

# Chapter 1

## Natural Heritage at Risk by Climate Change

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### 1.1 Climate Change as a Threat to Habitat Diversity

The Fourth Assessment Report of the Inter governmental Panel on Climate Change (IPCC 2007a) clearly underlined the existing trend of climate change. It projected future developments with dramatic impacts, such as increasing temperature, changes in both amount and distribution of precipitation, change of the climatic water balance, and the increasing occurrences of extreme events.

These changes will have serious impacts on nature (IPCC 2007b) and endanger the natural heritage that is protected within nature reserves, national parks, biosphere reserves or other protection categories. These facts are already recognised on a European policy level: “Climate change has the potential, over a period of a few decades, to undermine our efforts for the conservation and sustainable use of biodiversity” (European Commission 2006, p. 13).

Current discussions connected to climate change often focus on the prevention or mitigation of greenhouse gas emissions. Even though mitigation of climate change is of utmost importance, protected area administrations as well as nature protection authorities also need support on the political (administration) as well as on the practical level (management) in order to cope with climate change and their adaptation to it. To preserve ecosystems, habitats, and species, as well as their goods and services, for society under changing climatic conditions it is recommended to:

- identify potential climate change and land use-induced threats;
- model regional climate change effects and their potential impacts on protected areas (see Chaps. 2 and 3);
- evaluate existing management practices;

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- derive a set of indicators reflecting local-scale effects of climate change (see Chap. 6);
- establish monitoring concepts based on earth observation data and ground truthing (see Chap. 7);
- assess habitat sensitivity to potential impacts (see Chap. 8);
- analyse existing legal framework for adapted management in protected areas (see Chap. 9);
- adapt management plans, strategies, and measures of protected areas to climate change effects (see Chap. 10);
- implement the findings on a practical level with the help of local experts, as well as fostering public awareness of the policy and stakeholders, and also the demand for adaptive management (see Chaps. 11, 12, 13, 14, 15, 16, 17, 18, and 19);
- provide guidelines for climate change adaptation of protected areas on national and transnational (e.g. EU) level.

These issues were part of the project objectives of “Adaptive Management of Climate-induced Changes of Habitat Diversity in Protected Areas” (HABIT-CHANGE) and will be presented and discussed in this book. Thus, the information about existing problems and solutions on local and regional levels and the experiences of implementing adaptation strategies with all its facets shall be shared. This volume should support other conservation managers in coping with the challenges of climate adapted management.

## 1.2 The Need for Adaptation and Obstacles for Application

The diversity of species and habitats is one of the foundations of life on earth (Barnosky et al. 2012; Cardinale et al. 2012). Therefore, it seems advisable to safeguard biodiversity on Earth from substantial threats like climate change (e.g. McLaughlin et al. 2002; Carvalho et al. 2010; Bellard et al. 2012). Its first effects are already apparent (Parmesan et al. 1999; Root et al. 2003) and the speed of change is increasing (Chen et al. 2011). The impacts of climate change will put additional pressure on the majority of endangered species and habitats. The adaptation of conservation management in the face of such extensive transformations is a pressing need and an ambitious target. Changing climate conditions as well as global transformations are challenging nature protection in general and conservation management on site. To address these challenges new and adapted concepts, tools, and practices are necessary (Dawson et al. 2011; Hobbs et al. 2010). Most methods and tools are already available but need to be used with a new perspective of climate change adaptation in mind (Hansen and Hoffman 2011; Lawler 2009). This could be achieved, for instance, by:

- incorporating climate change in national or regional biodiversity conservation plans (e.g. Groves et al. 2012);
- reflecting potential effects of climate change in the design of wildlife corridors and adapting existing area networks (e.g. Vos et al. 2008);

- including vulnerability to climate change effects as a factor in the development of endangered species lists;
- considering potential effects of climate change in protected area management plans (e.g. March et al. 2011);
- considering potential effects of climate change like shifting distributions within species action plans (Singh and Milner-Gulland 2011);
- assessing the effect of climate-induced changes in carrying capacity in population viability analysis;
- considering potential effects of climate change on habitat restoration plans (e.g. Battin et al. 2007);
- developing habitat restoration plans for habitats that are endangered by climate change effects like sea level rise.

The following chapters exemplify the adaptation of concepts, methods and tools for conservation management. This is illustrated for protected areas located in Central and Eastern Europe.

