



ASSESSMENT OF THE STATE OF
NATURE AND GOVERNANCE OF
NATURAL RESOURCES IN
BOSNIA AND HERZEGOVINA

► **SUMMARY FOR POLICYMAKERS**

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ASSESSMENT OF THE STATE OF NATURE AND GOVERNANCE OF NATURAL RESOURCES IN BOSNIA AND HERZEGOVINA SUMMARY FOR POLICYMAKERS

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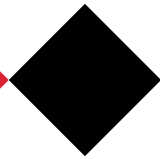
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LIST OF ABBREVIATIONS



Abbreviation	Full title
BD BiH	Brčko District of Bosnia and Herzegovina
BiH	Bosnia and Herzegovina
EC	European Commission
ESAP	Environmental Strategy and Action Plan
EU	European Union
FBiH	Federation of Bosnia and Herzegovina
FHMZ	FBiH Hydrometeorological Institute
IKI	International Climate Initiative (IKI) of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety, and Consumer Protection of the Federal Republic of Germany
ILK	Indigenous and Local Knowledge
IPBES	The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	International Union for Conservation of Nature and Natural Resources
NCP	Nature's Contributions to People
MAT	Multidisciplinary Team of Authors
NBSAP	National Biodiversity Strategies and Action Plan
NTFP	Non-Timber Forest Products
RS	Republika Srpska
SDGs	Sustainable Development Goals
UNBiH	United Nations Bosnia and Herzegovina
UNEP- WCMC	UN Environment Programme World Conservation Monitoring Centre
WB	Water Body



PREFACE

The nature of Bosnia and Herzegovina (BiH) has always contributed to a good quality of life for people living in the territory of BiH. However, current global and local pressures have been increasingly adversely affecting the state of nature in BiH, and which in turn is impacting people's quality of life.

The purpose of the *Summary for Policy Makers (SPM)* document is to provide answers to key questions and convey key messages identified during the implementation of the *Assessment of the state of nature and governance of natural resources in Bosnia and Herzegovina*. This is an analysis of the available scientific, technical, and traditional knowledge on the state of biological diversity, different types of nature's contributions to people (NCPs), trends in direct and indirect drivers, as well as scenarios and options for the sustainable management of nature in BiH.

The *Assessment of the State of Nature and governance of Natural Resources* is a publicly available document; a scientific monograph consisting of six chapters that tackle the above outlined aspects of nature in Bosnia and Herzegovina.

The work to develop the Assessment began in 2019, after an Agreement was signed between the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) based in Cambridge, United Kingdom of Great Britain and Northern Ireland) and the University of Sarajevo, with funding provided by the International Climate Initiative (IKI) of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety, and Consumer Protection of the Federal Republic of Germany. The *Assessment* was put together by the Multidisciplinary Team of over 100 contributors from different public universities in Bosnia and Herzegovina, with expertise and scientific support provided by the Project Team and advice provided by the members of the Project Board, consisting of representatives from the institutions responsible for the governance of nature policies in BiH (Annex 1).

The *Assessment of the state of nature and governance of natural resources in Bosnia and Herzegovina* was developed in line with the IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) methodology for undertaking assessments. BiH has been a member of IPBES since its establishment in 2012. The IPBES Conceptual Framework (Annex 2) reviews the relationships

between nature and people on different spatial scales in the past, current and future. UNEP-WCMC through its National Ecosystem Assessment (NEA) Initiative provided overall guidance, technical and capacity building support throughout the assessment process. Also, under the umbrella of Biodiversity and Ecosystem Services Network (BES-Net), the UN Educational, Scientific and Cultural Organization (UNESCO) provided guidance and technical support on mainstreaming traditional and local knowledge in the assessment, while UN Development Programme (UNDP) provided guidance on stakeholder engagement.

The *Summary for Policy Makers* is a complex synthesised document that provides comprehensive analysis of multidisciplinary knowledge on the aforementioned aspects of nature in BiH, collected and synthesised across four years by Multidisciplinary Team of contributors.

In the first part, the *Summary for Policy Makers* provides answers to five key questions set forth in the initial conceptual document from 2019 (www.procjenaprirode.ba).

In the second part, *Summary for Policy Makers* communicates key messages derived from the analysed knowledge.

In the third part, *Summary for Policy Makers* outlines executive summaries of individual chapters of the *Assessment*, together with the confidence and consistency level for the scientific and technical knowledge (Annex 3) and information on the chapter and section number where the given subject was described in detail.

The guiding ideas behind the *Assessment of the state of nature and governance of natural resources in Bosnia and Herzegovina*, and *Summary for Policy Makers*, are to support the conservation and sustainable use of natural resources and diversity of the ecosystems, species and genes in Bosnia and Herzegovina (Annex 4).

Through the *Assessment of the state of nature and governance of natural resources in Bosnia and Herzegovina* and *Summary for Policy Makers*, contributors from the Multidisciplinary Team have initiated the establishment of a continuous science-policy interface for the purpose of sustainable nature management in Bosnia and Herzegovina.

INTRODUCTION

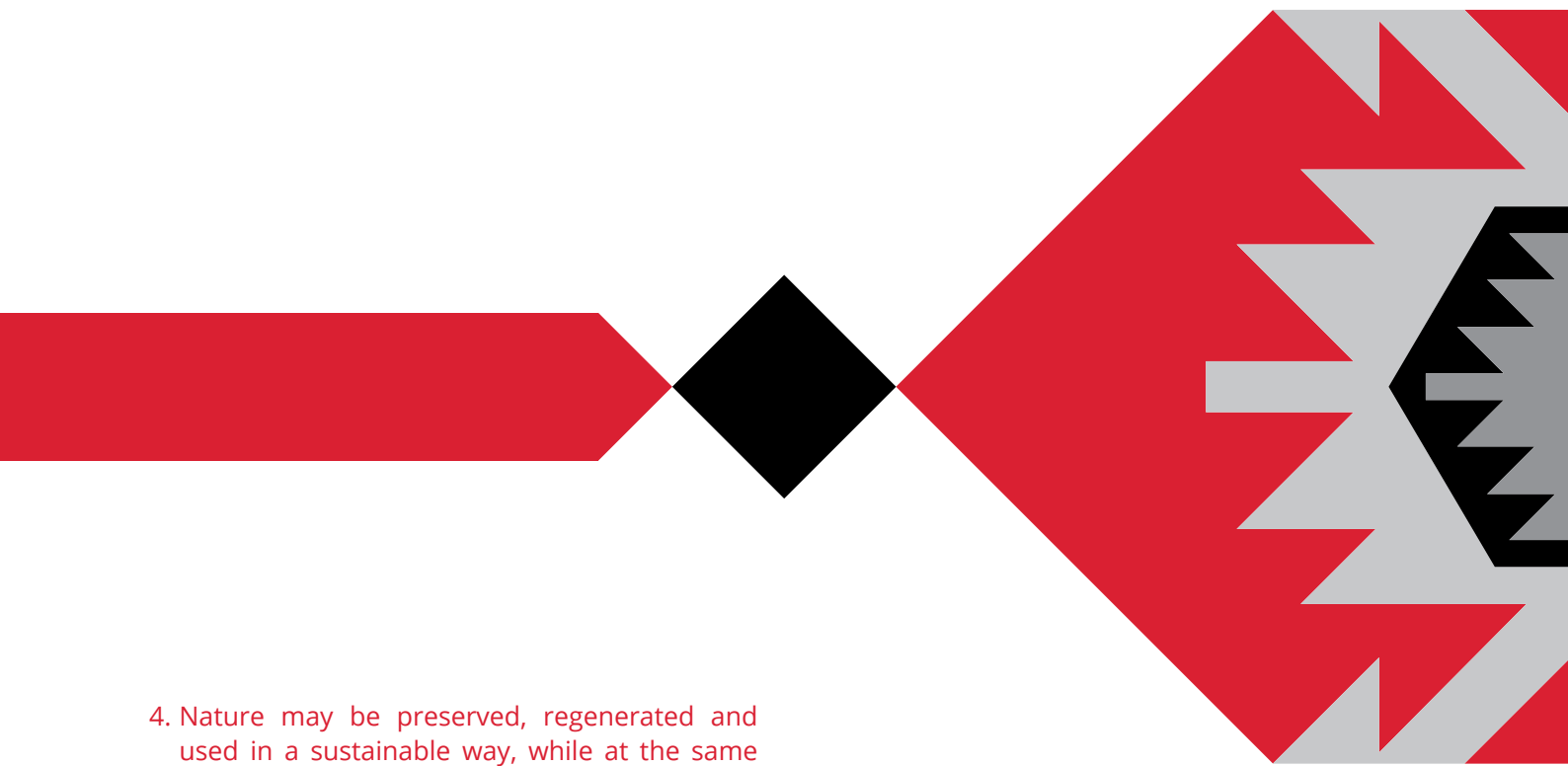
This *Assessment* is based on the principles and methods identified in the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), an international body that Bosnia and Herzegovina has been a member of since 2012. The IPBES member states recognised the links between people's quality of life and nature's contributions to people and expressed the need for current and robust knowledge on the nature's value for human wellbeing.

Nature and its contributions to people have fundamental significance for current and future human populations and future human development. The abundance of biological diversity and continuous provision of ecosystem functions and quality ecosystem services represent the basis for economic development and are a precondition for people's quality of life worldwide. On the other hand, population growth, air, water and land pollution, expansion of invasive species and ever increasing use of resources has resulted in loss of natural habitats, loss of biodiversity and the occurrence of climate change. It is evident that these changes in nature have an impact on the quality of human life. Contrary to this, nature conservation and biological diversity contribute to sustainable development and reduction of poverty, climate regulation, reduction of greenhouse gases effect, and maintenance of air, water and food quality. With the aim of compiling all available data and knowledge on the state of biological diversity for the

purpose of informing decisions on sustainable use of natural resources, the IPBES seeks to establish and strengthen the science-policy interface for biodiversity and ecosystem services.

Over the past 50 years, 60% of ecosystems worldwide have suffered degradation and often overexploitation, and drivers affecting nature have increased despite the growing number of initiatives tackling the loss of biodiversity (Leadley et al., 2013; MEA, 2005). According to numerous earlier assessments, the state of nature (biodiversity and ecosystems) has been worsening globally, as noted in the IPBES Global Assessment Report on Biodiversity and Ecosystem Services (IPBES, 2019). The 2019 Global Assessment Report provides four key recommendations:

1. Nature and its vital contributions to people, which together represent biodiversity and ecosystem services, have been deteriorating around the world.
2. Direct and indirect drivers of change have intensified over the course of the last 50 years.
3. Goals related to conservation and sustainable use of nature and achievement of sustainability cannot be achieved with the current trends, while objectives for 2030 can still be achieved only through transformative changes in economic, social, political and technological factors.



4. Nature may be preserved, regenerated and used in a sustainable way, while at the same time other global social objectives are achieved through urgent and harmonised efforts that encourage transformative changes.

In addition to the assessment, with engagement from numerous scientists and knowledge holders worldwide, the following biodiversity and ecosystem service-related issues have been addressed in IPBES reports over the past ten years: Assessment Report on Land Degradation and Restoration (IPBES, 2018a), Assessment Report on Pollinators, Pollination and Food Production (IPBES, 2016), Assessment Report on the Sustainable Use of Wild Species (IPBES, 2022a), Methodological Assessment Report on the Diverse Values and Valuation of Nature (IPBES, 2022b), Thematic Assessment Report on Invasive Alien Species and their Control (IPBES, 2023), and other thematic and regional assessments of biodiversity and ecosystem services.

In line with global and regional assessments, such as IPBES (Ibid) and millennium ecosystem assessment (MA, 2005), the Assessment of the state of nature and governance of natural resources in BiH represents a critical assessment of the available knowledge on the state of nature, based on which decisions on complex public issues that are significant for both nature and society would be made. Firstly, the purpose of this Assessment is to identify the state and trends of biological diversity and ecosystem services, cause and effect linkages between the drivers and trends, and their impacts on people's

quality of life. The Assessment analyses the state of knowledge on past, current and future interactions among the people and nature in BiH, including identification of potential important milestones, feedback and elements of sustainability, in terms of these interactions. The objective is to provide policymakers with evidence arguments, informed by scientific, traditional and local knowledge systems for decision-making that would lead to sustainable use of natural resources, as well as provide clear guidance to the science and practice communities and support for implementation of politically and socially relevant research in future.

Strategic objectives for the conservation of biological diversity can help to identify actions directed at stopping the loss of biodiversity at the global level. Implementation of these objectives relies on having a solid knowledge base and stronger interaction between the scientific and practice communities and policymakers. Unfortunately, such interaction is still insufficient, both globally and at the level of BiH. In that regard, the Assessment of the state of nature and governance of natural resources in BiH should also be understood as an opportunity to:

- strengthen capacities for improvement of the science-policy-practice interface,



- identify gaps in current knowledge and generate new knowledge related to nature and natural resources,
- foster the recognition and integration of traditional and local knowledge in biodiversity policies and actions.
- develop and use instruments, tools and methodologies to support decision-making processes through application of the results of the Assessment in the sectoral policies

Additional benefits of the *Assessment* include identifying current knowledge and capacity gaps among the science, policy, and practice communities, as well as analysing options for overcoming these knowledge and capacity gaps at the relevant levels. In addition, the *Assessment* provides useful information to all interested and concerned parties from public and private sector, as well as the civil society, including local and rural communities.

Significant added value of the *Assessment* is that the adoption and domestication of the IPBES assessment methodology that was applied to assess biodiversity, ecosystem services and nature's contributions to people in BiH, based on the IPBES Conceptual Framework (Díaz et al., 2015; Annex 2) which facilitates an integrated view of the science-policy-society interface. The Conceptual Framework was created to provide an assessment structure comparable to other assessments implemented by IPBES on different spatial scales, different topics and in different regions. Implementation of the Conceptual Framework requires interdisciplinary cooperation, a shared working understanding across different disciplines, knowledge systems and stakeholders, and supports consistent use of terminology used in IPBES assessments. In addition, the Framework recognizes and considers diverse knowledge systems, including traditional and local knowledge, which can be complementary to the scientific (empirical) knowledge leading to a more robust assessment informed by all available data, information, and knowledge.

The basic starting points for the *Assessment* are as follows: the nature of Bosnia and Herzegovina is characterised by a high level of diversity, the state

of nature in BiH depends on the intensity of direct drivers (degradation of habitats, excessive use, pollution, climate change, invasive alien species) and indirect drivers (anthropogenic activities and other activities resulting in direct drivers on nature), and future state of nature in BiH depends on the balanced management of material, non-material and regulatory NCPs.

The *Assessment* seeks to provide answers to the following questions:

- A. To what extent and in which ways do nature and the use of natural resources contribute to:
1. Provision of livelihoods, 2. Quality of life and 3. Sustainable development in BiH?
- B. What are the status, trends and future scenarios for the state of nature and use of natural resources in BiH?
- C. Which developmental (manufacturing and consumption of goods, energy needs, tourism, etc.) and social drivers (demographic developments, socio-political processes, etc.), and in which ways, directly or indirectly, do these drivers contribute to the state and trends of nature and natural resources in BiH?
- D. What are the current and potential options for improvement of different sectoral policies, interventions, investments and governance and institutional arrangements for greater contribution of nature and natural resources to sustainable development in BiH?
- E. Which gaps in terms of practice and knowledge need to be addressed to strengthen policymaking for the purpose of improving the state of nature and governance of natural resources in BiH?

After the scoping period, during the implementation of the NEA process a sixth key question was defined as follows:

- F. Is the methodological framework for assessing the state of nature and governance of natural resources in Bosnia and Herzegovina effective?

Over 100 contributors participated in preparation of this document (Annex 1) with a wide spectrum

of knowledge, expertise, and skills from different scientific and research fields (natural and social sciences, and technical and multidisciplinary groups). Following the IPBES assessment methodology, the assessment's experts synthesised and analysed the available knowledge and data, developed key messages and identified knowledge gaps in the available knowledge base. The Assessment is comprised of scientific and other relevant knowledge and data and covers a period spanning the last 50 years, focusing in particular on knowledge acquired since the year 2000 in the geographical area of Bosnia and Herzegovina. The Assessment evaluates the basic causes and effects of changes to BiH's ecosystems in the past, present and future for the purpose of supporting the sustainable management of natural resources and good quality of life.

The Assessment of the state of nature and governance of natural resources in BiH can yield multiple economic, ecological, social, and cultural benefits for the population of BiH. By mobilising current knowledge about the state of biological diversity and ecosystem services in BiH, and by enhancing the country's science-policy-practice interface and

mechanisms for participatory and evidence-based decision making, it is anticipated that solutions for sustainably managing BiH's natural resources will be more readily identifiable for decision-makers and compatible with livelihoods and lifestyles of nature-dependent local communities. Such an approach would result in multiple benefits for BiH's population, such as: conservation of nature and natural resources, improvement of general quality of life, assurance of good water supply, mitigation and reduction of natural disaster risk, creation of new green economy jobs, and management of migration flows from rural areas to urban areas, among others. Contributions to protection of biological diversity and ecosystem services in BiH, as well as contributions to global and European biocultural heritage are also significant.

Here we present key messages for policy makers that respond to pre-defined policy questions. Detailed explanation, evidence and positions presented in the *Summary for Policy Makers* (SPM) can be found (by reference to chapter and section number) in the full Assessment document.

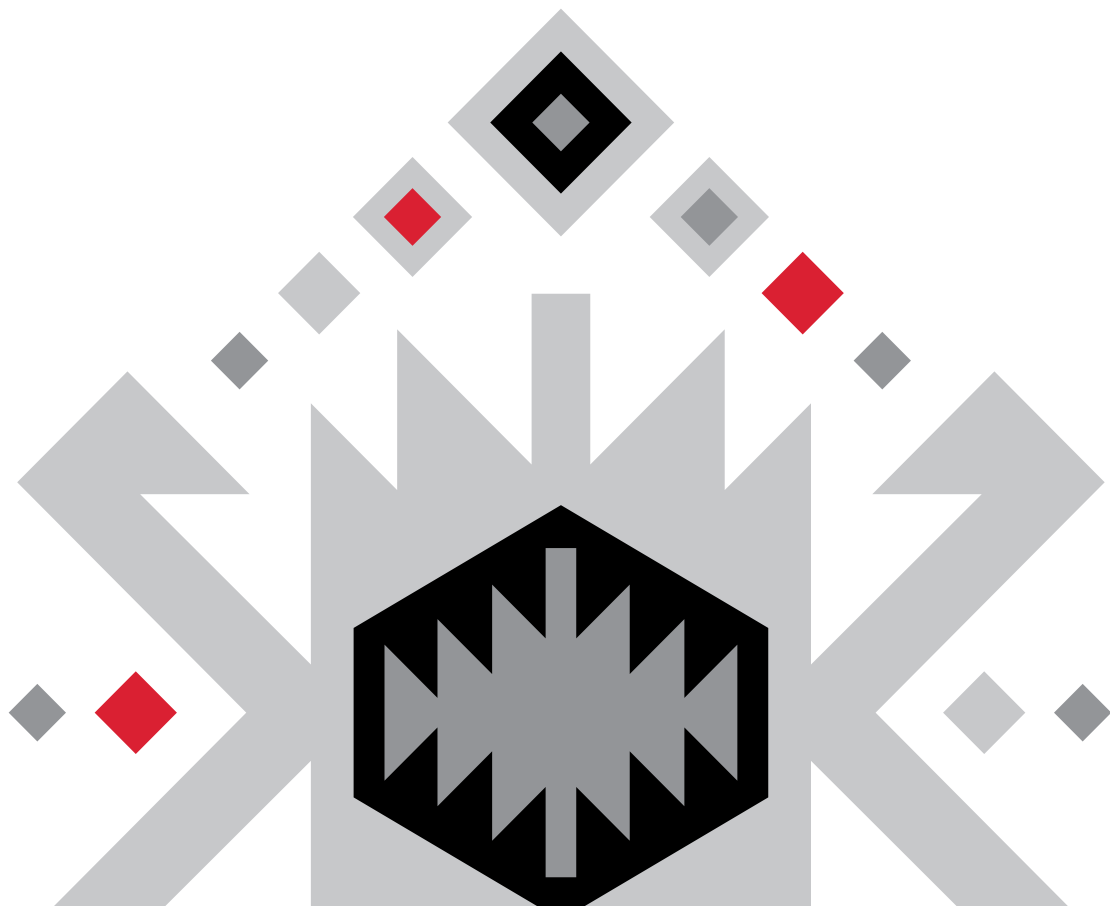


Image 1.

Mountain Prenj
(Photo credits:
Macanović)



**ANSWERS TO KEY
QUESTIONS AND KEY
FINDINGS OF THE
ASSESSMENT OF THE
STATE OF NATURE
AND GOVERNANCE OF
NATURAL RESOURCES
IN BOSNIA AND
HERZEGOVINA**

A|?

To what extent and in which ways do nature and the use of natural resources contribute to: 1. Provision of livelihoods, 2. Quality of life and 3. Sustainable development in BiH?

A. Biological diversity and natural resources in Bosnia and Herzegovina support good living conditions, improvement of the quality of life and sustainable development for people, providing numerous and diverse regulating, material and non-material NCPs.

A.1. Diversity of ecosystems, species and genes in Bosnia and Herzegovina continuously regulates ecological processes, provides people with food and materials, and supports the quality of life through material and non-material contributions (Annex 5). To examine how nature contributes to people’s quality of life, IPBES uses the concept of ‘Nature’s Contributions to People’ (NCP). The NCP framework enables a thorough and pluralistic analysis of the connections between the status and trends in nature and people’s livelihoods, wellbeing and quality of life.. The NCP concept builds on the ‘ecosystem services’ framing, but takes a broader and more encompassing approach to better capture the values that people associate with nature and to

enable analysis of the unidirectional and bidirectional relationships between nature and people. Research on NCP is still in its initial phase, both in Bosnia and Herzegovina and globally, since this is a relatively new concept. In cases where data and relevant research are available, it is possible, based on the expert knowledge, to assess and evaluate NCPs and analyse their connectedness to different forms of human activity (industry, agriculture, environment protection, rural development and similar) (Image 2). The contributions of biological diversity and natural resources to people’s quality of life through provision of material resources is prominent in both rural and urban areas, in particular for industrial development. Regulating and non-material contributions play an important role in improvement day-to-day environmental and health conditions for BiH’s citizens.

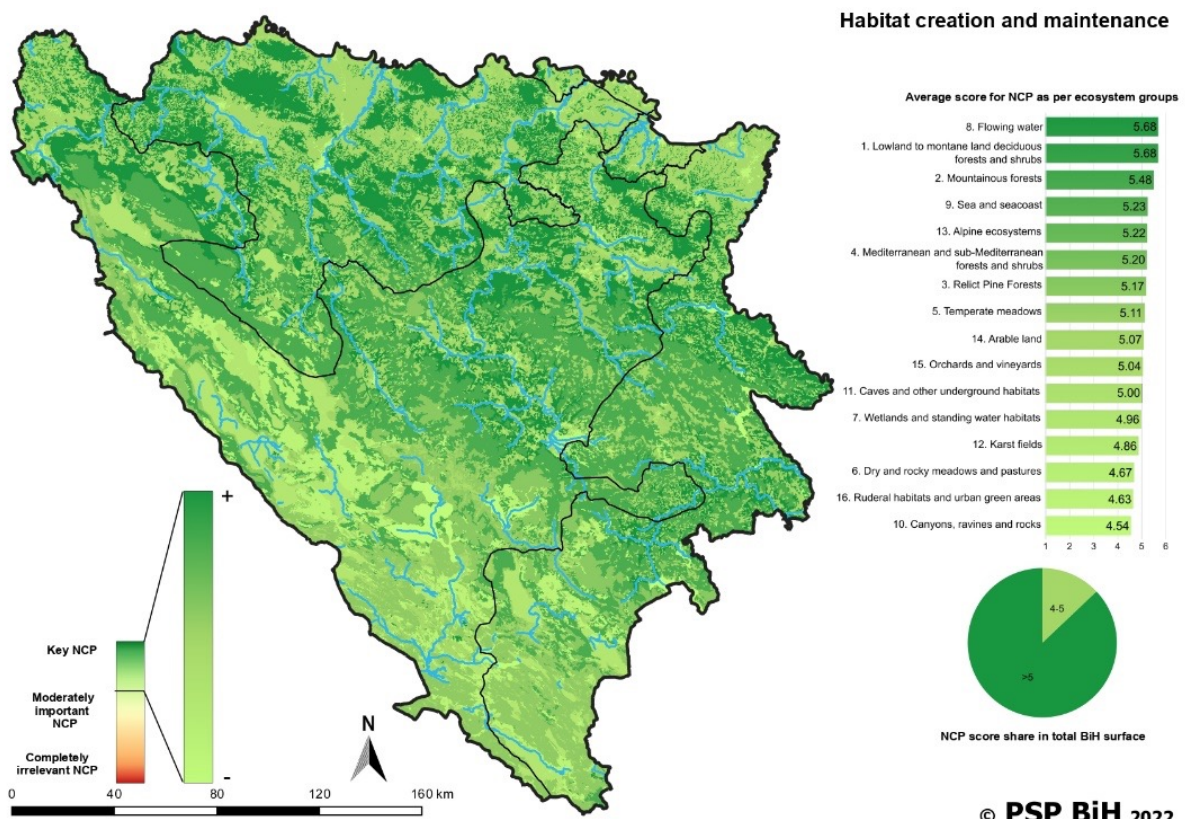


Image 2. Spatial visualisation of the importance of NCPs for habitat creation and maintenance, across the territory of BiH (Bećirović et al., 2023)

A.2. Regulating NCP maintain the stability and quality of environment by supporting adaptation of the entire society and economy of Bosnia and Herzegovina to ecological, economic and energy challenges (Annex 5).

