bioagora

Bio Knowledge Agora: Developing the Science Service for European Research and Biodiversity

Connecting **biodiversity knowledge** and **decision-making**

D5.1. Mapping the needs of decision-makers to tailor capacity development activities

Date of delivery - 31/01/2024

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ESSRG

Funded by the European Union

DOCUMENT TRACKS DETAILS

Project acronym	BioAgora
Project title	Bio Knowledge Agora: Developing the Science Service for European Research and Biodiversity Policymaking
Starting date	01/07/2022
Duration	60 months
Call identifier	HORIZON-CL6-2021-BIODIV-01
Grant Agreement No	101059438

Deliverable Information	
Deliverable number	D5.1
Work Package number	WP5
Deliverable title	Mapping the needs of decision-makers to tailor capacity development activities
Lead beneficiary	ESSRG
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Due date	31/12/2023
Actual submission date	31/01/2024
Type of deliverable	Report
Dissemination level	PU (Public)

VERSION MANAGEMENT

Revision table			
Version	Revision	Date	Description
1	Kármen Czett (ESSRG), Kata Fodor (ESSRG), Eszter Kelemen (ESSRG), Jomme Desair (INBO), Robin Dianoux (INRAE), Tyler Kulfan (Alternet)	16/12/2023	First draft
2	Chiara Cortinovis (UniTrento); Kinga Krauze (ERCE PAN); Lisa Norton (UKCEH); M. Susana Orta-Ortiz (UniTrento); György Pataki (ESSRG); Anna Salomaa (UFZ); Twan Stoffers (IGB); Renata Włodarczyk-Marciniak (ERCE PAN); Juliette Young (INRAE)	15/01/2024	Updated draft internally reviewed
3	Kármen Czett (ESSRG), Kata Fodor (ESSRG), Eszter Kelemen (ESSRG)	31/01/2024	Updated draft after contributions

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Meaning / Full text
BDS 2030	Biodiversity Strategy 2030
DG	Directorate General
EC	European Commission
EU	European Union
DC	Demonstration cases
KCBD	Knowledge Center for Biodiversity
MS	Member State
NbS	Nature-based solution
SPI	Science-policy interface
SPSI	Science-policy-society interface
SSBD	Science Service for Biodiversity

BACKGROUND: ABOUT THE BIOAGORA PROJECT

BioAgora is a collaborative European project funded by the Horizon Europe programme. It aims to connect research results on biodiversity to the needs of policy making in a targeted dialogue between scientists, other knowledge holders and policy actors.

Its main outcome will be the development of a Science Service for Biodiversity. This new service will fully support the ecological transition required by the European Green Deal and the European Union's Biodiversity Strategy for 2030.

The BioAgora project was launched in July 2022 for a duration of 5 years. It gathers a Consortium of 22 partners, from 13 European countries, led by SYKE, the Finnish Environment Institute. Partners represent a diversity of actors coming from academia, public authorities, SMEs, and associations.

Funded by the European Union. BioAgora receives funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101059438.

EXECUTIVE SUMMARY

The Science Service aims to ratchet up the EU Biodiversity Strategy 2030 by orchestrating science-policy-society interactions within the EU, which link scientific and non-scientific knowledge more efficiently with policymaking and implementation. To achieve this aim, it is crucial to identify relevant actors and help them participate in science-policy-society interactions in a meaningful way. This report aims to shed light on the capacity development needs of key actors and on the potential ways BioAgora and the future Science Service could enhance their capacities. Through surveys, in-depth interviews, and workshops, we engaged four main types of actors: scientists, policymakers, civil society actors, and businesses. The deliverable followed a solution-centered approach to analyse the empirical material, in order to highlight potential opportunities and next steps for BioAgora.

- The report identified eighteen major capacity development needs. Most of these have been reported in the literature before and have already been addressed to different degrees by existing capacity development efforts. Hence, the persistence of these needs suggests that there is a mismatch between the demand and supply side of capacity development initiatives, highlighting the importance of creating better targeted and less fragmented initiatives.
- Existing capacity development efforts focus more on individual rather than organizational capacities, and more on (natural) scientists than on other actors of the SPSI, neglecting systemic and policy-side challenges.
- Capacity needs vary across sectors, disciplines, age groups, and cultural and geographical regions highlighting the need to provide targeted capacity development initiatives.
- Stereotypes and prejudices across sectors and disciplines can significantly hamper participation and collaboration in the SPSI and need to be addressed openly.
- Potential trade-offs between inclusivity and scientific neutrality will likely arise in the SSBD, along with the possibility of power struggles and clashing views and interests. Thus, BioAgora should distinguish between primary and secondary stakeholders of the SSBD, considering how they could participate in the Science Service and what tools are available for the management of internal conflicts.
- The SSBD alone cannot address all capacity needs. Efforts to be undertaken by the Science Service should be clearly distinguished from those done by others, with duplications being avoided. The prioritisation of needs and collaboration with other organisations are necessary for this.
- Within the SSBD, a dual approach is necessary that encompasses both inherent functionalities and targeted initiatives in order to address diverse capacity needs.
- Independent capacity development efforts undertaken by the Science Service can include: 1) general training on SPSI skills and competences, 2) topical capacity development to enhance the implementation of the BDS2030 by forging collaborations with existing training centers, and 3) training boundary spanners.

NON-TECHNICAL SUMMARY

Functioning as a hub for science-policy-society interactions, the Science Service could play a crucial role in enhancing the implementation of biodiversity policies. However, existing research underscores challenges in this process, necessitating focused efforts on capacity development for key stakeholders. This report, employing a diverse methodology of expert interviews, surveys, workshops and desk research, thoroughly examines capacity needs in science-policy-society interfaces (SPSIs).

The research uncovers the landscape of capacity development opportunities, which, despite their increasing number, show a shortfall in fostering impactful SPSIs. Therefore, the question arises: are these shortcomings a result of unresolved historical needs or the emergence of new, unaddressed requirements? Persistent challenges include communication gaps, policy literacy deficiencies, and constraints in resource and time availability. However, the analysis of stakeholder interviews highlights disparate capacity needs across various thematic fields, emphasizing the urgency and variations in emphasis. The discussion explores the widespread presence of stereotypes among stakeholders, pointing out the barriers these biases pose to fostering collaborative SPSIs. The report also underscores the importance of inclusion, urging stakeholders to step out of their comfort zones for more effective engagement with diverse actors.

The recommendations of the report emphasise a strategic approach, advocating for the prioritisation of specific needs, targeted initiatives, and coordination with existing programs. Proposals extend to the development of specific capacity-building activities, encompassing the enhancement of general science-policy-society interaction skills, addressing topic-centred needs aligned with biodiversity conservation goals, as well as the training of new boundary spanners. The report concludes with a call for continual internal collaboration and iterative learning through SPSIs, and nuanced evaluations to optimise capacity development and support the resilience of biodiversity conservation strategies.

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1. Introduction

The EU Biodiversity Strategy 2030 (BDS 2030), which was launched on 20 May 2020, aims to address the five main drivers of biodiversity loss (changes in land, freshwater and sea use, overexploitation, climate change, pollution, and invasive alien species). Additionally, it sets out an enhanced governance framework to ensure the full implementation of EU legislation and pull together existing efforts. The Science Service, called to life by the BDS 2030 as part of its enhanced governance framework, aims to ratchet up the implementation of biodiversity policies by orchestrating science-policy interactions within the EU which can link scientific knowledge more efficiently with policymaking and implementation. To achieve this aim, it is crucial to identify relevant actors and help them to effectively participate in science-policy-society interactions. Relevant actors and their networks have been analysed in Deliverable 2.1 of BioAgora, while this report aims to shed light on capacity development needs of key actors, as well as on the potential ways BioAgora and the future science service could enhance their capacities.

Previous EU projects which analysed and developed biodiversity science-policy-society interfaces (SPSIs) in Europe, such as SPIRAL, KNEU and Eklipse, identified several barriers and gaps that limit the effectiveness of interaction and collaboration between science and policy. Conveying actionable knowledge for decision-making is challenged, among other factors, by the dynamic and fragmented nature of the institutional landscape on biodiversity. It requires understanding the role of key actors at national, European, and international level, such as, for example, governmental and intergovernmental bodies, civil society organizations, private interest groups, research performing organizations, boundary organizations that bridge the gap between science, policy and society, think tanks, and data management platforms. Previous work also highlighted that science-policy-society interfaces should provide capacity development to create dialogue, enable knowledge co-production, and to support the better implementation of biodiversity policy.

This call for capacity development has seemingly been addressed in recent years. A growing number of capacity development opportunities have been created which are available to scientists, practitioners and policymakers. Some of these focus on individual competences needed to act effectively at the science-policy-society interface (e.g. the JRC's Evidence4Policy initiative), others offer new or synthesised information to fill existing knowledge gaps (e.g. several online tools and databases developed for the monitoring of pollinators), while some others aim to improve internal processes, structures and resource availability of organizations to enable them to address SPSI challenges. However, recent literature concludes that science-policy-society interfaces have still not necessarily achieved their main objective in terms of creating better policies and arriving at better outcomes (Karcher et al. 2021, Glavovic et al. 2021).

Therefore, two main questions emerge:

1) Is this perceived failure of SPSIs due to historic capacity development needs which remain unfilled, or due to continuously emerging new needs which are not yet covered by existing capacity development?
2) Can available capacity development opportunities address these needs, or should they be rethought, reconfigured (i.e., better targeted, made more easily accessible) or added to, to be more effective?

In this deliverable we aim to answer these two questions. This report is the final output of the first task (T5.1) of BioAgora WP5, which aimed to assess the capacity needs of different SPSI actors. As part of the task, we mapped and analysed existing capacity development initiatives and carried out a needs assessment of SPSI actors, identified together with Task 1.2 and Task 2.1, to better understand the obstacles preventing and the leverages enabling their engagement in science-policy-society interactions. The main objective of this work is to support Task 5.2 by jointly identifying capacity development options which could be offered by the future Science Service.

The report is structured into six chapters. After this introduction the conceptual framework is explained (Chapter 2), which is followed by the detailed description of the methodology applied (Chapter 3). The results of the analysis are presented in the next three sections. Chapter 4 focuses on capacity needs: first it provides a general overview built on interview results, then it analyses the patterns of emerging capacity needs within and across actor groups. Chapter 5 focuses on capacity development options: it gives a brief analytical overview of over 150 capacity

development initiatives identified through desk research, and then it explains some best practice examples in more detail. Chapter 6 sums up the capacity needs and available capacity development options in specific topical areas, namely freshwater conservation, pollination, and urban nature-based solutions. The Discussion section (Chapter 7) highlights the main lessons learnt and acknowledges some of the limitations of the study. The deliverable concludes with a Recommendations section (Chapter 8) offering some action points and further opportunities to other BioAgora work packages as well as to the future Science Service.

2. Conceptual framework

This deliverable aims to assess the capacity needs of different actors in the science-policy-society interface (SPSI) and aid the subsequent creation of capacity development initiatives in the future Science Service. To this end and based on research done in D1.1, D2.1, and D2.3, we developed a conceptual framework to inform our data collection and analysis. The conceptual framework aims to outline some of the foundational concepts used in this deliverable, such as 'capacity', 'capacity development', 'knowledge user', knowledge provider', and 'co-production', among others, and to place our empirical results within the wider framework of SPSI scholarship. The framework also outlines the concept of a 'science-policy-society interface' (SPSI), reflecting learnings from D2.3 that the effective design and implementation of biodiversity policy will necessarily entail the inclusion of not only scientists and policymakers in science-policy interactions, but also wider society, such as NGOs working towards certain environmental causes or businesses implementing nature-based infrastructure projects, for instance. Therefore, the deliverable discusses the capacity needs of not only scientists and policymakers, but also other relevant social actors, like civil society organizations and the for-profit sector. Importantly, the conceptual framework makes the case for a co-productive approach to knowledge generation among SPSI actors, moving beyond the more traditional, linear model of science-policy interactions.

2.1. The science-policy-society interface

Science-policy interfaces (SPIs) have been developed to ensure that policy responses to current environmental challenges are informed by reliable, timely, and robust scientific knowledge. There are a large variety of science-policy arrangements operating at different scales from the local to the international. SPIs can be conceived both as platforms and processes and can take many different forms such as commissions and advisory bodies, technical review panels, or intergovernmental platforms. They may be formal or informal in their organization and governance, and may target diverse thematic areas, such as health, air pollution, biodiversity, etc. In general, SPIs aim to bridge the gap between science and policy by identifying socio-environmental challenges and impacts, mobilizing existing scientific knowledge, improving and synthesizing available data, and informing policymakers of the most relevant questions and the latest scientific findings to improve decision-making (Jagannathan et al. 2021). In addition, SPIs are argued to contribute to trust-building in science among the public via the democratisation of knowledge and the stronger collaboration between scientists, policymakers and societal actors (Lockie 2016).

Traditionally, the conception of SPIs have been drawn on a linear model of science-policy interactions, where knowledge producers (mainly scientists, who also act as primary knowledge providers) transmit scientific information to knowledge users (primarily policymakers) in a one-directional manner. Reflecting on the impact and outcomes of many existing SPIs, however, a growing body of literature now suggests that the linear understanding and design of science-policy interfaces is not only inadequate to deliver effective policy responses but is also problematic due to its exclusionary tendencies (Sienkiewicz & Mair 2020; Turnhout et al. 2020; van der Hel 2016; Kunseler 2017). On the one hand, the linear model assumes that science and policy are neatly separable, leaving the complex interdependencies between science and politics and the social and cultural practices within which science-policy relations are constituted unexamined (Maas et al. 2022). The failure to properly understand and make use of these complex interactions is argued to undermine the potential of SPIs to positively shape

environmental outcomes. On the other hand, the linear model also tends to omit several relevant actors who hold valuable biodiversity-related knowledge and/or capacity to significantly shape biodiversity outcomes, such as landowners and land managers (Sumane et al. 2021), and whose values and preferences need to be accounted for in shaping environmental policy and action. Science-policy interfaces function with embedded assumptions about what constitutes relevant and credible knowledge and who counts as its legitimate holder (Maas et al. 2022). Reflecting on these assumptions is critical for establishing the legitimacy and effectiveness of the future Science Service and to ensure the development of adequate capacities of diverse stakeholders.

Drawing on the approach taken in D2.3, this deliverable broadens the concept of SPIs to include various social groups and *"bridge the spheres of science, policy and society [by] link[ing] different forms of knowing and doing"* (Westerink et al. 2023), ranging from expert and scientific knowledge to indigenous/traditional knowledge, local knowledge, citizen scientists, civil society groups, business organisations, and others, thus creating a Science-Policy-Society Interface or SPSI. Such an interface allows not only for the integration of various knowledge sources but also for the transformation of knowledge through a more bottom-up, co-productive process that can explore alternative framings of problems and solutions and which often fall outside conventional, disciplinary silos (Urbinatti et al. 2020).

Horton and Brown (2018) similarly argue that the knowledge that is needed for effective SPSIs must engage not only with scientific evidence but also with the social discourse, cultural values, and political debate that surround most environmental questions. They argue that the importance of including such dimensions in the work of an SPSI can be observed through the example of public opposition against genetically modified (GM) foods in Europe. Horton and Brown (2018) argue that while scientific evidence shows minimal health risks associated with GM foods, strong public resistance against such products have effectively closed down political space for their introduction in Europe. They argue that beyond the more technical questions concerning health and environmental safety, scientific inquiry in an SPSI also needs to consider and provide adequate answers to questions related to, e.g. the emotional context of food consumption, the cultural value of 'natural' foods, or the growing public concern over the increasingly concentrated power and control of multinational agribusiness (Horton & Brown 2018).

While such information may be harder to produce and integrate into the scientific evidence base of SPSIs, failure to do so can easily undermine the effectiveness and usefulness of the interface to produce meaningful and policy-relevant recommendations. While a strong and singular focus on scientific knowledge in SPIs is usually justified by science's perceived 'neutrality' and 'objectivity', such terms can be misleading for our understanding of the scientific process and its products. Scientific inquiry is necessarily value-laden epistemically and morally, and thus cannot provide entirely neutral policy recommendations (Havstad and Brown 2017). However, SPIs can opt to refrain from decisively prescribing certain courses of action for policy from the policy options deemed available (as for instance done by the IPCC or IPBES), even if, from a scientific point of view, they are differentially feasible, or socially differentially desirable (Havstad and Brown 2017). Furthermore, acknowledging the value-ladenness of scientific research can lead to a better recognition of the political, cultural, economic, and social dimensions of environmental issues that shape public debate about the relative validity and worth of scientific evidence and in turn influence policy decisions (Horton & Brown 2018). This means that to create better policy outcomes, SPSIs need to go beyond questions and solutions provided by natural science and engage with the complex but critical issues of values, inequality, well-being, or agency.

Such engagement, however, requires the inclusion of not only social scientists in the SPSI, but also other stakeholders of non-scientific backgrounds, who nevertheless hold invaluable knowledge and may have considerable influence over public discourse and decision-making. Moreover, several societal actors, such as infrastructure developers or land managers substantially alter the state of biodiversity itself, making the consideration of their potentially opposing interests critically important for the success of an SPSI. There have been innovative examples of such integrative efforts for instance in health policy platforms where different stakeholder groups are included in the design, evaluation, communication, and implementation phases of research, ensuring the more precise identification of needs, an increased trust in research findings, and better policy translation and outcomes (Horton & Brown 2018).

Drawing on work done in D2.3, we thus link the concept of 'transformative change' within SPSIs to the platform's ability to go beyond mere technological fixes to the biodiversity crisis and to redistribute power to currently marginalised groups, incorporating their value choices and diverse perspectives in the process of biodiversity knowledge creation. *"Transformative change is then about systemic change, addressing not only the direct drivers of biodiversity loss but also the indirect drivers"* of socio-cultural, political, economic, and demographic factors (Westerink et al. 2023, 21).

Most science-policy platforms that exist today and which we also evaluate as part of this deliverable are closer to the traditional linear model of SPIs in that they only include societal actors and marginalized voices to a limited degree (or not at all), focusing mainly on stakeholders in the academic and policy communities. Nevertheless, we use the concept of SPSI throughout this deliverable to remain consistent across the text and to reiterate the importance of including societal actors and diverse voices in the future Science Service for greater transformative potential.

2.2. Knowledge providers and knowledge users

A broader understanding of where relevant biodiversity-related knowledge may come from in the SPSI informed our characterization of knowledge providers and knowledge users in this deliverable. If we accept that SPSIs function better when they consider the complex interrelationships between science, policy, and society, and aim to mutually aid and empower these spheres, then the neat separation of knowledge providers and knowledge users in the interface becomes meaningless. Thus, this deliverable identifies several social groups (such as scientists, policymakers, business actors, and civil society) as both producers and users of biodiversity-related knowledge, and policymakers as not the sole receivers of biodiversity knowledge. This understanding also informed our decision to include civil society groups and business actors in our research sample and to assess their institutional and individual capacity needs for effective and meaningful participation. Nevertheless, the concepts of knowledge providers and knowledge users are still valuable analytical categories, and we used them during data collection, in part to elicit further views on this distinction from our interviewees: whom do various stakeholders consider knowledge users and knowledge providers in the science-policy-society interface, and how do they see their roles and scope for participation?

However, while a co-productive approach can, in theory, ensure the production of high quality and socially robust knowledge, the reciprocity, mutuality, and equality of the various stakeholder groups within SPSIs is not usually self-evident. Several studies on participation show that different actors in the interface have different forms and sources of power – for example with scientists at universities and research institutions, government representatives, expert consultants, or big businesses having more paid time and resources to participate in the process, whereas citizens, SMEs, and civil society groups are often expected to volunteer their time and knowledge (Turnhout et al 2020; Cornwall 2002; Turnhout et al. 2010; Clark et al. 2016). Moreover, elite institutions and individuals are usually the ones that initiate the engagement process itself, determining its scope in terms of the topics to be discussed, the modes of participation, and the skills required for engagement. Such processes can easily neglect the socio-cultural biases embedded in knowledge production and can reinforce the traditional view of scientists as knowledge providers and others as *"holders of values or perspectives to be corrected by science, as receivers of scientific expertise, and as cocreators of solutions"* (Turnhout et al. 2020, 17). For stakeholders to have the capacity to participate in the SPSI effectively and meaningfully, the question of power imbalance inherent in current socio-economic and political systems needs to be seriously addressed.

2.3. The co-production of knowledge

There are two general ways that co-production is perceived in the SPSI literature, and both are useful for considering the capacity needs of various actors. The first is concerned with the idea that scientific facts are never

produced in an interpretive vacuum but are part of historical contexts that "*have already been conditioned to produce distinctive cultural responses to scientific claims*" (Kerkhoff & Lebel 2015, 13). This is in line with the growing recognition that scientific findings are often not the only - or even the most important -sources of reliable knowledge for environmental decision-making. Instead of thinking about the SPSI as a linear flow of scientific facts from scientists to policymakers, the co-production model describes SPSIs *"as governance processes that navigate politics and tensions - as opposed to primarily collaborative research and knowledge generation processes"* (Jagannathan et al. 2023, 183) that focus mainly on the sharing and synthesis of scientific knowledge. This reformulation is argued to open up new pathways in the interface to improve policy outcomes (Jagannathan et al. 2023). The other use of co-production is more concerned with its actionability at the project level and aims to address the practical questions of how to integrate the social and natural sciences, improve the relationships of various actors, and involve more diverse stakeholders in the process, especially marginalized and vulnerable voices (Kerkhoff & Lebel 2015, Future Earth 2012, Urbinatti et al. 2020).

The two uses of co-production are interrelated and inform our work on capacity needs. The scientific literature on how to make SPSIs more effective often focuses on 'capacity gaps', a metaphor that Kerkhoff and Lebel (2015) find ill-fitting, as it indicates a *"void waiting to be filled"*, rather than acknowledging the culturally and politically pre-conditioned spaces that already exists between science and policy. The historical contexts within which SPSIs develop fundamentally shape the stakeholders' willingness to participate in these processes and the ways in which they may do so. This space is already occupied by various rules, formal and informal processes, practices and capacities, and the question for SPSIs is how to take advantage of the existing strengths and opportunities presented by these preconditions, and how to overcome the challenges that make science-policy-society interactions ineffective and policy formulation incomplete. Thus, while the concept of 'capacity gaps' is useful for analytical purposes, in this deliverable we use the term of 'capacity development need' (capacity needs for short) to address the need for complex interconnections and interplay between science, society, and policy to improve the co-productive capacity of all actors.

