REINFORCING SCIENCE-POLICY INTERFACES FOR INTEGRATED BIODIVERSITY AND CLIMATE KNOWLEDGE AND POLICIES

D2.3 Report on link between Global and National Programs

Deliverable D2.3

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Table of Contents

Preface

It is RESPIN's mandate to foster both targeted knowledge provision and knowledge uptake. In the provision of knowledge IPBES and IPCC have identified pressing knowledge gaps. At the same time there are existing potentials in Europe and on national levels that can be harnessed to fill these knowledge gaps. The rationale of this task is to harness the millions of euros and hundreds of experts' work in the last years to generate new knowledge on ecosystems and their services, especially in the MAES projects of the EU Biodiversity Strategy to 2030. This report is the result of RESPIN's effort to bridge the gap between this huge knowledge 'asset" and the knowledge needs of IPBES and IPCC assessments and has been developed as a result of the task. This is a contribution to RESPIN Outcome 2: Increased uptake of knowledge and science engagement processes on biodiversity and climate by knowledge users, which includes assessment authors.

This task description is copied from the RESPIN work program:

"Task 2.3 Appraisal of national programs and databases to IPBES and IPCC processes"

The EU member states have ecosystem maps and assessments developed under the EU Biodiversity Strategy 2020 (e.g. SELINA). At the same time, large-scale reports like the IPBES Regional Assessment on Europe and Central Asia identify knowledge gaps in the effort to assess ecological and social dynamics linked to biodiversity loss and ecosystem degradation. This task aims at making a major advance by developing operative links by analysing how national results and knowledge bases can be harnessed to provide important knowledge for future IPBES and IPCC work programmes for Europe. This Task builds on expert participation in relevant work programme tasks, mainly to build capacity in Central and Eastern Europe. In addition, it scrutinises why IPBES and IPCC findings do not reach operative national levels in a desired way, and will explore barriers and solutions.

Summary

This report, prepared under the RESPIN project (Task 2.3), evaluates how national-level ecosystem service assessments (the EU MAES projects) can help address knowledge gaps identified by IPBES and IPCC. In a first analytical step, we identified and clustered 51 consolidated knowledge gaps from IPBES Europe and Central Asia Assessment report and IPCC Climate Change 2022 report. These gaps span ecosystem service status, governance, biodiversity trends, climate change impacts, and the integration of Indigenous knowledge and plural values. In a second step, we surveyed 14 European countries and French Guiana to map where new knowledge exists that can address these knowledge gaps and potentially support future IPBES and IPCC assessments.

The findings reveal that while significant new knowledge has been produced, especially on the status of habitats and species, water availability and quality, and soil quality, several important gaps remain. Indirect drivers of change, and the integration of human well-being, plural values, and Indigenous knowledge into biodiversity policy, and specific biodiversity components like carcass removal and microbes, are still underrepresented. The available data is unevenly distributed across countries, with Eastern European and Southeastern European countries providing previously overlooked contributions.

Despite this potential, barriers hinder the integration of national knowledge into global assessments. These include limited financial and human capacity, language barriers, low international visibility of (usually unpublished) national reports, and challenges in scaling or harmonizing data. Most national experts were already aware of key gaps through their work in EU projects or MAES assessments. They emphasized the need for improved database integration and inter-country coordination.

The study recommends better standardization in how knowledge gaps are framed in future assessments, increased visibility for national results (e.g., through scientific publication), and active inclusion of East-EU and Southeastern European knowledge. RESPIN Task 2.3 has initiated dialogues with IPBES, IPCC, and the JRC to channel the resulted metadata into future assessments, particularly the IPBES 2nd Global Assessment.

List of abbreviations and glossary

DoA	Description of Action
EC	European Commission
ECA	Europe and Central Asia
ES	Ecosystem service
EU	European Union
IPBES	Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Center
KG	Knowledge gap

CARE	The **CARE Principles for Indigenous Data Governance** are a framework that complements the FAIR principles, emphasizing **Collective benefit, Authority to control, Responsibility, and Ethics**. https://www.gida-global.org/care
Data	can be of any nature, including among others, spatial or non-spatial, qualitative or quantitative, descriptive, and from all scientific disciplines. This includes information from indigenous people and local communities (IPLC);
FAIR	The **FAIR** principles of data management are a set of guiding principles to improve the **Findability, Accessibility, Interoperability, and Reusability** of digital assets, particularly scientific data. https://www.go-fair.org/fair-principles/
Knowledge	is the understanding gained through experience, reasoning, interpretation, perception, intuition, and learning that is developed as a result of information use and processing. *Knowledge* is often essential in the interpretation and understanding of associated *data*
Knowledge gaps	can be defined as pieces of knowledge, information or data that are absent or insufficient to fulfil the mandate of an assessment (IPBES KD TF 2022)
MAES	Mapping and Assessment of Ecosystems and their Services

1 Introduction

1.1 On IPBES and IPCC knowledge gaps

Identifying knowledge gaps in IPCC (Intergovernmental Panel on Climate Change) and IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) assessments is crucial for advancing science, informing policy on uncertainties, guiding research priorities, and targeting research funding. These gaps highlight areas where understanding is limited—such as regional climate impacts, biodiversity-climate linkages, ecosystem services, using Indigenous and traditional knowledge—enabling targeted scientific projects and funding. Recognizing gaps ensures that decision-making is based on the best available evidence while acknowledging uncertainties. It also fosters interdisciplinary collaboration, includes diverse knowledge systems (e.g., traditional ecological knowledge), a highly ignored area in Europe (Tengö et al. 2017). Ultimately, addressing knowledge gaps strengthens the capacity of societies to respond to climate change and biodiversity loss with more effective, equitable, and informed solutions.

The two intergovernmental bodies are dedicated to provide the latest scientific evidence to policy-makers. For this, comprehensive assessment reports are prepared to critically oversight and synthesise the best scientific evidence to inform decision making. Despite their comprehensive assessments, both IPBES and IPCC reports identify significant knowledge gaps that hinder fully informed decision-making. In most assessment reports, each chapter contains a section on the knowledge gaps that the authors are faced with during the writing. According to IPBES, a knowledge gap refers to the absence or unavailability of information or data concerning various aspects of biodiversity and ecosystem services (see glossary). Further information can be found in the guide on the production of assessments (IPBES 2018a).

1.2 Rationale on the assessments chosen

This task focused on two specific assessments: The IPBES regional assessment report on biodiversity and ecosystem services for Europe and Central Asia (ECA) and the Europe Chapter of the IPCC WGII Sixth Assessment Report. The IPBES ECA presents extensive thematic coverage relevant to biodiversity and ecosystem services across Europe (IPBES 2018b)., while the IPCC Europe chapter addresses risks, adaptation options, and socioeconomic vulnerabilities. (The IPBES assessment was written by 12 Coordinating Lead Authors 85 Lead Authors, six fellows, and covers a wide range of topics, which resulted in high diversity of knowledge gaps in terms on generality, details, clarity for experts of other disciplines, etc.)

The diversity of topics is illustrated by the Table of Contents (Table 1) below:

Table 1: Table of contents of The IPBES regional assessment report on biodiversity and ecosystem services for Europe and Central Asia (IPBES 2018b).

For the IPCC, we chose the Europe chapter from the "Climate Change 2022: Impacts, Adaptation and Vulnerability" report (Bednar-Friedl et al., 2022). This chapter has a diversity of disciplines, from ecosystems to well-being, risks, adaptation, etc. At the end of each subchapter, there are knowledge gaps highlighted (Table 2).

Table 2: Table of contents of Europe chapter of "Climate Change 2022: Impacts, Adaptation and Vulnerability" report (Bednar-Friedl et al., 2022).

1.3 Ecosystem maps and assessments of the EU Biodiversity Strategy 2020

Action 5 of the EU Biodiversity Strategy 2020 calls Member States to map and assess the state of ecosystems and their services in their national territory. Thus, member states - and several associated states - launched so-called MAES (Mapping and Assessment of Ecosystems and their Services) projects. While the MAES initiative provides a common EU-level framework and guidance, the methodologies used by Member States in their national MAES projects vary considerably (Nedkov et al. 2018). Many countries have adopted the core principles and ecosystem typologies proposed by the European Commission, but differences arise in data availability, mapping techniques, indicators, and the extent of stakeholder involvement. For instance, some countries rely heavily on remote sensing and national biodiversity databases, while others emphasize participatory approaches that include local knowledge. Additionally, countries differ in the ecosystem services they prioritize—some focus

on provisioning services like agriculture and water, while others emphasize cultural or regulating services (Vári et al. 2024). This diversity reflects the varying ecological, socio-economic, and political contexts across Europe. Although this flexibility allows for national relevance and innovation, it can make cross-country comparisons challenging and underscores the need for further harmonization to support coherent EU-wide policy implementation.

1.4 Rationale of Task 2.3

Task 2.3 aims to assess the extent to which national MAES projects have produced new knowledge that addresses gaps identified in the selected IPBES and IPCC assessments. While the latter synthesize global and regional scientific findings without generating original data, MAES initiatives have produced primary knowledge through nationally funded, expert-driven processes. Here, primary knowledge refers to knowledge that has been created or made publicly available since approximately 2018—the year of the ECA assessment. IPBES and IPCC reports synthesize existing knowledge but do not conduct primary research. In contrast, MAES projects produce a significant amount of new data and insights. This distinction arises from the different operational conditions of the IPBES/IPCC assessments and the MAES programmes.

More specifically, these differences include variations in funding, expert involvement, and project duration (see Figure 1). Based on anecdotal evidence gathered during the surveys, a typical MAES project spans 4–5 years, involves 30–100 experts, and operates on a budget ranging from €0.5 to €1 million. At the European level, it sums up to a large programme with hundreds of experts hired and millions of euros spent. Thus, the MAES programmes generated significant amount of new knowledge, data and information. Contrary, IPBES assessment reports' authors did not receive payment (except covering travel costs for non-EU member Eastern Europe State experts), which limited their capacity.

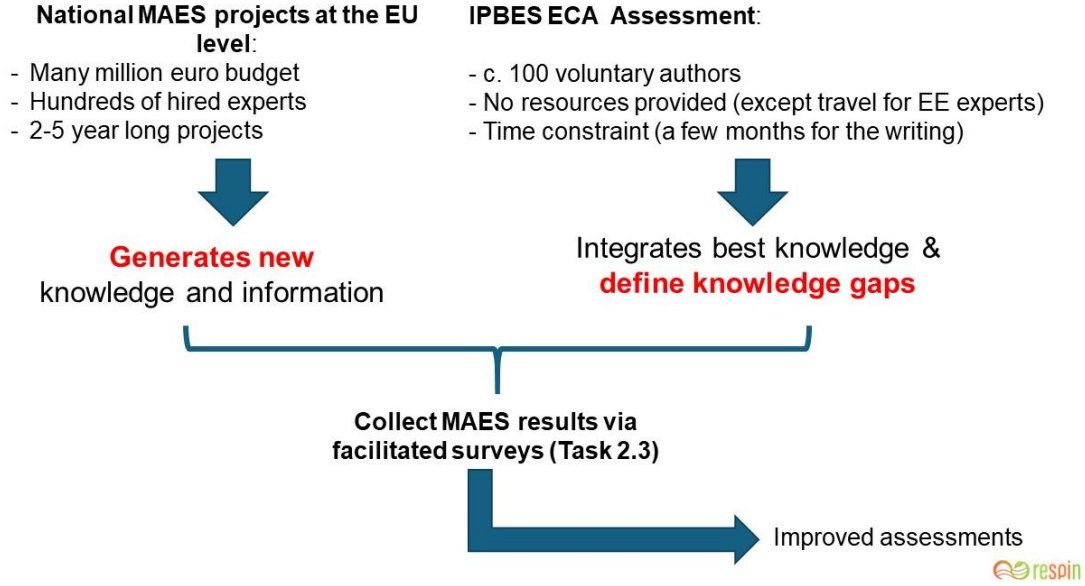

Figure 1. Illustration on how MAES and IPBES ECA assessment knowledge gaps can further better assessments in the future.

The aim of Task 2.3 is to assess (i) how the substantial new knowledge from the MAES projects aligns with the existing knowledge gaps, that is, if there are new sources of knowledge for a given knowledge gap; (ii) if there are patterns in the distribution of new knowledge to fill the gaps across European countries and across disciplines?

2. Methods

Step 1: Identifying and categorising IPBES and IPCC knowledge gaps

As the first step towards understanding how national results can fill up knowledge gaps in international policy, we selected two large-scale reports that identified knowledge gaps. The IPBES knowledge gaps are part of an online catalogue (https://www.ipbes.net/knowledge-gaps), but we use the knowledge gaps that were included in the report.

a) IPBES regional assessment report for Europe and Central Asia (https://www.ipbes.net/assessment-reports/eca)

b) IPCC Climate Change 2022: Impacts, Adaptation and Vulnerability report (https://www.ipcc.ch/report/ar6/wg2/)

As a next step, we compiled all the knowledge gaps that were identified in these two reports. As there were many overlaps in the knowledge gaps that were mentioned in different chapters of the reports, we merged some of the knowledge gaps with the same content to avoid redundancy. Some of the knowledge gaps were very long for a survey question, so we shortened them. At the end, 51 knowledge gaps were identified. We organized the 51 knowledge gaps into 7 thematic groups (See *Table 3*.).

Table 3. The 7 groups of knowledge gaps.

1. Status and trends of ecosystem services (ES)
2. Insufficient representation of plural values and Indigenous knowledge
3. Insufficient understanding of drivers of change, limited integration of ES capacity, ES use, and wellbeing
4. Insufficient understanding of governance, planning, and investments, and lack of quantification of targets and measures
5. Uneven knowledge of the status and trends of ecosystems and biodiversity in Europe and Central Asia
6. Biodiversity across marine and freshwater ecosystems
7. Status and population trends of certain taxonomic groups

See the original and the 51 re-organised knowledge gaps in *Tables* 4 and *5* in **Annex 5.1.**

Step 2: Survey design

In the next step, we created an online survey to collect information from national and regional MAES assessments. We asked for knowledge that can fill the knowledge gaps identified in the IPBES and IPCC reports. We used Google forms for data collection.

The survey was structured around the 7 groups of knowledge gaps. It also had an 8th section that consisted of questions on the barriers to knowledge exchange between international (IPBES/IPCC level) and national/regional level (MAES) policy processes regarding the knowledge gaps. This section 8 aimed on improve our knowledge on the barriers that hinder the information flow between MAES (and potentially other national biodiversity programs) level, and the international/continental level of IPBES/IPCC assessments, and on possibilities to overcome these barriers.

For each group of knowledge gaps, respondents were asked for available information and data bases to address each knowledge gap. After that, each of the seven sections asked respondents on the format and location of the information. This could be documents (reports, scientific articles), projects, or institutions that collected data on the knowledge gaps, or experts who may have information on the knowledge gaps. In the last section (section 8), we asked respondents about the knowledge exchange between IPBES/IPCC and MAES projects, focusing on the knowledge gaps. In the first and second questions of Section 8, we asked the respondents if they were aware of the knowledge gaps that we mentioned in the survey, and where they encountered the knowledge gaps. We also asked how the information that they shared with us could be made more useful to the IPBES and IPCC processes and what could make these IPCC/IPBES knowledge gaps more widely known. The fifth question addressed the drivers and barriers of knowledge exchange between the IPBES/IPCC and MAES projects regarding the knowledge gaps in our survey. See the survey in **Annex 5.3.**

Step 3: Respondent sampling

We used purposeful sampling and selected experts from European countries as respondents who possessed knowledge of MAES projects in their country. Purposeful sampling is a method that is based on selecting information-rich cases, which means selecting individuals who are especially knowledgeable or experienced in the topic that is the focus of the research (Creswell & Plano Clark 2011, Patton 2002).

We selected at least one individuals/experts per country using the following criteria: experts who had a significant role/were a leader of the MAES project in their country; therefore, they understood the whole MAES project, and had information about:

a) the knowledge/data generated in the MAES projects, and therefore, know how this knowledge can contribute to fill the IPBES/IPCC knowledge gaps. These gaps are listed in the survey.

b) the projects, institutions that generated the data in MAES projects, or experts who were involved in the MAES projects and may have information on the different knowledge gaps in our online survey.

We intended to include all European countries that had MAES projects in the last 10 years (we haven't included countries whose MAES projects were older than 10 years). We put together a first list of possible respondents with the help of our network and a key informant

(a CER colleague who is a MAES expert). We intended to invite national MAES project leaders, who have comprehensive knowledge on the results of their MAES. We also searched experts through the internet, and used the snowball method: experts were suggested by people whom we approached with the survey.

We arranged a database with experts from 26 countries in Europe (Austria, Bosnia-Herzegovina, Belgium, Bulgaria, Cyprus, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, North Macedonia, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden) and one for the overseas areas (French Guiana).

We have sent out invitation letters and reminders to experts in March and April 2025 (See the invitation letter in **Annex 5.2**). We got a response from 18 countries, and one from French Guiana. Finally, experts from 14 European countries and French Guiana filled out the survey (see Figure 2). Slovakia was in the initial phase of the MAES project, and they hadn't produced data yet.

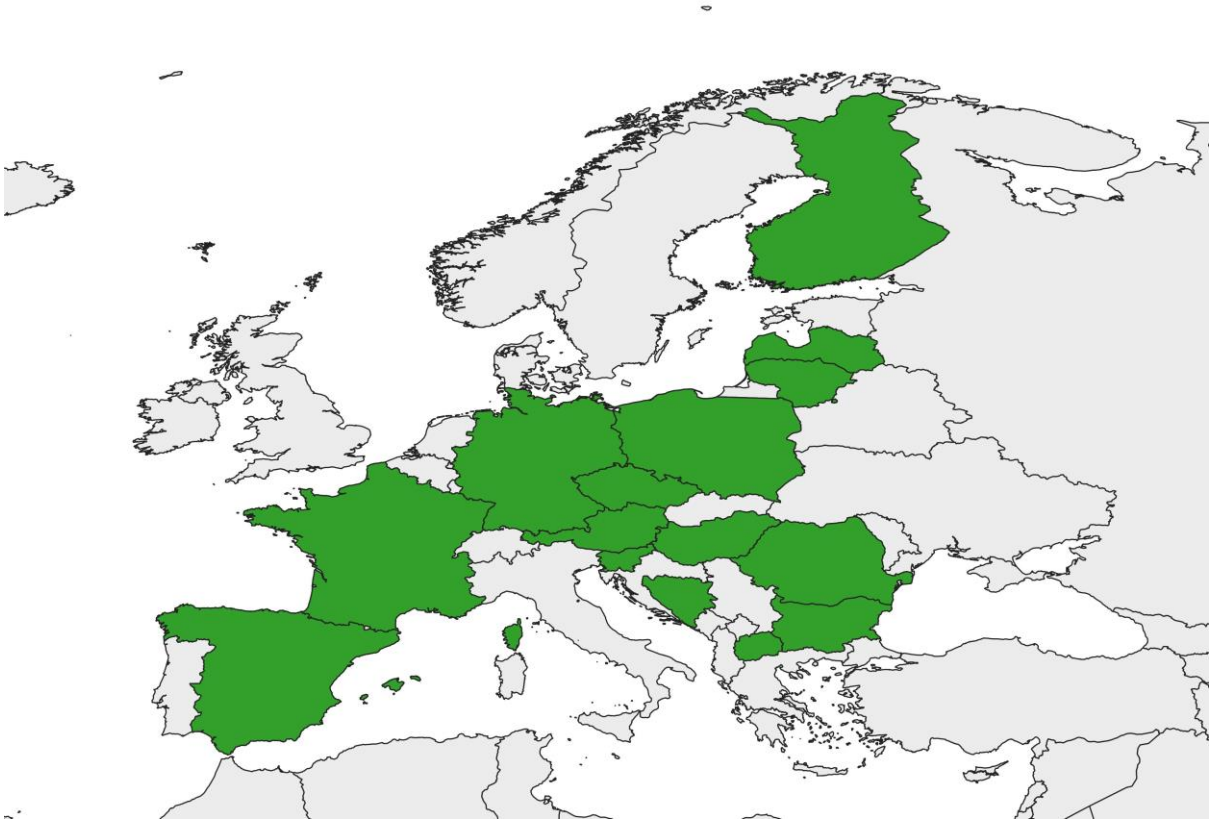

Figure 2. Map showing the countries covered by the survey. Green indicates countries who replied, and provided new knowledge based on national ecosystem mapping and assessment and other programs.

Table 6 shows the list of countries that filled out the survey, the background of the respondents, and the number of experts by country. In some countries, only one expert could provide eligible information, in others, more than one expert filled out the survey. Note that we had information for some other countries where national ecosystem mapping and assessment data are not available or was published before IPBES ECA was published. In theory, this knowledge was included in the ECA assessment.

Table 6. List of countries that participated in the survey, expertise and background of the experts, and number of experts who participated in the survey.

Country	Expertise	Background	No of experts
Austria	MAES	Biology	1
Bosnia and Herzegovina	MAES/IPBES	Nature protection	2
Bulgaria	MAES/IPBES	Landscape ecology	2
Czech Republic	MAES/IPBES	Ecosystem services, sustainability	1
Finland	MAES/IPBES	Biodiversity & ecosystem services	1
France	MAES	Ecological economics	Group of experts
France (French Guiana)	MAES	Ecosystem Services mapping and assessment, Participatory Approaches	1
Hungary	MAES/IPBES	Restoration ecology, ecosystem services, green infrastructure, and Nature conservation	2
Latvia	MAES	Biology, Law	1
Lithuania	MAES/IPBES	Ecosystem restoration, ecosystem services	1
North Macedonia	MAES/IPBES	Ecologist	2
Poland	MAES	Environmental management	2
Romania	MAES	System ecology; Ecosystem services; Freshwater ecology	1

Slovenia	MAES	Geography, cultural landscapes, natural resources, common lands, governance	1
Spain	MAES/IPBES	Forestry	1

As the survey was very long and complex, we offered the respondents to fill out the survey in an interview-style way to reduce the time they spent on it. This way, they could ask questions and we could explain each section and note down or record their answers and arguments. Experts from 5 countries asked for the interview-style survey, the other respondents filled out the survey themselves.

Step 4: Data analysis

We exported the raw survey data in Excel format. We summarized the results in two tables in each knowledge gap group for the *first 7 sections of the survey.*

We compiled one table for each knowledge gap group, comprising the binary (Yes/No) answers to the question on information availability (Are you aware of information…?) for each knowledge gap. We used Excel to analyse the answers. See the tables with the results for each knowledge gap per country in **Appendix 5.4**. In the tables we coloured the "Yes" answers with green, and the "No" answers with yellow. We used orange with those answers where the respondent skipped the whole knowledge gap group, because they considered it irrelevant. We left those cells white where there was no response. We also analysed numerical frequencies for each knowledge gap and prepared graphs using Excel for the numerical frequencies of "Yes" answers for each knowledge gap. We also prepared maps for the knowledge gaps that had the most "Yes" answers in each knowledge group (those that had the most available information). We coloured the countries with "Yes" answers dark green, the countries with "No" answers light green. Those countries that didn't participated in the survey were coloured grey.

We used QGIS 3.42 for preparing the maps. Draft maps were downloaded from: https://www.naturalearthdata.com/downloads/10m-cultural-vectors/. We prepared a second table for each knowledge gap groups comprising the format and location of the information on each knowledge gap per country. The tables contain documents (reports, scientific articles), projects, institutions and experts, see the tables in **Appendix 5.5**.

For the 8th Section we analysed the qualitative data and summarized the results without using a content analysis software. As not all respondents answered these questions, we did not have a large amount of data to analyse and summarize in Excel.

3 Results

In this section, we summarize the results of our survey, present the summary of results for the seven knowledge gap groups, and the results on the information flow between IPBES and IPCC knowledge gaps and the MAES projects. See the tables with the detailed survey

answers for each knowledge gap per country in **Appendix 5.4**, and see the actual format and location experts, institutions, publications, etc.) of information on each knowledge gap per country in **Appendix 5.5**.