The regulating NCP, as well as material and non-material contributions, are the result of the ecosystem functions and species interactions in the ecosystem. Properly functioning ecosystems generate favourable environmental conditions that improve the quality of life of people. This Assessment identified a significant lack of research that specifically focuses on better understanding how specific types of regulating NCPs support good quality of life in BiH. However, numerous sources prove the role of biodiversity for the creation and maintenance of habitat diversity, conservation of

gene material and support of migration processes. Important contributions include pollination, maintenance of air quality, and maintenance of the quantity and quality of water. Ecosystems are important regulators of land quality and protection, serving as 'green infrastructure' that prevents and mitigates the impact of extreme events and natural disasters (Image 3). Healthy functioning ecosystems have an indispensable role in supporting primary production of organic matter, as well as in its decomposition, carbon storage and regulation of all other environmental processes.

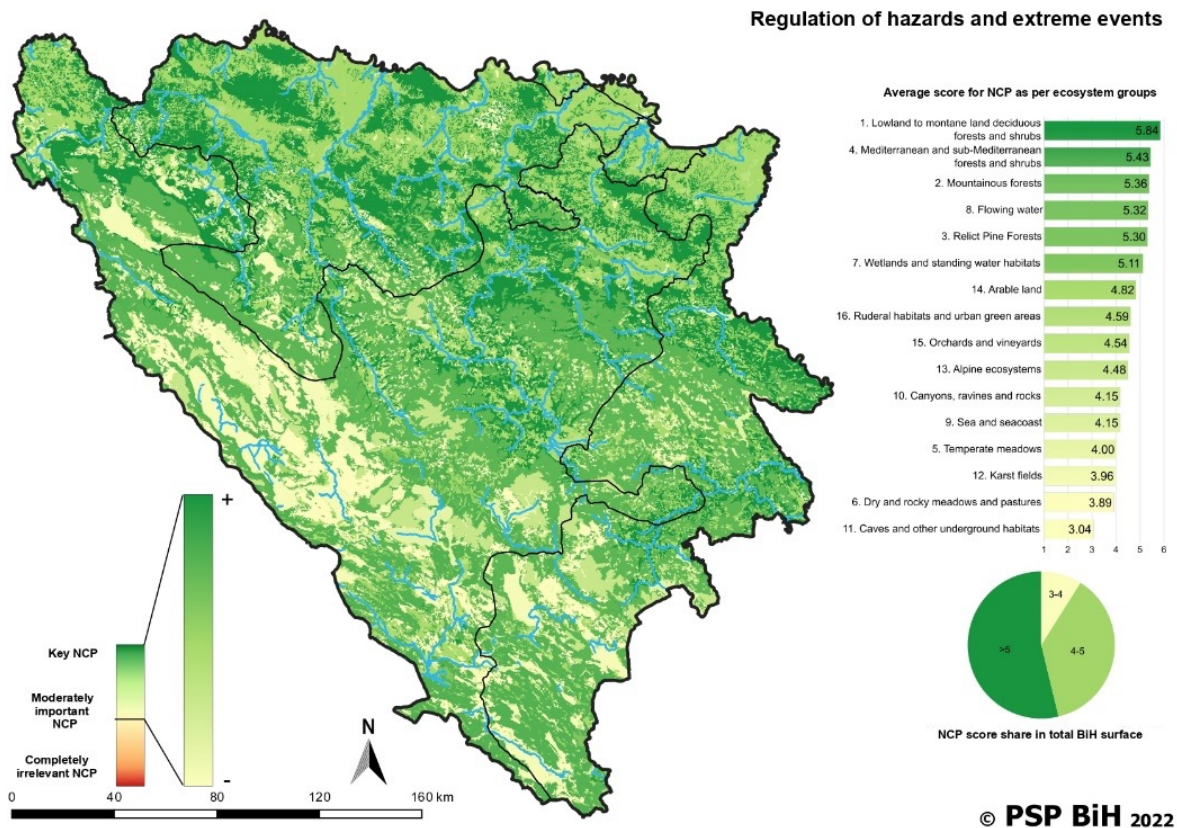


Image 3. Spatial visualisation of the importance of NCPs for supporting regulatory functions against hazards and extreme events, across the territory of BiH (Bećirović et al., 2023)

A.3. The diversity of ecosystems, species and genetics plays a vital role in mitigating climate change and supporting adaptation of Bosnia and Herzegovina to these changes, as well as in supporting other categories of NCPs. However, trends of drivers indicate reduction in diversity, leading to decreasing trend with regards to majority of NCP.

The important role of healthy functioning ecosystems is best understood in the context of adaptation to climate change, which although a global challenge, have already shown significant negative effects in BiH. Ecologically stable and resilient ecosystems positively support the process of adaptation to climate change locally. Current evidence on the state of ecosystems and trends of drivers suggest

a downward trend in the ability of BiH’s ecosystems to support human wellbeing through provision of NCPs (Table 1). National sectors that are vulnerable to climate change (such as) must adapt their operational and governance practices to mitigate the adverse impacts of climate change on BiH’s environment and society.

Table 1. State and trends of NCP in BiH (Bećirović et al., 2023)

	Types of NCP	Principal ecosystem groups for indicated NCP	State of key components	Intensity and trends		State and trends of NCP
				Direct drivers	Indirect drivers	
REGULATING	1 Habitat creation and maintenance	1-16	→	→	→	
	2 Pollination and dispersal of seeds and other propagules	1,4,5,6,12,14,15	→	→	→	
	3 Regulation of air quality	1,2,3,4,12,14,15	↑	→	↘	
	4 Regulation of climate	1,2,3,4,8,9,13,16	↑	→	↘	
	5 Regulation of ocean acidification	8,9	↑	↑	↑	
	6 Regulation of freshwater quantity, location and timing	1,2,4,5,7,8,10,12,13	↑	→	↘	
	7 Regulation of freshwater and coastal water quality	1,2,4,5,7,8,9,10,12	↑	→	↘	
	8 Formation, protection and decontamination of soils and sediments	1,2,3,4,7,12,13,14,15,16	↑	→	↘	
	9 Regulation of hazards and extreme events	1,2,3,4,7,8,14,15,16	↑	→	↘	
	10 Regulation of detrimental organisms and biological processes	2,5,7	→	→	→	
NON-MATERIAL	11 Food and feed	1,5,6,8,9,12,14,15	↑	→	↘	
	12 Energy	1,2,8	↑	↑	↑	
	13 Materials, companionship and labour	2,14,15	→	→	→	
	14 Medicinal, biochemical and genetic resources	3,4,5,6,13,14,15	→	↓	→	
	15 Learning and inspiration	2,8,9,14	↑	↑	↓	
	16 Physical and psychological experiences	1,2,3,8,9,13,14,15,16	↑	→	↘	
	17 Supporting identities	1,4,8,9,14,15,16	↑	→	↘	
	18 Maintenance of options	1-16	→	→	→	

KEY	
State	Poor → Good
Intensity of drivers	High → Low
Trend	↓ negative, ↘ decreasing, → stable, ↗ increasing, ↑ positive

A.4. Diversity of ecosystems, species and genes is a source of different products, materials and raw materials which are used the basis for local development and improvement of the quality of life and contribute to creation of environment for sustainable economic growth. Material NCPs are “products” of ecosystem processes (otherwise referred to as natural resources) that are used in various ways to satisfy people’s daily needs and to build infrastructure. BiH’s material NCPs ensure sufficient quantities of healthy food through activities in agriculture and natural ecosystems from which various edible and medicinal resources are used. Ecosystems play an important role in ensuring energy for people in Bosnia and Herzegovina, which is seen in the traditional use of wood, as well as in the potential for diversification of energy sources through energy produced from agricultural and forest biomass. Material NCPs contribute significantly to BiH’s industrial productivity including products that are distinct and competitive on the international market. BiH’s material NCPs are important for generating economic activity, particularly in rural areas, and form a significant basis for sustainable and socially just growth of BiH’s economy.

A.5. Biological diversity and traditional and local knowledge on the conservation and sustainable use of biodiversity are an integral part of cultural identity of Bosnia and Herzegovina which contribute to the achievement, maintenance and improvement of people’s good health, quality of life, socio-economic development, and cultural preservation through a set of non-material contributions (Annex 5). Non-material NCPs affect the psychological state of individuals and entire communities, as well as their quality of life. Knowledge on biological diversity and natural resources is an important part of the formal education in Bosnia and Herzegovina, and it has become increasingly important to teach and generate knowledge and values on sustainable practices and worldviews that ensure long term conservation of biodiversity and ecosystems. Traditional and local knowledge and practices play an important role in the conservation and sustainable use of biodiversity in BiH. However, as a result of changes in people’s ways of life and abandonment of the rural areas, BiH is experiencing a decline in cultural and traditional relations between people and nature. The abundance and value of traditional and local knowledge has not

received sufficient recognition from the scientific and expert communities in BiH, nor is it given space in the formal education of children, which disrupts the transfer, continuity, and appreciation of this knowledge. BiH has many natural assets and there is much potential for tourism development, but this also requires regulations that support principles of environmental and cultural sustainability and equality alongside economic growth. Awareness across society about the need for conservation of nature is growing in BiH, but nevertheless, challenges for sustainable development persist on account of BiH’s current state as a transitional economy.

A.6. Assessments of the monetary and non-monetary values of biodiversity and natural resources in Bosnia and Herzegovina are a much-needed knowledge base that is currently missing in BiH. Without this information it is not possible to conduct valuation and monitoring of BiH’s natural capital. Economic valuation of biodiversity, through analysis of ecosystem services and nature’s contributions to people, is common practice in developed countries. This process provides information on the social value of individual components and aspects of nature, which can be utilised for economic analysis by a wide spectrum of public and private-sector stakeholders for the purpose of in business and development planning. Economic valuation of nature’s contributions to people should play an important role in governance and regulatory procedures across sectors in BiH, and should be an integral aspect of planning and monitoring for all sectors who use and depend on biological diversity and natural resources. Implementation of the results of economic valuation requires a multidisciplinary approach and possible changes to current processes of decision-making. Integrating nature’s economic values into decision-making would allow the state and value of natural and cultural capital to be properly accounted for and would enable policy outcomes that better support the interests and needs of society.



B|?

What are the status, trends and future scenarios for the state of nature and use of natural resources in BiH?

B. Bosnia and Herzegovina is characterised by a high level of ecosystem, species and genetic diversity, however, current trends point towards a loss of biological diversity that will impede opportunities for sustainable use of natural resources. Current trends could be stopped by integrated governance of biodiversity and NCPs.

B.1. Bosnia and Herzegovina is characterised by a high level of ecosystem, species and genetic diversity, relative to the European average. The geographic position of BiH and its climate characteristics, as well as the diversity of terrain, geological substrate and land, have led to the occurrence of the rich ecosystems in these areas. The vertical and horizontal profiles of Bosnia and Herzegovina display a pattern made up of widespread and specific landscapes. The more widespread landscapes include the Mediterranean, sub-Mediterranean, Mediterranean-montane, mountainous, montane, Peri-pannonian and Pannonian. A group of specific landscapes includes the alpine, relict-refugial, wetland landscapes and the karst fields. BiH's landscape consists of over 250 ecosystems as described in the literature, at the level of plant communities. Forest ecosystems extend from the lowest altitudes to the boundaries of the high forests on the Dinaric Mountains. Habitats comprised of various endemic and rare species are located in the areas ranging from the Pannonian lowland, through montane, mountainous and alpine pastures and meadows, to warm and dry Herzegovinian meadows and karst terrain. The richest areas of endemic and relict flora are located in the canyons and ravines of BiH rivers. BiH's particularly sensitive ecosystems of wetlands and ponds have displayed a trend of decreasing surface size. Diversity of BiH's wetland and pond ecosystems is also high at the species level. The high level of fish diversity is reflected in 118 species and subspecies. Sea ichthyofauna is made of 12 taxa of fish with cartilaginous skeleton and around 210 representatives of fish with bone skeleton. According to older literature sources, there are 23 species of amphibians, 34 species and 37 subspecies of reptiles, 351 species of birds, 91 species of terrestrial mammals, 6,105 terrestrial invertebrates and 127 species of marine invertebrates in BiH.

BiH is characterised by an exceptional floral abundance of vascular plant taxa, and according to the available literature, cormophytes flora is made of 4,403 taxa in the species rank (3,317) and subspecies (1,086). Available literature on moss varieties in BiH document around 560 species of liverworts and mosses. According to the latest available data, there are 648 species of lichens in BiH. From analysis of the available literature, the number of fungi species in BiH exceeds 2,000. Cyanobacteria and algae in BiH amount to 2,373 species (1,859 freshwater and terrestrial and 514 marine species). There is also vast genetic diversity present of local breeds of domestic animals. BiH is the country of origin for two dog breeds: the Bosnian and Herzegovinian - Croatian Shepherd Dog, also called Tornjak, and Bosnian Coarse-Haired Hound- Barak. There are also breeds of BiH mountain horse and two native breeds of cattle (Busha and Gatačko Cattle). Numerous native plant species are also grown in BiH and used for food.

B.2 Growing trends in all types of direct and indirect drivers will continue to have a negative impact on the state and capacity of biological diversity to provide regulating, material and non-material contributions. The need for development combined with the country's economic challenges is leading to loss of natural habitats and occasional state of degradation in almost all of BiH's ecosystem groups. This is happening mainly as a result of overconsumption of BiH's natural resources. Such results suggest relatively high intensity and increasing trend of all types of direct and indirect drivers (Table 2). As a result, there are downward trends in nature's contributions to people and more visible reductions in the capacity of ecosystems to regulate environmental processes, decreased availability of material resources and declining quality of life for individuals and society as a whole.

Table 2. Trend of key ecosystem characteristics which contribute to different types of NCPs (Bećirović et al., 2023)

Principal ecosystem groups	Intensity and trends of ecosystem drivers		Trend of specific categories NCP by ecosystem groups			Trend of state of key ecosystem components	
	Direct drivers	Indirect drivers	Regulating NCP	Material NCP	Non-material NCP		
	1	Lowland to montane land deciduous forests and shrubs	Low, ↗	Low, ↗	High, ↘		Low, →
2	Mountainous forests	Low, ↗	Low, ↗	High, ↘	Low, ↘	Low, →	High, ↘
3	Relict Pine Forests	Low, ↗	Low, ↗	High, ↘	Low, ↘	Low, →	High, ↘
4	Mediterranean and sub-Mediterranean forests and shrubs	Low, ↗	Low, ↗	High, ↘	Low, ↘	Low, →	High, ↘
5	Temperate meadows	Low, ↗	Moderate, →	High, ↘	Low, →	Low, →	High, ↘
6	Dry and rocky meadows and pastures	Low, ↗	Moderate, →	High, ↘	Low, →	Low, →	High, ↘
7	Wetland and standing water habitats	Low, ↗	Low, ↗	High, ↓	Low, ↘	Low, ↘	High, ↓
8	Flowing water	Low, ↗	High, ↗	High, ↓	Low, ↘	Low, ↘	High, ↓
9	Sea and seacoast	High, ↘	Low, ↗	High, ↘	Low, ↘	Low, →	High, ↘
10	Canyons, ravines and rocks	Moderate, →	Moderate, →	High, ↘	Low, ↘	Low, →	High, ↘
11	Caves and other underground habitats	Moderate, →	Moderate, →	Low, →	Low, →	Low, →	High, ↘
12	Karst fields	Low, ↗	Low, ↗	High, ↘	Low, ↘	Low, →	High, ↘
13	Alpine ecosystems	Low, ↗	Low, ↗	High, ↘	Low, →	Low, →	High, ↘
14	Arable crops area and artificial meadows	Low, ↗	Low, ↗	Low, →	Low, →	Low, →	High, ↘
15	Orchards and vineyards	Low, ↗	Low, ↗	Low, →	Low, →	Low, →	High, ↘
16	Ruderal habitats and urban green areas	High, ↘	High, ↘	High, ↘	Low, ↘	Low, ↘	High, ↓

Key

	drivers			NCP				
Intensity	low	moderate	high	High, ↓	High, ↘	Low, →	Low, ↗	High, ↓
Trend	↘	→	↗	Continuous degradation	Occasional degradation	No change	Occasional improvement	Continuous improvement

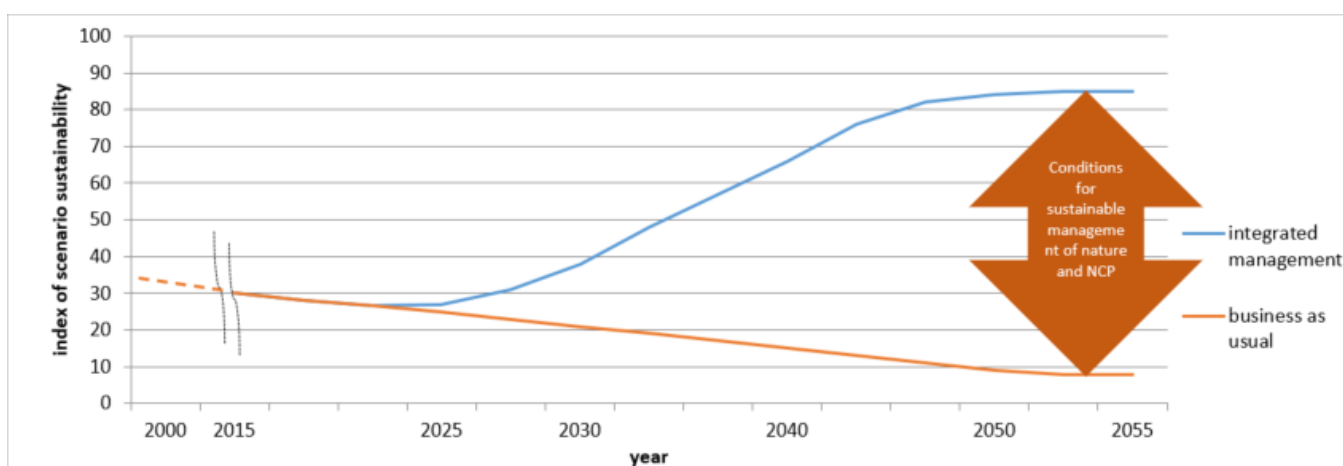
B.3. Governance of biological diversity and natural resources can be directed towards promoting and applying integrated, intersectoral and multidisciplinary approaches for the purpose of stopping the negative drivers of biodiversity loss. Management of material NCP has an impact on trends of regulating and non-material NCPs. Negative trends in nature are a direct consequence of negative drivers that affect material NCPs. The drivers occur as a result of the current practices and decisions that are made in the complex socio-economic context of BiH. The

drivers threaten biological diversity at the level of ecosystems, species and genetics. Science and research findings from various disciplines, as well as research findings at the international level, indicates that there is a lack in the uptake of scientific evidence in decision-making to support long-term sustainable management of biodiversity and natural resources in BiH. potential future state of biological diversity can be analysed through two possible scenarios (Graph 1):

A. Scenario involving continuity of the usual practices, or “business as usual”, regarding the use of nature, which is expected to reduce the capacities of ecosystems to provide all types of NCPs and contribute to economic and socio-developmental processes in BiH.

B. Scenario involving integrated governance of nature and NCPs for the purpose of achieving climate neutrality, that as a result of capacity development and implementation of international best practices, could result in successful conservation and recovery of biological diversity and NCP.

Under scenario B, existing institutional, scientific and financial capacities could be harnessed to integrate biodiversity conservation into actions and policies targeted at achieving climate neutrality, resulting in better integration of biodiversity and climate challenges into a range of sector policies. This in turn could facilitate better access to funds for BiH as an EU candidate country from the Western Balkans. Integrated (multisectoral) implementation of the EU Acquis could also contribute to changing the current trends of biodiversity loss and declining NCPs.



Graph 1. Trajectory of the sustainability index of the development scenarios ‘integrated governance’ and ‘business as usual’



Image 4. Traditional wool socks, Lukomir village (Photo credits: Šoljan)



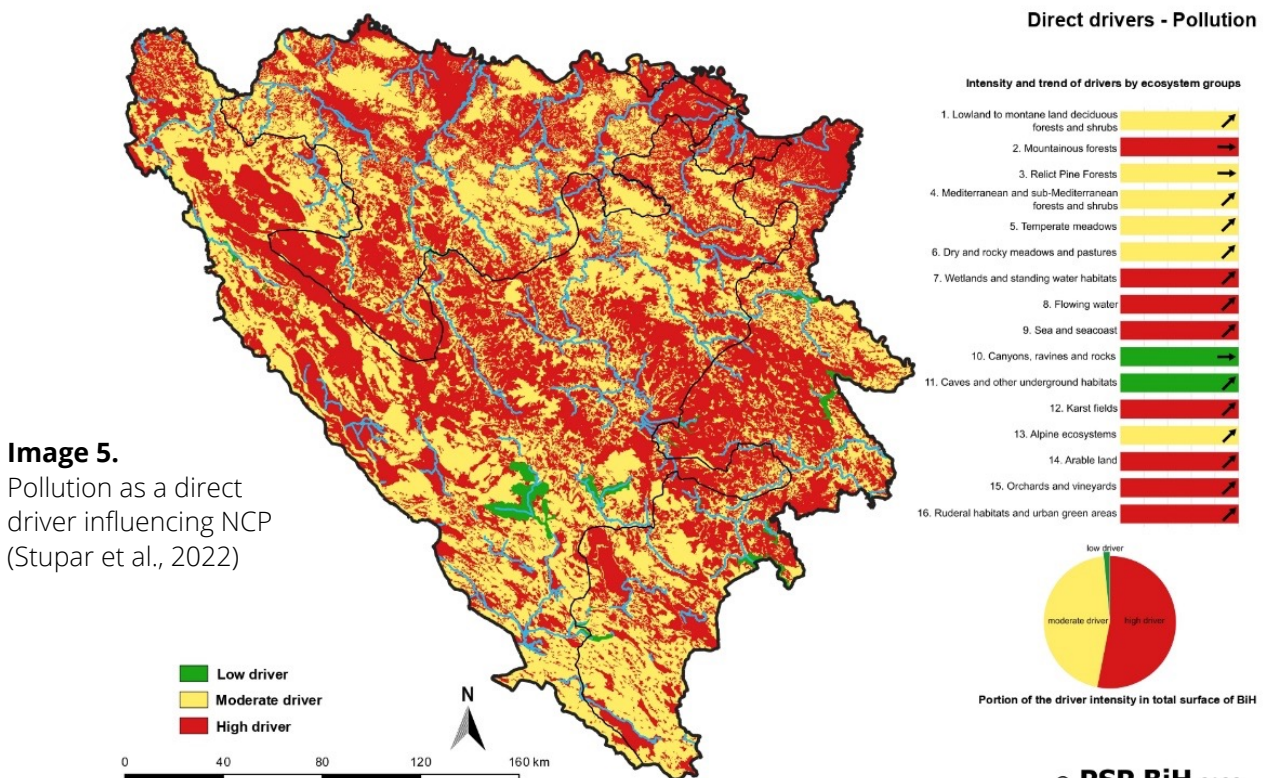
Which developmental drivers (manufacturing and consumption of goods, energy needs, tourism, etc.) and social drivers (demographic developments, socio-political processes, etc.), impact the state and trends of nature and natural resources in BiH? Also, in which ways (directly or indirectly)?

