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CHAPTER 1

SETTING THE SCENE

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EXECUTIVE SUMMARY

The IPBES Regional Assessment for Europe and Central Asia critically evaluates and summarizes the available knowledge on the status and trends of nature and its contributions to people. Nature is protected for its diverse values and because it is essential for sustaining human life. To conserve the planet's variety of life - including the human species - and to ensure that people benefit from nature's contributions now and into the future, effective policies and actions are required, based on a broad understanding of what is happening and why. The Regional Assessment for Europe and Central Asia supports decision-making processes by identifying options, opportunities and trade-offs building upon the best available data and information in compiling policy-relevant knowledge (1.1).

Assessing new knowledge is highly relevant and timely. More than 50 previous international and national assessments demonstrate that biodiversity and ecosystems have intrinsic value and are essential for human life. Since the publication of the Millennium Ecosystem Assessment in 2005, there are now four times as many scientific papers on biodiversity and ecosystem services, their drivers and their consequences for people, and on related options for decision-making. To support decision-making it is necessary to synthesize the most recent scientific literature in combination with the grey literature and indigenous and local knowledge (1.1).

The assessment responds to requests from Governments. In requesting this assessment, Governments have recognized the problems arising from the loss of biodiversity and nature's contributions to people and the potential of relevant information for future decision-making. Governments posed a number of policy-relevant key questions that underpin the Regional Assessment for Europe and Central Asia. Questions in common with the other IPBES regional assessments concern the dynamics of, and interplay between, nature's contributions to people, the underlying biodiversity and ecosystems, the drivers of change in biodiversity and ecosystems, their diverse values and relevance for human well-being. Further policy-relevant questions are specific to the Europe and Central Asia region. How can ecosystems be protected through investments, regulations and management regimes for terrestrial, freshwater, coastal and marine systems? What are the effects of production, consumption and economic development on biodiversity and ecosystem services and their contributions to human well-being? How can sectoral policies and new policy instruments encourage opportunities arising from the contributions of biodiversity and ecosystem services to human well-being? The assessment seeks to inform policy, public and private decisions, to raise public awareness and to initiate new research (1.1, 1.2).

Answering the region-specific key questions offers important knowledge concerning progress toward the Aichi Biodiversity Targets, the Sustainable Development Goals, and national policies. The questions specific to Europe and Central Asia map directly onto the Aichi Biodiversity Targets and are relevant to the Sustainable Development Goals (SDGs). Goals 14 and 15 address biodiversity and ecosystems explicitly and correspond closely with the Aichi Biodiversity Targets. Beyond Goals 14 and 15, several Sustainable Development Goals address the broader importance of biodiversity and ecosystems for human well-being. The European Union Biodiversity Strategy 2020 aims to halt biodiversity loss in the European Union, restoring ecosystems where possible, and stepping up efforts to avert global biodiversity loss. This underpins the European Union's commitment to the Convention on Biological Diversity and the Aichi Biodiversity Targets by integrating policies on the ecosystem services approach into member States' economies and planning. Non-European Union countries contribute to the implementation of the Aichi Biodiversity Targets through national strategies, plans or programmes. Most Europe and Central Asia countries have developed a national biodiversity strategy and a corresponding action plan (1.2, 1.4).

The Regional Assessment for Europe and Central Asia also takes account of the requests and knowledge of actors other than Governments and provides information for them. Identifying the existing and potential links between nature, nature's contributions to people, and human well-being supports the actions of a wide range of stakeholders in addition to Governments. Non-governmental organizations (NGOs), academic organizations and private businesses can protect and enhance biodiversity and ecosystem services through a number of actions, including management practices, education and awareness raising. The assessment provides relevant evidence upon which stakeholders can base such actions, which involved consulting stakeholders throughout the assessment process (1.2, 1.4).

Europe and Central Asia is characterised by strong differences in terms of industrialization and governance that have a high impact on the state of biodiversity and nature's contributions to people. There is large variability between the Europe and Central Asia subregions in governance systems, cultures, economies, ecoregions and sectors, as well as data monitoring and availability. Europe and Central Asia also has a long history of land management with major human intervention arising from high population densities in the west, but less intervention in the east. Europe and Central Asia faces many important transboundary issues, for example for water resources, pollution, and invasive species, which cut across the subregional divisions (1.3).

Processes within Europe and Central Asia have a large influence on the rest of the world, and Europe and Central Asia depends strongly on other world regions. Such influences include teleconnections via global markets that can displace impacts on biodiversity and ecosystems from Europe and Central Asia to other parts of the world, leading to a large ecological footprint elsewhere. Dependencies include the import of food, feed, fibre and other goods. Western and Central Europe's consumption, in particular, has impacts on land, water and biodiversity in other regions of the world (1.3).

The Regional Assessment for Europe and Central Asia addresses the interactions between nature and people through the IPBES conceptual framework, accounting for the different worldviews and values that exist within the region. To guide the assessment process, IPBES has developed and applied a conceptual framework, an integrated valuation approach and a strategy that integrates information from different knowledge systems, including indigenous and local knowledge. A number of actions were implemented to base the assessment on multiple worldviews and value systems, including the knowledge of local practitioners such as farmers and foresters. Thus, the assessment accounts for different worldviews and values, which underpins its credibility, legitimacy and relevance (1.1, 1.5).

The Regional Assessment for Europe and Central Asia communicates confidence in its findings using qualitative self-assessment in line with the standardised IPBES confidence terms. The need for confidence language arises from the differences in the availability of evidence across subregions, across taxa, and over time. Confidence levels for key messages and findings as well as knowledge gaps are used systematically, including a traceable account of their supporting information and data, to facilitate comparison and interpretation towards policy. Data-related and method-related limitations and issues beyond the scope of this assessment are clearly stated (1.5, 1.6).

The evidence base contains inevitable biases in coverage of the different components and values of nature. Only a small proportion of species are studied to any degree. Out of about 8 million species that exist globally, the 2016 Red List of Threatened Species assessed 82,954 of the estimated 1.64 million species that have been described. Within Europe and Central Asia, only 2,493 species were described on the Red List in 2016. Of the studied species some groups have complete coverage (all known bird and mammal species), while other groups have far less known about them (e.g. only 7% of known plants and <1% of fungi). Answering the policy-relevant questions requires knowledge about the three dimensions of values of nature: nature's values (i.e. biodiversity), nature's contributions to people (i.e. ecosystem services) and aspects of good quality of life. While the assessment covers these three dimensions equally, better supporting evidence on nature's contributions to people and good quality of life would improve the assessment's capacity to answer the policy-relevant questions (1.1, 1.6).

1.1 INTRODUCTION

1.1.1 The purpose of the Regional Assessment for Europe and Central Asia

The conservation and sustainable use of nature matter for its intrinsic value (Batavia & Nelson, 2017) and because it provides the basis for livelihoods, economies and the good quality of life of people throughout the world (Decision IPBES-5/1, Annex IV: Scoping report for a thematic assessment on the sustainable use of wild species: deliverable 3 (b) (iii)). Effective and urgent action is required to halt the loss of biodiversity to secure the planet's variety

Box 1 1 **Policy-relevant questions.**

General questions

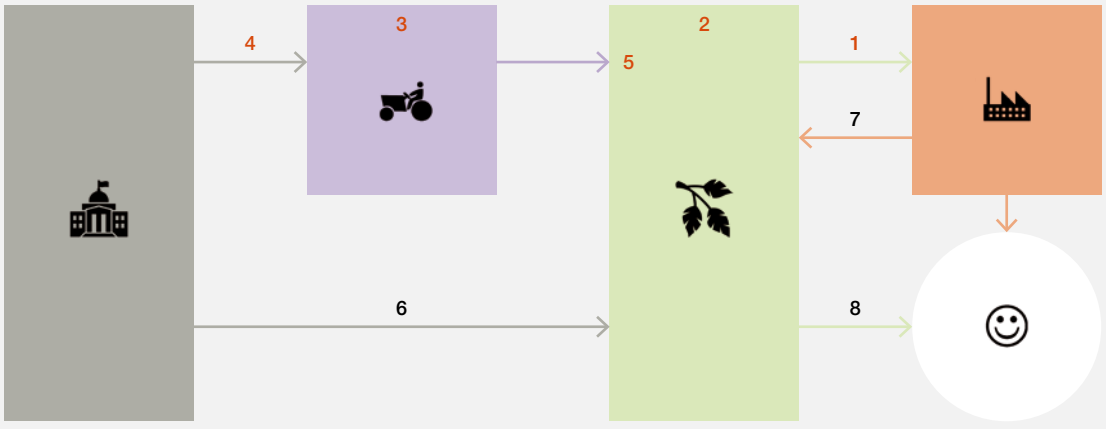
1. How do biodiversity and ecosystem functions and services contribute to the economy, livelihoods, food security, and good quality of life in the regions, and what are the interdependences among them?
2. What are the status, trends and potential future dynamics of biodiversity, ecosystem functions and ecosystem services that affect their contribution to the economy, livelihoods and well-being in the regions?
3. What are the pressures driving the change in the status and trends of biodiversity, ecosystem functions, ecosystem services and good quality of life in the regions?
4. What are the actual and potential impacts of various policies and interventions on the contribution of biodiversity, ecosystem functions and ecosystem services to the sustainability of the economy, livelihoods, food security and good quality of life in the regions?
5. What gaps in knowledge need to be addressed in order to better understand and assess drivers, impacts and responses of biodiversity, ecosystem functions and services at the regional level?

Questions specific to Europe and Central Asia

6. How can ecosystems that provide ecosystem services, such as those underpinning ecosystem-based adaptation to climate change and nature-based solutions to sustainable development, be protected through investments, regulations and management regimes for terrestrial, freshwater, coastal and marine systems?
7. What are the effects of production, consumption and economic development on biodiversity and ecosystem services and their contribution to human well-being? Major links with other regions will be assessed;
8. How can sectoral policies and new policy instruments encourage opportunities arising from the contribution of biodiversity and ecosystem services to human well-being?

Figure 1 1 **Simplified diagram of the sectors and processes addressed by the IPBES Europe and Central Asia policy questions.**

Red numbers: generic IPBES questions; black numbers: Europe and Central Asia-specific questions.
Key to symbols reflecting the IPBES conceptual framework (Díaz *et al.*, 2015) (see Section 1.1.5).



of life, which includes human life (CBD, 2010; Tittensor *et al.*, 2014; United Nations, 2015). These actions require a strong knowledge base, good communication between scientists and decision-makers, and the will to act.

The IPBES Regional Assessment for Europe and Central Asia is based on a request from Governments, multilateral environmental agreements and other stakeholders to investigate the key policy questions outlined in **Box 1.1.** IPBES member States have recognized the dependence of quality of life and the economy on nature, and have requested new knowledge about the importance of nature for the human species. Hence, the assessment critically evaluates and summarizes the available knowledge on the status and trends of nature (including biodiversity) and nature's contributions to people[1] (including ecosystem services) and how they support good quality of life. The assessment also evaluates the underlying causes and consequences of change in the past, present and future in support of governance towards sustainability and good quality of life. Section 1.7.2. describes how the policy-relevant questions structure the Regional Assessment for Europe and Central Asia.

1.1.2 Why is this assessment important?

Nature and its contributions to people are fundamental to the existence of humans as a species and for our societies and their future development. Nature and its contributions to people are, however, continuing to decline, largely because of human actions. Of 2,493 species assessed in Europe and Central Asia, 13% are included on the Red List of Threatened Species of the International Union for Conservation of Nature (IUCN), which constitutes 6.5% of the total number of the species included on the IUCN Red List of Threatened Species, globally (IUCN, 2017). The IPBES Regional Assessment for Europe and Central Asia responded to the need to establish a broader understanding of nature and its contributions to people for the past, present and future through an evidence base in support of effective options for policies and actions to maintain ecosystem integrity. The assessment analyses the relationship between nature and people for the region, based on the latest knowledge and the inclusive IPBES approach. It informs future decisions through a comprehensive analysis of the dynamics of, and interplay between, biodiversity and ecosystems (or nature), their drivers, and their contributions to people. It also identifies opportunities for sustainable development and good quality of life arising from nature.

1. Nature's contributions to people encompass the positive contributions, or benefits, and occasionally negative contributions, losses or detriments, that people obtain from nature. The term resonates with the original use of the term ecosystem services in the Millenium Ecosystem Assessment (MEA, 2005), and goes further by explicitly embracing concepts associated with other worldviews on human–nature relations and knowledge systems.

1.1.3 Review of previous assessments

Previous global assessments on the status of nature and its contributions to people showed that the levels or quality of both are declining (Leadley *et al.*, 2013; MEA, 2005). Over the past 50 years, humans have changed ecosystems more rapidly than ever before; 60% of ecosystems are degraded and often overexploited, and pressures on nature are increasing despite the growing number of responses to tackle biodiversity loss (Butchart *et al.*, 2010; Leadley *et al.*, 2013; MEA, 2005; Tittensor *et al.*, 2014). Effective responses can be achieved by mainstreaming nature, and its importance to good quality of life, at all societal levels, as in the Strategic Plan for Biodiversity 2012-2020 and its Aichi Biodiversity Targets (CBD, 2010).

Overall, the state of nature (biodiversity and ecosystems) is deteriorating in Western, Central and Eastern Europe (see for example: European Commission, 2015b; EEA, 2015b). Approximately, 60% of the European Union-level species assessments and 77% of the European Union-level habitat assessments indicate an unfavourable or deteriorating status (EEA, 2015b; European Commission, 2015b). Nevertheless, some species are returning to Western, Central and Eastern Europe after long periods of absence, for example, the European bison and the Eurasian beaver (Batbold *et al.*, 2016; European Commission, 2015b; Olech, 2008).

The state of nature is also deterioriating in Central Asia (Appleton *et al.*, 2012; Zoi International Network, 2011) **(Figure 1.2)**. Its most distinctive species are, and have been, heavily impacted. For example, the last tigers in the region are thought to have been killed in the 1950s; the snow leopard is extremely rare; and the saiga antelope is critically endangered (Mallon, 2008; Zoi International Network, 2011). Some positive signs are, however, observed in the development of policies for conservation and the expansion of protected areas **(Figure 1.2)**.

Of the 54 countries in Europe and Central Asia, only one has not submitted a fifth national report[2] to the Convention on Biological Diversity. Other national biodiversity or ecosystem assessments are available for the majority of the Europe and Central Asia countries with an updated list of current assessments available through IPBES (see http://catalog.ipbes.net/).

Since the Millenium Ecosystem Assessment (2005), the body of scientific knowledge on nature and its contributions to people has quadrupled by the end of

2. The fifth national reports provide, among other aspects, an update on the national status and trends of, and threats to, biodiversity, using national biodiversity indicators and also an assessment of the progress towards the Aichi Biodiverity Targets and the implementation of the Strategic Plan for Biodiversity 2011-2020.

2016 (based on a Scopus search using “biodiversity” and “ecosystem services” as search terms). The Regional Assessment for Europe and Central Asia covers previous and new knowledge in a synthetic assessment of the region. Scientific and societal debate on the valuation of nature and its contributions to people has generated new insights. For example, publications about “human well-being” increased rapidly after the Millennium Ecosystem Assessment concluded in 2005 and continued to rise after the publishing of the initial “The Economics of Ecosystems and Biodiversity” (TEEB) reports in 2010 (see **Figure 1.3**).

1.1.4 Why another assessment? The added value of the Regional Assessment for Europe and Central Asia

The Europe and Central Asia assessment aims to be broad and inclusive, builds on previous assessments and takes into account not only new research, but also evolved insights. Previous assessments covered various aspects of nature, nature’s contributions to people and good quality of life. Some of these assessments were more inclusive in terms of world

Figure 1 2 **Summary of the trends on the status of nature (biodiversity and ecosystems) in Central Asia. Source: Zoi International Network (2011).**

INDICATORS	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Population growth and pressure on ecosystems	↔	↗	↗	↗	↗
Habitat fragmentation and pollution	↗	↔	↔	↗	↗
Climate change impacts	↗	↗	↗	↗	↗
Over-exploitation of biodiversity	↔	↔	↔	↔	↔
Challenges of alien invasive species and biosafety	↗	↗	↗	↗	↗
Ecological footprint	↗	↘	↘	↗	↔
Forest and other wooded land, area	↗	↗	↗	↗	↗
Change in status of threatened species	↗	↗	—	↗	↗
Fish resources and catch: marine	↘	—	—	↘	↘
Fish resources and catch: freshwater	↘	↘	↘	↘	↘
Genetic resources of agrobiodiversity (domestic animals, plants)	↘	↘	↘	↘	↘
Food production	↗	↗	↗	↗	↗
Agricultural and forest areas under sustainable management	↗	↗	↗	↗	↗
Protected areas (number, coverage): terrestrial	↗	↗	↗	→	→
Protected areas (number, coverage): aquatic	↗	↗	↗	→	↗
Protected areas and ecological corridors: cross-border cooperation	↗	↗	↗	↗	↗
Protected areas: management and conservation eciency	↔	↔	↔	↔	↔
Afforestation efforts, forest fires and diseases control	↔	↔	↘	↔	↔
Botanical gardens, zoos, nurseries, ex-situ conservation	→	→	↘	→	→
Policies and measures on biodiversity: planning	↗	↗	↗	↗	↗
Policies and measures on biodiversity: implementation progress	↔	↔	↔	↔	↔
Biodiversity monitoring, forest inventory	↔	↗	↔	↔	↔

POSITIVE OR STABLE TRENDS:
- ↗ Increase, improvement
- → No negative changes
- ↘ Reduction of pressures

NEGATIVE TRENDS:
- ↗ Growing pressures
- ↘ Deteriorating capacities or effeciency

MIXED TRENDS:
- ↔

— No data

Sources of information:
The latest country biodiversity reports to the CBD, the latest UNECE environmental performance reviews, expert interviews. This table was distributed at the Istanbul regional workshop on biodiversity (17-20 October 2011, Turkey) to catalyse discussions on gaps, priorities and lessons for biodiversity conservation.

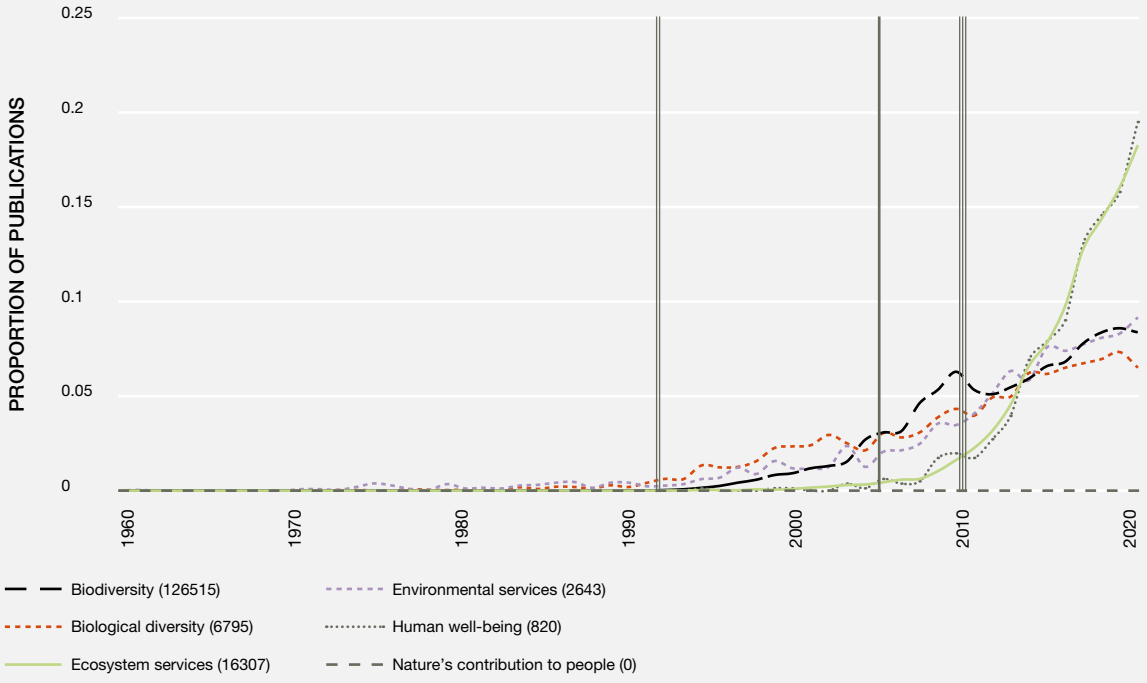
views and diverse values than others, but this was done implicitly (e.g., MEA, 2005). Nature has mainly been linked with a limited set of instrumental values (e.g., TEEB, 2010a). Although the valuation field has been developing rapidly, most assessments have emphasized traditional economic (monetary) valuation approaches (e.g. TEEB, 2010a). More recent regional assessments (e.g., Jacobs *et al.*, 2016) and research projects (e.g., OPERAs, 2017; OpenNESS, 2017) have been more inclusive of stakeholders and diverse values. The Regional Assessment of Europe and Central Asia explicitly covers the diverse values connected to nature, nature's contributions to people, and good quality of life (see **Figure 1.4**) according to the IPBES conceptual framework (see Section 1.1.5) (Díaz *et al.*, 2015; Pascual *et al.*, 2017). These values range from values of nature itself (individual organisms, biophysical assemblages, biophysical processes); regulating, material and non-material contributions of nature to people; new options for nature's contributions to people; and good quality of life from cultural, societal and individual perspectives.

The policy questions summarising Government requests (see Section 1.1.1) require these diverse values to be addressed, with a main focus on nature's contributions to people and to good quality of life **(Figure 1.4)**. Based on the conceptual framework, the Europe and Central Asia assessment aims to have a balanced representation of these different values. This responds more closely to policy demands and is a novelty of IPBES compared with previous assessments.

IPBES assessments are the first assessments on nature and its contributions to people to have been through a formal process to establish political legitimacy and to respond directly to requests from Governments. Of the 54 countries in Europe and Central Asia, 38 are members of IPBES. Moreover, many stakeholders from the region are part of IPBES's stakeholder network, including learned societies, NGOs, and representatives of indigenous and local communities. The assessment also uses a broad variety of knowledge and evidence sources beyond the natural sciences. All chapters consider indigenous and local knowledge (ILK). The assessment is therefore a legitimate and credible analysis relevant to all levels of governance and decision-making, from multinational organizations, through national Governments to the local level, and relevant to a broad audience.

Figure 1 3 **Changing frequency of keywords in the scientific literature to reflect the prevalence of these terms.**

Data generated from the Scopus database for all publications from 1960 to 2016 (using search terms as shown in the legend, except "human well-being" AND each of the other terms). The actual number of publications associated with each search term is shown in parentheses. The vertical axis shows the proportion within each search term published in each year to show the changing use of search terms through time. Each vertical black line represents a key moment relevant for global policy: the Rio Conventions in 1992 (Ⅱ) ; Millennium Ecosystem Assessment (Ⅰ); The Economics of Ecosystems and Biodiversity (Ⅲ).

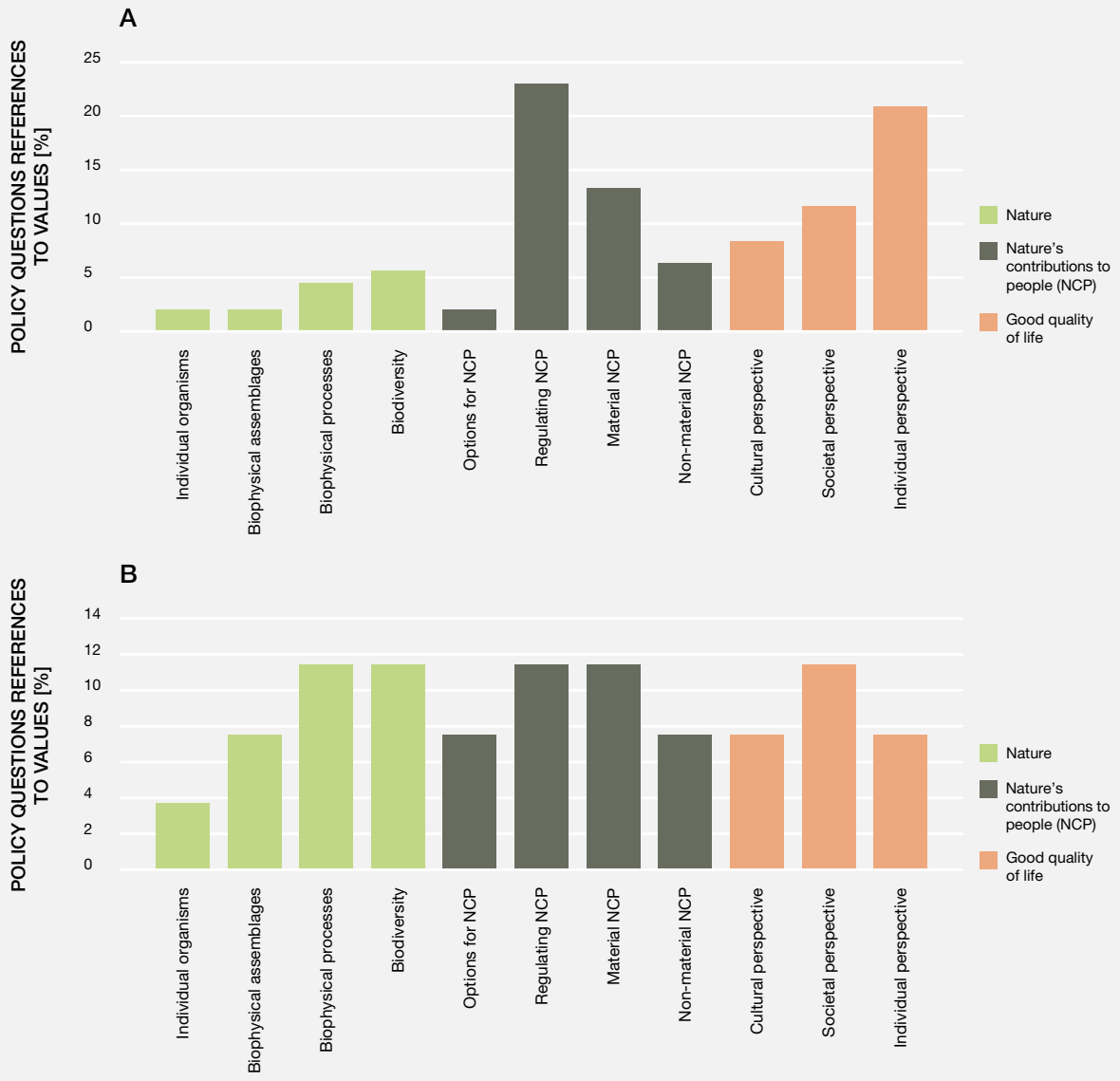


1.1.5 The IPBES conceptual framework

IPBES has developed and approved a conceptual framework to summarize the components of the system comprised of people and nature, and the relationships between them (Díaz *et al.*, 2015; IPBES, 2014). **Figure 1.5** is a simplified version of the conceptual framework as adopted by the second meeting of the IPBES Plenary. It retains all the essential elements, but some of the detailed wording for each of the elements has been removed from the boxes to improve readability.

The IPBES conceptual framework provides structure and comparability to the assessments that IPBES is producing at different spatial scales, on different themes, and in different regions. It was developed through a transparent and participatory process and explicitly considers diverse scientific disciplines, stakeholders, and knowledge systems, including indigenous and local knowledge. It is essential

Figure 1 4 **A Europe and Central Asia policy questions explicitly refer to diverse values. Bars are based on the number of times value targets are mentioned in the eight Europe and Central Asia policy questions. Policy questions are described in Section 1.1.1; B The Regional Assessment for Europe and Central Asia effectively covers diverse values. Bars based on cross-validated coverage estimates per value focus and per chapter. Value foci are introduced in Section 1.5.2.**



for interpreting the finding of the Regional Assessment for Europe and Central Asia and links strongly to the diverse values discussed in Section 1.5.2. The framework also provides common terminology for use across IPBES assessments. The six chapters of the Regional Assessment for Europe and Central Asia map onto the conceptual framework as indicated in **Table 1.1**.

Integrative, but explicit conceptual frameworks are particularly useful tools in fields requiring interdisciplinary collaboration. They help to cope with complexity by clarifying and focusing thinking about relationships, and supporting communication across disciplines and knowledge systems and between knowledge and policy. The main elements of the IPBES conceptual framework are:

- **Nature:** the natural world with an emphasis on the diversity of living organisms and their interactions among each other and with their environment.

- **Anthropogenic assets:** including knowledge, technology, work, financial assets, and built infrastructure that, together with nature, are essential in the co-production of nature's contributions to people.

- **Nature's contributions to people:** all the contributions of nature, both positive and negative, to the quality of life of humans as individuals and societies.