3.1 Knowledge gaps on indicator data for the status and trends of ecosystem services, especially for certain ES types (regulating and cultural ESs)

The first set of knowledge gaps referred to missing information on indicators for the status and trends of ecosystem services. Knowledge gaps were especially present for certain ecosystem service types, like regulating and cultural ecosystem services. As a result of our survey, we found that a significant amount of knowledge was produced in the responding countries on several knowledge gaps (*See Figure 3*).

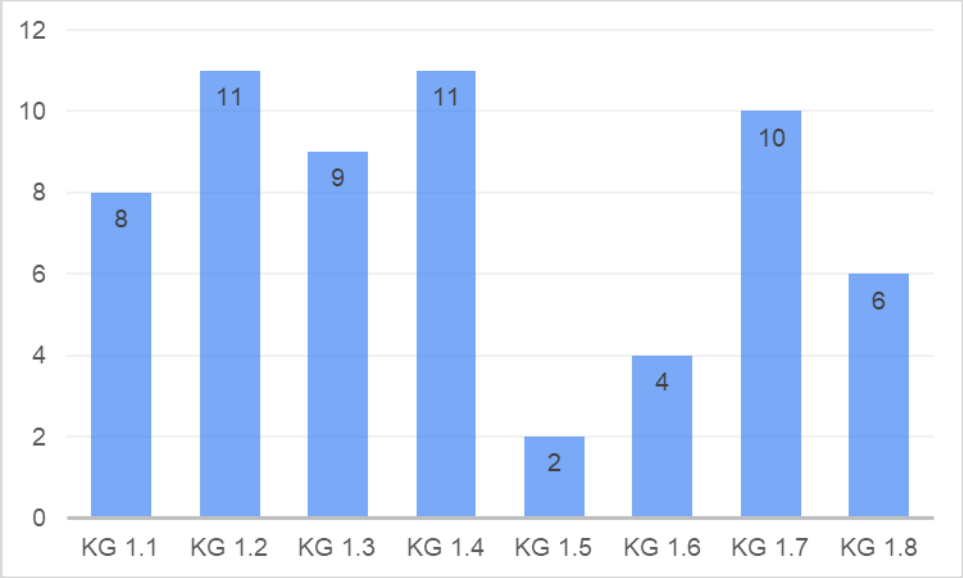

Figure 3. Number of countries that had information on the knowledge gaps 1.1-1.8. KG1.1: Climate change impacts and adaptation options for food (especially fruit and vegetables), fiber, and other provisioning ES; KG 1.2: Indicators of the trends in habitat creation and maintenance; KG1.3: Indicators on water use and water availability, and indicator data for freshwater quantity; KG1.4: Soil quality (physical, chemical, and biological components); KG1.5: Carcass removal by scavengers (vertebrate and invertebrate) and marine organisms; KG1.6: Medicinal potential of medicinal resources and plants; KG1.7: Wildlife-based tourism, accurate statistical information; KG1.8: Indicators on cultural identities

Eight countries had information on the climate change impacts and adaptation options for food (especially fruit and vegetables), fiber, and other provisioning ESs (KG 1.1). In Poland for instance, the FEW-meter project (https://jpi-urbaneurope.eu/project/few-meter/) measures the efficiency of urban agriculture in five developed countries and provides information on KG 1.1.

Similarly, respondents from eleven countries indicated the availability of knowledge on indicators for regulating services such as habitat creation and maintenance (KG 1.2). *See Figure 4* for countries that had information for habitat creation and maintenance. As an example, in Poland, the ECOSERV-POL project (https://ecoservpol.amu.edu.pl/en/results/) developed indicators for ecosystem services for different ecosystem types, and in Latvia, the LIFE Ecosystem Services project (https://ekosistemas.daba.gov.lv/public/eng/) developed

indicators for ecosystem services in coastal areas, both can provide information on habitat creation and maintenance.

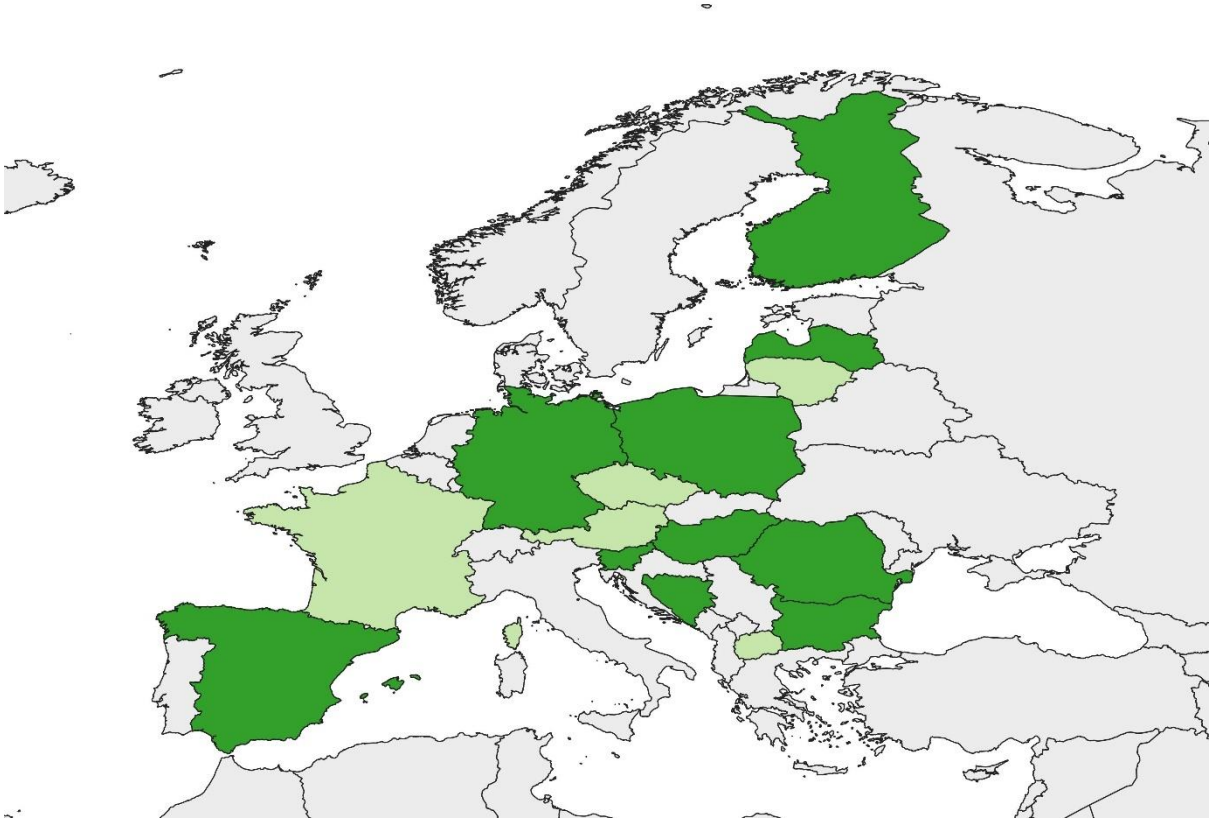

Figure 4. Available information for habitat creation and maintenance (KG 1.2) among the respondent countries. Dark green: information is available, light green: no available information (French Guiana is not included in the map).

Knowledge gaps on other regulating services, such as water use and water availability, and indicator data for freshwater quantity (KG 1.3) and soil quality (physical, chemical, and biological components) (KG 1.4) were also well covered in most responding countries (9 and 11 countries). The ECOSERV-POL project (https://ecoservpol.amu.edu.pl/en/results/) in Poland for example, covered both KGs. In Latvia, the LIFE Ecosystem Services project (https://ekosistemas.daba.gov.lv/public/eng/), in Bosnia and Herzegovina the National Ecosystem Assessments (NEA), and in Romania, the Water Action Hub project (https://wateractionhub.org/geos/country/181/d/romania) can provide information on water use, and freshwater quantity (KG 1.3). The BIOservicES project in Latvia (https://www.silava.lv/en/research/projects/BIOservicES) had data on soil quality (KG 1.4).

Carcass removal by scavengers (vertebrate and invertebrate) (KG 1.5) and the medicinal potential of medicinal resources and plants (KG 1.6) were knowledge gaps that couldn't be filled by the majority of the countries (2 and 4 countries). The exception was the LIFE Ecosystem Services project (https://ekosistemas.daba.gov.lv/public/eng/) in Latvia, which developed indicators for carcass removal by scavengers (KG 1.5) and the medicinal potential of medicinal resources and plants (KG 1.6). In Bosnia and Herzegovina, the National Ecosystem Assessment (NEA) also had information on the medicinal potential of plants (KG 1.6).

Regarding the cultural ecosystem services, the indicators of wildlife-based tourism and information (KG 1.7) were available in the majority of the countries, and indicators and knowledge on cultural identities (KG 1.8) were also relatively well covered (10 and 6 countries) (*See Figure 3*). For example, the LIFE Ecosystem Services project (https://ekosistemas.daba.gov.lv/public/eng/) in Latvia developed indicators for the leisure (active and passive) potential for nature and the ecosystem's interaction potential for cultural heritage, which can potentially provide information for wildlife-based tourism (KG 1.7) and indicators on cultural identities (KG 1.8). The ECOSERV-POL project in Poland also produced information on the indicators of wildlife-based tourism. In Bosnia and Herzegovina, the National Ecosystem Assessment (NEA) also had information on indicators of cultural identities serving as an ecosystem service (KG 1.8).

See ***Table 7 in Annex 5.4*** for available information in all countries for all knowledge gaps in Section 1 (KG 1.1-1.8), and ***see Table 14 in Annex 5.5*** for the format and location (experts, institutions, publications, etc.) of information on all knowledge gaps in Section 1 (KG1.1- 1.8) in all countries.

3.2 Knowledge gaps on the representation of plural values of nature, and insufficient integration of Indigenous knowledge into climate adaptation actions, and the lack of understanding of the climate risks for Indigenous and traditional livelihoods

The second group of knowledge gaps referred to the lack of integration of the plural values of nature and the insufficient integration of the values of different social groups (especially in Central and Eastern Europe and Central Asia) in biodiversity policy frameworks and assessments. It also addressed the insufficient integration of Indigenous knowledge into climate adaptation actions and the lack of understanding of the climate risks for Indigenous and traditional livelihoods.

Although respondents shared additional information on these knowledge gaps, and countries from Eastern Europe were among the respondents who shared information, these knowledge gaps were less covered than the knowledge gaps on ecosystem services (*See Figure 5*).

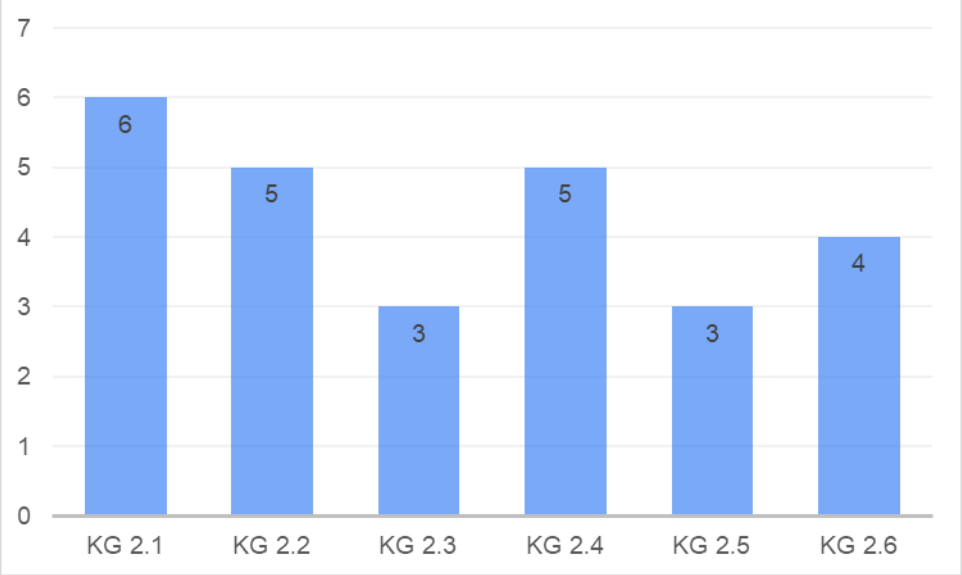

Figure 5. Number of countries that had information on the knowledge gaps 2.1-2.6; KG2.1: Integration of traditional, Indigenous, and local knowledge into national and international biodiversity policy frameworks and initiatives; KG2.2: Limited understanding of the plural values of ecosystem services endorsed by different societal groups and genders; KG2.3: Limited integration of the visions of different societal groups in identifying future targets and pathways for ecosystems; KG2.4: Insufficient representation of plural values and intrinsic values in scenario valuation of ecosystems; KG2.5: Insufficient understanding of climate risks for Indigenous, and traditional livelihoods at different warming levels; KG2.6: Insufficient integration of traditional, Indigenous, and local knowledge into climate adaptation actions

Information on the integration of traditional, Indigenous, and local knowledge into national and international biodiversity policy frameworks and initiatives (KG 2.1), understanding of the plural values of ecosystem services endorsed by different societal groups and genders (KG 2.2), and representation of plural values and intrinsic values in scenario valuation of ecosystems (KG 2.4) was available in less than half of the countries (6,5 and 5 countries) (See *Figure 5*). Romania, for example, shared articles on the integration of local knowledge (2.1) (e.g. https://doi.org/10.1017/S0376892912000392), and the representation of plural values (e.g. https://doi.org/10.3389/fevo.2021.609853) (KG 2.2). Hungary provided information on a research group (Traditional Ecological Knowledge Research Group - Centre for Ecological Research), whose main research focus is local ecological knowledge. See *Figure 6* for countries that had information on the integration of traditional, Indigenous, and local knowledge into national and international biodiversity policy frameworks and initiatives (KG 2.1). Finland shared an expert contact on the plural values of ecosystem services. The Czech Republic shared an article on plural values (KG 2.2 and 2.4) and on the integration of visions of different social groups to future targets (KG 2.3) (e.g. https://link.springer.com/article/10.1007/s11625-021-00953-8).

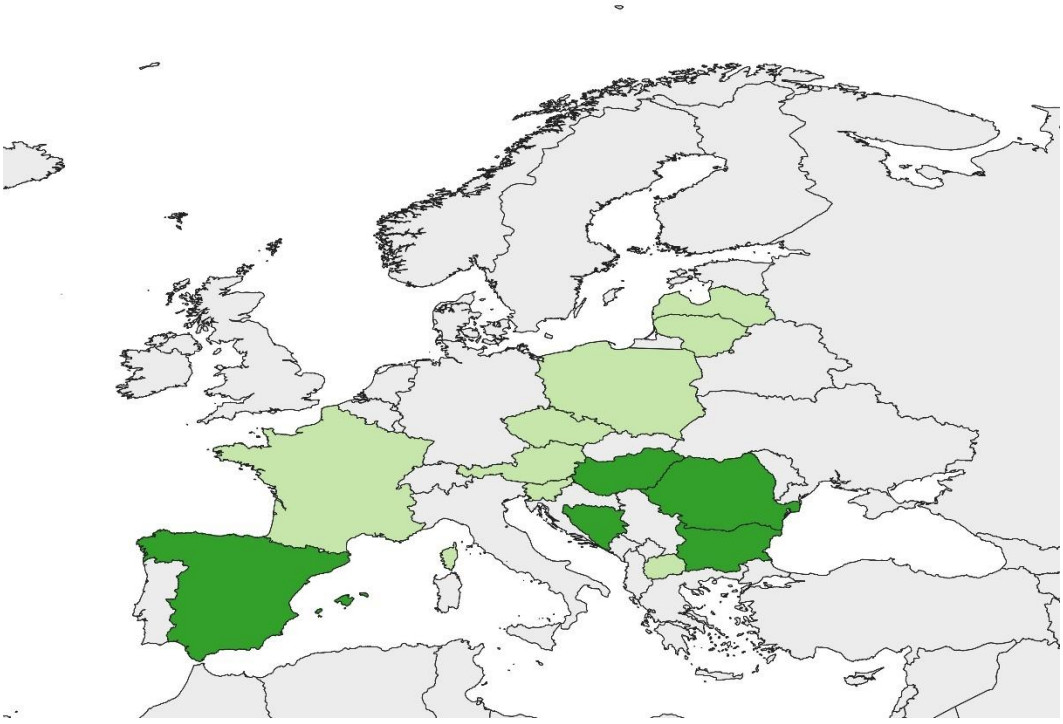

Figure 6. Available information on the integration of traditional, Indigenous, and local knowledge into national and international biodiversity policy frameworks and initiatives (KG 2.1) among the

respondent countries. Dark green: information is available, light green: no available information (French Guiana is not included in the map).

The integration of future visions for different groups (KG 2.3), the knowledge of the climate risks for Indigenous and traditional livelihoods (KG 2.5), and the integration of their knowledge into climate adaptation actions (KG 2.6) was scarce (3,3, and 4 countries) (See *Figure 5*).

See ***Table 8 in Annex 5.4*** for available information in all countries for all knowledge gaps in Section 2 (KG 2.1-2.6) and ***see Table 15 in Annex 5.5*** for the format and location (experts, institutions, publications, etc.) of information on knowledge gaps in Section 2 (KG2.1- 2.6) in all countries.

3.3 Knowledge gaps on drivers of change, and the limited integration of ES capacity, ES use, and ES benefits (human wellbeing) in biodiversity assessments

The third group of knowledge gaps addressed the lack of information on direct and indirect drivers of change, and the limited integration of ES capacity, ES use, and ES benefits (human wellbeing) in biodiversity assessments.

The results of the survey showed that the most information was available on the direct drivers and on the capacity of ecosystems to deliver ecosystem services; for the other knowledge gaps, information was not available for several countries (*See Figure 7*).

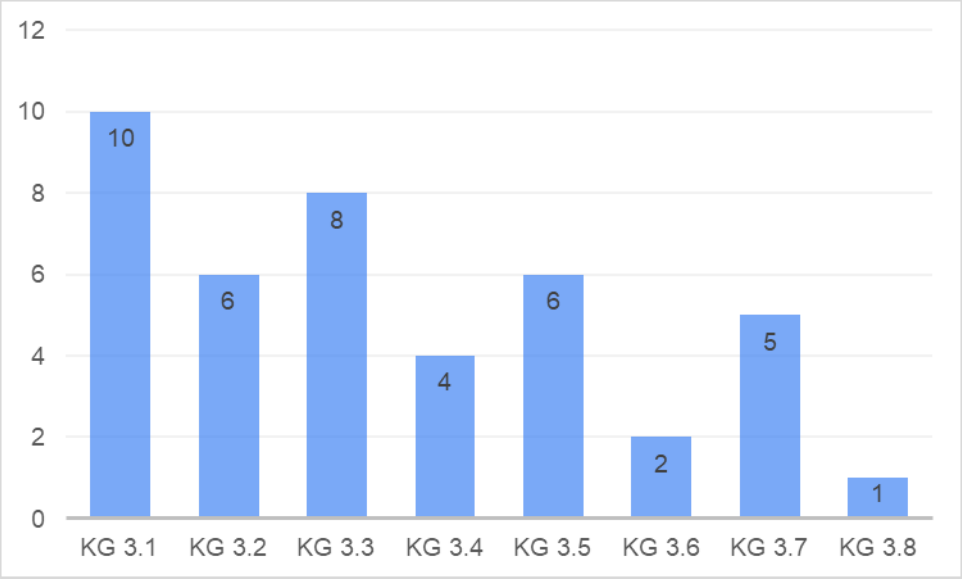

Figure 7. Number of countries that had information on the knowledge gaps 3.1-3.8; KG3.1: Limited understanding of direct drivers of change in assessments of biodiversity, ecosystems, and climate change; KG3.2: Limited understanding of indirect drivers of change in assessments of biodiversity, ecosystems. and climate change; KG3.3: Limited understanding of the underpinning role of nature and ecosystems in ES delivery especially in marine and freshwater systems; KG3.4: Underrepresentation of actual ES use indicators compared to indicators of ES capacity indicators; KG3.5: Limited integration of indicators of human wellbeing and quality of life into ES assessments; KG3.7 Insufficient assessments of synergies and trade-offs between the multiple aspects of ecosystems, their ESs, and human well-being; KG3.6: Limited knowledge of the health impacts of climate change, particularly for mental health and well-being, (mal)nutrition and food quality, and

climate-sensitive infectious diseases; KG3.7: Insufficient assessments of synergies and trade-offs between the multiple aspects of ecosystems, their ESs, and human well-being; KG3.8: Limited data on aggregated projections of impacts, especially of combined hazards on food, fiber, and other ecosystem products

For direct drivers of change in assessments of biodiversity, ecosystems, and climate change (such as land-use change and land abandonment, pollution, invasive alien species, overfishing, or climate change) (KG 3.1) and the underpinning role of nature and ecosystems in ES delivery (especially in marine and freshwater systems) (KG 3.3), information was available for more than half of the countries (10 and 8 countries). For example, in Bosnia and Herzegovina, the National Ecosystem Assessment (NEA), and in Germany, the Biodiversity Report contained information on direct drivers (https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/themenbereiche/trends-direkte-treiber/).

See Figure 8 for countries that had information on direct drivers of change in assessments of biodiversity, ecosystems, and climate change (such as land-use change and land abandonment, pollution, invasive alien species, overfishing, or climate change) (KG 3.1).

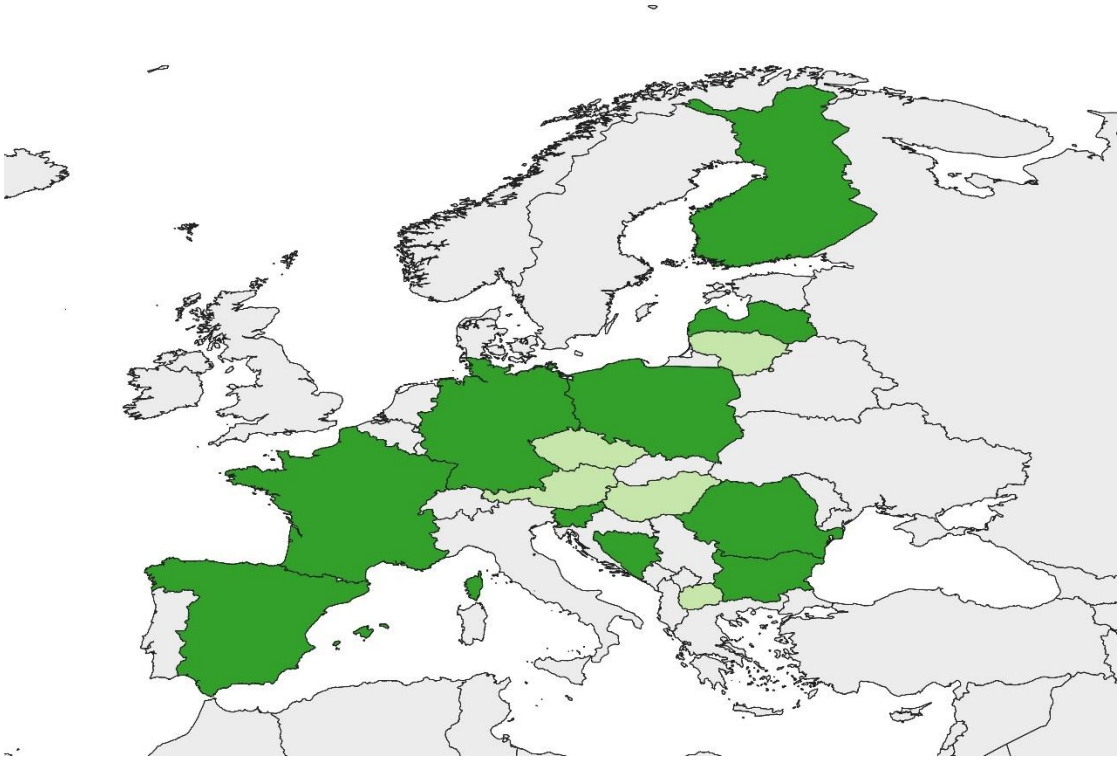

Figure 8. Available information on direct drivers of change in assessments of biodiversity, ecosystems, and climate change (such as land-use change and land abandonment, pollution, invasive alien species, overfishing, or climate change) (KG 3.1) among the respondent countries. Dark green: information is available, light green: no available information.

