But before we get to those findings, some more background information is useful. For this reason, Chapter 2 provides a short overview of the social and natural history of Southern Transylvania, and Chapter 3 introduces some of the most important methods used in our research.

Key messages

- Sustainability science seeks to find solutions to how human societies can thrive without destroying the natural environment.
- Our study drew on multiple disciplines (interdisciplinarity) and actors from outside the research sector (transdisciplinarity).
- The region of Southern Transylvania can be understood as a social-ecological system – that is, a set of interlinked social and ecological components.
- Southern Transylvania is facing rapid changes, with unknown effects both on humans and the environment.

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CHAPTER 2: SOUTHERN TRANSYLVANIA AS A SOCIAL-ECOLOGICAL SYSTEM

Much of the European countryside has been shaped by centuries of human land use. Such cultural landscapes have evolved through ongoing and dynamic interactions between rural people and local ecosystems. As described in the previous chapter, many rural landscapes were traditionally tightly coupled social–ecological systems, with strong interdependencies between people and ecosystems: Humans received goods and services from the landscape and, in turn, shaped the biophysical nature of the landscape. As a result, many ecosystem components and specific landscape elements, including wood pastures and protected species, depend on specific types of human interventions. Today, cultural landscapes play an important role for the conservation of traditions as well as for biodiversity. However, around the world, traditional cultural landscapes are vanishing as a result of a myriad of socio-economic and ecological changes.

Figure 2.1. The landscape in Southern Transylvania consists of many different small parcels of land use, which in their entirety create a mosaic of forests, fields and grasslands.

Southern Transylvania is one of the most notable cultural landscapes in Europe (Fig. 2.1). This area has, over centuries, been shaped in part by a particular ethnic group – Transylvanian Saxons. Saxons first settled in this area during the middle ages, and for several centuries were the most populous ethnic group inhabiting Southern Transylvania. Traditionally, Saxons had strict community rules, which ensured that the benefits derived from the landscape were shared among community members. Land use followed seasonal cycles, and major landscape elements such as pastures and woodlands were communally used.

The resulting mosaic of fields, grasslands and forest created a unique pattern of land uses, which was carefully adapted to the topographical conditions of the landscape (Fig. 2.1). Typically, houses were located near the flat valley bottoms, while arable fields were scattered around the village, and along the valley. Pastures and hay meadows were located on the slopes, and forests dominated the hilltops (Fig. 2.2).

Figure 2.2. Cross-section of a traditional village and its surroundings: the village is located in the valley, surrounded by arable fields. The slopes are used as pastures and hay meadows, and the hilltops are covered by forests and wood pastures. (Image: © Jan Hanspach)

After centuries of slow and gradual change, during the 20th century, Transylvania experienced a series of drastic social, cultural and economic changes. In 1920, Transylvania was separated from Hungary and assigned to the Kingdom of Romania, which after the Second World War became a communist country. Subsequently, agricultural land use became subject to rigorous state control through a process of agrarian reform (1945) and subsequent collectivisation of private and communal farmland into state farms (1949–1962). Especially in the flat and fertile parts of the landscape, agricultural land use was intensified, mainly through the increased use of fertilisers and pesticides. Only less accessible land remained largely unaffected by these measures. Also, the number of Saxons living in Transylvania declined progressively, and many Saxons emigrated to Germany. These perturbations not only altered land use and management practices, but also affected the cultural identities and the tight linkages of locals with their landscape.

In 1989, Romania's communist regime collapsed, and Transylvania experienced an unstable transition period. The opening of Romania's borders to the West led to a mass exodus of rural people, and especially of the remaining Saxons. In addition, the privatisation and restitution of land caused profound changes in land tenure – smallholdings measuring 2–3 ha were created throughout the landscape. Many people lost their employment with the closure of state farms, and instead resumed working their small parcels of land to support semi-subsistence livelihoods.

With Romania's accession to the European Union (EU) in 2007, new laws and regulations were introduced, and these have influenced the everyday business of small–scale farmers. From a sustainability perspective, EU membership has had both positive and negative consequences for Transylvania. For example, Southern Transylvania now contains one of the largest lowland Natura 2000 areas in Europe, including both Sites of Community Importance (SCI, under the EU Habitats Directive) and Special Protection Areas (SPA, under the EU Birds Directive). In principle, Natura 2000 designation provides financial and

other resources to assist sustainable land management. However, our work showed that some regional stakeholders in Transylvania are critical of Natura 2000 sites, because they perceive them as potential barriers to economic development. Similarly, the Common Agricultural Policy (CAP) of the EU grants access to financial support for agriculture. However, the complicated process of applying for funding has meant limited efficacy in attaining European rural development objectives in the region (Chapter 8).

Figure 2.3. The Clouded Apollo is listed as a threatened species under EU legislation. In Southern Transylvania, we found it on meadows in close proximity to the forest edge – in an area that may soon be transformed to a motorway.

Today, Transylvania stands out among European cultural landscapes for its high natural as well as cultural diversity. The vast majority of current inhabitants are Romanians, Hungarians and Roma – less than one percent are Transylvanian Saxons. At the same time, several species that are rare, threatened or extinct in other European countries remain abundant in Transylvania. Notable examples are the Brown Bear, the Wolf, amphibians such as the Yellow-Bellied Toad, and numerous bird, plant and butterfly species (e.g. the Clouded Apollo, Fig. 2.3). However, rapid changes in land use threaten the biodiversity of the region. On the one hand, the influence of global economic trends may cause land use intensification and landscape simplification (Fig. 2.4). On the other hand, the low profitability of farming in remote and less accessible areas may lead to land abandonment and subsequent shrub encroachment. Both intensification and land abandonment could have negative consequences for farmland biodiversity. In the following chapter, we explain our general approach to study this dynamic social-ecological system in its current state, but also its possible future trajectories.

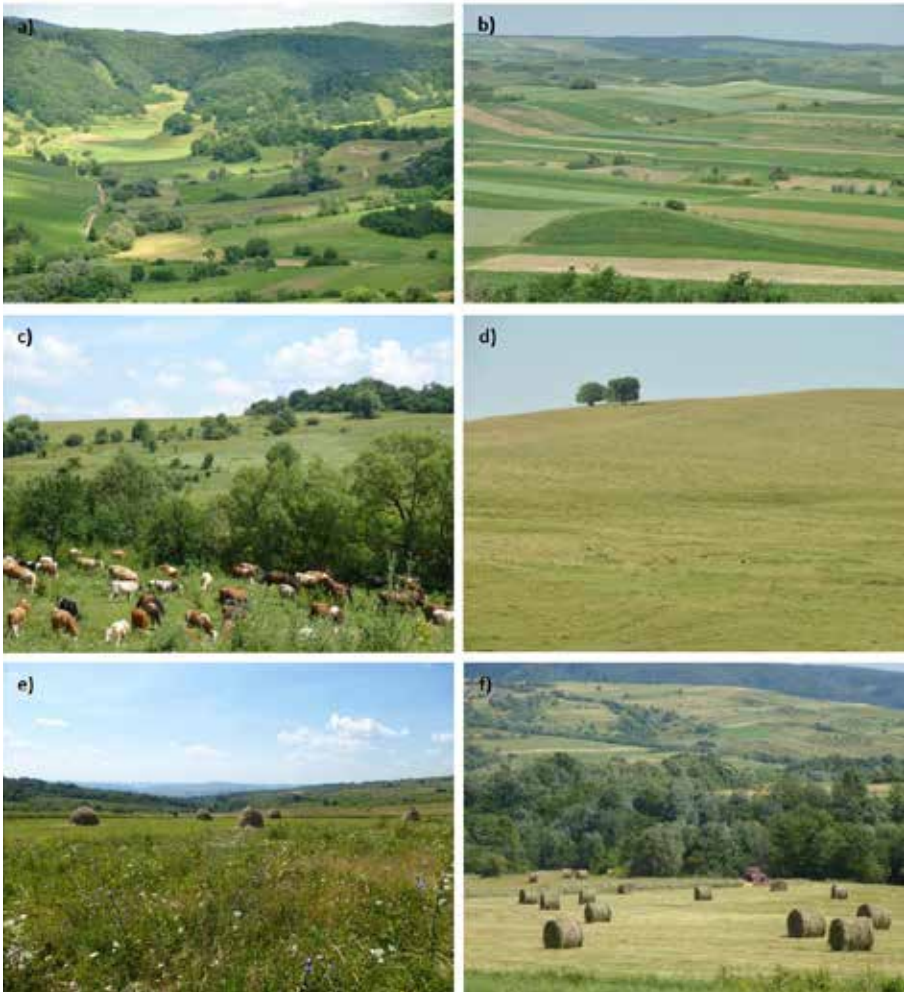

Figure 2.4. Examples of changing landscapes in the study area. The pictures illustrate the change from low intensity land use to higher intensity land use, for example in arable land (a & b) and in grassland (c & d). Intensification reduces the structural diversity of the landscape by reducing woody vegetation cover and land cover heterogeneity. Traditional land use practices such as manual hay cutting are highly beneficial for species richness; however, these techniques are increasingly replaced by mechanised harvesting (e & f).

Key messages

- The landscapes in Southern Transylvania are rich in animals, plants and cultural values.
- In the past decades, Southern Transylvania has experienced several major transitions due to political, social and market changes, such as the collapse of communism and accession to the EU.
- Transylvania's natural and cultural heritage is threatened by numerous interacting changes, which have political, institutional, economic, and social dimensions.
- Both land use intensification and land abandonment can cause structural simplification of the landscape, and are likely to harm biodiversity.

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CHAPTER 3: AN OVERVIEW OF OUR RESEARCH

Traditionally, science has focused on the development of disciplinary knowledge, with a clear separation between the natural and social sciences. This specialisation of science has led to many important insights. However, to better understand social-ecological systems as a whole, there is a pressing need to better integrate different kinds of research approaches. In particular, interdisciplinary sustainability research requires an approach to science that addresses both ecological and social issues, as well as their influences on one another (see Chapter 1).

The research undertaken in this project evolved through ongoing reflection on the research process and through mutual learning within the interdisciplinary research team, as well as with stakeholders in Transylvania. Our goal was to generate a practical and grounded understanding of local sustainability challenges. To facilitate this reflective, integrative and problem-oriented approach to science we focused on three aspects of science: place, case and process.

The first aspect, 'place', emphasises the value of carefully choosing where to conduct an interdisciplinary research project. We reasoned that, from a sustainability perspective, research will be of most applied value if it takes place in locations that actually face urgent sustainability problems. As described in the previous chapter, Transylvania provided a good example of a changing, traditionally tightly coupled social-ecological system facing multiple sustainability challenges. Perspectives from multiple scientific disciplines were needed to understand these challenges and how they relate to the social and ecological characteristics of the landscape. Here then, the physical landscape of central Romania provided a means to bring together social and natural science approaches to address the common problem of sustainability in a single shared space.

While a shared place in which to undertake research is helpful, it is not enough to ensure successful interdisciplinary research. The selection of common 'cases' can help further integrate different scientific approaches. In this project we shared common cases for a range of different analyses. Specifically, we focused on the notion of 'village catchments' as cases suitable for ecological, social and social-ecological research. Focusing on the same cases, in turn, naturally facilitated integration and communication among researchers from different disciplines. Village catchments were defined as villages with their surrounding land. Such village catchments represent a useful scale of analysis for social-ecological systems in rural landscapes because they are small enough to be studied in some detail – but also, many village catchments with different characteristics can be found within the region, thus enabling interesting comparisons. In total, our study area comprised 448 villages (and village catchments), distributed over an area of approximately 7,400 km^2 (Fig. 3.1). The average area of village catchments was approximately 16 km^2, and the average population was just over 600 people. For our study, we randomly selected a subset of 30 village catchments for in-depth investigation (Fig. 3.1). These 30 village catchments covered the different types of landscape found in the study area (from very hilly to relatively flat), and included land within and outside protected areas (i.e. Natura 2000 areas).

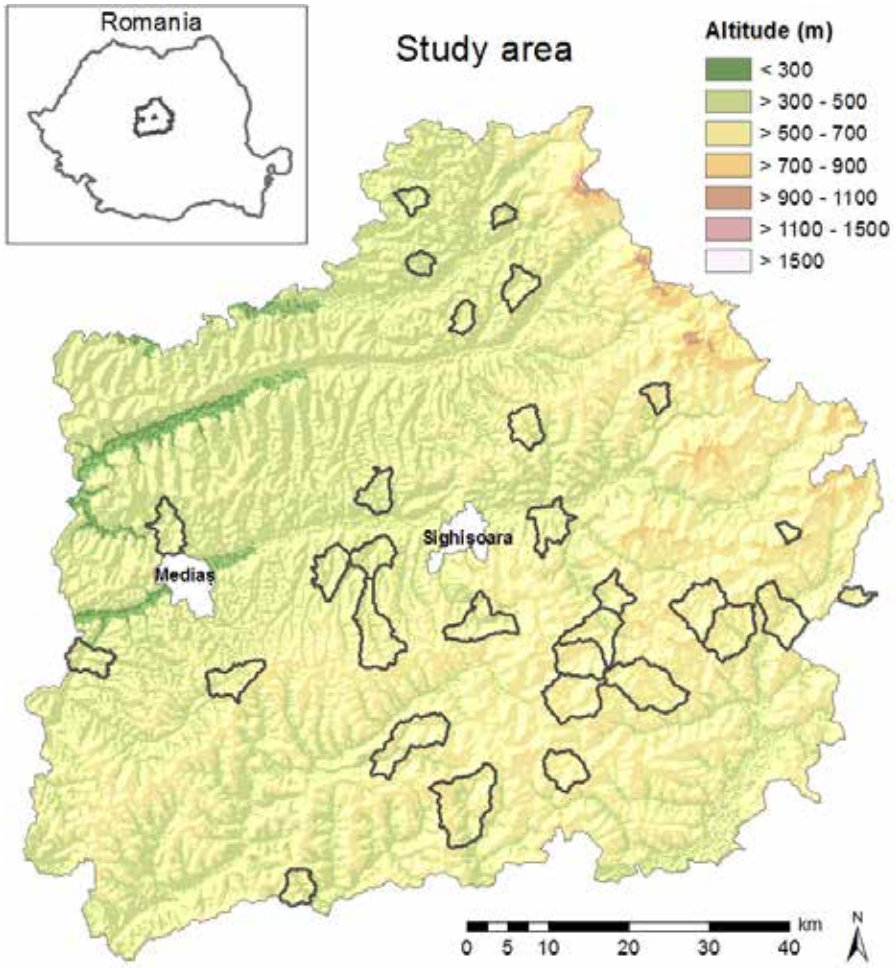

Figure 3.1. Study area in Transylvania. Thirty villages and their surrounding land were targeted for in-depth investigation (outlined in black).