- **Drivers of change:** all external factors that affect nature, and, consequently, the supply of nature's contributions to people. The conceptual framework includes drivers of change as two of its main elements: institutions, governance systems and other indirect drivers on the one hand and direct drivers on the other:
  - Institutions and governance systems are among the root causes of the direct anthropogenic drivers that affect nature. They include systems of access to land, legislative arrangements, international regimes (such as agreements for the protection of endangered species) and economic policies.
  - Direct drivers, both natural and anthropogenic, affect nature directly. Direct *anthropogenic* drivers result from institutions and governance systems and other indirect drivers. They include human-caused habitat conversion and climate change, pollution, exploitation of ecosystems and species, and species introductions. Direct *natural* drivers also directly affect anthropogenic assets and quality of life (e.g. a volcanic eruption can destroy roads and cause human deaths), but these impacts are not the main focus of IPBES.

- **Good quality of life:** the achievement of a fulfilled human life. It is a highly values-based and context-dependent element comprising multiple factors such as access to food, water, health, education, security, and cultural identity, material prosperity, spiritual satisfaction, and freedom of choice. A society's achievement of good quality of life and the vision of what this entails directly influences institutions and governance systems and other indirect drivers and, through them, all other elements in the conceptual framework.

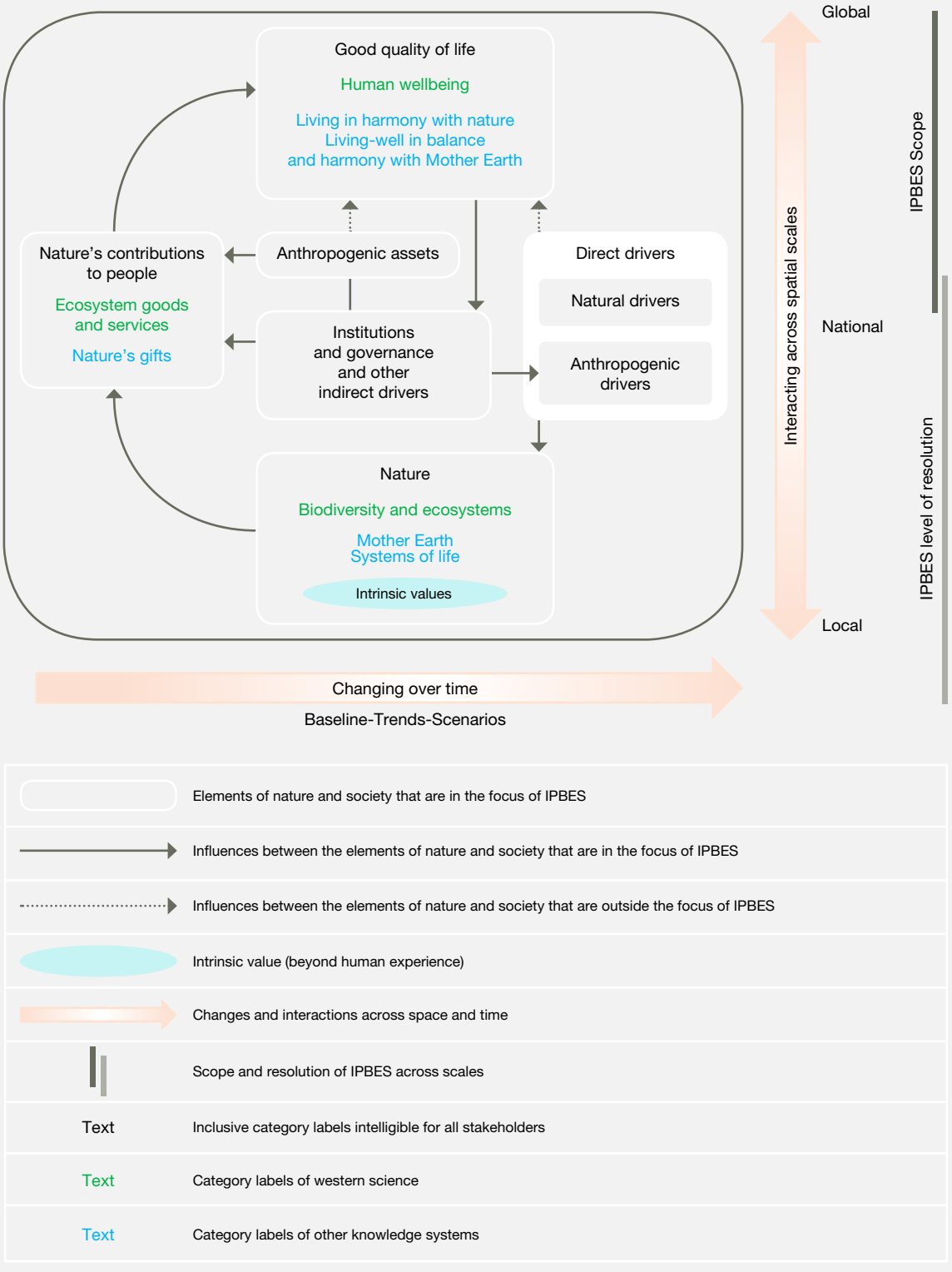
The inclusive nature of the conceptual framework, in terms of contributions, stakeholders, knowledge systems and worldviews, necessarily requires the consideration of diverse value systems. Value systems vary among individuals, within groups, and across groups at various temporal and spatial scales. For example, some nations tend to be more

Table 1 1 **How the IPBES conceptual framework maps onto the chapters of the Europe and Central Asia assessment.**

Chapter	Conceptual framework boxes and fluxes
Chapter 1: Setting the scene	All the boxes and fluxes of the conceptual framework
Chapter 2: Nature's contributions to people and quality of life	"Nature's contributions to people" and their relation to "good quality of life"
Chapter 3: Status, trends and future dynamics of biodiversity and ecosystems underpinning nature's contributions to people	"Nature" and its relation to "Nature's contributions to people"
Chapter 4: Direct and indirect drivers of change in biodiversity and nature's contributions to people	"Institutions and governance and other indirect drivers" and their relation to "direct drivers"
Chapter 5: Current and future interactions between nature and society	All the boxes and fluxes of the conceptual framework
Chapter 6: Options for governance and decision-making across scales and sectors	"Institutions and governance and other indirect drivers" and their effects on all other boxes of the conceptual framework

dominated by value systems that prioritize individual rights and others by value systems that prioritize collective and community-level values (Díaz *et al.*, 2015). The Regional Assessment for Europe and Central Asia covers the diverse values of nature, including non-anthropocentric, instrumental and relational values. This involves a range of different data and information sources that typically are not found within a single assessment, such as biophysical and socio-ecological

Figure 1 5 **The IPBES conceptual framework. Source: Díaz *et al.* (2015).**



models, socio-economic and socio-cultural valuation and qualitative data such as that based on discursive accounts and social elicitation methods. Accounting for the differences in data availability, and their representativeness for, and acceptance by, different disciplines is challenging both in synthesizing findings and in attributing confidence to these findings.

1.2 RELEVANT STAKEHOLDERS

1.2.1 Who does this assessment concern?

Governments and multilateral environmental agreements requested that the Regional Assessment for Europe and Central Asia be conducted. It is therefore directly relevant to Governments, as it answers their specific policy questions (see Section 1.1.1). Nevertheless, nature's contributions to people have effects not only at different ecological scales, but also at different organizational scales, from the individual to the community, and administrative scales from the local to the international. For instance, material contributions may be of interest to indigenous peoples and local communities (e.g. timber), but the same source can also be of interest at higher institutional levels (e.g. carbon sequestration). Furthermore, national or global stakeholders and indigenous and local communities may differ in their emphasis on the conservation of nature and sustainable use, and the enhancement of the aesthetic, cultural heritage, natural and recreational quality of their living environment. In addition, especially for indigenous peoples and local communities, ecosystems may also be a places of rituals and a point of reference in cultural and spiritual narratives (Hein, 2006; Reyers *et al.*, 2013; Raudsepp-Hearne & Peterson, 2016).

Many stakeholder groups were directly or indirectly involved in the production of the Regional Assessment for Europe and Central Asia - directly through data and knowledge sharing and reviewing drafts, and indirectly by encouraging, facilitating and supporting the participation of scientists and knowledge holders within the assessment (see also the preface for the assessment procedure and Section 1.5). The assessment experts obtained stakeholder knowledge, views and values through discussions at IPBES stakeholder days, IPBES Plenary meetings and by stakeholders reviewing drafts. In addition, grey literature was analysed and knowledge holders were consulted as experts. By including different knowledge and data sources and values, and allowing for a transparent process, an assessment gains credibility, legitimacy and relevance (Cash *et al.*, 2003).

1.2.2 Which benefits are available to stakeholders?

Stakeholder incentives and benefits associated with involvement in the assessment include the opportunity to contribute to the IPBES process, the inclusion of stakeholder-derived data and the acquisition of knowledge. Consequently, the capability to develop partnerships and to learn from insights from other disciplines increases as well as the potential for capacity building, identified from an IPBES stakeholder analysis survey (IPBES/5/INF/16: Implementation of the stakeholder engagement strategy). Stakeholder groups have specific information needs, but also derive different benefits from the insights and knowledge contained within the assessment (see discussion below). Stakeholders acknowledge that the IPBES process in general, and the Regional Assessment for Europe and Central Asia in particular, bring together different disciplines and stakeholder groups. In doing so, the participants gain insights into diverse conceptualisations of values and social and political contexts leading to the building of partnerships.

Regional (supra-national) Governments and national Governments. The questions posed by Governments are outlined in Section 1.1.1. The assessment offers insight into the best indicators to assess the status and trends of biodiversity and nature's contributions to people, as well as pinpointing data gaps. It also highlights the necessary responses and the potential opportunities and differences between countries.

Subnational governments: Subnational and local public actors have an interest in opportunities for investment in nature that leads to social and economic benefits. They request independent sources of information about how nature can help society to cope with future challenges such as water scarcity, climate change or air pollution and to enhance the living standards of citizens.

Multilateral environmental agreements and United Nations agencies: United Nations agencies have a range of scientific advisory processes in addition to being responsible for multilateral environmental agreements. Information provided through the assessment can contribute substantially to informing these processes. Multilateral environmental agreements have subsidiary bodies or other mechanisms to consider scientific and technical evidence. The information provided by the assessment contributes to some of these subsidiary bodies and mechanisms as a means of improving their effectiveness.

Intergovernmental organizations: Policy-relevant information provided by the assessment is also an important source of information about nature, its contributions to people, and good quality of life, for broader intergovernmental organizations.

Practitioners and implementers: Many organizations, including NGOs, and individuals involved in the operational management of nature and its contributions to people in practice can access IPBES products, such as policy support tools, and learn how these can be applied to conservation and sustainable use of nature (Decision IPBES-3/4: Communications, stakeholder engagement and strategic partnerships). The assessment provides examples and case studies for the use of such tools.

The scientific community: The assessment supports the scientific community in gathering information from different data sources and regions to highlight knowledge gaps and provide evidence to fill these gaps.

Indigenous peoples and local communities: Indigenous peoples and local communities are the main users and caretakers of nature and its contributions to people over large areas of Europe and Central Asia. Their understanding of nature, drivers, futures and policies can help to develop subregional or local actions and policies that are more relevant and acknowledge indigenous rights. The assessment serves as an important forum for discussion and knowledge co-production, which is urgently needed to improve the livelihoods of indigenous peoples and local communities.

Private sector: Business is often based on the use of natural resources and frequently has an impact on ecosystems, but the private sector can also find opportunities by aligning business activities with benefits to nature. To achieve this, the private sector requires insight into how to align their actions with goals of conservation and sustainable use by better recognizing and responding to interdependencies and impacts on nature (TEEB, 2010b). Businesses are also decision-makers and have an important role to play in the conservation, use and management of biodiversity and ecosystems upon which they depend. The information within the assessment supports the implementation of sustainable solutions that avoid, minimize or offset impacts on ecosystems and identifies the interdependencies between business and ecosystems.

The general public: "The people who are affected and those who provide resources are increasingly asking for evidence that interventions improve ecosystem services and human well-being." (Carpenter *et al.*, 2009). The assessment provides the general public with an independent source of knowledge.

1.2.3 Policy instruments for different stakeholders

An important function of the IPBES process is to support policy formulation and implementation by identifying policy relevant tools and methodologies. Stakeholders have a number of options and instruments available to protect and enhance biodiversity and ecosystem services. Policy instruments may take many different forms including environmental standards and regulation, economic incentives, education, capacity building and awareness raising (a non-exhaustive list is found in IPBES/4/INF/14: Information on work related to policy support tools and methodologies (deliverable 4 (c))). Policy instruments are often referred to as being designed by public authorities, but IPBES embraces design by all stakeholders including citizen organizations and indigenous peoples and local communities (IPBES/4/INF/14).

Four different categories of policy instruments for different actors have been identified in Chapter 6 (adapted from IPBES/4/INF/14):

1. Legal and regulatory instruments, for example implementing and articulating laws and regulations, planning instruments;

2. Economic and financial instruments or price-based instruments, for example fiscal instruments, and quantity-based instruments such as tradeable permits;

3. Social and information-based instruments with an emphasis on the intertwined relationship between ecosystems and socio-cultural dynamics, including: (i) information related instruments such as eco-labelling, and environmental education; (ii) self-regulation and corporate social responsibility; and (iii) enhancement of the collective actions of local communities;

4. Rights-based instruments and customary norms, that integrate rights, norms, standards and principles into policy, planning and implementation, for example by reconciling conservation and human rights standards, e.g. the rights and institutions of indigenous peoples, and heritage sites.

Various public and private actors can choose from a wide range of policy instruments to achieve their objectives. Traditionally, centralised and decentralised Governments have shaped environmental and biodiversity conservation policies, largely building on legal and regulatory instruments. Such hierarchical decision-making has increasingly been complemented by other governance modes addressing and involving private actors through economic, financial, social and information-based instruments. Furthermore, rights-based instruments and customary norms offer ways to reconcile human rights standards, and to foster complementarity with human well-being (IPBES/4/INF/14). The latter category is especially important to help develop regionally and locally relevant actions and policies for indigenous peoples and local communities. In practice, policy instruments are usually applied in combination in policy mixes (see Chapter 6).

Capacity building is another important function of the IPBES process. As **Figure 1.6** illustrates, capacity building typically represents the development and strengthening of human and institutional resources through the ability to perform functions, to solve problems, and to achieve objectives at individual, societal and institutional levels (United Nations, 2006). Addressing both public and private sectors plays a key role in successful capacity building processes. The Regional Assessment for Europe and Central Asia supports capacity building through new knowledge generation, particularly in the identification and quantification of nature's contributions to people and to good quality of life (Díaz *et al.* 2015). New knowledge can result, for example from long-term biomonitoring on permanent plots, from comparative studies or from experiments. Such records have the potential to contribute to more informed assessments of future changes in biodiversity patterns. By raising awareness at the individual level, such information facilitates appropriate strategies, plans and programmes developed at higher institutional levels.

Education also plays an important role in supporting societal choices that affect biodiversity and ecosystem services. Stakeholders can promote the work done in the assessment through local and region-wide networks and help by disseminating information to relevant communities. In this way, the assessment will raise awareness for important biodiversity and ecosystem issues across stakeholder groups, and across geographic locations.

1.3 DESCRIPTION OF THE REGION

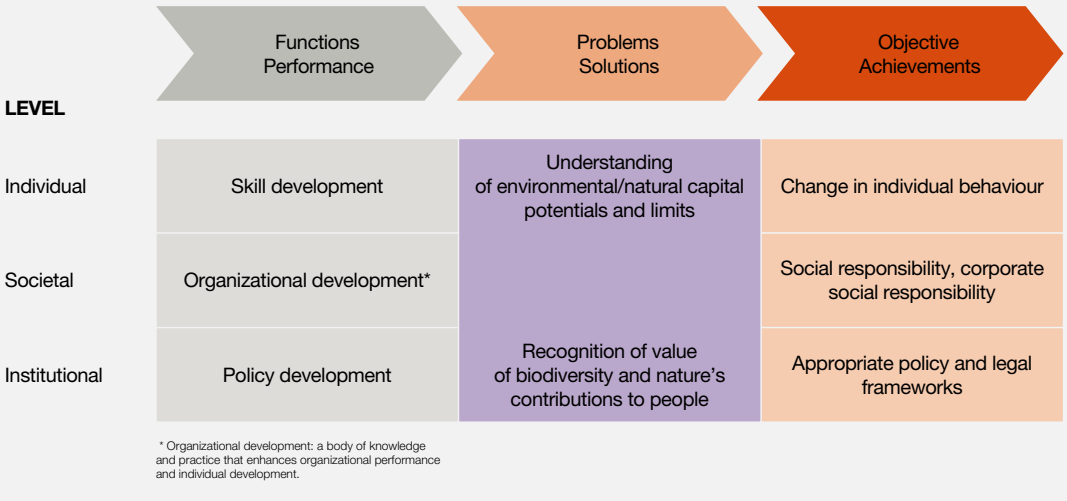
This section introduces the basic characteristics of the Europe and Central Asia region, including the geographic area, the subregional structure, the geographical characteristics including the region's main ecosystem types (units of analysis), together with their most important societal trends in recent history. The basic facts necessary for interpreting the findings of later chapters are introduced.

1.3.1 Overview of the region

Europe and Central Asia encompasses four subregions (see **Figure 1.7**) and 54 countries (see **Table 1.2**). These countries vary greatly in size, including the largest and smallest on Earth, have diverse geography and history, but also common properties in terms of geography and climate, history and social systems. The region shares many cultural norms and historical features reflected in some similarities in land use, environmental history, and nature and its contributions to people. Nevertheless, the region encompasses high heterogeneity in natural and socio-cultural aspects. The seas that surround the region are also very heterogeneous in terms of temperatures, currents, nutrient availability, depths and mixing regimes.

In the assessment, we refer to the IPBES subregions where the data fully covers one or more of them. However, the data shown often represents other divisions, mainly the European Union or "Continental Europe" (sensu European Environment Agency). This includes Western and Central

Figure 1 6 **Potential contribution of the Regional Assessment for Europe and Central Asia to capacity building. Source: Own representation.**



* Organizational development: a body of knowledge and practice that enhances organizational performance and individual development.

Europe, excluding Anatolia and Israel, and Eastern Europe to a eastern border following the Ural mountains, the river Ural to the Caspian Sea, and a southern board to the Manych valley to the Sea of Azov and the Black Sea, and the Bosporus. When referring to Europe we therefore refer to the geography just illustrated, recognizing that not all data sources will perfectly match this geography. Otherwise we refer to IPBES subregions (**Figure 1.7**).

Europe and Central Asia's climatic zones range from polar through temperate to subtropical (Peel *et al.*, 2007). In terms of area, large parts of the region lie in the subarctic and humid continental climate zones, but most of the human population lives in temperate (oceanic, Mediterranean or continental) climates (European Commission, 2017a). Large-scale climate zonation is influenced by many factors from cold and warm ocean currents at the continental scale, to elevation, slope or urban climate islands at the local scale. A large portion of Europe and Central Asia is highly fragmented in terms of geomorphology by mountain ranges and lake and sea coasts and major river systems. Most of Eastern Europe and Central Asia are lowlands or plateaus; while highly variable local conditions create a fine mosaic of land use and habitat types for most of Western and Central Europe (van Asselen & Verburg, 2012), including diverse cultural landscapes. Across large areas of sparsely-inhabited

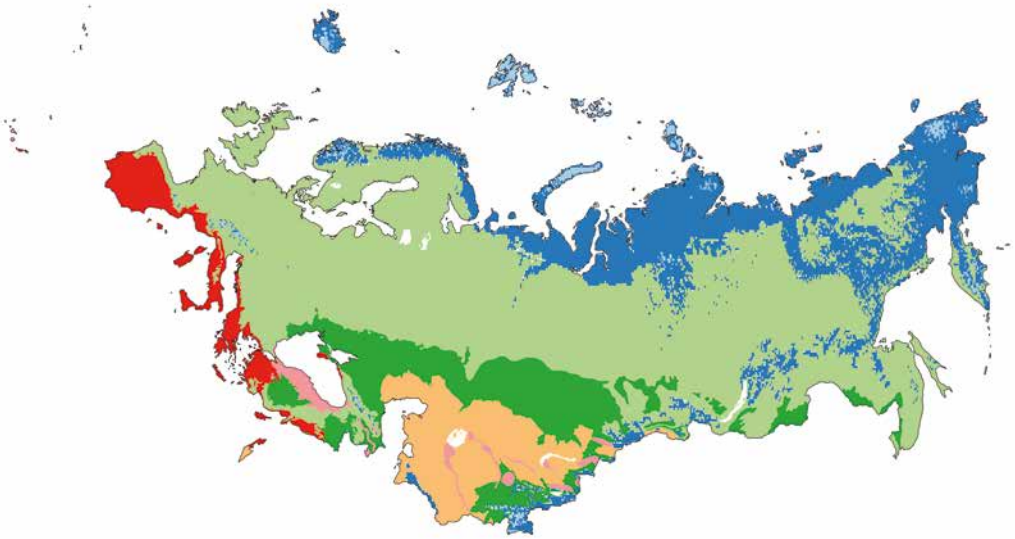
Figure 1 7 **Map showing the Europe and Central Asia region with the four subregions recognized by IPBES, and the surrounding seas.**

Table 1 2 **The subregions and countries covered by the Europe and Central Asia assessment.**

Subregion	Countries
Western Europe	Andorra, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Liechtenstein, Luxembourg, Malta, Monaco, Netherlands, Norway, Portugal, San Marino, Spain, Sweden, Switzerland, United Kingdom of Great Britain and Northern Ireland
Central Europe	Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia, the former Yugoslav Republic of Macedonia, Turkey
Eastern Europe	Armenia, Azerbaijan, Belarus, Georgia, Moldova (Republic of), Russian Federation, Ukraine
Central Asia	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

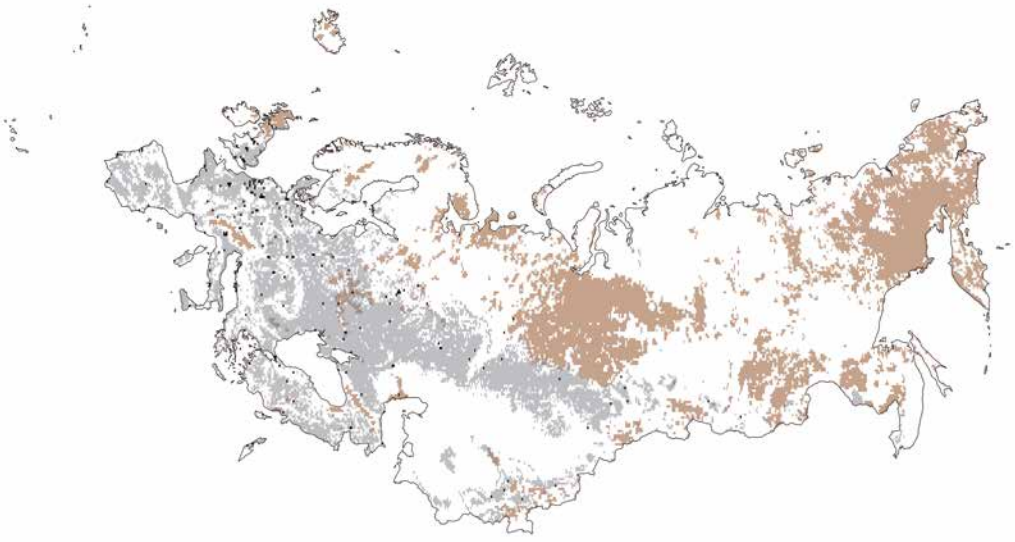
Figure 1 8 **Maps of the main units of analysis used in the Regional Assessment for Europe and Central Asia. Source: Own representation.**

A



- Deserts
- Temperate grasslands
- Tropical and subtropical dry and humid forests
- Mediterranean forests, woodland and scrub
- Broad-leaved, mixed and coniferous forests
- Tundra and mountain grasslands (only high-elevation grasslands)
- Snow and ice-dominated systems

B



- Urban ecosystems
- Agroecosystems
- Peatlands and mires

land in Eastern Europe and in Central Asia, ecosystems are less modified by local human activity, but nevertheless affected by global change and natural resource extraction (Hansen *et al.*, 2013). The main ecosystems and land use types (known as units of analysis) are described in **Table 1.3** and shown in **Figure 1.8**. These units of analysis are used throughout the assessment as a means of simplifying, through classification, the complexity of nature.

Europe and Central Asia is characterised by major human intervention arising from continuous high population densities and a long history of unbroken land management (Ellis *et al.*, 2013). This has led to the most populated parts of the region being strongly modified by people, including the creation of cultural landscapes based on traditional management approaches (Plieninger *et al.*, 2014). Within the subregions there is a large variability in human population density, with a broad trend of less intensive human impact in the eastern parts of the region (**Figure 1.9**, **Table 1.4**). Moreover, the subregions have different time lines of human intervention arising from very different histories (Jepsen *et al.*, 2015). This also reflects heterogeneity in cultures, natural heritage, governance structures, politics, and the implementation of environmental legislation. Small-scale

Table 1 3 **Main units of analysis for the purpose of the IPBES assessments and comments specific to the Europe and Central Asia region.**

Main type	Name	Description
Snow and ice dominated ecosystems	Glaciers	Areas where the terrain surface is constantly covered in ice
	Nival belt	Areas in mountains with an extremely short growing season (<10 days) and low average annual temperature (<3.5°C)
	Polar deserts	Vegetation covers less than half of the soil surface, dominated by mosses, lichens, algae and rarely vascular plants
Tundra and mountain grasslands	Tundra	Areas with permafrost, with conditions too adverse for forest growth. Dominated by mosses, grasses or dwarf shrubs
	Alpine belt	Not permanently snow or ice covered, low vegetation dominated by grasses, sedges and forbs
	Subalpine belt	Transition between alpine zone and forests or grasslands. High grass meadows, dwarf shrubs, heathlands or short grasslands, subalpine thinned/crooked forests
Temperate and boreal forests and woodlands	Broad-leaved, mixed and coniferous forest	Vegetation dominated by tall trees
Mediterranean forests and scrubs		Highly seasonal vegetation with water stress during part of the year, dominated by needle-leaved or sclerophyllous trees and/or shrubs
Tropical and subtropical dry or humid forest		Subtropical climate, dominated by deciduous, evergreen or mixed trees
Temperate grasslands		Dry or seasonally wet, non-coastal areas with more than 30% vegetation cover, mainly grasses and herbs. Self-sustaining due to fire, aridity or grazing; or secondary, sustained by mowing or grazing
Deserts		Precipitation less than 250 mm/year. Can be cold (with snow cover) or warm (very dry and hot in summer, no snow)
Peatlands		Organic matter accumulation in soil due to limited decomposition, water abundant, specific soil
Urban habitats		Natural and artificial habitats within or close to human settlement. Suburban (with abundant green space), or urban (dominated by built structures and sealed soil surfaces)
Agricultural areas		Human management of vegetation and soil. High, medium or low intensity
Special systems	Heathlands	Dwarf shrub dominated areas in Atlantic, Subboreal or Continental climate. Developed due to human land use in historic times
	Caves and other subterranean habitats	Lack of light, trophic dependence on aboveground systems, stable temperature, high humidity, limited supply of organic material. Terrestrial or aquatic, epikarst and endokarst
Marine and freshwater habitats	Deep seas benthic habitats	Deep sea benthic habitats and species inside the exclusive economic zones and deeper than 200 m
	Shelf and water column	All non-enclosed seas with benthic habitats shallower than 200 m and pelagic habitats
	Enclosed seas and saline lakes	Brackish to hypersaline enclosed water bodies, both temporary and permanent
	Freshwater lakes and streams	Water bodies with salt content below 0.1 g/l

heterogeneity and a high level of fragmentation both in a geographical and a cultural sense is probably the most important difference between most of Europe and Central Asia and some other continental regions. Partial coordination of governance across parts of this region is the role of the European Union and also of the various international treaties.