For the understanding of indirect drivers of change (such as institutional change, cultural change, and technology) (KG 3.2) and the integration of the indicators of human wellbeing and quality of life (KG 3.5) in assessments of biodiversity, ecosystems, and climate change, less than the half of the countries had information (6-6 countries). Assessments of synergies and trade-offs between the multiple aspects of ecosystems, their ESs, and human well-being

(KG 3.7) were available for five countries. For example, the Biodiversity Report in Germany contained information on indirect drivers (https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/themenbereiche/indirekte-treiber/), and Finland provided expert contact on human well-being (KG 3.5).

The representation of actual ES use indicators (KG 3.4), the knowledge of the health impacts of climate change, particularly for mental health and well-being, (mal)nutrition and food quality, and climate-sensitive infectious diseases (KG 3.6) and the data on aggregated projections of impacts, especially of combined hazards on food, fiber, and other ecosystem products (KG 3.8) was scarce for the majority of the countries (4, 2, 1 countries) (*See Figure7*). Hungary for example, shared an article on actual ES use (https://www.mdpi.com/2071-1050/15/11/8489; https://www.mdpi.com/2071-1050/14/19/12847),

See ***Table 9 in Annex 5.4*** for available information in all countries for all knowledge gaps in Section 3 (KG 3.1-3.8) and ***see Table 16 in Annex 5.5*** for the format and location (experts, institutions, publications, etc.) of information on knowledge gaps in Section 3 (KG3.1- 3.8) in all countries.

3.4 Knowledge gaps on biodiversity governance, planning, and investments, and the lack of quantification of targets and measures related to biodiversity and climate

The fourth group of knowledge gaps discussed the insufficient understanding of governance, planning, and investments, and the lack of quantification of targets and measures.

Overall, these knowledge gaps were not extensively covered by the respondent countries (See *Figure 9*).

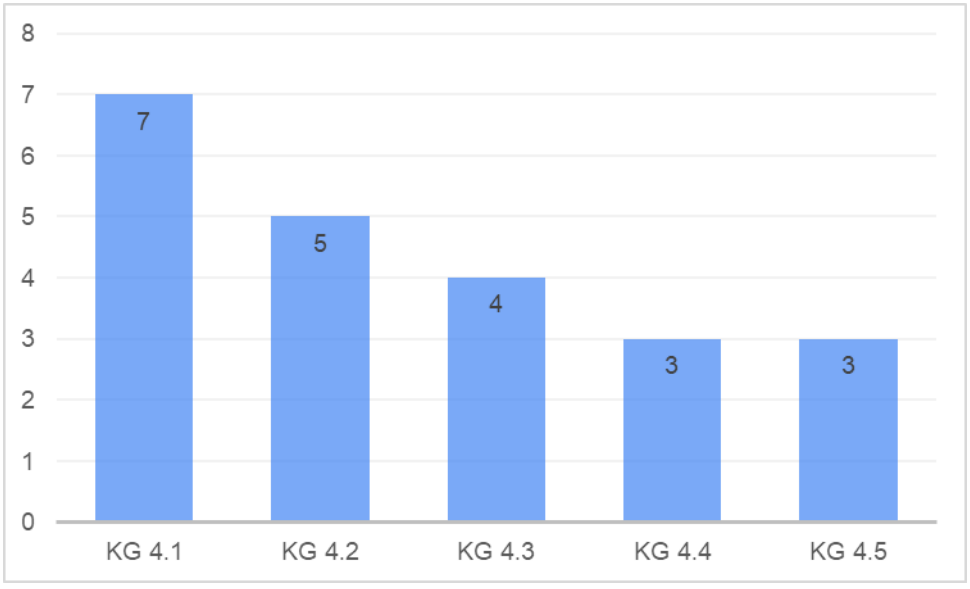

Figure 9. Number of countries that had information on the knowledge gaps 4.1-4.5; KG4.1: Limited quantification of targets and pathways related to biodiversity; 4.2 Limited knowledge about the impact and effectiveness of biodiversity governance processes the policy instruments, and limited understanding of the interactions between the policy instruments in their context; KG4.3: Lack of comparative overview of spatial planning throughout Europe and Central Asia and limited

knowledge of the impact of planning modes and instruments on biodiversity; KG4.4: Limited knowledge of the perspective and role of investments in achieving targets related to biodiversity and climate; KG4.5: Limited knowledge of the long-term effectiveness of climate adaptation options and limited quantification of the effectiveness of measures in reducing risk

The quantification of targets and pathways related to biodiversity (KG 4.1) and knowledge about the impact and effectiveness of biodiversity governance processes (especially informal governance) and the policy instruments (KG 4.2) was available in less than half of the countries (7 and 5 countries). *See Figure 10* for countries that had information on the quantification of targets and pathways related to biodiversity (KG 4.1). For example, Finland, Lithuania, and Slovenia provided expert contacts on biodiversity monitoring.

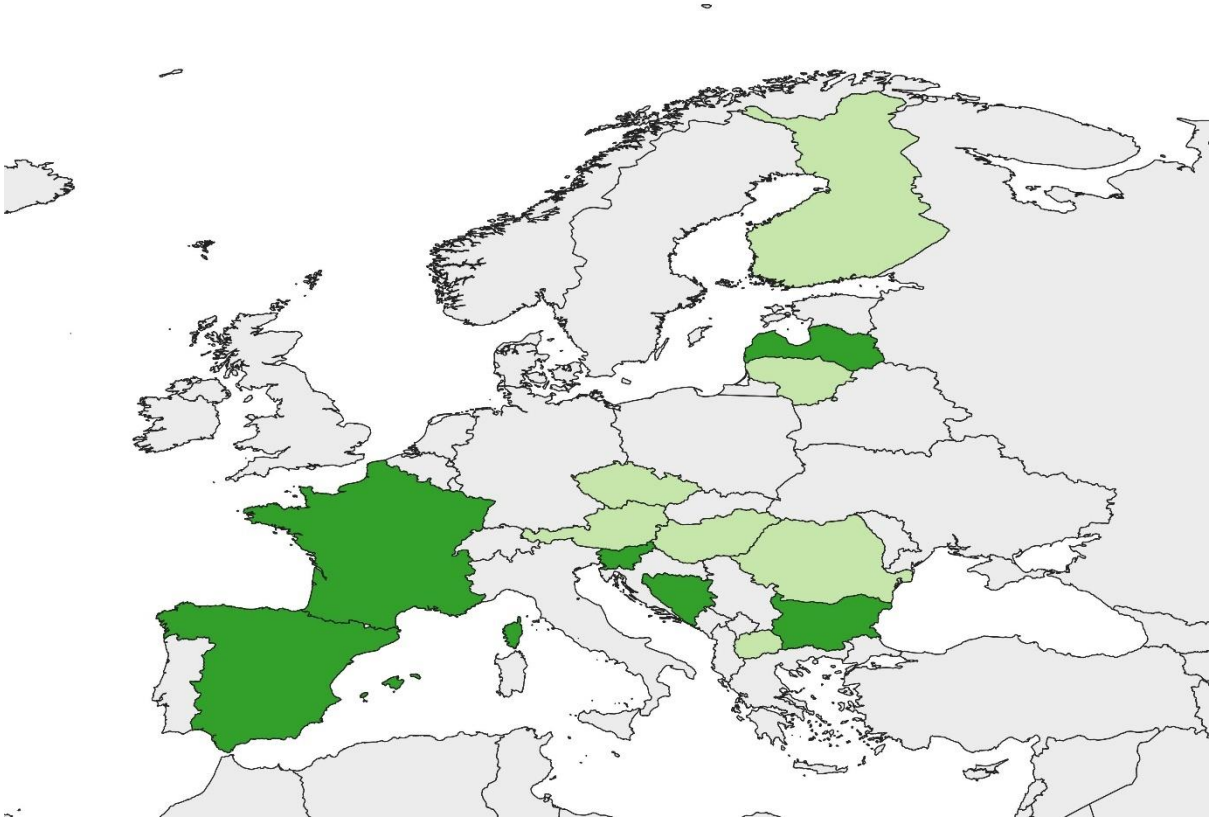

Figure 10. Available information on the quantification of targets and pathways related to biodiversity (KG 4.1) among the respondent countries (French Guiana is not included in the map). Dark green: information is available, light green: no available information.

The comparative overview of spatial planning and the knowledge of the impact of planning modes and instruments on biodiversity (KG 4.3), and the perspective and role of investments in achieving targets related to biodiversity and climate (KG 4.4) was only present in a limited number of countries (4 and 3 countries). Similarly, the knowledge of the long-term effectiveness of climate adaptation options and limited quantification of the effectiveness of measures in reducing risk (KG 4.5) was only available in 3 respondent countries (See *Figure 9*). For example, Latvia and Poland provided expert contacts on climate change research (KG

4.3 and 4.4). The TeRRIFICA – Territorial RRI Fostering Innovative Climate Action also had information on climate change adaptation in Poland (KG 4.5).

See ***Table 8 in Annex 5.4*** for available information in all countries for all knowledge gaps in Section 4 (KG 4.1-4.5) ***and see Table 15 in Annex 5.5*** for the format and location (experts, institutions, publications, etc.) of information on knowledge gaps in Section 4 (KG4.1- 4.5) in all countries.

3.5 Knowledge gaps on the status and trends of ecosystems and biodiversity

The fifth group of knowledge gaps emphasized the uneven knowledge of the status and trends of ecosystems and biodiversity. Although there were differences between the knowledge gaps in this group regarding the available information, overall, the survey identified a good amount of information on these knowledge gaps (*See Figure 11*).

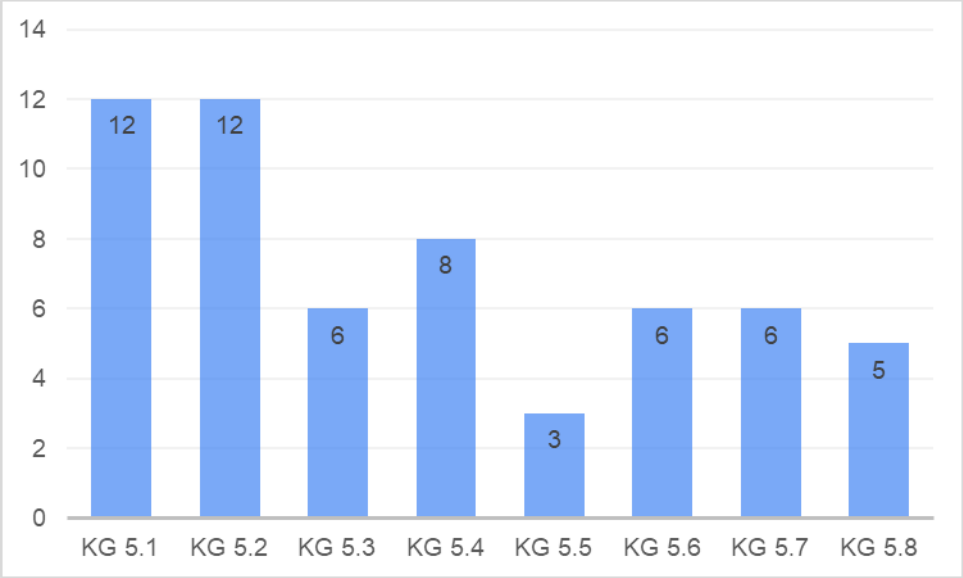

Figure 11. Number of countries that had information on the knowledge gaps 5.1-5.8; KG5.1: Limited knowledge of the extent and intactness of habitats critically for Eastern Europe and Central Asia; KG5.2: Limited knowledge of the conservation status and trends of species critically for Eastern Europe and Central Asia; 5.2 Limited knowledge of the conservation status and trends of species critically for Eastern Europe and Central Asia; 5.3 Limited knowledge of the trends and future projections of habitats; KG5.4: Lack of systematic monitoring of fungi, non-vascular plants, invertebrates, marine and freshwater species, and soil organisms across the range of subregions; KG5.5: Lack of long-term monitoring data for non-protected areas outside the EU; KG5.6: Knowledge of biodiversity trends in agricultural areas decreases from west to east; KG5.7: Insufficient understanding of the impacts of climate change and the associated risks for terrestrial ecosystems; KG5.8: Insufficient understanding of projections for climate change-related wildfire incidents, their magnitude, and their impacts particularly for Northern Europe, Eastern Europe, and Western Central Europe

There was a relatively significant amount of knowledge available on the extent and intactness of habitats (KG 5.1), of the conservation status and trends of species (KG 5.2) and fungi, non-vascular plants, invertebrates, marine and freshwater species, and soil organisms (KG 5.4) across the respondent countries (12,12, 8 countries). Knowledge gaps 5.1 and 5.2 were critical

for Eastern Europe and Central Asia; several countries from Eastern Europe shared information regarding these gaps. For example, information on habitat monitoring was available at the Czech Nature Conservation Agency (https://aopk.gov.cz/web/en) in Czech Republic, in Latvia at the Nature Conservation Agency (https://latvianature.daba.gov.lv/en/), in Lithuania at the Nature Research Center (https://gamtostyrimai.lt/en/about-us/info-about-the-center/), and in Slovenia at the Institute for Nature Conservation (https://zrsvn-varstvonarave.si/irsnc/). In Germany, the German Statistics Office (DESTATIS) published data on habitat extent and condition. At the EU level, the EuropaBON (https://europabon.org/) project and Biodiversa projects (Biodiversa+)(https://www.biodiversa.eu/) can provide information on KGs 5.1, 5.2, and 5.4. *See Figure 12* for countries that had information on the extent and intactness of habitats (KG 5.1).

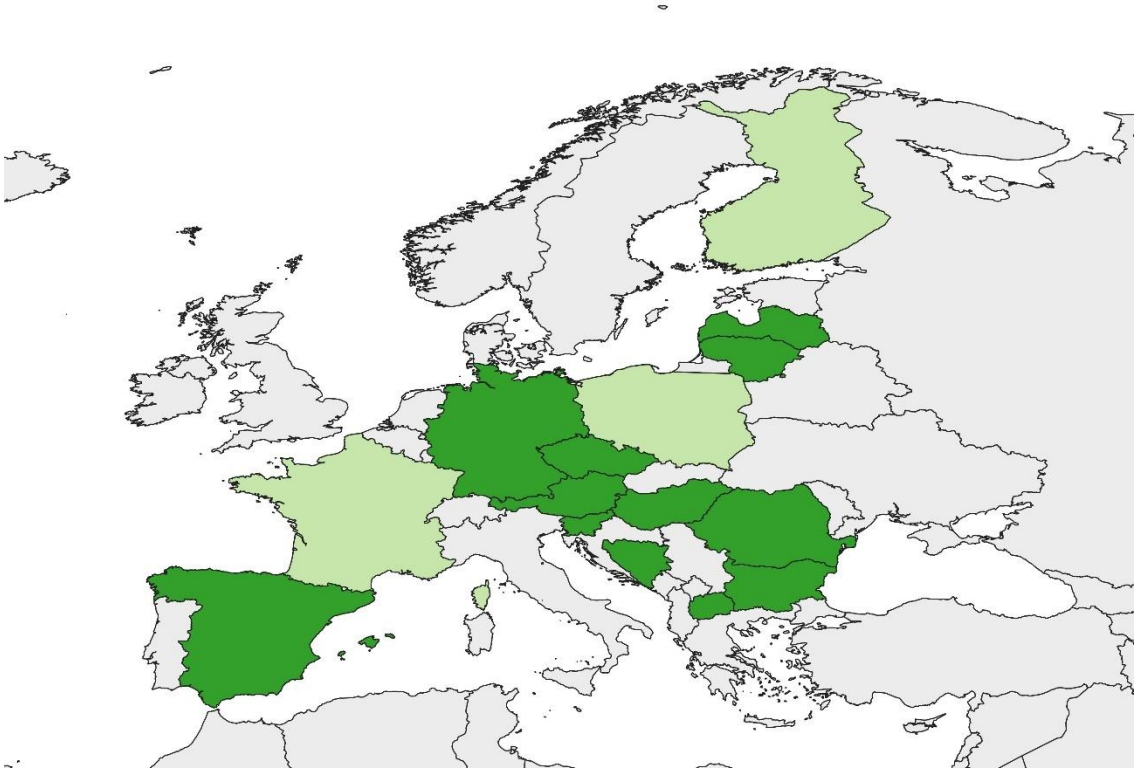

Figure 12. Available information on the extent and intactness of habitats (KG 5.1) among the respondent countries. Dark green: information is available, light green: no available information.

Less than half of the countries possessed knowledge of the trends and future projections of habitats (KG 5.3), of biodiversity trends in agricultural areas (KG 5.6) (almost all of them were Eastern European where this knowledge gap was more critical), and of the impacts of climate change and the associated risks for terrestrial ecosystems (KG 5.7) (6,6,6 countries). Information on the projections for climate change-related wildfire incidents, their magnitude, and their impacts (KG 5.8) was also present in 5 countries. For example, the project CzechGlobe (https://www.czechglobe.cz/en/) contained information on the impacts of climate change. Macedonia shared the Landscape Fire Management program (https://lfmwb.net/knowledge-platform/country-data/macedonia/), which can provide

information on climate change-related wildfire incidents (KG 5.8). Long-term monitoring data for non-protected areas outside the EU was very rare (KG 5.4) (3 countries) (*See Figure 11*).

See ***Table 11 in Annex 5.4*** for available information in all countries for all knowledge gaps in Section 5 (KG 5.1-5.8) ***and see Table 18 in Annex 5.5*** for the format and location (experts, institutions, publications, etc.) of information on knowledge gaps in Section 4 (KG5.1- 5.8) in all countries.

3.6 Knowledge gaps on the status of biodiversity across marine and freshwater ecosystems

The sixth group of knowledge gaps emphasizes the limited knowledge on the status of biodiversity across marine and freshwater ecosystems. Except for one knowledge gap (KG 6.5), information was not expansively available (knowledge gaps on the marine species and habitats were not relevant for all countries, 4 out of 16 responding countries didn't have marine areas) (*See Figure 13*).

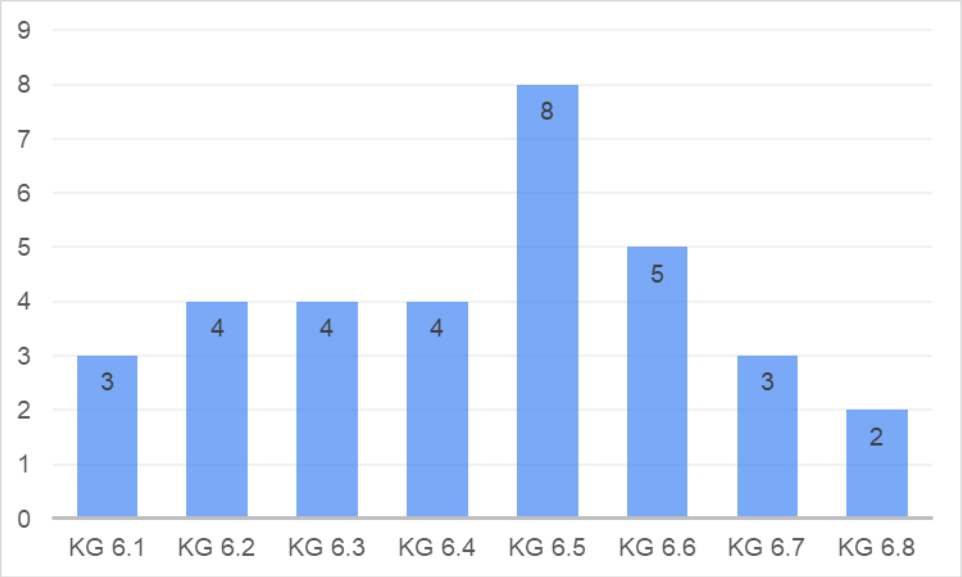

Figure13. Number of countries that had information on the knowledge gaps 6.1-6.8; KG6.1: Limited knowledge of current as well as future changes in genetic responses of marine species to environmental changes; 6.2 Limited knowledge of connectivity among marine populations, species, and ecosystems, which can provide new recruits, and enable gene flow in marine protected area networks; KG6.3: Insufficient knowledge of the status and trends of certain marine ecosystems: subtidal rocky areas, open ocean plankton communities, deep-sea areas (>200 m); KG6.4: Lacking of high-quality observations of key ocean characteristics at the level of regional sea basins to support decision-making for marine adaptation; KG6.5: Limited knowledge of the chemical status of surface freshwaters in Europe; KG6.6: Limited understanding of the trends in geographic extent and population size of freshwater species; KG6.7: Insufficient knowledge of the effects of climate change on freshwater fisheries; KG6.8: Lack of actionable climate adaptation strategies for European fisheries and aquaculture

Knowledge was available for the chemical status of surface freshwaters in Europe (KG 6.5) in half of the countries (8 countries). *See Figure 14* for countries that had information on the

chemical status of surface freshwaters in Europe (KG 6.5). Information was available in 5 countries on the trends of the extent and population size of freshwater species (KG 6.6). For example in Germany, the Biodiversity Report (https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/lebensraeume/binnengewaesser-auen/), and in Poland, the ECOSERV-POL project (https://ecoservpol.amu.edu.pl/en/results/) had information on freshwater ecosystems. In Lithuania, the Lithuanian Nature Research Centre (https://gamtostyrimai.lt/en/about-us/info-about-the-center/), and in Macedonia, the Hydrological Institute in Ohrid, owned data on freshwater issues.

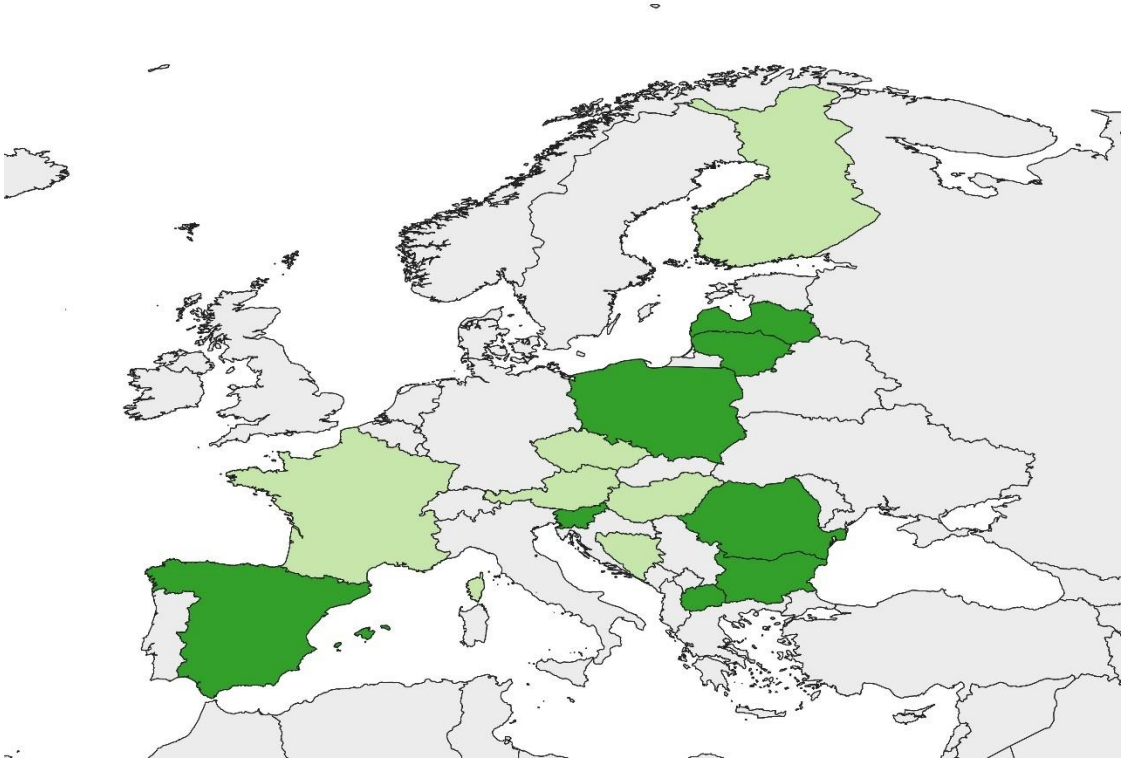

Figure 14. Available information on the chemical status of surface freshwaters in Europe (KG 6.5) among the respondent countries. Dark green: information is available, light green: no available information.