Finally, the third feature of our interdisciplinary approach – 'process' – related to day to day features of team research that improved integration across disciplines and communication with stakeholders. Key process-related features were working in a small team whose members shared an office building, planning for independent as well as joint project activities, involving some key stakeholders early on in the research process, and carefully targeting communication at different relevant audiences. Without the active involvement of many stakeholders this project would not have been possible. We are particularly grateful to the many different members of local communities for their interest and willingness to support our research project (a list of acknowledgements can be found at the end of this book).

The following chapters of this book provide an overview of our key findings. Detailed descriptions of the work we undertook can be found in the scientific publications listed at the end of each chapter. Key activities that were part of our study included the following:

- We mapped environmental conditions in each of the 448 village catchments.
- We quantified natural capital assets (e.g. pastures, orchards, scenic beauty) for 30 villages.
- We surveyed plants at 139 sites, butterflies at 120 sites, and birds at 150 sites.
- We looked for signs of bear activity along 550 km of forest edges.
- We obtained 650 completed questionnaires on living with carnivores.
- We interviewed 360 people in 66 villages about barriers to rural development.
- We interviewed 129 people in 30 villages about their appreciation of different landscapes.
- We led 25 group discussions in five villages about the distribution of nature's benefits among different members of the community.
- We conducted interviews with dozens of local administrators and non-governmental organisations about rural development, and impacts of policies by the European Union.
- We interviewed 39 people about forest governance.
- We developed scenarios illustrating plausible future developments for the region in collaboration with 18 local stakeholder groups.
- We went on an extensive village tour to disseminate our research findings.

The above list highlights that the project team drew on multiple methods from across the social and natural sciences to generate a holistic understanding of the study area. We used standardised ecological methods to survey birds, plants and butterflies. For the ecological data, one main goal was to understand how different species related to their environments. For example, what sorts of bird species were associated with farmland, and how did these differ from the species found in forests? A second goal was to specifically try and understand how landscape characteristics affect the distribution or abundance of certain species of conservation interest, such as the Yellow-Bellied Toad, Corncrake, or European Brown Bear. For example, we looked at how the complexity of agricultural landscapes influenced the occurrence of the Corncrake. To understand social issues influencing the sustainable development of Transylvania, we undertook interviews with individuals, groups of community members, and conducted participatory workshops.

These activities helped us to better understand the values people associate with the landscape, as well as socio-economic changes taking place.

In combination, drawing on our ecological and social studies together, we generated a comprehensive understanding how and why the study region is changing, how it might change in the future, and what such changes might mean for biodiversity conservation and human well-being. By late 2015, our research had generated more than 25 scientific articles. The most important findings of these are summarised in the following chapters.

Key messages

- Our research integrated methods and understandings of the social and natural sciences to generate a holistic, social-ecological understanding of Southern Transylvania.
- We used a 'place', 'case' and 'process' approach to integrate our findings across scientific disciplines and with stakeholders outside the research sector.
- Our 'place' was Southern Transylvania, our 'cases' were villages and their surrounding land, and the 'process' involved working in a small interdisciplinary team and involving local stakeholders.

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CHAPTER 4: THE CHANGING FLORA OF SOUTHERN TRANSYLVANIA

Transylvania's flora is best known for its exceptionally diverse mountain grasslands. However, the diversity of grasses and herbs – or species richness – can also be very high in lowland areas. Some of the plants in Southern Transylvania occur nowhere else, that is, they are endemic to this area. A diverse and variable flora, in turn, offers many resources for various animals, thus forming the basis of a complex food web, which is beneficial to the ecosystem and humans in several ways. For example, flower-rich grasslands offer nectar and pollen for butterflies, bumblebees, honeybees, flies and other insects. Pollinator communities, in turn, bring direct benefits to humans: numerous fruits and vegetables depend on the services of these insects, and of course, bees produce honey. In addition, the biomass produced by the grasslands is used to feed livestock, through grazing or hay production, and represents an important source of medicinal plants. Moreover, many people also enjoy the aesthetic beauty of Transylvania's colourful meadows (Fig. 4.1), and different types of timber are used for construction, to make furniture and as firewood. Thus, plants play an important role in the ecological, but also in the social system of Transylvania.

Figure 4.1. Transylvania's hay meadows are among the most species-rich grasslands in the world.

In this chapter, we summarise results on vegetation composition and structure in relation to land management practices in the farmland mosaic, as well as in wood pastures and forests. At the end of the chapter, we describe how some plants that do not originate from Southern Transylvania could be a problem for its flora in the future.

THE FARMLAND MOSAIC

Southern Transylvania's traditional cultural landscape has been shaped by people for centuries. The main land use categories comprise grassland (including pastures and hay meadows), arable land, and forest. These three land use categories cover approximately similar proportions of the landscape. Arable land, pastures and hay meadows are often interspersed at a fine spatial scale – in combination, we refer to these land cover types as the farmland mosaic. In our research on plant diversity, we surveyed all three major land uses and found that the plant communities clearly differed between them (Fig. 4.2). The most important driver underpinning differences in species community was the presence of trees and shrubs. Accordingly, plant communities in forests differed strongly from plant communities in arable land and grassland. Some arable land and grasslands had plant species in common, but overall, the plant community differed substantially also between these two land use categories. This pattern contrasts with our findings on farmland animals, whose communities were similar in arable land and grassland (Chapter 6).

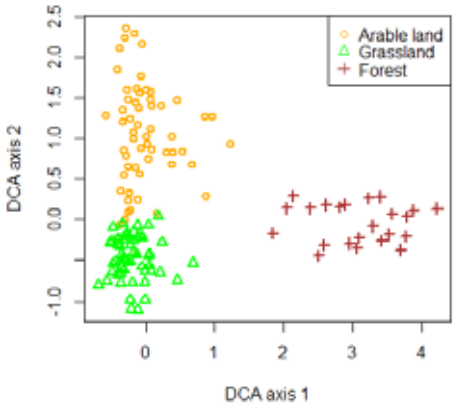

Figure 4.2. Multivariate analysis showing how plant species composition differed between forests, arable land and grassland. Each point denotes a survey site. Points that are close together in multivariate space had very similar kinds of species, whereas sites that are far apart had very different plant species.

Grassland, arable land and forest differed not only in species composition but also in the number of plant species they hosted. Grasslands were the most diverse environments. Here, we found up to 84 plant species in a single hectare, and overall, we identified 417 plant species in grasslands. However, many species of plants (381) also grew in arable land – mostly in the margins adjacent to fields, but surprisingly, sometimes also within arable fields themselves. Forests supported the lowest diversity of plants with a total of 137 species. Of all the plants we found, 50% were habitat specialists, that is, they were detected only in one land use category (Fig. 4.3). Hence, our findings revealed that the landscape creates numerous pockets of contrasting environmental conditions, all of which contribute to the overall species pool of plants (as well as supporting a high diversity of other species; see Chapters 5 & 6).

Some plants that we found in Southern Transylvania (for example Nodding Sage and Globeflower, Fig. 4.4) are known to be declining, rare or threatened in Western European countries. Among these are arable weeds and grassland specialists, which are well adapted to the environmental conditions created by traditional human land use. Arable weeds have declined in countries that apply large amounts of artificial fertilisers and pesticides in their fields. Such agrochemical input not only affects plants within the fields that are being

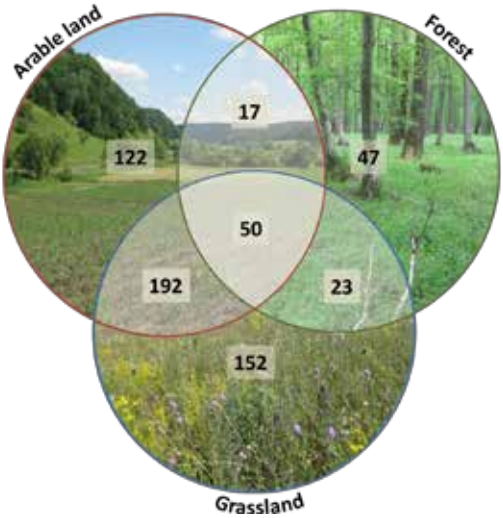

Figure 4.3. Numbers of plant species that occurred exclusively in a given land cover type, or were shared by the different land cover types.

treated, but the leaching of nutrients also influences the surrounding vegetation. Consequently, widespread and highly competitive plants thrive, while more slowly growing plants are suppressed. Of particular interest within the rural development policy of the EU is a set of plant species that is commonly referred to as "High Nature Value" (HNV) indicators. Most commonly, these indicator plants occur in grasslands. However, in our study region, we found that these indicators (as well as other species of conservation interest) also occurred in other parts of the landscape, such as in the margins between arable fields.

Figure 4.4. The Globeflower grows on damp ground in shady areas, for example near woodlands or shrubs. In some European countries this species is threatened, mostly because of abandonment of grasslands used at low intensity, and because of drainage of the soil.

Which mechanisms underpin the high diversity of flora in Southern Transylvania? We identified several key characteristics of the landscape that support plant diversity. These characteristics act and interact at different spatial scales, and varied for the species of interest. The presence of woody vegetation was found to be positively related to overall plant species diversity in arable land and grassland. Other environmental conditions also affected plant distribution: for example, in arable land, more rugged terrain hosted more species than flat and open arable fields. In grasslands, however, the effect was the opposite, and more rugged sites supported fewer plant species than flatter grasslands. Within arable land, HNV indicator plants were most diverse in highly heterogeneous landscapes. Similarly, in arable land, an intermediate amount of woody vegetation supported most HNV indicator plants, whereas grasslands with either little or much woody vegetation hosted more HNV indicator plants. These findings show that landscape characteristics such as woody vegetation, topography and land cover heterogeneity are of critical importance – but how exactly they influence plants may differ between arable land and grassland.

FORESTS AND WOOD PASTURES

Southern Transylvanian forests are dominated by Hornbeam, Oak, and Beech. Even though these forests are not particularly rich in plants, there are some plants occurring exclusively in forests, and some that are endemic to the forests of Transylvania, such as the Large Blue Hepatica (Fig. 4.5). Furthermore, forests play an important role for many animals (Chapter 5). Mediterranean floristic elements like the Downy Oak woodlands are also represented on the steep, south facing slopes.

Figure 4.5. The Large Blue Hepatica is endemic to herbaceous woodlands of Transylvania up to an altitude of 2,000 m. In spring, it is one of the earliest flowers to bloom (Photo credit: Karl Kristensen).

Wood pastures are sparsely treed landscapes grazed by livestock. This land cover type is considered to be among the oldest in Europe and has high ecological and cultural importance. In Transylvania, ancient wood pastures are still common and have long been important to the local economy. The region covered by our research contains over 6000 hectares of wood pastures, about two thirds of which contain large, old trees. Traditionally, wood pastures were managed primarily by grazing (with pigs, cows , buffalos and horses). The trees in wood pastures were maintained selectively, to fullfill many types of demands, including shadow for livestock, fruit production and halting erosion. Hence, most Southern Transylvanian wood pastures are dominated by Oak, but often also contain Hornbeam, Beech, Pear and Apple. The species composition of trees in wood pastures thus differs from that in forests (Fig. 4.6). Furthermore, the largest and possibly oldest trees can be found in the pastures and not in the managed forests; this makes wood pastures from Southern Transylvania hotspots of large, old trees.

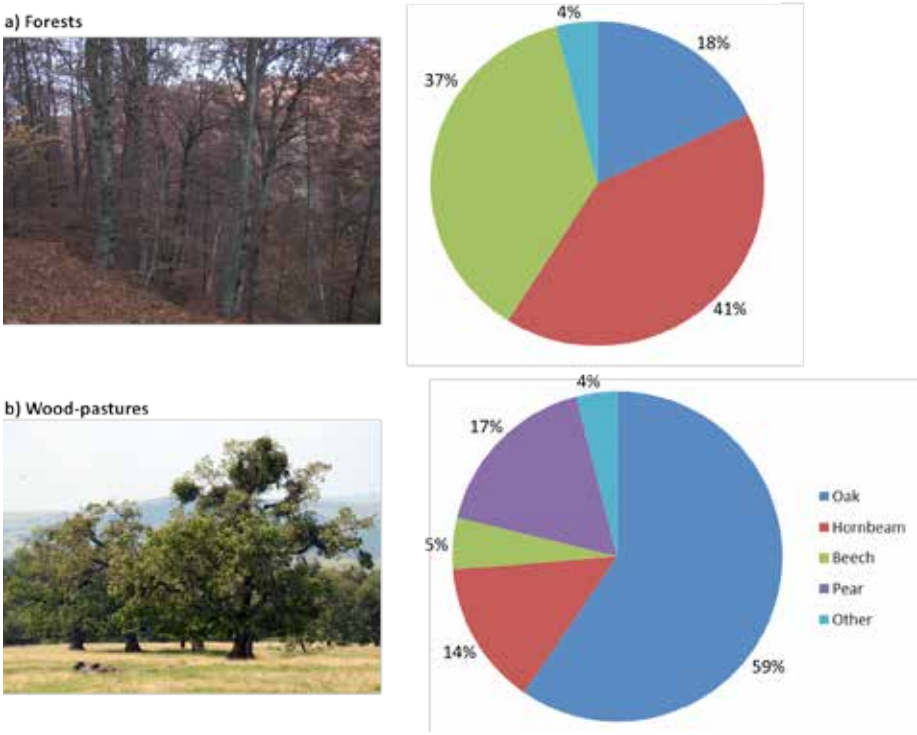

Figure 4.6. Tree species composition differs between a) forests and b) wood pastures.