2.4. Capacities to engage in the SPSI

Capacities have been construed in many ways in the scientific literature. They can, for instance, be understood as *"...the ability to perform functions, solve problems, and set and achieve objectives"* (Fukuda-Parr et al. 2003, 8). They can also encompass capabilities that are required to act but also the competences that are necessary to do so (Franks 1999). Some authors understand capacities as various forms of capital, including human, social, institutional, and economic capital which take the forms of skills, knowledge, values, or networks and whose mobilization also requires capacities in the form of social relations (Gustafsson et al. 2020, Beckley et al. 2008, Hunt 2005). In this deliverable, we aim to understand how and why various social actors succeed or fail to participate in the SPSI with the aim to co-produce biodiversity-related knowledge and policy. Thus, our analysis is focused primarily on capacities related to knowledge co-production and can be understood as capacities *"to create, access, interpret, and apply scientific and research-based knowledge; and capacities to combine science with existing, localized knowledge, practices, and governance to effect change"* (Kerkhoff & Lebel 2015).

This definition draws on Kerkhoff and Lebel's (2015) formulation of co-production, which recognizes the different political, cultural, economic, and social factors that impact relationships at the SPSI. They argue that 'co-productive capacity', which emerges from the convergence of governance capability and scientific resources, will shape the extent to which different actors (scientific, public, private, and civil society organizations) can act upon their dynamic relationships to create scientifically informed social change (Kerkhoff & Lebel 2015). To put scientific knowledge in a productive conversation with localized knowledge and governance, it is necessary to enhance not only individual capacities of diverse actors but also the institutional capacities that may otherwise limit or even undermine the productive interactions of individuals at the interface (UN 1997). Thus, co-productive capacities naturally encompass both individual and institutional capacities. For instance, Richards' (2018) list some of the critical elements of co-production in science-policy dialogues, such as *"holding one another accountable, [being] open to broad discussion, soliciting and accepting feedback from one another, [or] identifying and resolving*

disagreement". While dependent on individual actors' skills and willingness to act, these critical elements also depend on organizational arrangements, such as the presence of time and space for collaboration, possibilities for frequent meetings, appointed liaisons who are proficient in boundary work, flexible institutional structures, etc. (Richards 2018: 19-20).

Individual capacities refer to the competences and soft skills of individual actors. The nature of these capacities can differ according to the position of the actors in the SPSI. The EU Commission, for instance, differentiates competences required of scientists and those of policymakers and regulators (European Commission 2023). They recognize that these capacities are rarely acquired through the traditional channels of university education (although some universities now offer courses in SPSI skills) but are crucial for increasing the impact of science on decision-making by, for example, providing scientific evidence at the appropriate time and in the proper format during the policy cycle.

In the category of 'science for policy' competences, the European Commission outlined 27 capacities for researchers arranged under 5 broad clusters related to 1) collaboration, 2) participation in policymaking, 3) communication, 4) citizen and stakeholder engagement, and 5) policy understanding. There are skills, attitudes, and knowledge needs assigned to each capacity, with a descriptive scale of what counts as foundational or expert level capacity in each case.

The 'competence framework for innovative policymaking' is designed for policymakers and contains 36 individual capacities in 7 broad clusters: 1) collaboration, 2) communication, 3) citizen and stakeholder engagement, 4) futures literacy, 5) working with evidence, 6) innovating, and 7) advising the political level. These categories include competences e.g. in critical and systems thinking, data literacy, or designing and facilitating stakeholder consultation processes, etc. These individual capacities can play a critical role in strengthening co-production at the SPSI, however, by themselves may remain ineffective if existing institutional structures prohibit or limit their positive impact.

Institutional capacities for the SPSI include resources, structures, and processes (provided by the interface itself or by other research and policy organizations) that enable and support its members' participation. Based on D2.3., institutional or organizational capacities can be related to the institution's general mission, their internal activities and processes, their external engagements and influences, as well as to their outputs. Some capacities identified here include the organization's ability to reflect on its own mission and evolve; to assess, strategize and prioritize; to recognize knowledge needs and use leverage effectively; to collaborate, challenge and disrupt; to innovate; and to facilitate open deliberation processes. (For a full list of organizational capacities, see Westerink et al. 2023). Organizational capacities can take different forms, such as bureaucratic, associative, communal, or intercultural and thus provide different possibilities for members to achieve specific outcomes (Gustafsson et al. 2020; Beckley et al. 2008).

2.5. Capacity development

Several studies suggest that capacity development is a crucial element of effective and lasting collaborations between science and policy (e.g. Bednarek & Tseng 2022, Matsumoto et al., 2020). Capacity development in an SPSI can ensure that diverse knowledge providers are connected to each other and can efficiently collaborate with each other to resolve the policy problem (Tremblay et al., 2016). Evidence underlines the need to improve scientists' capacities to (co-)create more actionable knowledge and suggests that academia must better train and support scientists by renewing gradual programs, reforming university leadership, offering fellowships, etc. (Rozance et al. 2020). As highlighted above, it is also imperative that individual and institutional capacities are both strengthened.

To this end, we rely on the UN's definition of capacity development, which describes it as *"the process of enhancing individual skills or strengthening the competence of an organization or set of organizations to undertake specific tasks. In essence, it is the nurturing of the abilities needed by a society to take control of its destiny and direct and manage the development process, to make and carry out informed choices"* (UN 1997: 5) In the context of co-

productive capacities, such capacity development entails the enhancement of already existing competences and the acquisition of new skills, values, and social processes, which can become prerequisites in changing the direction of both science and policy. This means, for instance, adjusting the ways in which policies are implemented, prioritizing different issues, creating new legislation, or changing the direction of scientific research (Richards 2018). Capacity development in the SPSI can be understood both as a means towards better policy outcomes but also as a goal in and of itself (Gustafsson et al. 2020). As a means, it can help stakeholders achieve a specific outcome, while as a goal it can also contribute to the general functions of the SPSI by setting agendas, formulating problems, helping stakeholders formulating problems or identifying possible future pathways (Gustafsson et al. 2020, Chaskin 2001). As a goal in and of itself, capacity development can also actively counter the top-down approach to skills enhancement and instead can help acknowledge already existing capacities and take place within the collaborative mechanisms of the SPSI.

3. Methodology

This deliverable was produced over the course of 18 months, between July 2022 and December 2023, and were divided into three main phases: the first phases focusing on conceptualization and planning, the second phase gathering data, the third phase of data analysis and reflection (see Fig. 1. for a visual overview). These phases are explained in more detail in the next subsections.

3.1. Conceptualization and planning

In the first phase, a state-of-the art (non-comprehensive) literature review (Grant & Booth, 2009) was initiated to assess recent developments on which capacities are required for effective science-policy interactions and to identify potential gaps in the literature. In parallel, we re-assessed the interviews carried out in BioAgora Task1.1 on the challenges that impede the implementation of the EU Biodiversity Strategy, to search for challenges that might be related to the lack of capacities in policy formation, decision-making or implementation. Based on these inputs, we developed an initial conceptual framework (Section 2 in this deliverable) where we defined individual and organizational capacities and explained different approaches to capacity development. Still in the first phase we launched a desk research on existing capacity development opportunities. To this end, we looked for projects and initiatives related to the topics of the first BioAgora Demonstration Cases (DCs) that have a capacity development component, and assessed the tools and resources they offered, with a special focus on their target groups and forms of engagement. We created a database with relevant search results, ranging from online trainings, webinars and guidelines to summer schools and traineeship programs. We complemented the search results with capacity developmentn initiatives mentioned in peer reviewed publications or suggested by other project partners based on their personal experience.

Between March-June 2023, we organized several meetings with project partners. On the one hand, some of the meetings aimed at aligning the empirical data collection organized by other tasks, especially Task 2.1 on social network analysis and Task 4.1 on expectations towards the Science Service. As an outcome, capacity-related questions were included in both Task 2.1 and Task 4.1 interviews, which helped us enlarge our sample for data collection. On the other hand, we organized meetings with DCs (Task 1.2) on freshwater conservation, urban nature-based solutions, pollination, and later also on marine conservation. During these meetings, we used a Miro board to brainstorm together with the leaders of DCs on which capacities might be crucial in their specific cases, and which actors should be contacted to learn more about needs and limitations. As an outcome, we identified relevant informants representing the scientific, policy, civil society, and business domains in each DC. These meetings with other project partners also helped us to refine and simplify our conceptual framework and to develop the interview guidelines for DC-specific interviews.

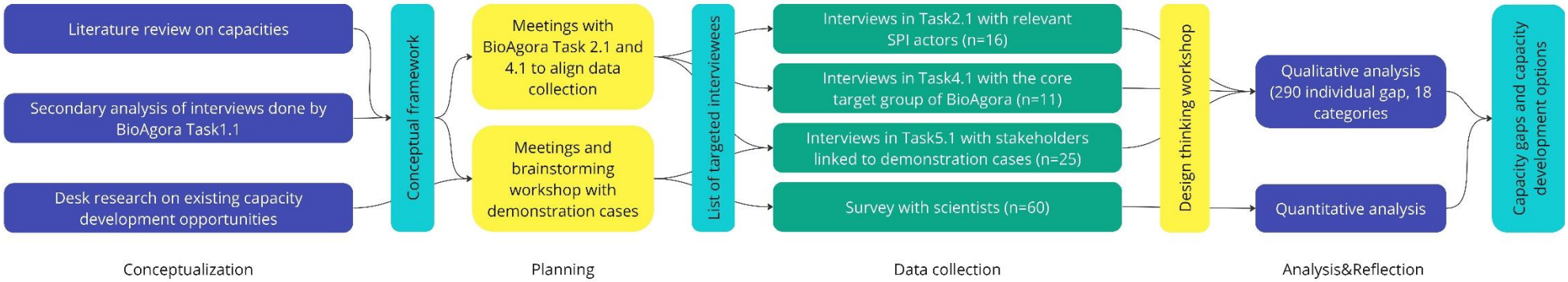

Figure 1 The evidence-base and the main steps of the research process

3.2. Data collection

Data collection was the second phase of the research and ran between June-November 2023 in collaboration with Task2.1 and Task4.1. It included interviews focusing on different stakeholder groups, a survey targeting researchers, and a workshop organized for BioAgora experts. Data collection methods and the main features of the data sources are explained below (interview and workshop guides, as well as survey questions can be found in the appendix). Research participants were asked to give their informed consent before participating in the research which they were allowed to withdraw during or after data collection. Anonymity was guaranteed, i.e. interview data were not shared beyond the consortium, and results are aggregated and detached from the individual participants. Data was managed according to current GDPR regulations.

Interviews in Task 2.1 applied a structured, semi-quantitative approach, including both quantitative and qualitative questions. Questions related to capacities were all open-ended qualitative questions. The target group of these interviews were the main actors of the biodiversity science-policy interface, including international umbrella organizations, NGOs, academic societies, and interest groups. Altogether 16 interviews were carried out online, which lasted between 60-90 minutes. Answers were summarized and noted down by the interviewer using an online survey platform. These notes were used for the analysis. More details on key informant selection and the used methodological approach can be found in deliverable 2.1 (D'Amato et al. 2023).

Interviews in Task 4.1 applied a semi-structured qualitative approach. Main topics have been identified for the interviews, and support questions were developed for each topic, but the interviewers could flexibly adapt the questions to the given situation (i.e., they could change the order of questions, or could spend more time on topics which seemed extremely relevant). The interview guide included capacities as one of the core topics, and questions on needs as well as best practices for capacity development were included. The target group of these interviews were the core partners of the future Science Service, including policy actors and background organizations at the European scale, other well-established science-policy interfaces, and large NGOs. Altogether 11 interviews were carried out online (some including more than one respondent). Interviews lasted between 60-120 minutes. Eight out of the 11 interviews were recorded and transcribed. The remaining 3 interviewees did not give their consent to record the discussion, so detailed notes were taken. Full transcripts and notes were used to carry out the analysis.

Interviews in Task 5.1 centred around the freshwater, urban nature-based solution, and pollination DCs (because the marine DC was launched later). For each topic, we aimed to contact at least one representative of the scientific, policy, civil society (including NGOs), and business domains. The interview guide followed a semi-structured qualitative approach, providing flexibility to the interviewer to tailor the discussion to the needs and interests of the interviewee. To be able to understand the specific viewpoint of representatives of each of these four domains, we developed specific interview guidelines for the scientific, the policy, the NGO and the business actors. Altogether 26 interviews were carried out: nine interviews on freshwater, five interviews on urban nature-based solutions, eight interviews on pollination, and four additional general interviews with capacity development experts. Interviews lasted approximately 60 minutes on average. All interviews were recorded and transcribed, and the full transcripts were used for the analysis.

The first few interviews revealed a huge diversity of capacity development needs. To understand how much these needs characterize the larger scientific context, we launched a quantitative survey asking researchers to identify those needs which they found the most striking in their own practice. The survey was launched online (using Google Forms) and was distributed within the Alternet research and summer school alumni network, the BioAgora consortium, and through the project's and project partners' social media accounts. Altogether 60 responses were submitted between September-November 2023. These responses were quantitatively analysed in the deliverable.

Table 1. provides a general overview of the number of interviews and surveys done with different types of stakeholders (the number of participants is higher because, in some occasions, the T4.1 interview was carried out in a group setting with more than one participant). The interview guides and the questionnaires can be found in the appendix.

Table 1 Number of stakeholders involved in the research process

Data source	Number of interviews / surveys done with respondents from...				
	Science	Policy	Boundary organizations[1]	Businesses / practitioners	Civil society
T2.1 interviews	4	0	4	6	2
T4.1 interviews	0	4	6	0	1
T5.1 interviews: Freshwater	2	2	0	1	4
T5.1 interviews: Urban NbS	1	1	1	1	1
T5.1 interviews: Pollination	2	1	0	3	2
T5.1 interviews: general experts	0	0	4	0	0
T5.1 survey	60	0	0	0	0
Total	69	8	15	11	10

As a final step of data collection, we organized a design thinking workshop in the BioAgora annual meeting in October 2023 to capitalize on preliminary results and initiate joint thinking on how the identified needs could be met by BioAgora. The workshop started by introducing the preliminary results of the research, and then people were asked to work in pairs and step in the shoes of individual stakeholders of BioAgora to think more deeply on how to enable the active participation of various actors in the future Science Service. We used the persona method from the design thinking toolbox, and we prepared 32 fictive characters prior to the workshop. The 32 personas were equally divided among the four demonstration cases (freshwater, urban NbS, pollination and marine) and eight stakeholder groups (European Commission, policymaker from local to national level, scientific community, European and international public institutions, science-policy interfaces, business sector, civil society, media). Workshop participants first familiarized themselves with the fictive character and imagined some personal qualities of the given character (Fig. 2). Then, participants were asked to respond to four specific questions: 1) Is the person interested in the Science Service? 2) How could the person best contribute to / benefit from the Science Service? 3) What makes it difficult for the person to actively engage in the Science Service (perceived capacity needs)? 4) How could we make it easier for the person to actively participate in the Science Service (capacity development)? Once the persona templates were filled, workshop participants were asked to arrange the personas according to how close they are to the core target of the Science Service. The workshop was organized in a hybrid format – in person participants filled a printed template, while online participants worked on a Miro board (Fig. 3). The templates filled (altogether 21), their order of relevance, as well as the follow-up open discussion was used as inputs for this analysis.

[1] Boundary organizations are considered here as organizations bridging across science and policy, such as IPBES.

Figure 2 Persona exercise at the consortium meeting in Leipzig

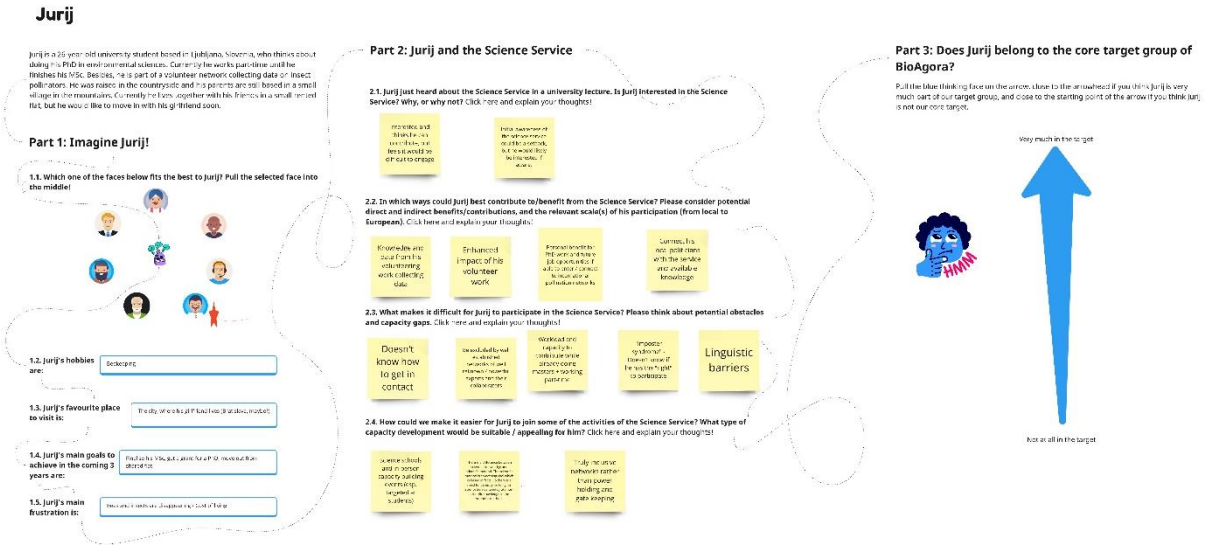

Figure 3 Miro board used by online participants during the persona workshop

3.3. Data analysis

In the last phase of the research, during November-December 2023, 5 authors of this deliverable analysed the empirical material collected during the third phase. Interview notes from Task 2.1 were analysed together with the transcripts of Task 4.1 and Task 5.1 interviews (altogether n=52). We used a qualitative-narrative approach during our analysis. First, a thorough reading of the interview notes and transcripts were carried out. Then, in several subsequent meetings, a table was developed in MS Excel where the main details of the interviews could be recorded and capacity needs could be defined, explained, and illustrated with quotes. Every capacity need was added as a

new row to the table, so if one interviewee mentioned several needs– or different aspects of the same need – these were included as separate entries to the table. Once data from every interview was added to the table, we coded, merged, and categorized the needs in an iterative way. Through this process, 290 original entries to the Excel database (i.e. quotes from the interviews) were coded into 18 different categories, which were then grouped into three main groups: individual skills, organizational capacities, and wider contextual factors. Afterwards, we looked for general patterns of how the different needs emerged – i.e., if there are differences between stakeholder groups or thematic areas in terms of most frequently mentioned or dominant needs. Finally, a narrative analysis was written to sum up the main results.

Quantitative data from the survey targeting researchers were downloaded as an MS Excel database and was analysed with descriptive statistics. Altogether 60 respondents answered the questions. Considering their scientific background, the majority had a background in natural or environmental sciences (68.3%, n=41), the second largest group identified themselves as inter- or transdisciplinary scientists (20.0%, n=12), while only the minority had a background in social or legal sciences (11.7%, n=7). Almost two third of the respondents worked at a university or academic institution (63.3%, n=38), and one quarter had a position in a governmental body (25.0%, n=15). The rest of the respondents had more diverse organizational backgrounds, ranging from NGOs (n=3) and business actors (n=3) to international organizations (n=1). The majority of the respondents (60.0%, n=36) gained some personal experiences with science-policy interactions, 15 respondents (25.0%) indicated that they had never been involved in SPSIs, while 9 respondents (15%) were unsure.

4. Capacity development needs

4.1. Capacity development needs from a broader perspective

Capacity development needs at the SPSI have been assessed by earlier projects. Eklipse, for instance, combined a quantitative survey with qualitative interviews, addressing mainly scientists, to better understand their perceptions on SPSIs (Kelemen et al., 2018). They found that the main hindrances which make science-policy interactions less effective were the weak relationships between scientific and policy actors, the lack of resources including time and funding actors could allocate to SPSI interactions, and the lack of transparency concerning the information flow at the SPSI and how the knowledge was used, which was also linked to the lack of clear understanding of how the policy process worked. Additional capacity needs were also mentioned by this study, such as needs in communication and knowledge co-production skills (e.g., dissemination and outreach to various target audiences using clear and simple language), and the lack of clear mandate and transparent processes. Altogether these systemic hindrances were reported to be more relevant than thematic knowledge gaps.

In BioAgora Task 5.1 we aimed to check if and how perceived difficulties that hindered the engagement in SPSI processes earlier has changed in the last 8 years. As the BioAgora sample, as well as the survey questions, were different from the ones used in Eklipse, the current survey does not allow for a full comparison, but it can still offer some insights based on which capacity development in BioAgora could be tailored. Furthermore, it can provide some hints on whether increased participation in SPSI activities during the last couple of years had any influence on the perceived hindrances.

In the BioAgora survey, we asked respondents, how much influence they think their work had on biodiversity-related policy decisions. They had to indicate their perceived influence on a scale from 1 to 6 where 1 referred to no influence at all, and 6 referred to very high influence. As Figure 4 highlights, those participants who already participated in SPSI activities had a more positive impression of how much influence their work can have on policy decisions than those who had no prior personal experience with SPSI activities. 80% of those participating in SPSIs earlier had a rather positive impression (indicated that their work had some, high or very high influence), while only

37,5% of those having no prior experience on the SPSI indicated the same. Considering the whole sample, almost one third of respondents indicated to have no or constrained influence, another third indicated some influence, and the last third indicated high or very high influence.