1.3.2 Marine areas of Europe and Central Asia

In terms of marine areas, this assessment focuses on the Exclusive Economic Zones (EEZ) of the countries in the region, therefore mainly marine areas within 200 nautical miles from the shores (unless interrupted by

Figure 19 **Population density across Europe and Central Asia. Source: SEDAC (2017).**

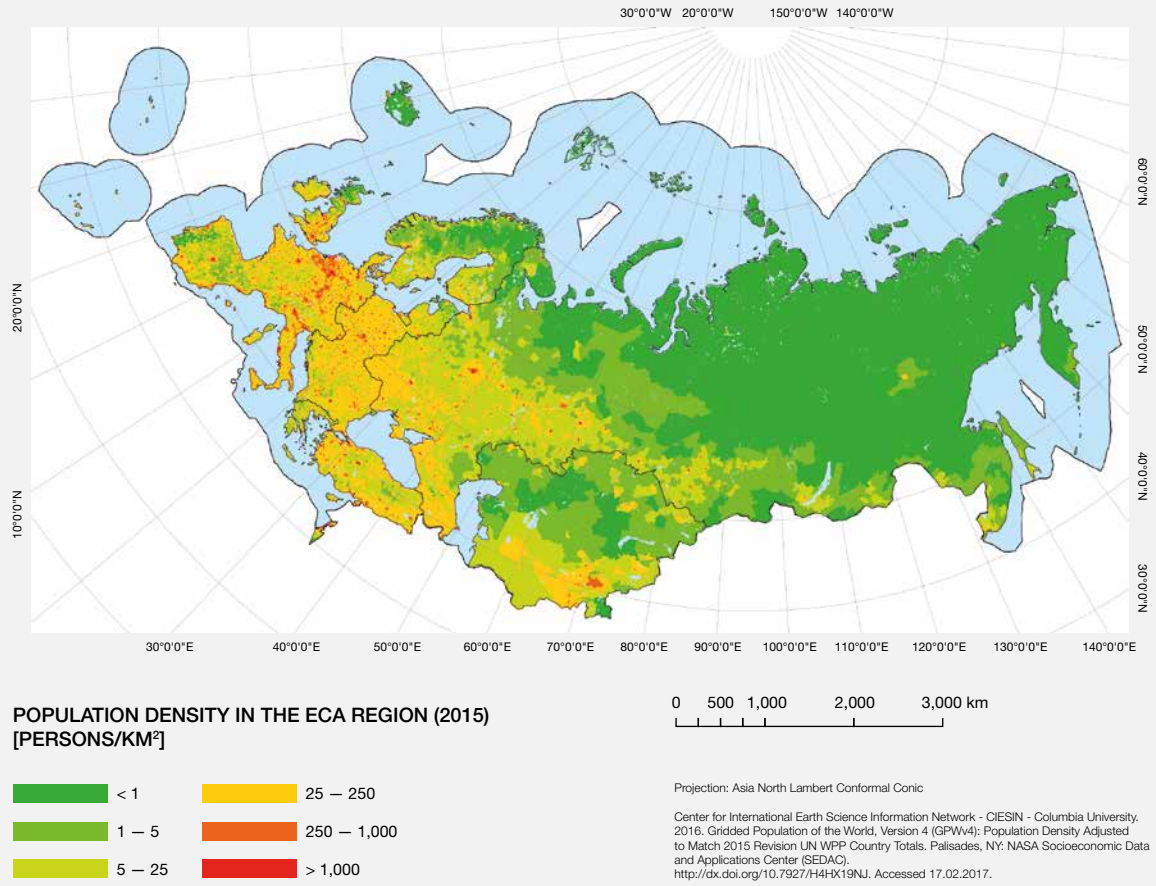


Table 14 **Indicators of land use in Europe and Central Asia. Source: data.worldbank.org.**

Indicator	Western Europe	Central Europe	Eastern Europe	Central Asia
Area (km²)	3,837,700	2,238,000	20,785,800	4,008,000
Population	421,446,000	200,486,000	217,576,000	69,052,000
Average population density (people/km²)	110	90	10	17
Urban population %	78	66	71	40
Agricultural land %	37	48	21	75
Forested land %	39	27	43	3

land) are discussed. Since marine units typically bridge several subregions, here they are presented followed by a description of their main habitat types (units of analysis) in an order that is independent of the subregions (see **Figure 1.7**).

North East Atlantic. The European part of the Atlantic Ocean (*sensu lato*, i.e. including North Sea, Irish Sea, English Channel, Iberian coast and Macaronesean Islands) encompasses large latitudinal gradients, extending from the sub-tropics (e.g. Gibraltar at approximately 36°N) to the upper latitudes of Svalbard in the Arctic (e.g. 77°N) and bridging several biogeographic provinces from Arctic to warm temperate systems (Spalding *et al.*, 2007). It includes highly diverse and complex benthic habitats such as hyderothermal vents, seagrass meadows, kelp forests and biogenic reefs (Prather *et al.*, 2013; Smale *et al.*, 2013; Worm *et al.*, 2006). The North East Atlantic is influenced by transcontinental ship traffic in addition to climate change, pollution, fisheries and aquaculture. Shore areas have also been widely altered by human activities in the past, including the building of shorewalls, drainage and infilling of coastal wetlands and pollution via inflowing rivers. Coastal areas are hotspots of urbanization, with about 40% of the Western European population living in coastal areas.

Baltic Sea. The Baltic sea is relatively shallow and brackish, has almost no tide, and experiences intense seasonality in temperature and inflow. It holds both marine and freshwater species, with relatively low species diversity, also influenced by industrialization mainly in its southern part. Human influence is similar or even more intensive than in the North East Atlantic.

Mediterranean Sea. The Mediterranean Sea is one of the largest of the marine units in the Europe and Central Asia region. It is microtidal, oligotrophic, homothermic and highly saline. The Mediterranean is composed of four sub-units, and has its own zonation predominantly influenced by vast watersheds and rivers that flow into them, resulting in a wide diversity of conditions and high biodiversity (Lejeusne *et al.*, 2010).

Black Sea (including Azov sea). The Black sea is a medium-sized tideless inland sea with an outlet to the Mediterranean. It is extremely stratified, resulting in a lack of oxygen in the deeper strata. The depth of the thermocline and the anoxic layer depends on seasonality, with changes resulting in major losses of biota. It is a highly sensitive ecosystem dominated by mediterranean species (although less diverse than the mediterranean itself).

Arctic Ocean. The Arctic Ocean has a large area, and is characterized by ice-associated ecosystems. Climate change (especially changes in sea ice) is rapidly changing the situation in the Arctic Ocean, and opening up new opportunities for natural resource exploration and shipping, which are however expected to strongly affect local biodiversity and ecosystem functioning. Species diversity is largely unexplored (Belikov *et al.*, 2011).

North West Pacific. The seas linked to the Russian Far East include a continental shelf, but also very deep basins which have their own circulation, partially connected to the Pacifc Ocean. As one of the most highly productive regions of the global ocean (Antonov *et al.*, 2016), these are important fishing areas with high biodiversity, threatened by recent hydrocarbon exploration. Marine mammal diversity is especially important (Artyukhin & Burkanov, 1999; Burdin *et al.*, 2009; Geptner *et al.*, 1976; Hunt *et al.*, 2000; Sokolov, 1986; Yablokov *et al.*, 1972).

1.3.3 Marine and inland surface water units of analysis of the Europe and Central Asia region

Shelf and water column. This unit of analysis includes all the benthic habitats down to 200 m depth and all the water column within the exclusive economic zone of the Europe and Central Asia region. This unit was sub-divided geographically into the different seas and ocean areas described above. Many of the policies regarding the marine environment, e.g. the European Union Marine Strategy Framework Directive (European Union, 2008) as well as regional cooperation agreements (e.g. HELCOM, 2017; OSPAR, 2017) consider the seas and oceans separately.

Deep Sea benthic habitats. All benthic habitats inside the Exclusive Economic Zones of Europe and Central Asia countries that are deeper than 200 m fall into this category. This is the most widespread habitat type on Earth with rich diversity, but it is not well known or understood. Deep sea habitats and biodiversity contribute important regulating functions and services on a global scale.

Enclosed seas and saline lakes. Saline lakes range from several thousand square kilometers (Caspian Sea) to small ephemeral habitats. Based on their salt content, saline lakes are classified as brackish (salt content in the range 0.1-3.5 g/l), saline (above 3.5 g/l) or hypersaline (above 50 g/l) lakes. The Caspian is large and brackish with high biodiversity and many endemisms. The Aral Sea is now extremely saline and mostly dried up. Smaller saline lakes are typical in endorheic basins and lowland areas mainly in the Mediterranean (Čížková *et al.*, 2013) and continental regions (Comin & Alonso, 1988; EEA, 2002; Izmailova, n.d.; Kazanci *et al.*, 2004; Kortekaas & Vayá, 2009; Kotova *et al.*, 2016; Kulagin *et al.*, 1990; Montes & Martino, 1987; Orlov *et al.*, 2011; Örmeci & Ekercin, 2005; Government of Turkey, 2014; Stenger-Kovács *et al.*, 2014; Williams, 1981; Zektser, 2000).

They are fed by rain and groundwater, with highly variable salinity conditions depending on inflow and evaporation. Brackish lakes can be highly diverse while very saline lakes usually hold only a less diverse flora and fauna, including unique and highly valuable extremophile bacterial diversity (Oren, 2006). Both salinity and ionic composition control species richness and biodiversity, but this is also influenced by ionic composition (Balushkina *et al.*, 2009; Boros *et al.*, 2013; Brucet *et al.*, 2012; Oren, 2006; Ventosa & Arahal, 2009). Both large permanent and small ephemeral saline lakes are important habitats for migratory birds.

Freshwater lakes and streams. Freshwater habitats include both standing and running water, with the Europe and Central Asia region holding almost 60% of the global freshwater volume (Messager *et al.*, 2016). Many lakes are found in the sub-boreal and boreal zone as relicts of glacial activity. Central and Eastern Europe hold vast drainage basins that feed a system of large rivers (compared with Western Europe, where watersheds are more fragmented, and Central Asia, where the climate is more arid). The overall diversity of freshwater species in Europe and Central Asia was routinely reported to increase towards lower latitudes (Hof *et al.*, 2008). River and lake systems often sustain coastal wetlands which are hotspots of biological production and diversity in the landsape mosaic. Therefore, freshwater habitats contribute importantly to green corridors and networks.

1.3.4 Subregion descriptions of Europe and Central Asia

Western Europe

Western Europe has highly fragmented and diverse landscapes of peninsulas, islands, mountain ranges and riverbasins. The subregion includes a wide range of climatic zones from from polar deserts on Svalbard and Iceland to the most extreme desert, the Negev Desert in Israel, and to subtropical island forests. The climate is typically favourable for agricultural production, except at northern latitudes and in some parts of the Mediterranean, where water is limiting. Hence, agro-ecosystems and forests dominate the landscape. Agro-ecosystems are maintained by human activity, and include croplands, orchards, horticultural systems and managed grasslands. Except for extensive grasslands, these habitats have low species diversity. Agriculture includes intensive cropland production and livestock production on grassland that ranges from intensive pasture to extensive rangelands and mountain meadows. Soils are often over-used in intensive agricultural areas and degraded due to erosion and salinization (Montgomery, 2007; Pimentel, 2006). Forests mainly dominate the high latitudes and altitudes, and can be both managed and semi-natural. Boreal forests have high diversity and provide important services (e.g. carbon sequestration), but are also very sensitive to climate change and management. Temperate forests have a long history of human influence in the region and maintain high biodiversity. Mediterranean forests grow in areas of cool wet winters and hot summers, and are typically evergreen or hard-leaved. These range from forests through shrublands to semi-open heaths depending on climate and disturbance. Mediterranean forests and scrubs have extremely high species richness (ca. 25,000 vascular plant species) with high endemism in spite of being heavily modified in historic times. Alpine and sub-alpine meadows, heaths and shrublands occur in the upland areas, with the actual treeline heavily modified by human activity. These habitats are very diverse with a high level of endemism. Urban and semi-urban areas with sealed surfaces also occupy large areas in the densely populated countries of Western Europe, which also contain two (the London and Paris metropolitan areas) of the four megacities - with more than 10 million inhabitants - in Europe and Central Asia. These ecosystems have high levels of disturbance and pollution, but especially residual habitats such as parks can conserve relics of local natural vegetation and may be relatively diverse. In peat bogs, water-saturated soils result in incomplete decomposition of organic matter, leading to an accumulation of organic-rich soils. These habitats have many specialist species, and are common in the oceanic, sub-boreal and boreal zone, but more rare towards the continental and mediterranean regions. Wetlands connected to lakes and rivers are often significantly diminished and modified by water regime regulations. Subterranean habitats are dark systems, which depend trophically on above-ground systems. They have many endemic species that are not well studied, but are extremely sensitive to environmental change.

The historic transition from self-sustaining agricultural systems to industrialized monocultures with high inputs (chemical and mineral inputs, energy and machinery) has led to the transformation of mosaic landscapes into homogeneous agricultural areas where nature and its contributions to people have relatively low value (Mazoyer & Roudart, 2006). The industrial revolution starting in the 18th century, and associated rapid urbanization, have also had a profound impact on the landscapes of much of Western Europe (Jepsen *et al.*, 2015). More recent land use trends have seen a reduction in agricultural area, especially for cropland, and increases in forest areas. This has happened because of the productivity gains of the green revolution, but also because of increasing imports of food and other commodities causing land use change in other parts of the world (Meyfroidt *et al.*, 2010).

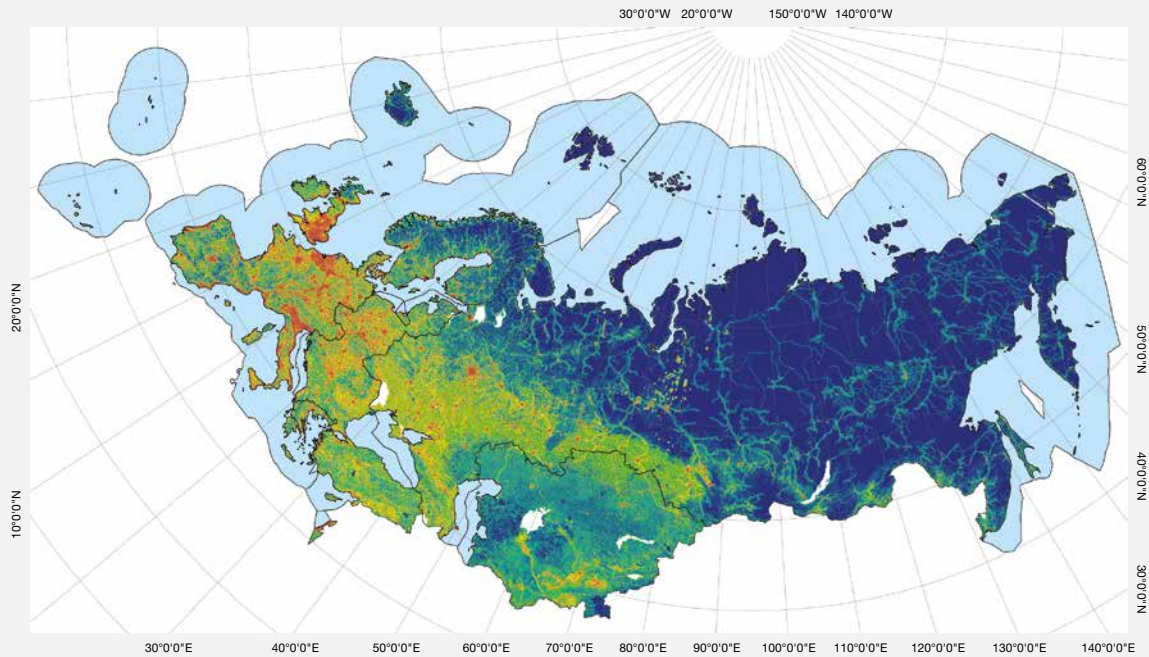
Western Europe is the most densely populated subregion of Europe and Central Asia, with half of the total population of the subregion living on approximately 10% of its

terrestrial surface. Worldviews and value systems are highly diverse. Many countries in the subregion are deeply rooted in democracy where individual human rights are at the centre of those worldviews and values. During the 20th century relatively multi-cultural societies developed with diverse, often contrasting worldviews among citizens. Very large ecological footprints led to a strong increase in environmental awareness. Lifestyles and consumption are rapidly globalizing, but local products and local cultural keystone places are gaining increasing recognition. Traditional lifestyles have almost disappeared, but there are movements toward a new generation of farmers who are more conscious of sustainability.

Fifteen of the 24 countries within Western Europe are members of the European Union; the others retain strong cultural and trade links to the European Union. Hence, environmental policy in this subregion is dominated by European Union legislation, although European Union member States determine how European Union directives are implemented at the national scale, and non-member States define their own environmental policies, albeit influenced by the European Union approach. There is a strong political will within the European Union to use policy to conserve natural and cultural heritage. This is demonstrated by the large number of ecologically-oriented European Union policies, including the Biodiversity Strategy, the Habitats Directive, the Marine Strategy Framework Directive and the Water Framework Directive, amongst others. However, some other European Union sectoral policies have had negative impacts on biodiversity and ecosystem functioning in the past, such as the Common Agricultural Policy's subsidising of intensive agriculture. In addition to the strong political will, there is strong public support for, and interest in, biological conservation across Western European societies.

The Western European region supports a wide range of conservation measures and marine protected areas driven largely by the European Union Habitats Directive. The European Environment Agency 2015 State of the Seas report (EEA, 2015c), estimates that, as of 2012, about 4%

Figure 1 10 **Human footprint in the Europe and Central Asia region derived from the following indicators: 1) built environments, 2) population density, 3) electric infrastructure, 4) crop lands, 5) pasture lands, 6) roads, 7) railways, and 8) navigable waterways. Source: Venter *et al.* (2016).**



THE HUMAN FOOTPRINT MAP FOR 2009
USING A 0–50 COOL TO HOT COLOUR SCALE

HIGH: 50 LOW: 0

0 500 1,000 2,000 3,000 km

Projection: Asia North Lambert Conformal Conic

Source: Venter O, Sanderson EW, Magrach A, Allan JR, Beher J, Jones KR, Possingham HP, Laurance WF, Wood P, Fekete BM, Levy MA, Watson JEM (2016) Data from: Global terrestrial Human Footprint maps for 1993 and 2009. Dryad Digital Repository. http://dx.doi.org/10.5061/dryad.052q5.2

of European Union marine areas were part of the Natura 2000 Network. However, given the vast biogeographic and geopolitical scope of Western Europe, there is a range of long-standing cumulative environmental pressures (e.g. centuries of coastal habitat alteration and fishing), to more emerging challenges, in particular those associated with climate change. Key examples, within Western Europe include: changes in sea-surface temperature (Philippart *et al.*, 2011) and poleward species migrations, as well as declining polar sea-ice and the opening of Arctic shipping areas (Wassmann & Reigstad, 2011). Various countries provide ongoing regional management plans for respective seas, e.g. Norway for the Norwegian Sea and Barents Sea (Government of Norway, 2012).

Western Europe has many countries with high levels of development that is commensurate with high levels of consumption, in terms of both the amount of consumption, e.g. Alexander *et al.* (2016a), and the variety of products consumed. This has had a profound effect on the ecosystems of Western Europe, which are all under strong human influence (see **Figure 1.10**). The general trend of habitat loss and deterioration (Birdlife Europe and Central Asia, 2015; European Commission, 2015b) has also reached Alpine and sparsely-populated Arctic areas, but even these are under pressure from tourism, natural resource exploitation and global change. Meanwhile, there is an increasing trend towards restoring natural habitats, with many successful examples. Western Europe is a net "ecological debtor" (with the exception of Sweden, Norway and Finland) being dependent on the import of external resources, therefore causing environmental impacts elsewhere. The human appropriation of net primary productivity (HANPP) embodied in the European Union's consumption is strongly dependent on the appropriation of biological productivity outside of Western Europe (Kastner *et al.*, 2015), with increasing reliance on Latin America as a main supplier. Moreover, deforestation embodied in European Union consumption is almost entirely due to imports, as deforestation within the European Union is negligible (EEA, 2015b).

Central Europe

Central Europe is mostly a continental biogeographical region with segments of Alpine, Boreal, Pannonian, and Steppic landscapes, and also comprises Mediterranean and, in Turkey, subtropical ecosystems, and many subterranean cave habitats, especially in the Balkans. It includes a wide variety of landforms and geographical conditions. Low elevation moraine landscapes prevail around the Baltic coast (Estonia, Latvia, Lithuania, central and northern Poland), and are dissected by rivers, lakes and wetland systems following glacial landforms (Metzger, *et al.*, 2012). Geographically, these areas belong to the eastern periphery of the Eastern European Plain. Farming dominates these landscapes, but one of Central Europe's largest primeval forests, Białowieza forest, is also located here, as well as large wetland areas in north-eastern Poland and Estonia. At the westernmost edge of the steppe zone, both semi-natural and natural grasslands occur, maintained by soil conditions, fire, aridity, and nowadays to a lesser extent herbivore pressure. These are some of the most diverse habitats of the region. Further south, lowland basins dominate the landscape separated by sub-alpine mountain ranges, including the Carpathian basin (with its sub-basins, the small and large Hungarian Plain and the Transsylvanian Plain), the Czech basin (drained by the Elbe, Vltava and Morava rivers) and the Wallachian Plain of the lower Danube. Mountain ranges and hills dissect the Balkan area (the main watercourses being the Danube and Sava rivers) which lacks extensive lowlands. The Anatolian Peninsula is surrounded by mountain ranges around the semi-arid Anatolian plateau. Although highly variable within small areas, climatic and edaphic conditions in Central Europe are favourable for agriculture, except in some water-deficient areas in the Anatolian plateau, and agriculture and forestry are the most widespread land use types. Relatively large, but fragmented, forests exist mainly in boreal areas, while unmanaged forests are rare. Except for Białowieza forest in Poland, Romanian old-growth forests are unique in continental Europe. To safeguard the remnants of primeval forests, the world heritage list of the United Nations Educational, Scientific and Cultural Organization has recently been expanded (in July 2017), to include the Primeval Beech forests of the Carpathians, which stretch over Albania, Bulgaria, Croatia, Romania, Slovakia and Ukraine.

The political borders within Central Europe have been highly dynamic throughout history. This was caused by changes in political regimes from self-sustaining kingdoms to empires (Austria-Hungary, Prussia, the Ottoman Empire), two world wars in the 20th century, and finally by the dissolution of the Soviet Union in the late 1980s. Since the 1990s, most of Central Europe has been through important political and socio-economic transformations. This determined the nature of governance structures, affecting environmental protection and the management of natural resources, which currently remain of secondary importance to economic growth. Traditional practices and indigenous and local knowledge that are important for local nature conservation often survive in marginal cultural landscapes.

Although geopolitical transformations had different effects in different countries, the basic economic processes were similar as a consequence of the preparation of accession to the European Union (Bański, 2008). The semi-enclosed seas of the subregion have been influenced by eutrophication due to urbanization and fertilizer use, and the shore areas are increasingly under pressure from tourism. Invasive species are particularly a problem in the Black Sea and the

mediterranean sea (Blenckner *et al.*, 2015). Large patches of wetlands exist attached to floodplain river deltas and freshwater lake systems, but are influenced by water level regulation, infilling, pollution and drainage (Hein *et al.*, 2016).

Central Europe is home to about 20% of the population of Europe and Central Asia on 6% of its land area, with population densities comparable to Western Europe. Many people live in rural areas in Central Europe, and there is only one megacity - Istanbul (out of 4 megacities located in Europe and Central Asia). However, with the exception of Albania, the added value of agriculture to the GDP of Central Europe is minor and economies are built on services and industry (The World Bank Group, 2016). Worldviews and value systems are highly diverse, partly as a consequence of this diverse history. Top-down determination of worldviews and values became stronger during the 20th century causing considerable change. During the Soviet era many community-level structures and informal regulations were deliberately dismantled. After 1989, a strong cultural revival was typical in many countries, together with an increase in national identity. Traditional values and lifestyles survive and are being adapted to the new socio-economic environment in thousands of semi-subsistence villages in marginal areas throughout Central Europe.

Central Europe is characterised by rapid economic and social development and urbanization in recent decades that increasingly resembles Western Europe together with relatively large areas of more intact nature in the form of cultural landscapes. The green corridors throughout such areas are of critical importance. These networks of landscape features dominated by near-natural vegetation enhance landscape connectivity, facilitating migration and dispersal of species. These existing resources raise the challenge of an alternative economic development pathway that can conserve natural capital while consumption patterns appear to continue to adjust to Western European norms. While local value systems are close to Western Europe, due to a similar long-term history, the ecological, economic and cultural heritage is different in many ways, influenced by divergent historical pathways in the 20th century. Environmental policy in Central Europe is strongly influenced by the European Union since all Central European countries are either members of, or closely associated with, the European Union.

During the 20th century, many ecosystems were impaired by water and air pollution, such as acid rain, industrial waste, and production intensification. In Western Europe, protected areas cover on average 25% of the land surface, while in Central Europe the equivalent area is only 21% and in Eastern Europe 7% (The World Bank Group, 2016). However, biodiversity is often on average richer than in most parts of Western Europe. For example, some of the most species-rich grasslands in the world are found in Estonia and Romania (Wilson *et al.*, 2012). There is increasing public support for, and interest in, nature conservation across Central European societies. Natural areas are seen as resources providing ecosystem services, supporting environmental resilence and facilitating adaptation to, and mitigation of, climate change (EEA, 2012). Climate change observations and projections indicate that Central Europe faces increasing risk of droughts and warm temperature extremes (EEA, 2015b) and, especially in the Mediterranean Sea, increasing sea temperatures and ocean acidification (Gambaiani *et al.*, 2009).

Eastern Europe

Most of the IPBES subregion of Eastern Europe is geographically located in Asia: only Belarus, Moldova, Ukraine and the western part of Russia are completely within what is commonly known as Europe, while most of Russia is beyond the Urals, and Azerbaijan, Armenia and Georgia are beyond the Greater Caucasus, which are traditionally set as the geographic divides between Europe and Asia.

Most of this “European” part of Eastern Europe is occupied by the Eastern European Plain, spanning from the Black Sea and Caucasus to the Arctic Ocean, and from the easternmost European Union borders to the Urals. The Plain contains the basins of some of Europe’s longest rivers, such as the Volga, Dnepr and Pechora. Being a vast mountain-free space with an average elevation of only 170 m, the Plain shows a uniquely gradual and continuous change of climatic zones and biogeographic regions, from Arctic deserts and tundra to boreal taiga, and then to mixed and deciduous continental forests and forested steppes, steppes and semi-deserts of the steppic zone. Arctic deserts have negligible vegetation productivity due to the extreme cold and the short growing season, and are dominated by algae, mosses, lichens and only a few vascular plants (ca. 100 species), covering about half of the ground surface altogether. Tundra habitats also have permanently frozen subsoils and environmental conditions that do not allow for forest growth (temperature, wind, precipitation). Vegetation is composed of a grass and a moss layer with sparse bushes, inter-laced with open soil, including lichen and moss or alternatively shrub tundra. Such habitats have relatively low species diversity (totalling ca. 500 vascular plants). Only continental, and northern and middle steppic regions are dominated by croplands (with steppe soils often heavily overused and degraded), while the boreal taiga region is mostly forested, except the areas around major cities. The forests are mostly natural and semi-natural, and managed only towards the southern part of the taiga region and further to the south. The south-eastern segment of the steppic and semi-desert and desert strip (especially within the Caspian Depression) contains vast arid rangelands (Isachenko, 1985). Several old industrial areas (notably Donbass in Ukraine) are densely

populated, while elsewhere, except the south-western part of the plain, population density drops to less than 10-15 people/km^2. The region contains the Moscow metropolitan area, one of the four in the region with more than 10 million inhabitants. Many areas in western Russia have been rapidly losing their rural population over several decades (Alekseev & Safronov, 2015). In addition, the Chernobyl nuclear accident of 1986 led to the relocation of hundreds of thousands of people in Belarus, Ukraine and Russia (Hostert *et al.*, 2011).

There are several mountain systems on the edge of the Eastern European Plain: the eastern (Ukrainian) Carpathians, Urals, Crimean Mountains, the Greater Caucasus and Khibiny. All of these, especially the Greater Caucasus can be regarded as very important for biodiversity and, in general, their ecosystems are better preserved than the surrounding areas, except for some mining and industrial areas in the central and southern Urals, and the edges (especially in the south) of the Crimean Mountains and the Greater Caucasus, which are densely populated. The Greater Caucasus features a broad range of ecosystems, from dry steppes, semi-boreal forests, alpine meadows and glaciers to humid subtropical forests (Isachenko, 1985). Some of its peaks, including seven peaks over 5,000 m, are Europe's highest.

The geographically Asian part of Russia (Siberia and the Far East) stretches for over 5,000 km from the Urals to the Pacific coast, and for over 3,000 km from the Arctic Ocean to Mongolia and China. It consists of the flat and swampy (except the southern steppic part) Western Siberian Lowland, the hilly and sometimes low mountainous Central Siberian Plateau, the Southern Siberian (Altai, Sayany) and Transbaikalian Mountains limiting the lowlands and the plateau in the south, and the extremely complex topography of the almost entirely mountainous Russian Far East. Most of the area is covered by boreal taiga, except for tundra and Arctic deserts in the extreme north and in Arctic archipelagos, while in the south, the taiga changes to semi-steppes and steppes. There is an area of semi-deserts between the Sayany mountains and Mongolia. The mountains (except those located in high latitudes) are mostly forested and recognised as important global and regional biodiversity hotspots. Taiga forests are not managed sustainably. There, control and protection cannot prevent forest fires and illegal logging and the area of burnt forests is larger than the area of logging reported by the Russian Forest Agency (Minprirody of Russia, 2016). Most of the steppe and semi-steppe landscapes have been converted to croplands and pastures, except saline areas and some broken terrains. The Russian Far East is richer in biodiversity than Siberia, especially its south-eastern part, which is covered with deciduous and mixed monsoon forests (this also includes the southern part of the Kuril Islands) (Gvozdeckii & Mikhailov, 1978). Siberia and the Far East are drained by some of Asia's largest rivers, such as Lena, Yenisei, Ob' and Amur; Lake Baikal located at the south-eastern edge of the Central Siberian Plateau is the world's largest (in terms of volume of water) and deepest (up to 1,642 m) freshwater body and a unique habitat to many endemic species. Human population density is extremely low in most of Siberia and the Far East, and everywhere except the southern steppic edge and some industrial and mining areas, is below 1 person/km^2. In the areas north of the relatively inhabited strip, most settlements are in river valleys. The industrial areas are often heavily polluted. Climate change is an important threat to the nature of Siberia and the Far East, especially given that most of the region has permafrost, while the ecosystems in the Arctic Ocean are sensitive to sea ice dynamics.