Information on marine ecosystems, such as the the connectivity among marine populations, species, and ecosystems (KG 6.2), the status and trends of certain marine ecosystems (subtidal rocky areas, open ocean plankton communities, deep-sea areas (>200 m)) (KG 6.3) and the key ocean characteristics at the level of regional sea basins (KG 6.4) was available in 4 countries. Knowledge of genetic responses of marine species to environmental changes (KG 6.1) was only present in 3 countries. In Bulgaria the Institute of Oceanology (http://www.niggg.bas.bg/en/), in Finland, Syke (https://www.syke.fi/en), in Latvia the Latvian Institute of Aquatic Ecology, (https://lhei.lv/en/ecosystem-management/), in Lithuania the Marine Research Institute, (https://jti.ku.lt/en/), and in Poland, the Institute of Oceanology can provide information on marine ecosystems. In Germany the Biodiversity Report (https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/lebensraeume/kuesten-kuestengewaesser/) contained information on coastal ecosystems. In Finland, the Marco-BOLO HEU project (https://marcobolo-project.eu/), generated information on marine, coastal, and freshwater biodiversity, in Poland ECOSERV-POL project

(https://ecoservpol.amu.edu.pl/en/results/) contained further information on marine ecosystems.

Information on the effects of climate change on freshwater fisheries (KG 6.7) and of actionable climate adaptation strategies for European fisheries and aquaculture (KG 6.8) was rare (3,2 countries) (*See Figure 13*). See ***Table 12 in Annex 5.4*** for available information in all countries for all knowledge gaps in Section 6 (KG 6.1-6.8) and ***see Table 19 in Annex 5.5*** for the format and location (experts, institutions, publications, etc.) of information on knowledge gaps in Section 6 (KG6.1- 6.8) in all countries.

3.7 Knowledge on the status and population trends of certain taxonomic groups

The last group of knowledge gaps addressed the insufficient knowledge of the status and population trends of certain taxonomic groups. Although information was scarce for some knowledge gaps, the respondent countries shared a significant amount of information on long-term population trends of different animal or plant groups (*See Figure 15).*

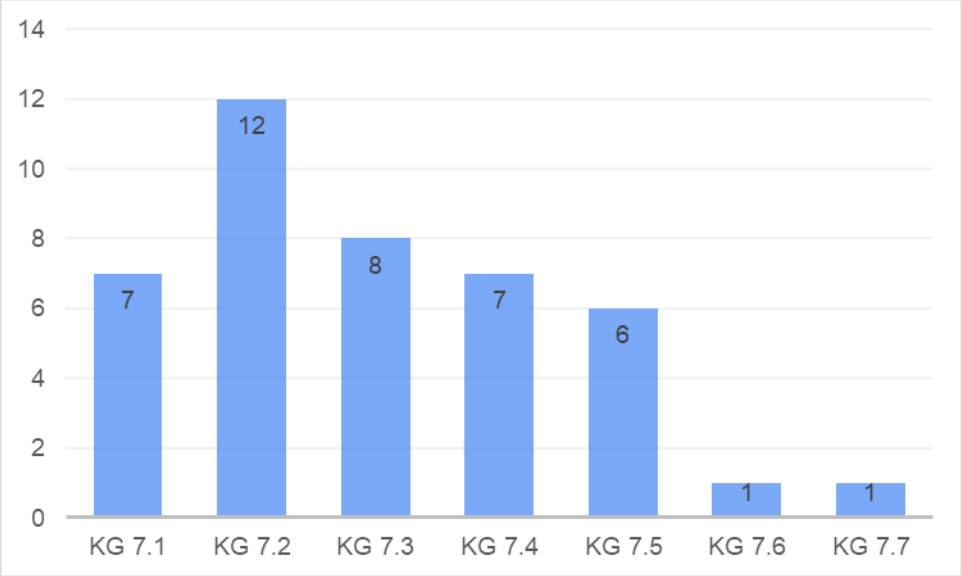

Figure 15. Number of countries that had information on the knowledge gaps 7.1-7.7; KG7.1: Insufficient knowledge of the long-term population trends of several vascular plant species; KG7.2: Insufficient knowledge of the long-term population trends of birds; KG7.3: Insufficient knowledge of the long-term population trends of terrestrial vertebrates (mammals, reptiles, and amphibians); KG7.4: Insufficient knowledge of the status, trends, and threats for terrestrial invertebrates; KG7.5: Largely unknown regional or continental data on the status, trends, and threats for lichens and fungi; KG7.6: Largely unknown status, trends, and threats for soil and freshwater micro-organisms; KG7.7: Limited knowledge of urban biodiversity, specifically: Syrphids and other Diptera

The responding countries had the most information on the long-term population trends of birds (KG 7.2) and on terrestrial vertebrates (mammals, reptiles, and amphibians) (KG 7.3) (12 and 8 countries). *See Figure 16* for countries that had information on the long-term population trends of birds (KG 7.2).

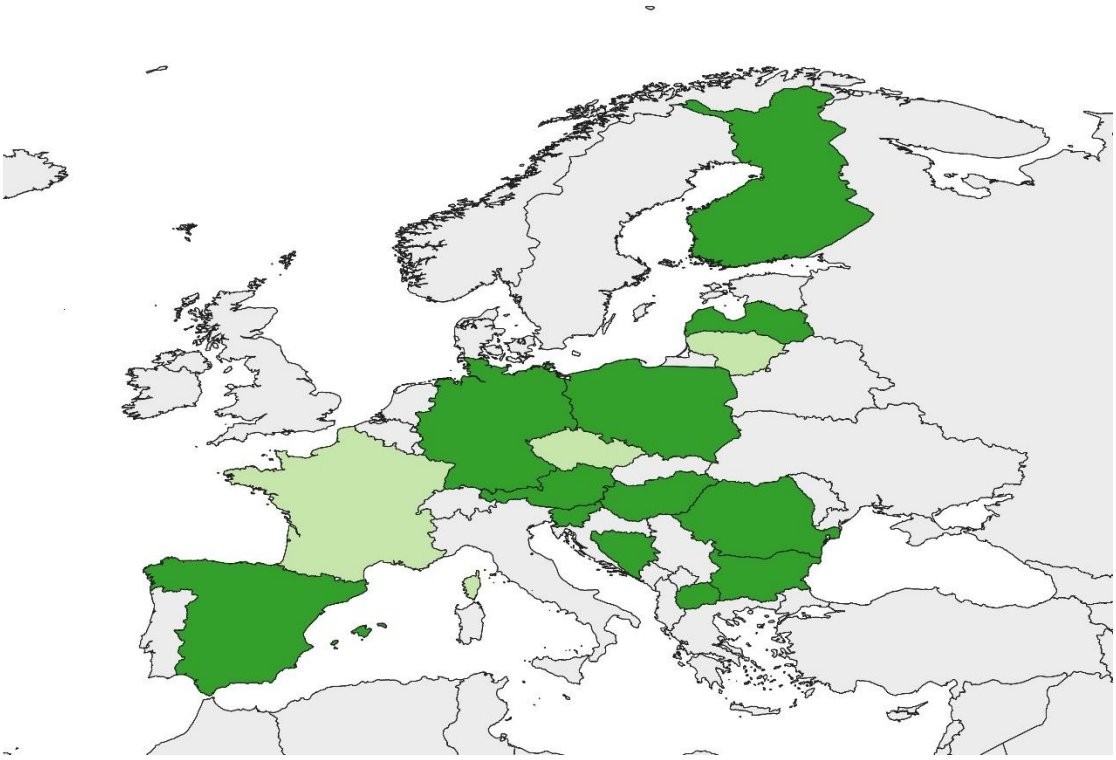

Figure 16. Available information on the long-term population trends of birds (KG 7.2) among the respondent countries. Dark green: information is available, light green: no available information.

Knowledge of the long-term population trends of several vascular plant species (KG 7.1), and the status, trends, and threats for terrestrial invertebrates (KG 7.4) and lichens and fungi (KG 7.5) was relatively available as well (7,7, 6 countries). Information on the trends of bird populations was available at BirdLife Austria (https://www.birdlife.at/), BirdLife Hungary (https://mme.hu/en), the Bulgarian Ornithology Society (https://bspb.org/en/), and in Romania (//datazone.birdlife.org/country/factsheet/romania; https://ebird.org/region/RO). In Hungary, the Biodiversity Monitoring System (https://termeszetvedelem.hu/nemzeti-biodiverzitas-monitorozo-rendszer-nbmr/) contained monitoring information on vascular plant species, birds, terrestrial vertebrates, terrestrial invertebrates, and fungi. In Finland, information on the Red Lists of Species and Habitats can be found in a database (https://luontotieto.syke.fi/en/ and https://punainenkirja.laji.fi/).

Knowledge of the status, trends, and threats for soil and freshwater micro-organisms (KG 7.6) and of urban biodiversity (specifically Syrphids and other Diptera) (KG 7.7) was very rare (only 1-1 country) (*See Figure 15*). See ***Table 13 in Annex 5.4*** for available information in all countries for all knowledge gaps in Section 7 (KG 7.1-7.7) and see **Table 20 in Annex 5.5** for the format and location (experts, institutions, publications, etc.) of information on knowledge gaps in Section 7 (KG7.1- 7.7) in all countries.

3.8 Information flow between IPBES and IPCC knowledge gaps and MAES projects

In the last 5 questions of the survey (in Section 8), we asked the respondents to reflect on the information flow between MAES projects and the IPBES/IPCC assessments. What are the

drivers and barriers that are helping or hindering to fill the knowledge gaps identified in IPBES and IPCC documents with new data from MAES projects.

In the first and second questions, we asked the respondents if they were aware of the knowledge gaps that we mentioned in the survey, and where they encountered the knowledge gaps. Most respondents (11 respondents) were aware of the mentioned knowledge gaps; they encountered them through participating in MAES or EU projects, or networking with other scientists, or their general work experience, or they learned from IPBES assessments.

We also asked how the information that they shared with us could be made more useful to the IPBES and IPCC processes. 7 respondents answered the question. They mentioned that the usefulness of the knowledge for IPBES and IPCC processes would depend on the spatial scales that will be considered in the IPBES and IPCC processes, as the mentioned data varied in their spatial scale (national, regional, and local). They also mentioned that the connection between the different databases (or creation of a meta-database) could improve the information on the available data for IPBES and IPCC processes. Also, the implementation of the INSPIRE directive in each country would help the information flow from the national level research to the IPBES and IPCC processes. They also emphasized the importance of including data in the IPBES and IPCC processes from underrepresented regions.

We also asked what could make these IPCC/IPBES knowledge gaps more widely known. 7 respondents answered the question. The respondents mentioned that it would be important to foster the synergies between countries regarding IPCC and IPBES knowledge gaps, to initiate cross-institutional collaborations, to establish communities of practice, to train students, and to strengthen the communication between science and policy. Awareness raising and organizing promotional events in the countries would also help to present knowledge gaps to a wider community of researchers.

We also addressed the drivers and barriers of knowledge exchange between the IPBES/IPCC and MAES projects regarding the knowledge gaps in our survey. Only 5 respondents answered the question. The Respondents mentioned the lack of financial support, the lack of human capacity in institutions and academia, the constant rotation of officers in biodiversity administration, and the lack of coherent biodiversity policies as the main barriers to exchange between IPBES/IPCC knowledge gaps and the national level MAES projects.

4 Discussion

This study demonstrates that a significant amount of new information from European MAES (Mapping and Assessment of Ecosystems and their Services) and other projects is available to address knowledge gaps identified by the IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) and IPCC (Intergovernmental Panel on Climate Change). By organizing and cataloguing national data relevant to 51 knowledge gaps, we demonstrate that European countries have generated significant information capable of informing global processes—particularly in domains traditionally well-supported by natural sciences, such as conservation status and trends of species, habitat condition, soil and water quality, direct drivers and provisioning services. However, despite this volume of data, many critical gaps persist—particularly those requiring interdisciplinary or context-sensitive inputs, such as indirect drivers, health impacts, plural values, and Indigenous knowledge systems.

A subset of knowledge gaps identified in the IPBES and IPCC assessments, for example, remains only partially addressed. These include highly specific or complex topics such as carcass removal, the medicinal potential of plants, and indicators of actual ecosystem service use. Gaps persist in data related to agricultural habitats, non-protected areas, and the impacts of climate change on terrestrial and freshwater ecosystems, including freshwater fisheries, and microorganisms. Moreover, crucial social and political dimensions such as indicators of human well-being, climate risks for Indigenous people, Indigenous and traditional knowledge systems, plural valuation frameworks, and governance effectiveness remain poorly integrated across most countries.

In contrast, national-level information was more consistently available for classical ecological indicators, such as the extent and condition of habitats, long-term species population trends (especially birds and vertebrates), and provisioning services like freshwater availability. Many countries also reported on soil quality, chemical status of surface water, wildlife-related tourism, and direct drivers of biodiversity change. Biophysical functions underpinning ecosystem services—particularly in marine and freshwater systems—were relatively well-covered. These patterns reflect a broader trend in biodiversity–climate assessments: a dominance of academic, natural science–based knowledge production (Wiegleb and Bruns 2025), supported by institutional investments in classical ecological monitoring, especially in Western and Northern Europe. This dominance persists despite ongoing efforts to broaden the disciplinary and geographic scope of assessments (Báldi and Palotás 2021). Specific knowledge gaps, such as those related to carcass removal, were addressed in only a few countries, reflecting the difficulty of generating data on more complex, multidisciplinary, or context-specific topics. Overall, classical aspects of assessment—such as status and trends—are generally much better covered than those requiring interdisciplinary or localized approaches.

Notably, these more complex and underrepresented knowledge needs—particularly those aligned with IPBES and IPCC priorities—are also widely recognized by practitioners themselves. Encouragingly, most survey respondents were already aware of these gaps and indicated that they had also encountered IPBES/IPCC knowledge gaps in their assessments, EU-funded projects, or national ecosystem service initiatives. Bridging these gaps requires better integration of existing databases, particularly given the scale differences between MAES (typically national) and IPBES/IPCC (continental or global). Experts further highlighted the lack of financial and human resources, and the inconsistency and policy incoherence across countries, as key barriers to integrating national and international efforts.

Despite these challenges, our study demonstrates that national-level data—or at least the source/owner of data—can be integrated into a meta-database capable of covering a significant portion of Europe. Achieving this integration calls for stronger coordination and cooperation among European countries while conducting national ecosystem assessment and mapping projects. Given the dynamic nature of ecosystems—for example, due to climate change (Dyderski et al. 2025)—such coordination is also essential at the European scale for improving mitigation and adaptation strategies.

To support this effort, a stakeholder network analysis conducted under RESPIN Task 2.1 mapped the flow of biodiversity and climate-related information (Yogya et al. 2025). The resulting social network can help connecting national knowledge holders with decision making

procedures to improve information flows and ultimately increase the visibility of national-level results in international forums. In this way, the integration and connection of knowledge databases across the EU can also serve as a blueprint for facilitating information exchange at the international level—for example, in future IPBES and IPCC assessments or in support of CBD evaluations.

One clear recommendation emerging from our work is the need for greater consistency and clarity in how knowledge gaps are formulated in IPBES and IPCC reports and the underlying scoping reports. A review of the IPBES ECA knowledge gaps revealed considerable variability in terms of generality, disciplinary focus, and wording. For example, the gap described as "Insufficient representation of plural values and intrinsic values in scenario valuation of ecosystems" were difficult for some survey respondents to interpret, particularly those unfamiliar with such specialized terminology. Given the heterogeneous nature of the gaps—in terms of scale, generality, and feasibility—we recommend that authors of future assessments follow more closely the guidelines developed by the IPBES task force on knowledge and data for identifying knowledge gaps (IPBES 2018a). At the same time, targeted mini-workshops at the beginning of assessment procedures can provide authors with an overview and understanding of the potential of available data sources. Beyond IPBES and IPCC assessments, the so identified and mapped knowledge databases are also operationally useful for national reporting systems.

Importantly, the contributions from Eastern and Southeastern Europe indicate the need to revisit assumptions about data scarcity in these regions. Our study shows that a considerable volume of new information exists, often the result of high-quality projects carried out under national biodiversity or EU funding frameworks. Although our sample was limited, and it was not the focus of our investigation, our impression is that respondents from East-EU and Southeastern European countries were more enthusiastic about being involved. One respondent noted that although high-quality biodiversity and ecosystem service assessments and mappings were conducted under well-funded projects, their results remain largely invisible on the international stage. Hence, the considerable potential of this knowledge remains largely invisible internationally, either because it is housed in grey literature or unpublished reports, or because it is not widely accessible in English or academic journals. In some cases, even English-language reports failed to gain traction due to lack of indexing in global knowledge repositories. Respondents from these regions expressed a strong desire to see their work acknowledged and utilized in global forums, but also frustration that dissemination pathways remain weak. The Hungarian national MAES project, which has since led to several peer-reviewed publications (e.g. Tanács et al. 2021, 2022, 2024; Vári et al. 2024), offers a promising model for addressing this disparity. Institutional incentives should explicitly encourage project teams to publish key outputs in indexed scientific journals and citable formats, beyond the standard reporting requirements. Another strategy is to directly link existing MAES datasets and maps with current and future IPBES and IPCC assessments, or at least make them known to assessment authors, and provide them in a format usable for the assessment. This approach is a key objective of RESPIN Task 2.3, which has successfully gathered numerous data sources from 14 countries, including underrepresented regions in Eastern-EU and Southeastern European countries.

Our findings offer substantial contributions toward filling IPBES and IPCC knowledge gaps by incorporating new data from lesser-known regions in Eastern EU and Southeastern European

countries. However, we emphasize that any use of this data in formal assessments must comply with the FAIR (Findable, Accessible, Interoperable, Reusable) and CARE (Collective Benefit, Authority to Control, Responsibility, Ethics) principles.

A potential limitation of our study is that the survey may not have captured all new knowledge generated by MAES projects, primarily due to the involvement of only one or two experts per country. However, we targeted the core national experts most familiar with their country's ecosystem service assessments. Our main objective was to identify and locate new knowledge that could address IPBES and IPCC knowledge gaps—essentially constructing a meta-database. Thus, it was not the specialised experts who were involved, but rather those overseeing the full national MAES project.

The sources of new knowledge identified through MAES projects are diverse, ranging from academic publications and national- and English-language reports to websites, research institutes, statistical offices, and expert knowledge. While this diversity is valuable, it also poses challenges for accessing primary data—particularly when no automated or AI-assisted tools can be easily applied, as is often the case when engaging directly with human data holders.

This study represents an initial step in the broader effort to map and access these varied data sources, along with their respective owners and domain specialists. Future steps should include engaging biodiversity and ecosystem assessment projects that were implemented independently of MAES projects. However, it is highly unlikely that such initiatives have results of comparable scope or alignment with the MAES framework to identify and retrieve the primary data from MAES projects—what we have termed the "entry points", referring to the location or ownership of the original data.

To this end, we are suggesting three potential pathways to integrate our meta-database into IPBES, IPCC, and JRC assessments. Consultation with the IPBES Data and Knowledge Technical Support Unit resulted in the design of the appropriate table format, which will be uploaded to Zenodo with a DOI number. Using AI techniques, primary data can be searched through the meta-data developed in this task. These meta-data can be added to data sources to be used by assessment authors, especially for the IPBES 2nd Global Assessment. The utilization of our meta-data by IPCC assessments is under investigation. We are in contact with the office of vice chair Diana Ürge-Vorsatz, who will redirect us to the appropriate contact. This is in progress, meaning that first we need to clarify with IPCC what exactly our meta-data entail. Regarding the JRC, and MAES-2 project, it seems that the direct use of our meta-data is not possible, as MAES needs the data and at a larger (European) scale, while we have metadata at national level. However, the framework we applied to handle and categorize the gaps may be of use for JRC's work. All three avenues have yielded positive outcomes, and we are committed to ensuring that our results are incorporated into upcoming assessments, particularly the IPBES 2nd Global Assessment. The timing of RESPIN Task 2.3 aligns well with the current demand for filling knowledge gaps, offering a unique opportunity for meaningful impact.

Conclusion

In accordance with the RESPIN Work Programme, we developed and conducted a survey across 14 countries, as we describe above, and we also gathered expert opinions and recommendations to identify barriers and propose solutions to improve the flow of information from national to continental levels— specifically, how to link MAES projects with IPBES and IPCC assessments. That is, on how to link MAES projects with IPBES and IPCC assessments. This work marks an important step forward in connecting knowledge gaps and new information sources. While limitations remain, especially the limited sample size of respondents per country and the lack of full primary data access, the study serves its primary purpose: to map where, and through whom, new biodiversity and ecosystem knowledge can be found. Our findings offer a practical foundation for further exploration, integration, and expansion.

This deliverable confirms that national MAES projects in Europe hold untapped potential for addressing key knowledge gaps identified in IPBES and IPCC assessments. Yet, realizing this potential demands greater attention to the structural and procedural barriers that prevent effective knowledge integration. Concrete efforts are needed to standardize the identification and communication of knowledge gaps, support equitable publishing practices across EU regions, and develop mechanisms for systematic data harvesting and recognition at the international level. The RESPIN Task 2.3 database serves as an initial demonstration of this potential. With continued coordination, especially through engagement with assessment bodies, these efforts can significantly improve the relevance, accessibility, and inclusiveness of knowledge used in future biodiversity and climate assessments.

5 Annexes

5.1 Table with the original IPBES and IPCC knowledge gaps

Table 4. The re-organised IPBES knowledge gaps and the original knowledge gaps from the IPBES regional assessment report for Europe and Central Asia (https://www.ipbes.net/assessment-reports/eca). The grey cells show the gaps which were inlcuded into our survey, and below that in whitin the cells the original gaps written in the assessment. The number of the chapter where the original knowledge gaps can be found in the report is also given. The missing numbers (like 1.1) are knowledge gaps which are from the IPCC assessment, and listed in the next table. The survey did not differentiate between IPBES and IPCC gaps, to avoid confusion for the respondent.

1.2 Indicators of the trends in habitat creation and maintenance
2 Indicators of the trends in habitat creation and maintenance; a number of indicators can be used to evaluate its current state such as some key migratory and breeding species and their habitat and indigenous and local knowledge can also be used to assess the status and trends of this contribution from nature to people
1.3 Relationship between water use and water availability; indicator data for freshwater quantity for Eastern Europe and Central Asia
2 The relationship between water use and water availability; indicator data for freshwater quantity for Eastern Europe and Central Asia is also lacking Europe and Central Asia
1.4 Soil quality; encompassing its physical, chemical, and biological components
2 Soil quality; encompassing its physical, chemical and biological components
1.5 Carcass removal by vertebrate and invertebrate scavengers and marine organisms
2 Carcass removal by vertebrate and invertebrate scavengers and marine organisms
1.6 Medicinal potential of medicinal resources and plants, national measures and indicators need to become comparable on an international scale
2 The use of medicinal resources and plants; ethnobotanical research is central to a better understanding of the medicinal potential of medicinal plants and national measures and indicators need to become comparable on an international scale, regarding health, ecological, cultural, legal or socioeconomic aspects
1.7 Wildlife-based tourism, accurate statistical information on the number of users enjoying recreational activities around wildlife (i.e. whale-watching, bird-watching).