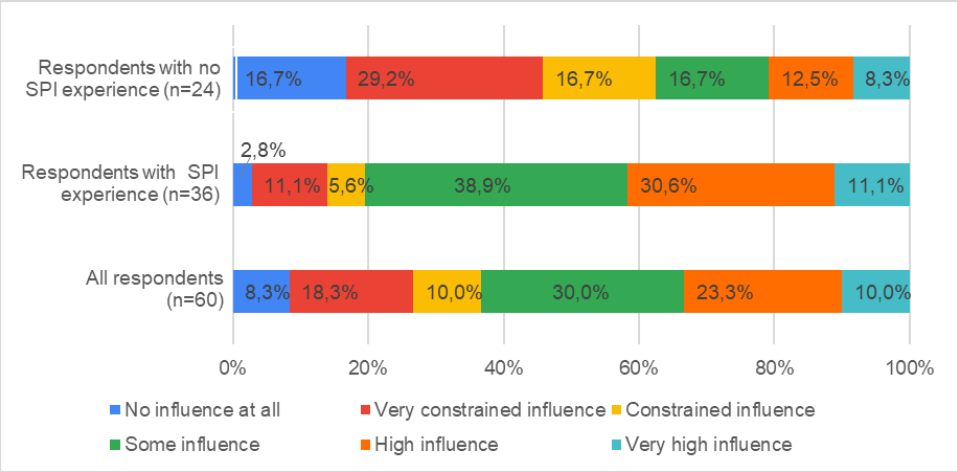

Figure 4 Scientists' perceived influence on policy decision-making

The survey also asked about the perceived importance of certain pre-defined capacity needs, which were partly derived from the first few BioAgora interviews and were partly built on the capacity needs identified in the Eklipse project. In the survey, we listed eight difficulties which might make SPSI participation challenging, such as:

- The complexity of the policy process where science provides only one argument beside several others (identified in BioAgora interviews)
- The problem that policy decision-making often focuses on different questions than science, and therefore research is often not relevant (identified in BioAgora interviews)
- The time misalignment between policy and science, i.e., policy processes are often faster than scientific processes (identified in BioAgora interviews)
- The limited opportunity for face-to-face dialogues where different actors are brought together (identified in Eklipse)
- The lack of understanding of the policy process (lack of policy literacy) among scientists (identified in Eklipse)
- The fact that scientific results are often difficult to access in an easily understandable way (identified in Eklipse)
- The lack of understanding of the scientific process (i.e., how to deal with uncertainty) among policymakers (identified in Eklipse)
- The difficulties of synthesising scientific information across different knowledge domains (identified in Eklipse).

As Figure 5 highlights, all of these difficulties were considered rather relevant. The complexity of the policy process received the highest average scores (and at the same time standard deviation was the smallest for this need), while the difficulties of synthesising across various knowledge domains were perceived as the least relevant ones (although with considerable standard deviation).

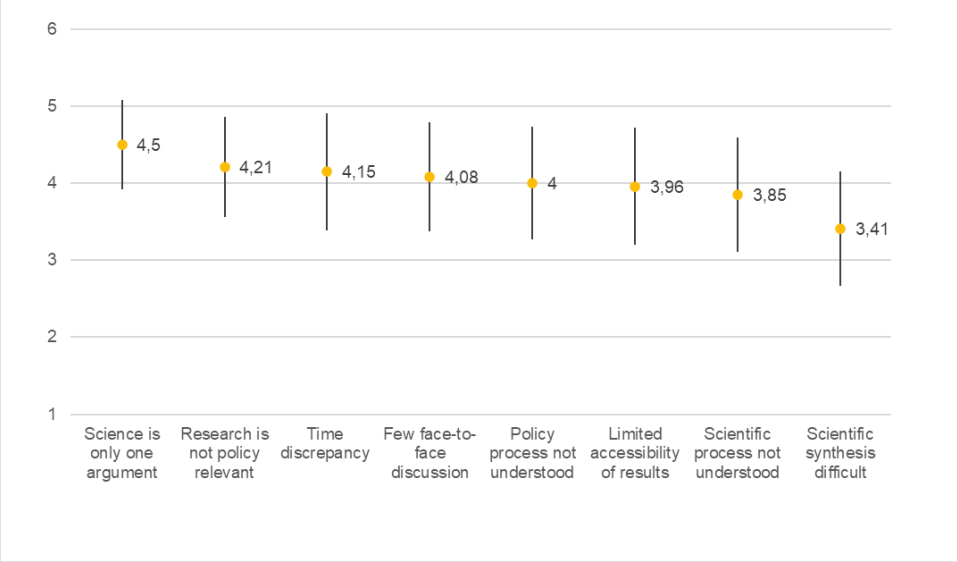

Figure 5 The perceived relevance of difficulties hindering SPSI participation (n=60). Blue dots indicate the average scores on a scale 1-6, and the black lines indicate standard deviation

If we compare the perception of those respondents who previously took part in SPSI related activities with the perception of those who did not have prior experience with SPSIs (or were unsure), we see significant differences in the perceptions of four difficulties (Fig. 6). Those with no prior experience with SPSIs considered more challenging the needs related to the relevance of research, time misalignment, and lack of understanding the scientific process by policy makers, while those with prior SPSI experience scored much higher the challenge related to the complexity of the policy process.

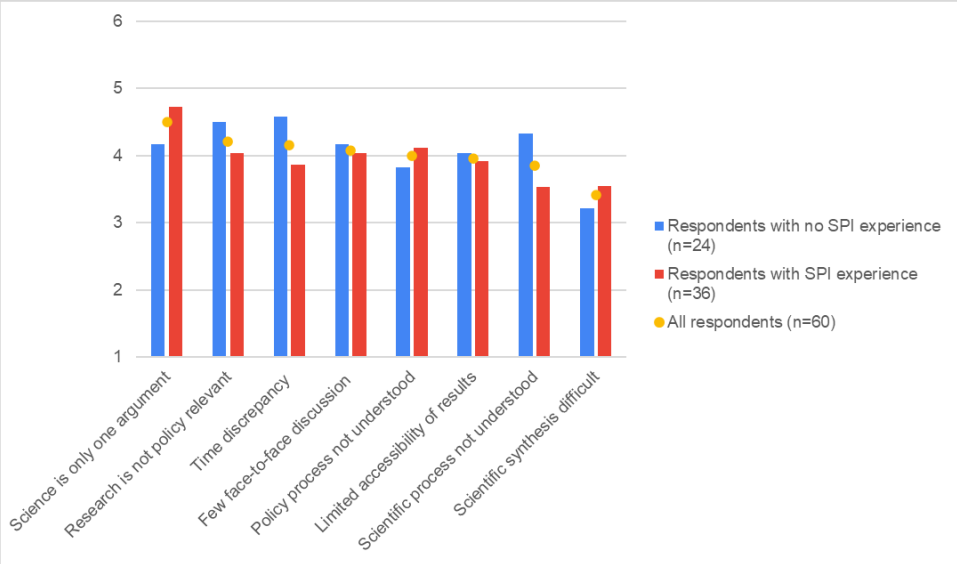

Figure 6 Differences in perceptions of difficulties among participants with and without prior SPSI experience. The relevance of difficulties was assessed on a scale of 1 to 6 (1=not relevant, 6=highly relevant)

Two main observations can be drawn from this superficial analysis. First, the differences in perceptions between researchers with and without SPSI experience suggest that some of the difficulties are rooted in mindsets (i.e., they are more the fear of scientists than real life experiences on the SPSI). This highlights the necessity for building connections and eliminating stereotypes among current and potential SPSI participants. Second, our analysis suggests that capacity needs identified several years ago are still relevant and highly ranked. This is a striking

observation as we know that several capacity development opportunities were launched recently to overcome these difficulties. Reasons could be manifold, i.e. existing capacity development initiatives might be too narrow or not well targeted (not reaching a sufficient number of researchers or reaching only scientists with specific backgrounds), or it is also possible that there are other, more systemic problems that hamper the wider utilization of capacity development opportunities by raising barriers against spillover effects. In the remaining part of this chapter, we investigate if in-depth interviews can provide an explanation for the persistence of the major difficulties. In the chapter afterwards, we analyse the array and scope of existing capacity development to check for inconsistencies in outreach or targeting of capacity development.

4.2. Main categories of capacity needs as identified in the interviews

This section introduces the eighteen capacity development need categories identified during the interview analysis. As interviewed experts often shared the difficulties they perceived, the analysis focuses mainly on the challenges and barriers which lead to the emergence of the given capacity need. Categories are presented in the order of frequency: we start this section with the most frequently mentioned category (i.e., where the number of quotes coded with the given category was the highest) and finish with the least frequently mentioned category (Fig. 7).

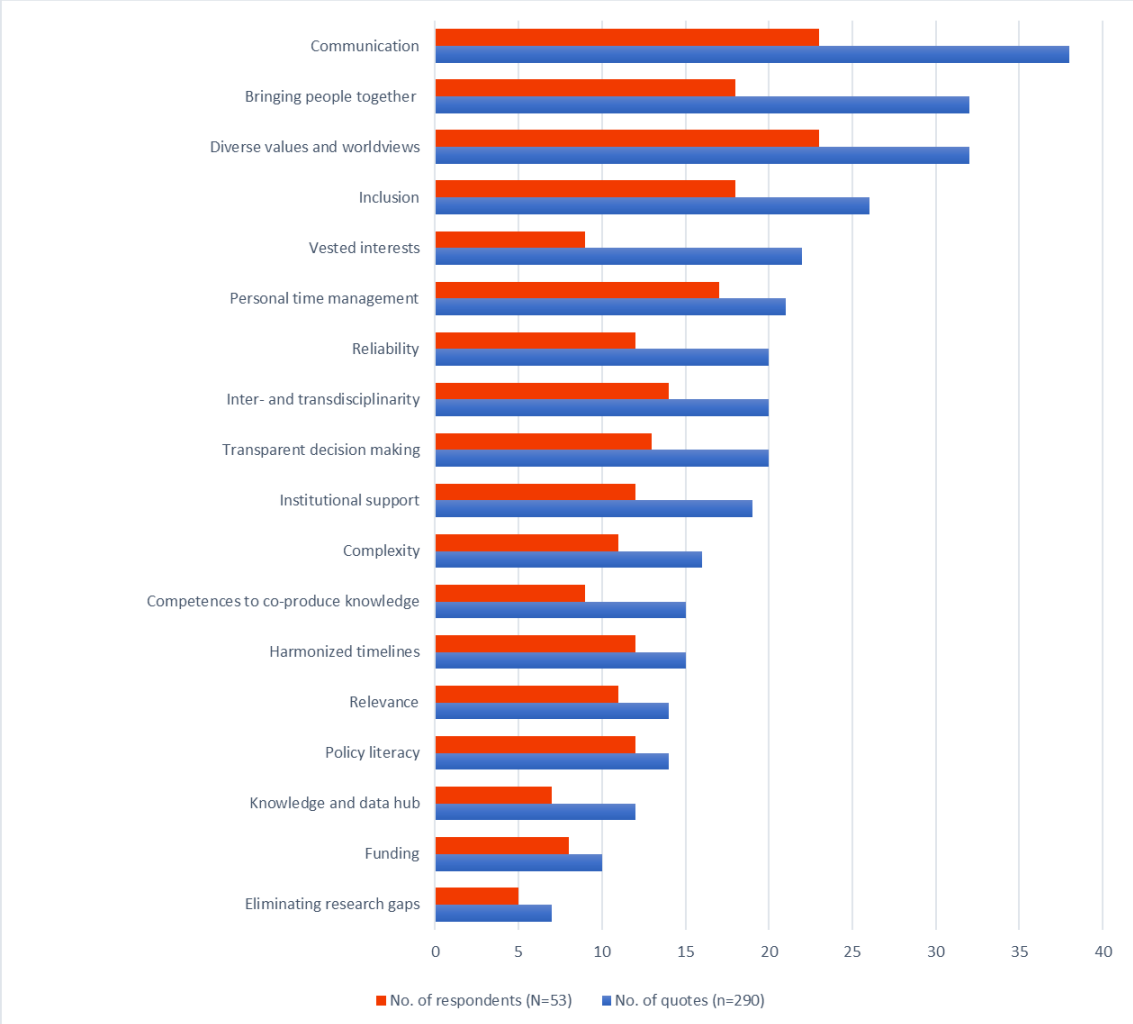

Figure 7 Capacity development needs identified in the interviews

4.2.1. Communication

Communication between scientists, policymakers and other societal actors is a critical aspect of science-policy interfaces, ensuring that scientific and other types of knowledge inform policy decisions effectively, and it is communicated well to the broader society. This capacity need category encompasses five major challenges and nuances that hinder efficient communication, emphasizing the need for improved dialogue, mutual understanding, and tailored messaging, and was cited the most by experts.

First, clear communication within the scientific community and across knowledge domains is highlighted as a prerequisite for effective communication: *"Be clear in your messaging, concise, relevant, show the impact, be very clear on how you're writing. Don't write as a scientist, write as a communications person."* Scientific jargon and differences in language between scientists and policymakers pose challenges, necessitating efforts to bridge these linguistic gaps. Moreover, the lack of a structured process for scientists to communicate regularly with policymakers underscores the importance of establishing formal channels and the help of facilitators for information exchange.

Another key dimension of the communication problem evolves around the need to broaden the range of stakeholders engaging with policymakers: *"I think our job in [x organization] is not to give the power to certain individuals to talk to policy so much as to give the opportunities to as many people as possible to engage and hopefully influence policy, and learn also from decision-makers."* Stakeholders' problems should be thoroughly understood before scientific answers are provided, emphasizing the importance of empathy and active listening in the communication process.

Third, tailoring scientific messages to different audiences is identified as a critical skill, recognizing that each audience requires a specific approach. Whether communicating with policymakers, business actors, or the wider society, adapting the message to the audience's understanding is essential.

Fourth, the role of mainstream media in shaping perceptions of scientific information, fuelling polarisation, and influencing policy decisions is also acknowledged. However, the challenge lies in ensuring accurate portrayal without oversimplification. The need for scientists to play a proactive role in communication through media is emphasised, necessitating the translation of complex scientific data into accessible formats.

Finally, a recurring theme is the need for third-party mediators who can facilitate the bidirectional flow of information between science and policy. These mediators play a crucial role in managing dialogue, ensuring that the right information reaches policymakers and addressing the challenge of facilitating knowledge transfer: *"the biggest challenge, I think it is a very good knowledge broker, so we are always trying to translate."*

This capacity need was mostly mentioned in relation to the needs of diverse values and worldviews, complexity, as well as knowledge and data hub.

In conclusion, the capacity need category of communication encompasses multifaceted challenges that, when addressed, can lead to more effective science-policy interfaces. According to interviewed experts, bridging the divide requires efforts to broaden the range of stakeholders, enhance clarity within the scientific community, adapt messages to different audiences, and establish structured communication pathways. The ultimate goal is to empower policymakers as well as other societal actors with scientifically sound information or local and traditional knowledge, fostering evidence-based decision-making and better policy outcomes.

4.2.2. Diverse values and worldviews

The capacity need category of 'Diverse values and worldviews' refers to a myriad of challenges that arise from the diversity of personalities and characters of stakeholders and hinder trust and effective cooperation between them. We could identify four main aspects of this category – these four challenges highlight the need for bridging needs in understanding, appreciating differing perspectives, and fostering a more holistic approach to decision-making.

One prominent issue is the existence of extreme opinions, leading to polarization in debates. This polarization is further exacerbated by entrenched positions around certain topics, where evidence struggles to sway opinions. The lack of appreciation between scientists and policymakers, coupled with a lack of a common language, adds an

additional layer of complexity, hindering meaningful dialogue and collaboration: *"What we're currently lacking and what I observe in myself is a lack of appreciation for policymakers and I believe to observe the opposite in policymakers."*

Secondly, two interviewees mentioned that competences to co-produce knowledge face resistance, with scientists expressing fear and reluctance. The courage of scientists to make policy recommendations on incomplete knowledge also came up numerous times, as the demand for absolute scientific certainty clashes with the dynamic and evolving nature of many policy challenges.

Another important aspect of this category is the lack of awareness among a variety of actors: *"But a lot of people, they don't, they cannot grasp biodiversity. It's a bit of an abstract concept. [...] I think I would say awareness raising is number one that we need."* In the case of practitioners, a perception of the impracticality of research creates a barrier. In city developments, biodiversity is often overlooked, reflecting a lack of awareness and understanding. The difference in mindsets and attitudes within cities contributes to resistance against change, hampering the integration of sustainable practices.

Finally, divergent mindsets and training between policymakers and scientists pose another barrier: *"So you've got all policies being made by people whose mindset is very different from a scientific mindset."* The perception of nature conservation by practitioners and policymakers as a cost further highlights the complexities. The dynamics extend to mistrust between policymakers and business actors, as well as between NGOs and businesses.

This capacity need was mostly mentioned in relation to the needs about inclusion, reliability, communication as well as inter- and transdisciplinarity.

All in all, this category underscores the need for a paradigm shift towards a more inclusive, collaborative, and solution-oriented approach. According to interviews, overcoming diverse values and worldviews requires fostering mutual understanding, effective communication, and a shared commitment to addressing the pressing challenges at the intersection of science and policy. Recognizing the importance of diverse perspectives and actively working towards common ground will be pivotal in navigating these complexities and ensuring the effective integration of knowledge into policy decisions.

4.2.3. Bringing people together

The 'Bringing people together' category refers to the importance of dialogue – i.e., mutual exchange and co-creation of knowledge – between policymakers, scientists, and other knowledge providers, which was perceived by the interviewees as critical to create effective science policy interactions. To achieve the best results, longer term and deeper collaboration was suggested, where participants can develop a common understanding and engage in joint problem-solving. While some good examples were mentioned (e.g., communities of practice or policy labs), most interviews identified serious deficiencies of current science-policy interfaces in this regard, and highlighted that efforts are needed from all involved actors to bring people together more efficiently. Three main aspects (or potential ways forward) were mentioned.

'Bringing people together' has a strong networking component, where boundary spanners or intermediaries have a crucial role. These actors (either individuals or organizations) have connections to both the policy and the scientific world (and ideally to practice as well) and can easily find the right contact person who has suitable knowledge or position through which she can achieve real impact. These intermediary actors can create alliances and are well-suited to develop interconnected networks. However, currently there is a lack of these actors as neither policy, nor science really appreciate this type of work (this is not a profession yet, although it could be).

The second aspect refers to processes which guarantee that people can interact in a safe collaborative space. This is important to make sure that all knowledge providers (including practitioners) feel safe to share their knowledge, because they know that the information shared will not be misused and that power hierarchies are not distorting the dialogue.

While exact processes of how to guarantee a safe collaborative space were not outlined in the interviews, professional facilitation was often highlighted as the third aspect through which collaboration could be enhanced. Interviewees mentioned that skilled, professional facilitators are very rarely present in science-policy interactions.

However, they could help with bridging across worldviews, building trust and ensuring that all relevant knowledge providers are listened to.

This category was mentioned together with 'Inclusion', 'Reliability', 'Competences to co-produce knowledge', 'Diverse values and worldviews' and 'Personal time management'.

In conclusion, the capacity need category of 'Bringing people together' entails deficiencies in networking, collaborative processes, and facilitation. Addressing this need requires the inclusion of people with specific skills and capabilities – such as boundary spanners who have connections to both science and policy, and professional facilitators who by profession know how to create safe collaborative space. If this capacity need is filled, diverse values and worldviews can be brought closer together, competences to co-produce knowledge can be enhanced, and science-policy interactions can be more inclusive and reliable. However, lack of time can be a barrier that limits opportunities for bringing people together.

4.2.4. Inclusion

The capacity need category of 'Inclusion' in knowledge and policy interactions revolves around the need for a more inclusive, diverse, and participatory approach in decision-making processes related to biodiversity policy. This necessitates overcoming barriers, fostering collaboration, and acknowledging the importance of a variety of perspectives. We identified six main aspects of this category, as explained below.

The first key dimension of this inclusivity need is the imperative to include marginalized perspectives, particularly those of indigenous and local communities: *"So not thinking about society as a group, but really thinking about these subsets of vulnerable populations or marginalized populations within society and how policy can affect them. It's being talked about more and more in the scientific community but not in the policy arena is my feeling."* Ensuring diversity in SPSIs not only empowers disadvantaged voices but also contributes to the robustness of decision-making and facilitates the acceptance of policies.

Another facet of the inclusion need focuses on the underrepresentation of social scientists and economists in SPSIs, especially in biodiversity policy discussions dominated by natural scientists: *"Because I think that is where it will be critical, when people will effectively lose their property [...] because that will need to be a floodplain and that was my holiday house, [...] or there was a lake where I had my [...] boats and it's actually not going to be a lake anymore. [...] I think that is where social scientists will play an incredibly important role, but we're not there yet."* The call for more social scientists stems from the recognition that a holistic approach to biodiversity policy involves understanding trade-offs with other targets, such as economics and trade.

Third, the elitist system of science is identified as a significant barrier to inclusion. The hierarchical and ivory tower nature of the scientific community hampers collaboration, both within the scientific community and with policymakers and other societal actors. Overcoming this elitism requires system-wide changes to make room for transdisciplinarity, knowledge co-production, and more open, responsive science: *"The science system shall be changed because it is a very elitist system. Funds should target more diverse projects and research with true impact. This is the responsibility of the science community (...) to show the benefits of transdisciplinary knowledge production, to prove the concept and get science funders behind."*

Fourth, inclusive knowledge co-production is hindered by the difficulty of keeping stakeholders engaged for extended periods, as highlighted by challenges related to personal time management and a lack of time for collaboration: *"And that was done in a series of two or three workshops with really a lot of experts but also stakeholders. And what you see then is that if you involve them, it's difficult to keep them on board for a long series of workshops. The first one we started with maybe 40 people or so and the second there were 25, and the third one not even 20."* Additionally, an interviewee highlighted that the need in inclusivity extends to EU projects, where stakeholders, even those the projects aim to help, are often excluded.

The lack of inclusivity in SPSIs is also evident in the emphasis on scientific knowledge to the detriment of non-scientific, practical knowledge. Recognizing the value of diverse forms of knowledge is essential for effective biodiversity policy, and co-design and co-production should be emphasized.

Finally, mistrust among stakeholders, such as scientists in business actors, further exacerbates the inclusion problem. Overcoming these trust issues requires concerted efforts to foster collaboration and understanding. Similarly, difficulties in organizing and maintaining networks, reaching non-usual suspects, and including diverse organizations in projects highlight the need for a more deliberate and inclusive approach.

This category was mostly mentioned together with the categories of inter- and transdisciplinarity, diverse values and worldviews, as well as competences to co-produce knowledge.

In conclusion, addressing the inclusion need requires a paradigm shift towards inclusivity, diversity, and collaboration. This involves institutional changes, breaking down elitist barriers, recognizing the value of diverse knowledge sources, and fostering trust among stakeholders. By embracing a more inclusive approach, SPSIs can enhance the robustness and legitimacy of biodiversity policies and contribute to more effective and equitable decision-making processes.