Wood pastures in Southern Transylvania have significant ecological, cultural, economic and historical values. Their ecological value lies in the diversity of ecological conditions provided by the combination of grasses and herbs, shrubs, and big, old trees, many of which contain hollows. Because of these highly diverse conditions, wood pastures have higher ecological values than many other managed landscape elements. Species that require open landscapes (such as the Skylark or Corncrake) can be found in wood pastures, as can species requiring trees (such as woodpeckers), and species living on dead

wood (such as the Longhorn Beetle, Stag Beetle). Wood pastures are also attractive to the Brown Bear because they harbour food resources in the form of anthills (see Chapter 5) – in spring, ant larvae are a valuable source of protein for the Brown Bear.

In terms of their historical and cultural values, old trees in wood pastures reflect a long history of the landscape including evidence for traditional management techniques applied to trees. For example, many Hornbeam trees are shaped by pollarding, an ancient tree farming technique that has disappeared from much of Europe, and is now also disappearing from Southern Transylvania. Pollarding may increase the longevity of the trees and may also promote the hollowing process, thereby making the tree attractive to many organisms. Similarly, Pear trees were once common in European wood pastures. Pear trees were planted for their fruit, wood, and to prevent soil erosion. While Pear trees disappeared from large parts of Western Europe, they are still common in the wood pastures of Transylvania, and represent a significant cultural legacy. The largest trees found in Southern Transylvania have outstanding national and international values due to their rarity, including an oak with 920 cm trunk circumference (Mercheasa), a hornbeam with 420 cm trunk circumference (Apold), a birch with 300 cm trunk circumference and a pear with 410 cm trunk circumference (Daia).

Wood pastures also have high social values. Traditionally, they were communally managed and were important arenas for social interactions – including regular "pasture cleaning". Although these activities are not practiced anymore, they are still present in the memory of many local people, who often associate positive feelings with traditional pasture management.

Recent initiatives have recognised the cultural, historical and ecological values of old trees in Transylvania. For example, the project 'Find the oldest tree' by the Mihai Eminescu Trust mobilised several hundred students and adults to discover large trees. As a result, new data have been gathered on several hundred ancient trees. Similarly, the citizen science project 'Remarkable Trees of Romania', which is run by a consortium of organisations, aims to motivate people to locate and collect data on large trees, which are shared widely in numerous interactive ways.

THE SPREAD OF INVASIVE SPECIES

Although Southern Transylvania's current diversity of plants is remarkable, there are changes taking place that pose a threat to this diversity. Some plants have been introduced from other regions either unintentionally or for gardening, or because their cultivation promised to be profitable. Unfortunately, because their life history traits are often adapted to fast reproduction and rapid growth, some of these introduced plants have dispersed widely into the landscape, and now replace the native vegetation. Hence, the spread of invasive introduced plant species is increasingly recognised as a major problem for local ecosystems.

One prominent example in Transylvania is the Canadian Goldenrod (Fig. 4.7), which has started to dominate parts of the landscape. Another example is the Black Locust tree,

which is being used for timber and which attracts pollinators such as bees. This tree now occurs in many locations where it has never been planted, because it can spread easily without active management. Our research found that the risk of introduced plants invading Transylvania appears to be highest near road margins, which represent highly disturbed habitat. Moreover, the abundance of invasive species was high in heterogeneous arable land characterised by high levels of disturbance, and in areas that used to be farmed but have recently been abandoned. These findings show that Transylvania's plant diversity is likely to be changing in the future, and that such change is closely related to socio-economic factors and changes in land management (see also Chapters 7 & 10).

Figure 4.7. The Canadian Goldenrod is currently spreading across the landscape, invading not only road verges and arable land, but also disturbed pastures and forest margins.

Key messages

- The composition of plant species communities differed strongly between forest, arable land and grassland.
- Grasslands supported most plant species, but the number of species found in arable land was also surprisingly high. Plant species richness was lowest in forests.
- Plant species of conservation interest were found in many parts of the farmland mosaic, especially in extensive grasslands and in structurally complex field margins.
- Wood pastures are of particular importance for many plant and animal species and have historical heritage values.
- Invasive plant species spread along roads and in heterogeneous parts of the landscape, and can threaten local plant communities.

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CHAPTER 5: ANIMALS IN THE FORESTS OF SOUTHERN TRANSYLVANIA

Forests cover approximately one third of the Transylvanian landscape. Most forest patches have been there for centuries and remain well connected to other forest patches. Transylvanian forests host many wild animals that used to be widespread throughout Europe, but have now become rare on most of the continent. Traditionally, local villagers used woodlands to collect firewood, berries and mushrooms. Traditionally, the timber was extracted through coppicing and pollarding. These traditional methods were abandoned in the 1940-1950´s, being replaced with modern forestry. However, old coppices and old forest edges can still be found in Southern Transylvania. Today, these traditional uses remain important for some people. Moreover, people also appreciate the forests for their beauty and because they regulate environmental processes. For example, forests prevent soil erosion, regulate the climate, and purify the air. However, forests are increasingly exploited for their economic benefits only, and some forest areas are managed primarily for timber extraction. Some of this extraction is highly intensive and involves clearcutting. Such intensified (and sometimes illegal) logging is responsible for growing rates of deforestation throughout Romania, and threatens the values of forests for both people and wildlife.

In this chapter, we summarise our findings on the ecological values of forests, focusing on birds and mammals. Many different species of birds inhabit forests, including several species of woodpeckers that depend on old trees and other features of old-growth forest. Our investigations of mammals included work on the Brown Bear, which remains common in Transylvania, despite centuries of human land use.

BIRDS

Especially in spring, the forests in Transylvania are teeming with bird life. From surveys in 30 forest patches, we found 30 bird species breeding in the forests, including some of European conservation concern. The most common species were the Great Tit, the Chaffinch and the European Robin (Fig. 5.1). With ten breeding species on average in one hectare, species richness was higher in forest sites than in farmland sites (see Chapter 6). In addition, the community of bird species in forest sites strongly differed from that in farmland sites – but interestingly, similar sets of bird species occurred in most patches of forest (Fig. 5.2). We classified birds into groups of typical forest specialists, farmland birds and open-country specialists. Of 26 typical forest specialists, 19 species were also observed in farmland sites. Only seven species that we had classified as typical forest specialists were exclusively found in forests (e.g. the Collared Flycatcher). Farmland thus appeared to provide valuable complementary habitat for many forest specialists.

WOODPECKERS

Europe is home to ten species of woodpeckers. Many of these have declined in the last few decades (especially in Western Europe), and six woodpecker species are now protected by

Figure 5.1. The European Robin is a bird that is characteristic of forests and woodlands. (Photo: © Francis C. Franklin / CC-BY-SA-3.0)

law. We were interested in learning more about which factors influence the occurrence of woodpeckers in Transylvania. Woodpeckers have demanding habitat requirements. They require large trees to build their nests, and often also dead wood to forage for insects and larvae. In contrast to many intensively managed forests in other European countries, old trees and dead wood are relatively common in the forests of Transylvania. In addition, many old trees can be found in wood pastures, which are often adjacent to forests (Chapter 4).

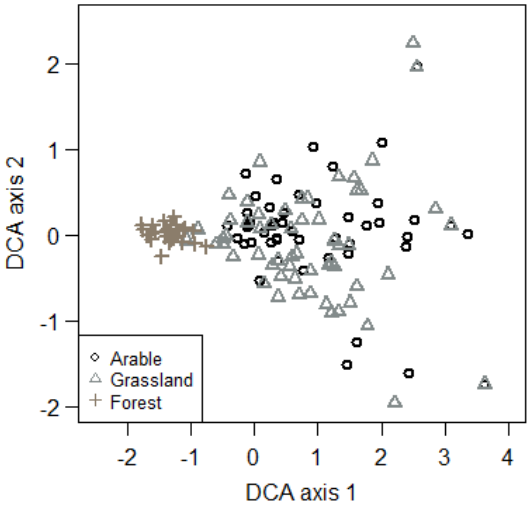

Figure 5.2. Overview of the bird community composition in arable land, grassland and forest. Each point in this multivariate ordination refers to the community composition of one survey site. Points that are close together had similar kinds of species, whereas sites that are far apart had very different bird species. Forest sites are all clustered in one small part of the plot, showing that most forest sites were inhabited by similar sets of bird species.

In our research, we focused on six species of woodpeckers, including three of conservation concern. Of these, different species preferred either forests or wood pastures. For example, the Lesser-Spotted Woodpecker more commonly occurred in forests, whereas the

Green Woodpecker favoured wood pastures. Three protected species (Grey-Headed Woodpecker, Middle-Spotted Woodpecker and Black Woodpecker; Fig. 5.3) occurred both in forests and wood pastures. Thus, the reasons why woodpeckers thrive in Transylvania appear to be the extensively managed forests, as well as the abundance of nearby wood pastures, which provide complementary habitat.

Figure 5.3. The Black Woodpecker is widely distributed throughout Transylvania and is protected under the EU Birds Directive. It is known as a forest species, but in Transylvania, it occurs both in wood pastures and forests. (Photo credit: Anne-Catherine Klein)

MAMMALS

Romania sustains large, stable populations of the Brown Bear (Fig. 5.4a), Wolf, Lynx and Wildcat. These animals have become very rare in other European countries. Especially the population of bears is exceptionally large in Romania. Most of Romania's bears live in the Carpathian Mountains, but many also occur in the Transylvanian foothills. This situation is interesting, because most other bear populations in Europe are restricted to remote, mountainous areas. We were interested in the conditions which facilitated the bear to be so widespread in Transylvania – where it has lived side by side with people for many centuries.

In our research, we surveyed bear activity by looking for bear signs along forest margins. Specifically, we looked for destroyed anthills, which are common in the pastures adjacent to the forest (Fig. 5.4b). In spring, bears often come out of the forest to dig for ant larvae, which are a valuable source of protein. We observed that bear activity was highest close to the Carpathian Mountains, in areas with a rugged terrain, and near large forest patches. Interestingly, bear activity was high throughout the landscape, and not just within the protected Natura 2000 area (see Fig. 5.5). One of the reasons for this may be the connectivity between large blocks of forests, which provides corridors within the study region, and also connects the foothills to the larger population of bears in the Carpathian Mountains.

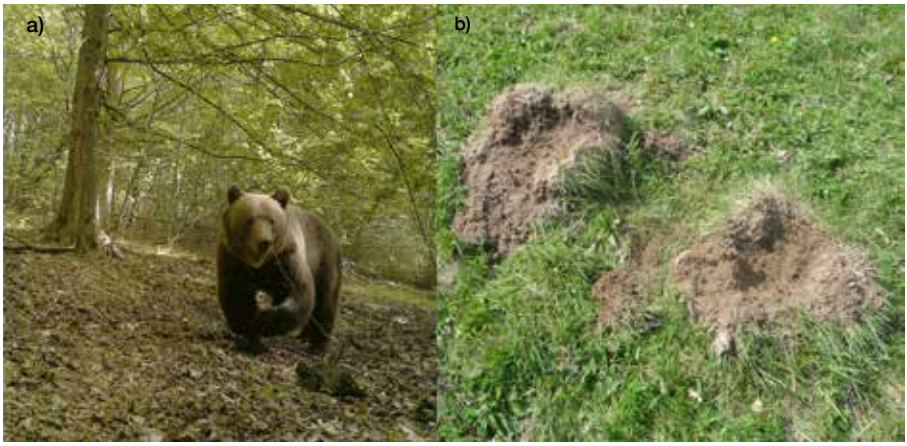

Figure 5.4. a) Large populations of the Brown Bear can be found in Romania, including in Southern Transylvania. Most bears are shy and avoid people. This picture was taken with an automatic, motion-triggered camera hidden in the forest. b) These anthills have been destroyed by a Brown Bear. Especially in spring, bears feed on ant larvae, which are rich in protein and abundant in the pastures adjacent to the forest.

Interestingly, our work also showed that many local people had a generally positive attitude towards living in the same landscape with bears. Many people appeared to value the natural heritage of their landscape, and they considered bears to be a part of that landscape. Moreover, people have adapted their livestock husbandry practices to the presence of large predators. Traditional management practices, such as rounding up sheep in enclosures overnight, and protecting livestock with shepherds and guarding dogs (Fig. 5.6), are two key ways of minimising predation of livestock by large carnivores. These factors may help explain why people have co-existed with bears for such a long time in Southern Transylvania. Inevitably, however, where humans and large carnivores share the same landscape, there are also some conflicts: despite careful

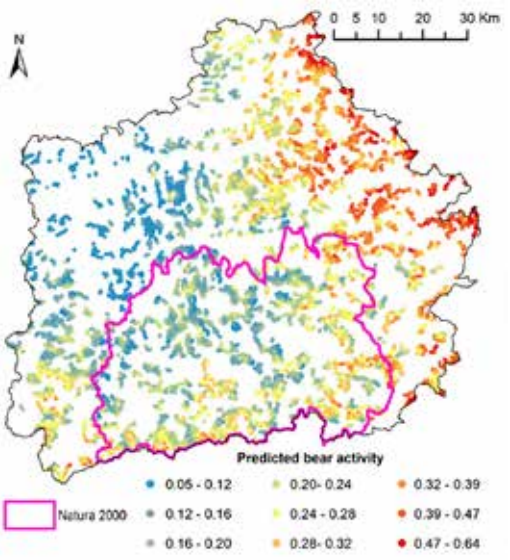

Figure 5.5. Predicted Brown Bear activity in the study area, where red indicates relatively higher activity and blue indicates lower activity. The highest activity levels were found near the Carpathian Mountains. Brown Bear activity was equally high within the protected Natura 2000 area and outside it.

Figure 5.6. Traditional livestock husbandry involves the use of guarding dogs to protect livestock against attacks by bears and wolves.

management, bears (as well as wolves) occasionally attack livestock, and bears can also damage crops, orchards and beehives. Nonetheless, during our interviews, shepherds indicated that occasional conflicts with wildlife appeared tolerable – for example, only few shepherds indicated that they strongly disliked bears.