The Transcaucasia region contains the flat and wet Kolkhida Depression open to the Black Sea, the dry Kura-Aras Depression open to the Caspian Sea, the Lesser Caucasus Highlands between and to the south of the Lowlands, and the Greater Caucasus in the north. The coastal lowland areas are home to the only humid and semi-humid subtropical forests of the subregion, with high levels of endemism and quite high diversity (several thousand vascular plant species). The Kolkhida Depression is densely populated (mostly by over 100 people per km^2) and dominated by croplands, with only very small fragments of subtropical wetlands remaining by the seashore. The Kura-Aras Depression is located in the zones of subtropical steppes, subtropical forests and semi-deserts, and most of it is converted to croplands and pastures, except some saline and broken lands; the population density is sparser in general (50-100 people per km^2) than in Kolkhida, although next to major cities it can be as high. The Lesser Caucasus is a system of relatively low mountain ridges, mostly deforested and heavily eroded, occupied by pastures and with high-density populations in the valleys. It is an important regional biodiversity hotspot.

The common historical legacy of Eastern Europe is closely tied to the history of the Soviet Union, which has led to a gradual and challenging political and socio-economic transition. During the Soviet era, many social and economic institutions, especially those related to self-organization, enterpreneurship and religion, were destroyed or severely damaged. This also had a strong and clearly visible impact on patterns of rural settlements. In Belarus and Ukraine, whose western parts only became Soviet in 1939, the pre-war border of the USSR can be traced even on topographic maps, where dense networks of small villages and farms suddenly change to patterns dominated by large villages with vast empty spaces surrounding them. This divider can also be found in many behavioural patterns and cultural preferences including attitudes towards nature and livelihoods. It is generally noted that more traditional ways have been preserved in the Caucasus, some other mountain systems (e.g. Carpathians) and the northern

parts of Eastern Europe. The trend in recent decades has been a growing interest in traditional values combined with rapidly globalizing lifestyles and consumption. Environmental awareness is generally growing, but is still a somewhat low priority.

The core of the system of protected areas was established by the USSR, although it has significantly expanded since then, inspite of conservation programmes being underfunded in most countries. The countries of Eastern Europe maintain hierarchical political systems, limiting public participation in the development of nature conservation mechanisms and with different degrees of involvement of the public and of non-govermental organizations in the establishment and management of proteced areas; corruption is also considered to be a serious concern in some countries, and can result in illegal deforestation, land-grabbing, soil degradation and environmental pollution (Newell & Simeone, 2014; Richardson, 2015). All Eastern European countries, except Belarus, are involved in local armed conflicts that have led to substantial biodiversity losses (Burns *et al.* 2017). Eastern European countries have well-integrated environmental legislation, initially based on common USSR legislation. More recently, some countries have started to harmonize their environmental legislation with European Union directives and best practices, but compliance standards are rather low in most instances (Ermolin & Svolkinas, 2016; Malets, 2015). All Eastern European countries report to the Convention on Biological Diversity.

Nevertheless, the emerging multilevel biodiversity governance arrangements, such as the European Diploma for Protected Areas or forest certification schemes, work towards more transparent and accountable nature conservation regimes (Otto *et al.*, 2011).

Central Asia

The five countries constituting Central Asia were all former Soviet republics, located between the Caspian Sea and China. The subregion has a harsh continental climate, and is dominated by steppic landscapes in the north changing to deserts in central and southern parts. Its deserts have warm or cold climates with precipitation less than 250 mm/year (according to the Köppen-Geiger classification, or 150 mm according to the IPBES land degradation assessment), with specific soil types and vegetation (Asian Development Bank, 2010). They have moderate species richness, for example comprising a total of 1,000-1,500 recorded vascular plant species. Most of Central Asia consists of plains or hilly uplands, which are delimited by mountain systems on the eastern and southern peripheries. The main geographical subdivisions of Central Asia are central Kazakhstan (subdivided into the Turgay Plateau and Kazakh Uplands) and the vast desert plain to the south that contains numerous plateaus, uplands and lowlands. In the geographic literature, this plain is often divided into two: the region of northern deserts and the region of southern deserts (Gvozdeckii & Mikhailov, 1978). Central Asia is limited in the east and south by large mountain systems with extensive glacier and nival ecosystems. Such habitats have low temperatures and a short growing season (< 10 days) (Körner *et al.*, 2011). Central Asia also includes the southernmost parts of the Eastern Siberian Lowlands, the Urals (Mugodzhar Hills), Altai and the Eastern European Plain. Croplands in Central Asia are irrigated everywhere except at their northern edge and in some mountainous areas and, therefore, most settlements and the highest density of rural population are found in river valleys and similar irrigated areas. The vast areas between these settlements are almost uninhabited and mostly used for animal husbandry (usually nomadic), often based on indigenous and local knowledge. All the rivers in the central and southern parts of the subregion belong to endorheic basins (closed basins or internal drainage systems), and water overuse due to irrigation has led to severe downstream water quantity and quality issues, the most famous being the dessication of the Aral Sea, which was one of the largest inland lakes of the world in terms of surface area.

The Caspian Depression geographically belongs to the Eastern European Plain and is a flat lowland (Gvozdeckii & Mikhailov, 1978). Its southern part is dominated by rangelands with sandy and salty deserts, salt marshes and salty lakes, while in the central part and further towards the north the landscapes change to desert and then to dry steppes. Croplands are found only on the northern edge of the depression, while the rest is used for sheep husbandry, mostly nomadic. The south-east of the depression is an old oil production area with soil and water pollution widespread. The Eastern Siberian Lowland within Central Asia is a steppic landscape that changes to dry steppes in the south, often with salty soils, marshlands and numerous salty lakes towards the south-east (Isachenko, 1985). It is dominated by croplands, with rangelands mostly occurring in salty landscapes.

The Mugodzhar Hills and Central Kazakhstan are dominated by dry steppes in the north and semi-deserts towards the south. The steppes are mostly cultivated, while the semi-deserts are used for sheep husbandry. The Mugodzhar Hills reach 657 m; the Turgay Plateau is a system of plateaus slightly elevated over surrounding areas (up to 310 m); while the Kazakh Uplands is a hilly area with strongly eroded residual mountain ridges (the highest peak is 1,565 m), thousands of small lakes, and relict pine forests on northern slopes (Gvozdeckii & Mikhailov, 1978). A large area in the north-eastern segment of the Uplands (over 18,500 km^2) was used from 1949 to 1991 as a test site for

nuclear weapons, and is still heavily contaminated. Central Kazakhstan is limited in the east by the westernmost ranges of the Altai and the Saur and Tarbagatai Mountains. The core of Altai is in Russia, while peripheral parts are also found in China and Mongolia. The Altai Mountains are dominated by coniferous forests. Alpine and subalpine meadows are less common. The Kazakh part of Altai is an important mining area with large-scale non-ferrous metal production that causes heavy environmental pollution.

The region of the northern deserts is located in southern Kazakhstan, northern and western Uzbekistan, and northern Turkmenistan, and includes a small portion of Kyrgyzstan in the valley of the Chu River. It is characterised by low winter temperatures, with January averages from -4°C in the south to -16°C towards the north (Asian Development Bank, 2010). The most prominent landforms of the region of northern deserts are the Plateaus of Ustyurt (raising from 150 to 365 m) and Mangyshlak (555 m); the rest is a rather extensive plain with a few residual mountain ridges, gradually raising from about 5 m under the cliff of Plateaus of Ustyurt to 300-500 m in the east, next to the Dzungarian Gate, connecting the plain with the Dzungarian Depression in China. This plain is dominated by sandy deserts in the western (Kyzylkum, Aralian Karakum, Barsuki) and eastern parts (Saryesik-Atyrau), while the central part is mostly stony and clay desert (Betpak-Dala). The plain contains several large lakes, including the remnants of the Aral Sea, and the Lake of Balkhash (half of which is salty, while the other half is fresh water), and is crossed by a few major rivers with large deltas, such as the rivers of Syr Darya and Amu Darya that used to be tributaries of the Aral Sea, the Ili that is a tributary of the Balkhash, and the Chu disappearing into the desert. Due to intensive irrigation, the rivers' discharge is continuously dropping which, in addition to the loss of the Aral Sea, threatens the existence of the Lake of Balkhash. Surface irrigation also leads to soil salinisation, especially in clay deserts, such as Betpak-Dala. Most of the area is rangeland, used for animal husbandry. Croplands such as cereal and cotton are found in river valleys and irrigated areas fed by the rivers. Remnants of riparian forests (also known as "tugai") can be found in the deltas of the Amu Darya and the Ili, and along the along the Syr Darya. These have high productivity and moderate species diversity (ca. 600 vascular plants) with many endemics, and serve as habitats for many iconic mammal species (Milkov, 1977) (Sokolov & Syroyechkovskiy, 1990).

The region of southern deserts includes most of Turkmenistan (except the extreme north and the south-western mountain part), central Uzbekistan, and the southernmost part of Kazakhstan. January average temperatures are 0°C or higher, while July averages are the highest in the Europe and Central Asia region exceeding +32°C in southern Turkmenistan (Asian Development Bank, 2010). Most of the region is a rather monotonous plain gently raising from -28 m at the shore of the Caspian Sea to 200-300 m in the east. The prevailing landscape is sandy deserts (Karakum, southern Kyzylkum) with salty marshes and clay deserts occurring by the Caspian Sea (especially by the Bay of Garabogazköl) and in local depressions. The most important rivers are the Syr Darya, the Amu Darya, the Zeravshan and the Murghab (the latter two with deltas disappearing into deserts); all heavily utilised in large-scale irrigation projects. The most important project was the Karakum Canal, constructed in 1954-1988 to promote cotton production in Turkmenistan. It is 1,375 km-long, and carries over 13 km^3 of water annually from the Amu Darya, which arguably led to the disappearance of the Aral Sea. Due to its high water losses the canal also causes soil salinization along its route. Deserted rangelands dominate the region of southern deserts and are mostly used for sheep and camel husbandry, often nomadic.

The mountain peripheries of Central Asia are often divided into three areas, which are distinctively different in terms of geomorphology and climatic characteristics (Gvozdeckii & Mikhailov, 1978): (1) the Central Asian Mountains (Saur, Tarbagatai, Dzungarian Alatau, northern Tian Shan), (2) south-eastern Tian-Shan and Pamir, and (3) Kopet Dag. All of these areas are important for biodiversity. The Central Asian Mountains consist of high ranges (Dzungarian Alatau reaches 4,464 m, and northern Tian Shan reaches 7,439 m), which usually stretch latitudinally. The mountains are dominated by steppes, shrubs and dry meadows, while lower ranges are covered by shrubs and arid woodlands. The foothils and intermountain depressions are mountain deserts, which are often irrigated and densely populated; the most important depressions (also known as "valleys"), such as Fergana and Gissar, and contain a large proportion of Central Asia's population. The Central Asian Mountains include several large lakes, notably Issyk-Kul, which is a habitat for many endemic species. Primary wild walnut-fruit forests are a specific feature of the Central Asian Mountains, occuring on mountain slopes around 1,000 m above sea level wherever precipitation is sufficient (Shukurov, 2016; Shukurov *et al.*, 2005). They are dominated by walnut (*Juglans regia*), maple, juniper and wild variants of many cultivated fruit trees, thus representing an extremely important genetic reserve. With about 300 species of vascular plants, these forests are not particularly diverse, but have a large number of tree and shrub species, with many endemics and rare species (Ashimov, 2014; Government of Tajikistan., 2014; Shukurov, 2016). South-eastern Tian-Shan and Pamir is a complex junction of the Central Asian mountain ranges. Its highest peak in Central Asia is 7,495 m. The prevailing landscapes are high-mountain plateaus, valleys and ridges covered with dry meadows and mountain steppes. There are many glaciers, including the Fedchenko Glacier that is the world's longest outside of the polar regions. Most of Pamir is sparsely populated; the valleys are used for seasonal pastures. Kopet Dag is recognised as the northern extension

of the Iranian Uplands. It is a relatively low mountain range reaching 2,940 m and covered with shrubs and low woodlands, which are mostly used for sheep husbandry.

Central Asia experienced attempts at rapid industrialisation and socio-economic change during the Soviet era, followed by massive migration from the western parts of the USSR, while local ethnic communities maintained many traditional ways and practices, especially in the countryside, and remained almost unchanged in remote areas, such as the mountain periphery. The exceptions include northern Kazakhstan dominated by migrants from western parts of the USSR, and some large cities. After the dissolution of the Soviet Union in 1991, the significance of traditional cultural and religious views and practices grew considerably, although to varying extents across the region. Environmental disasters, such as the drying out of the Aral Sea and large scale soil salinisation, as well as conflicts over water resources, keep environmental awareness relatively high and well represented in policy agendas, although much oriented towards resource availability and quality of life.

When Central Asia was part of the Soviet Union, many large-scale irrigation and hydropower projects were launched that led to water management problems. With the end of the Soviet era these issues became transboundary in nature, but with Central Asian countries rebuilding their economies, the preservation of natural resources was often assigned a low priority. In the 21st century, the transition to a green economy and more resource-conscious agriculture was initiated in several Central Asian countries. Programmes for conserving agro-biodiversity, wetland habitats and CO_2 sequestration have been put in place, and indigenous and local knowledge continues to contribute to land management, especially in areas where semi-nomadic and transhumance livelihoods prevail. The natural contributions provided by these large steppe areas are important at the global level, especially for climate regulation, water regulation and soil formation. Many Central Asian States are interested in the transition to a green economy and have the natural capital to support this, but the prospect of rapid economic development based on the export of resources also has strong potential.

1.3.5 Relationships between Europe and Central Asia subregions

Transboundary connections within and beyond Europe and Central Asia are briefly introduced here, and are dealt with more extensively in Chapter 2. Europe and Central Asia has a number of transboundary issues that broadly fall into 3 categories: 1) transboundary governance systems, 2) transboundary nature and its contributions to people, and 3) links to other regions of the world. The European Union is economically the largest of the transboundary governance structures, and a major player in ecological protection in the region. However, other important transboundary governance structures exist, such as the European Free Trade Association (EFTA) of Iceland, Liechtenstein, Norway, and Switzerland, the Commonwealth of Independent States (CIS) of Russia, Ukraine, Belarus, Kazakhstan, Kyrgyzstan, Tajikistan, Armenia, Azerbaijan, Uzbekistan, Turkmenistan and Moldova, and the Eurasian Economic Union (EEU) of Belarus, Kazakhstan, Russia, Armenia and Kyrgyzstan. Although these associations are broadly based on economic criteria, they provide opportunities for cultural exchange and shared interests across a range of topics, potentially including the protection of natural capital.

A major transboundary issue for nature and its contributions to people concerns water as a resource and as a habitat, especially along major rivers, with the impact of dams, hydroelectric plants and water abstraction for irrigation from lakes, rivers and inland seas. Effects can be far-reaching from source to sea inlet and often bridge several subregions. Furthermore, air pollution can have widespread geographic impacts on habitat quality, especially nitrogenous compounds. Resources, products, pollution and waste are also transported across the boundaries within Europe and Central Asia, which impacts on ecosystems in multiple ways, including eutrophication and invasive species. However, green corridors (mountain ranges, river floodplains, the former Iron Curtain) provide a more positive benefit of transboundary interactions across Europe and Central Asia.

1.3.6 Global connections and issues

Europe and Central Asia has many links and teleconnections with the rest of the world, notably through global trade and the transport of goods (Kastner *et al.*, 2015). Transport supports the movement of invasive species that impact directly on ecosystem quality within the region (Hulme, 2009). The import of food and other goods has the effect of displacing the environmental pressures exerted by Europe and Central Asia's regional consumption to other parts of the world (Cuypers *et al.*, 2013), while Europe and Central Asia is dependent on these imported goods. Moreover, there is some evidence to suggest that Western Europe has been responsible for overfishing in waters beyond its jurisdiction (e.g. Akiba, 1997). Cultural links with regions outside of Europe and Central Asia are important in transforming human livelihoods, consumption patterns, value systems and attitudes towards nature, which also affect local nature and its contributions to people. China is an important emerging power that has an influence from outside the Europe and Central Asia region (Tracy *et al.*, 2017). China-led political, security and economic initiatives, such as the Silk Road Economic Belt or the

Shanghai Cooperation Organization are increasingly visible in the region, in particular in Eastern Europe, and even more so in Central Asia. The implications for nature are not entirely clear yet, but impacts may arise from the further growth of international trade, and possibly with large-scale infrastructural developments in regions bordering China (Tracy *et al.*, 2017).

1.4 THE GLOBAL AND REGIONAL POLICY CONTEXT

1.4.1 The Aichi Biodiversity Targets and the Sustainable Development Goals

Aichi Biodiversity Targets. In 2010, the Parties to the Convention on Biological Diversity adopted the Strategic Plan for Biodiversity 2011-2020, encompassing a long-term vision and a shorter-term mission (see **Box 1.2**). The 20 Aichi Biodiversity Targets, divided among five Strategic Goals, are part of the Strategic Plan and an essential tool for its implementation (CBD, 2010). To determine whether progress is being made toward halting biodiversity loss and ensuring that ecosystems are resilient and provide essential services for good quality of life, requires an assessment of current states, and an understanding of past and future trends. Tracking progress towards the Aichi Biodiversity Targets allows an evaluation of the progress towards the accomplishment of both the vision and mission of the Strategic Plan.

Sustainable Development Goals. The Sustainable Development Goals (SDGs) (United Nations, 2015) form the key component of the United Nations' 2030 Agenda for Sustainable Development, and are a re-affirmation of the world's commitment to move towards sustainable development. There are 17 Sustainable Development Goals with 169 targets covering a wide-range of areas, from ending poverty to empowering women and protecting the environment. The Sustainable Development Goals (together with the Aichi Biodiversity Targets) provide a global framework within which to tackle the biodiversity crisis. Goals 14 and 15 address biodiversity and ecosystems (nature) explicitly. However, the broader importance of nature to quality of life makes the Europe and Central Asia assessment relevant for several Sustainable Development Goals. **Table 1.5** maps the Europe and Central Asia questions onto the Goals.

The fifth national reports to the Convention on Biological Diversity provided an important source of information for the mid-term review of progress towards the implementation of the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets. The fifth national reports have also contributed to the development of the fourth edition of the Global Biodiversity Outlook (CBD, 2014).

1.4.2 The relationship between the Europe and Central Asia policy questions, the Aichi Biodiversity Targets, the Sustainable Development Goals, and other biodiversity policies

Since the formulation of the general questions, and those specific to Europe and Central Asia, responded to requests by Governments, multilateral environmental agreements and other stakeholders, they are relevant to policy agendas encapsulated within the Strategic Plan for Biodiversity 2011-2020 and the 2030 Sustainable Development

Box 1 2 **The vision and mission of the Strategic Plan for Biodiversity 2011-2020.**

"Living in harmony with nature"- The vision of the Strategic Plan

"By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people."

The mission of the Strategic Plan

"take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication. To ensure this, pressures on biodiversity are reduced, ecosystems are restored, biological resources are sustainably used and benefits arising out of utilization of genetic resources are shared in a fair and equitable manner; adequate financial resources are provided, capacities are enhanced, biodiversity issues and values mainstreamed, appropriate policies are effectively implemented, and decision-making is based on sound science and the precautionary approach."
(Convention on Biological Diversity 2010)

Agenda. **Table 1.5** maps the Europe and Central Asia policy questions onto the Aichi Biodiversity Targets and the Sustainable Development Goals. The following sections describe how different parts of the Europe and Central Asia region contribute to achieving these policy goals.

European Union Countries. The European Union Biodiversity Strategy 2020 emerged from the Birds and Habitats Directive, as the cornerstone of European Union biodiversity protection policy (adopted in May 2011). The aim of the Biodiversity Strategy 2020 is to halt biodiversity loss in the European Union, restoring ecosystems where possible, and stepping up efforts to avert global biodiversity loss. The European Union Biodiversity Strategy to 2020 sets six targets addressing the main pressures on nature and ecosystem services in the European Union and beyond (Birdlife Europe and Central Asia, 2015; European Commission, 2011). As such, the European Union has laid down a commitment to various biodiversity-related conventions and the Aichi Biodiversity Targets. **Table 1.6** shows the links between the European Union Strategy targets and the Aichi Biodiversity Targets, which integrate the concept of ecosystem services as an approach to ecosystem conservation and restoration. For example, at the European Union level, policies already integrate the ecosystem services approach into member States' economy and planning, for example in the new rural development policy for 2014-2020, the European Union's regional and cohesion policy, and the blueprint to safeguard the future of its waters by 2015 (Maes *et al.*, 2012).

Table 15 **How the Europe and Central Asia policy questions relate to the Aichi Biodiversity Targets and Sustainable Development Goals (see Section 1.1.1 for an overview of the Europe and Central Asia questions).**

Policy-relevant questions	Aichi Biodiversity Targets	Sustainable Development Goals
1. Importance of nature to humans	1, 2, 3, 4, 14, 15, 16	1, 2, 3, 6, 7, 8, 9, 11, 13, 14, 15
2. Current change of nature (ecosystems and biodiversity) and its consequences	5, 6, 7, 11, 12, 13, 14, 15, 18, 19	3, 6, 13, 14, 15
3. Causes of this change	3, 4, 8, 9, 10	12, 13, 14, 15
4. Opportunities for policies and interventions	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17	1, 2, 3, 6, 7, 8, 12, 13, 14, 15, 16, 17
5. Identification of knowledge gaps	18, 19	6, 12, 13, 14, 15
6. Opportunities to apply investment, regulation and management instruments for protection of important ecosystems and management of their contribution to people and good quality of life	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	1, 2, 3, 6, 7, 8, 9, 11, 12, 14, 15, 17
7. Impacts of production, consumption and economic development on nature and nature's contributions, including effects in other regions	2, 4, 6, 7, 8, 9, 10	10, 12, 13, 14, 15
8. How policy sectors and instruments can encourage opportunities for good quality of life related to biodiversity and ecosystems (nature)	3, 4, 6, 8, 9, 10, 13, 14	2, 3, 6, 7, 8, 9, 11, 12, 13, 14, 15

Table 16 **Comparison of the targets of the European Union Biodiversity Strategy to 2020 and the Aichi Biodiversity Targets. Source: Based on BISE (2015); CBD (2015).**

European Union Biodiversity Targets	Aichi Biodiversity Targets*
Target 1: Fully implement the Birds and Habitats Directives	1, 11, 12
Target 2: Maintain and restore ecosystems and their services	15, 14, 8, 10
Target 3: Increase the contribution of agriculture and forestry to maintaining and enhancing biodiversity	7, 5, 13
Target 4: Ensure the sustainable use of fisheries resources	6, 7, 10
Target 5: Help combat invasive alien species	9
Target 6: Help avert global biodiversity loss	2, 3, 16, 17, 20

* The three missing Aichi Biodiversity Targets, particularly Target 4 (partnership for biodiversity), and Targets 18 and 19 (building on the biodiversity knowledge base) are cross-cutting issues.

Table 17 **Status of the development of national biodiversity strategies and action plans (NBSAPs) of countries in Europe and Central Asia as at July 2017. Source: www.cbd.int/doc/nbsap/nbsap-status.doc.**

	Status of NBSAPs development	Pre-COP-10	Post COP-10
Western Europe	Andorra		X
	Austria		X
	Belgium		X
	Denmark		X
	Finland		X
	France		X
	Germany		X
	Greece		X
	Iceland	Partial revision planned	
	Ireland		X
	Israel	X	
	Italy		X
	Liechtenstein		X
	Luxembourg		X
	Malta		X
	Monaco	NBSAP not submitted yet	
	Netherlands		X
	Norway		X
	Portugal	X	
	San Marino	NBSAP not submitted yet	
	Spain		X
	Sweden		X
	Switzerland		X
	UK		X

	Status of NBSAPs development	Pre-COP-10	Post COP-10
Central Europe	Albania		X
	Bosnia and Herzegovina		X
	Bulgaria	X	
	Croatia		X
	Cyprus	NBSAP not submitted yet	
	Czech Republic		X
	Estonia		X
	Hungary		X
	Latvia		X
	Lithuania		X
	Montenegro		X
	Poland		X
	Romania		X
	Serbia		X
	Slovakia		X
	Slovenia	Strategy only	
	TFYR Macedonia	X	
	Turkey	X	
Eastern Europe	Armenia		X
	Azerbaijan		X
	Belarus		X
	Georgia		X
	Moldova		X
	Russian Federation		X
	Ukraine		X
Central Asia	Kazakhstan	X	
	Kyrgyzstan		X
	Tajikistan		X
	Turkmenistan	X	
	Uzbekistan	X	

Non-European Union countries. Countries outside the European Union contribute to the implementation of the Aichi Biodiversity Targets through national strategies, plans or programmes (in line with Article 6 of the Convention on Biological Diversity). Currently, almost all Parties to the Convention (189 out of 196) and all countries in Europe and Central Asia with the exception of Cyprus, Monaco and San Marino, have developed national biodiversity strategies and action plans (NBSAPs). NBSAPs are instruments for the effective implementation of the Convention at the national level, with the expectation of leading to the successful fulfilment of the Convention. Parties have different levels of NBSAP completion. Only 10 Europe and Central Asia countries completed a revision of the NBSAPs prior to the 10th Conference of the Parties to the Convention on Biological Diversity, when the Aichi Biodiversity Targets were adopted. By August 2017, most of the Europe and Central Asia countries had a revised version of the NBSAP, but for the others, revisions are still underway (**Table 1.7**).

Countries of Europe and Central Asia are signatory to the Convention on Biological Diversity and so, have committed to change their biodiversity strategy to meet the Aichi Biodiversity Targets. The Europe and Central Asia key questions reflect this engagement in responding to current needs and requests by diverse stakeholders from governments to local communities.

1.4.3 Other environmental and non-environmental policies and governance

European Union countries. In addition to the European Union Biodiversity Strategy 2020, there are a number of other sectoral polices within the European Union that affect biodiversity and ecosystems. The Water Framework Directive aims to ensure the "good ecological status" of European water bodies (European Union, 2000). The Common Agricultural Policy (CAP) has been expanded from its food production focus to consider the broader implications of farm management for the environment, through a range of agri-environmental schemes targeting ecological infrastructure (e.g. Batáry *et al.*, 2015). The Common Agricultural Policy also supports rural development and the continuation of traditional agricultural practices of high nature value (EEA, 2015a). At the national and local level, European Union countries have implemented a number of land use planning policies to support green space (Kabisch *et al.*, 2016), and to use the ecosystem services concept for improved nature conservation. There are also many listed conservation areas, implemented through national policy or as part of the European Union Natura 2000 network of protected areas (European Commission, 2008).

The Common Fisheries Policy has become increasingly concerned with the management of fish stocks, although more action is needed to ensure the sustainability of all European Union fisheries. The European Union has developed Sea Basin Management Plans for the Mediterranean (Adriatic and Ionian Seas), the Black Sea, the North Sea, the Atlantic Ocean and the Arctic Ocean (European Commission, 2017b). It also implemented the Marine Strategy Framework Directive (MSFD) in 2008 (European Union, 2008), a Directive for maritime spatial planning (European Union, 2014), and set out a Blue Growth Agenda (European Commission, 2015a).

Non-European Union countries. Most of the non-European Union countries of Europe and Central Asia are either involved in European Union- led initiatives, such as the European Environment Agency (EEA, n.d.), or European Union association agreements (all the non-European Union Western and Central European countries except for Switzerland, Georgia, Moldova and Ukraine), non-European Union organizations such as The European Free Trade Association (EFTA) (EFTA, n.d.), or in post-USSR, organizations led by Russia, such as the Commonwealth of Independent States (CIS) (CIS, n.d.) or the Eurasian Economic Union (EEU, n.d.). The countries involved in European Union-related initiatives are converging their biodiversity governance frameworks with that of the European Union. Post-USSR initiatives do not promote policies or institutions with direct implications for nature. Essentially, they are trade and customs agreements, although with ambitions of expanding to other sectors. The indirect impacts include, for example, the orientation of the agricultural sectors of the Commonwealth of Independent States and Eurasian Economic Union countries towards exports to the Russian market.