4.2.5. Personal time management

According to interviews, a major constraint to effective science-policy interactions is the scarcity of time, not just at the side of policymaking, but also in science and practice. Lack of time negatively influences engagement and collaboration, and it makes knowledge synthesis and co-production more challenging. Even when there is an opportunity for collaboration (e.g., a workshop or a conference), there is often not enough time for deeper level reflection and knowledge co-production, as the following quote highlights: *"You know, there are some conferences or some workshops where you've got an opportunity for the dialogue to take place. But (…) you don't necessarily have the time to go in-depth into one's data. To look more in-depth into what people have done. (…) We should take really the time to exchange on how it was done."* This category has two main components according to who struggles with personal time management, as explained below.

Scientists lack the time to reach out to and collaborate with policymakers. The reason is, on the one hand, the tight timeline of research projects, which is often too short to include collaborative activities. On the other hand, researchers have several other responsibilities, ranging from publishing, research administration and management, to lecturing and mentoring. If science-policy interaction is not part of the job description of researchers or their performance evaluation, their time allowance for such activities is often limited. *"You've got your teaching to do. You've got your research to do, students to supervise, papers to write, the admin to do what's associated with that, making that time to go out and talk to the school kids, to meet with the decision makers, and build connections with businesses. You got to put the time into that."*

Policymakers and practitioners also suffer from the scarcity of time. They often do not have enough time to synthesise data and information which are available or to digest scientific papers which are published. They also often lack time to participate in workshops at remote locations. Reasons are partly due to structural problems. Setting up science-policy processes to synthesise knowledge requires sufficient time, while decisions must often be made in a shorter time frame, as the following quote shows: *"From the Commission side, we cannot always launch studies which are bulky in a way, they're slow in their process in setting up. It always takes almost a year to get something launched."*

This category was mentioned together with 'Reliability', 'Institutional support', 'Competencies to co-produce knowledge', and 'Diverse values and worldviews'.

In sum, the capacity need related to 'Personal time management' refers to the limited working time individuals can devote to collaboration at the science-policy interface. Due to scarcity of time, collaborative processes might lack deeper engagement (especially of non-usual stakeholders) and might induce that science-policy collaborations are less reliable. While the lack of time often stems from institutional constraints (i.e., institutional rigidity or lack of rewarding structures), it can also be the result of individual prioritization which is rooted in social norms, values and worldviews.

4.2.6. Transparent decision making

Policy decision making is multifaceted, there are only a few points where different forms of knowledge can be channelled into the process, and even in these intervention points there are many other actors and factors that

influence the decision. These influences are hard to realise for those who are outsiders to the policy process, as the following quote highlights: *"Things can move fast, and there's what you see officially and hear officially. But then there's all the subtexts and currents and politically sensitive discussions that are kind of hidden away sometimes."* Therefore, the need for making decisions more transparent becomes apparent. The interview analysis highlighted two main dimensions of this need.

On the one hand, the multifaceted nature of policy decision making can be traced back to structural conditions, that is, to trade-offs between different social priorities (and also to related vested interests). Diverse actors try to intervene in the policy process based on their knowledge, opinion, or sectorial interests, and these interventions are often in contradiction with each other. This leads to polarization and makes policy integration challenging (i.e., trade-offs and conflicts must be managed). Complexity of decision making is further increased by the fact that existing legislation and strategic documents are often interpreted differently by different actors during the implementation phase. Therefore, initiating substantial policy changes is easier if alliances are built and public opinion is also in favour of the reform, as highlighted by one of our interviewees: *"It's not enough to just go to political decision makers and ask them to change this or that legislation, without having shifted public opinion in our backs and showcasing examples that have actually demonstrated the additional value of healthy fresh waters rather than degraded and exploited ones."*

On the other hand, the complexity of decision making is partly rooted in the internal structures and processes of policymaking. Most policy units are hierarchically structured across several layers, and information flow between them is often incomplete. Scientific knowledge can be more easily channelled into the lower levels, but decision-making power lies in the higher levels, and it is often unclear how information flows and decisions are taken across these levels, as the following quote proves: *"When you're looking at how a committee makes a decision, it isn't necessarily done in any democratic way. It's not necessarily done in any particularly rational way. It's not necessarily done in a way that you could really trace exactly how that decision happened."* Despite policy decision making is often explained as a circular, stepwise process – starting with agenda setting, followed by policy formulation, implementation, and evaluation that leads back again to agenda setting – it is very difficult to change previously made ineffective or harmful policies, because that would indicate a policy failure. *"So, if they are expected to make a decision, they can make a decision that will be very difficult to undo because going backwards is not a political movement that is the preferred one. For absolutely nobody, even us, here. So, it's very normal under pressure, if anybody's putting pressure on you, you need to do something, there is no room for - "Let's just stop this, let's stop the machine and think." - and this is not how you build solid policy. "*

This category was mentioned together with 'Reliability', 'Vested interests' and 'Eliminating research gaps'.

In conclusion, the capacity need related to Transparent decision making refers to both external conditions (trade-offs among societal priorities) and internal structures and processes which makes policy decision making complicated and sometimes trapped in power battles, leaving a relatively small room for scientific information to be channelled in. It primarily entails organizational capacities instead of individual capacities, and therefore can be managed through institutional reforms rather than trainings or other typical forms of capacity development.

4.2.7. Vested interests

Vested interests emerged in several interviews as an important factor limiting the effective function of biodiversity science-policy interfaces. This category refers to lobbying and coalition building, and its consequence, the prioritization of private interests over societal goals. It is associated with power imbalance and the dominance of certain actors over the policy process.

Vested interests were mentioned mainly by scientists and NGO representatives as an important reason for the low biodiversity ambitions and the lack of political will to preserve nature through stronger legislation. Both economic and policy actors were considered to underrate the significance of biodiversity to short term economic gains. Examples were shared from the agricultural and the energy sector, which underlined that biodiversity conservation is often seen by economic actors as a direct threat to their economic profitability. For instance: *"They can be advocates, they can be leaders, they can deliver genuine positive impacts on the ground, but they can also be very resistant and potentially even being a threat to the political process, because they have strong lobby groups, and*

they particularly use things like food security as an argument." Due to intertwined interests and institutional lock-ins, these arguments are sometimes taken up by politicians and communicated more widely as a limiting factor to development and societal well-being. In such cases, knowledge gaps are often referred to as a key gap but used only as an excuse to delay policy decision-making. As the following quote highlights: *"It's true, we have data gaps, and we need more data. But sometimes what we've also seen is asking for more research or for filling more data gaps. Sometimes it's just a tactic, you know, to delay it. I think the case for action is very strong."*

This category was mentioned together with the 'Transparent decision making' and with 'Reliability'.

It is important to note that while this was a capacity need mentioned by respondents relatively frequently, it refers to the general socio-political and economic context (including institutional structures and underlying worldviews and values) and therefore goes beyond the concept of capacity development. Systemwide transformative change – i.e., political re-organization and struggle – is required to break-down vested interests. Capacity development might be able to contribute to such a change but only indirectly (i.e., through improving competences to co-produce knowledge or bringing closer different attitudes and mindsets).

4.2.8. Inter- and transdisciplinarity

The capacity need category of 'Inter- and transdisciplinarity' underscores the challenges arising from silo thinking, fragmented and specialized approaches to knowledge production and decision-making. Silo thinking manifests in various forms, hindering holistic perspectives, inter- and transdisciplinary collaboration, and the integration of diverse knowledge domains.

One aspect of this is the pressure on scientists to specialize excessively, often at the cost of developing a comprehensive understanding of their field's interconnectedness with others. Career advancement encourages deep specialization, limiting the ability to communicate effectively across disciplines and hindering the development of a cross-disciplinary common language. The specialization of scientists is identified as a barrier to transformative change, as experts with highly specific knowledge find it challenging to adopt a broader, integrated approach: *"And of course, if your knowledge is specialized and your area of work is specialized, then it's difficult to really have an integrated approach in your policy and it becomes more difficult to interdisciplinary work."* This lack of an integrated approach is also linked to a scarcity of ecological knowledge among policymakers, highlighting the disconnect between specialized knowledge and broader environmental priorities.

There is also a lack of synergies and cooperation both within and across disciplines, emphasizing the necessity to build bridges between specialized fields and avoid duplications: *"there is really a need to streamline a little bit and avoid duplications and overlaps and try to build synergies and cooperation rather than adding to the landscape."* The fragmented approach to policy formulation and implementation hinders the focus on the broader picture and the incorporation of a systems perspective. Additionally, science education is identified as a contributor to silo thinking, emphasizing the need for trans- and interdisciplinary training and education in decision-making.

The gap in understanding and collaboration between different Directorates-General (DGs) within policy sectors, such as environment, energy, transport, and climate, is also an example for silo thinking. The need for better integration and communication among these DGs is crucial for developing comprehensive policies that address ecological implications across sectors.

This capacity need was mostly mentioned in relation to the categories of inclusion and diverse values and worldviews.

In conclusion, addressing this capacity need requires a paradigm shift towards fostering inter- and transdisciplinary collaboration, knowledge integration, and a systems-thinking mindset. Overcoming the challenges posed by silo thinking is essential for the effective functioning of SPSIs, ensuring that policies are informed by comprehensive, interconnected knowledge, and facilitating transformative change in response to complex global challenges.

4.2.9. Reliability

The category of 'Reliability' refers to needs in ensuring that published data and results are reliable and not manipulated to reflect private interests, which is associated with the (in)dependence of scientific research both

financially and institutionally. Reliability was also mentioned by interviewees when they referred to the neutral position of scientists, i.e., the need to share unbiased and objective facts instead of opinion.

While mandating research projects by policy or business actors can be seen as a way to increase the relevance of scientific findings, it can also create dependent situations, where the research process gets influenced by the expectations of the actor who commissioned the project, and as a result it can contribute to reduced reliability of results. Several respondents mentioned examples where, due to the involvement of private companies or NGOs in the research, it was unsure if published data and knowledge was impartial or only information favourable to these actors was published. According to these examples, bias can emerge at several actors: research funded by public companies can advocate for the company's interest, research by NGOs can skew towards environmental values and advocate against private companies, while data collection by EU member states can obscure enforcement gaps if a member state would like to avoid negative consequences. These examples often referred to a connection between the categories of 'Reliability' and 'Vested interests', and raises the question of how to differentiate between one's agenda and real research need*? "Well, I think first the funded research.... It's often privately funded. So, it's not maybe with the intention of long-term sustainable vision rather than making money on a short term and being extractive rather than looking for regenerative practices to safeguard planet and future generations. That's not often their number one priority. So that's a part, the funding of research, that we should really look in. Long term research that serves long term goals of society and sustainability."*

The source of the biases mentioned above can be twofold. On one hand, it is possible that the whole research project is manipulated either by mistake or consciously (e.g. by using unreliable methods to collect data or selecting a biased sample). On the other hand, it might happen that the research process was robust, but only those end results are published and made accessible which are favourable to the actor who commissioned the project. Both failures can be traced back to the lack of transparency on how data was generated.

While interviews highlighted several real examples of needs in relation to reliability, we could also observe some stereotypes. For instance, some interviewees representing the private sector complained about their experience that their research results are not trusted by other actors of the SPSI. This was reinforced by some general statements which suggested that privately funded research is skewed towards private interests. This aspect creates a link between the categories of 'Reliability' and 'Diverse values and worldviews' as the following quote shows: *"(...) [W]e belong to a regulated sector. So, we can't just do what we want, we have to comply with very strict regulations. There is this sort of belief that we will be hiding things which isn't true again anymore. We were not hiding things before, but now that processes are open, anybody can consult them anyway. There is this idea that we are not... our role is not to deliver scientific messages. That's for universities. That's for academia to do so. "*

Reliability was also mentioned in relation to the trustworthiness and objectivity of scientists, however, there was no consensus found in the interviews. While some emphasised that scientists should stay neutral at the SPSI and strive for objective, hard facts, others emphasised that no objective science exists as such, and that scientists should rather be transparent about their value commitments. This debate leads us back to the roles of scientists at the SPSI as defined by Roger Pielke, i.e., whether scientists take the role of honest brokers or issue advocates, as the following quote highlights: *"When we get older scientists to engage in our processes, they've got to a stage in life where they want to give back, and they want to advocate particularly in the environmental space. And they're actually stretching the science where it should not be going. And so they're making claims about how many people are going to die or how many species will be lost or whatever else that are not founded on science."*

As a potential solution, interviewees suggested that scientific investigations should support alternative narratives, i.e., instead of showing one major interpretation of the data collected, various interpretations and viewpoints could be shared, highlighting contradictions between those. Open data policy was also mentioned as an important step forward.

4.2.10. Institutional support

The category of institutional support refers to the need to eliminate several factors that hinder different actors' participation in SPSIs and make collaboration more difficult, such as lack of rewarding structures, lack of human

resources and organizational capacities, or high level of bureaucracy. This category is often reinforced by the 'Funding' and the 'Personal time management' categories and can impede 'Inclusion'.

Several respondents highlighted that organizational structures and processes are not supportive and provide little motivation or reward to participate actively in SPSI processes. Science-policy work is often not recognized as part of scientists' job description and is not accountable in performance measurement. *"There's very little credit given in academia for this impact stuff. We all talk about it, but actually you look at the promotions, it's all about what papers have you published and what grants did you get in and what's your teaching profile. There's a tiny proportion that goes to making a difference in the real-world stuff."*

This goes hand-in-hand with the lack of long-term commitments, clear mandates, and available human resources. Several interviews mentioned that in both scientific and policy-oriented organizations there is no personnel available with suitable expertise and sufficient working time, and therefore relevant organizations are often not represented in science-policy interactions. *"This is something which is valid for all policies. Don't believe that because you are putting a new policy you will get 20 more people today to deal with this policy. We are working in the quite frozen framework. It's extremely difficult to say: OK, we have a priority."* If sufficient capacities would be available, one respondent would even consider the SPSI as non-relevant (if knowledge synthesis could be done in-house).

For business and societal actors, lack of sufficient organizational capacities was mentioned, especially at smaller organizations and organizations based in Eastern European countries. Due to high opportunity costs (benefits sacrificed), they have limited capacity to participate in SPSI processes if funding is not provided for them. Their lack of resources also limits their capacities to be the engine (or at least part) of transformative change.

Finally, interviews also highlighted that bureaucracy in scientific and policy organizations is present at all levels of decision making (from EU to national and local). Bureaucracy slows down SPSI processes and hinder flexible adaptation.

4.2.11. Complexity

The capacity need category 'Complexity' refers to the challenges arising from the complex and uncertain nature of scientific research and of natural processes and the difficulty of translating complexity into actionable policy recommendations. This category encompasses a range of issues that underscore the need for improved understanding, integration, and communication of complex scientific concepts within the policymaking process.

A fundamental challenge is policymakers' need to better understand uncertainty, including the different types and levels of uncertainty and confidence inherent in scientific research: *"So I think it's important for policymakers to understand that science is complex, and these topics and nature especially are incredibly complex."* Bridging this gap is essential for informed decision-making, acknowledging the deep-rooted complexities of scientific and other types of knowledge.

Ecological approaches and ecosystem management, while often more nuanced and context-specific, pose challenges in terms of explanation and generalization: *"I think that's one reason that it's hard to translate ecological research to directly to policy is because of that nuance and that variation and that complexity in the natural world."* Bridging this gap involves finding ways to communicate the technical intricacies of ecological approaches in a manner that is accessible and understandable for policymakers and the broader public. The application of the precautionary principle in policymaking is highlighted as an area of concern, emphasizing the need for policymakers to consider the potential risks and uncertainties associated with complex scientific issues.

The segmentation of policy and society, marked by excessive specialization, is identified as a barrier to addressing the interconnectedness of climate and biodiversity with various aspects of life. Bridging this divide requires a holistic approach that recognizes the interdependence of these issues with other societal and policy domains.

Finally, the lack of systems thinking among decision-makers and business leaders is identified as a critical issue: *"And it's very hard for us, for everybody to have a complex thinking mode, that is to accept that you can't talk about climate change without talking about biodiversity, without talking about inequalities in the world, without talking about how we produce, how we consume. […] And then you think, "how can I act"?* This is so big, so systemic that I

can't act. So how do you train decision makers in business and politics to really grasp the broader picture and still be able to act? And maybe there's something lacking there." Overcoming reductionist thinking and understanding the broader picture without losing the ability to act requires training and a shift in mindset towards a more holistic and interconnected perspective.

This capacity need was mostly mentioned together with the gap in communication.

In conclusion, addressing the complexity capacity need necessitates fostering a deeper understanding of scientific intricacies, enhancing policymakers' capacity to navigate uncertainty, and promoting a holistic, systems thinking approach. Embracing complexity within SPSIs is vital for developing robust, evidence-based policies that effectively address the interconnected challenges of climate, biodiversity, and broader societal concerns.

4.2.12. Harmonized timelines

The category 'Harmonized timelines' highlights the need to overcome the temporal challenges that hinder effective collaboration and knowledge translation between science, policy and other societal actors. The various dimensions of this gap underscore the need for synchronization, flexibility, and better integration of time frames to ensure that timely, quality knowledge informs policy decisions.

A significant aspect of this time misalignment arises from the discrepancy between the policy cycle and the scientific process. Quality scientific research takes time to conduct, and thus the results often emerge after policy decisions have been made, rendering them irrelevant for immediate application: *"To bring it back to Horizon 2020 and post Horizon projects that there was also the comment I heard from a colleague at DG Environment that by the time the EU comes up with Horizon project call for proposals, it is far too late. And by the time the projects are finishing and delivering the results, policy moved on. And that is what they are struggling with as well."* This mismatch in time frames is exacerbated by the duration of HORIZON projects, which delay the publication of results that could inform policy decisions in a more timely manner. More flexible and adaptive research designs would be needed: "*How to design research in a more flexible and adaptable way that you can really take into account feedback and the reality of the situation as opposed to we write a proposal two years before we start the project, and then we wait two years and we get the funding, and then we conduct the project for five years, and now we have seven years of a gap between what we propose and what we're actually doing."*

Another manifestation of time misalignment involves the inflexibility of policy processes, which fail to adjust timelines to accommodate the complexities and time requirements of quality scientific research. Policymakers' immediate need for knowledge contrasts with the time-consuming nature of scientific research, creating challenges in delivering timely and relevant information. This lack of synchronization hinders the integration of up-to-date scientific knowledge into policy formulation.

The short-term nature of academic projects, geared toward advancing science within limited time frames, adds another layer to the challenge, emphasizing the need for longer-term perspectives in research and policy development: *"in academia there's a focus more on innovation in the sense that you want to advance science. That's often based on rather short-term projects of PhD projects and postdocs. So, projects of only a few years, whereas of course a few years is not very meaningful in terms of biodiversity change."*

In the interactions between science and practice, researchers often find themselves constrained by the need to align their research with specific industry cycles, such as farming cycles. Thus, it is important for scientists to time their research accordingly.

This capacity need was mostly mentioned in relation to the need for institutional support, specifically to overcome bureaucracy.

In conclusion, addressing the capacity need of harmonized timelines requires a more nuanced and flexible approach in aligning the timelines of scientific research, policy formulation, and industry cycles. Fostering better communication, understanding, and collaboration between scientists and policymakers can help overcome the temporal challenges inherent in SPSIs, ensuring that timely and relevant knowledge informs evidence-based policy decisions.

4.2.13. Competences to co-produce knowledge

This category refers to weak capacities of scientific, policy, practice and societal actors to take an active part in knowledge co-production processes. According to interviews, this gap can be observed both at the level of individual skills and organizational capacities.

Regarding individual capacities, co-production requires inner motivation to collaborate as well as social skills, i.e., the ability of connecting to others and building relationships. Several interviews highlighted the importance of greater openness and skills of listening to others, as the following quote shows: *"Because real co-production requires a willingness to listen to stakeholders and allow their voice to actually change what you're doing. If you do real co-production, stakeholders have to be there to make decisions with you. And that decision might be actually: No, your idea sucks. I don't want to use that output you're creating. It's completely wrong. I need something else."* Listening and openness is also closely linked to the ability to act proactively and be flexible and adaptive in changing circumstances, which can be considered both as an individual and organizational capacity.

Individual capacities associated with knowledge co-production also include capacities to bridge across different knowledge domains. Interviews highlighted the importance of being able to work in inter- and transdisciplinary environments (i.e., breaking disciplinary silos, developing shared terminology, etc.), and to take part in critical discussions in a reflexive manner. If these capacity needs are fulfilled, knowledge co-production can become more inclusive (link to the category 'Inclusivity') and co-produced results can become more relevant for decision makers (link to the category 'relevance').

Regarding organizational capacities, several interviews highlighted that institutional resistance often hinders knowledge co-production. Scientific and policy organizations often have rigid structures that prohibit flexibility and responsive action. To tackle these issues, the institutional framework needs to be re-conceptualized and opportunities for stronger vertical and horizontal collaboration should be fostered. These organizational capacities for co-production are strongly interlinked with the category of 'Institutional support'.

4.2.14. Policy literacy

The capacity need associated with policy literacy refers to deficiencies in understanding the policy landscape. This gap is more prevalent for scientific actors than societal actors or practitioners. Several different aspects can be identified within this category, depending on which dimension of the policy landscape / process is not known by other stakeholders. The following quote sums up the main aspects as follows: *"So that kind of intelligence - when is the right time, towards which state should one work, and what to do - I think that's one of the key ones. (…) If you read the landscape and you start seeing those problems going to come, you just prepare for them."*

Interviews often mentioned that scientists are not aware of the timeliness of the policy process - they do not know when a new legislation gets into preparatory phase, and when a window of opportunity opens to fill in scientific knowledge. Similarly, there is often a lack of knowledge of who the main actors and their roles are, who have influence over the process, and which actor at which level of hierarchy is the best to target with scientific information. This lack of awareness can lead to certain naivety of what can be brought in the legislative process (i.e., not being aware of what are the limitations and what is a feasible policy change).

Policy illiteracy partly emerges because the European Commission and national governments are complex organizations with internal structures and working procedures not transparent for outsiders (this links to the capacity need on 'Transparent decision making'). For instance, there are established formal procedures to share knowledge and opinion at different stages of the policy process, but these opportunities are often unknown or unused by scientists and societal actors, as the following quote suggests: *"By talking with scientists outside sometimes they ask me how does the policymaking process work? How could they be involved? Sometimes scientists could be involved, for example, as external experts in these scientific studies. Or as stakeholders, because before the directive is published, there is always a consultation period where any person can comment. There is the 'Have your say' portal where [...] people can send in their comments."*

The increased transparency of the policy process, as well as trainings or guidelines can potentially help meet needs associated with policy literacy.