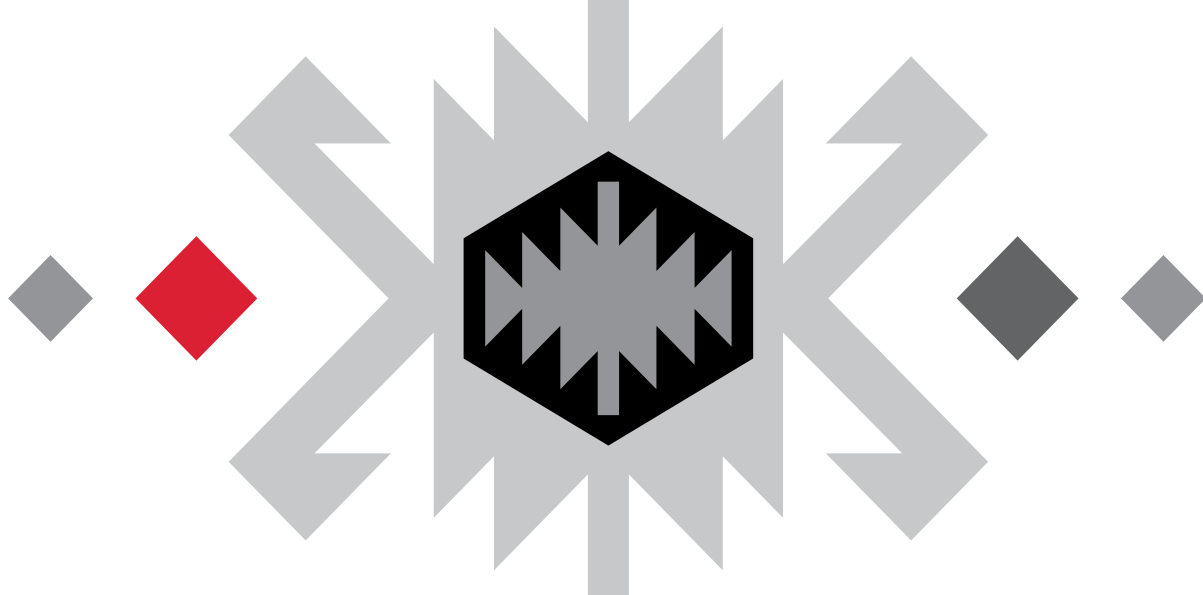
C. Numerous direct and indirect developmental and social drivers have had increasingly negative impact on the state and trends of nature and natural resources in BiH.

C.1. Increasing trends in the loss of biological diversity and NCP in BiH are occurring as a result of different direct and indirect drivers that interact with and exacerbate one another.

Direct drivers impact biodiversity and NCPs at their source, which in turn often occur as a result of indirect drivers in the form of anthropogenic activities. Prominent among the direct drivers are conversions of habitats which leads to a loss of natural habitats and expansion of areas that are low in biodiversity and have a low capacity for providing contributions to people and excessive exploitation of natural resources that exceeds the carrying capacity of the ecosystem (meaning the ecosystems are unable to restore themselves to level that is sufficient for producing goods and services for people). Moreover, pollution of air, land and water is a consequence of human activity, which reduces the health and resilience of soil and water

ecosystems, and the species contained within them (Image 5). The impacts of these drivers combined with the worsening effects of climate change is leading to increased numbers of invasive alien species into already degraded ecosystems. At the same time, land converted for agriculture in BiH has produced large areas of land that are low in biodiversity and have low resilience to extreme weather, pests and diseases. Indirect drivers that adversely impact biodiversity also include weak institutional capacity for conserving biodiversity and promoting sustainable development and poor enforcement of the legislative framework, challenging economic circumstances for the society of BiH during the current period of transition, demographic processes such as abandonment of rural areas and loss of traditional religious and cultural norms and practices as a result of social change, and low scientific and technological capacity of BiH to develop and apply better standards for the conservation of biological diversity and sustainable use of NCPs.





C.2. Direct drivers are intensifying and having an increasingly negative effect on the state of biological diversity and NCP in BiH.

BiH's natural habitats are being lost and degraded as a result of land conversion for infrastructure development, improper waste disposal and increasingly frequent erosions and landslides. Natural processes such as succession of vegetation, fires and other causes of degradation predominantly impact the state of agricultural and forest areas. In view of the fact that economic activity in BiH is to a large extent dependent on the use of natural resources, the relatively high intensity of drivers affecting the state of biological

diversity was recorded through excessive use of resources in almost all resource-dependent sectors. Economic growth is mostly followed by water, air and land pollution, which is a permanent problem that will greatly impact people's quality of life across BiH. A growing frequency of extreme climate events such as drought, heat waves, floods, windstorms and wildfires are a local manifestation of global climatic changes and an ever increasing driver that affects the nature and citizens of BiH (Table 3). Finally, expansions of invasive species represent an important direct driver and contribute to loss of biological diversity and NCP in BiH.

Table 3. Overview of the intensity and trends of direct drivers per ecosystem groups in BiH (Stupar et al., 2022)

	Land-use change	Natural resource use and exploitation	Pollution	Invasive species	Climate change
Lowland to montane land deciduous forests and shrubs	moderate ↗	high ↗	moderate ↗	moderate ↗	moderate ↗
Mountainous forests	moderate ↗	high ↗	high →	moderate ↗	moderate ↗
Relict Pine Forests	moderate ↗	moderate ↗	moderate →	low ↗	moderate ↗
Mediterranean and sub-Mediterranean forests and shrubs	low ↗	high ↗	moderate ↗	moderate ↗	high ↗
Temperate meadows	moderate ↗	low →	moderate ↗	moderate ↗	moderate ↗
Dry and rocky meadows and pastures	moderate →	moderate ↗	moderate ↗	moderate ↗	moderate ↗
Wetland and standing water habitats	moderate ↗	moderate ↗	high ↗	moderate ↗	moderate ↗
Flowing water	moderate ↗	high ↗	high ↗	moderate ↗	moderate ↗
Sea and seacoast	high	high ↗	high ↗	moderate ↗	moderate ↗
Canyons, ravines and rocks	low →	low →	low →	moderate ↗	moderate ↗
Caves and other underground habitats	low →	low →	low →	low →	low →
Karst fields	moderate ↗	high ↗	high ↗	moderate →	moderate ↗
Alpine ecosystems	moderate ↗	moderate ↗	moderate ↗	moderate →	high ↗
Arable crops area	moderate ↗	moderate ↗	high ↗	moderate ↗	moderate ↗
Orchards and vineyards	moderate ↗	moderate →	high ↗	high ↗	high ↗
Ruderal habitats and urban green areas	high ↗	high ↗	high ↗	moderate ↗	moderate ↗

intensity	low	moderate	high
trend	↘ decreasing	→ stable	↗ increasing

C.3. Indirect drivers, such as societal processes and socio-economic change, in turn contribute to the emergence of one or several direct drivers.

Institutional drivers that significantly impact biodiversity and nature's contributions to people often manifest in the form of inefficient implementation of regulations, limited technical, financial, institutional and human resource capacities, non-compliance with rules and regulations, and practices that are harmful to the environment. Economic drivers in BiH stem from the complex transitional processes and characteristics of BiH's economic activity, which is based predominantly on the use of natural resources for manufacturing of market goods, decreasing population size and low birth rates have been recorded in BiH, which can be seen as negative demographic driver. In many parts of BiH, demographic growth in towns and rapid depopulation of the villages and rural areas lead to increased land-use change in and around urban areas (construction and urbanisation) whilst at the same land that is abandoned in rural areas

is subject to ecological succession and irreversible loss of, traditional and local knowledge and practices (Table 4). Cultural and religious factors are not strong drivers of change of biodiversity and land use in BiH. However, there is insufficient awareness and consensus, among citizens, national institutions, and policymakers, about the need for joint actions to preserve biodiversity and the natural environment, which has limited multi stakeholders collaboration and joint responsibility for the protection of biological diversity and natural resources. Indirect drivers in BiH are complex and there is a need for further research on. This includes research on how growing trends in scientific and technological drivers impact biodiversity in BiH. For example, due to lack of capacities, cooperation and communication, the science community has weak influence or impact in mobilising solutions for the conservation of biodiversity.

Table 4. Overview of the intensity and trends of indirect drivers per ecosystem groups in BiH (Stupar et al., 2022)

	Institutional	Economic	Demographic	Cultural and religious	Science and technological
Lowland to montane land deciduous forests and shrubs	High, stable	Moderate, increasing	Moderate, increasing	Moderate, stable	Moderate, increasing
Mountainous forests	High, stable	Moderate, increasing	Moderate, increasing	Moderate, stable	Moderate, increasing
Relict Pine Forests	Moderate, stable	Moderate, increasing	Moderate, increasing	Moderate, stable	Moderate, increasing
Mediterranean and sub-Mediterranean forests and shrubs	High, stable	Moderate, increasing	Moderate, stable	Moderate, stable	Moderate, increasing
Temperate meadows	Moderate, increasing	Moderate, stable	Moderate, stable	Moderate, stable	Low, stable
Dry and rocky meadows and pastures	Low, stable	Low, increasing	Moderate, increasing	Moderate, stable	Moderate, stable
Wetland and standing water habitats	Moderate, increasing	Moderate, increasing	Moderate, increasing	Moderate, stable	Moderate, increasing
Flowing water	High, increasing	High, increasing	Moderate, increasing	Moderate, stable	Moderate, increasing
Sea and seacoast	Moderate, increasing	Moderate, increasing	Moderate, increasing	Low, stable	Moderate, stable
Canyons, ravines and rocks	Moderate, increasing	Moderate, stable	Moderate, stable	Low, stable	Low, stable
Caves and other underground habitats	Low, stable	Low, increasing	Low, increasing	Moderate, stable	Low, stable
Karst fields	Moderate, increasing	High, increasing	High, increasing	Moderate, stable	Moderate, increasing
Alpine ecosystems	High, stable	Moderate, increasing	Moderate, increasing	Low, stable	Moderate, increasing
Arable crops area	Moderate, increasing	High, increasing	High, increasing	Moderate, stable	Moderate, increasing
Orchards and vineyards	Moderate, increasing	Moderate, stable	Moderate, increasing	Moderate, stable	Moderate, increasing
Ruderal habitats and urban green areas	High, increasing	Moderate, stable	High, increasing	Moderate, stable	Moderate, increasing

intensity	low	moderate	high
trend	decreasing	stable	increasing

D|?

What are the current and potential options for improvement of different sectoral policies, interventions, investments and governance and institutional arrangements for greater contribution of nature and natural resources to sustainable development in BiH?

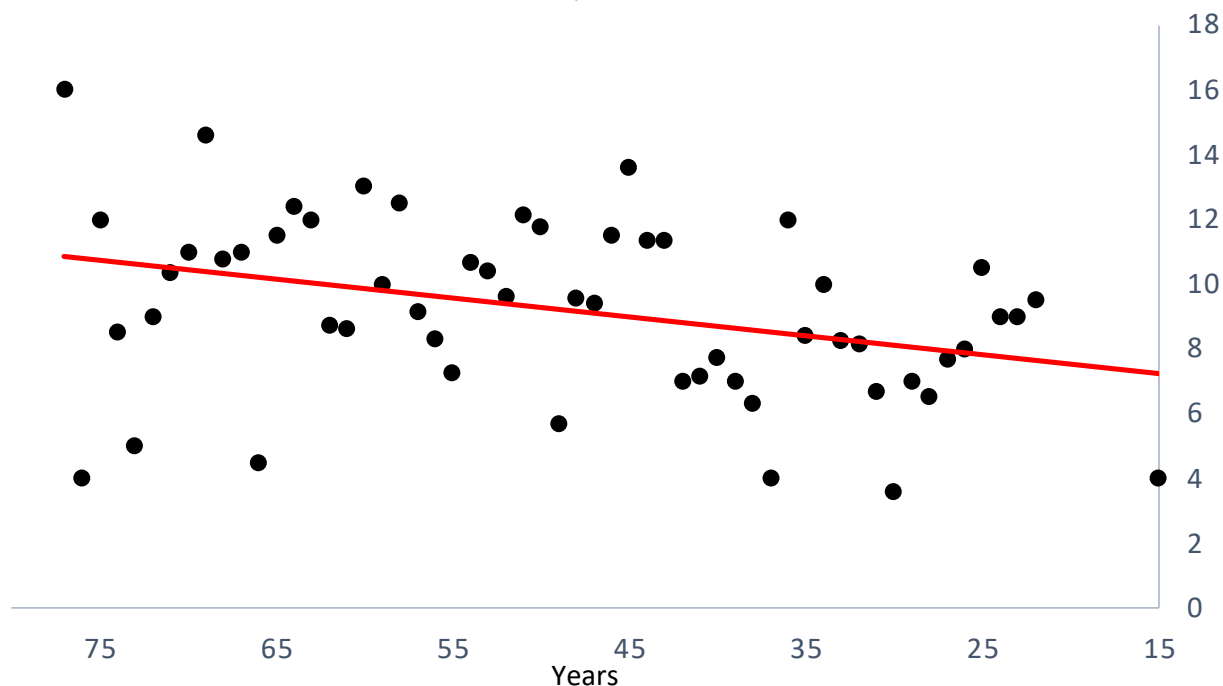
D. Although there is significant potential for improvement, current sectoral policies, forms of governance, and institutional arrangements do not provide the required regulatory and financial framework to ensure effective long-term management of nature and natural resources for sustainable development in BiH.

D.1. To ensure quality of life in BiH, practices for the sustainable management of biodiversity and nature's contributions to people are required. In terms of policies relating to the conservation and sustainable use of biodiversity, BiH has committed to goals and targets at the global, European and Western Balkans levels, (although it has not as yet signed agreements on conservation of genetic diversity and related traditional and local knowledge). BiH committed to national implementation of the Kunming-Montreal Global Biodiversity Framework and is currently preparing an integrated National Energy and Climate Plan for 2021-2030. However, BiH is not a party to the Nagoya Protocol on Access and Benefit Sharing and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) Treaty. This has hampered opportunities to regulate access to local genetic resources and ensure fair and equitable sharing arising benefits from their utilization. Biological diversity has been integrated into some sectoral strategies, but not into BiH's sectoral programmes and regulations. The need for coordinated and efficient planning to support the conservation and sustainable use of biodiversity through a multisectoral approach is evident.

D.2. Current capacities and other necessary conditions for the conservation of biodiversity and sustainable use of the nature's contributions to people is not satisfactory. Information systems for conserving and monitoring the state of biodiversity are established at the level of the Entities in BiH and do contain certain amounts of data. However, priorities for monitoring and methods of data collection and flow have still not been identified, which impedes progress in the planning and establishment of ecological

networks in BiH. Information systems have not been established in the Brcko District of BiH. Suitable indicators that are aligned to the reporting needs of international agreements and EU policies have not been developed and implemented, nor have strategies for the conservation of specific biodiversity. Limited capacities for the conservation and sustainable use of biodiversity is evident in BiH, in particular: institutional and administrative capacities of different administrative unites as well as research and financial capacities. Participation of scientific experts in policymaking regarding the conservation and sustainable use of biodiversity is currently insufficient. Nature protection and conservation in BiH is financed through a set of non-tax levies/revenues, but very little funding comes through overall public revenues. Although BiH receives significant international funds to tackle environment issues, a very small proportion of those funds are allocated for the protection and conservation of biodiversity. Knowledge of local biological diversity and traditional and local knowledge are not sufficiently represented and taught in the elementary and secondary school curricula. In higher-level education, this form of knowledge is somewhat covered in the programmes of science, agriculture and forestry faculties. Research has confirmed a gradual loss of traditional and local knowledge in BiH, while the option of including traditional and local knowledge in policymaking processes has not been utilised (Graph 2). Participation of the public and inclusion of social justice measures are not at a satisfactory level in BiH due to lack of publicly available information and late involvement of the public in the process of policy development. Conservation and sustainable use of nature are not seen as a priority by the media. Local

self-governance units have much to contribute but are insufficiently involved in processes of planning, conservation and sustainable use of biodiversity.



Graph 2. Loss of traditional and local knowledge (Barudanović et al., 2023)

D.3. The institutional and legal framework for the governance of biodiversity and NCPs is complex in BiH, and their effectiveness are not sufficient to achieve sustainable development.

Public institutions in BiH are established according to different levels of administrative authority. However, the legislative frameworks that cover the protection of biodiversity and environment are not implemented by the same institutions as those who are responsible for adopting and applying legislative framework for NCPs. In Federation of BiH (FBiH), the institutional framework is more complex. Current institutions in BiH do not have sufficient human or technical resources for implementation and oversight of the adopted regulations. Horizontal legislation has to a limited extent been aligned with the EU legal framework. Lack of vertical alignment of legislation among different administrative levels in BiH is evident, as well as of the horizontal one among different sectors within individual administrative units. The procedure of issuing environmental permits is not sufficiently transparent, and together with the procedure for environmental impact assessment, does not result in sufficient protection of biological diversity under many development initiatives and projects.

D.4. In BiH, there are several regulatory, economic and information instruments/tools for the sustainable management of biodiversity and nature’s contributions to people that are not sufficiently used.

Various instruments and tools are applied for the conservation of biodiversity in BiH, but the extent and quality of their application are not at a satisfactory level. The effectiveness of tools/instruments for the conservation and sustainable use of nature’s contributions is higher in institutions compared to the effectiveness of tools employed by the non-governmental sector. Our findings indicate that there are only a few tools and instruments, such as sanitary and phytosanitary measures, tools relating to food safety, forest certification, that have been consistently and efficiently applied in BiH. However, there is a need for more research into the effective use of available tools and instruments for the sustainable management of natural resources in BiH.

**E|?**

Which gaps in practice and knowledge need to be addressed to strengthen policy making processes for the purpose of improving the state of nature and governance of natural resources in BiH?

E. In order to amplify the potential for policymaking to improve the state of nature and governance of natural resources in BiH, many knowledge gaps need to be filled. These knowledge gaps are mainly characterised by a lack of certain areas of knowledge and inconsistencies across space and time. BiH's capacity to identify policy priorities and evidence-based and sustainable solutions could be achieved by establishing a stronger interface between science, policy and practice in BiH.

E.1. In all thematic areas of the Assessment, a significant lack of knowledge was identified.

In order to conduct further assessments on the state of nature to enable informed decision-making, it is necessary to ensure there are continuous opportunities for the implementation of research in order to address BiH's significant knowledge gaps. Support from competent and specialized institutions and participation of the entire social and political community around the issue of conservation and sustainable use of biodiversity can provide the necessary conditions for scaling up research. At present, a lack of multidisciplinary and integrative research approaches (natural science, social, humanistic and other sciences and arts) is evident, particularly in relation to specific sectoral policies (policies on nature protection, environment, forest, agriculture, energy, spatial planning policies and others).

E.2. The scientific community has not been engaged sufficiently in the identification of solutions for sustainable development and improvement on the quality of life in BiH. Again, strengthening the interface between science, policy and practice in BiH could help to overcome this challengey.

A total of 3,343 information sources were used for this Assessment (scientific and technical references, reports and regulations), with over 80% of them being domestic sources of information. The number of sources used in this assessment reflects the high productivity of BiH's scientific and research community. At the same time, our knowledge gap analysis suggests that there is a lack of information that is of high relevance for decision making relating to sustainable management of biodiversity and NCPs. BiH's science-policy-practice interface exists in some limited forms, but no systematic mechanisms have been put in place to enable policymakers to raise questions to the science and research community in BiH. In BiH, science-based solutions for the management of biodiversity and natural resources in practice do not include traditional and local knowledge relating to biological and cultural diversity, despite the fact that it could provide solutions to some of BiH's environmental challenges. Establishment of a continuous science-policy interface could significantly increase the effectiveness of current interventions aimed at the conservation of biodiversity and sustainability of nature's contributions to people, as well and create strong mechanisms for that enable integrated governance of BiH's biodiversity and natural resources.

F|?

Is the methodological framework for assessing the state of nature and governance of natural resources in Bosnia and Herzegovina effective?

F) The present methodological framework for assessing the state of nature in BiH has provided a basis for strengthening the science-policy interface, as well as generating new knowledge, strengthening research capacities in BiH, creating a stronger research network and has led to recognition of the importance of the participation of BiH's social community in issues of conservation and sustainable use of biodiversity.

F.1. The IPBES conceptual framework represents an effective approach for assessing the state of nature in BiH. The IPBES methodological approaches enable novel conceptualisations of multiple values of nature in a way that adequately captures the interactions and relationships between society and nature. The Conceptual Framework also enables synthesis of multiple knowledge systems (including diverse scientific disciplines, and Indigenous and local knowledge) to understand the state of biodiversity, NCPs, biodiversity and ecosystem services. It includes terms such as 'nature's contributions to people' and 'science-policy interface'. As a globally recognised and innovative approach, the IPBES conceptual framework should be further studied, developed and implemented in a way that is tailored to the environmental and socio-economic realities of BiH.

F.2. The IPBES conceptual framework provides a solid basis for the establishment and strengthening of a science-policy-practice interface in BiH. The science-policy-practice interface is an important mechanism that enables exchange of ideas between science, policy and society, for the purpose of improving the decision-making. Assessment of the state of nature using the IPBES conceptual framework provides relevant policy makers in responsible institutions, at all administrative and policy levels, with an opportunity to use reliable evidence and scientific data to inform policies and actions relating to the sustainable use of natural resources. At the same time, by establishing a stronger interface between science and policy, the science community will have more clarity on priority policy issues and research needs and will be more informed on what knowledge gaps need to be addressed. A stronger science-policy interface would be mutually beneficial for the science and

policy communities. They should not be viewed as two separate communities, but rather they should be viewed as interdependent entities that require continuous interaction and co-creation. In addition to contributing to a more comprehensive understanding and valuation of ecosystem services that nature provides to people, a continuous interaction between science, policy and society would enable more advanced approaches for the protection, management and sustainable use of natural resources.

F.3. Assessment of the state of nature has generated new knowledge, strengthened research capacities and helped to establish a strong research network in BiH. Drafting of the Assessment of the state of nature was simultaneously a process of learning and developing individual and collective capacities for scientific research, which has laid strong foundations for implementation of similar research projects in future. This in particular refers to younger members of the Multidisciplinary Team of contributors, for whom participation in development of the Assessment, together with other types of education, provided a unique opportunity to advance their knowledge on different aspects of the Assessment's development. Joint effort between experts from almost all parts of BiH and different scientific disciplines demonstrates how working on topics aimed at conserving nature and natural resources can create a strong domestic research network that is more capable of implementing highly complex projects. The strengthened cooperation between BiH's research communities has created new opportunities for multidisciplinary and integrative research, which has resulted in first-of-its-kind, science-based knowledge on the state of nature in BiH.



Image 6.

Prenj mountain –
endemic development center
(Photo credits: Macanović)

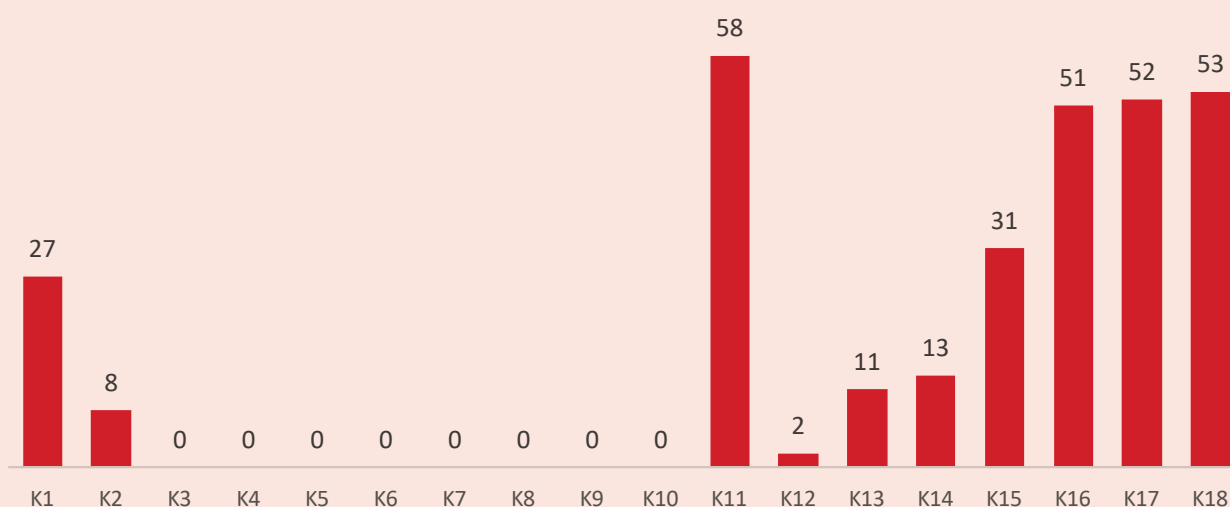
**EXECUTIVE SUMMARIES
FOR THE SIX CHAPTERS
OF THE ASSESSMENT OF
THE STATE OF NATURE
AND GOVERNANCE OF
NATURAL RESOURCES
IN BOSNIA AND
HERZEGOVINA**

3.1. CHAPTER 2

Natural resources and ecosystems continuously provide numerous contributions to people and positively impact the quality of life of individuals and communities in rural and urban areas of BiH (well established). Despite negative impacts that affect certain categories of Nature's Contributions to People (NCPs), nature and ecosystems still play a key role in regulating environmental and ecological processes, providing food and materials to individuals and industries, and supporting quality of life through a set of non-material NCPs of psychological, physical and cultural importance (well established) (2.2.1.1, 2.2.2.1, 2.2.3.2). The NCP concept, which uses an accepted methodology as its basis, enables systematic presentation of information on how nature and ecosystems contribute to people's quality of life, taking into account regulating, material and non-material NCPs. In this contexts, results of this chapter seek to answer the following key question: To what extent and in which ways do biodiversity and the use of natural resources contribute to provision of livelihoods, quality of life and sustainable development in BiH? It is important to note that research on NCP is still in its infancy, both in BiH and globally, since this is a relatively new concept. However, the results

of this chapter, quantify NCPs in BiH based on the available data and evidence and point to methods for the collection and comprehensive analysis of information relating to all categories of NCP, on which several types of human activity are particularly dependent (industry, agriculture, environment protection, rural development among others). Finally, due to its geographical position and abundance of ecosystems and biodiversity, all NCP categories are present across the entire BiH territory.