2 Wildlife-based tourism; a data gap exists about accurate statistical information on the number of users developing recreational activities around wildlife (i.e. whale-watching, bird-watching)
1.8 Supporting (cultural) identities, lack of consensus on suitable indicators
2 Supporting identities; there is a lack of consensus on suitable indicators but these could be developed using attitudes towards nature protection and species or ecosystem attributes or characteristics that are particularly valued for their existence (e.g. iconic, emblematic, symbolic species)
1.1-1.8 KGs
2 Uneven coverage in the existing literature of the different contributions for nature to people and subregions of Europe and Central Asia.
2 Limited availability of indicators for certain of nature's contributions to people in Europe and Central Asia 2 There are more accurate data on status and trends for material contributions, especially food and feed, than some regulating and non-material contributions.
2.1 Insufficient integration of traditional, Indigenous, and local knowledge into national and international biodiversity policy frameworks and initiatives
1 Little research on the integration of indigenous and local knowledge into national and international policy frameworks and initiatives to create synergies across knowledge systems
2 There is a knowledge gap, however, relating to the recording of indigenous and local know
5 Studies which explicitly covered indigenous and local knowledge were largely unrepresented and such information needs to be collected before it disappears
2.2 Limited understanding of the plural values of ecosystem services endorsed by different societal groups and genders
1 Limited understanding of how these diverse values are endorsed by different social groups and genders
2 limited understanding of the plural values of nature's contributions to people endorsed by different societal groups and genders
1 Need for better understanding, quantification and integrated monitoring of the diverse values of nature's contributions to people
2.3 Limited integration of the visions of different societal groups in identifying future targets and pathways for ecosystems
5 Visions can also be "stakeholder-specific" with different societal groups having different (and potentially conflicting) visions of the future

2.4 Insufficient representation of plural values and intrinsic values in scenario valuation of ecosystems
5 Different ways (eg. anthropocentric) of valuation in exloratory and normative scenario (eg. intrinsic values not considered) recognizing the diversity of values
3.1 Limited understanding of direct drivers of change (such as land-use change and land abandonment, pollution, invasive alien species, overfishing, and climate change) in assessments of biodiversity, ecosystems, and climate change
1 Understanding time lags in the effect of drivers on biodiversity and nature's contributions to people to comprehend their real impact.
1 Key gap in the identification, quantification and assessment of trends in drivers over time owing to their high spatial and temporal variability.
3 information on future trends in biodiversity was predominantly focused on the impact of climate change, especially on plants and vertebrate species. There were very few studies investigating the impact of land-use change and even fewer investigating future projected impacts of pollution,invasive species, fishing and other drivers of change lack of synthetic studies on this subject and the limited ability to meta-analyze the literature to provide this evidence. Therefore, the attribution of drivers to trends was based on the qualitative expert assessment of the authors rather than on quantitative empirical evidence from experimental or quasi-experimental studies.
3 Processes threatening vascular plants are also unknown for several species.
4 Abandonment of intensively managed agricultural land has been widespread across Europe and Central Asia (well established). However, a comprehensive assessment of the effects of this process on biodiversity and nature's contributions to people is limited by knowledge gaps. In the European Union, cropland area has decreased by almost 1.2 million hectares in recent decades and largely been replaced by forested and urban areas (4.5.2, 4.5.4). Enlargement of the European Union to Central Europe and implementation of the European Union Common Agricultural Policy in new member States have resulted in the reconversion of some of this abandoned farmland to intensive agriculture – a trend that is likely to continue. Eastern Europe and Central Asia are and will remain hotspots of agricultural land abandonment (well established) (4.5.2). This has resulted in substantial reduction in livestock, and decline in crop production in these subregions. With the economic recovery and increasing domestic and foreign investments in agriculture after the year 2000, re-cultivation of some abandoned croplands began, particularly in the agriculturally favourable black soil regions in the south of European Russia, Ukraine and northern Kazakhstan (4.5.2, 4.5.3).
4 Knowledge gaps remain with respect to changes in physiological processes and evolutionary adaptations to new climatic conditions (Bellard et al., 2012; Merilä & Hendry, 2014).
5 direct drivers of pollution and invasive alien species had limited coverage in exploratory scenarios compared to other direct drivers, such as climate change and land use change
3.2 Limited understanding of indirect drivers of change (such as institutional change, cultural change and technology) in assessments of biodiversity, ecosystems. and climate change

5	indirect drivers of institutional change, cultural change and technology rarely included in analyses
3.3 Limited understanding of the underpinning role of nature and ecosystems in ES delivery especially in marine and freshwater systems	
1	Lack of understanding about how biodiversity contributes to ecosystem services, especially in marine systems
1	Monitoring ecosystem functioning and species interactions is necessary to better understand the cascading effects of biodiversity changes and anticipate ecological tipping points
5	The underpinning role of nature and ecosystems in the delivery of nature's contributions and the maintenance of good quality of life was often missed.
3	For some ecosystem services, there is insufficient data to evaluate the relationship between biodiversity and ecosystem service provision. For example, the effects of fish diversity on fisheries yield and the effects of biodiversity on flood regulation are inconclusive (Cardinale et al., 2012). Additionally, ecosystem services provided by taxa other than plants are only beginning to be studied. Finally, the majority of studies reviewed focused on taxonomic diversity at the community level (i.e. species richness or diversity), rather than on intraspecific, functional phylogenetic diversity
3.4 Underrepresentation of actual ES use indicators compared to indicators of ES capacity indicators	
2	the kind of information and indicators that are recommended for monitoring progress towards the Aichi Biodiversity Targets indicates a bias towards information related to capacity of nature's contributions to people
2	knowledge gap regarding indicators on the use of nature's contributions to people, demand and governance, which are less developed for the Europe and Central Asia region than capacity indicators.
3.5 Limited integration of indicators of human wellbeing and quality of life into ES assessments	
2	Small set of documents assess the status and trends of contributions and even fewer consider relationships between nature's contributions to people and good quality of life
5	Poor coverage of nature's non-material contributions to people, and quality of life indicators + absent from, or limited to, recreational benefits
5	The underpinning role of nature and ecosystems in the delivery of nature's contributions and the maintenance of good quality of life was often missed.
2	knowledge gaps on nature-human health linkages in Europe and Central Asia and other regions
3.7 Insufficient assessments of synergies and trade-offs between the multiple aspects of ecosystems, their ESs, and human well-being	
5	Rare and limited integrated studies which attempt to capture some of the complex interdependencies between human and environmental systems under multiple drivers of change. There is a significant gap in integrated assessments in terms of exploring the full range of synergies and trade-offs between the multiple aspects of nature, its contributions to people, and a good quality of life under different scenario archetypes and across different scales

5	consideration of biotic regulation services (e.g. pollination, pest control), natural hazard protection and non-material contributions were largely absent from trade-off analyses
4.1 Limited quantification of targets and pathways related to biodiversity	
1	Gaps in the quantification and timing of pathways towards desired futures: Pathways and envisioning studies are often not supported by modelling and, so, lack detailed quantification of goals and actions. Detailed description and sequencing of actions within pathways is rare, as is information on combinations of policy instruments to implement specific actions {5.6.2}. The incorporation of combinations of exemplary transition movements pathways into large-scale scenario exercises and into participatory scenario development is suggested as a way forward for better resolving trade-offs and for scaling-up local or sectoral solutions.
5	Absence of direct links to international goals.
5	Studies covering the marine realm were poorly represented, and almost absent from visions and pathways
5	Limited number of regional visions. Thematic gaps: marine ecosystems and urban systems.
5	The level of development of visions lacked quantitative goals providing only qualitative orientating goals.
5	Detailed descriptions and sequencing of actions within pathways was rare, as was information on combinations of policy instruments for implementing specific actions
4.2 Limited knowledge about the impact and effectiveness of biodiversity governance processes (especially informal governance)and the policy instruments, and limited understanding of the interactions between the policy instruments in their context especially in Eastern Europe and Central Asia	
6	In particular, there are very few analyses of governance as a process (rather than an assemblage of institutions) in Eastern Europe and Central Asia, and analyses of local governance mechanisms and the role of local knowledge in environmental issues beyond water management
6	limited studies that take a multidisciplinary systemic perspective on environmental governance in the region, and that combine an analysis of policy instruments with an analysis of the behaviour of (economic) actors (e.g., households, companies) and the overarching economic and social system in which these behaviours are embedded. Such perspectives would provide insights into the root causes of the limited effectiveness of environmental governance
2	knowledge gap regarding indicators on the use of nature's contributions to people, demand and governance, which are less developed for the Europe and Central Asia region than capacity indicators.
6	analyses that trace the impacts of governance arrangements on biodiversity and ecosystem services (or nature's contributions to people) in some depth, and that report on synergies and trade-offs or conflicts between their impacts, are very scarce
6	literature on environmental governance seems to be largely focused on policy instruments and formal institutions. For the environmental sector, much less research and analysis is available on informal and hybrid governance mechanisms such as co-management and public-private partnerships. In particular, there are very few analyses of governance as a process (rather than an assemblage of institutions) in Eastern Europe and

Central Asia, and analyses of local governance mechanisms and the role of local knowledge in environmental issues beyond water management
1 Inadequate understanding of how to mainstream policy objectives within different sectors and integrate them across sectors and scales: This requires a better understanding of the interaction between different policy instruments in existing policy mixes, not just the optimization of single instruments. More knowledge is needed about the effectiveness and efficiency of policy instruments that also consider institutional contexts, social impacts and how equity can be improved. There are further knowledge gaps on the effects of policy instruments on behaviour (e.g., of households and of companies) and on the economic and social systems within which these stakeholders operate.
6 There are also very limited comparative insights into the effectiveness and ways of working of alternative policy instruments, and their interactions with each other in context
6 The current state of mainstreaming through rights-based instruments and customary norms has a huge potential for improvement. Despite the fact that rights-based approaches are at the very centre of the recently adopted Sustainable Development Goals, which aim at integrating human rights into all three dimensions of sustainable development (United Nations, 2015), our assessment shows that these types of instruments are rarely implemented and there are huge knowledge gaps in several sectors
4.3 Lack of comparative overview of spatial planning throughout Europe and Central Asia and limited knowledge of the impact of planning modes and instruments on biodiversity
6 Three methodological challenges for a systematic assessment can be pointed out: (i) an assigning problem related to difficulties in detecting cause-effect relations between planning measures and outcomes; (ii) an indicator problem because it is not possible to quantitatively measure the qualitative impact; and (iii) a time framing problem due to the long time span between implementation and impact of a measure (Fürst, 2005). Knowledge gaps exist concerning a comparative overview of spatial planning throughout Europe and Central Asia. Comparative studies on spatial planning and its ieffectiveness across such a diverse group of countries is particularly challenging.
4.4 Limited knowledge of the perspective and role of investments in achieving targets related to biodiversity and climate
5 While investments were mentioned in a number of studies across the chapter, none of them provided systematic research to appropriately respond to the role of investments in the protection of ecosystem.
5.1 Limited knowledge of the extent and intactness of habitats critically for Eastern Europe and Central Asia
5.2 Limited knowledge of the conservation status and trends of species critically for Eastern Europe and Central Asia
5.3 Limited knowledge of the trends and future projections of habitats
1 Gaps in our understanding of the status and trends of nature: These gaps include habitat extent and intactness, and species conservation status and trends for the whole region, but critically for Eastern Europe and Central Asia.
5 Knowledge and information gaps for Eastern Europe. Evidence based on few studies.

3	Large gaps in knowledge on habitat extent and intactness, and species conservation status and trends for Eastern Europe and Central Asia.
5.4 Lack of systematic monitoring of fungi, non-vascular plants, invertebrates, marine and freshwater species, and soil organisms across the range of subregions	
3	no systematic monitoring of plant and animal species across the range of subregions
1	Systematic and integrated biodiversity monitoring of fungi, non-vascular plants, invertebrates, marine and freshwater species and soil organisms are required to better assess the status and trends for the whole region.
5.5 Lack of long-term monitoring data for non-protected areas outside the EU	
3	Outside the European Union long-term monitoring data is available almost exclusively for protected areas
5.6 Knowledge of biodiversity trends in agricultural areas decreases from west to east	
3	Information on biodiversity trends in agricultural areas decreases from west to east. Studies on biodiversity and agriculture for Eastern Europe and Central Asia often focus on drivers of biodiversity in agricultural areas rather than biodiversity trends while biodiversity is surveyed for semi-natural ecosystems rather than more productive agroecosystems in these countries.
6.1 Limited knowledge of current as well as future changes in genetic responses of marine species to environmental changes	
3	Gap in knowledge regarding current as well as future changes is genetic responses to environmental changes. Only few taxa, among them fishes and algae, have been studied so far.
6.3 Insufficient knowledge of the status and trends of certain marine ecosystems: subtidal rocky areas, open ocean plankton communities, deep-sea areas (>200 m)	
3	Almost no data are available to document changes in subtidal rocky areas although they are rich in biodiversity and support key engineer species, for instance in subtidal kelp forests
3	Open ocean plankton communities are also poorly known. It is estimated that, in each litre of seawater, there are on average 10 billion organisms, including viruses, prokaryotes, unicellular eukaryotes, and metazoans
3	Lack of data on status and trends of biodiversity in deep-sea areas (>200 m)
6.5 Limited knowledge of the chemical status of surface freshwaters in Europe	
3	The chemical status of 40% of Europe's surface waters remains unknown (EEA, 2015d), considering that good chemical status was only achieved for all surface bodies in five of the 27 European Union member States, it is likely that the environmental conditions of some of these water bodies are poor
6.6 Limited understanding of the trends in geographic extent and population size of freshwater species	
3	There are no meaningful trends in geographic extent or population size of freshwater species available for Europe and Central Asia. Therefore, a table of trends and importance of drivers was impossible to produce
3	There are no meaningful trends in geographic extent or population size of freshwater species available for Europe and Central Asia. Therefore, a table of trends and

importance of drivers was impossible to produce. Of particular concern is the lack of data for freshwater invertebrates, for which even current status is available only for a minority of species (EEA, 2010). For example, several freshwater crab species have data deficient status according to the IUCN Red List, which highlights the need to increase monitoring efforts globally but also in Europe and Central Asia. Similarly, almost a quarter of all European freshwater molluscs are data deficient and many might prove to be threatened once enough data become available to evaluate their extinction risk. However, the number of data-deficient species may well increase, since 76% of freshwater fishes and 83% of freshwater molluscs have unknown population trends (Cuttelod et al., 2011). Data are also deficient for many other freshwater invertebrate groups (Balian et al., 2008). This is owing to several reasons such as lack of taxonomic information, knowledge gaps in geographical coverage of data and lack of long-term data. These gaps need to be assessed urgently, by fostering taxonomic research and monitoring and by making proprietary databases and databases under pay-wall freely and openly available
7.1 Insufficient knowledge of the long-term population trends of several vascular plant species
3 Less than 10% of all species of vascular plants known to occur in the region have been assessed by the IUCN Red List (2,483 species for an estimated >30,000 for the region) (IUCN, 2017c). Among those assessed, 46.2% have unknown population trends. These also include species of conservation concern, such as 20% of the species included in the European Red List of Vascular Plants; (Bilz et al., 2011). These knowledge gaps are caused by lack of field data, difficulties in accessing data for some countries, and uncertain taxonomy. Processes threatening vascular plants are also unknown for several species
7.2 Insufficient knowledge of the long-term population trends of birds
3 While birds are arguably the most studied and best known group in Europe and Central Asia, there is still one species, the large-billed reed-warbler, Acrocephalus orinus listed as being data deficient by the IUCN and therefore having unknown extinction risk, and there are also 79 species with unknown population trends in the European Union (EEA, 2015a). Long-term trends are rarely available. Low capacity or difficult access means that regions such as Caucasus, the Arctic part of Europe, Romania, Croatia, the Faroe Islands and the Azores are underrepresented in bird conservation status assessments (BirdLife International, 2015)
7.3 Insufficient knowledge of the long-term population trends of terrestrial vertebrates (mammals, reptiles, and amphibians)
3 More substantial knowledge gaps exist for other terrestrial vertebrate groups. There are, respectively, 55 mammals, 11 reptiles and three amphibians that are classified as data deficient by the IUCN. In addition, population trends are unknown for 100 of 1,026 bird species extant in the region and assessed by IUCN as well as 263 of 537 mammals, 7 of 129 amphibians and 56 of the 268 species of reptiles (IUCN, 2017c)
7.4 Insufficient knowledge of the status, trends, and threats for terrestrial invertebrates
3 There are at least 100,000 species of insects known in Europe, and an unknown number of earthworms, arachnids, snails and other invertebrate species. However, it is plausible that several hundreds of thousands of species of invertebrates occur in Europe and Central Asia. Despite this extremely high diversity, and importance for ecosystem services, only a very small proportion is listed in the IUCN Red List. More specifically, there are only 2,132 species of terrestrial invertebrates in the IUCN Red List

that are extant in the Europe and Central Asia region. The majority of these are European bees, which include 1,965 species (Nieto et al., 2014). Moreover, almost nothing is known about species, trends and threats for this taxonomic group from Central Asia
7.5 Largely unknown regional or continental data on the status, trends, and threats for lichens and fungi
3 At least 7,000 species of lichens are known to occur in Europe (excluding Russia), while across the whole of Europe and Central Asia only five lichen species have been assessed in the IUCN Red List and have known conservation status
3 The number of fungus species in Europe exceeds 75,000, 15,000 of which are macrofungi (Senn-irlet et al., 2007). Currently there are no regional or continental data on status and trends of fungi
7.6 Largely unknown status, trends, and threats for soil and freshwater micro-organisms
3 We were unable to assess status and trends in diversity, biomass and community composition of soil and freshwater micro-organisms: Protozoa, Bacteria, Rotifera, Nematoda, Tardigrada, despite the key role of these organisms in soil formation, nutrient and carbon cycling, and water retention
7.7 Limited knowledge of urban biodiversity, specifically: Syrphids and other Diptera
3 The data available for urban areas are mostly for the larger and more easily observed taxa, such as vascular plants, birds and mammals. There is good data for bats, and reasonably good data on amphibians, reptiles and some insect taxa, including butterflies. The small amount of data available on taxa more difficult to observe and distinguish, such as Syrphids and other Diptera, suggest high levels of diversity and numerous rare and threatened species (Kelcey, 2015). Thus, more surveying of such taxa would generate valuable new knowledge on urban biodiversity.

Table 5. The re-organised IPCC knowledge gaps and the original knowledge gaps from the IPCC Climate Change 2022: Impacts, Adaptation and Vulnerability report (https://www.ipcc.ch/report/ar6/wg2/). The grey cells show the gaps which were inlcuded into our survey, and below that in whit cells the original gaps written in the assessment. The number of the chapter where the original knowledge gaps can be found in the report is also given.

1.1 Limited coverage of climate change impacts and adaptation options for food (especially fruit and vegetables), fiber, and other provisioning ES
13.5 Concerning climate change impact and adaptation, a bias towards modelling of cereals, specifically wheat and maize, results in gaps in knowledge for fruit and vegetables. The assessments tend to focus on individual species and processes hindering upscaling to multiple stressors and mixed production.
13.5 Coverage of climate change impacts and adaptation options for food, fibre and other ecosystem products in Europe are biased towards the EU-28 and have gaps within the eastern part of WCE and EEU.
2.5 Insufficient understanding of climate risks for Indigenous, and traditional livelihoods at different warming levels

13.8 Limited understanding of the risks for indigenous and traditional livelihoods in Europe at different warming levels
2.6 Insufficient integration of traditional, Indigenous, and local knowledge into climate adaptation actions
13.3 Climate adaptation actions will depend on local implementation and benefit from being assessed using cultural and Indigenous knowledge where applicable, but this is hardly studied (medium confidence).
3.1 Limited understanding of direct drivers of change (such as land-use change and land abandonment, pollution, invasive alien species, overfishing, and climate change) in assessments of biodiversity, ecosystems, and climate change
3.2 Limited understanding of indirect drivers of change (such as institutional change, cultural change and technology) in assessments of biodiversity, ecosystems. and climate change
13.4 Major knowledge gaps are uncertainties and shortcomings in our understanding of combined, cascading and interacting impacts of climatic and non-climatic pressures on European marine and coastal socio-ecological systems (Korpinen et al., 2021). Further observational, experimental and modelling work will enhance the insight into multiple drivers, processes and their interactions, strengthen the confidence of risk projections and provide a foundation for future adaptation actions.
13.3 Many studies consider only individual climate drivers, though new research shows strong interactions between hazards such as warming and drought (Section 13.3.1), as well as non-climatic drivers (Chapter 2). This creates uncertainty about the emergence of extinctions and the magnitudes of impacts for European ecosystems and the services they provide (high confidence), such as pollination on food production. RCP-SSP combinations to assess risks are only just emerging (Harrison et al., 2019).
3.6 Limited knowledge of the health impacts of climate change, particularly for mental health and well-being, (mal)nutrition and food quality, and climate-sensitive infectious diseases
13.7 Attributing health impacts to climate change remains challenging, particularly for mental health and well-being, (mal)nutrition and food quality and climate-sensitive infectious diseases.
3.7 Insufficient assessments of synergies and trade-offs between the multiple aspects of ecosystems, their ESs, and human well-being
13.10 An integrated assessment, which projects the impacts of climate change on crop production by examining the potential availability of water for agricultural purposes together with other adaptation measures, is missing.

3.8 Limited data on aggregated projections of impacts, especially of combined hazards on food, fiber, and other ecosystem products
13.5 Aggregated projections of impacts, especially of combined hazards on food, fibre and other ecosystem products, are still rare. Effectiveness of adaptation options is predominantly qualitatively mentioned but not assessed, and the effectiveness of combinations of measures is rarely assessed.
4.3 Lack of comparative overview of spatial planning throughout Europe and Central Asia and limited knowledge of the impact of planning modes and instruments on biodiversity
13.2 Transformative options, such as land-use changes, planned relocation from exposed areas or restricting future development, are rarely considered.
4.5 Limited knowledge of the long-term effectiveness of climate adaptation options and limited quantification of the effectiveness of measures in reducing risk
13.3 Assessments of the long-term effectiveness of adaptation actions are missing, due to the time lag in determining the effectiveness of an action and attributing risk reduction (Morecroft et al., 2019). For example, many landscape restoration actions have been discussed, but it is unclear which would bring the greatest benefits and which species should be used for the restoration (Ockendon et al., 2018).
13.2 An assessment of the full solution space of adaptation options and pathways under low to high GWL (global warming level), including the long term, is lacking. A quantification of the effectiveness of measures in reducing risk is limited in the scientific literature. The available assessments consider adaptation by incremental measures.
5.7 Insufficient understanding of the impacts of climate change and the associated risks for terrestrial ecosystems
13.3 Despite growing evidence of climate-change impacts and risks, including attributed changes to terrestrial ecosystems (Section 13.10.1), this information is geographically not equally distributed, leaving clear gaps for some processes or regions (high confidence).
5.8 Insufficient understanding of projections for climate change-related wildfire incidents, their magnitude, and their impacts particularly for Northern Europe, Eastern Europe, and Western Central Europe
13.3 Robust projections for wildfire incidents, magnitudes and their impacts are currently limited, particularly for NEU (Northern Europe), EEU (Eastern Europe) and WCE (Western Central Europe).
6.2 Limited knowledge of connectivity among marine populations, species, and ecosystems, which can provide new recruits, and enable gene flow in marine protected area networks
13.4 There is limited knowledge about the connectivity among populations, species and ecosystems which would provide new recruits, enable gene flow in MPA networks (Dubois et al., 2016; Sahyoun et al., 2016) and facilitate assisted migration. Such MPAs cover a wide range of protection status with limited evidence regarding which level of protection and connectivity is needed to achieve adaptations goals in response to future warming.