4.2.15. Relevance

The 'Relevance' category refers to challenges arising from the (immediate) applicability of scientific research to policy questions. It encompasses issues such as the discrepancy between the specificity of science and the practical needs of policy, the misalignment of research with the political mood, and a gap between the research focus and the actual needs of policymakers.

A significant aspect of this gap is the recognition that not all scientific knowledge is inherently relevant for policymaking: *"I think my scientific output has very little impact on how biodiversity policymaking takes place and what that could possibly trigger."* Moreover, scientists often lack the skills to make their research matter.

A critical component of the relevance gap involves the misalignment between science and people's everyday concerns. One interviewee suggested that researchers need to be attuned to the prevailing political climate, adapting their discourse to align with current political sentiments: *"we need to be aware of the political mood and to adapt our discourse to that, to the new narratives that emerge, to the concerns of the people, because if we completely ignore what people feel and what politicians exploit in turn, it becomes really, really difficult to sell".*

The gap between what policymakers need and what researchers are inclined to investigate contributes to the relevance challenge: *"so there is somewhere a gap of what is needed and what is being researched and what is being done".* Researchers may prioritize topics that align with their interests rather than addressing the specific needs of local or European administrations.

To conclude, addressing the 'Relevance' capacity need requires a holistic approach that encompasses awareness and effective communication of policy needs, adaptation to the political context, and a shift towards solution-oriented research. By tackling these challenges, SPSIs can enhance the impact of scientific knowledge on policymaking, ensuring that research is not only rigorous but also directly contributes to addressing pressing societal challenges.

4.2.16. Knowledge and data hub

The category 'Knowledge and data hub' refers to the need to overcome challenges arising from the dispersed and fragmented nature of knowledge and data. This category refers to various issues that underscore the need for improved coordination, integration, and accessibility to ensure that scientific and other domains of knowledge effectively inform decisions.

A prominent challenge within this category is the fragmentation of scientific knowledge itself, which often hinders policy impact: *"Scientific knowledge is very fragmented and dispersed. [...] It's just scattered all over the place. [...] And from my experience, policymakers [...] don't actually want the science. What they want is to know what the science is telling them."* Collected data is dispersed across various disciplines and in different formats, requiring efforts to bring together, synthesize, and communicate knowledge more effectively. Connecting ecological research with evidence from multiple scientific realms, such as social science and economics, is crucial for a comprehensive understanding that informs policymaking.

Coordination and integration challenges are further exemplified by fragmented research outputs, which can lead to duplication and a lack of coherence. Effective coordination between projects is essential to integrate research outputs and to avoid redundancy: *"This makes me smile every time, I know of at least four pollinator projects that their main output is a one stop shop for everything to do with pollinators. Well, I think the idea of a one stop shop is you only need one of them."*

Accessibility is identified as a critical issue, with a vast amount of ecological data and knowledge existing but not readily accessible to policymakers or other societal actors: *"It was also the realization of, you know, the wealth of knowledge we have out there and the limited capacity for decision-maker to take all this knowledge."* Open access to data is emphasized as a key principle, advocating for producing data that is easily accessible and usable by a wide range of stakeholders. Moreover, the complexity of scientific articles and the difficulty in summarizing them accurately hinder effective communication and utilization of scientific knowledge by policymakers and the broader public.

This capacity need is mostly interlinked with the categories of communication and eliminating research gaps.

In conclusion, addressing the knowledge and data hub capacity need requires a concerted effort to improve coordination, integration, and accessibility of scientific knowledge within SPSIs. Initiatives to streamline research outputs, enhance data accessibility, and facilitate effective communication are essential for evidence-based policy decisions. By overcoming fragmentation, SPSIs can foster a more collaborative and informed approach to addressing complex challenges in biodiversity and beyond.

4.2.17. Funding

The capacity need category of 'Funding' sheds light on the limited availability of financial resources for various stakeholders. This category highlights diverse issues that point out the need for increased funding, equitable distribution, and strategic allocation to address critical gaps in capacity.

One of the main challenges is the scarcity of financial resources available, creating a competitive environment where certain actors, including small scale practitioners, NGOs, and local authorities, can only get a limited pool of funds*: "I think the one of the difficulties that the NGOs face is that they're generally not very well funded, so they're often fighting for attention. So, you certainly see them sort of fighting against each other about what's more important rather than coming together as environmental NGOs to push a common agenda."* Small businesses face difficulties in acting sustainably due to insufficient resources: *"So sometimes they can lose if they will implement a certain strategy. And if it's a big company, it's not so dangerous. But for small enterprises, it's really a thing. So, they have to decide between acting sustainable or survive."* In the meantime, NGOs struggle to secure the necessary money to fund themselves. Local authorities find it challenging to implement EU directives due to constraints in actual resources and funds, highlighting the impact of financial limitations on effective policy implementation. Furthermore, projects co-created by stakeholder groups often face a lack of appropriate funding, hindering the establishment of a solid scientific process.

A notable manifestation of the lack of funding is the investment gap in Nature-based Solutions (NbS), primarily attributed to the private sector's limited engagement. The insufficient involvement of private entities exacerbates the challenges in implementing sustainable practices and projects.

Funding for conservation projects, particularly those focusing on river conservation or dam removal, presents a persistent challenge. Despite the existence of viable ideas, the difficulty in securing funding hampers the execution of essential projects, especially at the local level, where financial constraints are most acutely felt.

All in all, the lack of funding poses a significant impediment to the effective functioning of SPSIs and the successful implementation of sustainable initiatives. Addressing this capacity need requires strategic efforts to secure adequate funding, promote equitable distribution, and foster collaboration among diverse stakeholders.

4.2.18. Eliminating research gaps

The 'Eliminating research gaps' category refers to the need to cover necessary research topics and eliminate difficulties arising from a lack in research. It encompasses a range of challenges that hinder the seamless integration of research into effective policymaking.

One aspect of this gap that came up several times is regarding businesses, especially small businesses. On the one hand, there is insufficient evidence available to convince businesses to invest in sustainable practices. On the other hand, in sustainability research, the focus is usually shifted towards large enterprises, leaving small businesses marginalized in the discourse: *"there is this lack of focus on businesses and in particular small businesses. [...] It's that are really focusing on big business and big impact. And then you have got small businesses which make up 98 percent of businesses in Europe".* Moreover, there is a gap in research about the actual process of how they could convert to more ecologically beneficial practices.

The prevailing emphasis on best practices rather than malpractices constitutes another facet of the research gap: *"there's really a focus in research and from the Commission and from all of these funding streams to focus on good practices and best practices. But actually, there's really the desire is what we hear all the time to have bad practices or malpractices or mistakes that have been made".* While the identification of successful strategies is crucial, understanding and mitigating malpractices is equally vital for informed policymaking.

Part of the problem is the issue of knowledge integration, particularly the lack of interdisciplinary collaboration between natural and social sciences. Technical knowledge often exists in silos, hindering the development of holistic and cross-disciplinary approaches to address complex sustainability issues.

This capacity need is most closely interlinked with the need for a knowledge and data hub.

In conclusion, the 'Eliminating research gaps' category within SPSIs underscores the need for more comprehensive, inclusive, and interdisciplinary research approaches.

To conclude this chapter, by addressing the above-mentioned needs and focusing on evidence generation, knowledge integration, and data availability, SPSIs can enhance their capacity to inform and shape sustainable policies.

4.3. Summary of the capacity development needs assessment

4.3.1. Relationships between different capacity needs

We have established a systematic framework (Fig. 8) for emerging capacity development needs, employing a categorization scheme that delineates these needs based on whether the specific capacity is contingent upon alterations in individual skills or organizational characteristics. Positioned at the bottom of this framework are its resultant products: data, knowledge, and research. Subsequently, individual skills occupy an intermediary layer (marked with lighter green), followed by the needs that are contingent upon both individual capabilities and organizational structures (marked with darker green). The azure layer encapsulates needs that necessitate changes solely through the modification of organizational structures and characteristics, while the outermost layer encompasses the overarching context within which these elements subsist — namely, vested interests that refer to the power relations, as well as the complexity inherent in the realms of science and nature itself. Though not strictly capacities, these contextual aspects have been built into the framework due to frequent mentions by experts.

Capacity development needs distributed across the five layers are often interrelated, therefore addressing them in combination might have stronger positive impact than focusing only on one specific need. For instance, 'Personal time management' can be partly addressed if tasks and responsibilities are re-prioritized at the personal level through a mindset change, but to address the systemic roots of the problem, institutional capacities should also be improved to combat 'Institutional support' and to overcome 'Funding' issues. Similarly, improving 'Competencies to co-produce knowledge' can help address 'Diverse values and worldviews' but only if 'Inclusion' is promoted and safe inclusive spaces are established to 'Bring people together'. However, if 'Vested interests' are not addressed at all, simply offering more opportunities to 'Bring people together' will not lead to better 'Inclusion' but only to the reproduction of power asymmetries.

In conclusion, addressing interrelated needs which are dispersed across several layers offers the opportunity of triggering system-wide transformations, because it allows personal, organizational, and contextual barriers to be targeted in a concerted way, and it induces synergistic change in multiple levels at the same time. From the perspective of the Science Service, it is therefore worth thinking about which combination of capacity development needs it can target that cut across several layers. This system could even be a tool to weigh up the needs and understand which are the capacities that the Science Service can improve, and which are outside its scope.

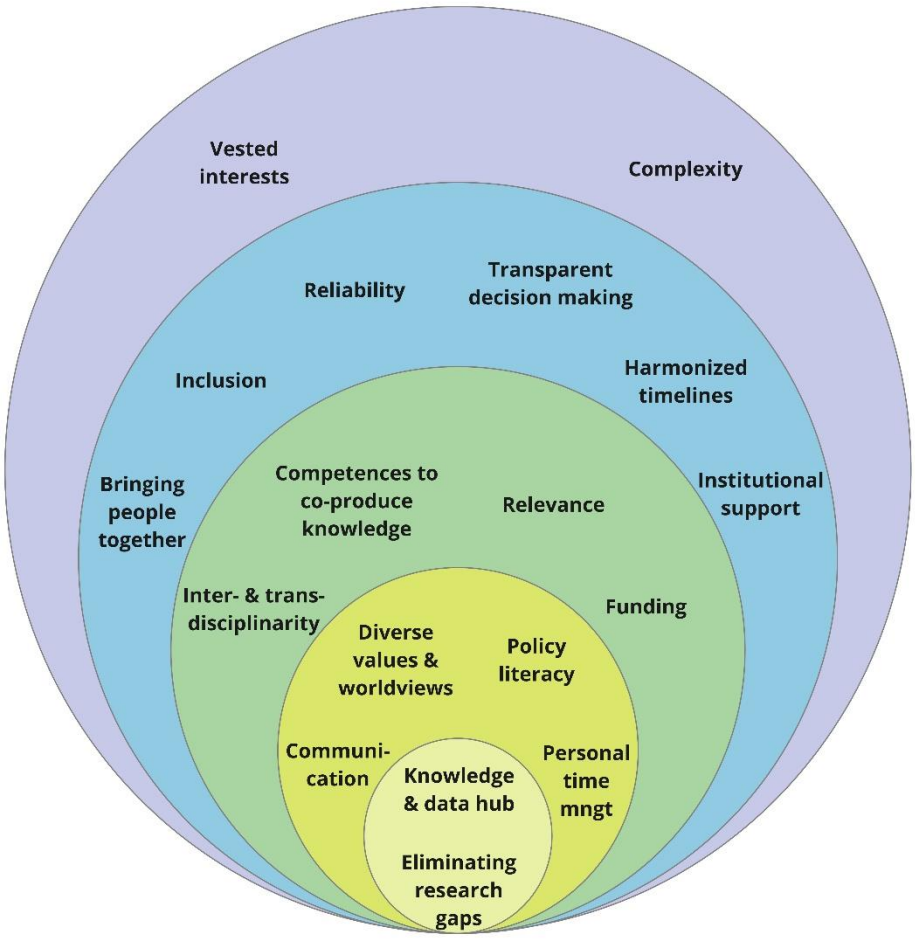

Figure 8 A systematic framework of emerging capacity development needs

4.3.2. Capacity development needs of different actors

During the interview analysis we also coded which type(s) of actors (science, policy, business/practitioners, societal actors or the media) were connected to the capacity needs mentioned, or in other words, which types of capacities were mentioned as lacking for the different actors. Capacity needs were often linked to more than one actor. Out of the 290 individual needs mentioned, 195 needs were attributed to scientific actors and 168 to policy actors, but only 63 to business actors and practitioners, 58 to societal actors (incl. NGOs, indigenous and local communities etc.), and 11 to the media. The skewed distribution of needs among different actor groups might reflect the overall assumption of interviewees that the main actors of SPSIs should be scientists and policy makers. However, it can also be traced back to the fact that most of our respondents had a scientific background, so they were more familiar with needs in their own sphere than with the needs of other actors. Figures 9-12 highlight the differences among the actor groups (in the figure media was included among societal actors).

As the figures show, 'Communication' and 'Bringing people together' were similarly relevant for the scientific and the policy community, and 'Inclusion' was almost similarly relevant for science, policy and society, The 'Diverse values and worldviews' category were mentioned for all four actor groups in nearly equal frequency (science: 11, policy: 12, business and practitioners: 7, societal actors: 11), but due to much fewer needs attributed to business/practice and societal actors, ' Diverse values and worldviews' came out as a more central category for them.

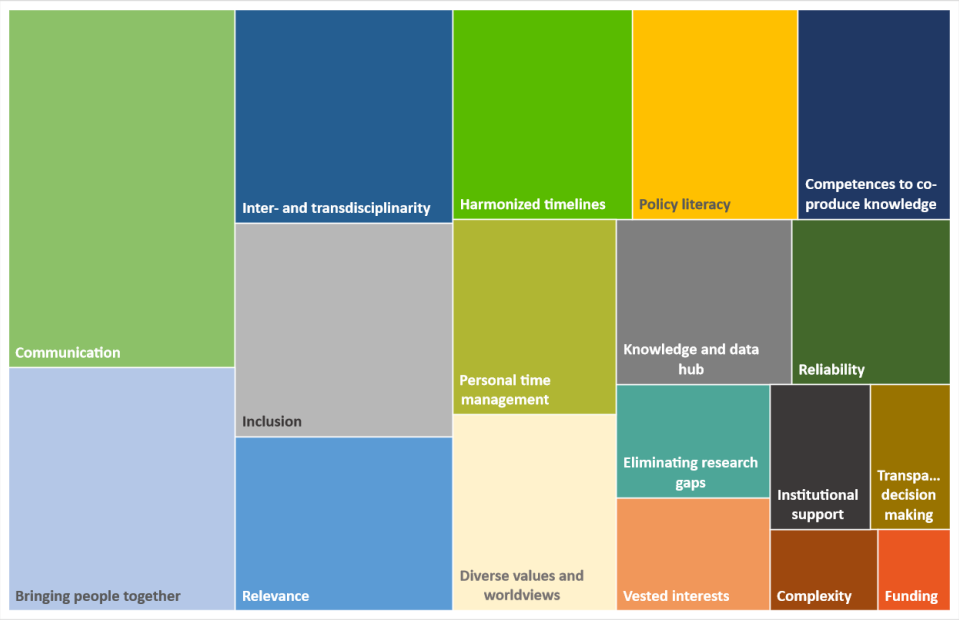

Figure 9 Scientific actors' capacity needs

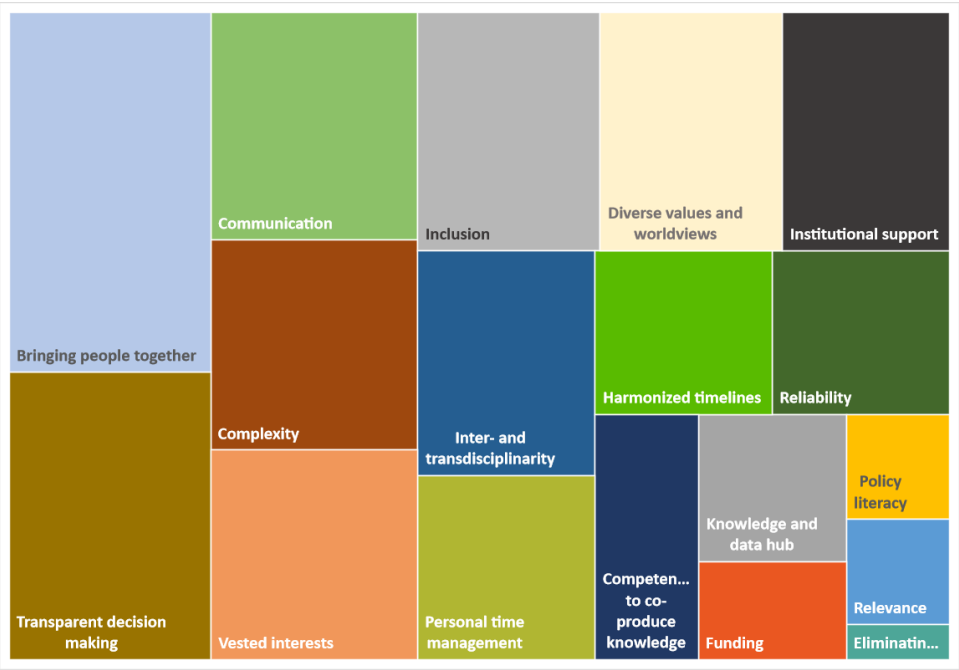

Figure 10 Policy actors' capacity needs

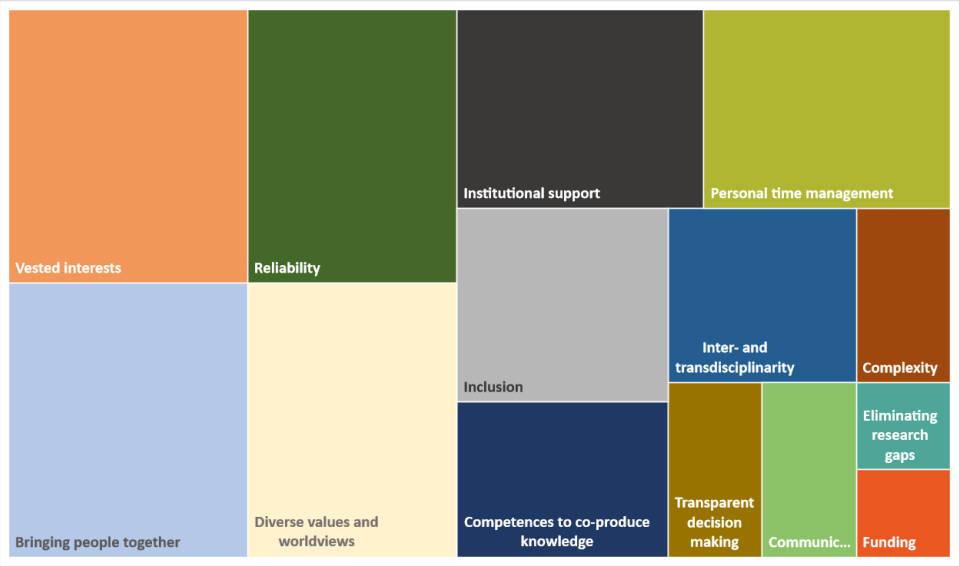

Figure 11 Business actors' and practitioners' capacity needs

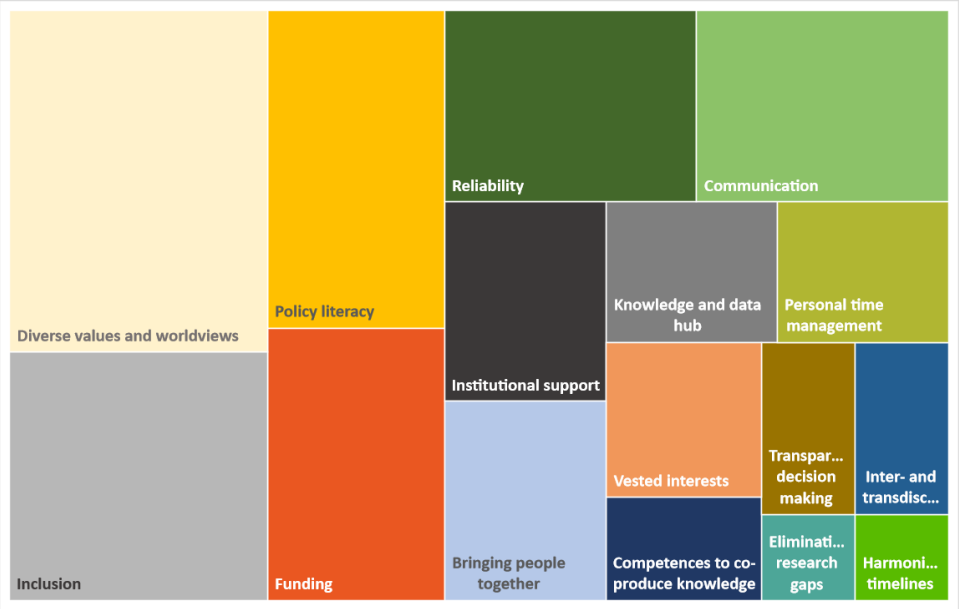

Figure 12 Societal actors' capacity needs

The most prominent differences among the actor groups include the 'Transparent decision making' which was among the most frequent needs for policy actors; the 'Vested interests' which was often attributed to policy and to business actors; and the 'Funding' which was highly relevant for societal actors.

The persona workshop, organized as part of the BioAgora annual meeting in Leipzig, was used to further think about the capacity needs of different actors and to delineate the main target groups of BioAgora, as well as to brainstorm about what BioAgora and the future Science Service could offer to meet the existing needs. While the capacity needs connected to the fictive characters were mostly the same as the ones identified from the interviews (e.g. personal time management or financial resources, institutional support, insufficient communication skills), the major barrier emphasised by workshop participants was the fact that the structure and the processes of the future Science Service are still unclear, so potential target groups cannot decide whether this platform could provide them benefits or not. The fictive characters were created to represent different stakeholder groups and different demonstration cases, providing the opportunity to corroborate the existence of actor-specific needs through our analysis. Nevertheless, we could not observe any specific patterns in the persona profiles – no major differences of

capacity needs could be identified across DCs, across stakeholder types, or across different regions of Europe. What seemed to be more important was the social position and the institutional background of the fictive characters (e.g. early career researchers were assumed to lack financial resources, or business representatives were assumed to have difficulties with understanding the scientific jargon).