Nature's contributions to quality of life, materially speaking, are prominent in rural and urban areas, but also in the industrial sector, whereas regulating and non-material NCP play an important role in the everyday lives of people as a result through their positive impacts on the environment and human health. Despite this, research conducted by Barudanović et al. (2023) show that the values of regulating NCPs are insufficiently understood by the BiH population (Graph 3). It is therefore important to analyse and revise current approaches (political, institutional and economic) for implementing measures directed at sustainable socio-economic development in BiH as well as the value of nature and management of the NCPs.



Graph 3. Identification of 18 NCP (K) types from discussions with local communities (Barudanović et al., 2023)

Regulating NCPs are important for maintaining the condition and resilience of the environment and ecosystem processes enable and support adaptation of BiH's society and economy to global environmental and energy challenges (established, but incomplete) (2.2.1).

Regulating NCPs as a result of ecosystems with high biodiversity, which in turn contributes to the condition of those ecosystems and their ability to function as well as their capacity to provide material and non-material NCPs linked to people's quality of life. Although research on specific categories of regulating NCPs is lacking, there is a pronounced role of ecosystems in the processes of creating and maintaining habitat biodiversity, conservation of genetic material and support to migration processes in BiH (2.2.1.1). Ecosystems make significant contributions towards the process of pollination (2.2.1.4), purification and maintenance of air quality (2.2.1.5), mitigating consequences of sea acidification (2.2.1.7) and maintenance of water quantity and quality (2.2.1.8 and 2.2.1.9).

In addition, nature and ecosystems are important regulators of the condition, quality and resilience of the land (2.2.1.10), acting as so-called "green infrastructure" that prevents and mitigates the consequences of extreme weather events and natural disasters (2.2.1.11), as well as playing an important role as natural regulators for degrading organic waste (2.2.1.12). The roles of biodiversity and ecosystems are particularly prominent in the context of climate change adaptation, which although viewed as a global issue, has significant negative effects at the local level. Ecologically stable and resilient ecosystems have positive effects in the process of adaptation to climate change locally, but these contributions are not sufficient to fully mitigate the negative effects of climate change. Therefore, transformations in the strategic, governance and operational approaches in climate sensitive sectors are necessary to mitigate the negative effects of climate change for the environment and people of BiH (established, but incomplete) (2.2.1.6).



Image 7. *Pinus heldreichii* H. Christ (Photo credits: Mataruga)

Nature and ecosystems provide different products, materials and raw materials for people and economies in BiH. They provide the basic building blocks for development and improvement to quality of life at the local level, and contribute to the creation of opportunities for economic growth and entrepreneurship and social stability (well established) (2.2.2.3). Material NCPs are the so called 'outputs' of ecosystem processes that are used by people in their material (physical) form for various purposes, for the purpose of meeting their material needs and building infrastructure. Material NCPs are an important part of people's everyday lives and an important prerequisite for the wellbeing of individuals and communities. They also contribute significantly to many economic activities. Since material NCPs are essential for human nutrition, the significance and status of agricultural production and availability of food for the needs of people in BiH are presented

(2.2.2.1), as well as modalities for the processing and use of non-timber forest products (NTFP). The findings also emphasise the importance of such products for the development of rural areas, including the role of fisheries and hunting for food provision (Image 8), and other material contributions (2.2.2.1 and 2.2.2.3). Ecosystems play an important role in energy provision in BiH, which is demonstrated in particular by the fact that, at the house-hold level, wood is traditionally burnt for fuel, but also in the sense that agriculture and forest biomass offer promising opportunities for energy diversification (2.2.2.2.1). BiH's ecosystems contribute significantly to the country's economy in BiH and the products and services derived from BiH's ecosystems are often used to create distinct and competitive products that are sold on the international markets (2.2.2.3). In BiH, the collection and use of medicinal herbs (Image 9) are recognised as particularly important contributions.

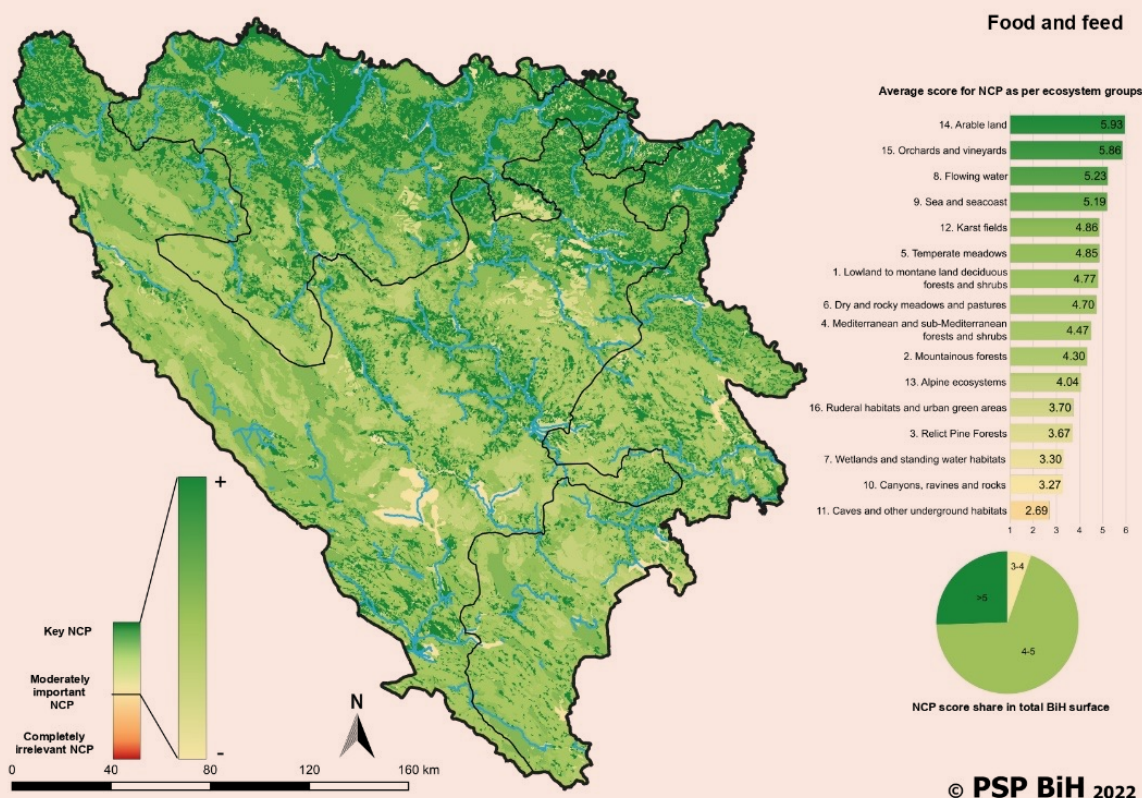


Image 8. Spatial visualisation showing the importance of nature's contributions for food and feed (Bećirović et al., 2023 in press)

Nature is an important part of cultural and traditional social identity in BiH and it supports the improvement of human health and well-being through a set of non-material NCPs (established, but incomplete) (2.2.3.3).

The importance of nature for improving the quality of life of people and communities is largely reflected by the non-material contributions that nature provides to people. These categories of contributions reflect the effects of nature on the subjective or psychological state of an individual's quality of life, and by extension the community. Knowledge about nature and natural resources is an important part of the formal education in BiH. There is a growing need to teach and generate knowledge on local practices relating to the sustainable use of nature, for the purpose of conservation and to raise general awareness on the importance of nature for human well-being (2.2.3.2). In BiH, a significant and invaluable portion of knowledge about nature is traditional and local knowledge. However, the scientific and expert community have not typically given sufficient attention to this knowledge., Furthermore, driven by changes in lifestyles and abandonment of rural areas, traditional and local knowledge of biodiversity and natural resource use is disappearing, along with some traditional and cultural interrelationships between people and nature. It has been recognised that BiH's

natural assets present good opportunities for the development of sustainable tourism, but the challenge lies in how to ensure these opportunities are embedded in sustainable economic and social systems that promote the conservation of ecosystems and nature (Image 14) (2.2.3.2), by implementing measures that ensure sustainable use of land and natural resources. Eco-tourism and rural tourism development can in some cases increase community engagement and support preservation of cultural identities and intangible cultural heritage, for example where cultural traditions are viewed by communities as an important factor in revitalisation of cultural heritage and promotion of community culture in the context of tourism. Through valorisation of cultural traditions and their promotion (and use) in tourism, the cultural identity of individuals and the broader community are encouraged and strengthened. Society in BiH has a basic level of awareness regarding the necessity to conserve nature, but still it is necessary to promote the importance of natural resources for people's quality of life. It is also important to understand and integrate the needs and perspectives of the broader community, especially nature-dependent communities, when making strategic and governance decisions to make them compatible with local realities (2.2.3.3).

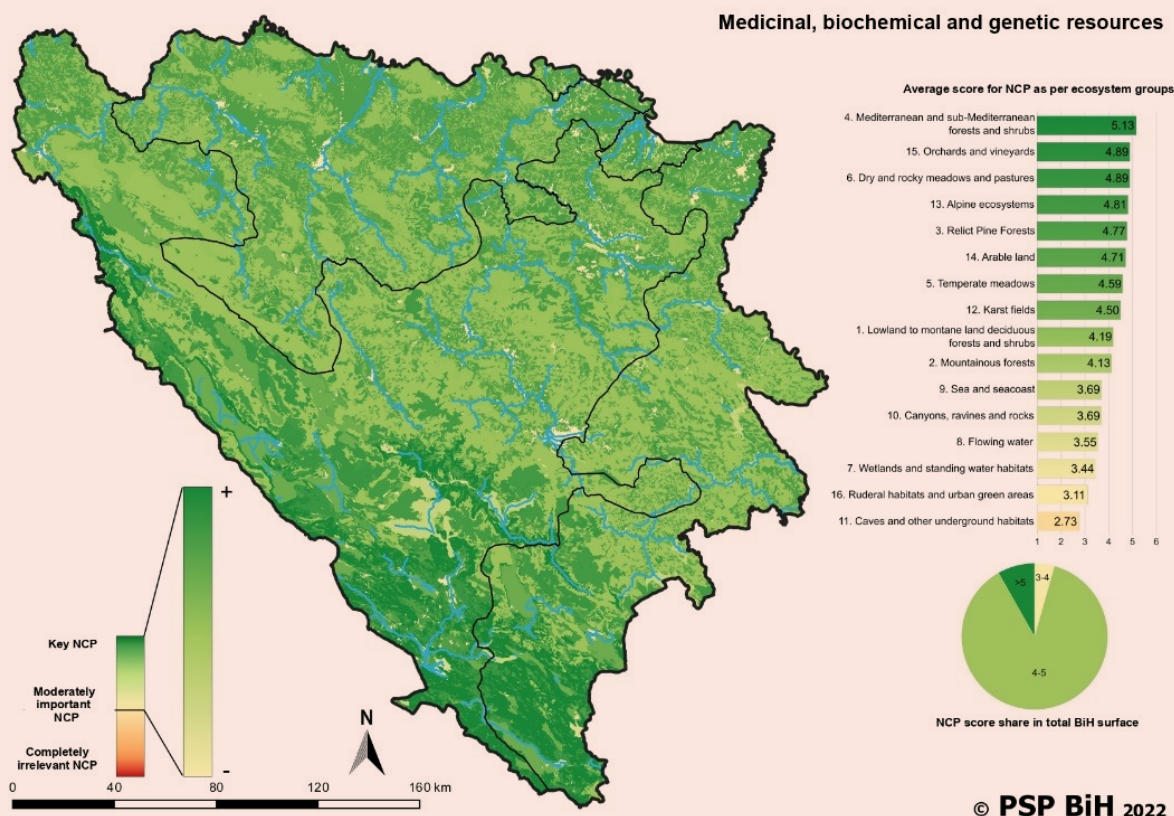


Image 9. Spatial visualisation showing the importance of NCPs for medicinal products across the territory of BiH (Bećirović et al., 2023 in press)

Although BiH has plentiful natural resources and there is high potential for food production, BiH meets a significant portion of its food needs through imports. This dependence on food from external sources places BiH in a position of “vulnerability” to disruptions in trade and commercial chains (well established) (2.2.2.1.1 and 2.2.2.1.2). BiH is not self-sufficient in food production and imports large quantities from abroad. Along with the need to increase the scope and scale of food production in all of BiH’s agricultural sectors, it is also necessary to increase BiH’s processing capacities in order to strengthen BiH’s self-sufficiency and resilience against potential disruptions in international food chains, whilst also meeting BiH’s food consumption needs. To ensure sufficient provision of quality food in BiH, it is necessary to improve quality control (health and safety of plant and animal-based products, veterinary-sanitary control of animal-based products and nutritional quality of products). BiH’s integration into the regional market, through introduction of the customs-free access to members countries in the process of EU accession, has created competitive pressure in BiH’s food production industry that will have a wide-ranging implications on BiH’s agricultural production and rural economy. Not all producers and processors will benefit from improved access to market for their products. Those agricultural

producers and processors who farm on a smaller scale, produce lower volumes of food and depend on lower-quality land for farming, will face significant challenges in competing with large-scale companies who provide BiH’s imports. These challenges will undoubtedly impact the long-term sustainability of many rural communities.

Bosnia and Herzegovina has significant water resources and the health and status of BiH’s ecosystems contributes to a large extent to the adequate supply of clean water to the citizens of BiH (well established) (2.2.1.8 and 2.2.1.9). As a result of monitoring, we can see that water quality in BiH is currently satisfactory and there is an upwards trend in the levels of water quality in BiH. From the perspective of the general public health situation, in general, the quality of surface waters in BiH is at risk of degradation, and some watercourses are already degraded (Image 10) (River Bosna basin). The biggest cause of contamination comes from municipal wastewater followed by industrial wastewater. Groundwater quality is mostly good, but the condition of BiH’s water resources will decrease if water contamination continues or intensifies, and if the spring recharge zones are not protected. Impaired quality is the consequence of increased water contamination and water intake, which is degrading natural ecosystems/habitats.

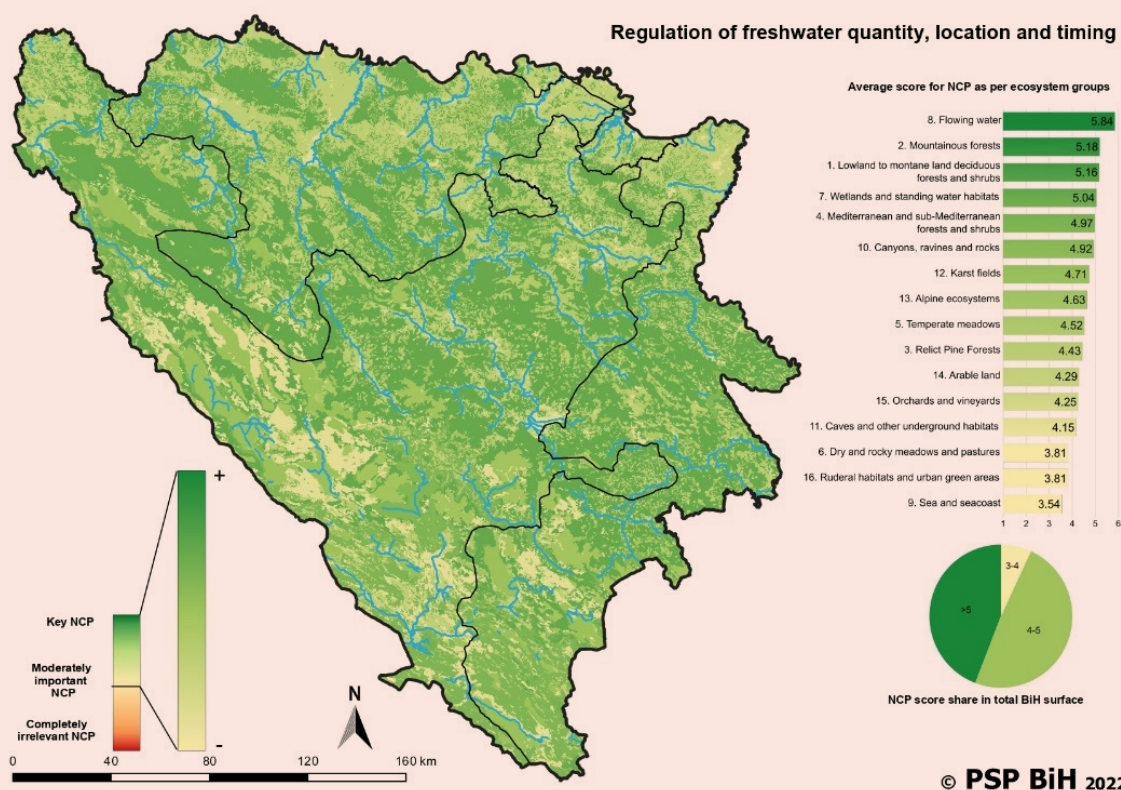
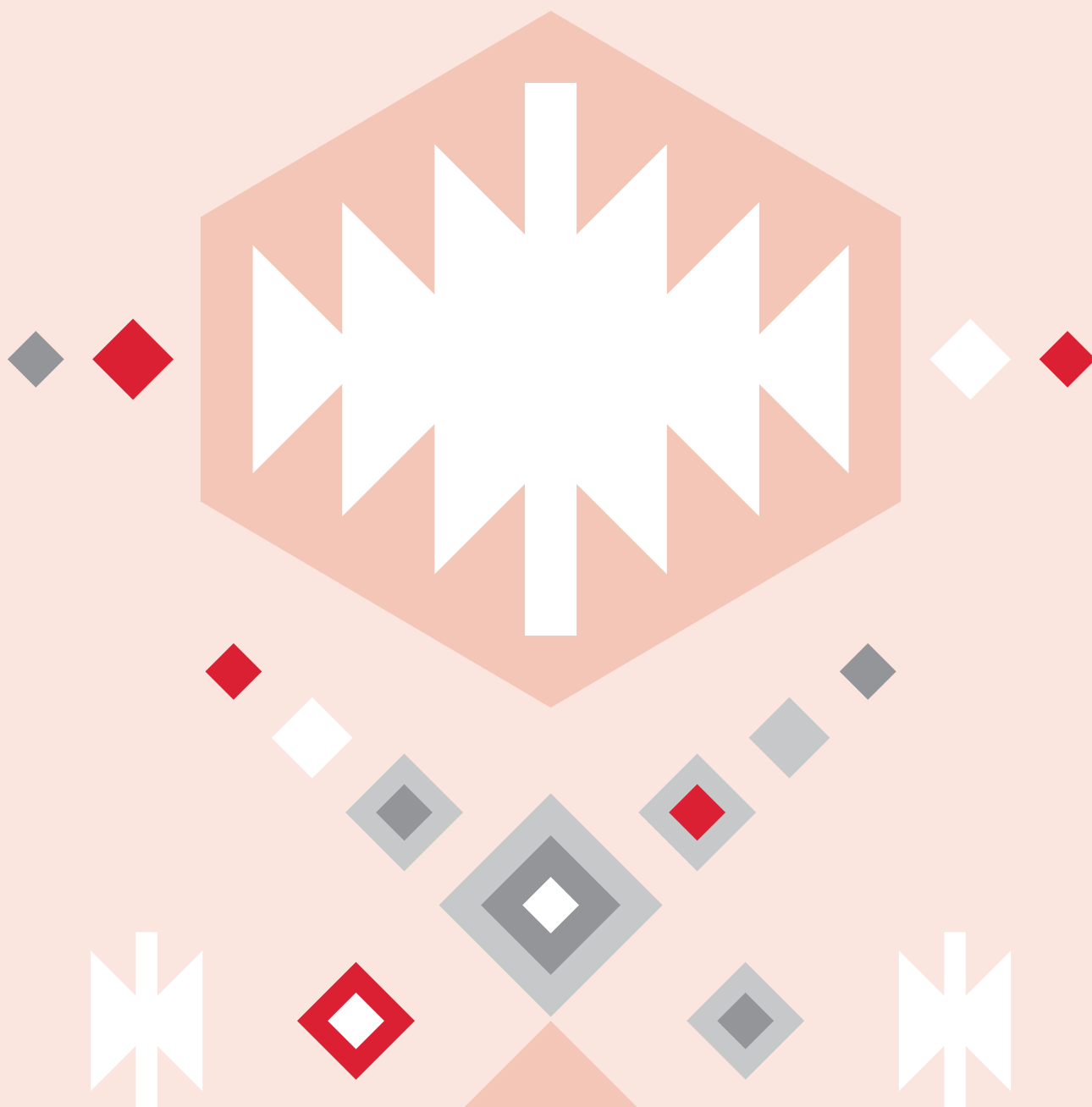


Image 10. Spatial visualisation of the importance of contributions from regulation of freshwater quantity, location and timing (Bećirović et al., 2023 in press)

The interconnections between all categories of NCP indicates a need for more comprehensive approaches to planning and governance of material NCPs since declines in material NCPs also reduces the ability of ecosystems to provide regulating and non-material NCPs (well established, but incomplete). Current trends on the use of biodiversity and natural resources indicate increasing levels of degradation of in the state and characteristics of BiH's ecosystems. Also, the focus of governance procedures on use of material resources jeopardizes their capacities to contribute to safe production of food, energy and water (2.3).

In addition to the use of common indicators (abundance of species, quality of ecosystems and similar), the continuous monitoring of the state of biodiversity and ecosystems should be enhanced with procedures that are based on assessment, mapping and valuation of ecosystem services, i.e. NCPs (established, but incomplete). Thus, in addition to the quantitative indicators that are commonly used for monitoring, it would be beneficial to generate robust information on the function, spatial distribution, status and value of certain ecosystem services that society is dependent on (2.4).



3.2. CHAPTER 3

Bosnia and Herzegovina (BiH) is characterised by a high level of ecosystem, species and genetic diversity, relative to the European average. BiH's rich ecosystems exist as a result of the specific geographic position of BiH, conditioned by climate characteristics, terrain, geological substrate and soil (well established) (3.1.1). The main climate types in BiH are: moderate continental, alpine and Adriatic (3.1.1.1). In terms of geological composition, BiH is a very heterogeneous area. Sedimentary rocks are the most common, metamorphic rocks less common and magmatic rocks the least common (3.1.1.4). In terms of types of terrain, the following are the most common in BiH: lowland, montane, alpine and karst terrain (3.1.1.5). Despite the fact that BiH is abundant in water, it is unevenly spatially and temporally distributed across BiH which presents challenges for the areas where water availability is low (3.1.1.7). The main soil types in BiH are brown earths which account for 50% (brown 27% and acidic brown 23%), chernozem on a limestone 16%, hydromorphic soil around 20%, ilimerised soil 7% and terra rossa 1.17% (3.1.1.8).

Scientific literature in BiH lists over 250 vegetation types, which puts BiH at the very top of the European list of countries in terms of ecosystem diversity. Although BiH's plant and animal have been scientifically recognised, it has not yet resulted in uniformed classification of habitat types (well established) (3.4.1). Forest ecosystems (3.4.1.1) and meadow and pasture ecosystems (3.4.1.2) in BiH are characterised by a vast ecosystem diversity and a high level of endemism and relict species (well established). Vast diversity is also found in water habitats (ecosystems of wet habitats of still waters (3.4.1.3.1), flowing water (3.4.1.3.2), seas and coastal habitats (3.4.1.3.3). Ecosystems in karst complexes are characterised by a high level of distinct (endemic and relict) biodiversity in BiH (well established) (3.4.1.4). BiH's alpine is very complex and is composed of different types

of ecosystems which are shaped by its geological substrates and position in the alpine massif (well established). Endemic species and glacial relicts account for a large part of the species abundance in the alpine complex (well established) (3.4.1.5). The diversity of tertiary arable vegetation in BiH is linked to current cultural and agricultural practices (well established) (3.4.1.6). Urban flora and vegetation are extremely floristically complex, and according to preliminary data, extremely biodiverse, given that it is comprised of more than 1,400 taxa in species and subspecies (well established). A large number of foreign varieties that tend to be invasive are included in this very dynamic complex (well established) (3.4.1.7). There are no studies on the resilience and functionality of ecosystems in BiH (well established) (3.2.2). The contributions that nature provides to the population of BiH are best recognised through material NCPs (well established), whereas other types of ecosystem services/NCPs have not been adequately investigated by science (well established) (3.2.3).