6.4 Lacking of high-quality observations of key ocean characteristics at the level of regional sea basins to support decision-making for marine adaptation
13.4 Although European seas and coasts are comparatively well studied on a global scale, the spatial and temporal resolution and coverage of open-access data is still limited in many regions, particularly in EEU. The detection and attribution of ongoing or emerging environmental and biological changes are therefore limited. Some efforts are in place, such as the six 'Sea-basin Checkpoints' (North Sea, Mediterranean Sea, Arctic, Atlantic, Baltic, Black Sea) that were established in 2013 under The European Marine Observation and Data Network, but high-quality observations of key ocean characteristics at the level of regional sea basins are still too scarce to support decision making for marine adaptation (Míguez et al., 2019).
6.7 Insufficient knowledge of the effects of climate change on freshwater fisheries
6.8 Lack of actionable climate adaptation strategies for European fisheries and aquaculture
13.5 Increased knowledge on the effects on freshwater fisheries and their resources is also needed.
13.5 There is a lack of actionable adaptation strategies for European fisheries and aquaculture. Knowledge gaps include adaptive capacities of local fishing communities to a new mix of target species and consumer acceptance of the product.

5.2 An example of an invitation letter to experts

Tárgy: feeding MAES results into IPBES/IPCC knowledge gaps
Feladó: András Báldi <baldi.andras@ecolres.hu>
Dátum: 2025. 04. 16. 12:15
Címzett: andrzej.mizgajski@amu.edu.pl
CC: Fabók Veronika <fabok.vera@gmail.com>, András Báldi <baldi.andras@ecolres.hu>

Dear Andrzej Mizgajski,

My name is András Báldi, a leading scientist at the Centre for Ecological Research, Hungary (https://ecolres.hun-ren.hu/en/home/).

With my colleagues, we are working on a research project (RESPIN, https://respin-project.eu), which aims to support filling the knowledge gaps identified in the IPBES regional assessment report for Europe and Central Asia (https://www.ipbes.net/assessment-reports/eca) and the IPCC Climate Change 2022: Impacts, Adaptation and Vulnerability report (https://www.ipcc.ch/report/ar6/wg2/).

MAES projects have generated a vast amount of data and knowledge; their integration into the intergovernmental processes, like IPBES and IPCC, is essential.

As part of the RESPIN project, we intend to collect recent knowledge (for the last 10 years) that has been generated by MAES projects at national and regional levels. This can fill the knowledge gaps identified by IPBES and IPCC reports in Europe and Central Asia concerning biodiversity, ecosystem services, and climate change, thus contributing to improving future assessments.

As you have significant knowledge of your national MAES project, we kindly ask you to help us collect information concerning the knowledge gaps identified in the IPBES and IPCC reports. Information from Eastern Europe and South-Eastern Europe is scarce, so these regions are of high priority in our survey!

As a first step towards this goal, we aim to collect information with a survey that can help the project move forward to fill these knowledge gaps and eventually build a database. Depending on the survey results, we are also thinking of publishing a paper on this.

We ask you to suggest to us experts, institutions, databases, or documents that can help fill the knowledge gaps. They are all valuable and important to us.

The survey consists of 8 sections, we ask you to contribute to the topics that align with your area of expertise/knowledge and skip the topics that are not relevant to you.

You can choose to fill out this survey in an interview situation, we will go through the knowledge gaps with you, and we will note down your suggestions. The survey will take approximately 50-60 minutes to complete. If you'd like, you can fill it out yourself.

https://docs.google.com/forms/d/e/1FAIpQLSfWLFl3CBdqklwdd0onTZeP9NrfoUS3hRgaDd9CGUOCAkswGg/viewform?usp=sf_link

Please let us know if you prefer to fill out the survey with us, and please suggest dates when you are available.

Thank you for your help!

Best wishes,

András Báldi

5.3 Online survey

Exploring and identifying existing knowledge on biodiversity, ecosystems and ecosystem services to fill in knowledge gaps identified by IPBES and IPCC

Dear MAES expert,

We invite you to fill out this survey. You can be an individual scientist or you can represent an institution, organization, or group working in the field of biodiversity and ecosystems.

We kindly ask you to suggest to us experts, and institutions who can help fill IPBES/IPCC knowledge gaps. Please mention the names of the experts or their institutions, so we will be able to contact them. If you can provide us with concrete information about databases or documents that you or others worked on, we will be more than grateful! The survey consists 7 sections of knowledge gap groups, you will be able to skip the sections that are not relevant to you. The survey will take approximately 60 minutes to complete.

Section 1. **Status and trends of ecosystem services (ES)**

Section 2. **Insufficient representation of plural values and Indigenous knowledge**

Section 3. **Insufficient understanding of drivers of change, limited integration of ES capacity, ES use, and wellbeing**

Section 4. **Insufficient understanding of governance, planning, and investments, and lack of quantification of targets and measures**

Section 5. **Uneven knowledge of the status and trends of ecosystems and biodiversity in Europe and Central Asia**

Section 6. **Biodiversity across marine and freshwater ecosystems**

Section 7. **Status and population trends of certain taxonomic groups**

Section 8. **Barriers to knowledge exchange between regional and national level of policy processes and IPBES/IPCC**

Your contribution will directly improve the integration of national and regional knowledge into the intergovernmental processes. The information that you provided will be a part of a report (D2.3 Report on the link between global and national programs). At the

end of the survey, you can opt to follow this task of the RESPIN project and be informed on the development of the task.

Thank you for your contribution!

Survey consent form

I voluntarily agree to participate in this research study. I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind. I understand that I can withdraw permission to use data from my survey. I understand that I will not benefit directly from participating in this research. I agree to my interview being audio-recorded. I understand that all information I provide for this study will be treated confidentially. I understand that in any report on the results of this research my identity will remain anonymous. I understand that the original audio recordings will be destroyed after transcripts being made. The data and transcripts will be retained safely.
All the data collected will be stored by the HUN-REN Centre for Ecological Research in compliance with the European General Data Protection Regulation (GDPR) rules in a safe server and will only be used for future communication related to RESPIN activities. You can find here the data protection regulations of the Centre for Ecological Research in Hungarian: https://ecolres.hun-ren.hu/en/privacy-policy.

I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.

In case of any questions or requests regarding the survey consent please contact: fabok.vera@gmail.com
*

I give my consent to take part in this interview

Please provide some information about yourself.

Your name*

Your institution/organization*

Your country of work *

Your background and/or area of expertise*

Section 1. Status and trends of ecosystem services (ES)

This group of knowledge gaps emphasizes the limited knowledge of **indicator data for the status and the trends of ecosystem services**, especially for certain ES types (regulating and cultural ESs).

1.1 Limited coverage of climate change impacts and adaptation options for **food** (especially fruit and vegetables), **fiber,** and **other provisioning ES**
1.2 Indicators of the trends in **habitat creation and maintenance**

1.3 Relationship between **water use and water availability**; indicator data for freshwater quantity for Eastern Europe and Central Asia
1.4 **Soil quality**; encompassing its physical, chemical, and biological components
1.5 **Carcass removal** by vertebrate and invertebrate scavengers and marine organisms
1.6 Medicinal potential of **medicinal resources** and plants, national measures and indicators need to become comparable on an international scale
1.7 W**ildlife-based tourism,** accurate statistical information on the number of users enjoying recreational activities around wildlife (i.e. whale-watching, bird-watching).
1.8 **Supporting (cultural) identities,** lack of consensus on suitable indicators

In the following section, we will ask you to suggest us experts, institutions, data, or documents (assessment, survey, mapping, monitoring, report etc.) that can contribute to filling these specific knowledge gaps. If this section is not relevant to you, you can jump to the next one.

Are you aware of **experts, institutions, data, or documents** concerning the mentioned knowledge gaps (**data for the status and the trends of the mentioned ecosystem services)?**
*

Yes, I can provide information on these knowledge gaps, I stay at Section 1
No, this section is not relevant to me. Jump to Section 2.

Section 1. Status and trends of ecosystem services (ES)

1. I can provide **information** (experts, institutions, data, or documents) that can help to fill the following knowledge gaps concerning **indicator data for the status and the trends of ecosystem services.**

	Yes, I have information on this knowledge gap	No, I don't have any information on this knowledge gap
1.1 Climate change impacts and adaptation options for food (especially fruit and vegetables), fiber and other provisioning ES		
1.2 Habitat creation and maintenance		
1.3 The relationship between water use, water availability and freshwater quantity		
1.4 Soil quality, encompassing its physical,		

chemical, and biological components		
1.5 Carcass removal by vertebrate and invertebrate scavengers and marine organisms		
1.6 Medicinal potential of medicinal resources and plants		
1.7 Wildlife-based tourism, accurate statistical information on the number of users		
1.8 Cultural identities		

If you clicked yes for any knowledge gaps, please list **experts, institutions, data, or documents** for each ecosystem service. This can orient us towards filling the mentioned knowledge gaps. If you can cite specific documents, please add links as well.

Your answer

Section 2 Insufficient representation of plural values and Indigenous knowledge

This group of knowledge gaps addresses **the insufficient representation of plural values of nature and its benefits endorsed by different social groups (especially in Central and Eastern Europe and Central Asia) in biodiversity policy frameworks and assessments.** The following knowledge gaps also explore **the insufficient integration of Indigenous knowledge into climate adaptation actions and the lack of understanding of the climate risks for Indigenous and traditional livelihoods.**

2.1 Insufficient integration of traditional, Indigenous, and local knowledge into national and international biodiversity **policy frameworks and initiatives**
2.2 Limited understanding of the plural values of **ecosystem services** endorsed by different societal groups and genders
2.3 Limited integration of the **visions of different societal groups** in identifying future targets and pathways for ecosystems
2.4 Insufficient representation of plural values and intrinsic values in **scenario valuation of ecosystems**
2.5 Insufficient **understanding of climate risks for Indigenous, and traditional livelihoods** at different warming levels
2.6 Insufficient integration of traditional, Indigenous, and local knowledge into **climate adaptation** actions

In the following section, we will ask you to orient us towards experts, institutions, data, or documents (assessment, survey, mapping, monitoring, report etc.,) that can contribute to filling these specific knowledge gaps. If this section is not relevant to you, you can jump to the next one.

Are you aware of **experts, institutions, data, or documents** concerning the mentioned knowledge gaps **(insufficient representation of plural values and Indigenous knowledge)?***

Yes, I can provide information on these knowledge gaps, I stay at Section 2.
No, this section is not relevant to me. Jump to Section 3.

Section 2 Insufficient representation of plural values and Indigenous knowledge

2. I can provide **information** (experts, institutions, data, or documents) that can help to fill the following knowledge gaps concerning **the insufficient representation of plural values and Indigenous knowledge.**

	Yes, I have information on this knowledge gap	No, I don't have any information on this knowledge gap
2.1 Insufficient integration of traditional, Indigenous and local knowledge into national and international biodiversity policy frameworks		
2.2 Limited understanding of the plural values of ecosystem services endorsed by different societal groups and genders		
2.3 Limited integration of the visions of different societal groups in identifying future targets and pathways for ecosystems		
2.4 Insufficient representation of plural values and intrinsic values in scenario valuation of ecosystems		
2.5 Insufficient understanding of climate risks for Indigenous and traditional livelihoods at different warming levels		
2.6 Insufficient integration of traditional, Indigenous and local knowledge into climate adaptation actions		

If you clicked yes for any knowledge gaps, please list **experts, institutions, data, or documents** for each ecosystem service, This can orient us towards filling the mentioned knowledge gaps. If you can cite specific documents, please add links as well.

Section 3. Insufficient understanding of drivers of change, limited integration of ES capacity, ES use, and wellbeing

This group of knowledge gaps emphasizes **the insufficient understanding of drivers of change, limited integration of ES capacity, ES use, and ES benefits (human wellbeing) in biodiversity assessments.**

3.1 Limited understanding of **direct drivers of change** (such as land-use change and land abandonment, pollution, invasive alien species, overfishing, and climate change) in **assessments of biodiversity, ecosystems, and climate change**
3.2 Limited understanding of **indirect drivers of change** (such as institutional change, cultural change and technology) in **assessments of biodiversity, ecosystems. and climate change**
3.3 Limited understanding of the **underpinning role of nature and ecosystems in ES delivery** especially in **marine and freshwater systems**
3.4 Underrepresentation of **actual ES use indicators compared to indicators of ES capacity indicators**
3.5 Limited integration of **indicators of human wellbeing and quality of life into ES assessments**
3.6 Limited knowledge of the **health impacts of climate change,** particularly for mental health and well-being, (mal)nutrition and food quality, and climate-sensitive infectious diseases
3.7 Insufficient assessments of **synergies and trade-offs between** the multiple aspects of ecosystems, their ESs, and human well-being
3.8 Limited data on **aggregated projections of impacts**, especially of combined hazards on food, fiber, and other ecosystem products

In the following section, we will ask you to orient us towards experts, institutions, data, or documents (assessment, survey, mapping, monitoring, report etc.,) that can contribute to filling these specific knowledge gaps. If this section is not relevant to you, you can jump to the next one.

Are you aware of **experts, institutions, data, or documents** concerning the mentioned knowledge gaps (**insufficient understanding of drivers of change, limited integration of ES capacity, ES use, and wellbeing)?**
*

Yes, I can provide information on these knowledge gaps, I stay at Section 3.
No, this section is not relevant to me. Jump to Section 4.

Section 3. Insufficient understanding of drivers of change, limited integration of ES capacity, ES use, and wellbeing

3. I can provide **information** (experts, institutions, data or documents) that can help to fill the following knowledge gaps concerning the **insufficient understanding of drivers of change, limited integration of ES capacity, ES use, and wellbeing.**

	Yes, I have information on this knowledge gap	No, I don't have any information on these knowledge gaps
3.1 Limited understanding of direct drivers of change (such as land-use change and land abandonment, pollution, invasive alien species, overfishing, and climate change)		
3.2 Limited understanding of indirect drivers of change (such as institutional change, cultural change, and technology)		
3.3 Limited understanding of the underpinning role of nature and ecosystems in ES delivery especially in marine and freshwater systems		
3.4 Underrepresentation of actual ES use indicators compared to indicators of ES capacity indicators		
3.5 Limited integration of indicators of human wellbeing and quality of life into ES assessments		
3.6 Limited knowledge of the health impacts of climate change		
3.7 Insufficient assessments of synergies and trade-offs between the multiple aspects of ecosystems, their ESs, and human well-being		
3.8 Limited data on aggregated projections of impacts, especially of combined hazards on food, fiber, and other ecosystem products		

If you clicked yes for any knowledge gaps, please list **experts, institutions, data, or documents** for each ecosystem service, This can orient us towards filling the mentioned knowledge gaps. If you can cite specific documents, please add links as well.

Section 4. Insufficient understanding of governance, planning, and investments, and the lack of quantification of targets and measures

This group of knowledge gaps emphasizes the **insufficient understanding of governance, planning, and investments, and the lack of quantification of targets and measures**

4.1 Limited **quantification of targets and pathways** related to biodiversity
4.2 Limited knowledge about **the impact and effectiveness of biodiversity governance processes (especially informal governance)and the policy instruments**, and limited understanding of the **interactions between the policy instruments in their context** especially in Eastern Europe and Central Asia
4.3 Lack of comparative overview of **spatial planning** throughout Europe and Central Asia and limited knowledge of the impact of planning modes and instruments on biodiversity
4.4 Limited knowledge of the **perspective and role of investments** in achieving targets related to biodiversity and climate
4.5 Limited knowledge of the long-term **effectiveness of climate adaptation options** and **limited quantification of the effectiveness of measures in reducing risk**

In the following section, we will ask you to orient us towards experts, institutions, data, or documents (assessment, survey, mapping, monitoring, report etc.) that can contribute to filling these specific knowledge gaps. If this section is not relevant to you, you can jump to the next one.

Are you aware of **experts, institutions, data, or documents** concerning the mentioned knowledge gaps **(insufficient understanding of governance, planning, and investments, and the lack of quantification of targets and measures)?**
*

Yes, I can provide information on these knowledge gaps, I stay at Section 4.
No, this section is not relevant to me. Jump to Section 5.

Section 4. Insufficient understanding of governance, planning, and investments, and the lack of quantification of targets and measures

4. I can provide **information** (experts, institutions, data, or documents) that can help to fill the following knowledge gaps concerning the **insufficient understanding of governance, planning, and investments, and the lack of quantification of targets and measures.**

	Yes, I have information on this knowledge gap	No, I don't have any information on this knowledge gap
4.1 Limited quantification of targets and pathways related to biodiversity		
4.2 Limited knowledge about the impact and effectiveness of biodiversity governance processes (especially informal governance)and the policy instruments, and limited understanding of the interactions between the policy		

instruments in their context especially in Eastern Europe and Central Asia		
4.3 Lack of comparative overview of spatial planning throughout Europe and Central Asia and limited knowledge of the impact of planning modes and instruments on biodiversity		
4.4 Limited knowledge of the perspective and role of investments in achieving targets related to biodiversity and climate		
4.5 Limited knowledge of the long-term effectiveness of climate adaptation options and limited quantification of the effectiveness of measures in reducing risk		

If you clicked yes for any knowledge gaps, please list **experts, institutions, data, or documents** for each ecosystem service, This can orient us towards filling the mentioned knowledge gaps. If you can cite specific documents, please add links as well.

Your answer

Section 5. Uneven knowledge of the status and trends of ecosystems and biodiversity in Europe and Central Asia

This group of knowledge gaps emphasizes the uneven **knowledge of the status and trends of ecosystems and biodiversity in Europe and Central Asia.**

5.1 Limited knowledge of **the extent and intactness of habitats critically for Eastern Europe and Central Asia**
5.2 Limited knowledge of **the conservation status and trends of species critically for Eastern Europe and Central Asia**
5.3 Limited knowledge of **the trends and future projections of habitats**
5.4 Lack of **systematic monitoring of fungi, non-vascular plants, invertebrates, marine and freshwater species, and soil organisms** across the range of subregions
5.5 Lack of **long-term monitoring data for non-protected areas outside the EU**
5.6 Knowledge of **biodiversity trends in agricultural areas** decreases from west to east
5.7 Insufficient understanding of the **impacts of climate change and the associated risks for terrestrial ecosystems**
5.8 Insufficient understanding of **climate change adaptation options for terrestrial ecosystems**
5.9 Insufficient understanding of **projections for climate change-related wildfire incidents, their magnitude, and their impacts** particularly for Northern Europe, Eastern Europe, and Western Central Europe

In the following section, we will ask you to orient us towards experts, institutions, data, or documents (assessment, survey, mapping, monitoring, report etc.,) that can contribute to filling these specific knowledge gaps. If this section is not relevant to you, you can jump to the next one.

Are you aware of **experts, institutions, data, or documents** concerning the mentioned knowledge gaps (**Uneven knowledge of the status and trends of ecosystems and biodiversity in Europe and Central Asia**)?*

Yes, I can provide information on these knowledge gaps, I stay at Section 5.
No, this section is not relevant to me. Jump to Section 6.

Section 5. Uneven knowledge of the status and trends of ecosystems and biodiversity in Europe and Central Asia

5. I can provide **information** (experts, institutions, data, or documents) that can help to fill the following knowledge gaps concerning the **uneven understanding of the status and trends of ecosystems and biodiversity in Europe and Central Asia.**

	Yes, I have information on this knowledge gap	No, I don't have any information on this knowledge gap
5.1 Limited knowledge of the extent and intactness of habitats critically for Eastern Europe and Central Asia		
5.2 Limited knowledge of the conservation status and trends of species critically for Eastern Europe and Central Asia		
5.3 Limited knowledge of the trends and future projections of habitats		
5.4 Lack of systematic monitoring of fungi, non-vascular plants, invertebrates, marine and freshwater species, and soil organisms across the range of subregions		
5.5 Lack of long-term monitoring data for non-protected areas outside the EU		
5.6 Knowledge of biodiversity trends in agricultural areas decreases from west to east		
5.7 Insufficient understanding of the impacts of climate change and the associated risks for terrestrial ecosystems		
5.8 Insufficient understanding of climate change adaptation		

options for terrestrial ecosystems		
5.9 Insufficient understanding of projections for climate change-related wildfire incidents, their magnitude, and their impacts particularly for Northern Europe, Eastern Europe, and Western Central Europe		

If you clicked yes for any knowledge gaps, please list **experts, institutions, data, or documents** for each ecosystem service. This can orient us towards filling the mentioned knowledge gaps. If you can cite specific documents, please add links as well.

Your answer

Section 6. Biodiversity across marine and freshwater ecosystems

This group of knowledge gaps emphasizes **the limited knowledge on the status of biodiversity across marine and freshwater ecosystems.**

6.1 Limited knowledge of **current as well as future changes in genetic responses of marine species to environmental changes**
6.2 Limited knowledge of **connectivity among marine populations, species, and ecosystems, which can provide new recruits, and enable gene flow in marine protected area networks**
6.3 Insufficient knowledge of **the status and trends of certain marine ecosystems: subtidal rocky areas, open ocean plankton communities, deep-sea areas (>200 m)**
6.4 Lacking of **high-quality observations of key ocean characteristics at the level of regional sea basins to support decision-making for marine adaptation**
6.5 Limited knowledge of **the chemical status of surface freshwaters in Europe**
6.6 Limited understanding of the **trends in geographic extent and population size of freshwater species**
6.7 Insufficient knowledge of **the effects of climate change on freshwater fisheries**
6.8 Lack of **actionable climate adaptation strategies for European fisheries and aquaculture**

In the following section, we will ask you to orient us towards experts, institutions, data, or documents (assessment, survey, mapping, monitoring, report etc.,) that can contribute to filling these specific knowledge gaps. If this section is not relevant to you, you can jump to the next one.

Are you aware of **experts, institutions, data or documents** concerning the mentioned knowledge gaps (**insufficient knowledge of the status of biodiversity across marine and freshwater ecosystems**)**?**
*

Yes, I can provide information on these knowledge gaps, I stay at Section 6.

No, it is not relevant to me. Jump to Section 7.

Section 6. Biodiversity across marine and freshwater ecosystems

6. I can provide **information** (experts, institutions, data or documents) that can help to fill the following knowledge gaps concerning **insufficient knowledge of the status of biodiversity across marine and freshwater ecosystems.**

	Yes, I have information on this knowledge gap	No, I don't have any information on this knowledge gap
6.1 Limited knowledge of current as well as future changes in genetic responses of marine species to environmental changes		
6.2 Limited knowledge of connectivity among marine populations, species, and ecosystems, which can provide new recruits, and enable gene flow in marine protected area networks		
6.3 Insufficient knowledge of the status and trends of certain marine ecosystems: subtidal rocky areas, open ocean plankton communities, deep-sea areas (>200 m)		
6.4 Lacking of high-quality observations of key ocean characteristics at the level of regional sea basins to support decision-making for marine adaptationw 4		
6.5 Limited knowledge of the chemical status of surface freshwaters in Europe		
6.6 Limited understanding of the trends in geographic extent and population size of freshwater species		
6.7 Insufficient knowledge of the effects of climate change on freshwater fisheries		
6.8 Lack of actionable climate adaptation strategies for European fisheries and aquaculture		

If you clicked yes for any knowledge gaps, please list **experts, institutions, data, or documents** for each ecosystem service. This can orient us towards filling the mentioned knowledge gaps. If you can cite specific documents, please add links as well.

Your answer

Section 7. Status and population trends of certain taxonomic groups

This group of knowledge gaps emphasizes the **insufficient knowledge of the status and population trends of certain taxonomic groups**

Based on IUCN assessments, the knowledge gap specifically concerns the following trends and taxa:
7.1 Insufficient knowledge of **the long-term population trends of several vascular plant species**
7.2 Insufficient knowledge of **the long-term population trends of birds**
7.3 Insufficient knowledge **of the long-term population trends of terrestrial vertebrates (mammals, reptiles, and amphibians)**
7.4 Insufficient knowledge **of the status, trends, and threats for terrestrial invertebrates**
7.5 Largely unknown regional or continental data **on the status, trends, and threats for lichens and fungi**
7.6 Largely unknown **status, trends, and threats for soil and freshwater micro-organisms**
7.7 Limited knowledge **of urban biodiversity**, **specifically: Syrphids and other Diptera**

In this section, we will ask you to orient us towards experts, institutions, data, or documents (assessment, survey, mapping, monitoring, report etc.,) that can contribute to filling these specific knowledge gaps. If this section is not relevant to you, you can jump to the last section.