Regarding opportunities the future Science Service could offer to fill capacity needs, four main ideas emerged. First and most importantly, workshop participants considered networking opportunities to be a crucial form of capacity development. Through longer term engagement and improved personal connections different SPSI actors (who are often alone in their organizations in terms of the scope of their work) can be better embedded and even provide mentoring or other types of support to each other. This approach helps bring people together, improves inclusion, and can contribute to a change of mindsets and attitudes. The second most frequently mentioned option was to provide thematic training opportunities and workshops to SPSI actors, related to topics of the demonstration cases. While this is a more conventional approach to capacity development, this option was considered useful to fill still existing knowledge gaps, but also to share the outputs generated by the Science Service, and therefore it can serve the purpose of community building and engagement. The third most frequent capacity development opportunity was related to the general understanding of how SPSIs – and more specifically the Science Service – works. In-person trainings and workshops, as well as an easily accessible and user-friendly web platform were suggested as the best ways to enable SPSI actors to better navigate across complex institutional structures and processes. Such opportunities can increase policy literacy and can also help to better manage expectations towards the different actors. The fourth opportunity focused on the engagement of early career scientists and societal actors and highlighted that stipends or small funds could be used to enable the participation of actors who operate with limited resources.

Finally, the last part of the persona workshop allowed us to delineate the main target groups of BioAgora capacity development by asking workshop participants to place their fictive character on a scale ranging from very relevant to absolutely not relevant stakeholders. According to this closing exercise, the most relevant target groups are policymakers and scientists, followed by business actors and practitioners. Small, innovative startups on sustainability were considered more relevant for the SSBD, than large scale businesses having a direct negative impact on biodiversity (such as the fictive character of a CEO operating fishing trawls). Societal actors (incl. indigenous and local communities, citizen scientists, or the media) were usually placed to the least relevant end of the spectrum. Also, hypothetical actors who had a conflicting agenda (e.g. a Saami fisherman fighting for fishing rights on a protected river, or an investigative journalist) were considered less relevant for BioAgora.

5. Capacity development opportunities

5.1. What is out there currently

As part of our work in T5.1, we created a table of existing capacity development initiatives. This table includes examples of general as well as DC-specific capacity development efforts. While this compilation is not exhaustive or systematic and is meant to function as a living document, which can be continuously updated, there are some general observations that can be drawn from it, and which may be useful for planning future capacity development efforts in the Science Service.

All together, we compiled 35 general capacity development initiatives at the global and EU level, and 150 DC-related capacity development efforts at the EU level. Of the 150 DC-related initiatives, 93 came from urban Nature-based Solutions, 39 from Freshwater, and 38 from Pollination (some capacity development efforts overlapped and could be linked to more than one DC). The overrepresentation of NbS-related initiatives is rather clear and reflects the general imbalance of European funding towards some areas over others. Resources devoted to Horizon and other projects in certain fields can significantly impact the availability of capacity development tools in that area. A short analysis of all DC-related initiatives can be found under the Capacity development needs in topical areas chapter.

The target groups of these capacity development initiatives are not always (well) defined. In certain cases, the target group is so broad that it may hinder the accurate assessment of the target group's needs and the effective tailoring of the initiative. For instance, one NbS initiative defines its target group as follows: *"decision-makers in public and private organizations; professionals who may not be familiar with EbA [Ecosystem-based Actions] but who work in a related field (development, infrastructure, agriculture, integrated water resources management); civil society organizations; actors at community, national, and global scales; early-career EbA professionals, current students, and university faculty; and EbA practitioners from both the Global North and Global South."* The most common target groups of capacity development initiatives include 'citizens' and a blanket category we called 'anyone interested'. For co-production to take place at the SPSI, it is essential that there are more tailored approaches, aiming to tackle concrete issues faced by the science or policy community rather than simply disseminating information on environmental issues and solutions through webinars or online courses. It is important to recognize that not all stakeholders benefit from the same capacity development strategies and that engagement with different actors will necessitate tailored efforts.

Current capacity development initiatives at the EU and global level predominantly leverage online tools such as webinars and Massive Open Online Courses (MOOCs), providing accessible and flexible learning opportunities. Resources also include guides, case studies, handbooks, technical and policy briefs, alongside curated databases for comprehensive knowledge dissemination. While occasional workshops and networking events are held, they are often tied to specific projects and usually end with them as well. Moreover, there is a limited presence of more immersive practices such as summer schools, study trips, living labs, and communities of practice, suggesting a potential gap in more engaging learning methodologies.

The survey conducted with scientists included a question on preferred capacity development modalities, which gives us the opportunity to compare the demand towards capacity development opportunities with the actual supply explained above. As we can see in Fig.13, online materials (including handbooks, MOOCs, webinars) are less preferred formats, although more prevalent. On the other hand, different types of face-to-face interaction, inviting not just scientists but other actors of the SPSI were rated more relevant, although relatively few examples were found for these modalities.

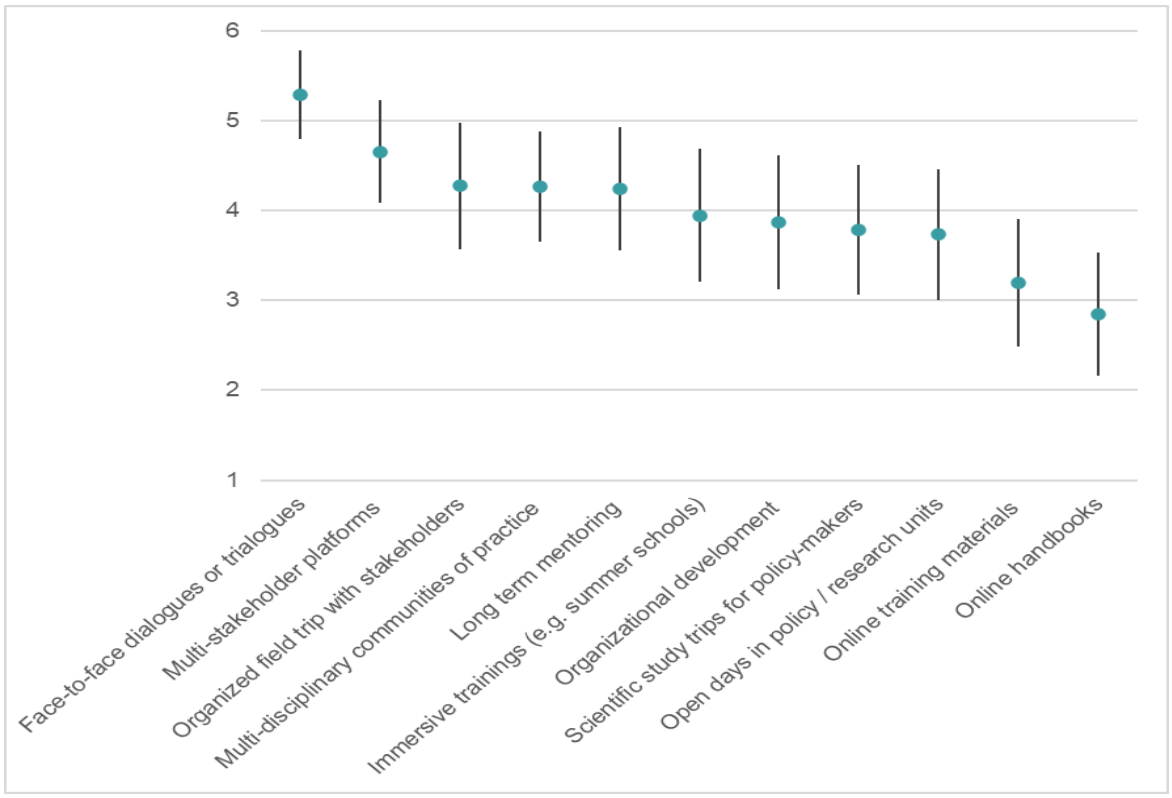

Figure 13 Preferences towards different types of capacity development based on the Alternet survey. Respondents assessed the listed capacity development options on a scale of 1-6 (1=not relevant, 6=highly relevant). Blue dots indicate the average scores while the black lines indicate standard deviation.

5.2. Best practice case studies

In this subsection, we explain five capacity development initiatives (Table 2) which were selected from the longer list of available capacity development options to showcase different modalities which proved to be successful (i.e., these examples were either highlighted by interviewed experts or were analysed in detail in peer reviewed publications). All five cases have been running for several years and have trained a wide range of actors; however, they apply different approaches and target different key players of the SPSI (mostly different types of researchers but some of them also policy makers and administrators). Despite these differences, the showcased examples are still focused more on the research domain than on policy, society or business. A truly inclusive SPSI, which is fully open towards non-scientific stakeholders, might therefore need other types of capacity development tools or more innovative approaches to respond to specific needs of societal or business actors.

Table 2 Five best practice case studies on capacity development

Name	Target group	Expected outcome	Format	Targeted capacity needs
Alternet summer schools	Early career researchers and experts	"Network for life" of open-minded researchers	10 days long interactive, remote summer school	General SPSI skills
CIHEAM advanced courses	Professionals with MSc or PhD incl. policymakers	Better informed decision makers and implementers	1-2 weeks long in-person training, sharing topical, applied knowledge	Knowledge, expertise and methods related to specific topics
Earth Leadership Program	Mid-career researchers	Researchers as change agents	Combined retreats, personal reflection and mentoring over years (currently inactive)	General SPSI skills and entrepreneurial capacities
IPBES Fellowship program	Early career researchers	Researchers with improved SPSI skills and policy literacy	Trainings, networking opportunities and mentoring over years	General SPSI skills
JRC Evidence for Policy programme	Researchers and policymakers at any career stage (separate courses)	Improved skills and reformed institutions for evidence-based policymaking	Varied formats (short to long term, in-person, online or project-based), organized by JRC or trained trainers	General SPSI skills (but sometimes topically centred)

5.2.1. Alternet summer school

Can a ten-day summer school programme be meaningfully transformative? For close to two decades, the Alternet Summer School has brought students together in a small village in the South of France *to "address the challenges of biodiversity conservation following transdisciplinary and systemic approaches"* (van Dijk et al. 2012).

The Alternet Summer School is held annually in Peyresq, a remote mountain village in the Alpes de Haute Provence. The summer school programme focuses on the challenge of biodiversity management and conservation by exploring drivers of biodiversity loss, and the role of ecological knowledge and social science approaches. Debate on the potential of concepts such as valuation and nature's contributions to people is facilitated and the ways in which various initiatives at the science-policy interface embrace these concepts for decision-making are explored. Interdisciplinary and transdisciplinary approaches and stakeholder interactions are central focuses of the programme.

The programme of activities includes:

- Morning talks and discussion with 20 invited speakers; aperitif talks prior to dinner
- Afternoon group work on a mutual learning project about the local social-ecological system and its possible futures
- Field trips to the mountain pastures used by local shepherds and the Parc National du Mercantour
- Free time in the evenings for leisure and further discussion

The summer school is open to graduate students, post-graduate scientists and professionals from environmental and social science fields with an interest in sustainability science.

All participants are expected to actively contribute to all aspects of the summer school, and many go on to collaborate in capacity development beyond the summer school, engage in alumni initiatives and events, and contribute to future summer schools as tutors or speakers.

Taking seriously and literally the motto of the Alternet Summer School as a "network for life", a self-organised consortium of Alternet Summer School Alumni (mostly comprised of students from the 2021 programme) formed in 2021 to conduct research on the potential of transdisciplinary science education for fostering transformative change and increased biodiversity conservation. Their article, published in a special issue of Biodiversity and Conservation, used the authors' own experiences in Peyresq as a case study. The conclusions of their research (see:

"What could BioAgora learn…") carry recommendations of high value and relevance to those considering best practices for capacity development initiatives.

Strengths and weaknesses

Impact pathways of the summer school were also identified; these were gleaned from the input of participants and organisers. Impact pathways supported transformative change on three main levels: personal, research, and societal. On the personal level, the Alternet Summer School was demonstrated to spark a shift in values and inspire reassessment of the participants' positioning in society. On the research level, the programme enabled and encouraged transdisciplinary research, along with open, collective questioning about the role of science in society. On the societal level, the summer school "*stimulated the creation of a shared vision for a sustainable future, which can foster transformative change"* (Casas et al., 2023) By shifting values, perspectives, and approaches, the summer school programme holds the potential for an immediate, direct impact on biodiversity conservation (by shifting individual actions and habits) and a longer-term impact (by supporting more effective research methods and priorities).

The Alternet Summer School is generally limited to approximately 30 students per year, and, as such, its impact is necessarily limited. Cost (€1000 fee with scholarships covering 50% of total cost available for up to five students from developing nations) is also a factor limiting participation for many students. However, many elements of the school may serve as a best practices model for capacity development. Indeed, the alumni research consortium explicitly expresses their hope that the findings of its research and the example of the Alternet Summer School will inspire similar educational endeavors that foster transformative change. As stated in their conclusions, *"if more such endeavors follow, the impact will be greater."* From transdisciplinary methods and direct engagement with stakeholders to immersion in the local landscape and the radical trust-building cultivated by communal living, learning, eating, and play–the Alternet Summer School represents a model way forward for capacity development among the international community of biodiversity knowledge providers and decision makers.

What BioAgora can learn from the Alternet Summer School example

The alumni authors identified the seven most important elements of transdisciplinary learning in the Alternet Summer School programme as follows:

"(1) learning by doing, (2) fostering group processes, and (3) interdisciplinary exchanges, all of which were cultivated by the group work. Together with thought-provoking talks, this led to (4) activation of shared values and the construction of a shared vision of a sustainable future, guiding the way forward to transformative change. The key role in these processes was (5) critical self-reflection, fostered and nurtured in the safe environment of the summer school. It helped participants to (6) identify the position they want to take in society and the role they want to play in transformative change. All of this was possible through and supported by (7) the setting and spirit of the summer school, an isolated village grounded in nature and culture.

Nonetheless, there are still elements that can be improved to increase the summer school's transdisciplinarity – for example, rooting the group work even more deeply into practice with co-creation of the research together with the local stakeholders.

5.2.2. CIHEAM Advanced course

The CIHEAM (International Centre for Advanced Mediterranean Agronomic Studies) was established by the governments of 6 Mediterranean countries (Spain, Italy, France, Greece, Portugal and former Yugoslavia) in the 1960ies. Its main objective was to foster collaboration and create joint educational opportunities to cope with challenges which were rooted in the similar geographical and socio-economic context. CIHEAM offers opportunities to collaborate and build networks within the region, and to strengthen science-policy interactions in the field of agriculture and land use. It also makes it possible to represent the region in global policy processes (e.g. CIHEAM was one of the organizations representing the Mediterranean region in the last COP and it organized side events).

As a capacity development activity, CIHEAM offers supplementary education, incl. MSc courses, advanced courses for professionals, mobility programs in collaboration with the Erasmus+, ad-hoc courses focusing on a specific urgent topic, and online available open course materials. MSc and advanced courses are organized either online or in-person in one of the three training centres of CIHEAM (Bari, Montpellier or Zaragoza). Courses usually offer

practical / technical insights; however, they can also include more methodological or sometimes theoretical aspects. We will explain advanced courses in more detail because this format is relatively rare but can be highly relevant for BioAgora.

CIHEAM advanced courses advocate for life-long learning and offer capacity development for professionals with a university degree whose work experience is related to the subject matter of the course. Courses are taught by invited experts who work in research centres, universities, private firms, administrative bodies, or international organizations. Advanced courses are one or two weeks long, and usually organized in-person, at the premises of CIHEAM or its partner organizations. Courses are delivered in English, Spanish or French, and when needed, in all three languages using simultaneous interpretation.

For instance, a 1-week long course on ecosystem services valuation was held in 2022 by a team of 6 researchers coming from different organizations across Europe. The course included theoretical sessions that explained the concept of ecosystem services, methodological sessions that introduced different method families to participants, and implementation sessions that opened for discussion on how ecosystem services valuation results can be taken up in policy decisions. The sessions were accompanied by interactive exercises (e.g. situational games) through which course participants could try out their improved skills in fictive examples. Participants were coming mainly from less developed Mediterranean countries (e.g. Lebanon, Morocco) but also from other non-mediterranean European countries. Several of the participants worked at ministries, public administration institutions or similar, but early career researchers were also involved.

Advanced courses have an applied orientation, i.e., they provide actionable knowledge and improve professional skills which can be used in the daily work of the course participants. The main objective is to help Mediterranean professionals to apply the best available knowledge in their work in ministries, research or public administration organizations, or private companies.

Strengths

- Courses are focusing on topics which are highly relevant in the Mediterranean context. Some courses are fully demand driven, some are more supply driven, but the preparation process helps to tailor the course content to needs and expectations.
- Each year a wide selection of courses is offered which covers different topics.
- Advanced courses are open to professionals of different seniority, and the course structure allows for equal exchanges between them.
- Researchers who deliver a course can work in a team which leads to creative solutions and helps integrate various sources of knowledge in one course.
- A highly professional staff helps the preparation of the course, including advertisement, selection of applicants, organizing practicalities, providing interpretation etc. Researchers holding the course are paid for their time competitively.
- In most cases participants need to pay a participation fee, but course participants from less developed countries (e.g. Lebanon, Morocco) can apply to the courses at a reduced rate.

Weaknesses

- Courses are highly resource intensive; a large professional staff is needed to take care for all the organizational aspects.

What could BioAgora learn from this example?

- Governments played a crucial role in establishing and financing the activities of CIHEAM. This helps to develop demand-driven courses which are attractive to policymakers and technical staff working at governments and public administration institutions. Course calls are also actively distributed by the collaborating governments which helps reach the target audience and contributes to relatively high participation rates.

5.2.3. Future Earth's Earth Leadership Programme

The Earth Leadership Program (ELP) was established in 1999 and was run as a collaborative effort of several organizations (the Ecological Society of America, The New England Aquarium, Oregon State University, Stanford University and Future Earth). Following a recent decision of the board, the ELP is currently inactive due to changes of foundation funding preferences, university priorities and the increasing number of other available capacity development initiatives. While new cohort-based program will not be launched for a while, earlier cohorts of students are still actively collaborating and creating smaller scale capacity development initiatives (e.g., trainings at conferences). Furthermore, a wide range of resources (e.g., guidelines, training materials) targeting specific skills are freely available online at the website of the initiative.

ELP offered blended training opportunities for mid-career researchers over the course of one year (including in-person retreats, online collaborations and activities that fellows could carry out in their own organizations) with a strong focus on leadership and collaboration skills needed to co-create strategic visions and jointly solve environmental problems. As a broad objective, it aimed to contribute to behaviour, organizational and systemic change through bridging communities and catalysing action. It trained over 250 fellows over 23 years.

The training programme consisted of four main stages. It started with a multiple-day retreat where participants could self-reflect, build personalized future plans, acquire new skills, and network with each other. Training modules focused on individual leadership skills, collaboration and facilitation techniques, and systems thinking. After the initial retreat, fellows practiced their new skills in their regular working environment (i.e., by incorporating new techniques in their teaching or research practice, or by using innovative facilitation tools in their collaborative projects). During the practice phase, fellows stayed in contact and supported each other through periodic check-ins and mentoring discussions. One year after the initial training, fellows gathered again in a remote location for the closing retreat, where they could continue self-reflection, revisit their original plans, broaden their skillset and decide on how to continue their journey towards more impactful research. Finally, after the programme finished, fellows were encouraged to stay an active member of the alumni and serve as mentors to new cohorts of fellows.

Strengths

- Long term programme including both offline and online elements which helped practice the acquired skills and therefore contributed to a deeper level (double-loop) learning.
- Strong focus on individual skills and reflection: going beyond networking and knowledge sharing the ELP could initiate changes in the general approach and the everyday practice of the fellows, who – through their work – could multiplied the impacts in their own networks and communities.
- Organized in collaboration across different organizations which helped cover the costs and reach out to a diverse audience.
- The alumni continued to support the programme through mentoring and coaching new cohorts, therefore a strong and long-lasting network could be created.

Weaknesses

- Highly resource intensive both in financial terms and timewise.
- Self-selection of participants: the programme targeted researchers who, from the very beginning, were highly committed to collaborative research and were ready to step out of their comfort zone. Researchers with more mainstream mindsets could not directly benefit from the programme.

What could BioAgora learn from this example?

- The fellowship offered by the ELP shows many similarities with the Alternet summer school - can be considered as an expanded and longer-term version of retreat-like immersions. Capacity development options like this initiative could be useful to train boundary spanners – researchers and other professionals who bridge across science, policy and society and fosters collaboration and co-production of knowledge.

5.2.4. IPBES capacity development activities

The IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) aims at strengthening the science-policy interface to promote the conservation and sustainable use of biodiversity by undertaking international assessments and supporting national ones, by helping knowledge diffusion and the development of policy support tools, and by undertaking and facilitating capacity development. Its capacity development initiatives are aimed at enhancing this interface and are based on a rolling plan, elaborated by a dedicated task force, that identifies and prioritizes capacity development needs, with a focus on enhancing the capacity of effective participation of individuals and institutions involved in the platform's work. The plan is supported by a capacity development forum, which serves as a platform to enhance engagement, cooperation, and collaboration among participants to advance common agendas and facilitate longer-term strategic alignments of their ongoing capacity development programs and activities.

IPBES' capacity development activities aim first at advancing learning and engagement. This is done mainly through the organisation of dialogue meetings and workshops for IPBES national focal points, experts and stakeholders, including practitioners, to help them provide inputs at each stage of the development and review of assessments or frameworks. Another way to enhance engagement is the fellowship program, which supports outstanding early-career individuals to engage in the work of IPBES, particularly in the preparation of assessments, and attend author meetings, receive training to gain an in-depth understanding of the assessment process, and are paired with a mentor for the assessment period. This is completed by a 'training and familiarization program', which involves the organisation of webinars, oriented towards the dissemination of the findings of the IPBES assessments and the appropriation of the methods, and other online resources like guides and learning materials. These take the shape of e-learning interactive modules hosted by the UNEP-WCMC about the IPBES assessment process and conceptual framework, and a series of tutorials about data management in the form of YouTube videos.

The IPBES has also organised in-person youth workshops, with the goal to present them the work of the platform and enhance its uptake, as well as to facilitate their future engagement. The 2019 edition brought together 33 participants from 23 countries, was organised by the IPBES technical support unit on capacity development in collaboration with several research institutions and was funded by the Government of Norway. It comprised an exercise of envisioning positive futures for nature and people based on IPBES Nature Futures Framework which led to the publication of a scientific article. Both fellowship program and youth workshops aim to provide opportunities to early-career scholars from around the world to network with leading experts and contribute to significant scientific assessments, which can enhance their professional development and expertise, but also to work with a diverse group of peers and thus to foster a community of practice which will become a pool of experts suited for contributing to future assessments and promoting the work of IPBES.