Bosnia and Herzegovina is characterised by a high diversity of species of fish, amphibians, reptiles, birds, mammals, invertebrates, vascular plants, moss, cyanobacteria, algae, lichens and fungi (established, but incomplete) (3.6.12). The diversity of species of plants, animals and fungi in ecosystems in BiH is high (well established) (3.2.1.2). The high diversity of freshwater agnates and fish in BiH is reflected in the presence of 118 species and subspecies. Sea ichthyofauna is comprised of 12 representatives of fish with cartilaginous skeleton (seven species of sharks and five species of stingrays) and around 210 representatives of fish with bone skeleton (3.6.1). It is well known that there are 23 species of amphibians (well established) (3.6.2) and 34 species and 37 subspecies of reptiles (well established) in BiH (3.6.3). In BiH, to-date, research has recorded 351 species of birds (well established) (3.6.4), and among terrestrial mammals that occur in the wild, a total of 91 species

have been recorded (well established). To date, research on marine mammals in BiH's territorial waters have been insufficient (3.6.5). A total of 6,105 terrestrial invertebrates and 127 species of marine invertebrates have been recorded in BiH so far (established, but incomplete) (3.6.6). BiH is characterised by an exceptional floristic abundance of vascular plants taxa, and according to the latest research, cormophytes flora is made of 4,403 taxa in the species rank (3,317) and subspecies (1,086) (3.6.8). Available literature on mosses in BiH provide information on more than 560 species of liverworts and mosses, although there are geographical areas where mosses have not yet been adequately investigated despite their abundance in those ecosystems (3.6.9). According

to the latest data, lichens in BiH consist of 648 species (4 subspecies and 14 varieties), 13 non-lichenized or suspected lichenized species and 26 lichenicolous fungi (lichen ascomycetes), but this has also not yet been fully explored (3.6.10). The literature states that 552 species of fungi have been identified in BiH, however, according to the analysed literature sources and assessments of fungi research in BiH, their number exceeds 2,000 species (established, but incomplete) (3.6.11). Cyanobacteria and algae in BiH are represented by 2,373 species, out of which 1,859 occur in freshwater and terrestrial ecosystems and 514 are marine species. There are also a large number of habitats that are insufficiently explored or not explored at all (well established) (3.6.12).



Image 11. *Moltkia petraea* (Tratt.) Griseb. (Photo credits: Lubarda)

Research, inventories and collections on genetic resources in BiH show that there is a long tradition of cultivating native varieties of grain, fruits and grapevine, local varieties of vegetable, as well as traditions around the breeding of local animal breeds and use of medicinal and aromatic herbs in BiH (established, but incomplete) (3.7.1). BiH is recognised as the origin country for two dog breeds: the Bosnian and Herzegovinian - Croatian Shepherd Dog, also called Tornjak, and Bosnian Coarse-Haired Hound- Barak, the Bosnian and Herzegovinian mountain horse, and two native cattle breeds - Busha and Gatačko Cattle (well established) (3.7.2). A big challenge in the conservation of genetic diversity of endemic, rare and endangered species in BiH is the lack of scientific and technical data on established numbers of native plant and animal species that comprise a large portion of BiH's flora and fauna, and established parameters of nativeness. In BiH, there is very little action to conserve animal genetic resources, for example gene banks do not exist, and conservation projects are mainly implemented by individuals or associations on a small scale (3.7.4). Furthermore, poor management of forest ecosystems also diminishes genetic diversity and overuse of forest products may disrupt their ecological structures (3.7.5).

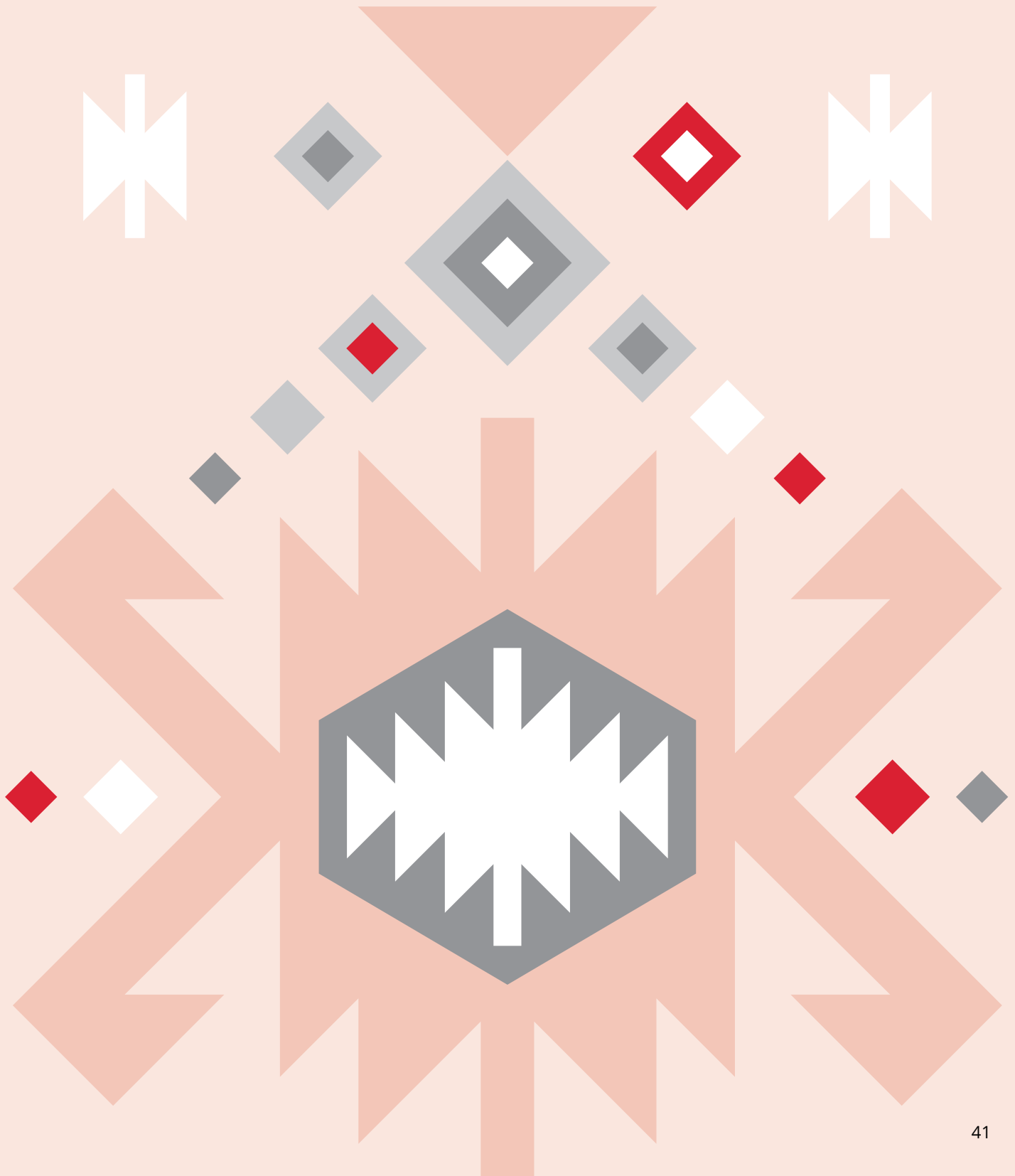
As a result of ecosystem functions, each type of ecosystem in BiH provides regulating, material and non-material NCPs. Three ecosystem groups (forest, water and agricultural) provide critical NCPs that are essential to the population of BiH (established, but incomplete) (3.1.1). Forest ecosystems are divided according to high productivity and low productivity based on their total wood mass. Forest ecosystems also provide important regulating functions such as reducing flood risks, carbon sequestration, climate regulation, air purification, soil generation and prevention of erosion, among others (3.1.1). Aquatic ecosystems include ecosystems of flowing waters, alpine creeks, lake ecosystems, wetlands and pond habitats, all of which play a key role in providing NCPs. Despite this, water ecosystems face high pressures from anthropogenic activities and continue to be degraded (3.1.1). Agricultural ecosystems are of great importance for the production of food and other ecosystem services that are derived from agrobiodiversity (3.1.1).

Due to poor opportunities for terrain explorations, documentation and monitoring of ecosystems, species and genetic diversity in BiH suffered a historical halt between the period of 1992 and the end of the 2010. The largest amount of data on biodiversity pertains to certain groups of species and ecosystems that were a focus of research, whereas for some ecosystems and species the data for this period are non-existent (well established) (3.10). The current state of data on biodiversity in BiH is the result of historical discontinuity in research and low capacities for new research during the past decades (well established). The knowledge gaps that have been identified in every chapter testify to this. Existing data on ecosystems are mostly outdated and scientifically inconsistent (3.9). The most data is available for areas around big cities or for areas that are of particular interest to researchers (for example, specific geological substrates, alpine areas or geomorphological phenomena) (3.10). A contemporary inventory of living organisms in BiH has not been conducted (3.6, 3.7). Some research has been conducted in more recent times (e.g., for vascular flora) but still very little is known about the overall biodiversity of BiH, particularly for some groups such as invertebrates, fungi and microorganisms (3.6).

There is a great abundance of traditional and local knowledge and practices regarding the use and conservation of biodiversity and ecosystem services in BiH, but its loss due to demographic changes is confirmed in our findings (well established). Biodiversity likely played a key role in the historical development of BiH due to its provision of natural resources (well established), but there is no systemic collection and documentation of traditional and local knowledge regarding biodiversity conservation and sustainable use of resources in BiH (3.3). In the last 100 years, industrialisation and depopulation of rural areas has led to declines in the intergenerational transmission of traditional and local knowledge and practices supporting biodiversity conservation (well established); and numerous crafts that traditionally used herbal products, especially forest products, are also declining (well established) (3.3.2). Traditional and local knowledge in BiH is at risk of disappearing. Currently in BiH, a large portion of traditional knowledge about the role of biodiversity and

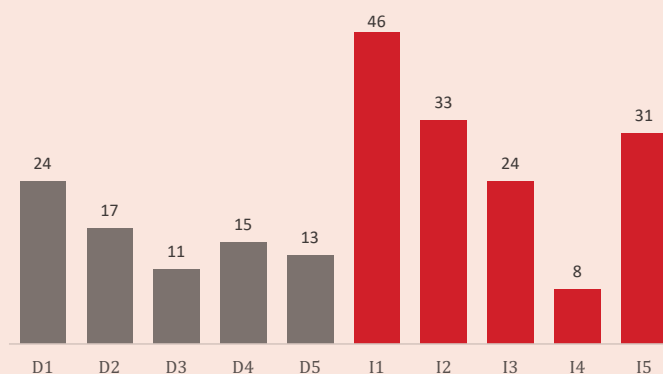
ecosystem services for the provision of food is completely neglected, and knowledge on medicinal herbs has partially survived due to its practical use in traditional medicine (3.3.4).

Growing numbers of alien invasive species of plants, animals and fungi are recorded in BiH, but there is no data on their distribution (well established). Currently, the distribution of alien invasive species and their direct impacts on native biodiversity in BiH is not sufficiently known (well established) (3.8.1).



3.3. CHAPTER 4

All direct drivers (such as habitat conversion, overexploitation of resources, pollution, invasive species and climate change) significantly impact the state of biodiversity and NCPs in BiH (well established) (4.2). Direct drivers rarely occur independently, and often exacerbate negative impacts on biodiversity and NCPs when combined with one another (well established) (4.4). Also, strong interaction of direct drivers through various systems impacts their trends (established, but incomplete) (4.2.6). The social drivers that to a lesser or greater extent indirectly impact the state and trends of nature and natural resources in BiH are institutional, economic, demographic, cultural and religious, as well as scientific and technical drivers (well established). (Graph 4) (4.3).




Graph 4. Graph showing the degree to which local communities recognized direct (D1–D5) and indirect (I1–I5) drivers affect nature in Bosnia and Herzegovina (Barudanović et al., 2023)

Conversion and degradation of habitats is one of the most pronounced direct drivers affecting the state of biodiversity and NCPs in BiH (well established) (4.2.1). In BiH, there is a continuous trend in the spatial reduction of agricultural areas. The following factors have contributed to the neglect of agricultural land which in turn has caused ecological succession: construction of settlements, roads, industrial and other facilities and infrastructures, water accumulation, erosion and landslides, surface exploitation of various raw materials, waste disposal, and more (well established) (4.2.1.1). Land cover change in the forest vegetation class and other land types is the result of two parallel processes : (1) progressive succession - expansion of forests that spread to available areas or regeneration of damaged forest vegetation and (2) regressive succession - degradation of forest cover (well established). Unregulated and ad hoc construction has resulted in evident degradation of natural ecosystems and habitat conversion. Finally, expansion of artificial areas is one of the biggest direct threats to natural habitats (established, but incomplete) (4.2.1.3). Although BiH has some of the most abundant biodiversity in Europe, its importance and contributions of resource provision is insufficiently recognised and environmentally sensitive areas are not adequately protected, noting that only 3.46% of the total area of BiH is currently

designated as protected areas (well established) (4.2.1.7).

Overuse of resources forestry and fishery resources, overhunting, as well as unregulated use of water and mineral extraction are a significant negative driver affecting the state of biodiversity and NCPs in BiH (well established) (4.2.2). According to official data, only around 50% of annual increment is being cut from BiH's productive forests, and around 43% in coppice forests out of the total annual harvest. It can therefore be concluded that the management of the forest resources in BiH is currently at sustainable levels (well established) (4.2.2.1). However, uneven use of forest resources in the forestry sector combined with the fact that forestry is often concentrated in small areas and particular sites, has led to a generally poor public perception of the forestry sector (established, but incomplete). Due to knowledge gaps, the potential and current scope for the utilisation of non-timber forest products in BiH cannot be fully determined and established (well established) (4.2.2.1). The main challenges for BiH's hunting sector are because of fragmentation and differences in legislations among the Entities (including different interpretations of the legislation), lack of skilled labour, narrow and private interests and in many cases absence of adequate institutional support (well established) (4.2.2.2). BiH's



fish stocks are mostly affected by the construction of barriers on rivers which prevents reproduction. The most endangered fish species in open waters are salmonids and sturgeons. Significant negative drivers in the fishing industry also occur as a result of unregulated intake and restocking of water bodies with invasive alien species that compete with native fish stock. Pressures also arise from fisherfolk focusing mainly on catching the most economically valuable fish species based on market prices and demand. Significant impacts can also be seen in changes in the level of water quality, caused by various factors such as water contamination, barrier construction in water bodies and climate change (well established) (4.2.2.4). Results from the assessment show that the dominant negative driver to the groundwater quality is the flow of agricultural chemicals into the water table. Large and small hydropower plants have multiple impacts on the environment and to surface water bodies in BiH including interruption of river flow, change in hydrological regime, change in riverbed geometry, change from flowing to static water, change in composition and receding of banks, fouling of banks, microclimatic changes, changes in granulometric composition of riverbed, and impact on plant and animal communities in terms of changes to habitat and composition of species. The negative impacts from settlements without structured wastewater drainage and from landfills are significantly smaller (well established) (4.2.2.4). In BiH, production of wastewater is most common in households, followed by industry and agriculture (established, but incomplete) (4.2.2.4.1). As in the rest of the world, water extracted from groundwater sources is most commonly used in BiH (well established) (4.2.2.4.1). The use of water in BiH is historically characterised by an extremely high rate of water loss, but in recent years, there has been a decline in a loss trend (well established). The use of water (through anthropogenic activity) results in a decline of water quality in water bodies (well established). These changes to the conditions of water bodies directly impact some populations of flora and fauna species and lead to their decline, but also lead to the occurrence of new adapted species (established, but incomplete) (4.2.2.4.1). The global impact of mineral extraction and fossil fuels on nature is undisputable and well documented, but BiH lacks research on how

these activities impact the state, changes and trends of ecosystems in BiH. Based on available limited literature, it has been proven that the extraction of minerals and fossil fuels has negative impacts on biodiversity and NCPs in BiH (established, but incomplete) (4.2.1.4.2). Finally, there is a clear lack of measures for monitoring resource use in BiH, as well weak application of modern technologies for environment protection and conservation.

Pollution is the biggest driver affecting biodiversity, NCPs and public health. Pollution of soil, water and air is an issue of concern in BiH (well established) (4.2.3). The biggest soil pollution is found in the industrial areas. Most of the landfills are inadequately rehabilitated. BiH is one of the most mine polluted countries in the world (established, but incomplete) (4.2.3.1). Decline of surface water quality in BiH can be attributed to industrial growth and unregulated discharge of untreated wastewater, lack of an adequate sewage network and insufficient wastewater treatment plants (well established) (4.2.3.2). The biggest pressure on groundwater comes from agricultural land use, including contamination through use of pesticides and fertilizers and silage effects. There is an increasing trend of secondary treatment of (municipal) wastewater (established, but incomplete) (4.2.3.2) (Image 5). During winter, the air in Sarajevo is some of the most polluted in the world. Air quality is being monitored in some BiH cities. Globally, the impacts of air pollution on nature is well evidenced and well documented, whereas BiH lacks research on how air pollution affects state, changes and trends in nature (well established) (4.2.3.2). Levels of naturally occurring radionuclides in soil samples from BiH were found to be consistent with global average values. Depleted uranium was detected in the area of Hadžići and Han-Pijesak. However, tests from all the study locations indicate that levels of depleted uranium were within accepted limits and bear no risk to human health and environment. It is estimated that more than 3.3 tons of ammunition with depleted uranium were dropped in BiH during NATO raids in 1995 (established, but incomplete) (4.2.3.4). Finally, there is an evident lack of robust science based monitoring of pollution levels and their associated trends in BiH.



Image 12. ArcelorMittal Zenica - Coke production plant (Photo credits: UG Eko forum Zenica)

Invasive species are a growing negative driver that are increasingly impacting biodiversity in BiH (well established) (4.2.4). Invasive species grew in number for all taxonomy groups in BiH, which has serious repercussions for BiH's biodiversity and NCPs (established, but incomplete). Although monitoring and control of foreign invasive species are included in the National Strategy and Action Plan for the Protection of Biodiversity in BiH, there is still no system in place to prevent them entering the environment in BiH nor a plan for tackling the invasive species already present. Again, there is currently a clear lack of science-based monitoring (well established) (4.2.4.1).

Climate change is a growing negative driver that is impacting biodiversity and ecosystem services in BiH (well established) (4.2.5). It can be predicted with a high level of certainty that climate change will leave its mark on the nature of BiH (Image 13). There is a need for systematic research on the spatial and temporal impacts of climate change in BiH through establishment of long terms systems for monitoring (4.2.5.1).

Based on the little research conducted in BiH on the environmental impacts of climate change, the findings confirm that there have been significant impacts on the growth and phenology of plants confirmed (established, but incomplete) (4.2.5.1.1). The research also confirms a lack of research on the impacts of climate change in BiH (well established) (4.2.5.1.1). There is no research in BiH on how climate change impacts ecological processes and ecosystem function (well established) (4.2.5.1.2) although negative impacts are expected (well established) (4.2.5.1.2). There is no research in BiH on the impacts of extreme weather events on biodiversity and ecosystem services (well established) (4.2.5.1.3). In the last few decades, a significant increase in air temperature in BiH was recorded (well established). Although temperature increase was recorded in all seasons, the biggest increase occurs in summers, whereas the autumn temperature increase was only incremental (well established). Change in the precipitation regimes showed no coherent spatial or temporal trends (there are both positive and negative trends) in annual, seasonal and monthly precipitation (well established). Significantly larger-

scale changes were established in the patterns of seasonal precipitation compared to changes in the total annual quantities of precipitation - the most pronounced changes are demonstrated by lower levels of precipitation in the summer season and increased levels of precipitation in the autumn season (well established) (4.2.5.2). Climate change brings about changes in frequency, intensity, spatial coverage and duration of weather and extreme weather events such as heat waves, drought, floods, fires and windstorms in BiH (established, but incomplete) (4.2.5.2.1). Extreme temperature indexes are based on absolute values, and indexes of warm days, warm nights, duration of heat waves, summer days, tropical days, tropical nights show pronounced positive trends in BiH, whereas cold indexes (cold days, cold nights, duration of cold waves, freezing days, frosty days) show a downward trends (well established) (4.2.5.2.1). Changes in precipitation levels throughout the year (especially negative trend in summer season), along with temperature rise, are the key factors for increased occurrence of drought in BiH (established, but incomplete) (4.2.5.2.1). Current trends in extreme weather events are difficult to assess due to a lack of

research that covers the entire territory of BiH and the fact that extreme events are rare in frequency (well established) (4.2.5.2.1). Record high CO₂ concentrations are recorded nowadays. All scenarios until the end of the 21st century show that CO₂ concentrations will continue to rise (well established) (4.2.5.2.2). Projections in air temperature until the end of the 21st century also show that air temperatures will continue to rise throughout the country (well established) (4.2.5.2).

Temperature rise will occur in all seasons, especially in summer. By the end of the 21st century, precipitation will decrease in most parts of BiH, on a gradual annual basis and in certain seasons (especially in summers) (well established) (4.2.5.2). Economic growth and per capita consumption are the main causes of increasing greenhouse gasses emission globally (well established) (4.3.4). Although per capita emissions in BiH are less than the EU average, emissions relative to GDP are almost five times higher than in the European Union, which indicates reckless use of natural resources (primarily energy) (well established) (4.3.4).

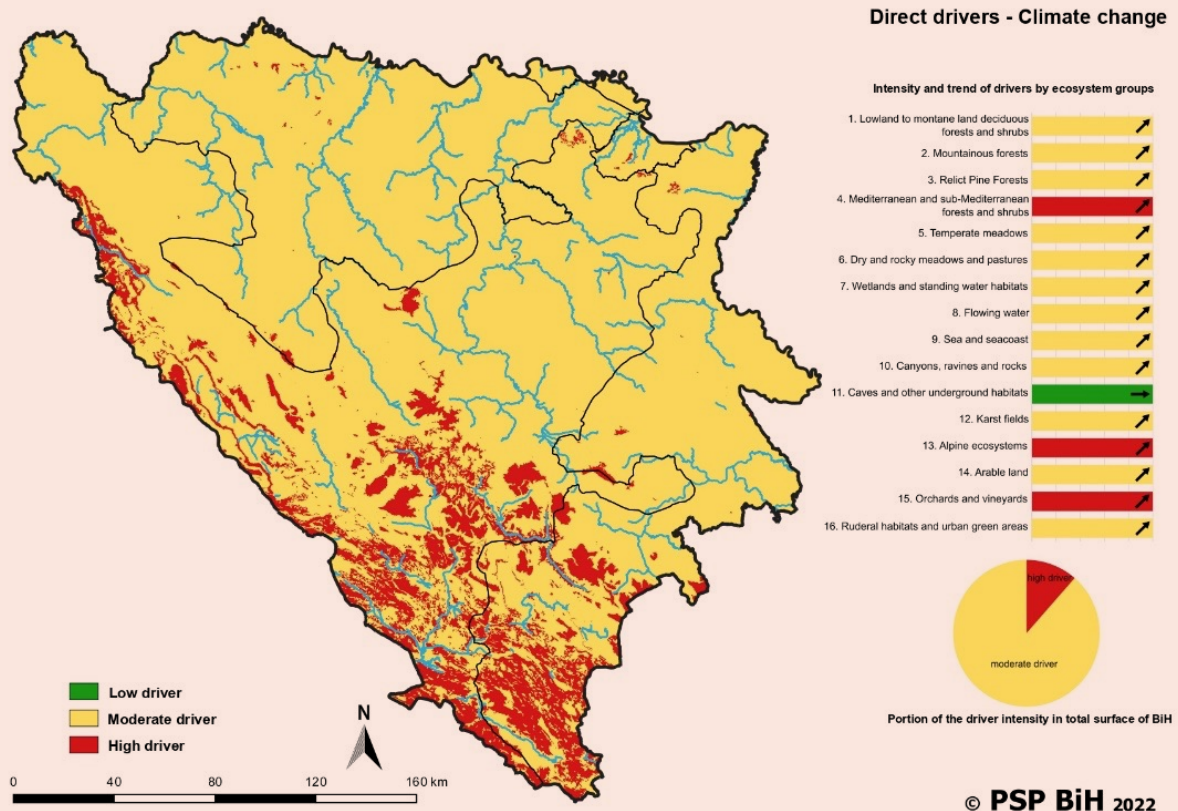


Image 13. Spatial visualisation of the direct impacts of climate change on NCPs across the territory of BiH (Stupar et al., 2022)

Institutional indirect drivers in BiH result from inconsistent implementation of regulations, complex institutional frameworks and observed unlawful environmental actions (well established) (4.3.3, 4.3.5). Adoption of a set of environmental laws in all of BiH's administrative units, including the Law on Nature Protection as a fundamental law regulating the use and management of biodiversity, provided the legal protection of nature and natural resources in BiH in the early 21st century. However, incomplete and undeveloped by-laws prevent effective and efficient implementation of the law in practice (well established) (4.3.3). Moreover, at the institutional level there are pressures resulting from a lack of organisational structure and coordination mechanisms for the effective implementation of international treaties. In addition, there is poor and limited horizontal and vertical interinstitutional cooperation, inadequate integration of biodiversity values in sectoral and intersectoral policies and absence of coordination and cooperation across sectors, absence of expert institutions for nature protection at the state and Entity levels, and absence of public institutions for the governance of the protected areas. Responsible institutions operate with limited human resources, both in terms of number of employees relative to the scale and scope of work and in terms of expertise (well established) (4.3.3). All levels of legislative power in BiH are characterised by insufficient democracy and transparency in decision-making processes regarding the use of biodiversity and natural resources. In addition to the above, there is a chronic lack of funds for implementation and enforcement of regulations, and for scientific research and expert activities that support the protection and preservation of nature (established, but incomplete) (4.3.3). Environmental challenges in BiH are linked to systemic corruption which often manifests in the form of administrative corruption through bribery, nepotism and similar, but also through chronic political corruption. Such conditions enable individuals and interest groups, who seek to gain benefits for themselves or others, to exert influence via informal channels on decision-making processes in the legislative, executive and judicial bodies, with little regard for how these decisions contribute to irrevocable damage to nature and natural resources in BiH (established, but incomplete) (4.3.3).