Are you aware of **experts, institutions, data, or documents** concerning the mentioned knowledge gaps (**data on the status and trends of certain taxonomic groups)?**
*

Yes, I can provide information on these knowledge gaps, I stay at Section 7.
No, it is not relevant to me. Jump to the Section 8.

Section 7. Status and population trends of certain taxonomic groups

7. I can provide **information** (experts, institutions, data, or documents) that can help to fill the following knowledge gaps concerning **insufficient knowledge of the status and population trends of certain taxonomic groups.**

	Yes, I have information on this knowledge gap	No, I don't have any information on this knowledge gap

7.1 Insufficient knowledge of the long-term population trends of several vascular plant species		
7.2 Insufficient knowledge of the long-term population trends of birds		
7.3 Insufficient knowledge of the long-term population trends of terrestrial vertebrates (mammals, reptiles, and amphibians)		
7.4 Insufficient knowledge of the status, trends, and threats for terrestrial invertebrates		
7.5 Largely unknown regional or continental data on the status, trends, and threats for lichens and fungi		
7.6 Largely unknown status, trends, and threats for soil and freshwater micro-organisms		
7.7 Limited knowledge of urban biodiversity, specifically: Syrphids and other Diptera		

If you clicked yes for any knowledge gaps, please list **experts, institutions, data, or documents** for each ecosystem service. This can orient us towards filling the mentioned knowledge gaps. If you can cite specific documents, please add links as well.

8. Barriers to knowledge exchange between regional and national level of policy processes and IPBES/IPCC

8.1 Have you been aware of the knowledge gaps that were mentioned in this survey before?

Yes
No
Other:

8.2 If yes, please elaborate on how/through which channels you know about these knowledge gaps.

Your answer

8.3 What would it take to make these IPCC/IPBES knowledge gaps more widely known?

Your answer

8.4 What are the main drivers and barriers that you can mention that are helping or hindering the IPCC/IPBES knowledge gaps to reach MAES projects?

Your answer

8.5 How can the knowledge bases that you mentioned be made useful to IPBES and IPCC processes?

Your answer

8.6 Can you suggest other databases (social science/ecosystems/biodiversity/ES) that you think are important in improving knowledge gaps?

Your answer

Do you have any other comments or suggestions?

Your answer

Thank you for your contribution! If you would like to be informed of the developments of this task, please let us know below. We will keep you informed via email.

Please keep me informed about the developments of this task
No, thank you
Other:

5.4 Tables with the detailed survey answers for each knowledge gap per country

1.1 Limited coverage of climate change impacts and adaptation options for food (especially fruit and vegetables), fiber, and other provisioning ES
1.2 Indicators of the trends in habitat creation and maintenance
1.3 Relationship between water use and water availability; indicator data for freshwater quantity for Eastern Europe and Central Asia
1.4 Soil quality; encompassing its physical, chemical, and biological components
1.5 Carcass removal by vertebrate and invertebrate scavengers and marine organisms
1.6 Medicinal potential of medicinal resources and plants, national measures and indicators need to become comparable on an international scale
1.7 Wildlife-based tourism, accurate statistical information on the number of users enjoying recreational activities around wildlife (i.e. whale-watching, bird-watching).
1.8 Supporting (cultural) identities, lack of consensus on suitable indicators

	Austria	Bosnia and Herzegovin	Bulgaria	Czech Republic	Finland	France	French Guiana	Germany	Hungary	Latvia	Lithuania	North Macedonia	Poland	Romania	Slovenia	Spain	No countries
1.1 Climate change impacts and adaptation options for food fiber and other provisioning ES	No	No	Yes	No	No	Yes	No	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	8
1.2 Indicators of the trends in habitat creation and maintenance	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	11
1.3 Relationship between water use and water availability; indicator data for freshwater quantity	Yes	Yes	No	No	No	No	Yes		Yes	Yes	No	No	Yes	Yes	Yes	Yes	9
1.4 Soil quality; encompassing its physical, chemical, and biological components	No	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	11
1.5 Carcass removal by vertebrate and invertebrate scavengers and marine organisms	No	No	No	No	No	Yes			No	Yes	No	No		No	No	No	2
1.6 Medicinal potential of medicinal resources and plants, national measures and indicators	No	Yes	No	No	No	No			No	Yes	No	Yes		No	No	Yes	4
1.7 Wildlife-based tourism, accurate statistical information	No	Yes	Yes	No	Yes	No	Yes		Yes	Yes	No	Yes	Yes	No	Yes	Yes	10
1.8 Supporting (cultural) identities, lack of consensus on suitable indicators	No	Yes	Yes	No	No	No	Yes		No	Yes	No	No		No	Yes	Yes	6

Table 7. Available information for knowledge gaps 1.1-1.8 per country

2.1 Insufficient integration of traditional, Indigenous, and local knowledge into national and international biodiversity policy frameworks and initiatives
2.2 Limited understanding of the plural values of ecosystem services endorsed by different societal groups and genders
2.3 Limited integration of the visions of different societal groups in identifying future targets and pathways for ecosystems
2.4 Insufficient representation of plural values and intrinsic values in scenario valuation of ecosystems
2.5 Insufficient understanding of climate risks for Indigenous, and traditional livelihoods at different warming levels
2.6 Insufficient integration of traditional, Indigenous, and local knowledge into climate adaptation actions

	Austria	Bosnia and Herzegovin	Bulgaria	Czech Republic	Finland	France	French Guiana	Germany	Hungary	Latvia	Lithuania	North Macedonia	Poland	Romania	Slovenia	Spain	No countries
2.1 Insufficient integration of traditional, Indigenous, and local knowledge into national and international biodiversity policy frameworks and initiatives	No	Yes	Yes	No		No	Yes		Yes	No	No	No	No	Yes	No	Yes	6
2.2 Limited understanding of the plural values of ecosystem services endorsed by different societal groups and genders	No	Yes	No	Yes	Yes	No			Yes	No	No	No	No	Yes	No	No	5
2.3 Limited integration of the visions of different societal groups in identifying future targets and pathways for ecosystems	No	No	No	Yes	Yes	No			No	No	No	No	No	Yes	No	No	3
2.4 Insufficient representation of plural values and intrinsic values in scenario valuation of ecosystems	No	No	No	Yes	Yes	No	Yes		No	No	No	Yes	No	No	No	Yes	5
2.5 Insufficient understanding of climate risks for Indigenous and traditional livelihoods at different warming levels	No	No	Yes	No		No	Yes		No	No	No	No	No	No	Yes	No	3
2.6 Insufficient integration of traditional, Indigenous, and local knowledge into climate adaptation actions	No	No	Yes	No		No	Yes		No	No	No	No	No	Yes	Yes	No	4

Table 8. Available information for knowledge gaps 2.1-2.6 per country

3.1 Limited understanding of direct drivers of change (such as land-use change and land abandonment, pollution, invasive alien species, overfishing, and climate change) in assessments of biodiversity, ecosystems, and climate change
3.2 Limited understanding of indirect drivers of change (such as institutional change, cultural change, and technology) in assessments of biodiversity, ecosystems. and climate change
3.3 Limited understanding of the underpinning role of nature and ecosystems in ES delivery , especially in marine and freshwater systems
3.4 Underrepresentation of actual ES use indicators compared to indicators of ES capacity
3.5 Limited integration of indicators of human wellbeing and quality of life into ES assessments
3.6 Limited knowledge of the health impacts of climate change, particularly for mental health and well-being, (mal)nutrition and food quality, and climate-sensitive infectious diseases
3.7 Insufficient assessments of synergies and trade-offs between the multiple aspects of ecosystems, their ESs, and human well-being
3.8 Limited data on aggregated projections of impacts, especially of combined hazards on food, fiber, and other ecosystem products

	Austria	Bosnia and Herzegovin	Bulgaria	Czech Republic	Finland	France	French Guiana	Germany	Hungary	Latvia	Lithuania	North Macedonia	Poland	Romania	Slovenia	Spain	No countries
3.1 Limited understanding of direct drivers of change in assessments of biodiversity, ecosystems, and climate change	No	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	10
3.2 Limited understanding of indirect drivers of change in assessments of biodiversity, ecosystems. and climate change	No	Yes	No	No	No	Yes	No	Yes	No	No	No	No	Yes	No	Yes	Yes	6
3.3 Limited understanding of the underpinning role of nature and ecosystems in ES delivery especially in marine and freshwater systems	No	Yes	Yes	No	Yes	No	No		Yes	Yes	No	No	Yes	Yes	No	Yes	8
3.4 Underrepresentation of actual ES use indicators compared to indicators of ES capacity indicators	No	No	Yes	No	No	No	No		Yes	No	No	No	Yes	No	Yes	No	4
3.5 Limited integration of indicators of human wellbeing and quality of life into ES Assessments	No	Yes	No	No	Yes	Yes	No		Yes	No	No	No		No	Yes	Yes	6

	Austria	Bosnia and Herzegovin	Bulgaria	Czech Republic	Finland	France	French Guiana	Germany	Hungary	Latvia	Lithuania	North Macedonia	Poland	Romania	Slovenia	Spain	No countries
3.6 Limited knowledge of the health impacts of climate change, particularly for mental health and well-being, (mal)nutrition and food quality, and climate-sensitive infectious disease	No	No	Yes	No	No	Yes	No		No	No	No	No		No	No	No	2
3.7 Insufficient assessments of synergies and trade-offs between the multiple aspects of ecosystems, their ESs, and human well-being	No	Yes	No	No	No	No	No		Yes	No	No	No	Yes	No	Yes	Yes	5
3.8 Limited data on aggregated projections of impacts, especially of combined hazards on food, fiber, and other ecosystem products	No	No	No	No	No	No	No		No	Yes	No	No		No	No	No	1

Table 9. Available information for knowledge gaps 3.1-3.8 per country

4.1 Limited quantification of targets and pathways related to biodiversity
4.2 Limited knowledge about the impact and effectiveness of biodiversity governance processes (especially informal governance) and the policy instruments, and limited understanding of the interactions between the policy instruments in their context, especially in Eastern Europe and Central Asia
4.3 Lack of comparative overview of spatial planning throughout Europe and Central Asia, and limited knowledge of the impact of planning modes and instruments on biodiversity
4.4 Limited knowledge of the perspective and role of investments in achieving targets related to biodiversity and climate
4.5 Limited knowledge of the long-term effectiveness of climate adaptation options and limited quantification of the effectiveness of measures in reducing risk

	Austria	Bosnia and Herzegovin	Bulgaria	Czech Republic	Finland	France	French Guiana	Germany	Hungary	Latvia	Lithuania	North Macedonia	Poland	Romania	Slovenia	Spain	No of countries
4.1 Limited quantification of targets and pathways related to biodiversity	No	Yes	Yes	No	No	Yes	Yes		No	Yes	No	No		No	Yes	Yes	7
4.2 Limited knowledge about the impact and effectiveness of biodiversity governance processes and the policy instruments	No	Yes	No	No	Yes	No	Yes		No	Yes	No	No		No	Yes	No	5
4.3 Lack of comparative overview of spatial planning throughout Europe and Central Asia and limited knowledge of the impact of planning modes and instruments on biodiversity	No	No	No	No	No	No	Yes			No	No	Yes		No	Yes	Yes	4
4.4 Limited knowledge of the perspective and role of investments in achieving targets related to biodiversity and climate	No	No	No	No	No	No			No	Yes	No	No	Yes	No	Yes	No	3
4.5 Limited knowledge of the long-term effectiveness of climate adaptation options and limited quantification of the effectiveness of measures in reducing risk	No	No	Yes	No	No	No				Yes	No	No	Yes	No	No	No	3

Table 10. Available information for knowledge gaps 4.1-4.5 per country

5.1 Limited knowledge of the extent and intactness of habitats is critical for Eastern Europe and Central Asia
5.2 Limited knowledge of the conservation status and trends of species critically for Eastern Europe and Central Asia
5.3 Limited knowledge of the trends and future projections of habitats
5.4 Lack of systematic monitoring of fungi, non-vascular plants, invertebrates, marine and freshwater species, and soil organisms across the range of subregions
5.5 Lack of long-term monitoring data for non-protected areas outside the EU
5.6 Knowledge of biodiversity trends in agricultural areas decreases from west to east
5.7 Insufficient understanding of the impacts of climate change and the associated risks for terrestrial ecosystems
5.8 Insufficient understanding of projections for climate change-related wildfire incidents, their magnitude, and their impacts particularly for Northern Europe, Eastern Europe, and Western Central Europe

	Austria	Bosnia and Herzegovin	Bulgaria	Czech Republic	Finland	France	French Guiana	Germany	Hungary	Latvia	Lithuania	North Macedonia	Poland	Romania	Slovenia	Spain	No of countries
5.1 Limited knowledge of the extent and intactness of habitats	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	12
5.2 Limited knowledge of the conservation status and trends of species critically for Eastern Europe and Central Asia	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	12
5.3 Limited knowledge of the trends and future projections of habitats	Yes	Yes	Yes	No	No	No	No			Yes	No	No	No	Yes	Yes	No	6
5.4 Lack of systematic monitoring of fungi, non-vascular plants, invertebrates, marine and freshwater species, and soil organisms across the range of subregions	No	Yes	Yes	No	Yes	No	No		Yes	Yes	Yes	Yes	No	No	Yes	No	8
5.5 Lack of long-term monitoring data for non-protected areas outside the EU	No	Yes	No	Yes	Yes	No	No		No	No	No	No	No	No	No	No	3
5.6 Knowledge of biodiversity trends in agricultural areas decreases from west to east	No	Yes	Yes	No	No	No	No		Yes	No	Yes	No	No	No	Yes	Yes	6
5.7 Insufficient understanding of the impacts of climate change and the associated risks for terrestrial ecosystems	No	No	Yes	Yes	No	No	No		Yes	Yes	Yes	No	No	No	Yes	No	6

5.8 Insufficient understanding of projections for climate change-related wildfire incidents, their magnitude, and their impacts	No	No	Yes	No	No	No	No			Yes	Yes	Yes	No	No	Yes	No	5

Table 11. Available information for knowledge gaps 5.1-5.8 per country

6.1 Limited knowledge of current as well as future changes in genetic responses of marine species to environmental changes
6.2 Limited knowledge of connectivity among marine populations, species, and ecosystems, which can provide new recruits, and enable gene flow in marine protected area networks
6.3 Insufficient knowledge of the status and trends of certain marine ecosystems: subtidal rocky areas, open ocean plankton communities, deep-sea areas (>200 m)
6.4 Lacking of high-quality observations of key ocean characteristics at the level of regional sea basins to support decision-making for marine adaptation
6.5 Limited knowledge of the chemical status of surface freshwaters in Europe
6.6 Limited understanding of the trends in geographic extent and population size of freshwater species
6.7 Insufficient knowledge of the effects of climate change on freshwater fisheries
6.8 Lack of actionable climate adaptation strategies for European fisheries and aquaculture

	Austria	Bosnia and Herzegovina	Bulgaria	Czech Republic	Finland	France	French Guiana	Germany	Hungary	Latvia	Lithuania	North Macedonia	Poland	Romania	Slovenia	Spain	No of countries
6.1 Limited knowledge of current as well as future changes in genetic responses of marine species	No	Yes	Yes	No	No	No	No		No	Yes	No	No		No	No	No	3
6.2 Limited knowledge of connectivity among marine populations, species, and ecosystems	No	No	Yes	No	No	No	No		No	Yes	Yes	No		No	No	Yes	4
6.3 Insufficient knowledge of the status and trends of certain marine	No	No	No	No	Yes	No	No		No	Yes	No	No	Yes	No	No	Yes	4
6.4 Lacking of high-quality observations of key ocean characteristics at the level of regional sea basins	No	No	Yes	No	Yes	No	No		No	Yes	No	No	Yes	No	No	No	4

	Austria	Bosnia and Herzegovina	Bulgaria	Czech Republic	Finland	France	French Guiana	Germany	Hungary	Latvia	Lithuania	North Macedonia	Poland	Romania	Slovenia	Spain	No of countries
6.5 Limited knowledge of the chemical status of surface freshwaters in Europe	No	No	Yes	No	No	No	No		No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
6.6 Limited understanding of the trends in geographic extent and population size of freshwater species	No	No	Yes	No	No	No	No		No	Yes	Yes	No	Yes	No	Yes	No	5
6.7 Insufficient knowledge of the effects of climate change on freshwater fisheries	No	No	No	No	No	No	No		No	Yes	No	No	Yes	No	Yes	No	3
6.8 Lack of actionable climate adaptation strategies for European fisheries and aquaculture	No	No	No	No	No	No	No		No	No	No	No	Yes	No	Yes	No	2

Table 12. Available information for knowledge gaps 6.1-6.8 per country

7.1 Insufficient knowledge of the long-term population trends of several vascular plant species
7.2 Insufficient knowledge of the long-term population trends of birds
7.3 Insufficient knowledge of the long-term population trends of terrestrial vertebrates (mammals, reptiles, and amphibians)
7.4 Insufficient knowledge of the status, trends, and threats for terrestrial invertebrates
7.5 Largely unknown regional or continental data on the status, trends, and threats for lichens and fungi
7.6 Largely unknown status, trends, and threats for soil and freshwater micro-organisms
7.7 Limited knowledge of urban biodiversity, specifically: Syrphids and other Diptera

	Austria	Bosnia and Herzegovin	Bulgaria	Czech Republic	Finland	France	French Guiana	Germany	Hungary	Latvia	Lithuania	North Macedonia	Poland	Romania	Slovenia	Spain	No of countries
7.1 Insufficient knowledge of the long-term population trends of several vascular plant species	No	Yes	Yes	No	Yes	No	No		Yes	Yes	No	No		No	Yes	Yes	7
7.2 Insufficient knowledge of the long-term population trends of birds	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	12
7.3 Insufficient knowledge of the long-term population trends of terrestrial vertebrates	No	Yes	Yes	No	Yes	No	No		Yes	Yes	No	Yes		No	Yes	Yes	8
7.4 Insufficient knowledge of the status, trends, and threats for terrestrial invertebrates	No	Yes	Yes	No	No	No	No		Yes	Yes	No	Yes	Yes	No	Yes	No	7
7.5 Largely unknown regional or continental data on the status, trends, and threats for lichens and fungi	No	Yes	Yes	No	No	No	No		Yes	Yes	No	Yes		No	Yes	No	6
7.6 Largely unknown status, trends, and threats for soil and freshwater micro-organisms	No	No	No	No	No	No	No			No	No	No		No	Yes	No	1
7.7 Limited knowledge of urban biodiversity, specifically: Syrphids and other Diptera	No	No	No	No	No	No	No			Yes	No	No		No	No	No	1

Table 13. Available information for knowledge gaps 7.1-7.7 per country

4.5 Information (experts, institutions, publications, etc.) on each knowledge gap per country

	1.1	1.2	1.3	1.4	1.5	1.6	1.7
Austria	Environment Agency Austria						
Bosnia and Herzegovina	Bosnia and Herzegovina conducted National Ecosystem assessments (NEA) and identified knowledge gaps related to nature protection, including cross-sector aspects. Most of them are, at least partially, completed. In this way, 1.3., 1.4., 1.6., and 1.8. cover most information, such as 1.4. covering biological components more than physical.						
Bulgaria	NIGGG-BAS, IBER-BAS, FRI-BAS, ExEa, NSI						
Finland	Syke about habitats; tourism (and ES in general) at Luke, Natural Resources Institute Finland						
French Guiana	Mapping and assessment of the capacity of ecosystems in French Guiana to supply ecosystem services https://www.wwf.fr/sites/default/files/doc-2022-11/ECOSEO%20Ecosystem%20services%20assessment%20French%20Guiana.pdf						
Germany	Information of several ES, including regulating and cultural ones can be found on the webpage (wood provisioning, crop supply, erosion regulation, flood prevention in floodplains, urban climate regulation, potential pollination, GHG emission and sequestration, biodiversity indicators, accessibility of green space, nature recreation) Ecosystems' conservation status, ecological connectivity: https://ioer-fdz.de/oekosysteme-deutschland With data, maps, visualization: https://monitor.ioer.de/?baselayer=topplus&opacity=0.8&raeumliche_gliederung=gebiete&zoom=6&lat=51.32374658474385&lng=10.458984375000002&time=2024&basiskarte=true&glaettung=0& Biodiversity index (map viewer + tabular data): https://ioer-fdz.de/oekosysteme-deutschland/oekosystemleistungen/biodiversitaetsflaechenindikator Schweppe-Kraft B, Grunewald K, Meier S, Schwarz S, Syrbe R- (2023) Nature under Pressure – Report on the state of ecosystems and their services for society and economy. German MAESReport on Target 2, Action 5 of the EU-Biodiversity Strategy 2020, Bonn, Bundesamt für Naturschutz, 224 p. https://biodiversity.europa.eu/countries/germany/maes/maesreport_d_23april2024.pdf/@@download/file Climate change adaptation, incl. agriculture – federal monitoring: https://www.umweltbundesamt.de/publikationen/2023-monitoring-report-on-the-german-strategy-for Environmental indicators monitoring (federal, Umwelbundesamt): With soil N: https://www.umweltbundesamt.de/daten/umweltindikatoren?thema%5B%5D=102887 Soil data also available from: https://metadaten.uba.de/smartfinder-client/?lang=en#/search?term=boden&sortAttribute=modified&sortDesc=true&filter=%7B%7D Soil moisture: https://gdz.bkg.bund.de/index.php/default/duerreatlas.html						
Hungary	1.2 https://oneecosystem.pensoft.net/article/81543/ https://www.tandfonline.com/doi/abs/10.1080/10106049.2021.2005158 1.3 https://www.ovf.hu/en 1.4 https://atk.hun-ren.hu/en/taki_angol/institute-for-soil-sciences/ 1.7 https://www.mdpi.com/2071-1050/15/11/8489						
Latvia	1.1. Department of Water Resources Sustainability, Ministry of Climate and Energy 1.2. Nature Conservation Agency of Latvia						

	1.1	1.2	1.3	1.4	1.5	1.6	1.7
	1.3. Department of Water Resources Sustainability, Ministry of Climate and Energy 1.4. Institute of Soil and Plant Sciences https://www.silava.lv/en/research/projects/BIOservicES 1.5. The Latvian Institute of Forestry,Marine monitoring department, Latvian Institute of Aquatic Ecology,info - https://lhei.lv/en/ecosystem-management/; 1.6. https://grasslife.lv/en/; 1.7. https://centralbaltic.eu/project/nat-tour-expo/; SPATIAL RESEARCH LABORATORY HESPI (, Nature Conservation Agency of Latvia 1.1 – 1.7 https://www.varam.gov.lv/en/maritime-spatial-planning - info about marine ecosystem services; projects on ecosystem services in Latvia - https://ekosistemas.daba.gov.lv/public/eng/; https://restore.daba.gov.lv/public/eng/.						
North Macedonia	Nature Conservation Programme https://www.bregalnica-ncp.mk/ekosistemski-uslugi-2/						
Poland	1.1Outcomes of project FEW-meter – an integrative model to measure and improve urban agriculture towards circular urban metabolism; https://jpi-urbaneurope.eu/project/few-meter/ 1.2 Outcomes of project ECOSERV-POL related to the Ecological values of ecosystem services; Poznań University of Life Sciences; https://ecoservpol.amu.edu.pl/en/results/ 1.3 Outcomes of project ECOSERV-POL related to the Freshwater ecosystems; European Regional Centre for Ecohydrology, Polish Academy of Sciences; https://ecoservpol.amu.edu.pl/en/results/ 1.4 Outcomes of project ECOSERV-POL related to the Agroecosystems; Institute of Soil Science and Plant Cultivation; https://ecoservpol.amu.edu.pl/en/results/ 1.7 Outcomes of project ECOSERV-POL related to the Cultural values of ecosystem services; University of Warsaw, Faculty of Geography and Regional Studies; https://ecoservpol.amu.edu.pl/en/results/						
Romania	1.1 Climate change impacts and adaptation options for food (especially fruit and vegetables), fiber and other provisioning ES - Climate change adaptation measures in Romanian agriculture (https://climate-adapt.eea.europa.eu/en/metadata/case-studies/climate-change-adaptation-measures-in-romanian-agriculture); Danube Delta adaptation strategy (https://awsassets.panda.org/downloads/2_danube_delta_adaptation_strategy.pdf) 1.2Habitat creation and maintenance; Reporting tool of the EU (https://nature-art17.eionet.europa.eu/article17/habitat/report/?period=5&group=Freshwater+habitats&country=RO&region=); 1.3 The relationship between water use, water availability and freshwater quantity (https://environment.ec.europa.eu/topics/water/water-wise-eu/romania_en); (https://wateractionhub.org/geos/country/181/d/romania/) 1.4 Soil quality, encompassing its physical, chemical, and biological components (10.1371/journal.pone.0289286; derived from modeling; no biological components)						
Slovenia	1.1 https://www.kis.si/en/ 1.2 https://www.kis.si/en/ 1.3 https://www.tcvode.si/?lang=en, 1.4 https://www.kis.si/en/ 1.7 and 1.8 At Anton Melik Geographical Institute ZRC SAZU we are also dealing with cultural heritage, cultural landscapes and similar studies.						