In Romania, compensation schemes exist for damages caused by carnivores, such as livestock killing. However, in our study area, we found that many people who were affected by carnivore attacks did not know about such compensation schemes; others said they had applied for reimbursement but never received their payment. Thus, current efforts to mitigate conflicts with bears did not seem to work from the perspective of many local people. This could be a serious problem, because perceived mismanagement may ultimately undermine the relatively high level of tolerance to living with bears. At the same time, some of our interview partners were worried that conflicts with bears may increase in the future because their habitat – the forest – is increasingly disturbed through logging activities. An increase in conflicts with carnivores has led to reduced tolerance towards them in other countries – to the point that illegal killing can become one of the greatest threats to their survival. With this pattern in mind, it seems important to pay close attention to the misgivings of local people about the ways bears and their habitat are managed, before conflicts escalate.

As an additional way of surveying forest mammals, we set up motion-triggered cameras throughout the forest. This enabled us to learn about the mammal communities in different locations, and also provided an opportunity to learn about the interactions between different species. From an ecological point of view, carnivores are top predators.

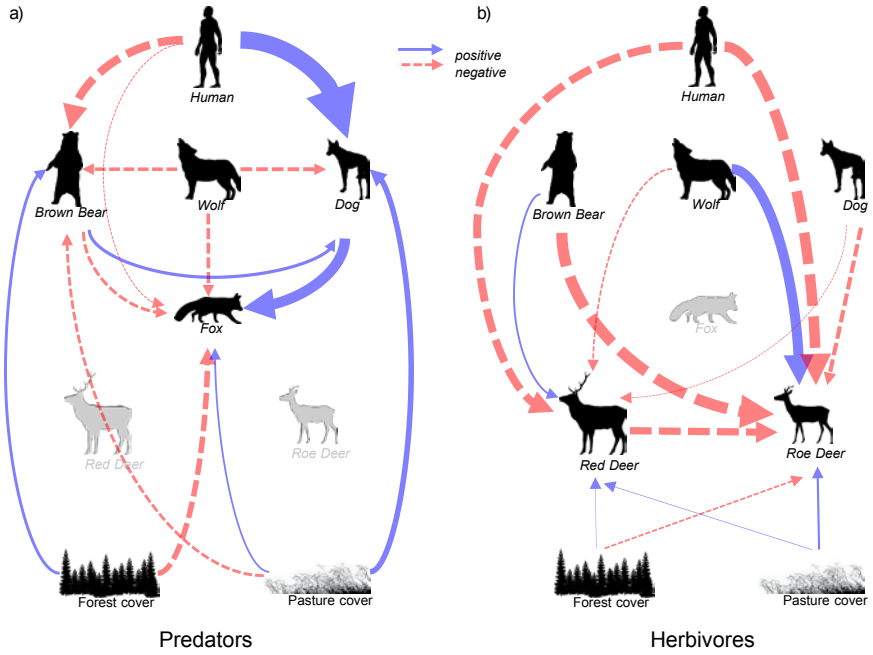

Figure 5.7 Relations between humans, predators, herbivores and land cover. Figure a) shows the relationsships focusing on predators, and b) focuses on herbivores. Positive influences are indicated by solid blue arrows and negative relations are indicated by dashed red arrows. The thicker the line is, the stronger the effect of the relation was on the presence of a given forest animal.

This means they play an important role in structuring the forest ecosystem – all levels in the food web below top predators are directly or indirectly affected by their presence. In our research, we found a number of interesting relationships between top predators, herbivores and also humans. While the presence of the Wolf had a negative effect on Red Deer, the presence of the Brown Bear had a negative effect on Roe Deer. Most likely due to competition, Roe Deer was less likely to occur in locations with Red Deer, and vice versa (Fig. 5.7). We found only limited evidence for predator control on the Fox, which was limited with equal strength by predators as by the amount of forest cover (Fig. 5.7). Most interestingly, we found that the presence of humans had a strong effect on all species in the forest. On Red Deer, the presence of humans had a stronger effect than the presence of wolves. On Roe Deer, human presence had as strong an effect as the presence of bears. In addition, humans bring dogs into the food web, and these, too, reduced the prevalence of Roe Deer. Finally, humans also influence the food web through bottom-up processes – for example, they may reduce forest cover, which leads to a decrease in bears and wolves, and hence a potential increase in deer (Fig. 5.7).

For Southern Transylvania, our findings show that both humans and large carnivores play important roles in structuring the forest ecosystem. Thus, careful management is needed both of large carnivores themselves and of human activities that may influence carnivore habitat.

Key messages

- Transylvania's forests are inhabited by several rare or threatened birds and mammals.
- Bird communities differed between forests and farmland. Forest bird communities were less variable than farmland bird communities.
- The same number of woodpecker species occurred in forests and in wood pastures, but community composition differed between the two.
- Bears were abundant throughout the entire study area, with highest densities close to the Carpathian mountains and in rugged terrain near large forests patches.
- Most local people had a generally positive attitude towards human-bear co-existence.
- Large predators influenced the community of forest mammals, but their influence was outweighed by that of humans.

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CHAPTER 6: ANIMALS IN THE FARMLAND MOSAIC OF SOUTHERN TRANSYLVANIA

Unlike in many farming landscapes, substantial amounts of semi-natural elements have been retained in Transylvania's farmland (Fig. 6.1). Such semi-natural elements include grasslands, such as ancient hay meadows and pastures that are grazed by sheep and cattle. Other widespread semi-natural elements are strips of vegetation between agricultural fields, and trees and shrubs that are scattered throughout the landscape. Our research investigated the effects of semi-natural elements on farmland animals, including birds, butterflies and to a lesser extent, amphibians. We examined grasslands and arable land separately, because we expected that species might respond differently to environmental conditions in these two main land cover types.

Figure 6.1. The mosaic landscape of Southern Transylvania contains arable land, grasslands and forest patches. The landscape is heterogeneous and offers habitat for many different species.

FARMLAND BIRDS

Throughout Europe, farmland provides important habitat for a wide range of birds. In our surveys of 120 sites in Transylvanian farmland of a variety of conditions, we found 36 breeding bird species in arable land and 46 species in grassland. At a given site, within one hectare we found an average of five bird species, both in arable land and grassland –

which is only half of the number of species typically observed in forest sites (Chapter 5). Yet, although a given patch of forest typically had more species than a given patch of farmland, the overall number of observed species was higher in farmland: of the 61 species observed in the entire study, 54 were observed at least once in grassland or arable land (including in field margins or scattered trees). Whereas forest sites usually had a distinct set of species associated with them, bird communities in arable land and grassland were similar to one another (see Chapter 5, Fig. 5.1).

Both in arable land and in grassland, we regularly observed bird species of conservation concern, such as the EU-protected Red-Backed Shrike (Fig. 6.2). To better understand the specific requirements of different species and their response to environmental conditions, we distinguished between birds widely classified as "farmland species" (which often use field margins and scattered trees) and birds known to be "open-country specialists" (which generally avoid trees and shrubs). In addition, we considered that some "forest specialists" might also use farmland under certain conditions. In our surveys of farmland, we observed ten farmland species, nine open-country specialists, and 22 forest specialists. We confirmed that the presence of woody vegetation within the home range was beneficial for farmland birds and forest specialists, whereas open country specialists specifically sought out areas without woody vegetation. The presence of birds with different specialisations in different parts of the farmland thus reflected gradients of heterogeneity and woody vegetation throughout the landscape. These landscape gradients thus appear to be of critical importance to bird diversity.

Figure 6.2. The Red-Backed Shrike is a bird species that is characteristic of farmland with some woody vegetation. It has declined in other European countries due to agricultural intensification, and is now protected under the EU Birds Directive. In Southern Transylvania, this bird is still common in the countryside. (Photo credit: Nathanaël Vetter)

What would happen if landscape heterogeneity was lost in the future, for example because of land use intensification? We examined the potential effects of landscape homogenisation via a case study focusing on one of the most interesting bird species in Transylvanian farmland: the Corncrake (Fig. 6.3). In most of its range, the Corncrake primarily occurs in low-intensity grasslands and wet meadows with plenty of shelter. It is a nocturnal bird, and is known best for its distinctive "crex crex crex..." call, which carries far on quiet nights during spring. Over the last few decades, the species has declined drastically in many Western European countries, which has been attributed to agricultural intensification. Only recently, some Western European populations have begun to recover. Conversely, the Corncrake still has very large populations in parts of Eastern Europe. The Romanian Corncrake population, for example, has been estimated at approximately 60,000 individuals.

Figure 6.3. The Corncrake has experienced major declines in Western European countries due to agricultural intensification. Although it is considered a grassland specialist, in Southern Transylvania this species still occurs throughout the farmland mosaic, including in heterogeneous arable land. (Photo: © Sergey Yeliseev / CC-BY-SA-2.0)

Despite the Corncrake being widespread in Transylvania today, changes in the landscape could also lead to its decline here. We were interested in estimating the Corncrake's sensitivity to possible land cover homogenisation, as may be expected if land use is modernised and intensified. Drawing on extensive night time surveys to identify the habitat requirements of the Corncrake, we found that the Corncrake would be strongly affected by a loss of land cover diversity. Even moderate amounts of land cover homogenisation would lead to major declines in the availability of potential Corncrake habitat. For example, reducing land cover diversity by 11% would result in a loss of 33% of suitable Corncrake habitat, and reducing land cover diversity by 35% would lead to a loss of 66% of Corncrake habitat (Fig. 6.4).

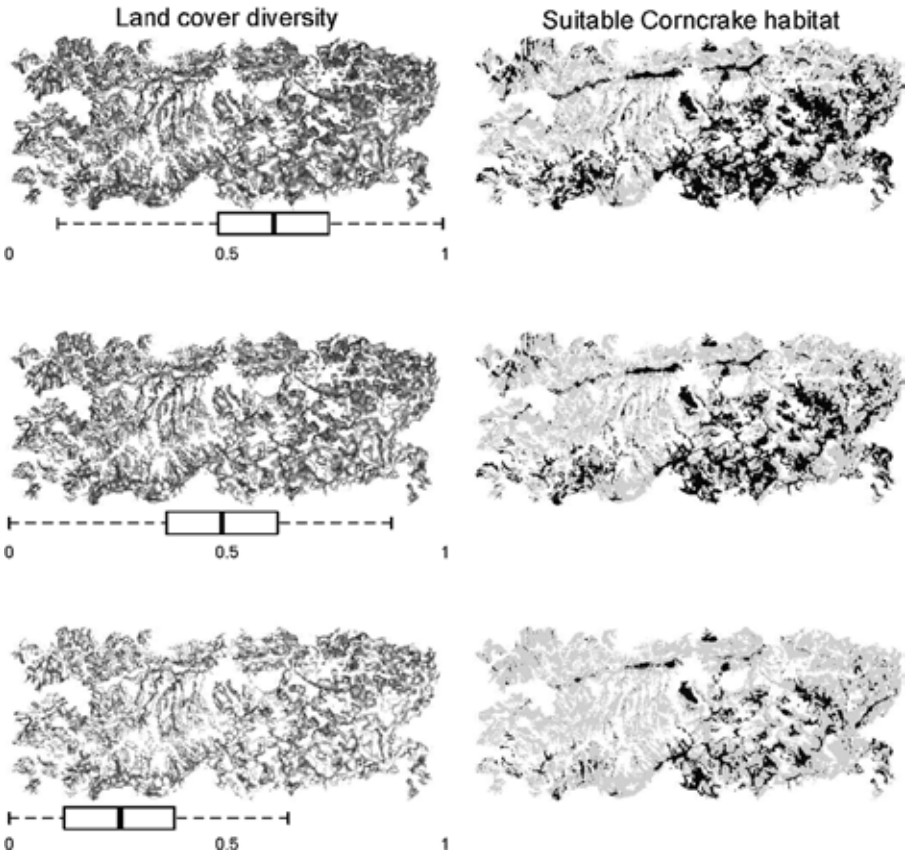

Figure 6.4. A simulated loss of land cover diversity leads to disproportional loss of suitable habitat for the Corncrake. The left column shows changes in land cover diversity and the right column shows the predicted concurrent changes in the distribution of suitable Corncrake habitat. The upper row represents the current situation, the middle row represents a hypothetical reduction of 11% in land cover diversity, and the lower row represents a hypothetical reduction in land cover diversity by 33%.

BUTTERFLIES IN FARMLAND

Flower-rich pastures and meadows have long been recognised as particularly important habitat for butterflies. However, our research on butterflies showed that in Southern Transylvania, butterflies are in fact widespread throughout the entire agricultural landscape. On average, after a total of four surveys, we had recorded 16 and 17 species of butterflies per site in arable land and grassland, respectively. As expected, overall, grassland hosted most butterflies with 82 species; however, with 78 species, butterfly richness in arable land was almost equally high. Interestingly, species composition was also very similar in the two land cover types. Moreover, some species of conservation concern – including some usually considered grassland specialists – were found in the arable mosaic (again, including field margins, scattered trees, and other semi-natural elements) or even in arable

fields themselves. For example, we observed the Large Copper (Fig. 6.5) and the Large Blue nectaring on Alfalfa. Moreover, arable land not only provided food resources for butterflies, but we also observed butterflies depositing eggs in arable land, and using shrubs and trees for thermoregulation.

Figure 6.5. The Large Copper is considered a grassland specialist. However, we observed this threatened butterfly species in the arable mosaic where several of its host plants grow.

As with birds, our observation that butterflies are widespread throughout the landscape is likely to be directly linked to the characteristics of the farmland. With many small fields, semi-natural field margins, and plenty of scattered woody vegetation, butterflies find a heterogeneous landscape that offers many different resources and niches. Some butterflies may have been present in arable land due to "spill-over" effects originating from other landscape elements that constitute their main habitat. Spill-over effects occur when species cross borders between land cover types while foraging or moving. Interestingly, we found that butterflies in arable land and grassland responded differently to landscape heterogeneity – while greater heterogeneity increased butterfly diversity in arable land, it reduced the number of butterfly species in grasslands. Heterogeneity in arable land may be beneficial for butterflies because it indicates that hospitable niches are present within a land cover type that otherwise provides only limited resources. Heterogeneity in grasslands, on the other hand, may indicate that the grassland is fragmented, which may negatively influence the occurrence of some butterfly species and their host plants (see also Chapter 7).