Indirect economic drivers affecting biodiversity and ecosystem services in BiH primarily arise from BiH's complex process of economic transition and economic activities that are mostly dependent on the use of natural resources for manufacturing marketable products (well established) (4.3.4, 4.3.5, 4.3.9). In the last 100 years, specific forms of industrial development in BiH (coal mining, smelteries, heavy industry, chemical industry, processing industry, etc.) changed the state of biodiversity and ecosystems to a very large extent (Image 14). Development and expansion of the energy sector (hydroaccumulation and thermal powerplants) resulted in the degradation of entire habitats, destroying entire areas of that are of international ecological significance (such as Buško blato and Popovo polje) (well established) (4.3.9). BiH's economy has been through a long period of transition and is characterised by an inadequate restructuring and privatisation process, fragmented market, weak legislation and regulatory frameworks, current business practices and key economic reforms (well established) (4.3.5). BiH's current policies on the use of natural resources for manufacturing of marketable products are not sustainable. Although principles for the sustainable production and use of natural resources are integrated into many sectoral strategies and plans in BiH, companies, especially those companies that depend on a range of natural resources, are not sufficiently informed on how their business activities impact nature and make no attempts to use natural resources in a sustainable manner. In addition, industrial processes in BiH do not have measures in place to ensure efficiency in the use of natural resources (established, but incomplete) (4.3.9). Finally, a system established on principles of unsustainability restricts the potential for economic growth and sustainable development, negatively impacts investments, administrative procedures and political stability. There is currently a lack of support for the promotion and implementation of principles for sustainable development and poverty reduction through economic and social development programs (well established) (4.3.4).

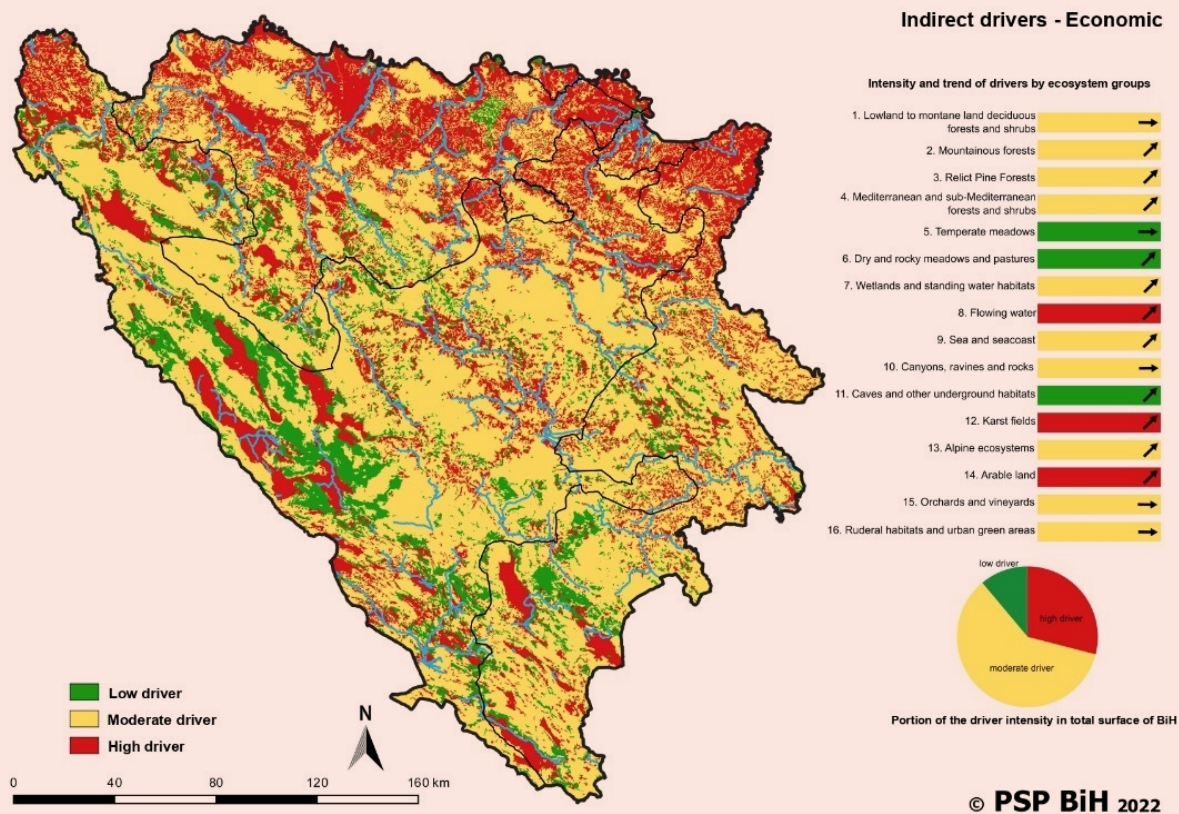


Image 14. Image showing the spatial distribution of economic drivers that affect NCPs across the territory of BiH (Stupar et al., 2022)

Negative demographic trends that are linked to the overall social and economic circumstances of BiH, shape population density and affect the state of the nature and natural resources in BiH (well established) (4.3.6, 4.3.9). Armed conflict that took place from 1992 to 1995 significantly changed the demographic structure of BiH. The country is currently experiencing one of the lowest fertility rates globally, a population with high average age, and high rates of emigration (mostly among people of a working age any young people) (well established) (4.3.6). Also, uneven development of urban and rural areas due to migration patterns from less developed parts of the country to more developed parts of the country (Banja Luka, Sarajevo, Tuzla, Mostar, Zenica, Trebinje etc.) is a huge factor in demographic change (well established) (4.3.6).

With the entailing economic and other social drivers, such unfavourable demographic trends impact conversion of the habitats. Migrations of people from high altitude areas - rural areas - left vast areas unpopulated. At the same time, such migrations created huge pressures in urban areas, which is consequently reflected in further urbanisation. Unpopulated areas, that were for centuries formed by nature and people, domestic animals etc., took the succession road, thus leaving some very sensitive habitats reduced, with tendency of further reduction (well established) (4.3.6). Internal migrations and emigrations of BiH population negatively reflect on traditional and local knowledge and practices (4.3.9).

Cultural and religious indirect pressures were not recognised as a significant threat to biodiversity and ecosystem services. However, nowadays, human-nature relationship in BiH is characterized by the low interest to assume a role and responsibilities to conserve and protect biodiversity. Nevertheless, green activism as a form of organised action aimed at preserving biodiversity has intensified in BiH (established, but incomplete) (4.3.7, 4.3.9). There is low public awareness campaigns and initiatives by governmental bodies at all levels, education institutions, media and society in general, on the importance and value of biodiversity and ecosystem services and viable strategies to conserve and protect biodiversity (well established) (4.3.7). Although current public awareness raising is present in all segments of the society, the relationship of the public towards the environment shows that the undertaken initiatives and campaigns are insufficient and that additional efforts must be made to sensitize and educate the public on environmental conservation. There

are tendencies among some local communities to oppose the establishment of protected areas in their territories due to concerns that protected areas would restrict their access and use rights to natural resources, and partly due to their lack of awareness of the potential economic opportunities that could emerge with such a designation, and possibly because of limited community engagement in the designation process coupled with limited understanding by external stakeholders about local communities' priorities, and failure to effectively integrate cultural practices and values in the designation process. (established, but incomplete) (4.3.9). However, cultural and religious factors, as indirect drivers, often have a positive impact on biodiversity. For example, in BiH autochthone population of rural areas use traditional and local knowledge in daily practices therefore contributing to conservation of biodiversity and ecosystem services in their living areas. (established, but incomplete) (Image 15) (4.3.9).

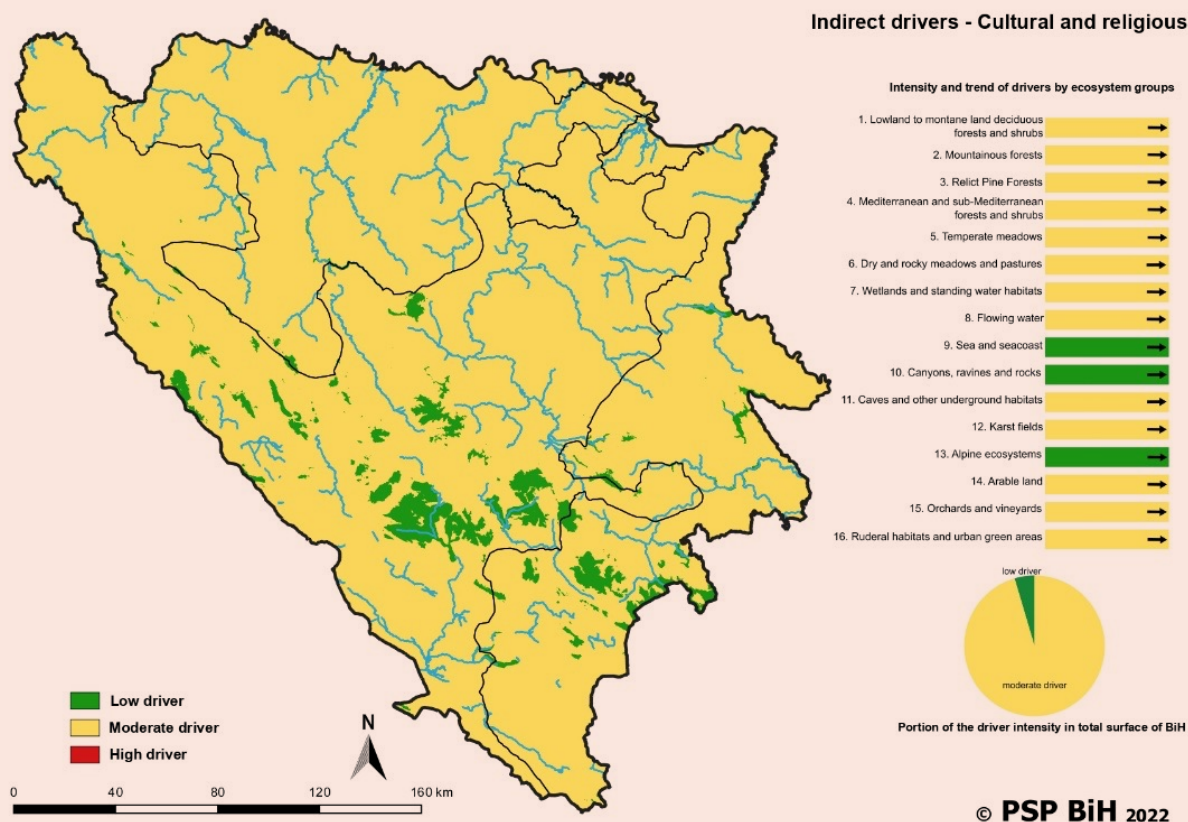
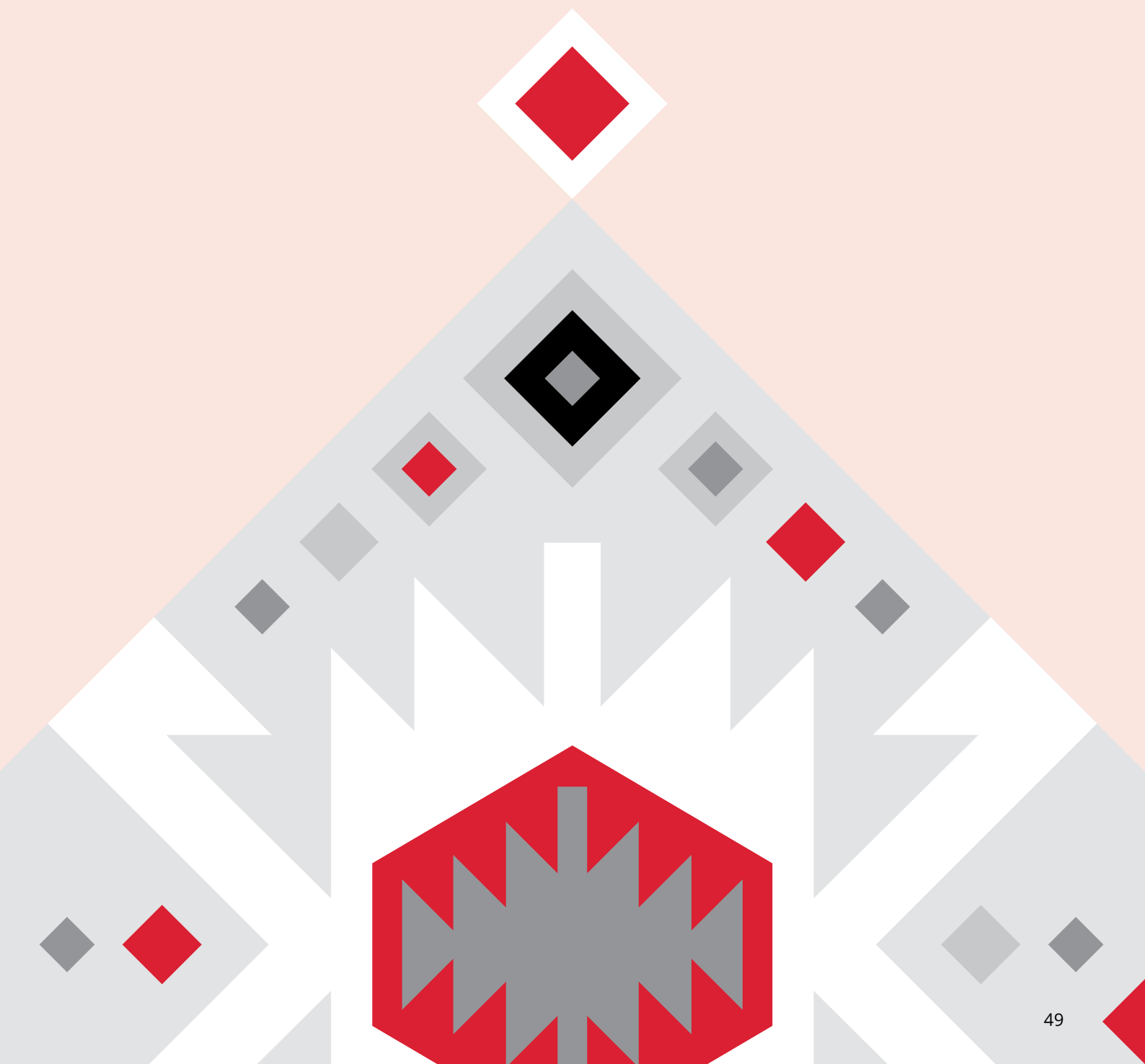


Image 15. Cultural and religious indirect drivers affecting NCP (Stupar et al., 2022)

Due to unfavourable status of science caused by low-scale scientific research, technical and financial capacities, and lack of cooperation and communication, the scientific community has an inadequate impact on modern challenges related to biodiversity conservation (well established) (4.3.8). Funds planned for the financing of projects and scientific research, which contribute to achieving biodiversity goals in BiH, although relevant, are not significantly relevant to their proportion in the overall expenditures of the entity budgets (well established) (4.3.8). Implementation of these funds is not always carried out in a coordinated manner, and they do

not enable full achievement of goals to protect biodiversity (well established) (4.3.8). Insufficient material and institutional capacities contribute to a low level of transformation of scientific research into publications and innovations, which could be a positive driver to biodiversity (well established) (4.3.8). Although the Clearing House Mechanism was established in BiH, with the aim of providing efficient information service, promoting and enabling scientific and technical cooperation, knowledge sharing and data exchange. However databases have not been created as yet for all scientific research institutions and experts in the area of biodiversity (well established) (4.3.8).



3.4. CHAPTER 5

Scenarios are a tool for providing information to decision makers for the purpose of assessing the impact of policy measures on future development and the state of nature (well established) (5.1). Models and scenarios are important tools for better understanding of complex interactions between nature and society. Using a scenario approach can bring a number of benefits to decision-making, especially in case of decisions that prioritise long-term NCPs (well-established) (5.1.2). Despite the complexity of the challenges that society will face in the future, understanding the potential impacts that drivers can have on the state of nature and NCPs, and understanding the key connections between system components is important for informed decision-making and development of efficient governance strategies. Scenarios and models provide an opportunity to understand the causes and consequences of changes in nature in an objective and holistic way (well established) (5.1). Scenarios represent possible and usually simplified descriptions of how the future might develop, and these descriptions are based on a consistent set of assumptions about the key drivers and their relationships (well established) (5.1.2). It is possible to use more dimensions and more factors for practical development of scenario, which increases the complexity of the system being described, but provides potentially closer descriptions of possible futures in relation to two-axes approach (well established) (5.1.2). The main benefits of using scenarios and models are better understanding of the processes, connections and sequences of events that can give a better insight into what the future state of nature will be (well established) (5.1.2). Tools that can support decision-making contribute to such decisions having an advantage over ad hoc decisions because they provide information on the potential outcomes of decisions (well established) (5.1.2).

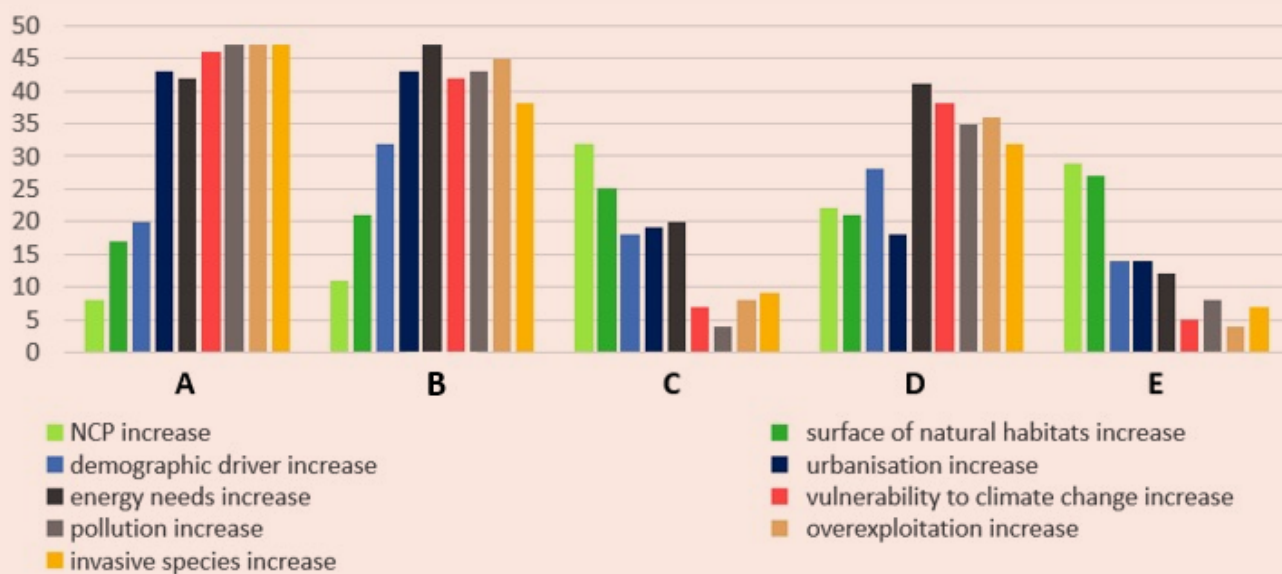
So far, the scenario analyses were used in BiH exclusively for predicting the effects of climate change. Different types of scenarios can be used in making decisions related to the state of biodiversity and NCPs (well established) (5.1). There are no known sources and examples where models and scenarios are used to make decisions that have an impact on the state of nature and NCPs in Bosnia and Herzegovina (well established) (5.1.2). Scenarios of impact on nature and NCPs can be used in all stages of decision-making. In terms of the goal and method of implementation, scenarios are divided into four groups: (i) research scenarios, (ii) goal defining scenarios, (iii) scenarios for evaluating the effectiveness of previous decisions and (iv) scenarios for predicting the effectiveness of future decisions. Research scenarios are primarily used in the agenda-setting stage, and in the simplest case they represent the extrapolation of current trends in the state of nature into the future. The second group of scenarios is used as a tool to test the sustainability and effectiveness of different paths to a previously defined objective. The third group of scenarios is used to predict the effects of alternative policy or governance interventions on biodiversity outcomes, in search of answers to the question: "What would have happened if different decisions were made?" The last group of scenarios analyses the effects of decisions or governance frameworks that were previously adopted and compares them with alternative decisions and practices. This analysis provides an answer to the question: "Did the decisions made achieve the desired objectives and outcomes?" (well established) (5.1.2).

A key determinant of the BiH's development is the commitment to implementation of the Green Agenda for the Western Balkans, which includes climate neutrality, circular economy, biodiversity protection, action against water, air and soil pollution, sustainability of rural areas and food systems. The key factors of sustainable development are adaptation to climate change through reduction of direct and indirect drivers in order to improve the quality of life and stop negative demographic trends (well established) (5.2, 5.3, 4.2, 4.3).

Due to an undeniable link between the systems on global and regional spatial scales, it is important to frame the assessment of the future state of nature in BiH in global and regional processes and, therewith, in global and regional descriptions of possible futures (5.2.1). In terms of achievement of the sustainable development goals, BiH ranked 71st out of 156 countries included in the analysis in 2018. In order to achieve sustainable development, BiH strives to separate economic growth from negative effects on the environment (well established) (5.5). The assessment of the future state of nature in BiH is based on predictable socioeconomic patterns and the predictable intensity of climate change (5.2.1). The most extreme increase can be expected by the end of 21st century, when average annual temperature might raise for 5°C (well established) (5.3.1.2). Such an increase is expected if the greenhouse emissions are not decreased. According to the same scenarios, a significant change in precipitation distribution during a year is expected in BiH. A great deficit of precipitation, particularly in the summer period, can be expected towards the end of 21st century. However, the change in precipitation will also manifest through an increase of precipitation intensity causing torrential and urban flooding (well established

(5.3.1.2). In addition to climate changes, the state of nature and NCP depend on the intensity of a series of direct and indirect drivers (5.3.1, 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.3.3, 4.3.4, 4.3.5, 4.3.7, 4.3.8). Negative demographic trends, which are related to general social and economic circumstances in BiH, affect population and the state of nature and natural resources (well established) (4.3.6). A significant population decline is predicted for Bosnia and Herzegovina by 2050 in all scenarios. BiH is faced with population aging. Population decline would be accompanied with changes in the age structure of the population, with a significantly larger share of the elderly population. Natural and economic resources of rural areas are underutilised due to the fact that the young population is abandoning those areas, leaving behind elderly population. These changes can lead to changes in the socioeconomic drivers that can further impact on the state of nature and NCPs (well established) (5.3.1.1). The Green Agenda for the Western Balkans is based on the European Green Deal plan, which represents a set of policies and measures to make the European Union climate neutral by 2050. The European Green Deal plan, and thus the Green Agenda for the Western Balkans, is a way to enhance the efficient use of resources by moving to a clean, circular economy and to restore biodiversity and reduce pollution (well established) (5.2.1). Bosnia and Herzegovina, a country rich in natural resources, is making efforts to meet the objectives of the Green Agenda for the Western Balkans in the next 10 years and to adopt the principles of circular economy and decarbonisation (well established) (5.2.1).

Outcomes of the scenario analysis are five possible development scenarios in BiH, namely: development scenario according to usual practices (A), economic growth scenario based on intensive use of resources (B), integrated governance of nature and NCP scenario towards the climate neutrality (C), food production scenario as a development priority (D) and the expansion of protected areas scenario as a development priority (E) (well established) (5.6).