This book focuses on protected areas because they are a prominent element of conservation schemes worldwide. They safeguard the most treasured biodiversity hotspots and focus conservation action at the local and regional level. Even though climate change is considered a global problem and changes, e.g. in species distribution, become only apparent when analysed on the global or regional scale, it is the individual sites that are the first to feel the effects on endangered species and habitats. During the last years a growing number of parks and conservation sites have made individual adaptation efforts (e.g. March et al. 2011; Littell et al. 2011). These efforts are challenged by the fact that climate change rarely is the only pressure to consider. This is especially true for large conservation sites, such as biosphere reserves, which are characterised by cultural landscapes and influenced by existing land use.

At most Central and Eastern European conservation sites climate change adds to a myriad of existing problems and interacts, either directly or indirectly, with them. Changes in temperature, precipitation, seasonality, or the frequency and severity of extreme events, have direct effects on species and habitats. Indirect effects, however, need to be considered, too. For instance changes in abiotic conditions, like changing river runoff and groundwater regimes or changing phenology, and biotic interactions, have impacts on local biodiversity. In addition, autonomous adaptations of local stakeholders show potential for increasing existing or creating new conflicts. Changing practices in agriculture, forestry, fisheries, or tourism have ripple effects on protected sites and surrounding areas. Improvement of conservation management at site level is needed to handle these new problems.

Projections of future climatic trajectories are accompanied with notorious uncertainties and ecosystem responses are complex due to their non-linear and often unclear relationships between causes and effects of changes, like feedback loops, substantial temporal and spatial lags, and frequent discontinuities (Prato 2008). Most local conservation experts are uncertain when to react and how to

adapt to the impacts of climate change. There is still a lack of transfer from existing scientific knowledge into conservation strategies and measures. Especially, the social effects of climate change and their impact on conservation management are not well addressed, even though they frame its decision context (Heller and Zavaleta 2009).

Most of the available concepts and guidelines for the adaptation of conservation management are lacking connection to local strategies and actions. There is an urgent need for more science-practice partnerships to identify strategies that are robust to uncertainty deriving from climate projections and their ecological consequences. In addition, easy applicable tools are needed that provide no-regret options for adaptation, based on available scientific information.

The adaptation of conservation management is a huge task and has to overcome multiple challenges on local level:

- The lack of resources: local conservation management is chronically scarce of resources like budget and manpower. New challenges like climate change are therefore hard to tackle.
- The lack of expertise in adaptation issues: on a local level there might be several experts trained to identifying effects of climate change, but only few are trained in adaptation issues.
- The lack of guidance to find suitable data and methods: in the last years an overwhelming amount of data and information on climate change and its effects has become available. A plethora of approaches and data has been published making it hard to identify relevant information and useful methods.
- The lack of suitable monitoring methods: signals of local climate change and its effects are hard to distinguish from the noise of natural dynamics. Robust methods helping to disentangle the web of pressures like land use and climate change are still rare.
- The lack of management methods: conservation experts in the field need simple, applicable tools and guidance for decision support in everyday management of conservation sites. They need methods to identify climate change related conflicts, to identify robust adaptation strategies, to choose suitable management measures, and to prioritise action.
- The lack of tools for communication and awareness raising: effective adaptation of conservation management needs to build public, as well as political, support for local adaptation activities. Tools for communication and participation are needed to foster environmental education, to illustrate effects of climate change, to show the relevance of adaptation measures, to guide autonomous adaptation of other land users, and to include stakeholders and the wider public in the adaptation process.

Despite the existing gaps and challenges, local conservation management cannot hesitate to take action and must proceed in the face of considerable uncertainty (Conroy et al. 2011).

### 1.3 Recognition and Adaptation on Higher Spatial and Administrative Levels

The protection of biodiversity and ecosystem services from adverse impacts of climate change is of importance on local and regional levels worldwide (Pérez et al. 2010). Systematic support and guidance by higher policy levels is needed (SCBD 2007). The European Commission adopted an EU strategy on adaptation to climate change in 2013.

Adaptation to climate change is addressed in several recent regulations as well as strategies on EU levels – but it is not yet mainstreamed into all EU policies. Biodiversity, and therewith, the diversity of habitats is one of the focus areas of adaptation. “Biodiversity and climate change” is one of four key policy areas within the EU Action Plan for “Halting the Loss of biodiversity by 2010 – and Beyond”. The Action Plan states that “policies will also be needed to help biodiversity adapt to changing temperature and water regimes” (European Commission 2006, p. 13).

Subsequently, a White Paper on climate change adaptation was issued (European Commission 2009). It emphasises the importance of maintaining and restoring ecosystem integrity and names as actions: “increasing the resilience of biodiversity, ecosystems and water”; the need to “improve policies and develop measures which address biodiversity loss and climate change in an integrated manner to fully exploit co-benefits and avoid ecosystem feedbacks that accelerate global warming”; and, to “draft guidelines by 2010 on dealing with the impact of climate change on the management of Natura 2000<sup>1</sup> sites”. This draft guideline (European Commission 2012) points out the requirement to “review [...] other policies and strategic frameworks in terms of how they could be developed and utilised as part of the integrated solutions that will be increasingly required for climate change management”. It also gives core advices to site managers, e.g. “to develop adaptive management plans” (p. 96).