In addition to our interest in butterfly distribution, we also wanted to understand more about how butterflies move through the landscape. We hypothesised that the current diversity of semi-natural landscape structures enabled butterflies to move throughout the agricultural landscape, and that this could partly explain why we found so many species in many different places. To better understand the effects of landscape structures on butterfly movements, we therefore investigated in detail how different butterfly species with various levels of mobility moved through the landscape. We found that in simplified, relatively homogenous areas, species of all mobility classes showed similar movement patterns. However, in more complex landscapes with many semi-natural elements, movement patterns of butterflies differed according to their mobility. Here, mobile species displayed long and straight flight paths, whereas less mobile species had shorter and erratic flight paths. This finding corroborated that land use intensity may influence butterfly movements, and suggests that landscape homogenisation may negatively affect less mobile species more strongly than mobile species. This finding is consistent with the fact that most threatened butterfly species are of low mobility. Moreover, our study showed that almost all species examined avoided arable land when moving around the landscape and instead used the more heterogeneous, semi-natural parts of the landscape.

AMPHIBIANS

Amphibians were not a major focus of our research project because a lot of previous research had already addressed this group of animals. However, we were interested in understanding one species of amphibian in more detail – namely, the Yellow-Bellied Toad (Fig. 6.6). It is listed as threatened under the EU Habitats Directive and depends on small ephemeral water bodies that are susceptible to desiccation. In most European countries, this species has drastically declined with agricultural intensification. However, similarly to the Corncrake (see above), it remains common within the farmland of Transylvania. Research on the reasons why this species is still so abundant has shown that the Yellow-Bellied Toad prefers heterogeneous farmland, with high amounts of semi-natural vegetation and little human infrastructure (i.e. unsealed roads instead of sealed roads). Unsealed roads provide important habitat for this amphibian after rain because they enable the formation of temporary ponds. Similar temporary ponds are also created by cattle and buffaloes in pastures. By contrast, in man-made fish ponds, the Yellow-Bellied Toad is far less abundant.

Although we found the Yellow-Bellied Toad to be abundant throughout the landscape, not all locations provided equally valuable habitat. Apart from land use intensification, the amphibian disease chytridiomycosis could be a potential threat to the Yellow-Bellied Toad in the future. This disease is caused by a fungus and has caused the decline of amphibians in many locations around the world. In Southern Transylvania, we found that infection levels of chytridiomycosis were generally low in the Yellow-Bellied Toad, but were not equally distributed throughout the landscape. Temporary ponds in the open landscape seemed to provide an environmental refuge from the disease since they had lower infection rates than ponds in the forest and ponds closer to permanent water bodies.

Figure 6.6. The Yellow-Bellied Toad benefits from the low intensity of Transylvanian agriculture. The species successfully survives in temporary ponds along unsealed roads and in puddles created by cattle and buffaloes in pastures.

Key messages

- Farmland bird diversity was positively influenced by gradients of woody vegetation and heterogeneity throughout the landscape.
- Even a small decrease in land cover heterogeneity could substantially reduce the amount of suitable habitat for the Corncrake, a threatened bird species.
- Butterfly species richness and composition were similar in arable land and grassland, with contrasting effects of heterogeneity in these two land cover types.
- Land use intensity affected butterfly movement patterns. Landscape simplification would be most problematic for less mobile butterflies.
- Amphibians were abundant throughout the farmland – including the Yellow-Bellied Toad, which has been lost from many other parts of Europe.

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CHAPTER 7: CHALLENGES AND OPPORTUNITIES FOR BIODIVERSITY CONSERVATION

The high biodiversity in Southern Transylvania (Chapters 4-6) is tightly linked to the structural diversity and the specific management practices that can be found in that landscape. However, like many cultural landscapes, Southern Transylvania is changing rapidly, which poses a range of challenges for sustainability in general, as well as for biodiversity conservation in particular. In this chapter, we first summarise key social-ecological characteristics of Transylvanian landscapes that have favoured the maintenance of high biodiversity to date. We then discuss possible threats to biodiversity in the future, and conclude with conservation recommendations.

KEY LANDSCAPE CHARACTERISTICS SUPPORTING BIODIVERSITY

At the broadest scale, it is notable that approximately similar proportions of the region are covered by three main land cover types, namely forest, arable land and grassland (Fig. 7.1). Each of these land cover types hosts a significant share of species and thus contributes to the overall regional species pool (Chapter 4-6). Interestingly, each of the main land cover types covers approximately 30% of the region. This proportion seems to be enough for many species to survive and move between different habitat patches. Such movement, in turn, is important to facilitate an exchange of genes, thereby ensuring the long-term survival of viable populations.

Figure 7.1. The landscape of Southern Transylvania is covered by similarly high amounts of arable land, grassland and forests.

Not all parts of the landscape necessarily served as core breeding habitat for all species – but still, we observed that many species occurred in multiple types of land cover, often including highly modified areas (see Chapter 6). Many species in Transylvania thus appear not to be restricted to their primary habitat, but also use additional resources in adjacent areas. For example, the field margins of low intensity arable land often contain a diversity of flowers (Fig. 7.2), thereby attracting insects, which in turn offer a food resource for birds and other insectivorous species. Similarly, forest specialists such as woodpeckers and the Brown Bear were not restricted to forests but often also used adjacent wood pastures (Chapter 5). The heterogeneous mosaic of different land covers thus supplements and complements the core habitats of different species, favouring a rich biodiversity across the landscape.

Figure 7.2. Margins of agricultural fields managed at low intensity host many different flowering plants. In more intensively used agricultural land, often only few species of grasses remain.

At more local scales, biodiversity benefits from the occurrence of woody vegetation elements in many – but not all – parts of the landscape (Fig. 7.3). Especially in arable land, woody vegetation was associated with increased diversity of both plants and birds (Chapters 4, 6). However, not all species responded positively to woody vegetation. Especially in grassland, some species occurred primarily in extensive areas with little or no woody vegetation.

Landscape heterogeneity has been widely recognised to be particularly high in Southern Transylvania, and the fine-scale mosaic of land covers offers many benefits for biodiversity. In addition to small fields (Fig. 7.4), the landscape is rich in semi-natural habitat elements, including flower-rich grassland patches, as well as scattered trees and shrubs. We found

Figure 7.3. In Southern Transylvania, gradients of woody vegetation – from open pastures through scattered woody vegetation to dense forests – create a wide array of different environmental conditions. This provides habitat for a diversity of plant, bird and butterfly species.

that in heterogeneous locations, species such as the Corncrake, but also many butterflies, were highly abundant (Chapter 6). However, some plant species responded negatively to land cover heterogeneity. This suggests that for some species, heterogeneity may also represent a higher degree of fragmentation in the landscape, and such species may rely on large, contiguous areas of a single land cover type for their survival (e.g. grassland). At present, Transylvania offers both highly heterogeneous areas, as well as large, contiguous areas of semi-natural land (e.g. forest, grassland).

Figure 7.4. As a result of low-intensity agriculture and as a legacy of the cultural influence of the Saxons, many agricultural fields are smaller than one hectare.

Transylvania's land cover mosaic results from the long-term application of low-intensity, and often traditional, farming practices. In addition to such practices supporting a diverse land cover mosaic, they also have other benefits for biodiversity. First, the input of pesticides and fertilisers is low, while the amount of manual labour to work the land is high. Many farmers still plough their land with the help of horses (Fig. 7.5), weed their crops by hand, and manually cut hay for their livestock. While being labour-intensive, these techniques enable plants to spread their seeds and animals to survive within the cultivated land. Second, traditional silvo-pastoral techniques have created wood pastures, which host diverse ecological communities. In wood pastures, both forest species and grassland species thrive because of the combination of woody vegetation cover and grassland. Third, traditional livestock herding techniques are adapted to mitigate the risk of predation from bears and wolves. The use of guarding dogs, in particular, reduces livestock predation and thus facilitates a relatively peaceful co-existence of humans and carnivores. Carnivores, in turn, play an important role in regulating other animals (such as deer), with beneficial flow-on effects on vegetation (Chapter 5). Traditional practices thus have many benefits beyond the creation of a heterogeneous land cover mosaic.

Figure 7.5. High amounts of manual labour are part of traditional agriculture. Like centuries ago, horses remain important for tasks such as ploughing, and are still being used to transport goods and people in Transylvania.

Finally, many people in Transylvania remain deeply connected to their natural environment through everyday experience and through the resources they draw on (Fig. 7.6). We posit that such genuine connections probably play an important role in maintaining Transylvania's natural heritage. Maintaining biodiversity in Transylvania thus will mean paying close attention not only to the land cover mosaic, but also to the connections between people and their land, which ultimately underpin and maintain this mosaic (see also Chapter 9).

Figure 7.6. The natural environment not only provides goods and services to local people, but the connection between people and their land is often deeper. Carefully managing this connection may help in finding a balance between development and biodiversity conservation. (Photo credit: Rémi Bigonneau)

THREATS TO BIODIVERSITY

Notwithstanding its current state, the future of biodiversity in Southern Transylvanian is under severe threat. The traditional social-ecological system is rapidly changing, driven by changing markets, accession to the European Union, and other facets of globalisation. Specific risks for biodiversity lie in both the intensification and the abandonment of traditional land uses, as well as in the erosion of the social structures that have upheld diverse ecosystems to date.

Agricultural intensification often entails the increased use of agrochemicals, including artificial fertilisers and pesticides. Artificial fertilisers alter soil conditions, favour faster growing plant species, which as a consequence outcompete plants that are adapted to less fertile conditions. Thus, the resulting nutrient-rich locations ultimately become dominated by very few species. Importantly, fertilisation may also cause eutrophication of non-target areas surrounding arable land, for example through run-off by rainwater, thereby affecting the species pool across the entire landscape. Similarly, pesticides are used to control undesired species, such as arable weeds, pest insects and fungi that may damage crops. However, pesticides may also non-selectively kill species that have no negative effects on crop production, again, with negative flow-on effects on the entire ecosystem.

Other common measures to intensify agricultural production entail draining wet areas, enlarging field sizes, removing shrubs and trees, shortening fallow periods, and using a narrower range of high-yielding crop varieties, which may all have a negative impact on farmland biodiversity. In forests, land use intensification may entail a shift from selective harvesting towards clear-cutting of larger areas. In meadows, larger areas are cut at the same time, using heavy machinery, compressing the soil, and leaving little time for animals to find refuge and plants to release their seeds. In pastures, intensification can cause overgrazing, which in turn may cause soil erosion and a loss of plant and insect diversity.

At the other extreme, land abandonment may also result from the low profitability of traditional land use practices, especially in areas that are not easily accessible or less productive. Although land abandonment could support the eventual recovery of natural (forest) ecosystems, in the short term, it poses a threat to farmland biodiversity. First, abandoned land gradually turns into shrubland or forest, which is detrimental to species that depend on low-intensity farmland for their survival. Second, land that has previously been used for agriculture is at high risk of invasion by introduced plant species. As discussed in Chapter 4, such invasion can replace natural vegetation and lead to severe homogenisation of plant communities.

Finally, the close ties between people and their land are likely to be lost if an increasing number of people leave to live in cities or other countries. This, in turn, may shake the foundation of sustainable development, because to date, people and nature have lived in a tightly coupled social-ecological system: the landscape has provided benefits to people, and people, in turn, have looked after the landscape.

IMPLICATIONS FOR CONSERVATION MANAGEMENT

Based on our experience, we suggest addressing biodiversity conservation in Southern Transylvania through a combination of two complementary strategies: a broad and shallow strategy, and a deep and narrow strategy. Both of these strategies need to recognise the social-ecological context in which conservation takes place.

Broad and shallow conservation will target the entire forest-farmland mosaic. Conservation measures at the landscape scale should attempt to maintain certain proportions of different land use types, should promote large-scale connectivity, maintain complementary and supplementary habitats of different species, and maintain gradients in land cover heterogeneity and woody vegetation cover.

Deep and narrow conservation will target species of conservation concern, and focus on particular land-use types, threats, or traditional land uses. Under this strategy, conservation approaches need to be specifically tailored for different species and locations (e.g. for the Corncrake, the Brown Bear, or for traditionally managed grasslands).
At a broader level, conservation measures will only be successful if the two main types of land use change – land use intensification and land use abandonment – are carefully managed. Notably, these two threats are likely to play out in different locations (see also Chapter 10). Land abandonment is likely to be more prevalent in remote areas and on steep slopes, especially in pastures. It could be mitigated by providing incentives to main-

tain livestock grazing and regularly remove shrubs. In contrast, intensification is more likely to occur in easily accessible arable land. Here, the retention of woody vegetation cover should be a key priority.

Ultimately, the persistence of biodiversity in Southern Transylvania will depend on navigating social-ecological change in a way that seeks to not only maintain biodiversity but also benefit local people. Traditional farming practices have become largely unviable. Despite this, conventional conservation policies have taken a 'preservation approach', where financial incentives are provided for people to maintain traditional practices. Such strategies, however, may fail in the long term, because they do not account for socio-cultural ties with the natural environment – people are financially encouraged to maintain aspects of the past, but no attention is paid to non-financial aspects of human-nature relations. This lack of attention to non-financial aspects has been a serious shortcoming of conservation policy in the past. For example, our research showed that people do not tolerate bears because of economic benefits but because of cultural values ascribed to them.

Rather than rigidly trying to preserve the current state of Transylvania, we believe it would be worthwhile to foster new, strong links between the social and the ecological parts of the system (Fig. 7.7). This would re-vitalise genuine connections between people and the environment, and benefit both social and ecological processes. To this end, options may include the broader uptake of agro-ecological and organic farming as well as the development of agro-ecotourism. Because people may have aspirations for the future that are different from those prioritised by conservationists, community participation and the support of bottom-up driven initiatives will be essential to design lasting conservation strategies. This, in turn, requires a sound understanding of local people, their problems, and their aspirations – issues we will deal with in the following chapters of this book.