Most of the countries in the region have signed and ratified all the major multilateral environmental agreements dealing with nature and related trade and production issues. Private governance arrangements play an increasing role in national and international biodiversity governance regimes. A prime example is forest and fisheries certification, such as those by the Forest Stewardship Council and the Marine Stewardship Council. Although their fit to purpose and role in protecting species and habitats is heavily criticised, there is a consensus that the overall impact is positive (Elbakidze *et al.* 2011). In the case of the Forest Stewardship Council, this is often observed in countries with top-down governance systems (Niedziałkowski & Shkaruba, in press).

1.5 METHODS AND APPROACHES USED IN THE ASSESSMENT

1.5.1 The assessment procedure

The Regional Assessment for Europe and Central Asia synthesizes knowledge from the scientific literature and grey literature and captures indigenous and local knowledge. The assessment operates at the border of scientific *terra incognita*, dealing with large knowledge gaps, potential scientific disagreement and multiple evidence types. Interactions between humans and the natural environment are complex. To allow decision-makers to make informed decisions, experts need to communicate not only the findings in which they have a high level of confidence, but also those requiring further investigation. Confidence refers to the extent to which experts are assured of their findings. Low confidence describes incomplete knowledge and preventing a full explanation of an outcome or a reliable prediction of a future outcome; whereas high confidence conveys extensive knowledge and he ability to explain an outcome or predict a future outcome with much greater certainty. The Regional Assessment for Europe and Central Asia communicates confidence through the use of uncertainty statements (Seppelt *et al.*, 2012), qualitative self-assessment (Crossman *et al.*, 2013) and standardized confidence reporting (Jacobs *et al.*, 2015). By following a common approach to applying confidence langauge within an assessment, authors are able to increase consistency and transparency.

For every key finding in the assessment report, the supporting evidence and the level of scientific agreement was evaluated and qualified with confidence statements, including validation and evaluation by holders of indigenous and local knowledge (see 1.5.4). Confidence statements for qualitative evidence were applied using a four-box model (see **Figure 1.11**). For any of these statements, a reference is included from the key finding to the section in the main assessment report, where the the expert team treated the corresponding issue.

1.5.2 The approach to values used in the Regional Assessment for Europe and Central Asia

Valuation is central to assessments of nature. In this section, we explain how IPBES, and specifically the Regional Assessment for Europe and Central Asia, deals with valuation, which is essential to fully understand its findings. The design of governance, institutions and policies rarely takes account of the diverse values of nature. Valuation, if carried out in a way that is open to diverse perspectives, is a significant resource for a range of decision-makers, including governments, civil society organizations, and indigenous people and local communities. Therefore, value diversity is fully embodied within the IPBES conceptual framework. The Regional Assessment for Europe and Central Asia recognises culturally different worldviews, visions and approaches to achieving good quality of life, following the assessment guidelines on valuation (IPBES/4/INF/13: Preliminary guide regarding diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services (deliverable 3 (d))).

IPBES considers three main value dimensions: (1) values directly linked to nature itself (including biodiversity and ecosystem structure and functioning); (2) values derived from nature's contributions to people (including ecosystem services); and (3) values more directly linked to good quality of life (see **Table 1.8**). For each value dimension, the Europe and Central Asia assessment applied specific assessment methods. Basic understanding of the valuation methods used is important since these strongly influence the outcomes of each valuation (IPBES/4/INF/13: Preliminary guide regarding diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services (deliverable 3 (d))).

In each of the three main value dimensions, different foci and targets of valuation were distinguished as they relate to different policy arenas and societal decision-making. For example, concern for *individual living beings* is expressed by animal welfare movements and policies, whereas concerns for *genetic diversity* are expressed in the Cartagena Protocol to the Convention on Biological Diversity. As there is overlap

Figure 1 11 **The four-box model for the qualitative communication of confidence. Confidence increases towards the top-right corner as suggested by the increasing strength of shading. Source: Modified from Moss & Schneider (2000) in IPBES (2016a).**

between different foci and their significance varies in different contexts, **Table 1.8** - rather than being a rigid classification - is a tool to structure research and the analysis of diverse values across different worldviews. In the detailed value targets, differences may occur between chapters, but these are mostly minor and do not affect findings concerning the value foci or dimensions.

The following provides definitions applied in the Regional Assessment for Europe and Central Asia for the main value components. The definitions are based on the IPBES valuation guidance documents that are slightly adapted to the Europe and Central Asia context where needed.

Nature: In this assessment, the concept of "nature" refers to nature at large, encompassing a continuum from nature as an autonomous functioning and evolving system to nature involving domesticated plants and animals. Within the context of science, it includes categories such as biodiversity[3], ecosystems, ecosystem functioning, evolution, the biosphere, humankind's shared evolutionary heritage, and biocultural diversity. Within the context of other knowledge systems, nature also includes different beliefs and concepts held around the world by indigenous peoples and local communities, such as "Mother Earth" and "systems of life" (Díaz *et al.*, 2015).

Non-anthropocentric values. These include the values that people attribute to living beings, species, ecosystems or regions that are not centred exclusively on humans and contributions to good quality of human life. Some of these values can be assessed using quantitative measures of biological diversity and ecological integrity that involve studies on biodiversity, individual organisms, biophysical assemblages and ecological processes at different levels.

- **Intrinsic values** are independent of any human experience or evaluation. Since intrinsic value can be recognized, but not quantified, by humans it is not the target of any valuation process (Pascual *et al.*, 2017) (see also Batavia & Nelson, 2017). However, intrinsic values are one of the main motivations for nature conservation and for conducting this assessment.

Anthropocentric values. These are values centred on humans. An assessment of anthropocentric values must consider how they relate to the current state and potential changes in nature, nature's contributions to people, and good quality of life. The two main types of anthropocentric values considered in IPBES are instrumental and relational values:

- **Instrumental values** refer to the value attributed to something as a means to achieve a particular end for humans, and in IPBES these are referred to as nature´s contributions to people (see below).

- **Relational values** are the positive values assigned to "desirable relationships", such as those among people and between people and nature (Díaz *et al.*, 2015). Relational values refer to both desirable human-human interactions and human-nature interactions. "Living in harmony with nature", "living-well in balance and harmony with Mother Earth" and "human well-being" are examples of different perspectives on what in the IPBES context is referred to as good quality of life.

Nature's contributions to people. Defined by Pascual *et al.* (2017) as "all the positive contributions, or benefits, and occasionally negative contributions, losses or detriments, that people obtain from nature. It resonates with the original use of the term ecosystem services[4] in the Millenium Ecosystem Assessment (MEA, 2005), and goes further by explicitly embracing concepts associated with other worldviews on human–nature relations and knowledge systems (e.g. "nature's gifts" in many indigenous cultures) (Díaz *et al.*, 2015)". They can be assessed in many different ways, including economic, social and biophysical valuation methods. Each of these methods elicits different values and, so, requires a broad set of approaches (Boeraeve *et al.*, 2014; Jacobs *et al.*, 2016).

Good quality of life. The achievement of a fulfilled human life, the criteria for which may vary greatly across different societies and groups within societies. It is a context-dependent state of individuals and human groups, comprising aspects such as access to food, water, energy and livelihood security, and also health, good social relationships and equity, security, cultural identity, and freedom of choice and action (Díaz *et al.*, 2015). These values are assessed using various methods. A valuation that looks at the social-ecological system as a whole is essential for fully understanding relational values. Such valuation combines data from, for example, narratives, preference assessments, participatory geographical analyses, historical studies and biophysical models. First-hand information from individuals holding relational values is essential.

Integrated valuation. Some valuation methods are appropriate at eliciting a wide range of values (e.g. cultural and social methods) while others are limited to specific value types (e.g. monetary valuation) (Jacobs *et al.*, 2016). Values are not necessarily independent of one another and can

3. In the Regional Assessment for Europe and Central Asia, the term "biodiversity" is used in different senses, from its scientific sense of biological diversity to its more encompassing sense of the natural environment in general and the concept of intrinsic value (see also Mace *et al.*, 2012).

4. The Regional Assessment for Europe and Central Asia uses both the terms "nature's contributions to people" and "ecosystem services". The latter is used when refering to literature dealing with specific ecosystem services, while "nature's contributions to people" is applied to convey statements refering to the broader category of anthropocentric values (which include ecosystem services).

Table 1 8 **The diverse values addressed in the Europe and Central Asia assessment, based on document IPBES/4/INF/13: Preliminary guide regarding diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services (deliverable 3 (d))**

Value Dimension	Value Type	Value Focus*		IPBES-Valuation Targets
NATURE	Non-anthro-pocentric	N1	Individual organisms	Individual organisms
		N2	Biophysical assemblages	Biophysical assemblages
		N3	Biophysical processes	Biophysical processes
		N4	Biodiversity**	Biodiversity
NATURE'S CONTRIBUTIONS TO PEOPLE***	Anthropocentric-Instrumental	C1	Options for NCP	18 Maintenance of options
		C2	Regulating NCP	1 Habitat creation and maintenance
				2 Pollination and dispersal of seeds and other propagules
				3 Regulation of air quality
				4 Regulation of climate
				5 Regulation of ocean acidification
				6 Regulation of freshwater quantity, flow and timing
				7 Regulation of freshwater and coastal water quality
				8 Formation, protection and decontamination of soils and sediments
				9 Regulation of hazards and extreme events
				10 Regulation of organisms detrimental to humans
		C3	Material NCP	11 Energy
				12 Food and feed
				13 Materials and assistance
				14 Medicinal, biochemical and genetic resources
		C4	Non-material NCP	15 Learning and inspiration
				16 Physical and psychological experiences
				17 Supporting identities
GOOD QUALITY OF LIFE	Anthropocentric - Relational	Q1	Cultural	Living well in harmony with nature
				Identity and Autonomy
				Spirituality and Religions
				Art and Cultural heritage
		Q2	Societal	Sustainability and Resilience
				Diversity and Options
				Governance and Justice
		Q3	Individual	Health and Wellbeing
				Education and Knowledge
				Good social relations
				Security and Livelihoods

*: The categorisation in the "value focus" collumn strictly serves as an aid for balanced aggregation and depiction of the diverse value dimensions, rather than mutually exclusive categories

: In the ECA assessment, the term **"biodiversity" is used in different senses, from its scientific sense of biological diversity up till its more encompassing sense of the natural environment in general (see also Mace *et al.,* 2012)

co-exist. Human decisions are ideally made by weighing and summarizing different values that are highly dependent on socio-economic, biophysical and governance contexts (Gómez-Baggethun *et al.* 2014). Most policy decisions *de facto* include diverse values implicitly and are rarely based on economic, ecological or social impacts alone. Integrated valuation has been increasingly developed as a methodology or practice to achieve a more transparent approach in combining diverse values (Dendoncker *et al.*, 2014; Jacobs *et al.*, 2016). Integrated valuation was therefore put forward in the IPBES guidelines to achieve fair, reliable and policy relevant valuation (IPBES/4/INF/13: Preliminary guide

and accommodated following the wording of "nature's contributions to people" (NCP) for the purposes of Europe and Central Asia.

Further examples and clarifications
Living beings (biocentrism), sentient beings (animal welfare/rights)...
Populations, communities, ecosystems, biomes, the biosphere, Gaia, Pachamama, Mother Earth...
Evolution, ecosystem functions and processes, ecological resilience...
Genetic, functional, taxonomic and phylogenetic diversity, uniqueness, vulnerability...
Stewardship, relationships and interactions between people and nature inherently entwined as systems of life, as also indicated by time spent for managing ecosystems, conservation activities, contemplation of nature...
Sense of place, sense of community, historical values, agency, self-determination...
Sacred sites, totemic beings, spiritual well-being…
Inspiration, artistic creation...
Social-ecological resilience, social, economic and ecological sustainability...
Biocultural diversity, diversity of current and future options…
Environmental justice, intra-generational equity, inter-generational equity...
Physical, mental, holistic health, biophilia...
Inspiration, education, experience, learning space...
Community cohesion, social resilience, conviviality...
Physical security, political stability, food and water security, energy security, livelihood security...

***: In the ECA assessment, both terms **"nature contributions to people"** and **"ecosystem services"** are used. The latter is used where refering to literature dealing with specific ecosystem services, while "nature contributions to people" is applied to convey statements refering to the broader category of anthropocentric values (which includes ecosystem services).

regarding diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services (deliverable 3 (d))).

IPBES includes integrated valuation directly within the assessment process. In the Europe and Central Asia assessment, integrated valuation was realized through several initiatives supported by a technical support unit established to address these issues. A workshop of valuation experts, the values liaison group for the Regional Assesment for Europe and Central Asia, provided feedback, concrete suggestions and support to the assessment

authors, facilitated by the technical support unit for the assessment and the technical support unit on values.

1.5.3 Overview of methods and approaches used in the Regional Assessment for Europe and Central Asia

Each chapter of the Regional Assessment for Europe and Central Asia implemented a comprehensive literature review for a wide range of information sources, from primary information (map archives, databases) to peer-reviewed, academic literature as well as grey literature and knowledge from stakeholders, and indigenous peoples and local communities. The literature reviews adopted a systematic approach to evaluate the large body of information using specific key word searches in English, Russian and Ukrainian. The analysis also used supplementary sources of information, including indicators of relevance to the Convention on Biological Diversity, to the Aichi Biodiversity Targets, to the Sustainable Development Goals, and to regional biodiversity targets (e.g. the IUCN Red List species[5], UNstats[6], Sustainable Development Goal indicators[7], European Environment Agency indicators[8]). The literature reviews formed the basis of expert judgements by the author team including the attribution of confidence statements. Chapter 5 developed scenario archetypes to summarise plausible and consistent future developments for Europe and Central Asia. The archetypes synthesize impacts and identify the key sustainability issues facing policy and society across a wide range of scenarios found in the literature.

The assessment followed common guidelines to ensure consistency across chapters. This included the conceptual framework (see Section 1.1.5) introduced in the IPBES guide to assessments (IPBES/4/INF/9: Guide on the production and integration of assessments from and across all scales (deliverable 2 (a))), a glossary specific to the Europe and Central Asia assessment, a list of indicators (IPBES, 2017), a classification of the units of analysis (see **Table 1.3**), a typology of nature's contributions to people (Pascual *et al.*, 2017) and the confidence statements (see Section 1.5.1).

1.5.4 Consideration of indigenous and local knowledge (ILK)

Indigenous and local knowledge (ILK) systems in IPBES are dynamic bodies of integrated, holistic, social-ecological knowledge, and practices and beliefs about the relationships between living beings, including humans, and their environment. Indigenous and local knowledge is highly diverse, and produced in a collective manner at the interface between the diversity of ecosystems and human cultural systems. It is continuously evolving through the interaction of experiences and different types of knowledge (written, oral, tacit, practical, and scientific) among indigenous peoples and local communities.

Taking indigenous and local knowledge into account in nature-related assessments improves both the social robustness and the accuracy of the outcomes, i.e. outcomes are closer to the studied context (Cowling *et al.* 2008; Donovan *et al.* 2009; Flint *et al.* 2013). This follows from the recognition that many of the remaining biodiversity-rich regions of the world are also homelands to indigenous peoples and local communities (cf. Convention on Biological Diversity). Indigenous and local knowledge holders can represent complementary sources of knowledge, often working at different scales of time and space, addressing different kinds of issues, and informing areas that science has not investigated see e.g. Kalkanbekov & Samakov (2016). As indigenous peoples retain within their knowledge systems an inter-generational memory of fluctuations, trends and exceptional events in relation to the local environment, they can contribute importantly to understanding processes of change, whether these are long-term, global transformation processes or circumscribed local events.

Indigenous and local knowledge is partly available in the published scientific literature, which reports observations from indigenous peoples and local communities about ecosystem characteristics and trends, and drivers of change. However, the integration of indigenous and local knowledge into mainstream science often implies the application of a validation process, which may not be an appropriate way of treating knowledge holders (Agrawal, 2002; Danielsen *et al.*, 2014; Huntington *et al.*, 2002; Kalkanbekov & Samakov, 2016; Nadasdy, 1999). An increasing amount of scientific literature now seeks to produce and co-produce knowledge relevant to local conditions and actors by integrating the complex contextual and socio-ecological knowledge of indigenous peoples and local communities (e.g. Fagerholm *et al.* 2012; Fontaine *et al.* 2014; Sillitoe 2006). IPBES seeks to progress this approach by bringing indigenous and local knowledge into IPBES assessments from the outset. IPBES developed guidance for the integration of indigenous and local knowledge into its assessments that respects not only the diversity and value of this knowledge, but also the rights of indigenous and local communities to share the benefits of knowledge gained from the assessments. IPBES integrates indigenous and local knowledge into its assessments through the appointment of experts with expertise in the subject. In the Regional Assessment for Europe and Central Asia, indigenous and local knowledge was integrated

5. http://www.iucnredlist.org/
6. https://unstats.un.org/unsd/default.htm
7. https://unstats.un.org/sdgs/indicators/indicators-list/
8. http://www.eea.europa.eu/data-and-maps/indicators#c5=&c0=10&b_start=0

through several initiatives supported by a task force on indigenous and local knowledge. A workshop of indigenous and local knowledge holders and experts provided releant case studies and white and grey literature to the assessment authors. It also introduced the assessment to indigenous and local knowledge holders at an early stage. Subsequently, these knowledge holders and experts co-produced the workshop proceedings (Roué & Molnár, 2017) to provide indigenous and local knowledge-relevant information to the assessment. Authors of the assessment, represented by a liaison group on indigenous and local knowledge, reviewed relevant literature, supported by the task force. Furthermore, the assessment report drafts were made available to indigenous peoples and local communities through the external review process.

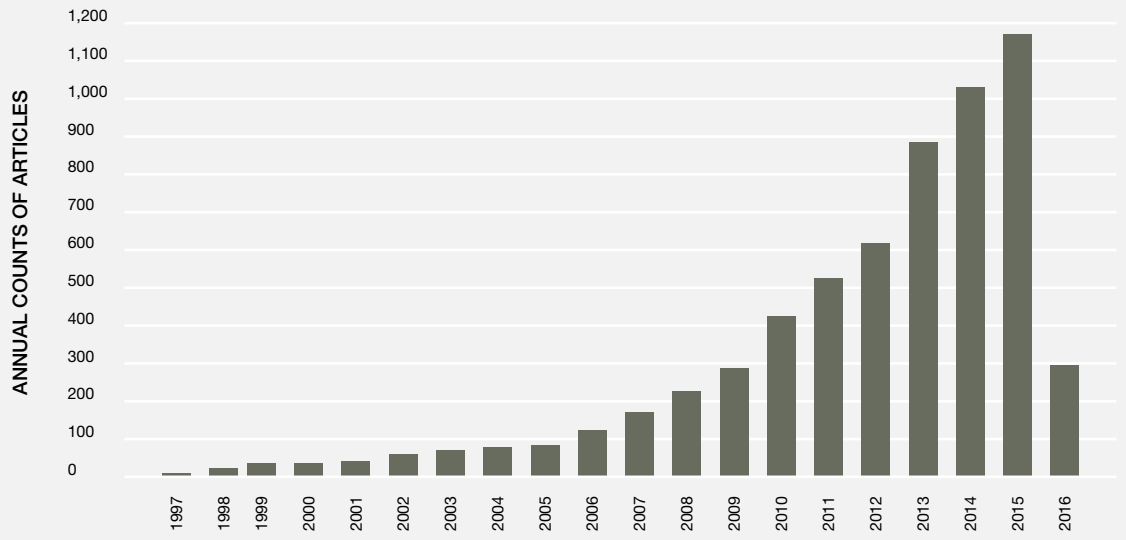
1.5.5 Data and indicators

Current knowledge on nature and its contributions to people is expanding rapidly (see **Figure 1.12** for a bibliographic search on biodiversity and ecosystem services), but is far from complete (see Section 1.6.1 which outlines differences in temporal, taxonomic and spatial coverage across Europe and Central Asia) (Cardinale *et al.*, 2012). Regional and global publically available datasets present opportunities to expand this knowledge (e.g. the IUCN Red List of Threatened Species, Key Biodiversity Areas (specifically Important Bird and Biodiversity Areas (IBAs), and Alliance for Zero Extinction (AZE) sites), Protected Planet, the Global Biodiversity Information Facility). Many efforts have been made to combine data into metrics or indicators that provide aggregate information about status and trends of nature and of pressures. For instance, data such as observations and measurements are used as the basis for deriving indicators, or several measurements can be combined to derive an index.

IPBES uses indicators in conducting its assessments. Indicators are defined here as data aggregated in a manner – quantitative or qualitative - that reflect the status, cause or outcome of an object or process, especially towards targets such as the Aichi Biodiversity Targets or those included under the Sustainable Development Goals. Meaningful indicators require long-term monitoring data. Indicators can help to simplify the enormous complexity of datasets, variables, frameworks and approaches available to IPBES assessments. Complementing other forms of information and knowledge, standardized indicators have the potential to provide a common thread and quantitative point of comparison among assessments. They facilitate the synthesis envisioned for the IPBES global assessment, and ensure comparability and coherence across the regional assessments and between the regional or land degradation and restoration assessments on the one hand, and the

Figure 1 12 **The exponential rise in numbers of scientific articles on the Web of Science produced from the search term [biodiversity AND ecosystem services] (accessed on 26 April 2016).**

The vertical axis shows the annual counts of articles, the horizontal axis the year. In total 7,145 papers were located. Although not a perfect index of the geographical spread of knowledge, the mention of a country (either by the location of authors, e.g. host institution, or the location of the study) gives a reasonable measure of expertise and focus of study on this topic. The countries associated with the most articles were, in descending order: USA, England, Germany, Australia, France, Canada, Netherlands, Spain, Sweden, Italy. Of these, 3,483 papers were associated with European countries, but none were associated with the five countries of Central Asia (limitations ensuing from this biased representation is discussed in 1.7).



global assessment on the other hand. They are useful tools for communicating the results of assessments and are a popular policy support tool used at multiple scales in tracking performance, exploring progress towards policy targets, and understanding the consequences of particular decisions, interventions or even future scenarios (Layke *et al.*, 2012).

Following the IPBES conceptual framework, the Regional Assessment for Europe and Central Asia distinguishes indicators of nature (e.g. biomass), of nature's contributions to people (e.g. production of commercial crops), of contributions to good quality of life (e.g. amount of calories) and of values (e.g. market or cultural values). The assessment has devoted efforts to fully referencing and documenting data sources to allow independent recalculation of indicators and indices and to allow tracing back to their component measures (Ash *et al.*, 2010). It is, however, important to recognize the limitations of a given set of indicators in capturing the complexities of the "real world", since indicators are restricted to what can be measured and for which there are available data. Notably, these limitations are especially significant when it comes to assessing the non-material contributions of nature to people and in quality of life. Moreover, the choice of indicators relates to diverse cultural perspectives. Hence, in IPBES assessments, indicators are subject to critical analysis and review from a diversity of experts. IPBES has consulted widely in arriving at a comprehensive list of biophysical and socio-ecological indicators that cover the conceptual framework (IPBES, 2017).

1.5.6 The role of scenarios and models in the assessment

As other environmental studies have shown (e.g. IPCC 2014; UK NEA 2011; UNEP 2012; MEA 2005), models and scenarios represent effective means of addressing relationships between nature, its contributions to people, and good quality of life for the past, present and future. "Models" are qualitative or quantitative descriptions of key components of a system and of the relationships between those components. "Scenarios" are representations of possible futures for one or more components of a system, especially for the drivers of change in nature and its contributions, including alternative policy or management options (Rounsevell & Metzger, 2010). A scenario archetype describes a group of futures that are deemed "similar" according to the purpose of a specific analysis (Boschetti *et al.*, 2016).

One of the key objectives in using scenarios and models is to move away from a reactive mode of decision-making, in which society responds to the degradation of nature and its contributions to people in an uncoordinated, piecemeal fashion. A proactive mode allows society to anticipate change and thereby to minimize adverse impacts and capitalize on important opportunities through thoughtful adaptation and mitigation strategies. The goals of using scenarios and models in assessments of nature and its contributions to people, are to better understand and synthesize a broad range of data (i) to assess future impacts of global changes, and (ii) to explore the implications of alternative social-ecological development pathways and policy options in support of decision-making (IPBES, 2016b) (see **Figure 1.13**).

Scenarios and models allow research questions to be addressed for which observational evidence is lacking (e.g. model applications across geographic space) or unavailable (e.g. scenarios of the future) (IPBES, 2016b). They allow "what if?" studies to be conducted that cannot be undertaken in empirical experiments, and to explore alternative pathways toward visions or goals for the future (Rounsevell & Metzger, 2010). Thus, scenarios can be exploratory by projecting different pathways from the present situation, or normative by analysing the pathways required to achieve future desired states or goals. The Europe and Central Asia assessment reports on both of these approaches. However, the importance of scenarios extends beyond the scientific or policy arenas. These tools can help to focus investments and technology development, induce societal change, and support engagement with key stakeholders (UNEP, 2012). For example, the Regional Assessment for Europe and Central Asia has access to a large literature base derived from social surveys and participatory scenario development exercises that provide insight into local knowledge (Gramberger *et al.*, 2015; Kok *et al.*, 2015). This involves engagement with a broad range of stakeholders, including primary producers (e.g. farmers, foresters, fishermen) and individuals supporting decision processes (e.g. civil servants, government officials).

Scenarios and models support an understanding of the connections between all aspects of the IPBES conceptual framework. Scenarios and models can be used independently or in combination. An example of a combined use of both are integrated assessment models. Integrated assessment models allow linkages between system components to be explored in interconnected, social-ecological systems (Harrison *et al.* 2016; van Vuuren *et al.* 2012). An economic dimension to biodiversity loss enhances social and ecological considerations and the consequent impacts on the availability of ecosystem services. Thus, integrated assessment models allow experimentation and analysis of co-evolving processes within the social-ecological system across spatial and temporal scales. Particularly, by synthetizing various pieces of disciplinary scientific knowledge and indigenous and local knowledge, models help to qualitatively or quantitatively analyse the cause-effect relationships of, for example, biodiversity loss, and provide outputs for policy-oriented applications (MEA, 2005).

1.6 CHALLENGES IN CONDUCTING THE REGIONAL ASSESSMENT FOR EUROPE AND CENTRAL ASIA

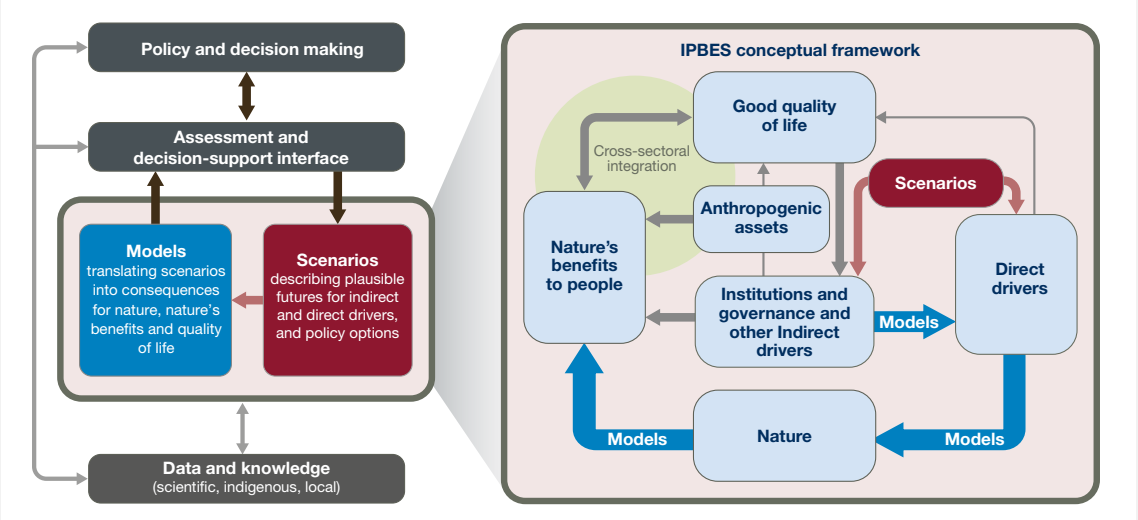
1.6.1 State of knowledge

Data gaps and uncertainties. The Regional Assessment for Europe and Central Asia draws on many different types of data and expert knowledge. Examples include large-scale quantitative data derived from remote sensing, data collected from field sampling of taxa at a range of scales and qualitative data collected by interviewing people. The challenge has been to combine such data into meaningful syntheses while acknowledging the differences in accuracy both within similar methods (in terms of sampling effort) and between methods. Complicating factors include: (i) the fact that the definition of biodiversity is often unclear (Cardinale *et al.*, 2012) and there is a bias towards easily studied taxa (Maier & Feest, 2015); (ii) difficulty in quantifying the different types of anthropogenic and non-anthropogenic values (Pearson, 2016); and (iii) capturing knowledge from regions with little underlying scientific information (although this can be offset in part by the integration of indigenous and local knowledge).