The second main focus of the IPBES capacity development activities is the facilitation of access to expertise and information, by promoting the uptake of IPBES's work on policy support tools and methodologies, knowledge and data, and Indigenous and local knowledge. This involves enhancing capacity in accessing and utilizing data, fostering collaboration between research institutions and policymakers, converting scientific assessments into policymaker-friendly formats, facilitating interscientific dialogue involving diverse perspectives and multi-stakeholder engagement, particularly with Indigenous and local communities, and the use of technologies for biodiversity research.

The third focus aim at fostering national and regional capacities through collaborative initiatives, with a particular emphasis on ongoing fellowship and training programs, as well as the development of science-policy platforms and networks at the national and (sub)regional levels, to facilitate the implementation of obligations and recommendations, and strengthen the sharing of information among different knowledge systems. This is done for example through the organisation of dialogue workshop with national and (sub)regional platforms.

Strengths

- The existence of a permanent task force on capacity development and the focus on different levels and publics, ranging from the general to more specialised training modules, from online to in-person, from live

events to on-demand, short vs long activities and involvement, and an emphasis on quality support for youth, even if limited in number.

- The capacity development forum supports engagement and cooperation among partners, who are invited to meetings and to matchmaking activities with the goal to help them share their experiences and co-organise activities, but also to match identified priority needs with financial and technical resources.
- An opening to contributions from organisations to the capacity development initiatives that can be either monetary or in-kind, that is support that can be technical or financial, to IPBES or to other institutions, or an offer to undertake some activities themselves, in collaboration with IPBES, or the alignment of their activities to take more into account the goals and work of IPBES.

Weakness

- The dependence on irregular funding and dependence from the benevolence of third parties.
- Many activities require applying via nomination by national governments, which may render the process not very accessible.

What could BioAgora learn from this example?

- It is key to clearly put forward the identified needs and means of attaining them and embed the Science Service into a network of organisations which may be willing to contribute to and align with the overarching goals, so that reaching them doesn't exclusively rely on the SSBD. Clear guidelines and suggestions should be developed for how other organisations can contribute, and what type of organisation can or is expected to do so. Additionally, a variety of activities and programs should be considered depending on the target audience and goals.

5.2.5. JRC Evidence for Policy Programme

The European Commission's Joint Research Centre's (JRC) Knowledge management for policy initiative emerged in 2015 when a professionalization program was developed by JRC staff with the goal of helping both scientists and policymakers to adopt pragmatic ways to connect the demand and supply of policy-relevant knowledge (Topp et al. 2018). Originally, this program was aimed at improving skills and competences of experts working at the European Commission, but it has been extended when program organizers realized that their insights might be useful to other organizations containing researchers, policymakers, communicators, and knowledge brokers. As a result, the Knowledge for Policy (K4P) platform was launched in 2018 with six knowledge services and then broadened from year to year, offering 20 services in 2021 and launching the first online knowledge community in 2022. The future Science Service for biodiversity, being currently developed by BioAgora, will become a new service once it is fully operational.

The Evidence for Policy Programme offers capacity development in various formats, targeting both scientists (the supply side) and policymakers (the demand side) of evidence informed policymaking. All these materials have been developed on the basis of JRC's competence frameworks (Topp et al. 2018). The most relevant competencies for scientists (i.e., the science for policy competence framework) include the better understanding of policy, the competences to participate in policymaking, communication skills, engagement skills, and collaborative competencies. The most relevant competencies for policymakers (i.e., the innovative policymaking competencies) include advising as part of the policy cycle, innovation competencies, the ability to work with scientific evidence, future orientation, engagement skills, collaborative competencies and communication skills.

The online platform offers freely available online materials that can be the starting point of improving one's knowledge and competences related to science-policy interactions. Here scientists can self-assess their existing competencies, access guidebooks, listen to podcasts and watch videos on key topics of evidence-based policymaking. Online and in-person trainings are also available from time to time. These trainings can be centred on specific topics (e.g. a training was recently delivered for experts working on disaster risk management), or focus on specific regions (e.g., another training this year was open to researchers coming from the West Balkans). The JRC also developed a train-the-trainers programme to multiplicate capacity development through existing networks. This train-the-trainers programme selects teams of two people (one scientist and one more applied personnel) and trains them to be able to deliver the JRC's training for their peers. The train-the-trainers programme

goes through the whole training material over several days, so course participants will earn personal experience of how the training goes, but at the same time also acquire skills to facilitate learning and reflect on their own competencies. The programme also sets up a network of trained trainers which helps develop a growing community of practice. More recently, JRC launched a 2-years project to promote overarching reforms in the public administration and research and innovation systems in seven selected EU member states to improve evidence informed policymaking. Therefore, the Evidence for policy programme goes beyond the development of personal skills and opens towards enhancing organizational capacities.

Strengths

- A theoretically grounded competence model has been developed and used to design training materials
- Various formats are available from self-assessment tool to videos, podcasts, downloadable guidebooks and in-person trainings
- Specific materials designed for scientists and for policymakers
- There is an opportunity to join a community of practice
- Embedded into the administrative system of the EC, therefore it might help to access the most relevant target groups more easily

Weaknesses

- Scientists and policymakers are trained in separate occasions, no direct interaction between supply and demand is provided (at least not yet).
- Trainings are relatively short therefore they might have more influence on skills than on mindsets or attitudes.
- Being embedded in the structures of the JRC/EC might result in some rigidity.
- Training materials reflect the linear approach to SPSIs.

What could BioAgora learn from this example?

- As the future Science Service for biodiversity will be part of and function in close collaboration with the JRC's Knowledge Centre for Biodiversity, working together with the Evidence for policy programme could provide mutual benefits. Therefore, BioAgora should aim to establish strong links and probably develop capacity development together with the JRC.

6. Capacity development needs in topical areas

This chapter introduces capacity development needs and opportunities in DC-related topical areas, commencing with Pollination, followed by Freshwater, and concluding with urban Nature-based Solutions. Each subchapter begins with an analysis of capacity needs derived from expert interviews in the DC-related fields. Subsequently, capacity development opportunities are presented, drawing from a combination of desk research and recommendations provided by experts in the DC-related domains.

6.1. Pollination

6.1.1. Capacity development needs according to pollination experts

For the pollination DC, the interviewees mentioned 18 of the 18 capacity needs that were found throughout all the interviews. A specific element that can be found throughout the pollination interviews is the tension between worldviews, more specifically the view on agricultural toxins. The different views have become entrenched and

polarized the debate that has been elevated to the highest political levels as illustrated by the nature restoration law, the biodiversity strategy and the debate on the use of pesticides. There is mutual reservation on the reliability of knowledge generated outside of the academic sector and the complexity of ecological systems and pollinators in general make it hard to provide ready-to-implement messages for policymakers. Nonetheless, all actors expressed interest in and the value of working together, indicating the added value of and willingness to contribute to meeting the capacity needs.

Communication

For pollination, the communication capacity need was mentioned by all actors. The scientists focused mainly on the lack of communication skills of the academic sector and the need to be able to talk to many different audiences. This was endorsed by a policymaker who also related this to the complexity of ecology in general and monitoring schemes more specifically and to the transparent decision making as illustrated by the following quote: *"You have to manage also the complexity of a monitoring scheme. You cannot monitor everything, and it is also clear that you cannot, even though it may be desirable, collect all scientific information on different types of species and their association with the host plants, for instance. (…) This may not answer all the scientific questions, but it should be feasible and acceptable for the Member States to implement."*

Diverse values and worldviews

For pollination this capacity need is expressed mainly as different worldviews that guide the perceptions on the impact of agricultural practices on biodiversity and pollinators specifically. This is a highly polarized debate that leaves little room for scientific evidence as expressed by the following quote of a scientist: *"some of these groups are very entrenched already in their values and views, and from my experience, for some of them, no amount of evidence is really going to change that."*

Connected to these worldviews, different attitudes are ascribed to the different actors. For example, a recurring theme is the mistrust in both business and civil society actors, as illustrated by the following quote from a business actor: *"I would appreciate if it would be better understood how we are acting for instance to develop products. How we are living product responsibility. That it is for us not just about selling as much products as possible, but it's about really responsibly developing products which are compatible with the environment.",* and from a civil society actor: *"as an environmental think tank of course you carry this green or left or very much environmental pillar stamp on you."*

Bringing people together

The capacity need to bring people together was highlighted by business actors and scientists for the pollination case. They followed the same line as the general description, highlighting the need for a good network to facilitate communication and the need for a safe space to discuss science outside of the political arena.

Inclusion

For the pollination case the capacity need of inclusion was only mentioned by business and civil society actors to highlight the difficulty of being included in research projects. For the civil society actors this related to bureaucratic issues and having difficulty reaching the non-usual suspects in their projects and dissemination while for business this was mainly related to the questioned neutrality of business actors by the academic sector.

Personal time management

Better personal time management was expressed by all actors to be a capacity need in the context of pollination. This followed largely the general capacity need as described in section 3.1.5. One specific example was raised by a business actor that for knowledge produced regarding pollination, farmers play an important role, but they also suffer from much the same gap: *"a lot of this research today is done by innovators that are at the same time, farmers, innovative farmers. And if you're lucky, they have time to make a podcast."*

Transparent decision making

For pollination this capacity need was linked to the politicized nature of pollinators that influences the decision making outside of the scientific debate as illustrated by the following quote from a business actor: *"pollinators are a political topic. So basically, everyone has become expert, and you may as well see someone political saying like "no, I want 15 species to be tested" And that's it. And then you as a scientist, you're like "Oh my God, but we haven't*

developed the test yet. (...) And the risk assessor is going to say: "I can't conclude on the risk assessment because politics said I want 15 species and we don't have them, so I can't make a decision". "

The consequences of the complexity of policymaking were highlighted by a civil society actor. The fact that a broad range of factors is being taken into account in policymaking is forcing the civil society organisation to adapt the reporting of their monitoring schemes to more broad trends as opposed to species-level data because policymakers are more sensitive to this: *"when you focus too much on single threatened species, then often there's an argument of "well, OK, but that species is also making life very difficult for itself" and "well it's only a single species but we have so many". So, I think it's good to have a broader basis to show biodiversity trends."*

Vested interests

For the pollination case, the vested interests were mentioned by all actors except the policymakers. All interviewees referred to the strong lobbying of some powerful agri-chem companies, as illustrated by the following quote: *"there are also some Agri-Chem, which is like biodiversity is a direct threat to my business (...) And they're very powerful and they have strong lobby groups and they have excellent comms teams and they play the game exceedingly well."*

Inter- and transdisciplinarity

Inter- and transdisciplinarity was only mentioned by one business actor for the pollination case. The interviewee referred to the siloed thinking of the agri-chem industry as opposed to the more holistic thinking of biological companies.

Reliability

For the pollination case all actors expressed their concerns on the reliability of data generated by both business and civil society actors. However, it was also broadly acknowledged that this data could also be useful as illustrated by the following quote of a scientist: *"I think the private sector has a lot of data and knowledge that would be really helpful. But I think there needs to be some filtering, like clear kind of checking that it is valid and it's not biased. (...) and that gets for NGOs as well."*

The neutrality of science was also questioned in the context of research on agro-toxins, by a business actor: *"you see publications appearing on very functional moments in time where it's important to actually just change the subject that I sometimes feel OK, but is scientific research still as neutral and as objective and as society serving as it's supposed to be."*. While on the other hand another business actor highlighted the transparency of research on agro-toxins but a lack of knowledge on the side of scientist about the reliability of this data: *"there was really little awareness of the academic sector of how the data was generated and it's not even the secret because the general flow, all these data must be accessible to everyone now. So, these data are open."*

Institutional support

For the pollination case respondents from the academic sector mainly discussed the lack of rewards in the academic world for policy impact, while policymakers focused on the rigid nature of administrations impeding in-house scientific support. One business actor referred to the bureaucratic barriers for working together transgressing academic, policy and business sectors.

Complexity

The complexity of nature was in the case of pollination stressed regarding both the (unintended) effects of agricultural chemicals, as well as in the context of more ecological alternatives as illustrated by the following quote from a business actor: *"these more ecological approaches, it's more contextualised and it's more technical. It needs a higher technical support than those monoculture systems that are more uniform."*

Harmonized timelines

The need for harmonized timelines was only mentioned by policymakers and civil society in the context of pollination. They followed the same line as the general description of the capacity need, with the policymaker stressing the long time frame of HORIZON projects while the civil society interviewee stressed the short term projects academia mainly builds on, as illustrated by the following quote: *"they wanted to have two or three years of good data so that their PhD students could actually write a proper thesis. And that's a really different objective from recording and monitoring the impact of measures that are taken in this living lab area."*

Competences to co-produce knowledge

The lack of competences to co-produce knowledge was only mentioned twice by the interviewees for the pollination case. Both referred to organizational capacities. The business actor highlighted the different profile of a person engaging in co-production as compared to a regular business employee. The civil society actor highlighted the gap of the academic sector to meaningfully engage in co-production due to the short-term engagement and seeking of novel topics as opposed to the long-term monitoring that civil society performs as illustrated by the following quote*: "the universities tend to make use of the existing monitoring data but do not actually contribute to the schemes that generate those data."*

Policy literacy

The gap in policy literacy was only mentioned by scientists and policymakers, always referring to scientists. The interviewees highlighted the complexity of the commission and the policy window that can be hard to find. The policymaker also mentioned the lack of understanding what type of information can be brought into legislation: *"It is always interesting to see that these high-level people which are top experts on their field, but they have often a very limited understanding of the policy process on what can really be brought into a legislative instrument."*

Relevance

The lack of relevance of scientific output to policymaking was mentioned twice as a gap by scientists and civil society. The science actor stressed the fragmentation of knowledge and the lack of integration to something that is useful as illustrated by the following quote: *"when it comes to biodiversity monitoring, we see a lot of fragmented, very good publications, individual publications, but they're very fragmented. They're not covering all the fields and they are basically snapshots of individual situations, but we don't really get the full picture because for that you would need a strategic approach."*

Knowledge and data hub

This capacity need was only mentioned in one interview with a scientist for the pollination case. Two different illustrations of this gap were mentioned, the need for an increased linking of ecological knowledge to social and economic evidence and the overlapping of goals of projects as illustrated by the following quote: *"I know of at least four pollinator projects that their main output is a one stop shop for everything to do with pollinators. Well, I think the idea of a one stop shop is you only need one of them."*

Funding

Funding was mentioned by civil society, science and small business actors in the context of pollination. The unequal distribution of funds was also stressed by a business actor: *"At least in the agricultural fields, a lot of the research has been financed by private sectors and private sectors that have a lot of money. So, actually, make sure that the system as it is installed today and being lucrative just continues."*

6.1.2. Capacity development opportunities in pollination

The most common capacity-building tools in the Pollination area include field recognition and taxonomic trainings, handbooks, and various citizen science tools, which aim to disseminate knowledge and raise awareness around pollinators among the public and coordinators of pollination projects. There are some innovative engagement programs, however, conducted by JRC and DG Environment, such as a Makers-in-Residence program which involves artists in pollinator conservation, or the Citizen-Farmer Dialogues, which designed a series of participatory processes, bringing together farmers and citizens in five European countries *"to explore how [they] can start working together to build trust, expand the public debate to include in it their concerns and matters of care, and ultimately develop together place-focused interventions grounded in local culture, needs and capacities. [...] Particular attention was paid to the sensitive aspects of the issue (e.g., the vulnerable position of farmers vis-a-vis environmental and market risk factors, contentious aspects like the use of pesticides) as well as to the context in which the discussion was taking place (local culture, practices, social relations, local media exposure)."* Such efforts, while still the exception in the Pollination DC, have the potential to target capacity needs related to 'Inclusion', 'Diverse values and worldviews', 'Competences to co-produce knowledge' and 'Bringing people together.'

For the pollination demonstration case, respondents from business, civil society, and policy mentioned different forms of public events that could bring science, policy and practice together and address the needs of "Bringing people together" and "Communication". This included scientific conferences, policy events and (virtual) marketplaces for information. The need to go beyond the usual partnerships was stressed by an NGO representative. More institutionalized connections were also mentioned by Business, NGOs and policy, like having NGO and scientific partners on boards of companies and vice versa, to ensure the connection and dialogue and overcome the "Vested interests" and "Reliability" needs. Creating a government body that could oversee all the data generated by companies in an impartial way, was also a suggestion to address these needs. A science-policy hotline was also suggested where policymakers could send their questions to slow down the forced decision-making process and refer to a scientific body when taking decisions, addressing the "Transparent decision making" and "Harmonized timelines" needs. It can be noted that this is quite similar to the Eklipse mechanism or the fast request function of the SSBD. More top-down decisions by policy on knowledge creation was also suggested as a way to overcome the "Relevance" need.

Living labs were mentioned by a business actor as a way of overcoming the need of "Competences to co-produce knowledge". In these living labs practitioners could learn together with scientists and policymakers could go there to get inspired. It would also serve to break down "Inter- and transdisciplinarity" and "Diverse values and worldviews" with science actors and within the business sector itself. It was emphasized that everyone should have an active role in these interactions.

Dedicated training on the science policy interface was mentioned by scientists to learn more about the policy processes, addressing the need of "Policy literacy". It was stressed that this would require different approaches for different career stages, including, for example, trainings on "communication" and how to increase the "Relevance" of research in early stages to more tailored and high-level training on participation in science-policy interfaces like IPBES for later career stages. There was also a suggestion to learn from business actors on how to successfully communicate and market science. From policy the suggestion was made to train more experts on mediating between the worlds of science and policy, thereby having a different approach to overcoming the "Communication" need.

A last capacity development initiative that was mentioned was regional or local IPBES-like assessments. As these have proven to be successful on an international scale, the processes could be translated to a more localized level to have the same capacity development effect.

6.2. Freshwater

6.2.1. Capacity development needs according to freshwater experts

With regards to the capacity needs described in the interviews linked to this DC, 17 out of the 18 general categories of capacity needs were identified. The main categories that emerged in absolute terms are Communication, Bringing people together, Policy literacy, Diverse values and worldviews, and Inter- and transdisciplinarity. In comparison to the other DCs, interviewees concerned with freshwater issues put more emphasis on Communication, Inter- and transdisciplinarity, Policy literacy, and Knowledge and data hub. The category Competences for knowledge co-production was the only one not mentioned in the interviews related to this DC. This, however, does not mean that actors in this DC do not have relevant capacity needs in this domain, rather, this is likely a result of how these needs have been formulated and thus coded after the interviews. For instance, their ability to co-produce knowledge may be related to breaking down disciplinary silos ('Inter- and transdisciplinarity'), being included in policy-relevant processes ('inclusion'), or lack of supporting institutional structures and processes ('institutional support').

Communication

Communication issues were defined mostly as the trouble for scientific knowledge to reach policymakers, due on the one hand to the format of scientific productions and lack of translation capacities to render the knowledge usable by policymakers, an interviewee considering that *"this is all it comes down to. It all comes down to making science available for policymakers in such a way that they can use it and that they can change the policies in such a way that it also helps free-flowing rivers".* Scientists are argued to have an insufficient understanding of the knowledge needs of policymakers, with some interviewees asserting that what policymakers needed was *"bits of information"*, in the form of straightforward, broken-down knowledge pieces. This translation capacity, however, was not to be necessarily expected from scientists, who are unfamiliar with efficient communication principles and who also lack the time to translate their findings (this links to the 'Personal time management' capacity need). As one interviewee put it, there is a need for professional communicators *"between policymakers and scientists to devote hours of time to translate those results in clear summaries in different languages, maybe on websites, on Twitter, as well, on social media, and LinkedIN."* At times, policymaking was also argued to be based on information from such sources rather than on scientific publications.

Another important aspect of communication was the lack of structured and regular interactions between scientists and policymakers. Scientists work with policymakers in an ad-hoc and coincidental fashion, if, for instance, they share the same background or *"they come from [the same] university"* and know each other personally. They, however, are not compelled to work together by involuntary structural arrangements. The deficient communication and knowledge transfer between national, regional or local authorities was also considered key to freshwater issues. From the perspective of policy, there is also a question of how to set politically palatable, exciting, motivating, but also scientifically relevant targets. Highlighting the case of the 30x30 target, one interviewee explained that policy needs issues and solutions that can be easily communicable to a wide audience. *"It sounds so nice that by 2030 you'd have 30% [of your area] protected. But is it science-based that if you are able to protect 30% then actually, we can halt and reverse biodiversity loss? I don't think there is any scientist out there who could say that 30% is enough. Because it depends on so many factors, like what happens with the remaining 70%, to start with."* Thus, being science-based may not be enough to create effective and politically relevant policy-campaigns.

Inter- and transdisciplinarity

Needs related to inter- and transdisciplinarity appeared in the freshwater DC in many ways. For instance, the ever-increasing specialization of scientists hinders their ability to develop a more holistic understanding of their area and adjacent fields, and how these connect to contemporary policy problems. This then impacts their skills in using a cross-disciplinary language to communicate across fields. This issue occurs even in seemingly highly connected areas, such as the ones concerning freshwater ecosystems. As one interviewee expressed, *"I don't think there's anybody in the face of earth now who says that I am a freshwater scientist [starting] from the species down up to river morphology and sediment transport and whatnot. It's just not existing now."* Specialization necessitates that scientists are much better trained in interdisciplinary thinking and collaborative work.

Some actors also highlighted the need of freshwater scientists and other stakeholders concerned with biodiversity issues to be better educated on connected questions like, for instance, the economy or transportation. As one interviewee highlighted, transport is a controversial area, connected to climate change and pollution, and thus in urgent need to transform itself (e.g. through electrification). However, this is a highly complex question with both economic and societal consequences (linking to the Diverse values and worldviews category), and one that needs to be considered by policymakers from the environment and climate DGs in order to produce effective policies. Thus, the need to overcome silo thinking appears not only at the level of scientific understanding, but also in policymaking with both vertical and horizontal integration and knowledge co-production, which is also linked to the 'Personal time management' category.