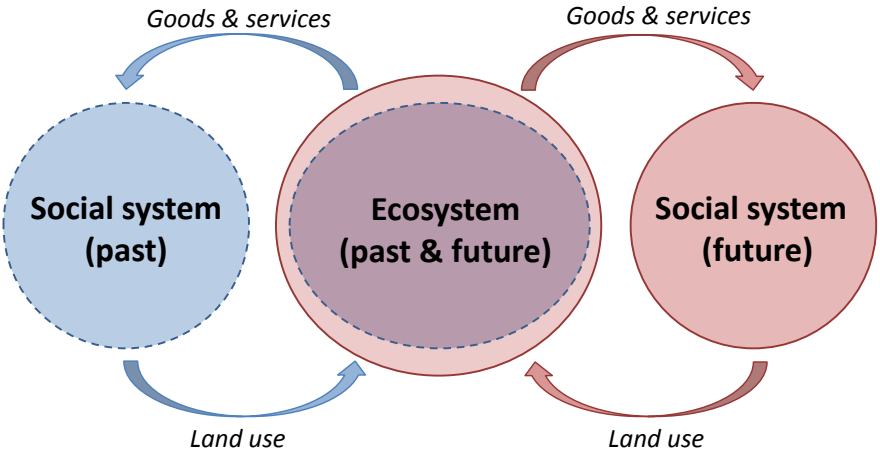

Figure 7.7. Rather than preserving the past state of the social-ecological system (dotted blue lines), we believe it would be worthwhile to create new links between people and their environment (solid red lines). Such links need to foster human well-being as well as biodiversity conservation.

Key messages

- Transylvania's high farmland biodiversity results from there being a variety of land cover types, which are used at low intensity and arranged in a small-scale mosaic.
- Both agricultural intensification and land abandonment would threaten biodiversity because these processes are associated with landscape simplification.
- Social changes could weaken the strong cultural ties between people and the environment.
- Broad and shallow conservation measures are needed across the landscape to protect biodiversity. These should be complemented by deep and narrow measures for particular species or locations.
- Conservation needs to work with local people.

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CHAPTER 8: GOVERNANCE CHALLENGES

As introduced in Chapter 1, we conceptualised the region of Southern Transylvania as a social-ecological system – that is, a set of interlinked social and ecological components. Humans modify the environment through their actions, but in turn also gain multiple benefits from it.

Most, if not all, human action in relation to the environment is governed by "institutions". Broadly interpreted, institutions are the formally and informally sanctioned rules and norms of a society that determine how decisions are made, and how responsibilities are shared. In this way, institutions shape governance, which can be considered as the processes through which power and authority are exercised. Governance takes place at various levels on a jurisdictional scale, from the local to the national and supra-national (e.g. EU) level. Notably, policy decisions taken at higher levels can substantially shape development at regional or local levels.

For Transylvania, the most notable higher-level influence stems from the EU. With Romania's accession to the EU in 2007, Transylvania became part of a complex multi-level governance system. This means that EU institutions, but also non-governmental and private actors now influence decision-making in numerous ways. In addition, local governments have (compared to the communist period, see also Chapter 2) gained greater authority through a process of decentralisation. The change from a communist system to a democratic society within the EU has not been without challenges. A new "European" governance system met a political culture shaped by a history of central control, state-led decision making, weak public participation, and the suppression of non-state actors.

The current governance system of Southern Transylvania is strongly influenced by EU law and international (agricultural) markets, and influences both rural development and biodiversity conservation. For example, in its directives and policy strategies, the EU has committed itself to halt biodiversity decline by 2020, and to foster people's living standards in rural areas. In addition, with Romania's integration into the EU, the domestic agricultural sector - once dominated by small-scale farming - has come under pressure. Among the most important effects have been a decline in subsistence agriculture and various changes in long entrenched institutions governing land use (e.g. communal grazing; see Chapter 9) – often with negative consequences for both traditional farming communities and farmland biodiversity.

CAUGHT IN A DEVELOPMENT TRAP?

In our project, we not only considered the region's biodiversity or 'natural capital' (Chapters 4-7), but also the state of village infrastructure (built capital), people's access to financial capital (loans, savings), and the level and quality of education (human capital). Besides, we investigated the level of trust and cohesion in the community (social capital) and the state of local traditions such as architecture (cultural capital). In many villages, it appeared that most of these capitals or 'livelihoods assets' were in relatively poor condition

(Fig. 8.1). This, in turn, resulted in multiple and interacting barriers to rural development. For example, many of our interviewees felt that due to low salaries, the work ethic of local people was often low, which subsequently meant that low-quality infrastructure was not being improved. Likewise, due to low incomes and a general sense of poverty, people felt reluctant or incapable to actively invest in rural development. Similarly, due to a widespread lack of off-farm jobs and a weakly developed education system, the aspirations of young people for well-paid jobs were often not met. As a result, many young people now migrate, sometimes seasonally, to major cities elsewhere in Romania or even to other European countries – thereby causing a further drain of human resources from the region.

Figure 8.1. In many Transylvanian villages, infrastructure is in a poor state. Despite potential benefits to biodiversity (see Chapter 6), unsealed dirt roads can represent a barrier to rural development.

The relatively low levels of capital stocks or livelihood assets appear to be further maintained by a challenging socio-political and institutional context. Villagers reported poor information transfer from authorities to local people, a lack of transparency in decision-making, and corruption in various local governments. In combination, the low levels of most capital stocks (human, social, built and financial) pose a risk to the careless over-exploitation of the region´s natural and cultural capitals. It thus appears that many Southern Transylvanian villages are currently "trapped" in terms of rural development. Escaping this trap will not be possible by just focusing on one of the capital stocks in isolation. For example, just tackling corruption is unlikely to be sufficient to improve development; similarly, just improving infrastructure will not be enough. Rather, escaping the rural development trap will require a concerted effort focusing on all kinds of capitals at the same time – improving human, social, infrastructure and financial capital, while also respecting and maintaining natural and cultural capital.

THE ROLE OF EU RURAL DEVELOPMENT POLICY

One of the most important policies affecting Southern Transylvania is the EU Common Agricultural Policy, and especially its "rural development pillar". We found that some measures under the Common Agricultural Policy were intended to support small-scale farming, but were ineffective because of how they were designed or implemented. For example, certain policy measures require farmers to form farming associations to receive funding. However, because the region's social capital is generally low, many farmers are reluctant to join such associations, and as a result, funding cannot be accessed. Similarly, financial support for small-scale farming requires considerable bureaucratic effort, but the process is simply too complicated for many local people. Moreover, some production-oriented funding instruments inadvertently promote the intensive use of pastures or agricultural land, thereby fostering biodiversity loss and competition for land (Fig. 8.2; see also Chapter 9).

Figure 8.2. Despite some funding available for small-scale farming, many aspects of the EU Common Agricultural policy support agricultural intensification.

Local people´s actions, but also the institutional context in which they operate, are thus driven by a combination of external policy incentives, economic realities brought about by globalisation, and the EU's policy goals. This combination translates into contradictory challenges: On the one hand, Transylvanian people are incentivised to follow a "production for profit" logic. On the other hand, they are asked to conserve the region's cultural and natural heritage. Our research revealed that development and conservation are often perceived as separate goals, whereas, we argue, a sustainable future should be based on the integration of both.

WAYS OUT OF THE DEVELOPMENT TRAP

Despite its declared goal to safeguard biodiversity, much of current EU policy erodes important activities of the primary caretakers of the land – smallholder farmers. Some regulations are meant to support traditional agricultural practices, but bureaucratic burdens are high and poorly communicated, so that many smallholder farmers remain unaware of schemes that could financially support them in their work.

Two tangible steps towards a better future for both people and nature are improved information flows on the one hand, and careful adjustment of EU policy to Transylvania's 'rural realities' on the other hand. Bridging EU and local levels of governance can be facilitated by further empowering local communities, for example through training events, better education, and continued support through local non-government organisations. In this way, local communities and other relevant actors can work together to share knowledge and information, while at the same time lobbying for the adjustment of policy at higher levels.

Key messages

- Romania's political system changed from a centralised, communist system to a less centralised, democratic system. The transition between old and new institutions and ways of governing can be challenging.
- EU policy has a major influence on rural development in Southern Transylvania. A key challenge is to balance biodiversity conservation and economic development.
- The rules and structures imposed by the EU often do not fit local realities, and may need to be adjusted in the future.
- Various important assets in Southern Transylvania are in a poor condition (e.g. infrastructure or education), and this can pose barriers to rural development.

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CHAPTER 9: PEOPLE AND THEIR CHANGING RELATIONSHIP TO THE ENVIRONMENT

The most important constituents of Southern Transylvania's social system are its local inhabitants. We were interested in better understanding how people relate to their environments – and how this relationship is changing. To this end, we talked with local people from many different walks of life. Drawing on these interactions, this chapter synthesises the diverse opinions by local people on the environment, and the different ways in which they interact with it. A key finding is that both people's values and the broader socio-economic context will be critical in shaping the future of Southern Transylvania.

HOW LOCALS PERCEIVE THEIR ENVIRONMENT: LANDSCAPE ASPIRATIONS

Local inhabitants of Southern Transylvania relate to the environment in many different ways. Our research showed that different groups of people emphasised and prioritised different roles of the natural environment. We summarised these different "landscape aspirations" in five main viewpoints (Figure 9.1).

Figure 9.1. Photos illustrating different, potentially conflicting, landscape aspirations: (1) landscapes for prosperity and economic growth; (2) landscapes for traditions and balanced lifestyles; (3) landscapes for human benefit; (4) landscapes for farming; and (5) landscapes for nature.

First, some local residents favoured landscapes for prosperity and economic growth. This group of people tended to think that the environment should, first of all, be put at the service of development. People sharing this viewpoint were willing to accept potential trade-offs associated with greater economic prosperity, such as losses of cultural and natural heritage. Other local residents had aspirations to maintain traditional landscapes. These individuals saw the environment as a way to maintain their cultural identity and traditions. Non-material benefits from nature, such as sense of place, cultural heritage, spiritual values,

and cultural diversity, were important to this group of people. A third group of inhabitants felt that landscapes should fulfil human needs, for example for food, water and recreation. A fourth group believed landscapes should be managed mainly for farming purposes, and these people envisioned farming as the most important way to achieve prosperity. Finally, a last group of people saw the main value of the landscape in providing a place for unspoiled nature, and believed it should be kept as such. People with this viewpoint appreciated green scenery, recreation in nature, as well as the aesthetic qualities of the environment.

These different landscape aspirations ranged from traditional to modern, showing that within the local population of Southern Transylvania, there are people longing for modernisation, while others would prefer to maintain customs and traditions. Similarly, local people disagreed on the type of farming that was preferred – ranging from revitalising traditional, small-scale farming practices to agricultural modernisation and intensification. Such disagreements suggest that exchanges of ideas will be needed between groups and individuals with an interest in cultural and natural heritage preservation, and other residents who seek modernisation. Notably, extreme points of view – such as those romanticising the past or those seeking agricultural modernisation at all costs – may prove untenable in the long run. Rather, it would be useful to foster the development of new ideas for integrated, multifunctional landscape management.

CONTEXTUAL FACTORS INFLUENCING THE PEOPLE-ENVIRONMENT RELATIONSHIP

An additional important aspect of human-environment relationships is that not all people depend on the environment, or benefit from it, in the same way. Goods and services from nature, such as hay, pastures, freshwater, or honey, are not distributed evenly among local people. To investigate who benefits from nature in which ways, we differentiated between five different groups of inhabitants. Smallholder (semi-subsistence) farmers have low numbers of cattle and sheep and work relatively small areas of land. They have no major source of income other than farming. Large farmers have a lot of animals and use bigger areas of arable land than other villagers. Locals with a substantial non-farming income include shop owners, mechanics, people working in industry, commuting to nearby towns, or working abroad for part of the year. Locals receiving state salaries include mayors, policemen, priests and teachers. Poor people receive social assistance, and sometimes work as day labourers.

These groups of people differ in how they derive benefits from nature, as well as in their capabilities and barriers in accessing these benefits. Based on workshops with people from the different groups we identified six factors explaining the inequities between people (Fig. 9.2). First, natural conditions refer to the capacity of ecosystems to provide benefits to people – for example, one pasture may be degraded while another may be in good condition. People who can access a non-degraded pasture will be able to derive higher benefits. Second, policies and institutions (Chapter 8) specify the rules by which benefits from nature are distributed, and some groups are naturally more able to take advantage of these rules. Third, social and power relations among beneficiary groups can influence who has access to various pieces of land or environmental benefits. Fourth, our research revealed the importance of individual strategies for well-being. That is, the livelihood choices, capacities, interests and

actions of different individuals affect how ecosystem services are accessed, and to what extent they contribute to individual well-being. Fifth, local perceptions about equity seemed to be crucial. Many people felt disempowered with regards to farming and believed that the rich were being favoured, and therefore had a fatalistic view on inequity. This fatalistic view meant that many locals tended to regard the wants of the rich and powerful as more important than the needs of the poor – thus giving the rich a distorted kind of legitimacy in their privileged access of ecosystem services. Finally, we found that the values held by individuals also mediated how they thought about accessing ecosystem services. Working the land, in particular, was widely seen as important, not only for the sake of profit, but also because it was considered a good and proper way of earning a living. In combination, these six factors tended to favour large farmers, and even landholders from outside the region controlling land in Transylvania. In contrast, through a mixture of formal institutions and the current cultural context, smallholder farmers are often disadvantaged in accessing ecosystem services.