Data collection as an ongoing process. Long-term and widespread data collection both for nature and its contributions to people can be expensive. Although citizen science offers exciting opportunities, it requires the potentially unjustified assumption that volunteers will engage in such projects and that data is of sufficient quality. That said, Europe and Central Asia has a number of ongoing data gathering exercises that can support the improvement of databases in the near term. These include the European Union's project Mapping and Assessment of Ecosystems and their Services, which encourages European Union member States to collect and map spatial data for a number of ecosystem service indicators (biodiversity.europa.eu/maes). The European Environment Agency has created the Biodiversity Information System for Europe (BISE) (http://biodiversity.europa.eu) and Water Information System for Europe (WISE) (http://water.europa.eu/) databases that are continually updated. The European Commission has also funded the development of the Oppla web platform (www.oppla.eu) that is engaging with communities of practice across the science-policy-practice nexus to provide tested methods, data and case study examples of the operationalisation of natural capital and ecosystem services. Oppla is supporting the IPBES process by contributing

Figure 1 13 **An overview of the roles that scenarios and models play in informing policy and decision-making. Source: IPBES (2016b).**

The left-hand panel illustrates how scenarios and models contribute to policy and decision-making through assessments, formal decision-support tools and informal processes. The right-hand panel provides a detailed view of the relationships between scenarios (burgundy arrows), models (blue arrows) and the key elements of the IPBES conceptual framework (light blue boxes; Díaz et al., 2015). Grey arrows indicate relationships between the different elements of the framework. The "cross-sectoral integration" element signifies that a comprehensive assessment of good quality of life will often involve the integration of modelling from multiple sectors (e.g., health, education and energy) addressing a broader range of values and objectives than those associated directly with nature and nature's contributions.



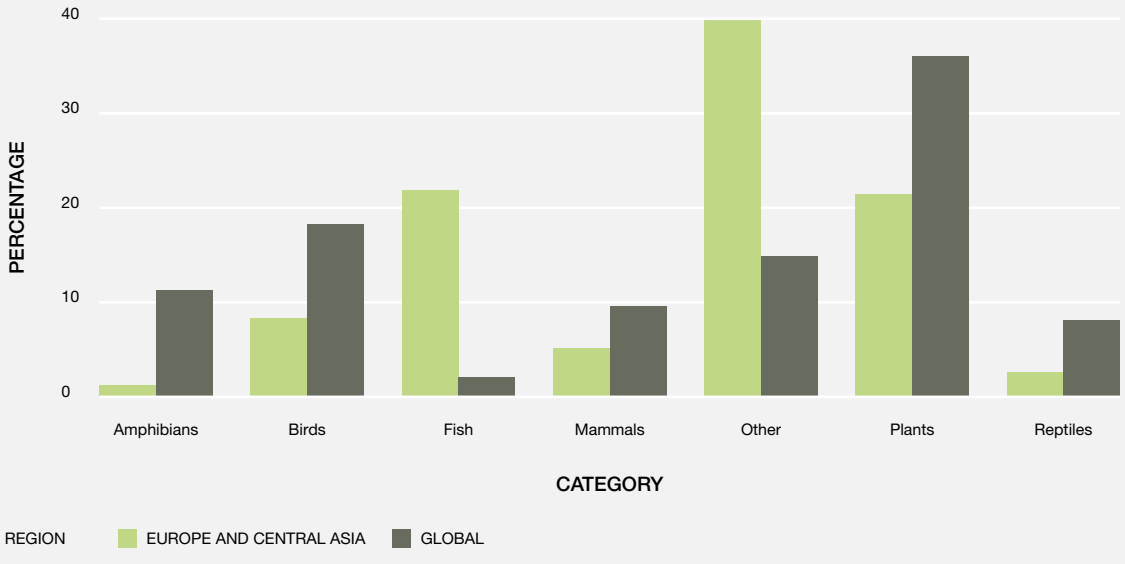
towards the development of the catalogue of policy support tools on the IPBES website (www.ipbes.net). There is also a range of global data collection exercises for biodiversity that can generate data relevant to Europe and Central Asia (e.g. IUCN Red List of Threatened Species) and which, in some cases, already have explicit derivatives (e.g. http://ec.europa.eu/environment/nature/conservation/species/redlist/).

Outside of the European Union, the most consistent peer-reviewed activity for making inventories of the conservation status of endangered species is the development and maintenance of national red lists, while the current trends are usually reported in annual assessments of the state of environment and natural resources (e.g. see Government of Belarus, n.d.; Minprirody of Russia, 2016). Such assessments are based on the outcomes of national programmes of biodiversity monitoring, which are typically run by research institutes of national academies of science or national ministries of environments (or their equivalents). National red lists are based on national lists of endangered species and published as Red Books. The Red Book of Belarus is published about every 10 years (in 1981, 1993, 2006 and the new edition is pending as of 2017) (Government of Belarus, n.d.). Others are one-off publications, such as the Red Book of Russia, published in 2001, while the actual red lists can be available as online databases. In Russia, red lists are kept (and subsequently published as a Red Book) by most of the members of the Federation (FSBI AARI, n.d.-b). In addition, national academies of science or botanical and zoological NGOs or agencies of ministries of environment, maintain national inventories of plant or animal species (e.g. Herbarium of CBG NASB MSKH, n.d.) or of the biodiversity of protected areas (e.g. FSBI AARI, n.d.-a). The initiatives driven by the non-governmental sector are usually less comprehensive, although some ambitious projects should not be overlooked, e.g. BIODAT in Russia (Biodat, 2017) or biodiversity monitoring in the Ukraine (Biodiversity Monitoring in Ukraine, n.d.).

Heterogeneity of data and knowledge across the region. Knowledge of biodiversity is not spread evenly across taxa and there is considerable bias in the coverage of different broad-level taxonomic groups both globally and within Europe and Central Asia (see **Figure 1.14** and **Figure 1.15**). Whilst over 1.64 million species have been described on Earth (Catalogue of Life, 2016) out of a global total of about 8 million (Mora *et al.*, 2011), only 82,954 have been assessed by 31 October 2016 on the IUCN Red List of Threatened Species. At more detailed scales, full assessments have been made of smaller subsets of species within some groups including the following taxonomic groups: amphibians, reef-building corals, chameleons, seasnakes, sharks and rays, tarpons and ladyfishes, parrotfishes and surgeonfishes, groupers, tunas and billfishes, hagfishes, angelfishes, blennies, butterflyfishes, picarels, porgies, pufferfishes, seabreams, sturgeon, wrasses, freshwater caridean shrimps, cone snails, freshwater crabs, freshwater crayfish, lobsters, cacti, conifers, cycads, seagrasses and plant species occurring in mangrove ecosystems (Brooks *et*

Figure 1 14 **Percentage of classified taxa among different broad taxonomic groups classified in Europe and Central Asia compared with the global proportion (note that all categories combined sum to 100%).**

The IUCN Red List has classified proportionally more of some groups of taxa (such as fish) than have been classified globally. Source: Data derived from the IUCN Red List of Threatened Species.



al., 2016). However, some groups have far less coverage, for example plants (7.1%), fungi and protists (<0.001%) and invertebrates (1.4%) (IUCN, 2017).

Europe and Central Asia supports 2,493 species that have been assessed on the IUCN Red List of Threatened Species. Of this group 13% are classified as threatened (Brooks *et al.*, 2016). Of the taxa classified on the global-scale IUCN Red List of Threatened Species the Europe and Central Asia region holds 6.5% (see **Figure 1.16**). There are fewer data available in Central Asia than in the other three subregions. Although there is background knowledge of the role of many taxa in ecosystem functioning, there is far less known about their individual roles in systems; about what would happen if they were removed from food webs; and about the services they provide as individual species. While there is some literature in this area, most is focused on plant studies, e.g. see Cardinale *et al.* (2012); Schwartz *et al.* (2000).

1.6.2 Methodological limitations

Model and scenario uncertainty. Models as tools for quantitative or qualitative descriptions of nature, its contributions to people, and the intra and interrelationships therein, are simplifications of a complex reality. Hence, the limitations of representing complex realities and interactions are embedded within model uncertainty. A number of model inter-comparison exercises have sought to quantify model uncertainty for some components of the natural world (e.g. Alexander *et al.*, 2016b; Prestele *et al.*, 2016). Scenarios, as descriptions of possible futures, contain the inherent uncertainties associated with socio-political, economic, technological and cultural drivers of change that affect nature. Dealing with scenario uncertainties is often done by creating different storylines that cover a range of possible futures, based on different sets of assumptions about future trajectories of key factors (e.g. population, income, technology development or consumption patterns (Rounsevell & Metzger, 2010). Both models and scenarios also share the uncertainty associated with the input data upon which they are based, although the use of confidence intervals can help to make uncertainty more transparent.

Uncertainties in model and input data can often be greater than the differences between the scenarios themselves (Alexander *et al.* 2016b; Dendoncker *et al.* 2008; Prestele *et al.* 2016) leading to conclusions about the need to run multiple ecosystem impact models to capture the full range of model uncertainties. Specific types of models such as integrated assessment models, have additional uncertainties associated with the propagation of errors through coupled sub-modules (e.g. Brown *et al.*, 2015; Dunford *et al.*, 2014). There has been increased interest in moving from scenarios to probabilistic futures of natural and socio-ecological system change, but these methods are in their infancy. Moreover, ascribing probabilities to future events is extremely difficult in practice, in spite of being desirable within a risk management framework. An approach that combines scenarios with likelihoods is based on conditional probabilistic futures (Engström *et al.*, 2016), in which future estimations of the likelihood of different future drivers are conditional on a scenario storyline (Rounsevell & Metzger, 2010).

Figure 1 15 **Percentage of taxa within each taxonomic category that have been classified globally. For example 100% of birds and mammals have been classified, but less than 1% of the known species of fungi.**

Source: Data derived from the IUCN Red List of Threatened Species. Note the "other" category includes all of the remaining taxonomic groups (e.g. fungi).

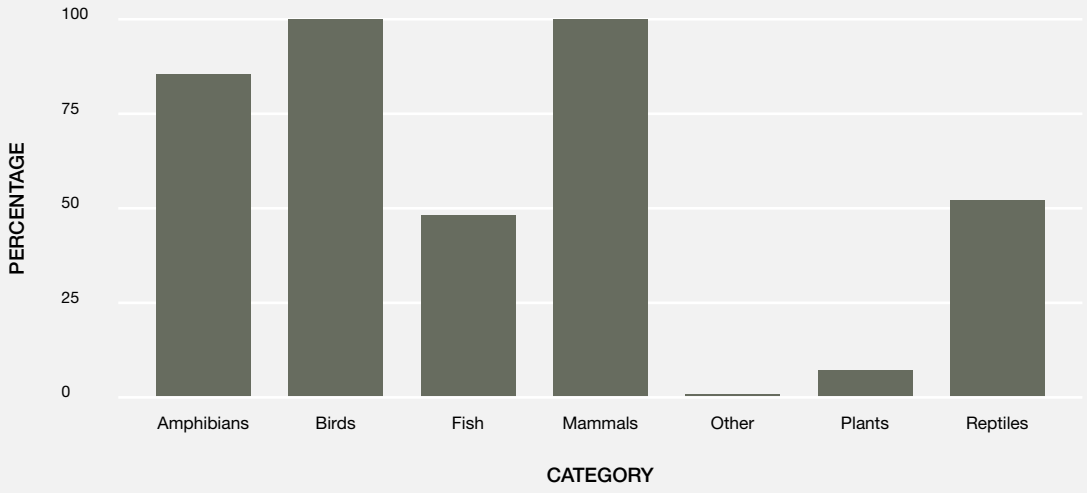
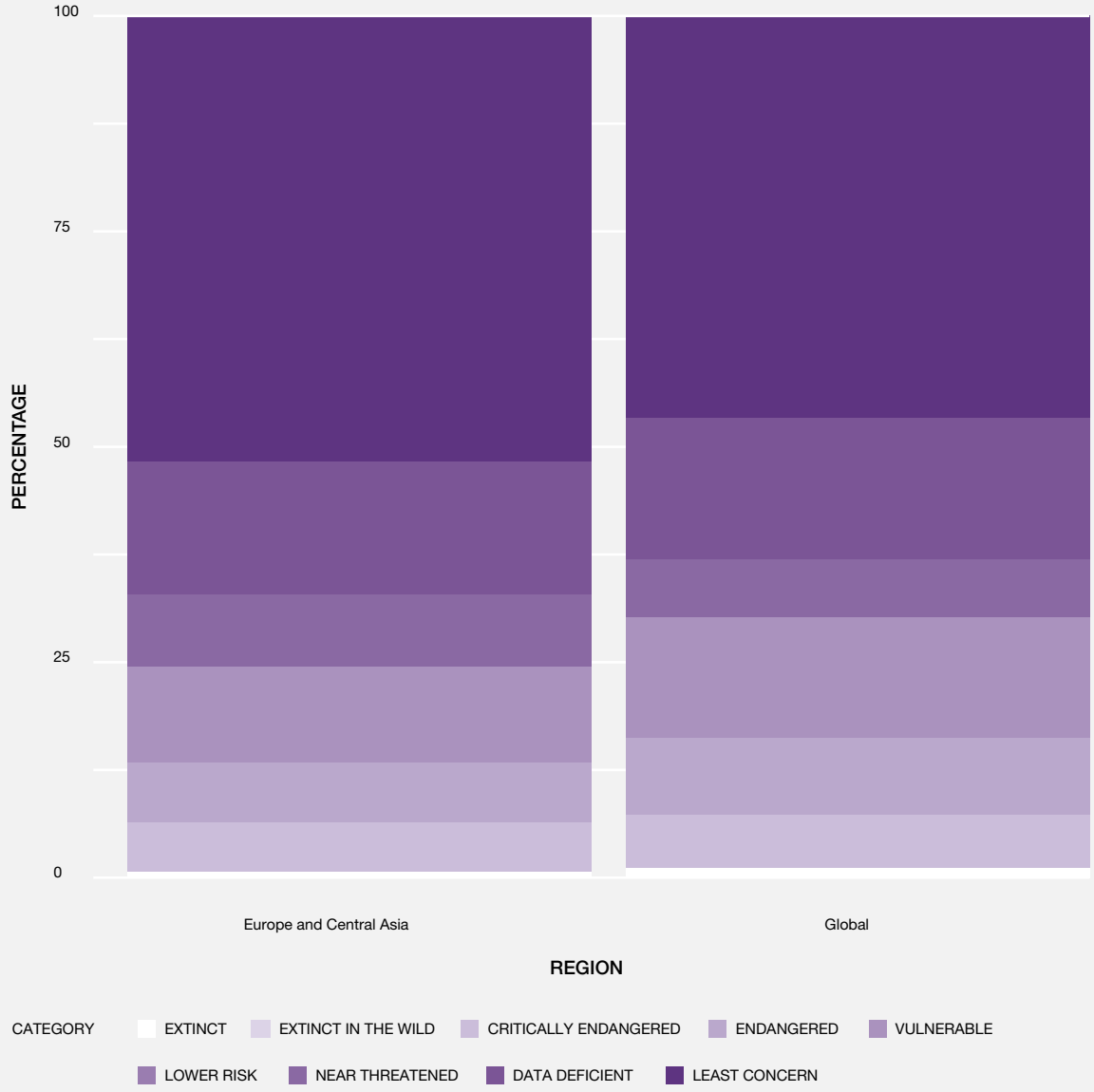


Figure 1 16 **The percentage of species in different extinction categories in Europe and Central Asia compared with the global situation (EX: extinct, EW: extinct in the wild, CR: critically endangered, EN: endangered, VU: vulnerable, LR: lower risk, NT: near threatened, DD: data deficient, LC: least concern).**

Proportionally there are fewer species classified as being at more severe threat from extinction in Europe and Central Asia than globally. Source: Data derived from the IUCN Red List of Threatened Species.



Scale (temporal/spatial/institutional). Assessing diverse values of nature over spatial, temporal and institutional scales is challenging, since these three scale types are interconnected. Spatial scales range from the interactions between the entire Europe and Central Asia region with other global regions, over aggregated large patterns and gradients within Europe and Central Asia down to local communities or smaller. Different organisms operate at different spatial scales, which makes the potential management of different taxa a challenge. Temporal scales involved in the Regional Assessment for Europe and Central Asia also vary: from the overarching sustainability principle spanning across generations, over the assessment of temporal data range (1950-2050, see 1.6.1), down to the varying ranges of data collected over multiple-year sampling campaigns or seasonal variations. A similar trade-off appears between aggregating comparable data for longer periods to capture broad and longer-term

trends and the higher precision and specificity of short-term variations.

Institutional scales are a key issue in IPBES. Values will vary greatly between the perspectives of the general public, subnational governments, national Governments, supra-national institutions, NGO's, and businesses (see 1.3.1). Depending on the institutional scale, an assessment may find conflicting or contradicting valuations, with one not necessarily more valid than another. Whether nature, contributions of nature, or good quality of life are considered, different values between scales persist, as do interactions across scales. This suggests caution when synthesizing and interpreting findings of the assessment from a specific spatial, temporal and institutional context.

Difficulties in harmonizing data and indices, limitations of indices, knowledge types, and data types. Given the logistical and resource challenges in monitoring biodiversity or nature and its contributions to people (see Section 1.6) it is not surprising that indicators are commonly used to represent a wider suite of organisms or contributions. Such approaches are common in the Regional Assesment for Europe and Central Asia and, hence, it is important to mention general issues when interpreting such data. There are limitations in the use of ecological, economic and social indicators (e.g. Selomane *et al.*, 2015; Stephens *et al.* 2015; Uuemaa *et al.*, 2013), which are important to recognise. Moreover, as the assessment draws upon a very diverse range of sources from many different places, harmonizing them across the whole of the region was a major challenge.

Gathering indigenous and local knowledge and integrating this knowledge within the assessment. A major challenge is the difference in scale between the regional scope of the assessment and the nature of indigenous and local knowledge, which is grounded in local territories. Hence, seeking representativeness of the highly heterogeneous and complex indigenous and local knowledge covered by the scale of the assessment was a substantial challenge. The Regional Assessment for Europe and Central Asia sought to resolve this scale issue by collating messages from individual publications on indigenous and local knowledge and by utilising available reviews (e.g. Hernández-Morcillo *et al.*, 2014) in highlighting common aspects of the interlinkages between nature, its contributions to people and good quality of life. The indigenous and local knowledge produced from a specific IPBES dialogue workshop (Roué & Molnár, 2017) aimed to illustrate, not represent, the complexity of understanding, values and worldviews held by indigenous and local knowledge holders in the Europe and Central Asia region. For these reasons, the indigenous and local knowledge available for the Europe and Central Asia assessment remained at an early stage of methodological development.

Epistemology and expert judgement (by authors) in the assessment process. IPBES assessments use a four-box model of confidence attributed to their key findings (see Section 1.5.1) based on evidence and agreement and summarised in four main confidence terms. This ensures consistency in the communication of confidence across chapters and assessments. However, the use of confidence terms depends strongly on the author team's expert judgement as to the quantity and quality of supporting evidence and on the level of scientific agreement. This is why a reference to the chapter section is also provided with each key finding.

1.6.3 Issues beyond the scope of this assessment

Emerging questions beyond the scope of the assessment. While the assessment presents the best available information on nature and its contributions to people, it does not analyse available datasets to test new hypotheses or to validate existing ones. During the development of the assessment, new natural or human impacts on nature may have emerged. As the assessment process involves the use of current information, however, any new aspects cannot form part of this regional assessment.

Time cut-off for evidence/published literature. The literature and evidence sourced for this assessment has a standard timeframe, extending from 1950 to the end of April 2017.

Intrinsic values. The IPBES conceptual framework, unlike the ecosystem services concept, includes intrinsic values. The term intrinsic value has many different meanings (Batavia & Nelson, 2017). For this assessment, we follow the definition provided by Jacobs *et al.* (2016) and Pascual *et al.* (2017), which refers to inherent value, i.e. *the value something has independent of any human experience or evaluation*. Since intrinsic value can be recognized, but not quantified, by humans it is not the target of any valuation process or assessment.

Disclaimer and liability - drawing inferences from general patterns. It is important to recognise that, while broad patterns exist, their exact nature in specific contexts may differ. For example, while general patterns of increased ecosystem functioning with increased biodiversity have been widely reported, mostly from experimental botanical and zoological studies, exceptions to this general rule also need to be considered (Hector & Bagchi, 2007; Cardinale *et al.*, 2012; Schwartz *et al.*, 2000). Moreover, many of the relationships reported between drivers, nature (biodiversity) and nature's contributions to people (including ecosystem services) in the literature are associative (e.g. correlative) and thus, in contrast to experimental evidence, not necessarily

causal. Particular caution is needed when applying existing knowledge to novel situations, because extrapolating outside of the bounds of where data were collected, might be misleading. It is worth noting, however, that methods that formally acknowledge uncertainty (e.g. scenario testing and modelling) are useful in this respect.

1.7 ROADMAP TO THE ASSESSMENT

1.7.1 What each of the six chapters covers

Chapter 1 sets the scene. Chapter 1 offers a roadmap to all chapters of the Europe and Central Asia assessment. It explains how the assessment has been developed and introduces both the purpose of the assessment and the geographical characteristics of the region. The chapter also provides an overview of the content, and introduces the most important concepts and methods used in the following chapters.

Chapter 2 shows how nature contributes to people's quality of life. Chapter 2 addresses trends in nature's contributions to people and the interactions between natures contributions to people and their quality of life. It assesses the status, trends and future dynamics of nature's contributions to people including material, regulating and non-material contributions. It also assesses the different impacts of changes in these contributions to the quality of life of people in terms of instrumental and relational values.

Chapter 3 provides insight into the relationship between biodiversity and ecosystem functiong and sevices, and into the dynamics of the major ecosystems of Europe and Central Asia. Chapter 3 assesses the existing knowledge on the relationship between biodiversity and ecosystem functioning and ecosystem services, and on the status, trends and future dynamics of nature and the processes underpinning nature's contributions to people. It deals with the entire scope of biodiversity including varying functional characteristics of taxa as well as interactions among living organisms in terrestrial and marine systems and trends in important ecosystem functions. It provides a synthetic analysis of the impact of drivers on the major ecosystems (units of analysis) and taxa.

Chapter 4 documents the drivers of change. Chapter 4 documents the status and trends in both direct and underlying indirect drivers of change that affect nature and its contributions to people across subregions and units of analysis.

Chapter 5 explores possible futures. Chapter 5 provides an integrated and cross-scale analysis of interactions of the natural world and human society. It explores plausible futures that take account of different values through scenario archetypes. It also assesses visions for the future and provides an analysis of the pathways that could lead to realising these visions.

Chapter 6 indicates opportunities in governance and policy. Chapter 6 explores governance options and institutional arrangements for better consideration of nature and nature's contributions to people in public and private decision-making. It also considers the opportunities for a wide range of actors and sectors for the conservation and sustainable use of nature, and the sustained provision of nature's contributions to people in Europe and Central Asia. It highlights areas for successful integration and assesses major categories of policy instruments.

1.7.2 How do the chapters address the policy-relevant questions?

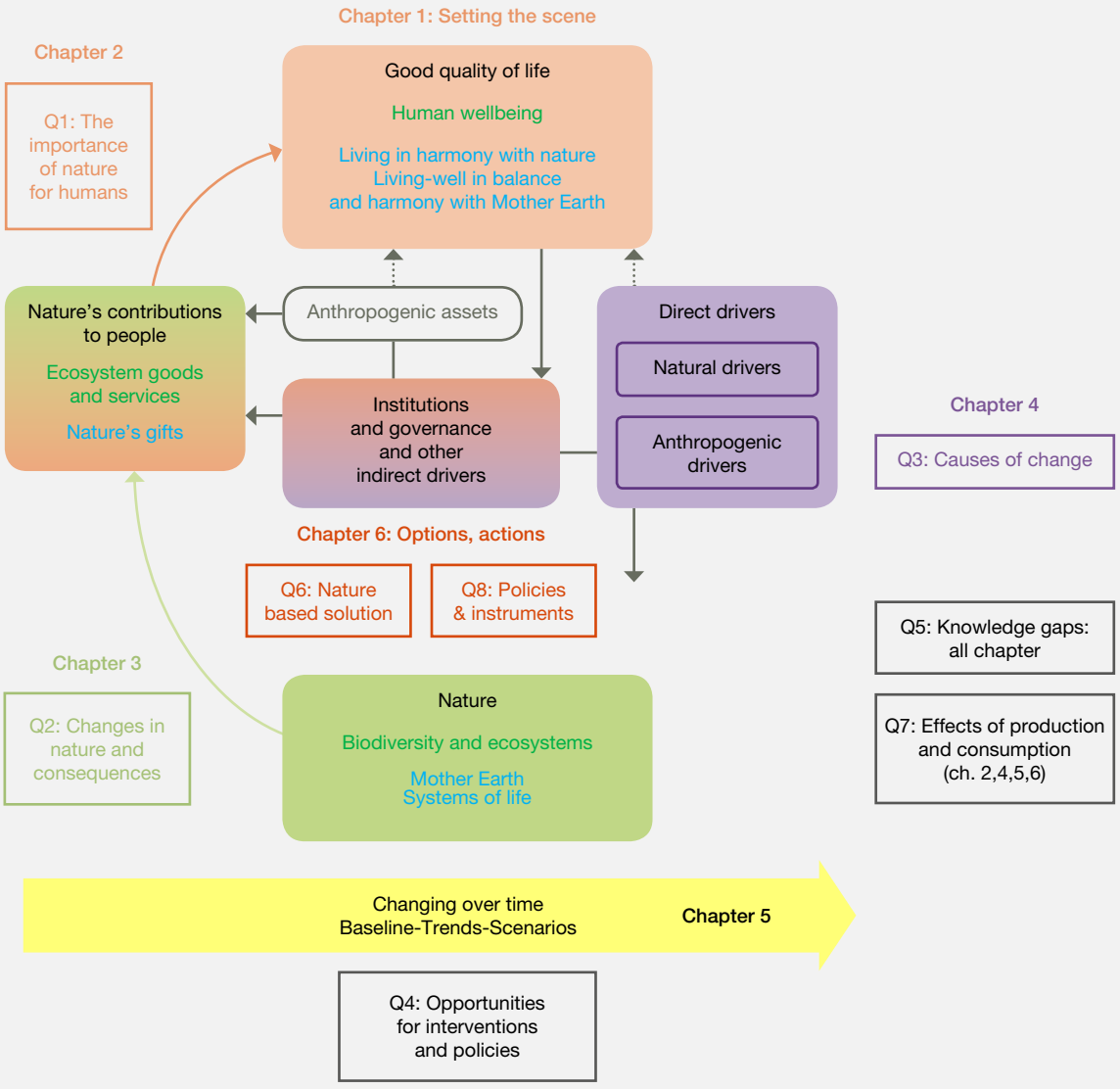
The five general IPBES policy questions on: urgent worldwide knowledge demands on the importance of nature for the human species (Question 1); the current change of nature and its consequences (Question 2); the causes of this change (Question 3); opportunities for policies and interventions (Question 4); and the identification of related knowledge gaps (Question 5) are addressed in Chapters 2 to 5 of this assessment. Questions 1 to 4 guide Chapters 2 to 5, and question 5 on knowledge gaps is addressed as a sub-section in each of Chapters 2-5. Chapter 6 provides governance options for private and public actors based on the findings of Chapters 2 to 5, and it addresses the Europe and Central Asia specific questions on nature-based solutions (Question 6), and how sectoral policies and innovative policy instruments encourage opportunities arising from the contributions of nature to good quality of life (Question 8). Question 7 on the effects of production and consumption and cross-regional linkages is covered by Chapters 2 (see e.g. 2.2.4), 4 (indirect drivers), 5 (scenarios) and 6 (governance options) (see **Figure 1.17**).

The responses to these questions, reflecting the requests of different stakeholders, are highlighted within each section in the key findings. Chapter 1 sets the scene for the different chapters by introducing the important issues discussed in the other chapters, which lead to the assessment's main messages. Transparently presenting the broad evidence base for these main messages and key findings is considered essential for not only the credibility, but also the legitimacy and reliability, of the Regional Assessment for Europe and Central Asia.

1.7.3 What will the Regional Assessment for Europe and Central Asia lead to?

Scientifically sound assessment reports review, summarize and evaluate the evidence related to a specific problem, and provide conclusions that are accessible not only across different disciplines of science, but also for decision-makers and the general public. Previous examples have shown the importance of such assessments. The Intergovernmental Panel on Climate Change (IPCC) reports, for example, have played a major role in securing international consensus for the Paris climate agreement and the Sustainable Development Goals. The IPBES pollination assessment has resulted in a substantial rise in public awareness of the loss of pollinators and has received significant policy interest. Both of these assessments have identified important knowledge gaps and have, therefore, increased research (and funding) interest in scientific studies address these gaps. Since the IPBES Regional Assessment for Europe and Central Asia responds to a direct request from the Governments of IPBES member States, it aspires to inform decision-makers at local, national and international levels, to raise public awareness and to stimulate new research.