The EU Biodiversity Strategy to 2020 (European Commission 2011) underlines the importance of addressing climate change in the EU. In order to improve the exchange of information on climate change and measures for adaptation, a European clearing-house for climate change was developed.<sup>2</sup>

Beside the activities of the European Commission other international policy declarations were made. UNESCO’s “Dresden Declaration” acknowledges that climate change mitigation, adaptation to climate change, and the conservation of biological diversity are among today’s key environmental challenges (UNESCO, German Commission 2011). Therefore, biosphere reserves serve as model regions for adaptation to the impacts of this change. Ensuring sustainable land use and

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<sup>1</sup>“Network Natura 2000” according to Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ L 206, 22.7.1992, p. 7) and to Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

<sup>2</sup><http://climate-adapt.eea.europa.eu>

safeguarding ecosystem services are important actions. The declaration demands to “place greater focus on the capacities of the MAB [Man and Biosphere] Programme and biosphere reserves for mitigating and adapting to the impacts of climate change, and [to] improve integrating their contributions into national and international climate strategies and policies”. It also calls for the establishment of “adequate legislative, administrative and institutional frameworks at national and/or local level for biosphere reserves”. At practical level, climate change adapted management plans shall be drawn up and implemented (UNESCO, German Commission 2011).

Further policy documents for adaptation were published by the Secretariat of the Convention on Biological Diversity (SCBD 2003, 2006, 2007, 2009). They: (a) show the connections between biodiversity and climate change mitigation and adaptation; (b) give guidance for promoting synergies among activities that address biological diversity, desertification, land degradation, and climate change; (c) give advice on the integration of biodiversity considerations into the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol; (d) state that maintaining biodiversity should be part of all national policies, programmes, and plans for adaptation to climate change to allow ecosystems to continue providing goods and services.

The interconnections between climate change and biodiversity are considered in many other conventions as well. The United Nations Framework Convention on Climate Change recognises the need to tackle climate change and calls upon the parties to act within a certain time frame that allows ecosystems to adapt to climate change. The World Heritage Committee elaborated a strategy to assist state parties to implement appropriate management responses to climate change. The Conference of the Parties to the Convention on the Conservation of Migratory Species requested their scientific council to afford climate change high priority in its future programme of activities and called on parties to implement, as appropriate, adaptation measures. The Conference of the Contracting Parties of the Ramsar Convention on Wetlands called upon contracting parties to manage wetlands so as to increase their resilience to climate change by promoting wetland and watershed protection and restoration (SCBD 2007).

Finally, guiding principles for adaptation to climate change in Europe were given (ETCACC 2010) and guidelines for protected area legislation were provided, which include “adaptive management” and “managing for climate change” (Lausche 2011).

## 1.4 Investigation Areas

HABIT-CHANGE focused on those habitats of community interest defined by annex 1 of the Habitats Directive (92/43/EEC), which are mainly affected by climate change and land-use pressures. Thus, the project included protected sites consisting of wetland, forest, grassland, alpine, and coastal ecosystems located in Central and Eastern Europe. The administrations of several suitable national parks, biosphere reserves, and natural parks cooperated as project partners (Fig. 1.1) or supported the work as associated institutions.



Fig. 1.1 Location of the investigation areas within Central and Eastern Europe

At site-level, climate change will lead to different conditions for the remaining habitats. Especially affected are water-based ecosystems, such as wetlands and rivers, but also the composition of forested areas and grasslands. Climate change-related impacts can be manifold (Table 1.1). Generally, all areas will be affected by more frequent extreme weather events, warming, changes in species composition and pattern (loss of habitats in the extreme case), migration of species, and expansion of invasive species. These impacts are usually accompanied and partly intensified by anthropogenic influences caused by land use.

## 1.5 Contents of the Book and Case Studies

This book sets out to meet the growing need for sharing knowledge and experiences in the area of biodiversity conservation and climate change. It builds on the results of the transdisciplinary HABIT-CHANGE project. Similar to the project, the book consists of a theoretical/methodical and a case study/practice-based part. It provides an overview on data, methods, models, and plans used within the project sharing the experiences of putting adaptation strategies, management measures, as well as monitoring into conservation action.