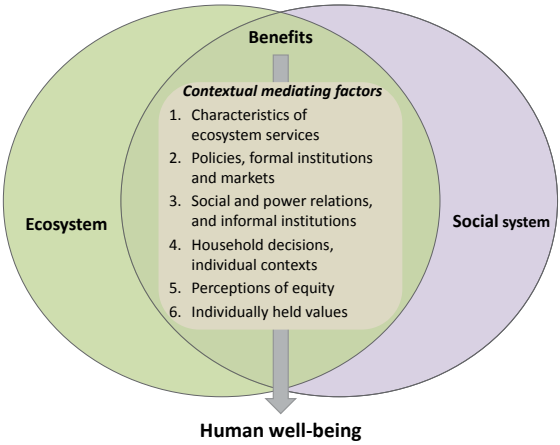

Figure 9.2. Summary of six key factors found to influence the contribution of ecosystem services to human well-being in Southern Transylvania.

CHANGING VALUES, CHANGING LANDSCAPES?

The way people relate to their environment is strongly influenced by their values and principles. As discussed above, two of the most common observations we made during our research were that people highly valued working the land as a proper way of making a living, and highly valued a well-maintained farming landscape. We believe that these values stem from the experiences of generations of local people engaging with the landscape – but they also highlight that landscape change may affect not only the ecology of Transylvania, but also the deeply engrained agrarian identity of Transylvanian people. Although values of working and maintaining the landscape probably helped to foster deep connections between people and nature in the past, these values are now at risk of being eroded by externally imposed national and EU regulations and financial incentives.

One of the most visible shifts in values is that many local people now value primarily those aspects of ecosystems that directly lead to money or marketable commodities. Recent policy measures such as agri-environment payments and other financial incentives (e.g. pasture subsidies) appear to be taking a toll on both the practice and appreciation of traditional farming activities. Partly as a result, conflicts now occur in many Transylvanian villages around accessing incentive payments. The changing use of pastures is a good example for such conflicts.

THE CHANGING USE OF PASTURES

In Southern Transylvania, pastures were historically managed as common property that was shared among villagers. This was perceived effective and efficient, and meant that the benefits of pastures were widely shared. However, with accession to the EU, the governance and management of pastures has changed. Today, most pastures are owned by town halls and leased out to farmers. Importantly, financial support available to cattle and sheep owners now incentivises people to have access to as much pasture as possible, so as to increase their numbers of livestock. This trend is pronounced, and even people who in the past had little to do with grazing have now purchased cattle and seek access to pastures – raising livestock has become an opportunity to make a more prosperous living. Yet, increased demand for pasture land has driven the progressive encroachment of the commons, and in some villages, has even led to their disappearance. Today, several pastures are "shared" in ways that benefit only very few people, often those who had higher levels of wealth to start with. When locals talk about how pastures are being shared, many mention corruption, and many acknowledge that communal ownership was more favourable to the poor than the current situation.

Our findings emphasise the need to understand people's beliefs and values because these underpin the governance of the landscape. Maintaining the multifunctionality of Southern Transylvania will require addressing both social needs and ecological conditions. Financial incentives are external drivers that influence human behaviour – but internal motivators such as cultural and aesthetic values play an equally important role in supporting biodiversity conservation in the landscape.

Key messages

- People relate to their environments in many different ways: Some favour economic development and modernisation, while others prefer to maintain local traditions.
- People benefit from the environment in different ways, either directly or indirectly.
- The extent to which people benefit from the environment depends on the ecosystem itself, but also on how it is governed, as well as on the values and beliefs of local people.
- The relationship of local people to the environment appears to be changing towards a preference for those elements of the ecosystem that promise a monetary benefit.
- Both people's values and the broader socio-economic context will be critical in shaping the future of Southern Transylvania.

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CHAPTER 10: THE FUTURE OF SOUTHERN TRANSYLVANIA

Visitors to Transylvania are invariably fascinated by its many remnants of pre-industrial rural live. Transylvanian villages are made up of traditional farm houses, typically built alongside small roads, and often overlooked by medieval fortified churches. People grow their supply of vegetables in their gardens and get drinking water from wells, which are usually located in the backyards of their houses. Shepherds and their dogs watch over sheep in the pastures, and many small fields are still ploughed using horses and weeded by hand. Horse carts remain a common sight, and after work, people meet in the street to exchange news. While most villages are situated in valleys, the hilltops are covered by forest that is home to wildlife such as deer, wildcats, bears and wolves.

A LANDSCAPE IN TRANSITION

These features of traditional farming landscapes, which used to be widespread throughout Europe, contrast sharply with many signs of modern life (Fig. 10.1). Many villagers own cars and mobile phones, or modernise their houses. The more affluent farmers have tractors and apply agro-chemicals to their fields. Pastures that used to be common property are now being rented to private individuals, and agricultural subsidies from the European Union provide important cash income to many farmers (see Chapter 9). Increasingly, roads are paved, and villages are getting connected to running water (see Chapter 8).

Figure 10.1. Villages in Southern Transylvania feature a broad mixture of characteristics: traditional and modern, poor and rich, rural and urban.

This stark contrast of old and new highlights that Southern Transylvania is a landscape in transition (Fig. 10.2). Over the last 30 years, the area has undergone a series of dramatic changes: Communism came to an end, the vast majority of Saxons left, Romania entered the European Union, and the new rules of a market economy took over. Many villages still suffer from an emigration of young people, who move to Romania's cities or Western Europe to find employment (seasonally or permanently). Especially in the more remote areas, many fields and houses are being abandoned. Different patterns can be observed in the more accessible parts of the landscape. Here, land use is in the process of being modernised, following a trend of agricultural intensification similar to that previously observed in Western Europe.

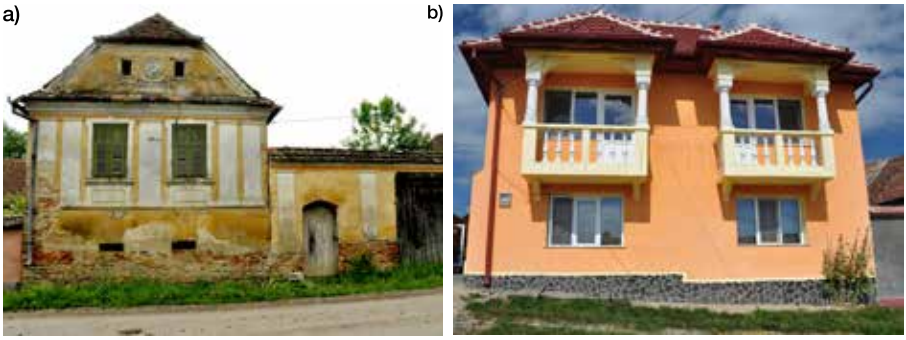

Figure 10.2. Many traditional houses are in poor condition, either because the owners cannot afford to maintain them or because they are abandoned. Contrasts in living standards can be very high, even within single villages – while some people can afford to build new (b), modern houses, others live in very basic conditions (a).

The major structural changes of the last few decades, in turn, have undermined the viability of small-scale farming. With the rise of a market economy and a desire for greater material wealth, for many people, semi-subsistence farming is no longer a desirable livelihood strategy. This has led to emigration, agricultural land abandonment and poverty. Alternative livelihood strategies exist in principle, such as intensified, market-oriented agriculture or income diversification (e.g. via eco-cultural tourism), but these alternative strategies are difficult to realise in practice. Poor infrastructure, a lack of social and financial capital, conflicts, crime, and poor education create a vicious cycle for many rural households and communities that is difficult to escape from (see Chapter 8). Moreover, the demise of small-scale farming has ecological consequences. Land abandonment, agricultural intensification, and exploitation of forests are driving the loss of the region's biodiversity (see Chapters 4-7; Fig. 10.3).

In combination, the various changes currently taking place pose a threat to Transylvania's unique cultural and biological diversity (Fig. 10.4). Of course, nobody can stop change – Transylvania in its current condition cannot be preserved, and perhaps it would not be good to conserve everything the way it is, either (see Chapter 7). But what will the future bring for Southern Transylvania? Will Transylvania remain a good home to both people and wildlife at the same time? Will it continue to provide its people with food, a

Figure 10.3. Farming in Southern Transylvania has many faces. In the fields, farmers grow maize, cereals and Alfalfa. Pastures are used to rear livestock such as sheep, cows and goats, and hay meadows provide fodder for winter. Settlements are surrounded by vegetable gardens and orchards of Apple, Plum, Pear and Walnut trees. Small vineyards are planted on some of the sunnier slopes.

cultural identity and a sense of place, as well as harbouring ecological treasures? How can communities escape from the vicious cycle of poverty and corruption, and what can be done so that many locals (and not just a few) benefit from the future?

Figure 10.4. Artistic depiction of Southern Transylvania in its current state. It is a hilly landscape that is characterised by small-scale agriculture, hay meadows and pastures. Villages are situated along small streams, and hilltops are covered by forest. What might this landscape look like in the future? (Image: © Jan Hanspach)

EXPLORING FUTURE TRAJECTORIES

Of course, there is no way of knowing what will happen. Yet, it is possible to imagine possible future trajectories, and explore their characteristics and impacts in order to work towards desired outcomes or to prevent undesired outcomes. One particularly useful approach to explore the future is called "scenario planning". Scenario planning has been used in a wide range of circumstances (from the military to multinational corporations), and can be used to develop a structured understanding of a highly uncertain future.

Together with 18 local organisations and individuals, we conducted a scenario planning exercise for Southern Transylvania. We developed four different scenarios that describe possible future conditions in 30 years from 2013. Stakeholders represented many different interests including farming, forestry, politics, religion, nature conservation, social issues, and tourism. Based on stakeholder input, we first developed an understanding of regional system dynamics and important drivers of change (Fig. 10.5). These findings highlighted, among others, that the low profitability of small-scale farming was one of the most important drivers of change in the region.

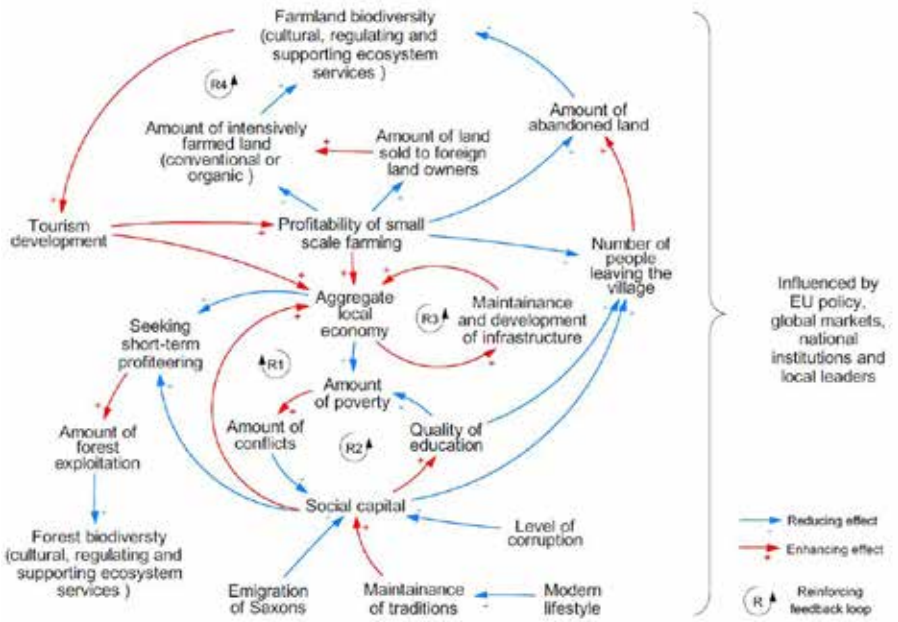

Figure. 10.5. Based on workshops with local stakeholders we developed a social-ecological systems understanding, which is summarised in this diagram. The diagram shows key socio-economic and ecological conditions and how they influence one another. Arrows depict either reducing or enhancing effects. The system includes four different reinforcing feedback loops (R1-R4) which are strengthening some of the changes taking place (e.g. in R3, poor local economic conditions lead to a deterioration of infrastructure, which in turn negatively influences the local economy).

Based on the resulting systems understanding, we identified two themes that were seen by stakeholders as important, but whose future impacts on the region were highly uncertain. First, will national and European policies continue to favour economic development – or will policies prioritise environmental sustainability? Second, will locals be able to self-organise, co-operate, solve conflicts, share information, and access funds together – or will they be unable to capitalise on potential development opportunities? By combining these two themes, or areas of uncertainty, we set up a matrix depicting four plausible scenarios of the future (Fig. 10.6).

Figure 10. 6. Overview of four scenarios developed for Southern Transylvania. The two main factors that were found to be highly influential, but also highly uncertain, for the future of Southern Transylvania were national and EU policy emphasis, and the ability of locals to capitalise on development opportunities.

Figure 10.7 provides a visual representation of what Southern Transylvania may look like under different scenarios. In the first scenario, "Prosperity through growth", the policy emphasis is on economic development, and local people make full use of the available incentives. As a result, small-scale farming is replaced by intensified, larger-scale, conventional agriculture. Forests are exploited where profitable, and tourism is restricted to the entertainment sector. Economic development is driven by local people, and consequently, people are wealthier than they are at the moment. However, these developments cause losses in farmland and forest biodiversity, as well as the deterioration of many ecosystem services.

In the second scenario, "Our land, their wealth", the polities also prioritise economic development – but as a community, local people fail to make use of the opportunities that present themselves. In this scenario, land use is also intensified and also causes the loss of many ecosystem services. However, economic development is driven by foreign investors, and consequently, few locals benefit from it. The gap between rich and poor widens. Crime and conflicts are frequent, including between ethnic groups. People leave their villages for Romanian towns or Western Europe, and most farmland that is unprofitable for foreign companies is abandoned. Due to the difficult socio-economic conditions and a highly disturbed landscape, tourism all but vanishes from Transylvania.

The third scenario, "Balance brings beauty", describes a future in which policies prioritise the environment. Local people work together, and hence are able to capitalise on high national and international demand for organic agricultural products. Sustainable use of resources co-exists with intensified land use via modern organic farming methods. Vibrant cultural tourism and eco-tourism stabilise people's incomes from the agricultural sector.

Figure 10.7. Visual summary of four scenarios developed for Southern Transylvania. From top to bottom, the scenarios are "Prosperity through growth", "Our land, their wealth", "Balance brings beauty", and "Missed opportunity". The scenarios are described in detail in the text. (Images: © Jan Hanspach)

Although few people are financially wealthy, economic and social inequalities are reduced, and community spirit is high. Cultural and natural capital is valued and actively maintained.