Figure 1 17 **Roadmap linking the chapters to the IPBES conceptual framework and the requests by Governments and multilateral environmental agreements. Source: Own representation.**



REFERENCES

Agrawal, A. (2002). Indigenous knowledge and the politics of classification. *International Social Science Journal*, *54*(173), 287–297. http://doi.org/10.1111/1468-2451.00382

Akiba, O. (1997). International Law of the Sea: The Legality of Canadian seizure of the Spanish trawler (Estai). *Natural Resources Journal*, *37,* 809–828.

Alekseev, A. I., & Safronov, S. G. (2015). Transformation trends of Russia's rural settlement patterns in the late soviet and post-soviet periods (1970–2010). *Regional Research of Russia, 5*(2), 193-201. https://doi.org/10.1134/S2079970515020021

Alexander, P., Brown, C., Arneth, A., Finnigan, J., & Rounsevell, M. D. A. (2016a). Human appropriation of land for food: The role of diet. *Global Environmental Change*, *41*, 88–98. http://doi.org/10.1016/j.gloenvcha.2016.09.005

Alexander, P., Prestele, R., Verburg, P. H., Arneth, A., Baranzelli, C., Batista e Silva, F., Brown, C., Butler, A., Calvin, K., Dendoncker, N., Doelman, J. C., Dunford, R., Engström, K., Eitelberg, D., Fujimori, S., Harrison, P. A., Hasegawa, T., Havlik, P., Holzhauer, S., Humpenöder, F., Jacobs-Crisioni, C., Jain, A. K., Krisztin, T., Kyle, P., Lavalle, C., Lenton, T., Liu, J., Meiyappan, P., Popp, A., Powell, T., Sands, R. D., Schaldach, R., Stehfest, E., Steinbuks, J., Tabeau, A., van Meijl, H., Wise, M. A., & Rounsevell, M. D. A. (2016b). Assessing uncertainties in land cover projections. *Global Change Biology, 23,* 767–781. http://doi.org/10.1111/gcb.13447

Antonov, N. P., Klovatch, N. V., Orlov, A. M., Datsky, A. V., Lepskaya, V. A., Kuznetsov, V. V., Yarzhombek, A. A., Abramov, A. A., Alekseyev, D. O., Moiseyev, S. I., Evseeva, N. V., & Sologub, D. O. [Антонов, Н. П., Кловач Н. В., Орлов, А. М., Датский, А. В., Лепская, В. А., Кузнецов, В. В., Яржомбек, А. А., Абрамов, А. А., Алексеев, Д. О., Моисеев, С. И., Евсеева, Н. В., & Сологуб, Д. О.]. (2016). Рыболовство в Дальневосточном рыбохозяйственном бассейне в 2013 г. [Fishing in the Russian Far East fishery basin in 2013]. Труды ВНИРО *[Proceedings of VNIRO]*, *160*, 133–211.

Appleton, M. R., Dinu, A., Liscakova, N., Panchenko, N., & Vergeichik, M. (2012). Biodiversity: Delivering results in Europe and the CIS. Bratislava, Slovakia: Global Environment Facility and United Nations Development Programme.

Artyukhin, Y. B., & Burkanov, V. N. [Артюхин, Ю. Б., & Бурканов, В. Н.]. (1999). Морские птицы и млекопитающие Дальнего Востока России: полевой определитель *[Marine birds and mammals of the Russian Far East: A field guide]*. Moscow, Russian Federation: ACT [AST].

Ash, N., Blanco, H., Brown, C., Garcia, K., Henrichs, T., Lucas, N., Raudsepp-Hearne, C., Simpson, R. D., Scholes, R., Tomich, T. P., Vira, B., & Zurek, M. (Eds.). (2010). Ecosystems and human well-being: A manual for assessment practitioners. In *Human Well-Being* (p. 285). Washington DC, USA: Island Press. Retrieved from https://www.unep-wcmc.org/resources-and-data/ecosystems-and-human-wellbeing--a-manual-for-assessment-practitioners

Ashimov, K. S. [Ашимов, К. С.]. (2014). Состояние орехово-плодовых лесов южной Киргизии [State of nut-fruit forests of Southern Kyrgyzstan]. Вестник Кыргызского Национального Аграрного Университета Имени К.И.Скрябина *[Herald of Kyrgyz National Agrarian University of Skryabin]*, *1*(30)), 267–270.

Asian Development Bank. (2010). *Central Asia atlas of natural resources*. Retrieved from https://www.adb.org/sites/default/files/publication/27508/central-asia-atlas.pdf

Balushkina, E.V., Golubkov, S.M., Golubkov, M.S., Litvinchuk, L. F., & Shadrin, N.V. [Балушкина Е. В., Голубков С. М., Голубков, М. С., Литвинчук, Л. Ф., & Шадрин, Н. В.]. (2009). Влияние абиотических и биотических факторов на структурно-функциональную организацию экосистем соленых озер Крыма [Effect of abiotic and biotic factors on the structural and functional organization of the saline lake ecosystems in Crimea]. Журнал Общей Биологии *[Journal of General Biology]*, *70*(6), 504–514.

Bański, J. (2008). Agriculture of Central Europe in the period of economic transformation. In J. Bański & M. Bednarek (Eds.), *Contemporary changes of agriculture in East-Central Europe* (pp. 7-20). Warsaw, Poland: Polish Geographical Society and Polish Academy of Sciences. Retrieved from http://rcin.org.pl/Content/101/WA51_209_r2008-vol15_SOW.pdf

Batáry, P., Dicks, L. V., Kleijn, D., & Sutherland, W. J. (2015). The role of agri-environment schemes in conservation and environmental management. *Conservation Biology*, *29*(4), 1006–1016. http://doi.org/10.1111/cobi.12536

Batavia, C., & Nelson, M. P. (2017). For goodness sake! What is intrinsic value and why should we care? *Biological Conservation*, *209*, 366–376. http://doi.org/10.1016/j.biocon.2017.03.003

Batbold, J., Batsaikhan, N., Shar, S., Hutterer, R., Kryštufek, B., Yigit, N., Mitsain, G., & Palomo, L. (2016). *Castor fiber*. The IUCN Red List of Threatened Species. Retrieved December 18, 2016. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T4007A22188115.en

Belikov, S. E., Gavrilo, M. V., Gorin, S. L., Ivanov, A. N., Krasnova, E. D., Krasnov, Y. V., Kulangiev, A. O., Lashmanov, F. I., Makarov, A. V., Nikolaeva, N. G., Popov, A. V., Sergienko, L. A., Shroeders, M. A., & Spiridonov VA. (2011). *Atlas of marine and coastal biological diversity of the Russian Arctic*. V. A. Spiridonov, M. V. Gavrilo, E. D. Krasnova, & N. G. Nikolaeva (Eds.). Moscow, Russian Federation: WWF Russia. Retrieved from http://www.wwf.ru/resources/publ/book/eng/500

Biodat. (2017). Retrieved December 8, 2017, from http://biodat.ru

Biodiversity Monitoring in Ukraine [Моніторинг біорізноманіття в Україні]. (n.d.). *Biodiversity Monitoring in Ukraine* [Моніторинг біорізноманіття в Україні]. Retrieved December 8, 2017, from http://biomon.org/

Birdlife Europe and Central Asia. (2015). *Halfway there? Mid-term assessment of*

the progress of the EU2020 Biodiversity Strategy.

BISE. (2015). EU biodiversity targets and related global Aichi targets. Retrieved May 12, 2016, from http://biodiversity.europa.eu/policy/target-1-and-related-aichi-targets

Blenckner, T., Llope, M., Möllmann, C., Voss, R., Quaas, M. F., Casini, M., Lindegren, M., Folke, C., & Stenseth, N. C. (2015). Climate and fishing steer ecosystem regeneration to uncertain economic futures. *Proceedings of the Royal Society B: Biological Sciences*, *282*(1803), 20142809. http://doi.org/10.1098/rspb.2014.2809

Boeraeve, F., Dendoncker, N., Jacobs, S., Gómez-Baggethun, E., & Dufrêne, M. (2014). How (not) to perform ecosystem service valuations: pricing gorillas in the mist. *Biodiversity and Conservation*, *24*(1), 187–197. http://doi.org/10.1007/s10531-014-0796-1

Boros, E., Ecsedi, Z., & Oláh, J. (2013). *Ecology and management of soda pans in the Carpathian Basin*. Balmazújváros, Hungary: Hortobágy Environmental Association.

Boschetti, F., Price, J., & Walker, I. (2016). Myths of the future and scenario archetypes. *Technological Forecasting and Social Change*, *111*, 76–85. http://doi.org/10.1016/j.techfore.2016.06.009

Brooks, T. M., Akçakaya, H. R., Burgess, N. D., Butchart, S. H. M., Hilton-Taylor, C., Hoffmann, M., Juffe-Bignoli, D., Kingston, N., MacSharry, B., Parr, M., Perianin, L., Regan, E. C., Rodrigues, A. S. L., Rondinini, C., Shennan-Farpon, Y., & Young, B. E. (2016). Analysing biodiversity and conservation knowledge products to support regional environmental assessments. *Scientific Data*, *3*, 160007. http://doi.org/10.1038/sdata.2016.7

Brown, C., Brown, E., Murray-Rust, D., Cojocaru, G., Savin, C., & Rounsevell, M. (2015). Analysing uncertainties in climate change impact assessment across sectors and scenarios. *Climatic Change*, *128*(3–4), 293–306. http://doi.org/10.1007/s10584-014-1133-0

Brucet, S., Boix, D., Nathansen, L. W., Quintana, X. D., Jensen, E., Balayla, D., Meerhoff, M., & Jeppesen, E. (2012). Effects of temperature, salinity and fish in structuring the macroinvertebrate community in shallow lakes: Implications for effects of climate change. *PLoS ONE*, *7*(2), e30877. http://doi.org/10.1371/journal.pone.0030877

Burdin, A. M., Filatova, O. A., & Khoit, E. [Бурдин, А. М., Филатова, О. А., & Хойт, Э.]. (2009). Морские млекопитающие России *[Marine mammals of Russia]*. Kirov, Russian Federation: Volga-Vyatka Publishing House.

Burns, S. L., Krott, M., Sayadyan, H., & Giessen, L. (2017). The World Bank improving environmental and natural resource policies: Power, deregulation, and privatization in (post-Soviet) Armenia. *World Development, 92,* 215-224. https://doi.org/10.1016/j.worlddev.2016.12.030

Butchart, S. H. M., Walpole, M., Collen, B., van Strien, A., Scharlemann, J. P. W., Almond, R. E. A, Baillie, J. E. M., Bomhard, Brown, C., Bruno, J., Carpenter, K. E., Carr, G. M., Chanson, J., Chenery, A. M., Csirke, J., Davidson, N. C., Dentener, F., Foster, M., Galli, A., Galloway, J. N., Genovesi, P., Gregory, R. D., Hockings, M., Kapos, V., Lamarque, J. F., Leverington, F., Loh, J., McGeoch, M. A., McRae, L., Minasyan, A., Morcillo, M. H. , Oldfield, T. E. E., Pauly, D., Quader, S., Revenga, C., Sauer, J. R., Skolnik, B., Spear, D., Stanwell-Smith, D., Stuart, S. N., Symes, A., Tierney, M., Tyrrell, T. D., Vie, J. C., & Watson, R. (2010). Global biodiversity: indicators of recent declines. *Science*, *328*(5982), 1164–1168. http://doi.org/10.1126/science.1187512

Cardinale, B. J., Duffy, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P., Narwani, A., Mace, M. M., Tilman, D., Wardle, D. A., Kinzig, A. P., Daily, G. C., Loreau, M., Grace, J. B., Larigauderie, A., Srivastava, D. S., & Naeem, S. (2012). Biodiversity loss and its impact on humanity. *Nature*, *486*, 59–67. Retrieved from http://dx.doi.org/10.1038/nature11148

Carpenter, S. R., Mooney, H. A., Agard, J., Capistrano, D., Defries, R. S., Díaz, S., Dietz, T., Duraiappah. A. K., Oteng-Yeboah, A., Pereira, H. M., Perrings, C., Reid, W. V., Sarukhan, J., Scholes, R. J., & Whyte, A. (2009). Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(5), 1305–1312. http://doi.org/10.1073/pnas.0808772106

Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., Jäger, J., & Mitchell, R. B. (2003). Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences of the United States of America*, *100*(14), 8086–8091. http://doi.org/10.1073/pnas.1231332100

Catalogue of Life. (2016). *2016 Annual Checklist.* Retrieved December 7, 2017, from http://www.catalogueoflife.org/annual-checklist/2016/info/ac

CBD. (2010). *The Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets*.

CBD. (2014). *Global biodiversity outlook 4: A mid-term assessment of progress towards the implementation of the Strategic Plan for Biodiversity 2011-2020*.

CBD. (2015). *Find National Targets.* Retrieved from https://www.cbd.int/nbsap/targets/

CIS [СНГ]. (n.d.). Исполнительный Комитет Содружества Независимых Государств [The Executive Committee of the Commonwealth of Independent States]. Retrieved December 7, 2017, from http://www.cis.minsk.by

Čížková, H., Květ, J., Comín, F. A., Laiho, R., Pokorný, J., & Pithart, D. (2013). Actual state of European wetlands and their possible future in the context of global climate change. *Aquatic Sciences*, *75*(1), 3–26. http://doi.org/10.1007/s00027-011-0233-4

Comin, F., & Alonso, M. (1988). Spanish salt lakes: Their chemistry and biota. *Hydrobiologia, 158,* 237–245.

Cowling, R. M., Egoh, B., Knight, A. T., O'Farrell, P. J., Reyers, B., Rouget, M., Roux, D. J., Welz, A., & Wilhelm-Rechman, A. (2008). An operational model for mainstreaming ecosystem services for implementation. *Proceedings of the National Academy of Sciences of the United States of America*, *105*(28), 9483–9488. http://doi.org/10.1073/pnas.0706559105

Crossman, N. D., Burkhard, B., Nedkov, S., Willemen, L., Petz, K., Palomo, I., Drakou, E. G., Martín-Lopez, B., McPhearson, T., Boyanova, K., Alkemade, R., Egoh, B., Dunbar, M. B., & Maes, J. (2013). A blueprint for mapping and modelling ecosystem services. *Ecosystem Services*, *4*, 4–14. http://doi.org/10.1016/j.ecoser.2013.02.001

Cuypers, D., Geerken, T., Gorissen, L., Lust, A., Peters, G., Karstensen, J., Prieler, S., Fisher, G., Hizsnyik, E., & Van Velthuizen, H. (2013). *The impact of EU consumption on deforestation: Comprehensive analysis of the impact of EU consumption on deforestation*. Retrieved from http://ec.europa.eu/environment/forests/pdf/1. Report analysis of impact.pdf

Danielsen, F., Jensen, P. M., Burgess, N. D., Coronado, I., Holt, S., Poulsen, M. K., Rueda, R. M., Skielbou, T., Enghoff, M., Hemmingsen, L. H., Sørensen, M., & Pirhofer-Walzl, K. (2014). Testing focus groups as a tool for connecting indigenous and local knowledge on abundance of natural resources with science-based land management systems. *Conservation Letters*, *7*(4), 380–389. http://doi.org/10.1111/conl.12100

Dendoncker, N., Keune, H., Jacobs, S., & Gomez-Baggethun, E. (2014). Inclusive ecosystem service valuation. In S. Jacobs, N. Dendoncker, & H. Keune (Eds.), *Ecosystem services: Global issues, local practices* (pp. xix–xxviii). New York, USA: Elsevier.

Dendoncker, N., Schmit, C., & Rounsevell, M. (2008). Exploring spatial data uncertainties in land-use change scenarios. *International Journal of Geographical Information Science*, *22*(9), 1013–1030. http://doi.org/10.1080/13658810701812836

Díaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., Larigauderie, Adhikari, J. R., Arico, S., Báldi, A., Bartuska, A., Baste, I. A., Bilgin, A., Brondizio, E., Chan, K. M. A., Figueroa, V. E., Duraiappah, A., Fischer, M., Hill, R., Koetz, T., Leadley, P., Lyver, P., Mace, G. M., Martin-Lopez, B., Okumura, M., Pacheco, D., Pascual, U., Pérez, E. S., Reyers, B., Roth, E., Saito, O., Scholes, R. J., Sharma, N., Tallis, H., Thaman, R., Watson, R., Yahara, T., Hamid, Z. A., Akosim, C., Al-Hafedh, Y., Allahverdiyev, R., Amankwah, E., Asah, S. T., Asfaw, Z., Bartus, G., Brooks, L. A., Caillaux, J., Dalle, G., Darnaedi, D., Driver, A., Erpul, G., Escobar-Eyzaguirre, P., Failler, P., Fouda, A. M. M., Fu, B., Gundimeda, H., Hashimoto, S., Homer, F., Lavorel, S., Lichtenstein, G., Mala, W. A., Mandivenyi, W., Matczak, P., Mbizvo, C., Mehrdadi, M., Metzger, J. P., Mikissa, J. B., Moller, H., Mooney, H. A., Mumby, P., Nagendra, H., Nesshover, C., ApauOteng-Yeboah, A., Pataki, G., Roué, M., Rubis, J., Schultz, M., Smith, P., Sumaila, R., Takeuchi, K., Thomas, S., Verma, M., Yeo-Chang, Y., & Zlatanova, D. (2015). The IPBES conceptual framework - connecting nature and people. *Current Opinion in Environmental Sustainability*, *14*, 1–16. http://doi.org/10.1016/j.cosust.2014.11.002

Donovan, S. M., Looney, C., Hanson, T., de León, Y. S., Wulfhorst, J. D., Eigenbrode, S. D., Jennings, M., Johnson-Maynard, J., & Bosque Pérez, N. A. (2009). Reconciling social and biological needs in an endangered ecosystem: The Palouse as a model for bioregional planning. *Ecology & Society*, *14*(1), 1–24. http://doi.org/10.5751/ES-02736-140109

Dunford, R., Harrison, P. A., & Rounsevell, M. D. A. (2014). Exploring scenario and model uncertainty in cross-sectoral integrated assessment approaches to climate change impacts. *Climatic Change*, *132*(3), 417–432. http://doi.org/10.1007/s10584-014-1211-3

EEA. (n.d.). *Countries*. Retrieved December 7, 2017, from https://www.eea.europa.eu/countries-and-regions

EEA. (2002). *Europe's biodiversity - biogeographical regions and seas*. Retrieved from http://www.eea.europa.eu/publications/report_2002_0524_154909

EEA. (2012). *Climate change, impacts and vulnerability in Europe 2012: An indicator-based report*. Retrieved from https://www.eea.europa.eu/publications

EEA. (2015a). *High nature value (HNV) farmland.* Retrieved from http://www.eea.europa.eu/data-and-maps/data/high-nature-value-farmland

EEA. (2015b). *SOER 2015 - The European environment — state and outlook 2015.* Retrieved November 20, 2015, from http://www.eea.europa.eu/soer

EEA. (2015c). State of Europe's seas. Retrieved from https://www.eea.europa.eu/publications/state-of-europes-seas

EEU. (n.d.). *Eurasian Economic Union.* Retrieved December 7, 2017, from http://www.eaeunion.org/?lang=en

EFTA. (n.d.). *European Free Trade Association.* Retrieved December 7, 2017, from http://www.efta.int

Elbakidze, M., Angelstam, P., Andersson, K., Nordberg, M. & Pautov, Y. (2011). How does forest certification contribute to boreal biodiversity conservation? Standards and outcomes in Sweden and NW Russia. *Forest Ecology and Management, 262*(11), 1983-1995. http://doi.org/10.1016/j.foreco.2011.08.040

Ellis, E. C., Kaplan, J. O., Fuller, D. Q., Vavrus, S., Klein Goldewijk, K., & Verburg, P. H. (2013). Used planet: A global history. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(20), 7978–7985. http://doi.org/10.1073/pnas.1217241110

Engström, K., Olin, S., Rounsevell, M. D. A., Brogaard, S., Van Vuuren, D. P., Alexander, P., Murray-Rust, D., & Arneth, A. (2016). Assessing uncertainties in global cropland futures using a conditional probabilistic modelling framework. *Earth System Dynamics*, *7*, 893–915. http://doi.org/10.5194/esd-7-893-2016

Ermolin, I., & Svolkinas, L. (2016). Who owns sturgeon in the Caspian? New theoretical model of social responses towards state conservation policy. *Biodiversity and Conservation, 25*(14), 2929-2945. https://doi.org/10.1007/s10531-016-1211-x

European Commission. (2008). Natura2000. Retrieved from http://ec.europa.eu/environment/nature/natura2000/index_en.htm

European Commission. (2011). *The EU Biodiversity Strategy to 2020.* http://doi.org/10.2779/39229

European Commission. (2015a). *Blue Growth: Opportunities for marine and maritime sustainable growth.* http://doi.org/10.2771/43949

European Commission. (2015b). *Report from the Commission to the European Parliament and the Council - The mid-term review of the EU Biodiversity Strategy to 2020*. Retrieved from https://publications.europa.eu/en/publication-detail/-/publication/eaa9f17e-68ea-11e5-9317-01aa75ed71a1

European Commission. (2017a). *GHSL - Global Human Settlement Layer.* Retrieved December 7, 2017, from http://ghslsys.jrc.ec.europa.eu

European Commission. (2017b). *Sea basin strategy: Seas around Europe's outermost regions.* Retrieved December 6, 2017, from https://ec.europa.eu/maritimeaffairs/policy/sea_basins/outermost_regions_en

European Union. (2000). *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.*

European Union. (2008). *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy.*

European Union. (2014). *Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning.*

Fagerholm, N., Käyhkö, N., Ndumbaro, F., & Khamis, M. (2012). Community stakeholders' knowledge in landscape assessments – Mapping indicators for landscape services. *Ecological Indicators*, *18*, 421–433. http://doi.org/10.1016/j.ecolind.2011.12.004

Flint, C. G., Kunze, I., Muhar, A., Yoshida, Y., & Penker, M. (2013). Exploring empirical typologies of human–nature relationships and linkages to the ecosystem services concept. *Landscape and Urban Planning*, *120*, 208–217. http://doi.org/10.1016/j.landurbplan.2013.09.002

Fontaine, C. M., Dendoncker, N., De Vreese, R., Jacquemin, I., Marek, A., Van Herzele, A., Devillet, G., Mortelmans, D., & François, L. (2014). Towards participatory integrated valuation and modelling of ecosystem services under land-use change. *Journal of Land Use Science*, *9*(3), 278–303. http://doi.org/10.1080/1747423X.2013.786150

FSBI AARI [ФГБУ "ААНИИ"]. (n.d.-a). База биоразнообразия [Biodiversity database]. Retrieved December 8, 2017, from http://oopt.aari.ru/bio

FSBI AARI [ФГБУ "ААНИИ"]. (n.d.-b). Красные книги. Законодательство в сфере охраны животного и растительного мира [The red books. The legislation in the sphere of protection of flora and fauna]. Retrieved December 8, 2017, from http://oopt.aari.ru/rbdata

Gambaiani, D. D., Mayol, P., Isaac, S. J., & Simmonds, M. P. (2009). Potential impacts of climate change and greenhouse gas emissions on Mediterranean marine ecosystems and cetaceans. *Journal of the Marine Biological Association of the United Kingdom*, *89*(1), 179-201. http://doi.org/10.1017/S0025315408002476

Geptner, V. G., Chapskiy, K. K., Arseniev, V. A., & Sokolov, V. E. [Гептнер, В. Г., Чапский, К. К., Арсеньев, В. А., & Соколов, В. Е.]. (1976). Млекопитающие Советского Союза. Том *2/3.* Ластоногие и зубатые киты *[Mammals of The Soviet Union. Volume 2/3. Pinnipeds and toothed whales]*.

Gómez-baggethun, E., Martín-López, B., Barton, D., Braat, L., Kelemen, E., García-Llorente, M., Saarikoski, H., & van den Bergh, J. (2014). *State-of-the-art report on integrated valuation of ecosystem services*. Retrieved from http://www.openness-project.eu/sites/default/files/Deliverable%204%201_Integrated-Valuation-Of-Ecosystem-Services.pdf

Government of Belarus [Правительство Беларуси]. (n.d.). *Environmental Bulletin for 2015 [Экологический бюллетень за 2015 год].* Retrieved December 8, 2017, from http://www.minpriroda.gov.by/ru/ecoza2015/

Government of Norway. (2012). *First update of the integrated management plan for the marine environment of the Barents Sea–Lofoten area*. Retrieved from https://www.regjeringen.no/contentassets/db61759a16874cf28b2f074c9191bed8/en-gb/pdfs/stm201020110010000en_pdfs.pdf

Government of Turkey. (2014). *Fifth national report*. Retrieved from https://www.cbd.int/reports/search

Gramberger, M., Zellmer, K., Kok, K., & Metzger, M. J. (2015). Stakeholder integrated research (STIR): a new approach tested in climate change adaptation research. *Climatic Change*, *128*, 201–214. http://doi.org/10.1007/s10584-014-1225-x

Gvozdeckii, N. A. & Mikhailov, N. I. [Гвоздецкий, Н. А., & Михайлов, Н. И.]. (1978). Физическая география СССР, Азиатская часть [Physical Geography of USSR, the Asian Part].

Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A., Tyukavina, A., Thau, D., Stehman, S. V., Goetz, S. J., Loveland, T. R., Kommareddy, A., Egorov, A., Chini, L., Justice, C. O., Townshend, J. R. G. (2013). High-resolution global maps of 21st-century forest cover change. *Science*, *342*(6160), 850–853. http://doi.org/10.1126/science.1244693

Harrison, P. A., Dunford, R. W., Holman, I. P., & Rounsevell, M. D. A. (2016). Climate change impact modelling needs to include cross-sectoral interactions. *Nature Climate Change*, *6,* 885-890. http://doi.org/10.1038/nclimate3039

Hector, A., & Bagchi, R. (2007). Biodiversity and ecosystem multifunctionality. *Nature*, *448*(7150), 188–190. http://dx.doi.org/10.1038/nature05947

Hein, L., van Koppen, K., de Groot, R. S., & van Ierland, E. C. (2006). Spatial scales, stakeholders and the valuation of ecosystem services. *Ecological Economics*, *57*(2), 209–228. http://doi.org/10.1016/j.ecolecon.2005.04.005

Hein, T., Schwarz, U., Habersack, H., Nichersu, I., Preiner, S., Willby, N., & Weigelhofer, G. (2016). Current status and restoration options for floodplains along the Danube River. *Science of the Total Environment*, *543*, 778–790. http://doi.org/10.1016/j.scitotenv.2015.09.073

HELCOM. (2017). *Baltic Marine Environment Protection Commission – Helsinki Commission.* Retrieved December 6, 2017, from http://www.helcom.fi/about-us

Herbarium of CBG NASB MSKH [Гербарий ЦБС НАН Беларуси MSKH]. (n.d.). Растения Беларуси [Plants of Belarus]. Retrieved December 8, 2017, from http://hbc.bas-net.by/plantae/

Hernández-Morcillo, M., Hoberg, J., Oteros-Rozas, E., Plieninger, T., Gómez-Baggethun, E., & Reyes-García, V. (2014). Traditional ecological knowledge in Europe: Status quo and insights for the environmental policy agenda. *Environment: Science and Policy for Sustainable Development*, *56*(1), 3–17. http://doi.org/10.1080/00139157.2014.861673

Hof, C., Brändle, M., & Brandl, R. (2008). Latitudinal variation of diversity in European freshwater animals is not concordant across habitat types. *Global Ecology and Biogeography*, *17*(4), 539–546. http://doi.org/10.1111/j.1466-8238.2008.00394.x

Hostert, P., Kuemmerle, T., Prishchepov, A., Sieber, A., Lambin, E. F., & Radeloff, V. C. (2011). Rapid land use change after socio-economic disturbances: the collapse of the Soviet Union versus Chernobyl. *Environmental Research Letters, 6*(4), 045201. http://doi.org/10.1088/1748-9326/6/4/045201

Hulme, P. E. (2009). Trade, transport and trouble: Managing invasive species pathways in an era of globalization. *Journal of Applied Ecology*, *46*(1), 10–18. http://doi.org/10.1111/j.1365-2664.2008.01600.x

Hunt, G. L., Katō, H., & McKinnell, S. M. (2000). *PICES Scientific Report No. 14: Predation by marine birds and mammals in the subarctic North Pacific Ocean*.

Huntington, H. P., Brown-Schwalenberg, P. K., Frost, K. J., Fernandez-Gimenez, M. E., Norton, D. W., & Rosenberg, D. H. (2002). Observations on the workshop as a means of improving communication between holders of traditional and scientific knowledge. *Environmental Management*, *30*(6), 0778–0792. http://doi.org/10.1007/s00267-002-2749-9

IPBES. (2014). *IPBES/2/17: Report of the second session of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*.