Graph 5. Acceptability of development scenarios

One of the key characteristics in scenario A is the use of fossil fuels for energy production and low resource efficiency, causing pressure on nature (exploitation, transport, emissions) and global climate change (Graph 5). The scenario is characterised by high resource intensity, resulting in depletion of natural resources and great pressure on all ecosystems, with a relatively low level of economic development (well established) (5.6.1). The economic growth rate in scenario B is higher than in scenario A. Higher economic growth rate is a consequence of more intensive exploitation of natural resources, both renewable and non-renewable. A higher economic growth rate reduces population outflow, causing population growth, which, in turn significantly increases the need for energy. The development of agriculture and food production in circumstances of climate change puts pressure on water resources due to intensive irrigation. The impact on climate change is increasing due to the increase in greenhouse gas emissions (5.6.2). Scenario C is on the verge of meeting the BiH's goal of climate neutrality by 2050 with a high level of implementation of environmental protection strategies at all levels of authority. The exploitation and use of coal is reduced in this scenario, i.e. it entails complete

decarbonisation of electricity production. The use of renewable resources for energy production is carried out in an integrated manner, accompanied with investment in climate change adaptation measures. This scenario implies a high level of integration and cooperation with the EU and the use of global funds for climate change mitigation and adaptation (well established) (5.6.3). According to this scenario, agriculture is expanded to almost all arable land and a larger share of the total production comes from large-scale commercial agriculture. Large areas, which are currently rural, are becoming urbanised. Resource consumption and greenhouse gas emissions per capita are increasing. Exposures to climate changes may be increased, but the level of adaptation is increasing to reduce overall vulnerability. Demand and energy production are changing in scenario B, and intensive use of surface and groundwater for irrigation creates additional pressure on the ecosystems (well established) (5.6.4). Scenario D is based on a large ($\geq 30\%$) expansion of protected areas as a factor for the sustainable development of local communities. The sustainability of nature, ecosystem services and natural resources is ensured in this scenario. The possibilities of tourism development are exploited, which, due to

the construction of new infrastructures, can lead to habitat conversion and increased pollution in protected and unprotected areas. The possibility of sequestration (sinks) of greenhouse gases increases and resistance to climate change grows due to an increase in protected areas. Limited economic activities are carried out in protected areas, so pressures such as urbanisation, land use changes, intensive agriculture, etc. are more distinct in other areas (well established) (5.6.5).

Integrated governance of nature and NCPs, in the direction of climate neutrality, provides opportunities for of the preservation biological diversity along with economic development in BiH. Integrated development requires improvement of the existing governance practices in terms of nature, NCPs and drivers affecting nature. Continuation of current economic development patterns leads to further loss of biological diversity and NCPs in BiH (well established) (5.6, 6.4). Integrated (multisectoral) application of the EU acquis could contribute to change in the current state of biodiversity governance options, in view of the potential for: (a) consolidation and better utilisation of existing institutional, scientific and financial capacities, (b) integration of biodiversity protection into activities leading to climate change neutrality, (c) easier integration into sectoral policies and (d) access to funds for BiH as a Western Balkan country with the EU candidate status (well established) (6.5). The views of a wide range of stakeholders were collected due to the lack of scientific sources and quality indicators to assess the impact of different development scenarios on nature and ecosystem services. The views show that intense pressures such as the urbanisation growth, overexploitation, pollution, energy demand, vulnerability to climate change and pressure of invasive alien species continue to be present in scenarios A, B and D, while scenarios C and E show the growth of NCPs and small loss of natural habitat areas. The integrated governance of nature and NCP scenario includes the advantages of the EU acquis transposition and implementation and the establishment of ecological networks at the level of entities and the Brčko District of BiH. Although the growth of pressures of urbanisation, the need for energy, pollution, overexploitation of resources and pressure of invasive species is lower in scenario E than in the integrated governance scenario C, it should be taken into account that increasing

protected areas coverage to $\geq 30\%$ of BiH would instigate stronger pressures on the remaining 70% of the territory. In the long term, this can lead to a greater loss of natural habitats and an increase in pressures on unprotected areas than it would be the case with the integrated governance scenario (C). The integrated governance scenario also includes an increase of the areas under protection by a certain percentage (well established) (5.6.6). The development of BiH according to the integrated governance of nature and NCP scenario is directly dependent on the level of fulfilment of necessary conditions, namely: (i) integration of conservation and sustainable use of nature into sectoral policies, (ii) implementation of plans, establishment of monitoring and reporting, (iii) building of institutional and scientific research capacities, securing financial capacities, (iv) integration of traditional and local knowledge into formal education, (v) public participation in decision-making, (vi) communication and knowledge sharing, (vii) promotion of positive local community attitudes towards biodiversity, (viii) active fight against indirect drivers in the society and (ix) inclusion of traditional and local knowledge into decision-making (well established) (6.4).

There is an apparent lack of research and tools for scenario analysis in BiH, which limits science-based decision making (well established) (5.1.2, 5.3.1, 6.4). Lack of knowledge, as well as lack of scientific and technical sources for preparation and use of scenarios in the processes of planning and decision-making about biodiversity, are very prominent in BiH. There is an evident lack of primary data on biodiversity, which are necessary for modelling in the assessment of the state of nature (well established) (5.1.2). Demographic data is also the base for preparing scenarios about the future state of nature, and there is also lack of sources about population movement scenarios. There is also a significant lack of data and literature on the potential impacts of population changes on the state of nature (well established) (5.3.1.1). The system of statistical institutes in BiH is complex and insufficiently supplied with data relevant for scenario preparation. Preparation, monitoring and use of indicators are limited. Indicators in the area of biodiversity and ecosystem services are not functional and are not aligned with indicators used internationally (6.3.2.3).

3.5. CHAPTER 6

Through policies for the conservation and sustainable use of biodiversity, BiH committed to contribute to global, European and Western Balkans goals. In line with the vision of climate neutrality by 2050, conservation of biodiversity and restoration of degraded ecosystems is the main strategic direction for governance of biodiversity in BiH (well established) (6.1.1).

BiH aligned its goals with the Strategic Plan for Biodiversity 2011 - 2020 by adopting NBSAP in 2015 (well established) (6.1.1). Insufficient progress made in the NBSAP's implementation indicates both the need to build new, but also to consolidate existing capacities of BiH's institutional framework for nature conservation and sustainable use of natural resources (well established) (6.1.1). Better progress in the implementation of NBSAP requires strengthening of legislative (well established) (6.1.2.1), institutional (well established) (6.1.2.2) and financial frameworks (well established) (6.3.3.3) that can be significantly supported by fully aligning of environmental and sectoral regulations with the EU acquis and their implementation (well established) (6.1.2.1). BiH revised its NBSAP in accordance with the Kunming-Montreal Globally Biodiversity Framework (well established) (6.1.1), and has prepared the first version of the integrated National Energy and Climate Plan 2021–2030 (well established) (6.2.6.7), which analyses scenarios for achieving climate neutrality by 2050.


Although BiH acceded to a large number of international treaties related to the protection of biodiversity, species and ecosystems, it still did not accede to treaties supporting conservation of gene diversity and related indigenous knowledge (well established) (6.1.1, 6.3.9).

With the exception of incentives for the cultivation of the indigenous plant varieties and animal, traditional and local knowledge about biodiversity is not included in decision-making processes in BiH (well established) (6.3.9). Opportunities identified so far for the inclusion of indigenous and local knowledge in the decision-making processes are the establishment of centres for traditional and local knowledge combining formal and indigenous knowledge in the education system, and access to the Nagoya

Protocol and ITPGRFA (well established) (6.3.9). The inclusion of indigenous and local knowledge in decision-making requires the support of both higher and local level administrations (well established) (6.3.9).

Governance of biodiversity and NCPs in BiH relies on a very complex institutional and legal framework. Growing pressures in the period of social and economic transition, the slow process of aligning with the EU acquis, horizontal and vertical inconsistency of legislation and fragmented decision-making on nature and natural resources create increasing risks for the loss of biodiversity and natural habitats in BiH (well established) (6.1.2.1, 6.1.2.2, 6.3.2.1).

Public institutions dealing with environment and nature in BiH are established in accordance with the constitutional distribution of competences at different levels of authority; however, the institutions responsible for the adoption and implementation of the legal framework for the protection of biodiversity and the environment are not responsible for the adoption and implementation of the legal framework for NCPs. In F BiH, the institutional framework is more complex (well established) (6.1.2.2). The existing institutions are not sufficiently staffed for overseeing and implementing the adopted regulations (established, but incomplete) (6.1.2.2). Horizontal legislation is aligned with the EU acquis to a limited extent. A lack of vertical alignment of legislation among different administrative levels in BiH is evident, as well as lack of horizontal alignment among different sectors within individual administrative units. Laws on the protection of nature and environment are not aligned (well established) (6.1.2.1). Coordination of activities in BiH, with the aim of improving the legal framework for conservation and sustainable use of biodiversity (NCP) is not established to a satisfactory extent (well established) (6.1.2.1, 6.3.2.1). The environmental permits procedure is not sufficiently transparent (well-established) (6.2.2.2) and, together with the environmental impact assessment, does not ensure sufficient protection of biological diversity in development activities (established, but incomplete) (6.2.2.2).



In BiH, a number of regulatory, economic and information instruments/tools for sustainable governance of biodiversity and NCPs are available. However, the current level and quality of application of the existing tools/instruments are not sufficient to ensure permanent conservation of biodiversity in BiH (well established) (6.2, 6.4).

Instruments/tools of different categories are used for the management of biodiversity and sustainable use of NCPs in BiH. The extent and quality of their application are not at a satisfactory level. Capacities for applying of the above-mentioned instruments are insufficient. The application of instruments is not consistent in BiH (well established) (6.4). The perceived efficiency of tools/instruments for the conservation and sustainable use of NCPs is higher among key stakeholders' compared to actors in the non-governmental sector, according to sources (established, but incomplete) (6.4). Access to information, public participation and social justice measures are not at a satisfactory level due to the lack of publicly available information and the late involvement of the public in the decision-making process (well established) (6.3.5). The size and coverage of protected areas in BiH is low, and their effectiveness in protecting endangered biodiversity has not been studied (well established) (6.2.2.1). Although relevant regulations in BiH enable the integrated issuance of permits, the permit issuance process is fragmented, and the permits are issued by different authorities without coordination. Separate permits are issued for air, land and water pollution, and there are no coordinated inspection efforts (well established) (6.2.2.2). The red lists of F BiH, RS and BD of BiH are not mutually aligned or do not exist (well established) (6.2.1.1). There are no ex-situ conservation programs for native endangered species in botanical gardens and zoos in BiH (well established) (6.2.1.2). There is no adequate legal framework for the ex-situ conservation of gene resources and the establishment of gene banks (well established) (6.2.3.1). The professional public is not aware of the potential benefits arising from use of seed bank facilities (established, but incomplete) (6.2.3.2). The sectors responsible for protecting plant health, animal health and

food safety in BiH are relatively well regulated by law, but capacities for implementing these laws are not adequate (well established) (6.2.3.3). EU species and habitat identification projects are implemented in BiH, but ecological networks in the entities and BD of BiH have not been established (well established) (6.2.4.1). It is necessary to enact more comprehensive regulations that enable monitoring on the effectiveness of different conservation interventions, better methods for determining the prevailing public interest, and compensatory mechanisms (well established) (6.2.4.2). The quality of implementation of the strategic environmental impact assessments is not satisfactory (established, but incomplete) (6.2.4.3). Further alignment of domestic regulations and policies with the EU legal framework in the area of spatial planning, transitional planning documents and public involvement in the planning process (well established) is necessary (6.2.4.4). Lists of invasive species do not exist for all administrative units in BiH (well established) (6.2.4.5). Certification of forest resource management is an effective tool for the protection and sustainable use of forest resources, and thereby also sustaining the benefits that the people derive forest ecosystems (well established) (6.2.5.1). The involvement of all relevant interest groups in the process of planning governance and management is ensured during the process of identification of high conservation value forests (well established) (6.2.5.2). The implementation of legislative solutions on water protection zones is not satisfactory in practice, as a result of conflicting interests in the use of these areas (established, but incomplete) (6.2.5.3). The loss of traditional and local knowledge about the sustainable use of medicinal flora and all other groups of plants, animals and fungi was confirmed in BiH. BiH is not a member of the Nagoya Protocol and the ITPGRFA, which represent an international framework for the development of domestic regulations for conservation and fair distribution of profits from the regulated use of indigenous knowledge (well established) (6.2.5.4). The agriculture strategic framework shows that all levels of government identify sustainable management of natural resources and the conservation of biodiversity as a top priority,

however, in practice this part of the strategy is treated as low priority based on the number of programs or measures included in the annual financing framework (well established) (6.2.6.1). The sub-sector of fisheries and aquaculture does not sufficiently use the existing natural capacities (established, but incomplete) (6.2.6.2). There is little intersectoral cooperation and the responsibilities of the water sector and sectors of environment protection, spatial planning, municipal utility sector, industry, transport, agriculture, forestry, tourism, who aim to achieve integrated and sustainable water management, are not sufficiently defined (established, but incomplete) (6.2.6.3). The complexity of the forestry sector setup results in weaker application of tools/instruments that support conservation and sustainable use of biodiversity and natural resources in forests (established, but incomplete) (6.2.6.4). There is no coordination on common issues between the four hunting associations operating in BiH. Relevant interest groups do not sufficiently participate in the process of planning, management and health protection of wild game (well established) (6.2.6.5). Environment impact assessment (EIA)s do not guarantee conservation of biodiversity, which is especially important in the absence of obligations to obtain an environmental permit. There is no horizontal connection between the EIA and the procedure for issuing other documents, such as water permits,

construction permits and operational permits. Coordinated alignment with the EU *acquis* can support better balance between industrial development and biodiversity conservation (well established) (6.2.6.6). BiH has fully aligned legislation in the energy sector with the EU *acquis* (well established) (6.2.6.7). Small hydropower plants are considered extremely harmful to the environment, because their disastrous impact on the conservation of biodiversity and sustainable development significantly exceeds their effectiveness for electricity production. It is crucial to ensure protection of the environment, mitigation of negative effects of climate change and preservation of biological diversity when building energy facilities and when assessing ways of strengthening the sustainability of energy supply (established, but incomplete) (6.2.6.7). Civic activism is a barrier to implementation of projects that reduce the value of public goods in the environment (well established) (6.3.8). The impacts of construction and use of infrastructure facilities could be reduced and slowed down if the existing tools in the legislative framework are applied well (well established) (6.2.6.8). Tourism is an activity that can contribute to the conservation and sustainable use of NCP, as well as to an income increase for the local population in BiH, if the principles of sustainability (well-established) are respected (6.8.6.9).



Image 16. NCP – Traditional medicinal plants drying practice (Photo credits: Hatibović)

Institutional and financial capacities for effective and high-quality application of tools/instruments for biodiversity conservation and sustainable use of NCPs are insufficient. Scientific capacities are used as a platform to seek optimal solutions, while traditional and local knowledge are not included in decision-making efforts to identify sustainable solutions (well established) (6.3.3). There is an evident lack of institutional and administrative capacities in BiH that can support the conservation and sustainable use of biodiversity in line with the competences of administrative units. Insufficient institutional capacities are one of the obstacles in the implementation of global goals, EU and BiH goals for conservation and sustainable use of biodiversity (well established) (6.3.3.1). Insufficient scientific research capacities and the weak involvement of scientific experts in decision-making are one of the obstacles in implementation of global, EU and BiH goals for the conservation and sustainable use of biodiversity. Social and economic challenges after 1992-1995 war caused a standstill in scientific research activities on biodiversity, which has impacted the state of data and the state of scientific research institutions capacity (well established) (6.3.3.2). The current state of scientific capacities is evidenced by numerous published scientific sources whose analyses show that a small number of the scientific community's members provide data relevant to the sustainable management of biodiversity in BiH (established, but incomplete) (6.3.3.2). There is an evident lack of financial capacity for the conservation and development of mechanisms for the sustainable use of biodiversity in BiH. BiH receives significant foreign funds for the environment, in which biodiversity funds have a negligible share. Protection and conservation of nature in BiH is financed through a set of non-tax benefits/revenues, i.e. types of revenue that include taxes, fees, fines and other measures, so almost exclusively from public revenue who deal with environmental protection, whose share in total public revenue is very low (well established) (6.3.3.1).

Systemic monitoring of the state of biodiversity and transparent data flows are not established in BiH, which reduces possibilities for efficient planning, decision-making and implementation, as well as support from other sectors and the public for the conservation and sustainable use of biodiversity. The development of a functional monitoring

system is not aligned with the reporting needs under international treaties and the EU institutions (well established) (6.3.2.2). Systematic monitoring, as well as collection and analysis of data on biodiversity, are practically non-existent in BiH. Biodiversity research is carried out in an ad hoc manner, but research results are not publicly available unless they are published (well established) (6.3.2.2). The RS information system for nature protection and monitoring and the FBiH information system for nature protection were established and contain a certain amount of data. Further priorities in the monitoring of species and habitats, as well as the collection and flow of data to information systems have not been established, which impedes progress in the planning and establishment of ecological networks in BiH. The information system of BD BiH is not established (well established) (6.3.2.2). Primary data on biodiversity (ecosystems, species, genes) are scattered in a number of private (not always accessible) and public databases. They are structured and formatted differently, which further prevents the integration of the little data that is available into a single databases (well established) (6.3.2.2). Development, application and monitoring of indicators of the state of biodiversity is neither prescribed as part of institutional responsibilities, nor have any of the non-institutional monitoring models been put into practice. This gap has negative consequences on reporting obligations through statistical agencies in BiH (well established) (6.3.2.2). The development and application of indicators are not aligned with the specific biodiversity conservation strategies in BiH, nor with the reporting needs under international treaties and towards the EU institutions (well established) (6.3.2.3). A comprehensive solution for the validation/verification of data on biodiversity is required, which can be used for the preparation of various reports (well established) (6.3.2.2). Development of a functional monitoring system is not aligned with the strategies for conservation of specific biodiversity of BiH (well established) (6.3.2.2). Lack of a functional monitoring system reduces the effectiveness of decisions made regarding the conservation and sustainable use of biodiversity, as well as preventing planning and establishment of environmental networks (well established) (6.3.2.2). Monitoring of forest, agricultural and water ecosystems is carried out through competent sectors. Data on monitoring are not available to the public (established, but incomplete) (6.3.2.2).

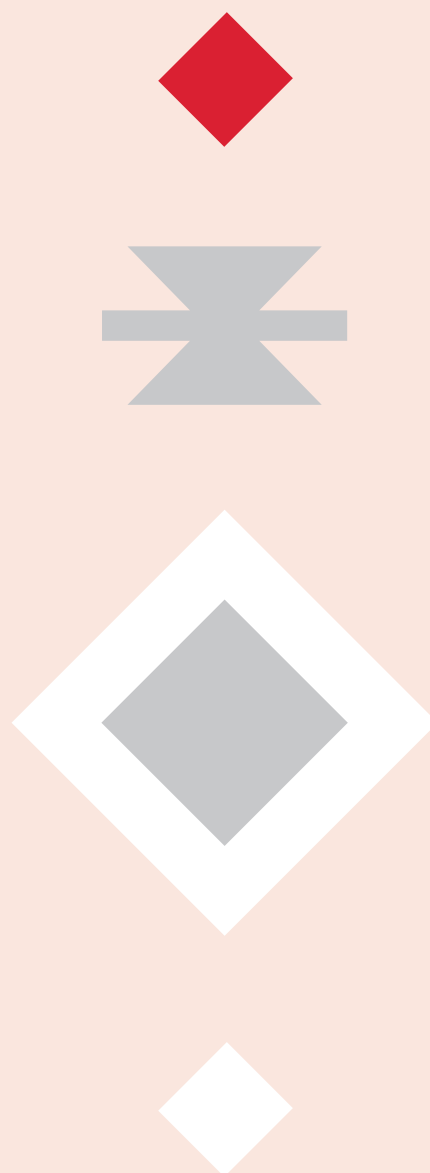
Ensuring quality of life requires sustainable governance of biodiversity and NCPs in BiH, which can be achieved by consolidating existing and building new institutional, financial and scientific capacities for implementation of the EU legislative framework, applying science-based solutions along with the participation of local communities and their knowledge, and having a functional system of education (well established) (6.5). Institutional and legal portion of the framework for governance of biodiversity and NCPs in BiH is complex, and the state, as well as efficiency, of certain components of the framework are not satisfactory (well established) (6.3.1). Biological diversity is integrated in a certain number of sectoral strategies in BiH, but mostly it is not integrated into sectoral programs and regulations (well established) (6.3.1). Reports on implementation of the Convention on Biological Diversity, other conventions concerning biodiversity and environment, and reports from other international organisations underline the need for a coordinated and effective plan for the conservation and sustainable use of biodiversity through a multisectoral approach in BiH (well established) (6.3.2.1). All types of media outlets play a major role and have high power and influence, but lack support and capacities to share information and raise awareness about conservation and sustainable use of biodiversity in BiH (well established) (6.3.6). Local communities (units of local self-government) also have a very important, but underutilised used role in the processes of planning, conservation and sustainable use of biodiversity in BiH (established, but incomplete) (6.3.7). Planning promotional, educational, infrastructural and economic empowerment of local communities, which are crucial for the tourist areas, would ensure long-term sustainable development of these areas (well established) (6.2.6.9). Contents covering topics related to biological diversity (especially locally) are not sufficiently covered in elementary and high schools (well established) (6.3.4.1). Programs that are directly or indirectly related to biological diversity are mostly represented in faculties of natural sciences, mathematics and agricultural sciences, while education for sustainable development requires reforms of all branches of science (well established) (6.3.4.1). Traditional and local knowledge in the BiH system of education is marginalised and almost completely neglected, except for high education specialised curriculum

(well established) (6.3.4.1). There are significant opportunities for the inclusion of traditional and local knowledge in the decision-making processes, through establishment of centres for traditional and local knowledge, combining formal and traditional knowledge in the education system, and access to the Nagoya Protocol and ITPGRFA (well established) (6.3.9). The inclusion of traditional and local knowledge in decision-making requires the support of both higher and local level administrations (well established) (6.3.9). A continuous science-policy interface is missing as an information tool for development of science based solutions (well established) (6.5). Integrated (multisectoral) application of the EU acquis could provide for a change of the current state of biodiversity governance options in view of the potential for: (a) consolidation and better use of existing institutional, scientific and financial capacities, (b) integration of biodiversity protection into activities leading to climate change neutrality, (c) easier integration into sectoral policies and (d) access to funds for BiH as a Western Balkan country with the EU candidate status (well established) (6.5).

Knowledge gaps relate both to the state and value of biodiversity, as well as to direct and social drivers that affect biodiversity, trends in regulatory, material and non-material NCPs, and especially to efficiency of individual tools, governance options and related scenarios for biodiversity (well established) (6.8). The key findings and knowledge gaps that this assessment identified point to the fact that the scientific community is not sufficiently and effectively engaged in the identification and implementation of solutions for sustainable development and improvement of quality of life in BiH (well established) (2.2, 3.15, 4.3, 5.6, 6.5, 6.6). The focus of research on socially relevant and scientifically based solutions can be achieved through establishment of a continuous dialogue at the science-policy interface. The science-policy interface operates occasionally on an ad hoc basis, but no comprehensive channel has been put in place to ask questions and look for science-based answers. The establishment of a continuous science-policy interface can significantly increase the level of efficiency of existing capacities in terms of tackling priority issues related to conservation of biodiversity and the sustainability of NCPs, and create acceptable models for fulfilling the

conditions for integrated governance in pursuit of sustainable development (well established) (6.3.6.6.4, 6.7). Science-based solutions, which are already used in practice in BiH, do not include traditional and local knowledge about biological diversity, which could have already contributed to the sustainability of decisions and reduction of negative trends on biological diversity and NCPs in BiH (well established) (6.3.9, 6.7). A total of 2669 sources (scientific and technical references, reports and regulations) were used in the Assessment, of which more than 80% were domestic sources (well established) (6.7). The number of used sources indicates high productivity of the science community. At the same time, the analysis shows that society does not have sufficient and synthesised information of that is of high relevance for decisions-making regarding sustainable governance of biodiversity and NCPs (2.5, 3.1, 4.2, 5.1, 6.6). A systematic approach to understanding NCPs and their role in improving the quality of life in BiH was not developed. There are no studies of the current state of NCPs, so it is not possible to precisely establish the trends of individual NCPs in BiH (well established) (2.2, 6.6). The inventory of biodiversity in BiH is not fully implemented, while the syntaxonomic classification of plant communities is neither harmonized within the scientific community in BiH, nor with the modern European classification system. Genetic research is sporadic with an emphasis on the analysis of the level of genetic diversity (well established) (3.4, 6.6). There is a discontinuity in research, created as a result of the 1992-1995 war and the lack of field research in the post-war period (well established) (3.11, 6.6). The biological diversity of all groups is not sufficiently researched (3.4, 6.6). The state of biological diversity in all groups of ecosystems in BiH is not subject to constant monitoring and systematic research. There are no reliable data on biodiversity trends due to non-existent monitoring and scant research (well established) (3.2, 6.6). There is a significant lack of research about the impact of habitats loss (conversion), overexploitation of resources, pollution of soil, air and water, invasive species, and especially climate change on the state of biodiversity in BiH. The current state of knowledge about the impacts of direct and indirect drivers is the result of an unsystematic approach and disproportionate focus on pollution drivers (well established) (4.2, 6.6). Neither unilateral nor multidisciplinary research have been undertaken on the impact

of institutional, economic, demographic, cultural-religious and scientific-technological indirect drivers affecting nature in BiH (well established) (4.2, 6.6). No domestic literature sources with scenario analyses and/or trends of genes, species and ecosystems that would contribute to the preparation of a scenario analysis of sustainable governance of biodiversity were identified (5.6, 6.6). The greatest knowledge gap concerning governance options relates to analyses of the efficiency of existing tools/instruments and the effectiveness for protecting the state of biodiversity in BiH (well established) (6.4, 6.6, 6.8).