The first part of the book provides necessary background information on climate trends in Central and Eastern Europe and their effects on abiotic and biotic components. It discusses climate change-adapted management issues with an

**Table 1.1** Overview of investigation areas, their main ecosystem type as well as climate change-related problems

Investigation area	Ecosystem type	Climate change-related challenge
Balaton Uplands National Park, Hungary	Grassland, wetland, forest	Droughts, water shortage
Biebrza National Park, Poland	Wetland, grassland, forest	Flooding
Danube Delta Biosphere Reserve, Romania	Wetland, forest, grassland	Changed water regime, sea level rise, droughts
Hainich National Park, Germany	Forest, grassland, bog	Forest composition, extreme events (storm)
Körös-Maros National Park, Hungary	Wetland, steppic grassland, forest	Droughts, eutrophication, flooding
Lake Neusiedl/Fertő-Hanság National Park, Austria/Hungary	Wetland (shallow steppic lake), grassland	Droughts, higher water temperatures, growth of algae, loss of ecosystem
Natural Park Bucegi, Romania	Alpine grassland, forest, rocky habitat, wetland	Shifting vegetation zones, changing snow cover
Rieserferner-Ahrn Nature Park, Italy	Alpine grassland, forest, rocky habitat, wetland, glacier	Shifting vegetation zones, glacier retreat, changing snow cover and permafrost
Riverside Landscape Elbe-Brandenburg Biosphere Reserve, Germany	Wetland, grassland, forest	Droughts, flooding
Sečovlje Salina Nature Park, Slovenia	Wetland, coastal area, grassland	Sea level rise, changed hydrological river regime, changes in salinity
Shatsk National Natural Park, Ukraine	Forest, wetland, bog	Changed climatic water balance
Škocjanski Zatok Nature Reserve, Slovenia	Wetland, coastal area, grassland	Sea level rise
Triglav National Park, Slovenia	Alpine forest, grassland, rocky habitat, wetland	Shifting vegetation zones, changing snow cover and permafrost
Vessertal-Thuringian Forest Biosphere Reserve, Germany	Forest, grassland, bog	Shifting woodland vegetation zones, extreme events (storm)

emphasis on topics like “Benefits and limitations of modelling approaches for nature conservation planning”, “Monitoring”, “Legal options and limits for adapted management” and a “Methodological approach to climate change adapted management plans”. The second part introduces case studies from investigation areas in Central and Eastern Europe focusing on habitats most vulnerable to changes of climatic conditions, namely alpine areas, wetlands, forests, lowland grasslands, and coastal areas. The case studies illustrate local impacts of climate change and the application of adaptation strategies and measures in protected areas. Potential benefits, as well as existing obstacles, for national parks, biosphere reserves, and natural parks are presented.



Valuable experiences were gained within the project and are presented in the lessons learned section of this book; existing methods were tested in new context and developed further. To preview a few of the issues that were overcome, three of them are highlighted in the following: (1) remote sensing approaches require a highly site and context specific design of fitting indicators to derive useful results. Short-term indicators can be used, e.g. to monitor the percentage of natural tree types at Natura 2000 sites, and long-term indicators can be utilised, for instance, to monitor the immigration of beech in a spruce dominated region. (2) Legal objectives need to be shifted from preservation and restoration to improving resilience and adaptive capacity. In principle, Natura 2000 law has got a high adaptive capacity. Resilience improvement, however, is not explicitly regulated and will remain the main subject of legal controversy. (3) Adaptation processes need cooperation beyond the protected area administration. The identification of relevant parameters for climate modelling, modelling of sensitivity, and assessments of climate change impacts can only be done with the help of scientific partners. Also, many elements of adaptation strategies and measures cannot be implemented by the protected area management alone. This can only be done in close collaboration with local stakeholders and land users, as well as regional and national institutions and administrations.

## 1.6 Target Audience

First and foremost, this book is targeted at administrations, managers, and practitioners of protected areas. They can benefit from the theoretical and conceptual information about climate change, its impacts, monitoring and modelling, as well as adapted area management and legal issues.

The contents of this book are addressed to nature protection administrations on international, European, national and regional levels; to NGO's working in the field of nature protection and environmental education; and to umbrella organisations focusing on nature protection. These include national authorities and organisations responsible for European regulations regarding Natura 2000 and monitoring in the context of the Water Framework Directive.<sup>3</sup>

Applied research institutions and scientists working on biodiversity, protected area management or climate change are addressed as well.

Finally, stakeholders within proximity of protected areas in Central and Eastern Europe and worldwide are another potential target group. Forest and water authorities, land development boards, and farmers' associations from national to local levels, for instance, can gain practical experience and background knowledge for their activities that affect the environment within protected areas.

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<sup>3</sup> Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (OJ L 327, 22.12.2000, p. 1).

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