Table 14. Information (experts, institutions, data, or documents) for knowledge gaps 1.1-1.8 per country

	2.1	2.2	2.3	2.4	2.5	2.6
Bosnia and Herzegovina	Through NEA BiH, knowledge gaps, such as climate adaptation actions, were identified but not covered in detail. The publication on traditional knowledge was also published last year, providing the status of traditional knowledge.					
Bulgaria	For 2.1 NIGGG-BAS For 2.5 and 2.6, I am not sure, but there should be some kind of information in the research institutions like IBER-BAS. FRI-BAS, Sofia University					
Czech Republic	We did some work on plural values and future visions, Publication in Sustainability Science: https://link.springer.com/article/10.1007/s11625-021-00953-8					
Finland	Syke on plural values of ecosystem services.					
French Guiana	Indigenous Peoples in French Guiana: will France ever recognize their right to self-determination, land, territory, biodiversity and Free, Prior and Informed Consent? https://journals.library.columbia.edu/index.php/sjshr/article/view/12623					
Hungary	2.1 https://ecolres.hun-ren.hu/en/kutatocsoportok/traditional-ecological-knowledge-research-group/ 2.2 https://www.essrg.hu/en/					
North Macedonia	Land utilization and ecosystem services valuation for forest and grasslands ecosystems in the pilot sites in the north-western part of North Macedonia (unpublished report);					
Romania	2.1 https://doi.org/10.1017/S0376892912000392 2.2 https://doi.org/10.3389/fevo.2021.609853 2.3 https://sdgtoolkit.org/wp-content/uploads/2019/10/Romanias-Sustainable-Development-Strategy-2030.pdf 2.6 https://www.mmediu.ro/app/webroot/uploads/files/SNASC_SEA_2022.pdf; https://doi.org/10.1007/s00704-022-04041-4					
Slovenia	It's not in the biodiversity policy framework but some institutions are dealing with intangible cultural heritage and traditional ecological knowledge (like traditional commons governed by agrarian communities), just now traditional commons are being registered as intangible cultural heritage by the Ministry of Culture. Some other types of traditional knowledge are described by anthropologists (e.g. Spela Ledinek Lozej - for pasture), and there is one study on local community adaptation to climate change					
Spain	MAES Spain					

Table 15. Information (experts, institutions, data, or documents) for knowledge gaps 2.1-2.6 per country

	3.1	3.2	3.3	3.4	3.5	3.7	3.8
Bosnia and Herzegovina	NEA references: https://www.besnet.world/country/bosnia-and-herzegovina/ https://ebooks.unsa.ba/index.php/ebooks/catalog/book/60 https://ebooks.unsa.ba/index.php/ebooks/catalog/book/59						
Bulgaria	NIGGG-BAS, IBER-BAS, FRI-BAS, ExEa						
Finland	Syke is an expert on climate change impacts on biodiversity, Syke can provide more information about marine ES (or other experts), Luke is expert of ES indicators and well-being.						
Germany	Several chapters of the biodiversity report “Artenvielfalt Faktencheck” Whole report: https://www.oekom.de/buch/faktencheck-artenvielfalt-9783987260957 Summary for policy makers: https://www.oekom.de/buch/faktencheck-artenvielfalt-9783987260964 Direct drivers: https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/themenbereiche/trends-direkte-treiber/ Indirect drivers https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/themenbereiche/indirekte-treiber/						
Hungary	3.3 https://link.springer.com/article/10.1007/s13280-022-01708-0 https://www.mdpi.com/2071-1050/15/11/8489 https://www.mdpi.com/2071-1050/14/19/12847 3.4 https://www.mdpi.com/2071-1050/15/11/8489 https://www.mdpi.com/2071-1050/14/19/12847 3.5 https://www.mdpi.com/2071-1050/15/11/8489 https://www.mdpi.com/2071-1050/14/19/12847 3.7 MAES Hungaryhttps://www.termeszetem.hu/hu/documents/tags/tanulmanyok?page=1						
Latvia	3.1 Climate Policy Department, Ministry of Climate and Energy,https://bior.lv/en/zinatniska-darbiba/scientific-work/fisheries 3.3 https://lhei.lv/projekts_ivalue/ 3.8 University of Latvia, Project “High-resolution Biodiversity Quantification for Nature Conservation and Management: HiQBioDiv”						
Poland	3.1 Adam Mickiewicz University in Poznań, Faculty of Human Geography and Planning; co/author of several case studies related to land use as driver of ES change 3.3 Outcomes of project ECOSERV-POL related to the Freshwater ecosystems;; European Regional Centre for Ecohydrology, Polish Academy of Sciences; https://ecoservpol.amu.edu.pl/en/results/ Outcomes of project ECOSERV-POL related to the Marine water ecosystems; Institute of Oceanology, Polish Academy of Sciences; https://ecoservpol.amu.edu.pl/en/results/ 3.2, 3.4. 3.7 A.Mizgajski, M.Stępniewska, 2023. Uwarunkowania i wyzwania wdrażania koncepcji usług ekosystemowych do praktyki, [w:] Stępniewska M., Mizgajski A. (red.): Usługi ekosystemowe w zarządzaniu układami przyrodniczymi. Bogucki Wyd. Nauk., Poznań [Conditions and challenges of implementing the ecosystem services concept into practice, [in:] Stępniewska M., Mizgajski A. (eds.): Ecosystem Services in the Management of Natural Systems]; https://ecoservpol.amu.edu.pl/tekst-podrecznika/						
Romania	3.1 https://doi.org/10.1007/978-3-031-43922-3_118 3.3 https://doi.org/10.1007/s13280-021-01556-4						

Slovenia	About indicators:Slovenian Forestry Institute - for forests, agricultureNational Institute of Biology- for water; for land use change several studies at our Anton Melik Geographical Institute ZRC SAZU
Spain	MAES and follow-up projects, Esmeralda

Table 16. Information (experts, institutions, data, or documents) for knowledge gaps 3.1-3.8 per country

	4.1	4.2	4.3	4.4	4.5
Bosnia and Herzegovina	In general, the knowledge gaps related to climate change and biodiversity, covering both, and creating a synergy, have not been strictly addressed. https://www.besnet.world/country/bosnia-and-herzegovina/ https://ebooks.unsa.ba/index.php/ebooks/catalog/book/60 https://ebooks.unsa.ba/index.php/ebooks/catalog/book/59				
Bulgaria	Ministry of Environment and Water, CAWRI_BAS				
Finland	Syke, is an expert in governance, especially on setting up biodiversity monitoring; DG REGIO knows widely about the situation of policy instruments in Eastern Europe.				
French Guiana - Outermost Region	https://www.sciencedirect.com/org/science/article/pii/S2367819422000041+				
Latvia	4.1., 4.2. Mhttps://latvianature.daba.gov.lv/en/, Nature Conservation Agency; 4.4., 4.5. Climate Policy Department,https://eeagrants.org/archive/2009-2014/projects/LV02-0012; https://www.kem.gov.lv/lv/pielagosanas-klimata-parmainam - please translate it in English.				
North Macedonia	Attempts for integration of the national assessment into the Study for nature as part of the new Spatial Plan of the country (this is an ongoing process).				
Poland	4.4 and 4.5. Outcomes of project TeRRIFICA – Territorial RRI Fostering Innovative Climate Action; https://cordis.europa.eu/project/id/824489/reporting;Adam Mickiewicz University in Poznań, Faculty of Human Geography and Planning; 4.4 and 4.5. Outcomes of project Connecting Nature – COproductioN with NaturE for City Transitioning, INnovation and Governance; https://connectingnature.eu/ Adam Mickiewicz University in Poznań, Faculty of Human Geography and Planning;				
Slovenia	Institute for Nature conservation -; Ministry of Natural Resources and Spatial Planning -				
Spain	IPBES Regional Assessment				

Table 17. Information (experts, institutions, data, or documents) for knowledge gaps 4.1-4.5 per country

	5.1	5.2	5.3	5.4	5.6	5.7	5.8
Austria	Environment Agency Austria						
Bosnia and Herzegovina	NEA references						
Bulgaria	5.1 and 5.2 National museum of Natural History, IBER-BAS, NIGGG-BAS 5.3 Probably there is information in ExEa 5.4-5.7 National museum of Natural History, IBER-BAS, NIGGG-BAS 5.8 University of Forestry (LTU), FRI-BAS, Sofia University						
Czech Republic	In Czechia, detailed monitoring scheme for habitats is working, coordinated by the Czech Nature Conservation Agency. Concerning impacts of climate change, our colleagues at CzechGlobe are developing coherent approach to modelling impacts of climate change. However, data portals are only available in Czech. https://www.klimatickazmena.cz/						
Finland	Systematic monitoring of various taxa both in EU and outside EU has been recently studied, e.g. in EuropaBON project and by Biodiversa+. You can find more information about those from their webpages (including publications). This is also an ongoing work of IPBES MTA (monitoring assessment), extensive database based on GBIF and other data, globally.						
Germany	The German Statistics office (DESTATIS) publishes accounts on ecosystem extent and condition. Overview extent accounts: https://www.destatis.de/EN/Themes/Society-Environment/Environment/Environmental-Economic-Accounting/ecosystem-account/Tables/overview-divisions.html Ecosystem type map viewer: https://oekosystematlas-ugr.destatis.de/ With more detailed ecosytem type tables and ecosystem condition tables per ecosystem type here: https://www.destatis.de/EN/Themes/Society-Environment/Environment/Environmental-Economic-Accounting/ecosystem-account/_node.html#648956 Red List of Endangered Biotope Types: https://www.bmuv.de/download/rote-liste-der-gefaehrdeten-biotoptypen-deutschlands						
Hungary	5.1 https://oneecosystem.pensoft.net/article/81543/ https://www.tandfonline.com/doi/abs/10.1080/10106049.2021.2005158 5.2 https://termeszetvedelem.hu/nemzeti-biodiverzitas-monitorozo-rendszer-nbmr/ 5.3 https://oneecosystem.pensoft.net/article/81543/ https://www.tandfonline.com/doi/abs/10.1080/10106049.2021.2005158 5.6 https://ecolres.hun-ren.hu/en/kutatocsoportok/lendulet-landscape-and-conservation-ecology-research-group/ 5.7 https://ecolres.hun-ren.hu/en/kutatocsoportok/experimental-vegetation-ecology-research-group/						
Latvia	5.1., 5.3. https://latvianature.daba.gov.lv/en/, Nature Conservation Agency; 5.2. LIFE for Species project (Nature Conservation Agency; https://sarkanagramata.lu.lv/en/about/ 5.4. Monitoring and Planning Department,Nature Conservation Agency 5.7., 5.8. Climate Policy Department); https://eeagrants.org/archive/2009-2014/projects/LV02-0012; https://www.kem.gov.lv/lv/pielagosanas-klimata-parmainam - please transleta it in english.						
Lithuania	For habitats and species - Lithuania nature research centre sekretoriatas@gamtc.lt For 5.8 - Vytautas Magnus University Agriculture Academy zua@vdu.lt						

	5.1	5.2	5.3	5.4	5.6	5.7	5.8
North Macedonia	NCP (https://www.bregalnica-ncp.mk/ekosistemski-uslugi-2/), Macedonian Ecological Society Database (https://mes.org.mk/en/), Landscape Fire Management (https://lfmwb.net/knowledge-platform/country-data/macedonia/)						
Romania	5.1 https://www.cbd.int/pa/doc/dossiers/romania-abt11-country-dossier2021.pdf; https://doi.org/10.1017/9781108654647.028 5.2 and 5.3 https://www.eionet.europa.eu/etcs/etc-be/activities/reporting/article-12; https://www.eionet.europa.eu/etcs/etc-be/activities/reporting/article-17						
Slovenia	For all except 5.8 Institute for Nature conservation for 5.8 The Slovenian Forestry Institute https://www.gozdis.si/en/ and Slovenian Forest service https://www.zgs.si/en/						
Spain	IPBES, MAIA						

Table 18. Information (experts, institutions, data, or documents) for knowledge gaps 5.1-5.8 per country

	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8
Bosnia and Herzegovina	NEA references							
Bulgaria	Institute of Oceanology - BAS, NIGGG-BAS, IBER-BAS, ExEa, Ministry of Environment and Water							
Finland	Syke has wide knowledge and could help to get more information on those marine-related issues. Marco-BOLO HEU project provides a lot of expertise for these topics too							
Germany	Several chapters of the biodiversity report “Artenvielfalt Faktencheck” For freshwater: https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/lebensraeume/binnengewaesser-auen/ For coastal: https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/lebensraeume/kuesten-kuestengewaesser/							
Latvia	6.1., 6.2.6.4.-6.7. https://lhei.lv/en/ecosystem-management/ 6.3. Nature Conservation Agency https://reef.daba.gov.lv/public/eng/ 6.1., 6.2.6.4.-6.7. https://lhei.lv/en/ecosystem-management/							
Lithuania	For marine questions - https://jti.ku.lt/en/; For freshwater questions - Lithuanian nature research centre sekretoriatas@gamtc.lt							
North Macedonia	Hydrological Institute in Ohrid; Contact for underground water project (https://skat.ch/our-projects?_sft_portfolio_entries=north-macedonia)							
Poland	Selected aspects of biodiversity across marine ecosystems: Outcomes of project ECOSERV-POL related to the Marine water ecosystems; Institute of Oceanology, Polish Academy of Sciences; https://ecoservpol.amu.edu.pl/en/results/ Selected aspects of biodiversity across freshwater ecosystems: Outcomes of project ECOSERV-POL related to the Freshwater ecosystems; European Regional Centre for Ecohydrology, Polish Academy of Sciences; https://ecoservpol.amu.edu.pl/en/results/							
Romania	6.5 https://rowater.ro/institution-activity/departments/integrated-european-water-resources-management/water-framework-directive/?lang=en; https://www.eea.europa.eu/en/analysis/maps-and-charts/wise-wfd-dashboards							
Slovenia	TC water https://www.tcvode.si/?lang=en; Limnos https://www.limnos.si/en/; https://www.nib.si/eng/							
Spain	SELINA project							

Table 19. Information (experts, institutions, data, or documents) for knowledge gaps 6.1-6.8 per country

	7.1	7.2	7.3	7.4	7.5	7.7
Austria	Bird Life Austria (office@birdlife.at)					
Bosnia	NEA references					
Bulgaria	Bulgarian Ornithology Society, IBER, ExEa, Ministry of Environment and Water					
Finland	For Finland, you will find the latest information from the Red Lists of Species and Habitats from here: https://luontotieto.syke.fi/en/ -> Nature Now and e.g., https://punainenkirja.laji.fi/					
Germany	Several chapters of the biodiversity report “Artenvielfalt Faktencheck” For soil: https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/themenbereiche/bodenbiodiversitaet/ For urban: https://www.feda.bio/de/was-ist-der-faktencheck-artenvielfalt/lebensraeume/urbane-raeume/ Database for soil: https://www.senckenberg.de/de/wissenschaft/forschungsinfrastruktur/datenbanken-und-digitale-ressourcen/edaphobase-datenbank-bodenzoologie/					
Hungary	eLTER reference system data,Monitoring of vascular plants (species and associations as well), fungi, vertebrates, intervertebrates in the Hungarian Biodiversity Monitoring System (https://termeszetvedelem.hu/nemzeti-biodiverzitas-monitorozo-rendszer-nbmr/), Birdlife Hungary, Reporting of Natura 2000 species in every 6 years					
Latvia	7.1. Monitoring and Planning Department,Nature Conservation Agency 7.2. Board of the Latvian Ornithological Society 7.3. The Latvian Institute of Forestry,, LSFRI "Silava"; 7.4. https://www.entomologi.lv/home-1/ 7.5. The Latvian National Museum of Natural History, International project - https://www.impel.eu/en/topic/nature-protection/conservation/projects/joint-network-for-wild-fungi-jonef; 7.7., University of Latvia					
North Macedonia	Macedonian Ecological Society (https://mes.org.mk/en/), Ministry of Environment and Physical Planning					
Poland	Selected results of project ECOSERV-POL related to the Ecological values of ecosystem services; University of Life Sciences; https://ecoservpol.amu.edu.pl/en/results/					
Romania	7.2 https://datazone.birdlife.org/country/factsheet/romania; https://ebird.org/region/RO; https://ebird.org/region/RO; https://inspire-geoportal.ec.europa.eu/srv/eng/catalog.search#/results?country=ro&view=priorityOverview&theme=none&iacs=none&legislation=none&envdomain=nature&basedomain=1					
Slovenia	Institute for Nature conservation (maybe the central unit?); for birds https://ptice.si/en/ ; The National Institute for Biology https://www.nib.si/eng/ ; Center for cartography of flora and fauna https://www.ckff.si/ /mapping habitats)					
Spain	SELINA, MAIA projects					

Table 20. Information (experts, institutions, data, or documents) for knowledge gaps 7.1-7.7 per country

We asked the respondents if they are aware of any other databases (social science/ecosystems/biodiversity/ES) that they think are important in improving knowledge gaps.

	Other suggested databases
France	The French EFESE programmes
North Macedonia	Natura 2000 (https://natura2000.gov.mk/); EU4Prespa (very big EU project in the beginning - contact MES (Macedonian Ecological Society) for details; Identification of high value forest (UNEP), National habitat map (Ministry for Environment and Physical Planning - https://habitatnakarta.moepp.gov.mk/#8/41.590/21.599), Biodiversity data in Prespa (https://www.pont.org/)
Slovenia	Natura 2000, Protected areas, Natural values (heritage) https://www.naravovarstveni-atlas.si/web/DefaultNvaPublic.aspx ; Land use https://rkg.gov.si/vstop/ A very important actor on ES is the Statistical office in Slovenia https://www.stat.si/StatWeb/en because they will need to start reporting to EC from Jan 2026 on. In 2024 they formed a non-formal group of experts on ES, In Slovenia we also have a national Community of Practice (contact person mateja.smid@zrc-sazu.si part of SELINA project)

Table 21. Other suggested databases per country

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7 References

- Báldi, A., & Palotás, B. (2021): How to diminish the geographical bias in IPBES and related science? *Conservation Letters*, 14: 1–5.
- Bednar-Friedl, B., R. Biesbroek, D.N. Schmidt, P. Alexander, K.Y. Børsheim, J. Carnicer, E. Georgopoulou, M. Haasnoot, G. Le Cozannet, P. Lionello, O. Lipka, C. Möllmann, V. Muccione, T. Mustonen, D. Piepenburg, and L. Whitmarsh, 2022: *Europe. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1817–1927.
- Cresswell JW, Plano Clark VL. (2011) Designing and conducting mixed method research. 2nd Sage; Thousand Oaks
- Dyderski MK, Paź-Dyderska S, Jagodziński AM, Puchałka R. (2025): Shifts in native tree species distributions in Europe under climate change. *Journal of Environmental Management*, 373: 123504
- IPBES (2018a): *IPBES Guide on the production of assessments*. Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany. 44 pages.
- IPBES (2018b): The IPBES regional assessment report on biodiversity and ecosystem services for Europe and Central Asia. Rounsevell, M., Fischer, M., Torre-Marin Rando, A. and Mader, A. (eds.). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany. 892 pages.
- IPBES KD TF (2022): Updated living guidelines to support assessment experts in the knowledge gaps' identification process. Guidance prepared by the task force on knowledge and data. Approved by the Multidisciplinary Expert Panel and Bureau in February 2022 (18th meetings)
- Nedkov S, Bratanova-Doncheva S, Zhiyanski M, Borisova B, editors (2018): Mapping and assessment of ecosystem condition and ecosystem services across different scales and domains in Europe. One Ecosystem https://doi.org/10.3897/oneeco.coll.42
- Patton MQ (2002) Qualitative research and evaluation methods. 3rd Sage Publications; Thousand Oaks
- Tanács E., Belényesi M., Lehoczki R., Pataki R., Petrik O., Standovár T., Pásztor L., Laborczi A., Szatmári G., Molnár Zs., Bede-Fazekas Á., Somodi I., Kristóf D., Kovács-

Hostyánszki A., Török K., Kisné Fodor L., Zsembery Z., Friedl Z., Maucha G. (2021): Compiling a high-resolution country-level ecosystem map to support environmental policy: methodological challenges and solutions from Hungary Geocarto International

- Tanács, E., Bede-Fazekas, Á., Csecserits, A., Kisné Fodor, L., Pásztor L., Somodi, I., Standovár, T., Zlinszky, Z., Zsembery, Z., Vári, Á. (2022): Assessing ecosystem condition at the national level in Hungary - indicators, approaches, challenges One Ecosystem 7: e81543
- Tanács, E., Bede-Fazekas, Á. & Báldi, A. (2024): Surprisingly good fit of pressure-based cropland condition map and bird census data at the national scale - Ecological Indicators 167: 112665
- Tengö, M., Hill, R., Malmer, P., Raymond, C. M., Spierenburg, M., Danielsen, F., Elmqvist, T., & Folke, C. (2017). Weaving knowledge systems in IPBES, CBD and beyond—Lessons learned for sustainability. Current Opinion in Environmental Sustainability, 26–27, 17–25.
- Vári, Á., Adamescu, C.M., Balzan, M., Gocheva, K., Götzl, M., Grunewald, K., Inácio, M., Linder, M., Ogiang-Ndong, G., Pereira, P., Santos-Martin, F., Sieber, I., Stepniewska, M., Tanács, E., Termansen, M., Tromeur, E., Vackárova, D. & Czúcz, B. (2024): National mapping and assessment of ecosystem services projects in Europe - Participants' experiences, state of the art and lessons learned. Ecosystem Services, 65: 101592
- Wiegleb, V., Bruns, A. (2025): Whose knowledge counts? Unpacking the uneven geographies and politics of knowledge co-production in IPBES. Human Ecology, 53: 73-86.
- Yogya, Y., Wapler, E., Zinngrebe, Y., Perez-Porro, A., de las Heras Carles, A., Báldi, A., Németh, T., Hernandez Marcado, C., Ngoy Shutcha, M., Mukubi, D., D'Amato, D., Kurki-Korhonen, K., Lipsanen, A. & Paulsch, A. (2025). *Mapping report on knowledge uptake: Social Network Analysis across cases of Armenia, Colombia, Democratic Republic of Congo, Finland, Germany, Hungary and Spain*. Deliverable D2.1, EU Horizon Europe RESPIN Project, Grant agreement No 101135490.