4 ANNEX

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4.2. ANNEX 2

IPBES CONCEPTUAL FRAMEWORK

The Conceptual framework was developed and approved by the IPBES. The framework includes components of an interconnected socio-ecological system that consist of people, nature and relationship between these (Díaz et al., 2015).

The conceptual framework helps to resolve complex tasks by clarifying and focusing the thinking on the relationships and supporting communication between the disciplines and knowledge systems, as well as between the knowledge and policies. The main elements are as follows:

- **Nature:** natural world, highlighting diversities of the living organisms and their interactions, mutually and with their environment.
- **Civilisational heritage:** knowledge, technology, labour, financial means and development of infrastructure, which, together with nature, is necessary in coproduction of NCP.
- **Nature's Contributions to People:** all the NCPs, positive and negative, to the quality of life of individual people and societies.

- **Drivers:** all outside factors that impact the nature, and thus the provision of NCPs. The conceptual framework includes direct and indirect drivers.
- **Good Quality of Life:** having a fulfilled life based on multiple factors, such as: access to food, water, health, education, safety and cultural identity, material prosperity, spiritual satisfaction and freedom of choice.

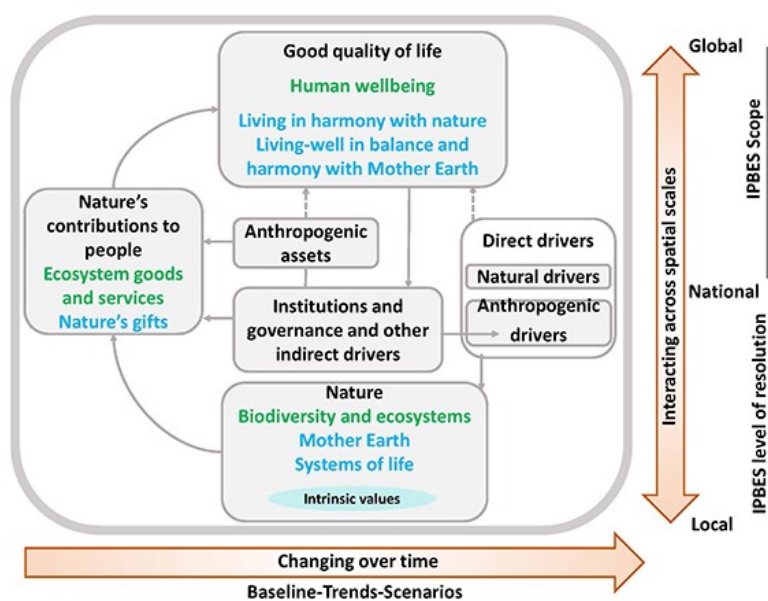


Image 17. Schematic presentation of the IPBES conceptual framework (adapted from: Díaz et al., 2015)

4.3. ANNEX 3

CONFIDENCE AND CONSISTENCY LEVEL OF AVAILABLE KNOWLEDGE

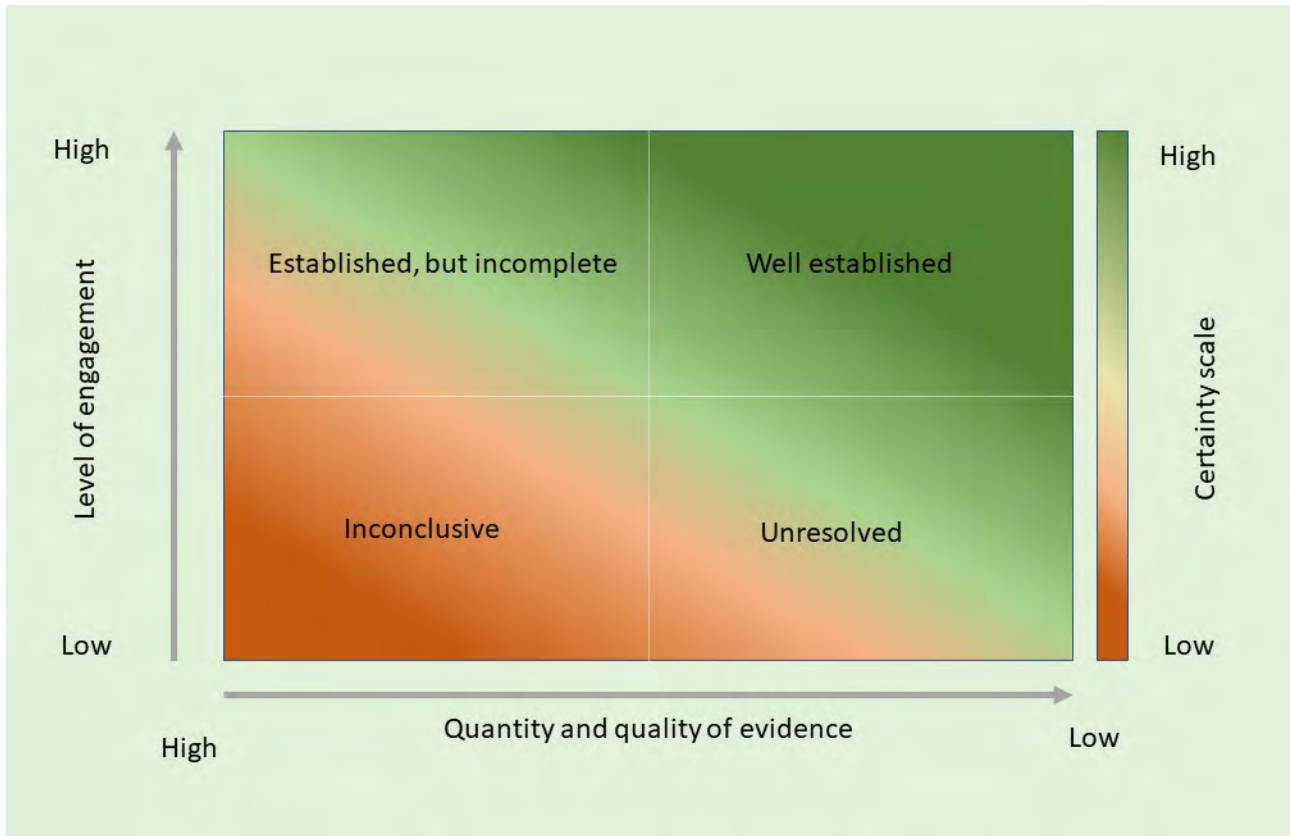
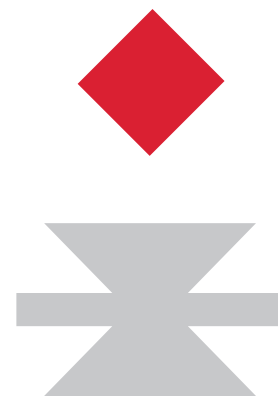


Image 18. IPBES model of data confidence levels (adapted from: IPBES, 2018)

The credibility of key results/findings is corroborated by evaluation of the confidence level of used data and gathered and analysed literature sources.

The model used to determine the data confidence level recognises 4 levels of confidence:

- 1. Well established** - numerous sources/evidence and high level of consistency among them;
- 2. Established, but incomplete** - few (limited) sources/evidence and high level of consistency among them;
- 3. Inconsistent** - many sources/evidence and low level of consistency among them;
- 4. Unreliable** - few (or limited) sources/evidence and low level of consistency among them.



4.4. ANNEX 4

ECOSYSTEM GROUPS

For the purpose of the Assessment, differentiation of the ecosystem groups in BiH was done based on the basic habitat conditions (Stupar et al., 2022).

Ecosystems in BiH were grouped in 16 groups, as follows:

Table 5. Ecosystem groups (Stupar et al., 2022)

	Ecosystem group	Surface /ha/	Key ecosystems and their characteristics (description)
1.	Lowland to montane land deciduous forests and shrubs	1111378	All deciduous forests and shrubs outside the Mediterranean influence (continental areas), but below the mountainous belt and outside the influence of groundwaters and surface waters: Pripanonian beech forests, sweet chestnut forests, sessile oak and hornbeam forests, Hungarian oak and Turkey oak, pure forests of sessile oak, pure forests of Turkey oak, Pedunculate oak and hornbeam forests, successive stages with birch and/or European aspen, forests of acer, ash and elm tree species. All 'microhabitats' related to the forests of this belt, which cannot be presented on the map due to their relatively small surfaces, such as tall herb communities, creeks and rivulets and similar, were included into this category on the ecosystem map
2.	Mountainous forests	1.091.917	All forests of the mountainous belt, including pure forests of beech, beech-fir, beech-fir-spruce, fir-spruce and pure spruce forests. And smaller portion of white pine forests, successive stages with birch and/or European aspen, forests of acer, ash and elm tree species. All 'microhabitats' related to the forests of this belt, which cannot be presented on the map due to their relatively small surfaces, such as tall herb communities, creeks and rivulets, peat bogs and similar, were included into this category on the ecosystem map
3.	Relict Pine Forests	71.014	Forests of black (and white) pine on the ultrabasite, dolomite and limestone. The relict Bosnian pine forests were included into the alpine ecosystem complex
4.	Mediterranean and sub-Mediterranean forests and shrubs	420.886	Conifer Mediterranean and deciduous sub-Mediterranean forests and shrubs, outside the influence of groundwaters and surface waters
5.	Temperate meadows	265.427	Lowland and montane mowing meadows

	Ecosystem group	Surface /ha/	Key ecosystems and their characteristics (description)
6.	Dry and rocky meadows and pastures	303.428	Thermophilic and xerophilous meadows and karst terrain ranging from the Mediterranean, sub-Mediterranean, Mediterranean-montane to montane belt of the continental area on all geological substrates
7.	Wetland and standing water habitats	40.8	Lakes, hydroaccumulations, ponds, wetlands, peat bogs, humid meadows, riparian willow, poplar or alder forests, as well as forests of hardwood broadleaves forests (Pedunculate oak, European white elm, narrow-leaved ash), impacted by the groundwaters
8.	Flowing water	17.871	Larger rivers, channels and back waters
9.	Sea and seacoast	1.453	All types of marine and coastal habitats
10.	Canyons, ravines and rocks	77.536	A complex of habitats joined into a functional unit: rocky cliffs and steep slopes, screes, canyon forests and shrubs. Related permanent or intermittent watercourses were included into this category on the ma.
11.	Caves and other underground habitats	-	Speleological facilities (caves, pits, etc.). This category has no surface as it is represented by points marking the entrance into the speleological facility
12.	Karst fields	191.762	A complex of habitats that form a functional unit: periodical lakes, ponds and wetlands, peat bogs, moist, mesophilic and thermophilic meadows, fragments of humid forests of pedunculate oak, narrow-leaved ash, willow and alder, as well as agricultural areas. Related permanent or intermittent watercourses were included into this category on the map
13.	Alpine ecosystems	155.527	A complex of habitats above 1,500 meters which cannot be mapped individually, make up a functional unit: rocky ridges and cliffs, screes, mountain lakes, creeks and rivulets, mountain (subalpine) forests and shrubs, shrubbery, heathland and alpine and sub-alpine grasslands, tall herb communities, sub-nival vegetation
14.	Arable crops area	1.276.010	Arable crops area and artificial meadows
15.	Orchards and vineyards	9.362	Orchards and vineyards
16.	Ruderal habitats and urban green areas	86.901	Urban ecosystems

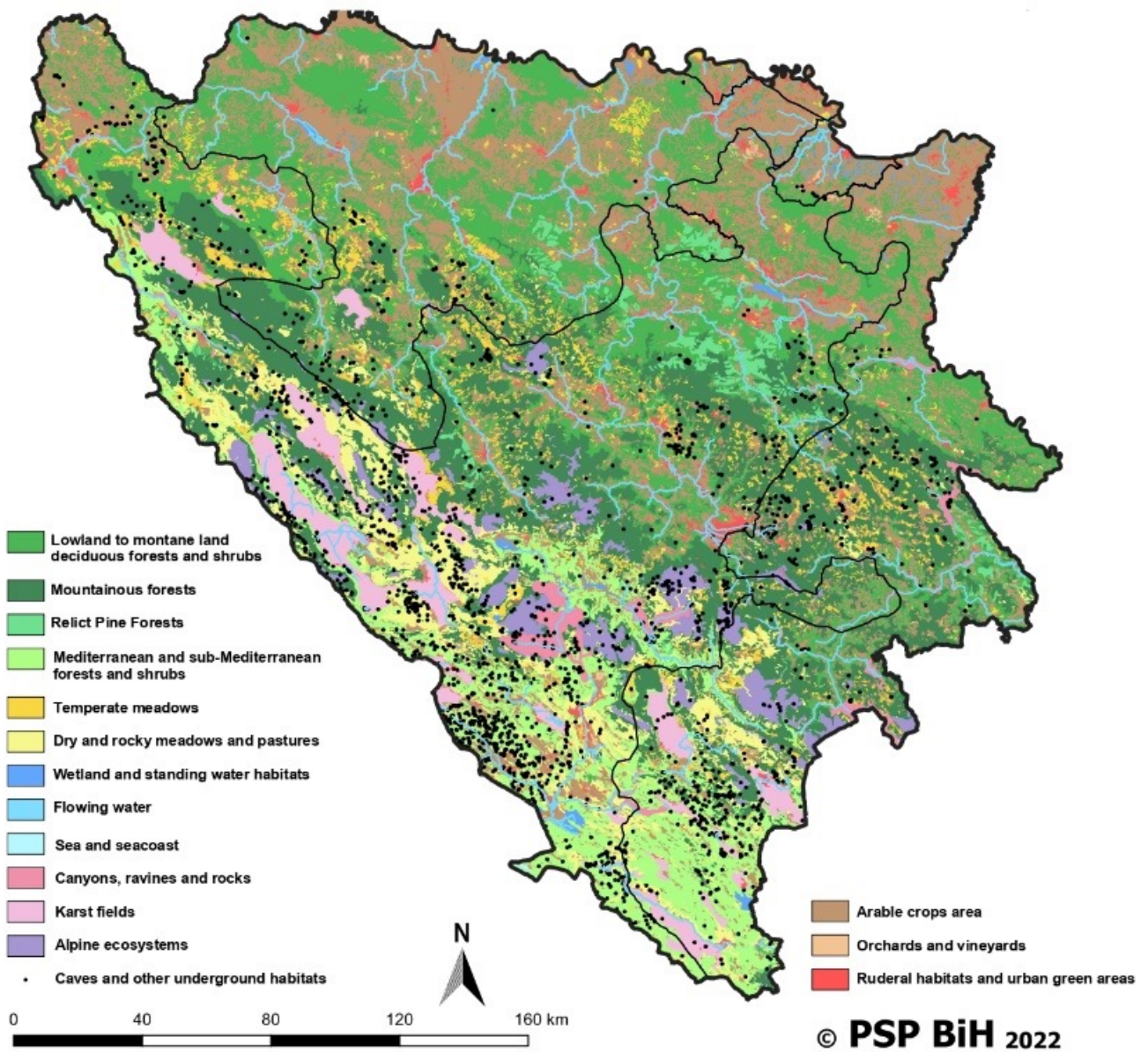


Image 19. Geographic distribution of the ecosystem groups (Stupar et al., 2022)

4.5. ANNEX 5

TYOLOGY OF THE NCP AND DRIVERS AFFECTING NATURE

18 categories of NCP were identified (according to Díaz et al., 2018) (Image 20), and organised in three partly overlapping groups:

1. **regulating,**
2. **material and**
3. **non-material contributions.**

The type of NCP is determined based on how it contributes to people's quality of life.

The **material** NCP group consists of raw materials, materials and other material elements provided by nature, which are directly used by people for their life activities and creation of other material goods through economic and other activities.

The **non-material** NCP group consists of the effects of nature and natural processes on the experience and psychological dimension of the people's quality of life, individually and collectively.

The **regulating** NCP group results from the functionality and ability of the ecosystems and organisms to impact the environment conditions and regulate the creation of material and non-material NCPs. These contributions have indirect, but continuous impact on the people's quality of life.

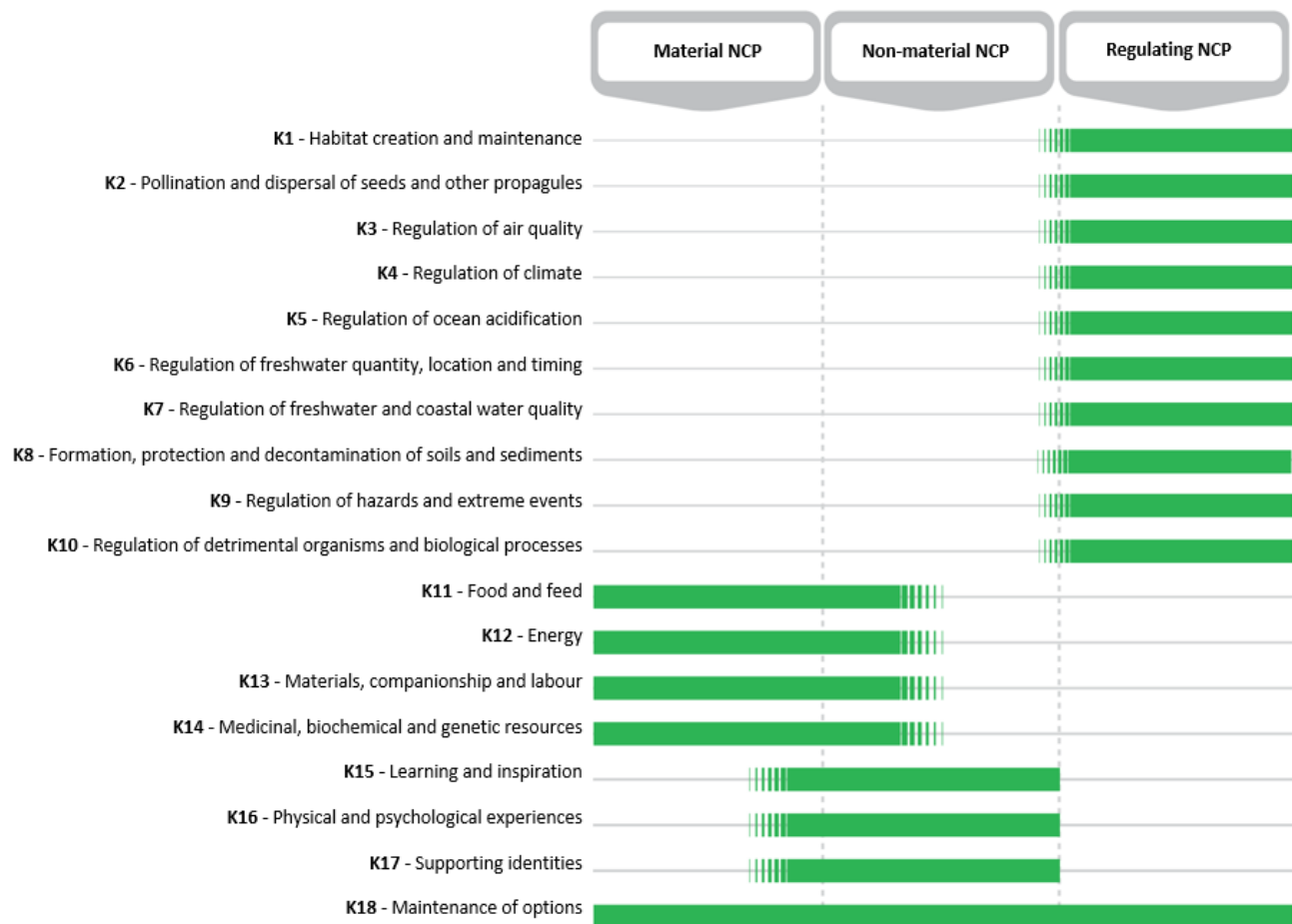


Image 20. Typology of NCP (according to Díaz et al., 2018)

Typology of drivers affecting biodiversity/nature

According to IPBES (2018), there are two large groups of drivers affecting biodiversity, namely:

1. Direct drivers (on-site drivers) and
2. Indirect drivers (unfavourable social phenomena and trends).

Both groups of drivers are further differentiated into corresponding categories, as presented in the table below.

Table 6. Typology of drivers affecting nature (according to IPBES, 2018)

DIRECT DRIVERS	INDIRECT DRIVERS
1. Land-use change	1. Governmental drivers
2. Natural resource use and exploitation	2. Economic drivers
3. Pollution	3. Demographic drivers
4. Invasive species	4. Cultural and religious drivers
5. Climate change	5. Science and technological drivers

A large, stylized red number '5' is partially visible on the left side of the page, overlapping the grey arrow shape.

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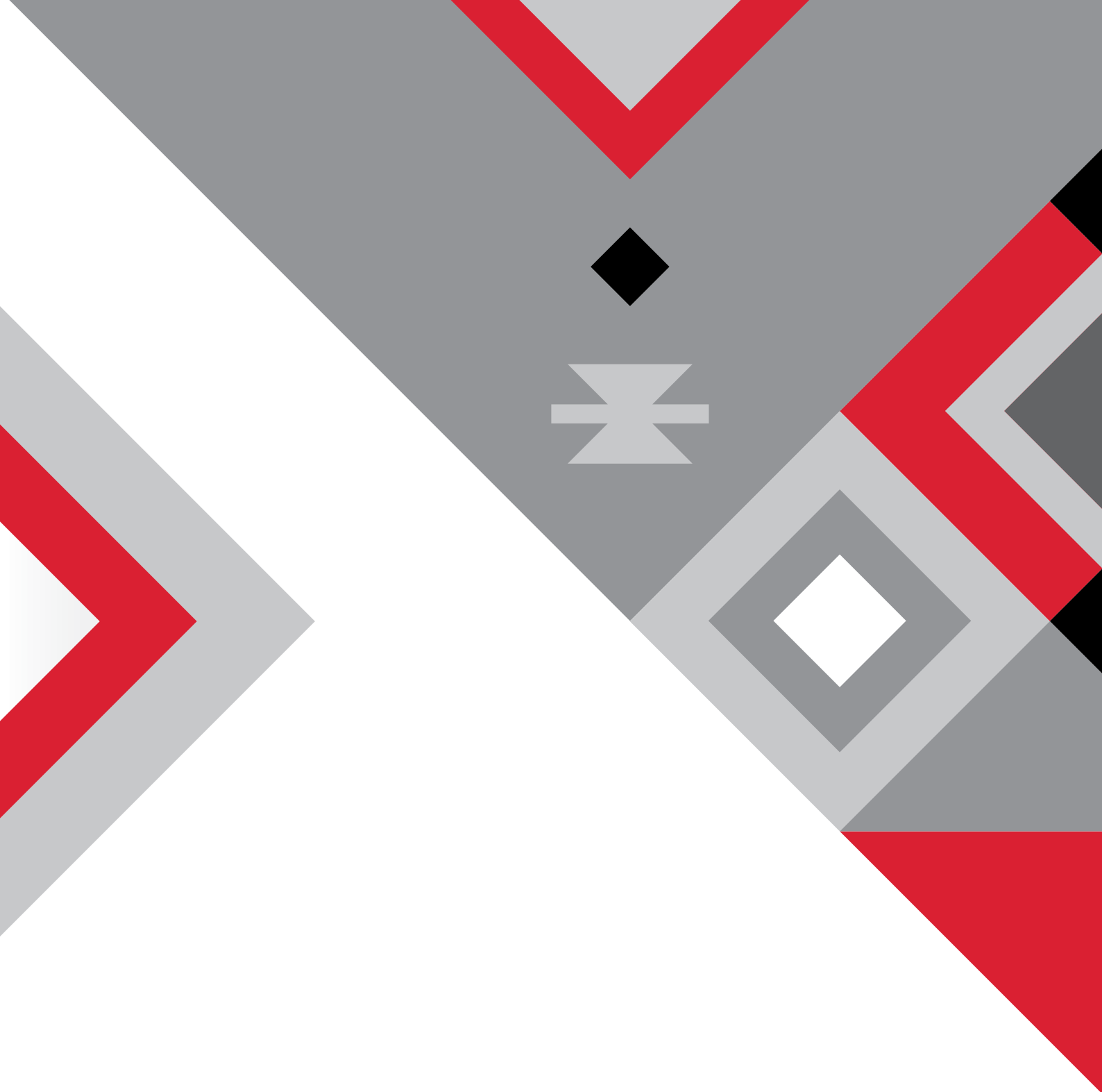
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