IPBES. (2016a). *IPBES/4/INF/9: Guide on the production and integration of assessments from and across all scales (deliverable 2 (a))*. Retrieved from https://www.ipbes.net/event/ipbes-4-plenary

IPBES. (2016b). *Methodological assessment report of the Intergovernmental Platform on Biodiversity and Ecosystem Services on scenarios and models of biodiversity and ecosystem services*. S. Ferrier, K. N. Ninan, P. Leadley, R. Alkemade, L. A. Acosta, H. R. Akçakaya, L. Brotons, W. Cheung, V. Christensen, K. A. Harhash, J. Kabubo-Mariara, C. Lundquist, M. Obersteiner, H. Pereira, G. Peterson, R. Pichs-Madruga, N. H. Ravindranath, C. Rondinini, & B. Wintle (Eds.). Bonn, Germany: Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

IPBES. (2017). Indicators and data for IPBES assessments. Retrieved December 7, 2017, from https://www.ipbes.net/indicators-data-ipbes-assessments

IPCC. (2014). *Climate change 2014: Synthesis report. Contribution of working groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change*. Core Writing Team, R. K. Pachauri, & L. A. Meyer (Eds.). Geneva, Switzerland: Intergovernmental Panel on Climate Change.

Isachenko, A. [Исаченко, А.]. (1985). Ландшафты СССР [Landscapes of USSR].

IUCN. (2017). *The IUCN Red List of Threatened Species. Version 2017-3.* Retrieved December 6, 2017, from http://www.iucnredlist.org

Izmailova A.V. [Измайлова А. В.]. (n.d.). Эльтон озеро [The Elton lake]. Retrieved from http://water-rf.ru/Водные_объекты/193/Эльтон

Jacobs, S., Dendoncker, N., Martín-López, B., Barton, D. N., Gomez-Baggethun, E., Boeraeve, F., McGrath, F. L., Vierikko, K., Geneletti, D., Sevecke, K. J., Pipart, N., Primmer, E., Mederly, P., Schmidt, S., Aragão, A., Baral, H., Bark, R. H., Briceno, T., Brogna, D., Cabral, P., De Vreese, R., Liquete, C., Mueller, H., Peh, K. S.-H. Phelan, A., Rincón, A. R., Rogers, S. H., Turkelboom, F., Van Reeth, W., van Zanten, B. T., Wam, H. K., & Washbourn, C.-L. (2016). A new valuation school: Integrating diverse values of nature in resource and land use decisions. *Ecosystem Services*, *22*, 213–220. http://doi.org/10.1016/j.ecoser.2016.11.007

Jacobs, S., Spanhove, T., De Smet, L., Van Daele, T., Van Reeth, W., Van Gossum, P., Stevens, M., Schneiders, A., Panis, J., Demolder, H., Michels, H., Thoonen, M., Simoens, I., Peymen, J. (2015). The ecosystem service assessment challenge: Reflections from Flanders-REA. *Ecological Indicators*, *61*, 715–727. http://doi.org/10.1016/j.ecolind.2015.10.023

Jepsen, M. R., Kuemmerle, T., Müller, D., Erb, K., Verburg, P. H., Haberl, H., Vesterager, J. P., Andrič, M., Antrop, M., Austrheim, G., Björn, I., Bondeau, A., Bürgi, M., Bryson, J., Caspar, G., Cassar, L. F., Conrad, E., Chromý, P., Daugirdas, V., Van Eetvelde, V., Elena-Rosselló, R., Gimmi, U., Izakovicova, Z., Jančák, V., Jansson, U., Kladnik, D, Kozak, J., Konkoly-Gyuró, E., Krausmann, F., Mander, U., McDonagh, J., Pärn, J., Niedertscheider, M., Nikodemus, O., Ostapowicz, K., Pérez-Soba, M., Pinto-Correia, T., Ribokas, G., Rounsevell, M., Schistou, D., Schmit, C., Terkenli, T. S., Tretvik, A. M., Trzepacz, P., Vadineanu, A., Walz, A., Zhllim, E., Reenberg, A., & Reenberg, A. (2015). Transitions in European land-management regimes between 1800 and 2010. *Land Use Policy*, *49*, 53–64. http://doi.org/10.1016/j.landusepol.2015.07.003

Kabisch, N., Strohbach, M., Haase, D., & Kronenberg, J. (2016). Urban green space availability in European cities. *Ecological Indicators*, *70*, 586–596. http://doi.org/10.1016/j.ecolind.2016.02.029

Kalkanbekov, S., & Samakov, A. (2017). Sacred sites and biocultural diversity conservation in Kyrgyzstan: Co-production of knowledge between traditional practitioners and scholars. In M. Roué & Z. Molnár (Eds.), *Knowing our lands and resources: Indigenous and local knowledge of biodiversity and ecosystem services in*

Europe and Central Asia (pp. 126-134). Paris, France: UNESCO.

Kastner, T., Erb, K.-H., & Haberl, H. (2015). Global human appropriation of net primary production for biomass consumption in the European Union, 1986-2007. *Journal of Industrial Ecology*, *19*(5), 825–836. http://doi.org/10.1111/jiec.12238

Kazanci, N., Girgin, S., & Dügel, M. (2004). On the limnology of Salda Lake, a large and deep soda lake in southwestern Turkey: Future management proposals. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *14*(2), 151–162. http://doi.org/10.1002/aqc.609

Kok, K., Bärlund, I., Flörke, M., Holman, I., Gramberger, M., Sendzimir, J., Stuch, B, & Zellmer, K. (2015). European participatory scenario development: strengthening the link between stories and models. *Climatic Change*, *128*, 187–200. http://doi.org/10.1007/s10584-014-1143-y

Körner, C., Paulsen, J., & Spehn, E. M. (2011). A definition of mountains and their bioclimatic belts for global comparisons of biodiversity data. *Alpine Botany*, *121*(2), 73–78. http://doi.org/10.1007/s00035-011-0094-4

Kortekaas, K. H., & Vayá, J. F. C. (2009). Biodiversity of inland saltscapes of the Iberian Peninsula. *Natural Resources and Environmental Issues*, *15*, 163–171.

Kotova, I., Kayukova, E., & Kotov, S. (2016). Peloids of Crimean salt lakes and the Dead Sea: controls on composition and formation. *Environmental Earth Sciences*, *75*, 1207. http://doi.org/10.1007/s12665-016-5999-1

Kulagin V.M., Markov P.A., & Tishkov A.A. [Кулагин, В. М., Марков, П. А., & Тишков, А. А.]. (1990). Иссык-Кульский заповедник [Issyk-Kul strict natural reserve]. In Заповедники Средней Азии и Казахстана. Заповедники СССР *[Strict natural reserves of Central Asia and Kazakhstan. Strict natural reserves of the USSR]* (pp. 362-375). Moscow, Russian Federation: Мысль [Mysl].

Layke, C., Mapendembe, A., Brown, C., Walpole, M., & Winn, J. (2012). Indicators from the global and sub-global Millennium Ecosystem Assessments: An analysis and next steps. *Ecological Indicators*, *17*, 77–87. http://doi.org/10.1016/j.ecolind.2011.04.025

Leadley, P. W., Krug, C. B., Alkemade, R., Pereira, H. M., Sumaila, U. R., Walpole, M., Marques, A., Newbold, T., Teh, L.S.L, van Kolck, J., Bellard, C., Januchowski-Hartley, S.R., & Mumby, P. J. (2013). *Progress towards the Aichi Biodiversity Targets: An assessment of biodiversity trends, policy scenarios and key actions. CBD technical series 78*. Montreal, Canada: Secretariat of the Convention on Biological Diversity. Retrieved from http://www.cbd.int/doc/publications/cbd-ts-78-en.pdf

Lejeusne, C., Chevaldonné, P., Pergent-Martini, C., Boudouresque, C. F., & Pérez, T. (2010). Climate change effects on a miniature ocean: the highly diverse, highly impacted Mediterranean Sea. *Trends in Ecology & Evolution*, *25*(4), 250–260. http://doi.org/10.1016/j.tree.2009.10.009

Mace, G. M., Norris, K., & Fitter, A. H. (2012). Biodiversity and ecosystem services: a multilayered relationship. *Trends in Ecology & Evolution*, *27*(1), 19–26. http://doi.org/10.1016/j.tree.2011.08.006

Maes, J., Egoh, B., Willemen, L., Liquete, C., Vihervaara, P., Schägner, J. P., Grizzetti, B., Drakou, E. G., LaNotte, A., Zulian, G., Bouraoui, F., Paracchini, M. L., Braat, L., & Bidoglio, G. (2012). Mapping ecosystem services for policy support and decision making in the European Union. *Ecosystem Services*, *1*(1), 31–39. http://doi.org/10.1016/j.ecoser.2012.06.004

Maier, D. S., & Feest, A. (2015). The IPBES conceptual framework: An unhelpful start. *Journal of Agricultural and Environmental Ethics*, *29*(2), 327–347. Retrieved from http://link.springer.com/10.1007/s10806-015-9584-5

Malets, O. (2015). When transnational standards hit the ground: Domestic regulations, compliance assessment and forest certification in Russia. *Journal of Environmental Policy and Planning, 17*(3), 332-359. http://dx.doi.org/10.1080/1523908X.2014.947922

Mallon, D. P. (2008). *Saiga tatarica*. The IUCN Red List of Threatened Species. Retrieved December 18, 2016. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T19832A9021682.en

Mazoyer, M., & Roudart, L. (2006). *A History of World Agriculture: From the Neolithic Age to the Current Crisis*. New York, USA: Monthly Review Press.

MEA. (2005). *Ecosystems and human well-being: Current state and trends, Volume 1.* Washington DC, USA: Island Press.

Messager, M. L., Lehner, B., Grill, G., Nedeva, I., & Schmitt, O. (2016). Estimating the volume and age of water stored in global lakes using a geo-statistical approach. *Nature Communications*, *7*, 13603. http://doi.org/10.1038/ncomms13603

Metzger, M.J., Shkaruba, A.D., Jongman, R.H.G., & Bunce, R. G. H. (2012). *Descriptions of the European Environmental Zones and Strata*. Wageningen, The Netherlands: Alterra.

Meyfroidt, P., Rudel, T. K., & Lambin, E. F. (2010). Forest transitions, trade, and the global displacement of land use. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(49), 20917-20922. http://doi.org/10.1073/pnas.1014773107

Milkov, F.N. [Мильков, Ф. Н. (1977). *Natural Zones of USSR [*Природные зоны СССР*]*. Moscow, USSR: Mysl' [Мысль].

Minprirody of Russia [Минприроды России]. (2016). Государственный доклад "О состоянии и об охране окружающей среды Российской Федерации в *2015* году" *[State report "The status of environment of the Russian Federation in 2015"]*. Moscow, Russian Federation: Минприроды России [Ministry of Natural Resources and Environment of Russia]. Retrieved from http://www.mnr.gov.ru/upload/iblock/62f/dokl2015.pdf

Montes, C., & Martino, P. (1987). Las lagunas salinas españolas [Spanish salt lakes]. In *Bases Cientficas para la protección de los humedales en España* (pp. 95–145). Madrid, Spain: Real Academia de Ciencias Exactas, Físicas y Naturales de Madrid.

Montgomery, D. R. (2007). Soil erosion and agricultural sustainability. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(33), 13268–13272. http://doi.org/10.1073/pnas.0611508104

Mora, C., Tittensor, D. P., Adl, S., Simpson, A. G. B., & Worm, B. (2011). How many species are there on earth and in the ocean? *PLoS Biology*, *9*(8), e1001127. http://doi.org/10.1371/journal.pbio.1001127

Moss, R., & Schneider, S. (2000). Uncertainties. In R. Pachauri, T. Taniguchi, & K. Tanaka (Eds.), *Guidance papers on the cross cutting issues of the third assessment report of the IPCC* (pp. 33–52). Geneva, Switzerland: Intergovernmental Panel on Climate Change.

Nadasdy, P. (1999). The politics of TEK: Power and the "integration" of knowledge. *Arctic Anthropology*, *36*(1/2), 1–18.

Newell, J., & Simeone, J. (2014). Russia's forests in a global economy: how consumption drives environmental change. *Eurasian Geography and Economics, 55*(1), 37-10. http://dx.doi.org/10.1080/15387216.2014.926254

Niedziałkowski, K., & Shkaruba, A. (in press). Governance and legitimacy of the Forest Stewardship Council certification in the national contexts – A comparative study of Belarus and Poland. *Forest Policy and Economics*.

Olech, W. (2008). *Bison bonasus*. The IUCN Red List of Threatened Species. Retrieved December 18, 2016, from http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T2814A9484719.en

OPERAs. (2017). *Ecosystem science for policy and practice*. Retrieved December 6, 2017, from http://operas-project.eu

OpenNESS. (2017). *Operationalisation of Natural Capital and Ecosystem Services*. Retrieved December 6, 2017, from http://www.openness-project.eu

Oren, A. (2006). Life at high salt concentrations. In E. Rosenberg, E. F. DeLong, S. Lory, E. Stackebrandt, & F. Thompson (Eds.), *The Prokaryotes* (pp. 421–440). New York, USA: Springer.

Orlov, A.A., Chechevishnikov, A.L., Chernyavskii, S.I., Alekseenkova, E.S., Borishpolets, K.P., Krylov, A. V., Kudeneeva, Yu. S., Mizin, V. I., Nikitin, A. I., Fedorchenko, A. V. [Орлов А. А., Чечевичников А. Л., Чернявский С. И., Алексеенкова Е. С., Боришполец К. П., Крылов А. В., Куденеева Ю. С., Мизин, В. И., Никитин, А. И., & Федорченко, А. В.]. (2011). Проблема пресной воды. Глобальный контекст политики России *[Problem of fresh water. Global context of Russian politics]*. Moscow, Russian Federation: МГИМО-Университет [MGIMO-University].

Örmeci, C., & Ekercin, S. (2005). Water quality monitoring using satellite image data: A case study around the Salt Lake in Turkey. In *Proc. SPIE 5977, Remote Sensing of the Ocean, Sea Ice, and Large Water Regions 2005, 59770K (October 20, 2005)*. http://doi.org/10.1117/12.628558

OSPAR. (2017). Retrieved from https://www.ospar.org

Otto, I. M., Shkaruba, A., & Kireyeu, V. (2011). The rise of multilevel governance for biodiversity conservation in Belarus. *Environment and Planning C: Government and Policy*, *29*(1), 113–132. http://doi.org/10.1068/c09196

Pascual, U., Balvanera, P., Diaz, S., Pataki, G., Roth, E., Stenseke, M., Watson, R. T., Başak Dessane, E., Islar, M., Kelemen, E., Maris, V., Quaas, M., Subramanian, S. M., Wittmer, H., Adlan, A., Ahn, S. Al-Hafedh, Y. S., Amankwah, E., Asah, S. T., Berry, P., Bilgin, A., Breslow, S. J. Bullock, C., Cáceres, D., Daly-Hassen, H., Figueroa, E., Golden, C. D., Gómez-Baggethun, E., González-Jiménez, D., Houdet, J., Keune, H., Kumar, R., Ma, K., May, P. H., Mead, A., O'Farrell, P., Pandit, R., Pengue, W., Pichis-Madruga, R., Popa, F., Preston, S., Pacheco-Balanza, D., Saarikoski, H., Strassburg, B. B., van den Belt, M., Verma, M., Wickson, F., & Yagi, N. (2017). Valuing nature's contributions to people: The IPBES approach. *Current Opinion in Environmental Sustainability, 26*, 7–16. http://doi.org/10.1016/j.cosust.2016.12.006

Pearson, R. G. (2016). Reasons to Conserve Nature. *Trends in Ecology and Evolution*, *31*(5), 366–371. http://doi.org/10.1016/j.tree.2016.02.005

Peel, M. C., Finlayson, B. L., & McMahon, T. A. (2007). Updated world map of the Köppen-Geiger climate classification. *Hydrology and Earth System Sciences Discussions, 11,* 1633-1644. http://doi.org/10.5194/hessd-4-439-2007

Philippart, C. J. M., Anadón, R., Danovaro, R., Dippner, J. W., Drinkwater, K. F., Hawkins, S. J., Oguz, T., O'Sullivan, G., & Reid, P. C. (2011). Impacts of climate change on European marine ecosystems: Observations, expectations and indicators. *Journal of Experimental Marine Biology and Ecology*, *400*, 52–69. http://doi.org/10.1016/j.jembe.2011.02.023

Pimentel, D. (2006). Soil erosion: A food and environmental threat. *Environment, Development and Sustainability*, *8*(1), 119–137. http://doi.org/10.1007/s10668-005-1262-8

Plieninger, T., van der Horst, D., Schleyer, C., & Bieling, C. (2014). Sustaining ecosystem services in cultural landscapes. *Ecology and Society*, *19*(2), 59. http://doi.org/10.5751/ES-06159-190259

Prather, C. M., Pelini, S. L., Laws, A., Rivest, E., Woltz, M., Bloch, C. P., Del Toro, I., Ho, C.-H., Kominoski, J., Newbold, T. A. S., Parsons, S., & Joern, A. (2013). Invertebrates, ecosystem services and climate change. *Biological Reviews*, *88*(2), 327–348. http://doi.org/10.1111/brv.12002

Prestele, R., Alexander, P., Rounsevell, M., Arneth, A., Calvin, K., Doelman, J., Eitelberg, D. A., Engstrom, K., Fujimori, S., Hasegawa, T., Havlik, P., Humpenoder, F., Jain, A. K., Krisztin, T., Kyle, P., Meiyappan, P., Popp, A., Sands, R. D., Schaldach, R., Schungel, J., Stehfest, E., Tabeau, A., Van Meijl, H., Van Vliet, J., & Verburg, P. H. (2016). Hotspots of uncertainty in land use and land cover change projections: a global scale model comparison. *Global Change Biology*, *22*(12), 3967-3983. http://doi.org/10.1111/gcb.13337

Raudsepp-Hearne, C., & Peterson, G. D. (2016). Scale and ecosystem services: how do observation, management, and analysis shift with scale — lessons from Québec. *Ecology and Society, 21*(3), 16. http://doi.org/10.5751/ES-08605-210316

Reyers, B., Biggs, R., Cumming, G. S., Elmqvist, T., Hejnowicz, A. P., & Polasky, S. (2013). Getting the measure of ecosystem services: a social-ecological approach. *Frontiers in Ecology and the Environment, 11*(5), 268-273. http://doi.org/10.1890/120144

Richardson, T. (2015). On the limits of liberalism in participatory environmental governance: Conflict and conservation in Ukraine's Danube Delta. *Development and Change 46*(3), 415-441. http://doi.org/10.1111/dech.12156

Roué, M., & Molnár, Z. (Eds.). (2017). *Knowing our lands and resources: Indigenous and local knowledge of biodiversity and ecosystem services in Europe and Central Asia*. Paris, France: UNESCO.

Rounsevell, M. D. A., & Metzger, M. J. (2010). Developing qualitative scenario storylines for environmental change assessment. *Wiley Interdisciplinary Reviews: Climate Change*, *1*(4). 606-619. http://doi.org/10.1002/wcc.63

Schwartz, M. W., Brigham, C. A., Hoeksema, J. D., Lyons, K. G., Mills, M. H., & Van Mantgem, P. J. (2000). Linking biodiversity to ecosystem function: implications for conservation ecology. *Oecologia*, *122*(3), 297–305. http://doi.org/10.1007/s004420050035

SEDAC. (2017). Retrieved December 6, 2017, from http://sedac.ciesin.columbia.edu

Selomane, O., Reyers, B., Biggs, R., Tallis, H., & Polasky, S. (2015). Towards integrated social-ecological sustainability indicators: Exploring the contribution and gaps in existing global data. *Ecological Economics*, *118*, 140–146. http://doi.org/10.1016/j.ecolecon.2015.07.024

Seppelt, R., Fath, B., Burkhard, B., Fisher, J. L., Grêt-Regamey, A., Lautenbach, S., Pert, P. Hotes., S., Spangenberg, J., Verburg, P. H., & Van Oudenhoven, A. P. E. (2012). Form follows function? Proposing a blueprint for ecosystem service assessments based on reviews and case studies. *Ecological Indicators*, *21*, 145–154. http://doi.org/10.1016/j.ecolind.2011.09.003

Shukurov, E. Dj. [Шукуров, Э. Дж.]. (2016). Зоогеография Кыргызстана *[Zoogeography of Kyrgyzstan]*. Bishkek, Kyrgyzstan: БИОМ [BIOM]. Retrieved from https://s3.eu-central-1.amazonaws.com/biom/work/pub/zoogeo.pdf

Shukurov E.Dj., Mitropolsky O.V., Talskykh V.N., Zhodubaeva L.Y., & Shevchenko V.V. [Шукуров, Э. Дж., Митропольский, О. В., Тальских, В. Н., Жолдубаева, Л. Ы., & Шевченко, В. В.]. (2005). Атлас биологического разнообразия Западного-Тянь-Шаня *[Atlas of biological diversity of western Tien Shan]*. Retrieved from https://s3.eu-central-1.amazonaws.com/biom/lib/book/atlas_biodiv_west_tian_shan.pdf

Sillitoe, P. (2006). Knowing the land: soil and land resource evaluation and indigenous knowledge. *Soil Use and Management*, *14*(4), 188–193. http://doi.org/10.1111/j.1475-2743.1998.tb00148.x

Smale, D. A., Burrows, M. T., Moore, P., O'Connor, N., & Hawkins, S. J. (2013). Threats and knowledge gaps for ecosystem services provided by kelp forests: A northeast Atlantic perspective. *Ecology and Evolution*, *3*(11), 4016–4038. http://doi.org/10.1002/ece3.774

Sokolov, V. E. [Соколов, В. Е.]. (1986). Редкие и исчезающие животные. Млекопитающие *[Rare and endangered animals. Mammals]*. Moscow, Russian Federation: Высшая школа [Higher School].

Sokolov, V. E., & Syroyechkovskiy, E. E. [Соколов, В. Е., & Сыроечковский, Е. Е.] (Eds.). (1990). Заповедники СССР. Заповедники Средней Азии и Казахстана *[Nature Reserves of USSR. Nature Reserves of Middle Asia and Kazakhstan]*. Moscow, USSR: Мысль [Mysl'].

Spalding, M. D., Fox, H. E., Allen, G. R., Davidson, N., Ferdaña, Z. a., Finlayson, M., Halpern, B. S., Jorge, M. A., Lombana, A., Lourie, S. A., Martin, K. D., McManus, E., Molnar, J., Cheri A. Recchia, C. A., & Robertson, J. (2007). Marine ecoregions of the world: A bioregionalization of coastal and shelf areas. *BioScience*, *57*(7), 573-583. http://doi.org/10.1641/B570707

Stenger-Kovács, C., Lengyel, E., Buczkó, K., Tóth, F., Crossetti, L., Pellinger, A., Doma, Z. Z., & Padisák, J. (2014). Vanishing world: alkaline, saline lakes in Central Europe and their diatom assemblages. *Inland Waters*, (4(4)), 383–396. http://doi.org/10.5268/IW-4.4.722

Stephens, P. A., Pettorelli, N., Barlow, J., Whittingham, M. J., & Cadotte, M. W. (2015). Management by proxy? The use of indices in applied ecology. *Journal of Applied Ecology*, *52*(1), 1–6. http://doi.org/10.1111/1365-2664.12383

TEEB. (2010a). *Mainstreaming the economics of nature: A synthesis of the approach, conclusions and recommendations of TEEB*. Retrieved from http://www.teebweb.org

TEEB. (2010b). *TEEB for business - Executive summary*. Retrieved from http://www.teebweb.org

The World Bank Group. (2016). *Terrestrial protected areas (% of total land area).* Retrieved May 12, 2016, from http://data.worldbank.org/indicator/ER.LND.PTLD.ZS/countries/1W?display=default

Tittensor, D. P., Walpole, M., Hill, S. L. L., Boyce, D. G., Britten, G. L., Burgess, N. D., Butchart, S. H. M., Leadley, P. W ., Regan, E. C., Alkemade, R., Baumung, R., Bellard, C., Bouwman, L., Bowles-Newark, N. J., Chenery, A. M., Cheung, W. W. L., Christensen, V., Cooper, H. D., Crowther, A. R., Dixon, M. J. R., Galli, A., Gaveau, V., Gregory, R. D., Gutierrez, N. L., Nicolas G. L., Hirsch, T. L., Hoft, R., Januchowski-Hartley, S. R., Karmann, M., Krug, C. B., Leverington, F. J., Loh, J., Lojenga, R. K., Malsch, K., Marques, A., Morgan, D. H. W., Mumby, P. J., Newbold, T., Noonan-Mooney, K., Pagad, S. N., Parks, B. C., Pereira, H. M., Robertson, T., Rondinini, C., Santini, L., Scharlemann, J. P. W., Schindler, S., Sumaila, U. R., Teh, L. S. L., van Kolck, J., Visconti, P., & Ye, Y. (2014). A mid-term analysis of progress toward international biodiversity targets. *Science*, *346*(6206), 241–244.

Tracy, E. F., Shvarts, E., Simonov, E., & Babenko, M. (2017). China's new Eurasian ambitions: The environmental risks of the Silk Road Economic Belt. *Eurasian Geography and Economics*, *58,* 56–88. http://doi.org/10.1080/15387216.2017.1295876

UK NEA. (2011). *The UK National Ecosystem Assessment: Synthesis of the key findings*. Cambridge, UK: UNEP-WCMC.

UNEP. (2012). *GEO-5 - Environment for the future we want*. Retrieved from http://web.unep.org/geo/

United Nations. (2006). *E/C.16/2006/4: Definition of basic concepts and terminologies in governance and public administration.*

United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*.

Uuemaa, E., Mander, Ü., & Marja, R. (2013). Trends in the use of landscape spatial metrics as landscape indicators: A review. *Ecological Indicators*, *28*, 100–106. http://doi.org/10.1016/j.ecolind.2012.07.018

van Asselen, S., & Verburg, P. H. (2012). A land system representation for global assessments and land-use modeling. *Global Change Biology*, *18*(10), 3125–3148. http://doi.org/10.1111/j.1365-2486.2012.02759.x

van Vuuren, D. P., Kok, M. T. J., Girod, B., Lucas, P. L., & de Vries, B. (2012). Scenarios in global environmental assessments: Key characteristics and lessons for future use. *Global Environmental Change*, *22*(4), 884–895. http://doi.org/10.1016/j.gloenvcha.2012.06.001

Venter, O., Sanderson, E. W., Magrach, A., Allan, J. R., Beher, J., Jones, K. R., Possingham, H. P., Laurance, W. F., Wood, P., Fekete, B. M., Levy, M. A., & Watson, J. E. M. (2016). Global terrestrial human footprint maps for 1993 and 2009. *Scientific Data*, *3*, 160067. http://doi.org/10.1038/sdata.2016.67

Ventosa, A., & Arahal, D. R. (2009). Physico-chemical characteristics of hypersaline environments and their biodiversity. In C. Gerday (Ed.), *Extremophiles* (pp. 247–262). Oxford, UK: EOLSS Publications.

Wassmann, P., & Reigstad, M. (2011). Future Arctic Ocean seasonal ice zones and implications for pelagic-bethic coupling. *Oceanography*, *24*(3), 220–231. http://doi.org/10.5670/oceanog.2011.74

Williams, W. D. (1981). Inland salt lakes: An introduction. In W. D. Williams (Ed.), *Salt lakes. Developments in hydrobiology, vol 5* (pp. 1–14). Dordrecht, The Netherlands: Springer. https://doi.org/10.1007/978-94-009-8665-7_1

Wilson, J. B., Peet, R. K., Dengler, J., & Pärtel, M. (2012). Plant species richness: the world records. *Journal of Vegetation Science*, *23*(4), 796–802. http://doi.org/10.1111/j.1654-1103.2012.01400.x

Worm, B., Barbier, E. B., Beaumont, N., Duffy, J. E., Folke, C., Halpern, B. S., Jackson, J. B. C., Lotze, H. K., Micheli, F., Palumbi, S. R., Sala, E., Selkoe, K. A., Stachowicz, J. J., & Watson, R. (2006). Impacts of biodiversity loss on ocean ecosystem services. *Science*, *314*(5800), 787–90. http://doi.org/10.1126/science.1132294

Yablokov, A. V., Belkovich, V. M., & Borisov, V. I. [Яблоков, А. В., Белькович, В. М., & Борисов, В. И.]. (1972). Киты и дельфины *[Whales and dolphins]*. Moscow, Russian Federation: Наука [Science].

Zektser, I. S. (2000). *Groundwater and the environment: Applications for the global community*. Boca Raton, USA: CRC Press.

Zoi International Network. (2011). *Biodiversity in Central Asia: A visual synthesis.*