In the fourth scenario, "Missed opportunity", locals are unable to capitalise on the opportunities provided by a pro-environment policy setting. Instead, foreign companies set up modern organic farms in the region, exploiting easy access to cheap land and labour. Semi-subsistence farming as it has been practised for many decades continues in the villages, while forests are exploited for firewood and sometimes logged illegally. Most locals are poor, and those who are able to, leave the area. Corruption, crime, and conflict are common. Farmland biodiversity experiences moderate decreases due to intensification in some areas and abandonment in others.

Each of these four different scenarios presents particular threats and opportunities for the social-ecological system of Southern Transylvania as a whole. For example, intensification of agricultural production is, at least to a certain degree, likely across all scenarios, leading to a likely loss of farmland heterogeneity and biodiversity. On the other hand, some trends may occur only locally or in certain scenarios. For example, social capital and tourism development are particularly strong in the scenario "Balance brings beauty". In contrast, land abandonment is likely to be most prevalent in the scenarios "Our land, their wealth" and "Missed opportunity", and most likely would affect primarily the more remote and rugged parts of the region.

SHARING THE SCENARIOS

The scenarios described above were not meant to tell local people which future is best, or what they should do – this, we believe, is something that is not up to researchers to say, but should be for local people to decide. Rather, we wanted our scenarios to trigger discussions among local people, so that a more informed and engaged community of people can proactively work towards whatever it perceives to be a desirable future.

To facilitate information sharing and community empowerment, we communicated our research findings to many different stakeholders and villagers in Southern Transylvania. In spring 2014, we went on an "outreach tour" to share our project results, including the scenarios described above. We travelled to 17 villages that we had studied in depth, and invited local people, mayors, and children from the local schools and kindergardens to look at posters, take postcards showing the scenario artwork, and discuss their perspectives on the future of Southern Transylvania. Among other activities, we asked people visiting our exhibitions to "vote" for their preferred scenario. The vast majority of people preferred the scenario "Balance brings beauty" to the other scenarios. This finding was confirmed in interviews that we conducted with 24 local NGOs and actors on their preferred scenarios. Consistently, they ranked "Balance brings beauty" as the most desired scenario, and "Our land their wealth" as the least desired scenario. Stakeholders highlighted the desire for improved income opportunities and the maintenance of cultural and natural heritage. Beyond this shared vision, however, opinions differed with regard to what would be the second most desirable scenario – while some stakeholders favoured an emphasis on economic development, others felt that environmental sustainability was more important.

Overall, the outcomes of the scenario planning process highlighted three key issues. First, current social-ecological conditions and development trends originate from the combination of particular biophysical conditions in a given location and historical events. Second, external factors such as national and EU policies are likely to have major effects on the general trajectory of the region. However, third, local social factors, such as education, leadership, and the presence of bridging organisations that link different stakeholders, can make a big difference to the future of any given village, or even for the region as a whole. Hence, while the future is uncertain, there is plenty of room for the people living and working in Southern Transylvania to help shape it – ideally, in a way that benefits local people as well as the environment.

Key messages

- Together with local stakeholders, we developed and visualised four plausible future scenarios, which were grounded in an understanding of regional system dynamics.
- These scenarios considered two critical uncertainties: 1. A policy emphasis on economic development versus environmental sustainability; 2. The ability or inability of local people to capitalise on emerging development opportunities.
- Each of the resulting four scenarios presents different threats and opportunities for the social-ecological system of Southern Transylvania.
- The scenarios illustrate that national and EU policies will have a strong impact on the trajectory of Southern Transylvania's future.
- However, local social factors, such as collaborations, leadership and education, can also make a big difference for rural development.

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CHAPTER 11: REFLECTION AND OUTLOOK

This book has summarised some of the most important outcomes of our five years of interdisciplinary research in Southern Transylvania. In some ways, this book has only scratched the surface – and we encourage interested readers to delve more deeply into our work by consulting the publications listed at the end of every chapter. In this chapter, we synthesise key take-home messages that are particularly relevant to local people and organisations, to scientists working in Transylvania, and to policy-makers from the local to the European level. But before we come to these, it is worthwhile to briefly summarise our most important ecological, social, and social-ecological findings.

With respect to its ecology, our research confirmed that Transylvania is one of Europe's most fascinating areas. No matter whether we investigated plants, birds, butterflies or forest mammals – many species that are rare elsewhere are still common in Transylvania. Key drivers of this biodiversity are the large amounts of land covered by forest, grassland and arable land – all of which are well connected to one another, and are used at low intensities. Moreover, Transylvania stands out against the rest of Europe through its unusually high landscape heterogeneity. It is this mosaic of fields, field margins rich in shrubs and flowers, and extensive grasslands and forest patches that make the landscape home to large numbers of a wide variety of plants and animals. However, Transylvania's ecology hinges, more than anything, on future changes in its social fabric.

In terms of the social system, our research uncovered many drivers of change. These range from a changed political system, to changed economic incentives, to changes in the values of local people. Each of these, in turn, will shape the future of Transylvania, and in all three spheres, this future is anything but certain. In terms of political changes, Transylvanians are still feeling the legacy of Saxon culture and institutions, as well as the (far less pleasant) legacy of one of Europe's most repressive dictatorships. While Transylvania's Saxon history gave continuity and a sense of order, the communist period has a lot to answer for in terms of many of the current struggles, including low social cohesion in many (but not all) villages, a general sense of mistrust, and in some cases, corruption. This political history intersects with an opening towards Western Europe – formalised in 2007 through Romania's accession to the European Union. An opening to the West has meant opening towards its markets and policies. Compared to the economically productive Western agricultural systems, traditional smallholder farming is seen as unprofitable, and financial incentives by the EU now fundamentally shape agricultural development. Finally, it is not only the economy that is changing. For better or worse, people's ways of thinking are increasingly "westernised" as well, meaning that more and more local people see a good life primarily as one of greater material wealth. Traditional values, such as an ethic of working the land, are slowly getting eroded.

Social-ecological linkages thus manifest in a number of different ways. There are direct links, such as land use, which in turn, are strongly influenced by financial incentives, such as various EU subsidies. But the social-ecological linkages in Transylvania are more than just land use, and go deeper than financial incentives can reach. Our work and experience

in Transylvania suggest that a significant part of its sustainability to date stems from people having lived in, of, and with nature for centuries – and hence, people's ways of living, using the land, and value systems have co-evolved with the landscape. For Transylvania to have a bright future, it is therefore necessary to address the landscape as a whole – to manage it as a social-ecological system – and to think about local people just as much as about all the rare species that are worthy of conservation. A simple rule in complex systems is that different parts of the system cannot be managed in isolation, because the various system components are linked and interact.

So what does this mean? For local people and organisations, it is critically important to engage with the many different understandings and visions for the future. Our work highlighted that Western-style modernisation is favoured by some people, while others prefer to remain more deeply grounded in the traditions of the past. Such disagreements are normal and should not come as a surprise. Arguably, what would be most useful for Transylvania at the moment is simply an emphasis on building a stronger civil society and culture of civic engagement. Our work on scenarios showed that once people come together, they quickly identify options that are clearly undesirable for the vast majority of local people – such as vast tracts of land being used by foreign investors for intensive agriculture. To start with, regarding local communities, we therefore believe the emphasis needs to be just as much on process as on outcomes; making sure everybody is heard, and feels safe and able to express their views on what the future of Transylvania should look like.

For scientists working in Transylvania, this can be challenging. It may mean needing to depart quite significantly from traditional modes of knowledge generation and sharing (Fig. 11.1). Traditionally, scientists have often operated in isolation from local people, and have sought to generate objective, incontestable knowledge. In the spirit of a transdisciplinary research approach, however, scientists need to engage with local communities. This takes considerable patience, and for many scientists, it is not what they have been trained to do. Nevertheless, we believe this approach will ultimately be more worthwhile, because it can ensure that the knowledge that is being produced is relevant to local people and decision-makers.

Finally, policy makers in Transylvania need to recognise the interlinked nature of the many sustainability problems facing local communities. Despite a history of managing agriculture, social well-being, and conservation in different sectors (or even ministries), our research demonstrated very clearly that linking across sectors will be vital to overcome current challenges. A big push in any area on its own is likely to fail, unless the dependencies between sectors are carefully analysed and managed accordingly.

Fig. 11.1. In May 2014, we presented research results via posters, presentations and booklets to locals in Southern Transylvania. All of our outreach materials are available online (visit http://peisajesustenabile.wordpress.com/).

Similarly, policy without people will fail. Already, mistrust towards officials in Southern Transylvania is high. While isolated short-term outcomes can perhaps be achieved without full buy-in from local communities, long-term change will require close collaborations between policy makers and local people. Last but not least, policy makers at the EU level need to be cognisant that ideas deemed suitable for one part of Europe (often Western countries) may backfire in another part of Europe (such as in Romania). A very worthwhile pursuit therefore is to further strengthen vertical links from local-level organisations to EU policy makers – something that some organisations in Transylvania are already pursuing very actively.

Transylvania can have a bright future if it draws on its key strengths. These are its tremendously rich ecology, its unique cultural heritage, and its people who intimately know and understand the local landscapes. Through these people, and through carefully navigating their aspirations for the future, Southern Transylvania can remain one of Europe's most precious regions.

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APPENDIX

Common name	Latin name
Plants	
Alfalfa	*Medicago sativa*
Apple	*Malus spp.*
Beech	*Fagus sylvativa*
Black Locust	*Robinia pseudoacacia*
Canadian Goldenrot	*Solidago canadensis*
Downy oak	*Quercus pubescens*
Globeflower	*Trollius europaeus*
Hornbeam	*Carpinus betulus*
Large Blue Hepatica	*Hepatica transsilvanica*
Nodding Sage	*Salvia nutans*
Oak	*Quercus spp.*
Pear	*Pyrus spp.*
Plum	*Prunus spp.*
Walnut	*Juglans regia*
Insects	
Clouded Apollo	*Parnassius mnemosyne*
Large Copper	*Lycaena dispar*
Large Blue	*Phengaris arion*
Longhorn Beetle	*Cerambycidae spp.*
Stag Beetle	*Lucanidae spp.*
Birds	
Black Woodpecker	*Dryocopus martius*
Chaffinch	*Fringilla coelebs*
Collared Flycatcher	*Ficedula albicollis*
Corncrake	*Crex crex*
European Robin	*Erithacus rubecula*
Great-Spotted Woodpecker	*Dendrocopos major*
Great Tit	*Parus major*
Green Woodpecker	*Picus viridis*
Grey-Headed Woodpecker	*Picus canus*
Lesser-Spotted Woodpecker	*Dryobates minor*
Middle-Spotted Woodpecker	*Leiopicus medius*
Red-Backed Shrike	*Lanius collurio*
Skylark	*Alauda arvensis*
Amphibians	
Yellow-Bellied Toad	*Bombina variegata*
Mammals	
Brown Bear	*Ursus arctos*
Dog	*Canis familiaris*
Fox	*Vulpes vulpes*
Lynx	*Lynx lynx*
Red Deer	*Cervus elaphus*
Roe Deer	*Capreolus capreolus*
Wildcat	*Felis sylvestris*
Wolf	*Canis lupus*

GLOSSARY

Agency: the capacity of an entity or individual to plan and initiate action.

Biodiversity: the diversity of genes, individuals, populations, species, communities, ecosystems, and the interactions between these entities.

Capital: valuable goods or conditions that are not immediately consumed but can be employed in the pursuit of additional goods or conditions. Capital assets can be financial (credit, income, savings), human (skills, health, knowledge), built (infrastructure, machinery) and social (bonding, bridging ties).

Ecosystem: a set of living organisms interacting with the non-living environment.

Ecosystem services: the various benefits ecosystems contribute to human well-being.

Endemism: the limited distribution of a species to a certain geographic region.

Fauna: the animals of an area.

Flora: the plants of an area.

Food web: feeding relationships between different organisms.

Governance: the processes and structures shaping power and policy, and how actors interact to create and implement rules and norms.

Habitat: the resources and conditions present in an area that produce occupancy – including survival and reproduction – by a given organism.

Institutions: the conventions, and the formally and informally sanctioned rules of a society defining legitimate norms that determine how decisions are made, how power is exercised and how responsibilities are shared.

Interdisciplinarity: an approach to science that draws simultaneously on multiple academic disciplines, such as ecology and the social sciences.

Invasive species: a species that is quickly spreading so that it becomes increasingly dominant and displaces other species. In many cases, the term applies to non-native, introduced species.

Land abandonment: the discontinuation of land use.

Land use intensification: increasing the agricultural output of a given piece of land, for example through shortening fallow times or applying fertilisers.

Livelihood assets: the natural, physical, human, financial and social capital that is used by households or communities to make a living.

Multi-level governance: the way in which governance interacts across vertical and horizontal levels, including state and non-state actors, considering interactions between core and periphery, state and society, and the domestic and international arena.

Natura 2000: An EU-wide network of protected areas established under the Birds and Habitat Directives. The aim of Natura 2000 areas is to assure the long-term survival of Europe's birds, species and habitats. Human activities are allowed within Natura 2000 sites, but should be managed so they do not threaten the site's long-term sustainability.

Social-ecological system: a set of interlinked social and ecological components that interact to shape the landscape.

Spill-over effects: occupancy of a species in a patch that is not its core habitat, typically resulting from movements across borders between land cover types while foraging or moving.

Stakeholder: a person, group or organisation with an interest in an area or project.

Sustainability: a state of long-term, equitable human well-being within Earth's ecological limits.

Transdisciplinarity: an approach to science that actively involves stakeholders in the research process.

As one of the last remaining biocultural refugia in Europe, the Romanian region of Southern Transylvania is experiencing unprecedented changes. For better or worse, these changes influence both humans and the environment. This book summarises the main findings of a five-year, interdisciplinary research project. It analyses Southern Transylvania as a social-ecological system, and reflects on its current and possible future development trajectories.