Policy literacy

Among the DCs, the policy literacy issue was most dominant in the case of freshwater. All relevant actors, from business to NGOs and scientists felt that they need to better understand the policy cycle, the times when policies are being reviewed and re-evaluated, and when others can provide their input. Often, stakeholders engage with the policy process in an ad hoc way, providing their input when they hear that something is coming up in the agenda

of the Commission and by linking up with other organizations in the same field for greater impact, e.g. during the Swimways Program. The need for a more structured and systematic process was clearly articulated, thus linking to the Bringing people together and Inclusion categories of needs. There is also an understanding that policymakers work, learn, and engage with scientific results and topics differently than, for instance, scientists, and this is something that would be useful for other stakeholders to understand.

Knowledge and data hub

Among the DCs, the capacity need related to a knowledge and data hub was most prominent in the freshwater DC. There are a lot of different kinds of information that is produced in different formats and in different countries concerning various aspects of freshwater ecology and river basin management. This information needs to be gathered, consolidated, and shared among the stakeholders, which means that there is also a need to standardize methods of collection and analysis across authorities working at the different scales (local, regional or national). A representative of an intergovernmental River Basin organization, for instance, highlighted how important it was to set up a transnational monitoring network that allowed for the sharing of information internationally and across knowledge domains – a task which is considered critical for freshwater biodiversity conservation, and which is argued to be one of the greatest needs.

Bringing people together

The necessity of bringing people together around freshwater issues mostly originates in the fragmentation of existing networks, which links to the lack of inclusion, noting the separation between scientists and NGOs, and the lack of dialogue between diverse stakeholders that would allow the enhancement of democratic choices. Non-scientific actors also expressed the importance of having access to scientific knowledge and scientists, however, there is also a frustration with the difficulty of finding the right scientists and connect with them. One interviewee mentioned in this regard that *"it's not the knowledge that is lacking, it's the connections with people that make the knowledge available."* Collaboration with policymakers was seen as relying on building strong personal connections and trust and the identification of allies.

Diverse values and worldviews

Clearly linking to the need for better communication and for bringing people together, this category came up as diverse values and worldviews in a variety of spheres, and in particular among the employees of the EC (and how they would each respond differently to solicitations by external actors), between scientists and policymakers (in terms of respective appreciation but also in terms of mindset and focus), among the larger society, and between scientists or NGOs and a 'public opinion' which should be "shifted" to weight on policymakers. This was for example expressed by one interviewee who considered that "it's not enough to just go to political decision makers and ask them to change this or that legislation without having shifted public opinion in our backs and showcasing example that have actually demonstrated the additional value of healthy fresh waters rather than degrade and exploited ones". This itself links to the Transparent decision making category which, in the case of freshwater issues, was both expressed in the consideration that science is just one of the aspects that policy needs to consider, and that biodiversity itself is only one topic among others, which may even be perceived to be in opposition to economic interests.

6.2.2. Capacity development opportunities in freshwater

Capacity development in the Freshwater area mainly consists of webinars and online trainings, network building and awareness raising, and data management and sharing tools. There are also efforts to bring diverse stakeholders together, e.g. through the Rome Water Dialogue, however, these often focus on information sharing rather than co-productive capacities. There are some interesting examples of strengthening joint problem-solving and multi-stakeholder engagement, e.g. through the work of the Stockholm International Water Institute, or the Global Water Partnership, which started an Integrated Drought Management programme in Central and Eastern Europe with the involvement of farmers associations and water managers. However, most of these more innovative programs that center water diplomacy and co-governance tend to focus on the Global South.

In the freshwater DC, stakeholders recommended several capacity development opportunities that could improve the ways in which scientists and policymakers interact with each other. Of these, recommendations for institutional and organizational improvements were the most common, highlighting a lack of general focus on organizational capacities (instead of personal technical skills and knowledge gaps) among existing efforts. Personal time management was one of the capacity needs that often came up in the interviews, especially on the side of policymakers, who have less time to attend conferences, summer schools, or online courses. Thus, interviewees often found that creating working structures and processes that bring scientists, policymakers, and practitioners together during and as part of their normal operation would be a way to mitigate this problem. Such efforts could include, for instance, Science Councils for policymakers that could act as an institutionalised scientific sounding board before and during policy-decisions are made.

Joint problem-solving was also emphasized as a way to restructure co-working arrangements. An IPBES or EPBRS (European Platform for Biodiversity Research Strategy) - like structure would be ideal for bringing the various disciplines (social and natural scientists, practitioners) together with policymakers, and to create scientific knowledge that is more relevant for policymaking (tackling the 'Relevance' gap). The lack of a freshwater focus within the EUBP has also been highlighted in the discussions on the lack of effective platforms for problem-oriented, co-productive work arrangements. One interviewee mentioned that such inter-institutional processes are a lot more frequent in the United States (between, for instance, the World Bank and WWF, where both institutions send staff to each other for regular knowledge exchange) and should be commonplace in European decision-making as well. For example, scientists could be seconded to DG Environment to review site designation processes, while staff from DG Environment could be sent to take part in projects on Natura 2000 sites in various countries. Such arrangements could help overcome needs related to Inter- and transdisciplinarity and Diverse values and worldviews. Currently, such multidisciplinary approaches are more common among freshwater NGOs, such as WWF or TNC, who occupy a more intermediate space between academia and policymaking. Involving scientists in the policymaking infrastructure more closely could enable scientific findings to inform decision-making at the right time, for instance, as budgetary plans are made. Understanding the policy cycle and the most appropriate time for presenting scientific findings is of critical importance for the science community. One interviewee also emphasized the importance of having a more holistic approach to fiscal planning, one that could streamline biodiversity-related concerns into other policy areas.

Strengthening personal capacities is also important at the SPSI. Recommendations were made to create in-house capacity development courses for scientists at research institutes and universities, where scientists have a chance to learn about how to present their findings in an engaging and politically relevant way. Such courses already exist, for instance, at the Research Institute for Nature and Forest (INBO), an independent research organization of the Flemish government, where communication courses are offered to scientists on a regular basis. Journalists are also well-placed to offer guidance (in the form of short-term trainings) on how and when to submit media-relevant content to news agencies. These courses can help fill capacity needs related to Relevance and Communication. However, the issue of time was emphasized here as well, highlighting the need for trained translators of knowledge instead of expecting researchers to spend their time on science communication, media campaigns, and political advocacy. Other recommendations focused on the need to help *"promoting river heroes in international news to inspire more people"*, and to link scientific and NGO representatives with policymakers at the individual level to encourage trust-building and the creation of continuous, collaborative relationships. Similarly, it was suggested that dedicated individuals who are already making a difference should be identified and offered training opportunities to enhance their capacity in awareness raising and advocacy and to help them expand their network. However, such functions are often fulfilled on a voluntary basis due to a lack of financial mechanisms that reward such efforts.

Finally, the Freshwater demonstration case faces important challenges regarding data availability, pooling and sharing. Knowledge and taxonomic data, especially on freshwater insects, is often sparse and geographically skewed. Specialists on various taxa should be better connected as well as connected to the state so that they can be called upon when expert knowledge and advice on certain areas is needed. Recommendations are made to create a Freshwater Biodiversity Knowledge Hub at the European level, which could serve multiple purposes. On the one hand, it could connect specialists with expertise on different species and ecological systems. On the other hand, it should also serve the purpose of compiling the latest scientific information on freshwater biodiversity.

Interviewees argued that even for scientists, it is often difficult to keep abreast with the scientific literature. Such a Hub could then serve the purpose of keeping various stakeholders informed, sharing data sets, providing policy-relevant input, make funding sources accessible to researchers, and establishing a system of acknowledgement for contributions to broaden the performance evaluation of scientists and other actors at the SPSI. Beyond biodiversity data, they could also share restoration and monitoring strategies and best practices to link up with undergoing implementation efforts taking place at different scales. Some good examples include WWF and Bird Watch Austria, who put together complete compendiums on certain biodiversity data and follow developments in legal entities and processes to inform the scientific community about relevant changes. Such hubs can help alleviate needs related to Knowledge and data hub, Communication, and Relevance.

Knowledge Hubs were also mentioned in the context of capturing non-scientific knowledge and including knowledge providers in the SPSI that are not scientists. Especially around the topic of (freshwater) insects, there is a need to capture a lot of information (e.g. occurence and taxonomic data), which could be done through local ecological consultancies, who often store lots of valuable but unpublished data, or through citizen and amateur scientists. These individuals frequently form part of large and well-connected, non-scientific networks. As one interviewee expressed: *"there is a whole community of what we would call amateurs, so people not paid for knowing things. If you look into Diptera, if you look into Trichoptera, in France there is an enormous community. They're not proper scientists, they're not properly in academia. They're just going out, looking at things and producing incredible data. Same is true for Switzerland, the same is true for Germany, Sweden, Italy, wherever you go. [...] [When] I compare my knowledge on Trichoptera to some of those guys, I'm nothing. There's people out there who, I mean, 70-year-old men who spend their entire lives on butterflies, on stoneflies, on whatever..."* Capturing the knowledge of non-academic experts would address important needs in the inclusivity of SPSIs and could significantly strengthen the contextual knowledge base of biodiversity policy. However, the question of willingness and interest for such consultancies and amateur scientists to participate arises, and the Science Service will need to consider how to appropriately engage such non-academic actors. To this end, reward systems and online repositories were recommended, where amateur scientists could also take ownership of their data and be recognized for their contributions.

6.3. Nature-based Solutions

6.3.1. Capacity development needs according to NbS experts

With regards to the capacity needs described in the interviews linked to the urban Nature-based Solutions DC, 18 out of the 18 general capacity needs were identified by the experts. The main category that emerged in absolute terms is Inter- and transdisciplinarity. In comparison to the other DCs, NbS experts put more emphasis on Inter- and transdisciplinarity, Harmonized timelines, Competences to co-produce knowledge, Eliminating research gaps, and Inclusion. To summarise briefly, experts highlighted the urgent need for collaborative efforts and knowledge co-creation among the most diverse possible range of stakeholders in the NbS community, emphasising the importance of mutual learning and adaptation to each other. They underscored the critical role of securing adequate research and financial resources to address capacity needs effectively, as well as a common ground regarding the concept of NbS. In the following, those capacity needs will be described in relation to the NbS DC that were identified as relevant or were specific to this context for some reason.

Inter- and transdisciplinarity

Inter- and transdisciplinarity as a capacity need was touched upon by almost all the NbS experts, mostly highlighting the need to build synergies and strengthen cooperation among sectors and across disciplines. A holistic systems perspective and sectoral collaboration would help to see the whole picture and avoid duplications: *"I think you cannot look at a transition to nature positively without taking systems perspective. The systems must transition together. So there is a need for both the policy, the finance, the science, all to collaborate together to support*

industry in transitioning." One of them added that scientists often work in isolated bubbles, neglecting broader inter- and transdisciplinary collaborations necessary for effective policy outcomes.

Harmonized timelines

According to three NbS experts, time misalignment issues between science, policy, and business cycles lead to delayed results and mismatched time frames: *"So research and engagement with these types of farmers has to take into account their cycle with nature-based businesses because they work very closely with nature and cycles of nature. So, if you want to talk to them, you have to time your research accordingly."* Aligning research timing with farming cycles, political timing in cities, and Horizon projects' timing with city schedules is critical for ensuring timely and impactful outcomes: *"And the timing, you know the timing because the decision-making process for a city has to have such a plan. They have to put out resources, they have to decide on an officer in the city who is gonna take that forward. They may have some democratic processes, so it has to go through approvals. So sometimes the timing doesn't match the Horizon timing."*

Competences to co-produce knowledge

The capacity need in co-producing knowledge was mentioned by three NbS experts, who referred to the lack of motivation to collaborate and work together, and the need to re-conceptualize institutional frameworks to promote collaboration: *"If you can only think within your specific municipality and you don't think beyond those boundaries, I think you're really limited in terms of what you can accomplish. So maybe capacities in terms of thinking how to re-conceptualize the institutional framework to allow more cross-municipal, cross-department, horizontal and vertical collaboration within the decision making".* Moreover, they pointed out the lack of exchanges and training offered to local policy actors and the existing divide between scientists producing knowledge and policymakers applying it: *"We working with nature based solutions and biodiversity, we notice that there is this gap, right always between, you know, what you produce and knowledge and how policymakers can apply this knowledge and it can impact policy in a positive way."*

Eliminating research gaps

Three NbS experts highlighted the gap in research that encompasses challenges such as the inability to provide sufficient evidence to convince businesses to invest, the neglect of research on small businesses, the lack of understanding regarding malpractices, as well as the integration of existing knowledge: *"So you've got a lot of technical knowledge on, this is good, this is bad, from a natural sciences perspective. But what you don't have is an integration of that knowledge with social sciences, so cross-disciplinary, interdisciplinary collaboration, where, OK, we know that farmers need to stop composting in this way and start composting in this way, but what are the financial implications of that? What are the business implications of that? What is the wider impact of that?"*

Inclusion

The inclusion gap was referred to by 3 out of 5 NbS experts and it persists in the form of marginalized perspectives being overlooked in policy considerations: *"So not thinking about society as a group, but really thinking about these subsets of vulnerable populations or marginalized populations within society and how policy can affect them."* Moreover, the existence of the scientific bubble, especially regarding biodiversity issues, where certain disciplines are less included in the discussions: *"We keep talking to ourselves. We keep talking to environment policymakers. They're already convinced. We need to talk to economic policymakers. We need to talk to business policymakers. We need to talk to finance policymakers. If we keep talking to environment policymakers who are talking to or preaching to the converters."*

Funding

Insufficient financial resources pose a significant barrier for adopting nature-based solutions. Although based on the final categorisation, there were only two mentions of this need, it is because some of the related issues were categorised under either institutional support or vested interests. The policymaker talked about the investment gap in NbS: *"so probably the main issue with NbS at the moment is the investment gap. And this investment gap, as we said, is largely because of the lack of engagement of the private sector and not only businesses, but actual investors".* Small businesses also struggle due to inadequate resources to support sustainable actions: *"So sometimes they can lose if they implement a certain strategy. And if it's a big company, it's not so dangerous. But*

for small enterprises, it's really a thing. So they have to decide between acting sustainably or survive." These quotes highlight that the first step to engage smaller-scale businesses in SPSIs would be to help them implement sustainable practices.

Diverse values and worldviews

According to the NbS experts, diverse values and worldviews mostly manifests in the lack of awareness of ecological and biodiversity values among certain stakeholders: *"So there's aesthetics there and they're looking for shade and you know, regulating the micro-climate. But then when you look into it in terms of biodiversity, it's like a green desert."* Overcoming scientists' reluctance to co-produce knowledge, and the establishment of a shared understanding were also brought up as capacity needs.

Bringing people together

The capacity need named bringing people together came up as the need for stronger interactions among experts, policymakers, and practitioners, as well as for an effective facilitation among them: "*So it's really about bringing people actually together and speaking because when it's a one-way conversation like policymakers at the receiving end, the people providing the knowledge might be missing what the policymakers actually need and in what format they need it."* This involves establishing long-term alliances, running policy labs, and ensuring effective communication between stakeholders through facilitation: *"I think that maybe we need really good translators or institutions that are, you know, neutral in a way that they value both sides."* The importance of a systems perspective is also reiterated.

Communication

Although communication came out as the most prominent capacity need in general, it was only mentioned by 2 out of the 5 NbS experts. It manifests in the complicated terminology around nature-based solutions along with the lack of a common language among stakeholders: *"if you go down to the local level and you get away from this EU jargon bubble and you break it down to local decision-makers and local policymakers, there's a lot of people that still have no idea what the concept of nature-based solutions is as a term, as a concept [...] one of the biggest things is getting everybody to really speak the same language and have some kind of common starting point."* Moreover, the inadequate communication among certain stakeholders, such as scientists and policymakers or practitioners poses another problem. The role of facilitators becomes crucial in bridging the communication gap between them.

Personal time management

Personal time management as a capacity need was referred to by two NbS experts. The policymaker highlighted the importance of workshops in co-producing knowledge but added her personal problem of lacking the time to engage: *"So for me, workshops are a great way to come together and actually discuss with each other what are the needs. Now we go back to the problem that I have personally. Ideally, I would love to, but then it's always the time that is missing."* The civil representative brought up the lack of time to develop biodiversity strategies for cities: *"In Horizon we work a lot with cities, but beyond Horizon I think we don't even have time. It's a bit of a hard thing."*

Institutional support

According to the NbS business expert, institutional support, such as a lack of support for practitioners, especially smaller scale businesses, impede progress: *"there is a lack of support for these practitioners to transition, in particular, smaller scale practitioners to transition towards nature positive, more positive biodiversity practices."* In the meantime, the NGO representative highlighted the absence of policies advocating biodiversity, as well as a typical path dependency of cities: *"I think the big challenge that we encounter there is really path dependency. So some local governments, they do not want to do things differently, they don't want to risk themselves."*

Relevance

Relevance came up during the discussions with the NGO representative and the policymaker. The latter mentioned that there is a misalignment between the scientific work and the political mood, and that researchers should adapt their discourse to match the prevailing political climate. According to the civil representative, in certain NbS-related Horizon projects biodiversity considerations are overlooked, and there is also a need for projects that have tangible impact beyond academia: *"I'm always very upset when people don't understand that nature based solutions should*

intrinsically help biodiversity, you know, like foster biodiversity, and it's upsetting that in 2023 you still have Horizon projects that, you know, they come up with NbS which does nothing for biodiversity."

Transparent decision making

Transparent decision making as a capacity need was only mentioned by the civil representative who highlighted the need for policies that actively promote NbS and biodiversity: *"you have to take into account biodiversity and biodiversity-friendly measures. How you can implement them. So there needs to be a push from the policy side for nature-based solutions because now it's growing."*

6.3.2. Capacity development opportunities in NbS

Most of the capacity development efforts related to the urban NbS DC revolve around webinars, online courses, and various events, whilst more interactive and immersive programmes are less frequent. An enlightening example for engagement and collaborative efforts were the residencies and summer school offered by the Resonances IV initiative, run by JRC SciArt. Its description says: "Informed by cutting-edge scientific research and public policy discussions, the aim of Resonances IV is to explore contemporary societal concerns with a transdisciplinary approach. Spurred by artists and creatives around the world we want to develop discourse, visions, artworks and exhibition that raise questions, change perceptions and widen awareness, that can trigger systemic change in support of the European Commission's Green Deal." They bring together a wide range of actors concerned with ecological issues, including artists, scientists, and policymakers, who work together on a project. These initiatives have the potential to fill in the needs related to 'Bringing people together', 'Inter- and transdisciplinarity', 'Competences to co-produce knowledge', 'Inclusion', and 'Diverse values and worldviews'.

NbS experts from all backgrounds emphasize the critical importance of collaborative initiatives and capacity development tools. The insights gleaned from them provide a comprehensive understanding of the diverse strategies employed to advance NbS.

Co-Creation and Engagement Initiatives: NbS experts across different sectors highlighted the centrality of co-creation and engagement initiatives. The policy expert underscored the significance of co-creating ideas with society at large, as well as emphasised the need for more exchanges, training, and interaction with practitioners at the local policymaking level. The NbS community, as noted by the policymaker, serves as a best practice in itself, embodying co-creation, engagement at all levels, and co-governance.

The scientists echoed these sentiments, emphasizing co-creation with society in decision-making processes. One of them pointed to the need of mainstreaming NbS, advocating for societal awareness and its integration into various policy fields. The importance of collaborating with local stakeholders, including citizens and NGOs, was also highlighted, acknowledging the need to overcome barriers through joint efforts.

According to the policymaker, great initiatives for co-creation are the internal workshop that they are organising for colleagues across the Commission with external speakers from the NbS community, the Network Nature task forces, and the NbS hubs in various cities. The two scientists mentioned city to city exchanges, as well as projects such as Connecting Nature, and EmpowerUs with its co-creation tools that are focusing on the *"empowerment of communities, and different representatives of communities"*. The Clever Cities project, in which scientists and NGOs are working together with the Commission of European Standards, was highlighted by the civil representative, as well as policy labs, emphasizing the importance of inviting the right partners, different departments, and researchers, as well as a skilled moderator.

Both scientists pointed to a range of tools for developing capacity, including the Urban Nature Atlas, the Urban Governance Atlas, and other handbooks and manuals are identified as effective means for achieving these objectives. Initiatives such as the Reconnect project were highlighted as crucial components of the NbS toolkit. Collaborative workshops and unconventional methods like transect walking are emphasized to enhance communication and understanding: *"And this informal outdoor activity when people not only sit in the room, but they are moving, our brain works in another way, and they are knowing each other and some of them even never have had such an opportunity to come into dialogue, it works perfectly in my view. So sometimes these already known tools but transferred in the field of nature-based solutions help us to better learn from each other and to better combine our perspectives to get the synergies and not only to conflict the whole time."*

Finance and Investor Involvement: The business expert stresses the inclusion of financial actors and investors in co-production efforts, recognizing their integral role in the success of NbS initiatives. She highlighted the importance of case studies, whilst one scientist identified participatory budgets as valuable best practices, illustrating successful instances of co-production in the financial realm.

In summary, these expert perspectives collectively underscore the importance of co-creation, engagement, and the use of diverse tools in enhancing capacity within the NbS domain, with an emphasis on collaborative efforts, learning from local stakeholders, and integrating finance and investors into the process.

7. Discussion

7.1. The persistence of capacity development needs

As highlighted at the beginning of this report, capacity development needs at the biodiversity SPSI have already been thoroughly studied and identified gaps have been increasingly targeted by capacity development initiatives launched in the last two decades (or even earlier). This leads us back to the first research question of this deliverable: whether the persistence of old capacity needs or the continuous evolution and emergence of new needs makes SPSI's less impactful than expected.

Considering the eighteen capacity development needs identified in this report, we can observe that many of them have been reported in earlier works (e.g. capacity needs associated with communication, inclusion, policy literacy, resource and time availability, alignment of timeframes, etc.). Furthermore, the analysis of the existing capacity development initiatives highlights that most of them (especially those which target general SPSI skills and capacities) indeed aimed to address these needs. Therefore, the continued emergence of these needs indicates a mismatch between the demand and the supply of capacity development, which can be traced back to two main reasons.

- The more intensive modalities which can achieve a deeper level change, such as summer schools or retreats, usually recruit only 15-30 participants per year, and focus on early to mid-career researchers, while established researchers (who are the ones often responsible for grant writing and initiating new projects) are not targeted. The less intensive modalities (e.g. 90 minutes long webinars, online guidelines or videos) can, in theory, reach a wider and more diverse audience (i.e., a few dozens to a few hundred people), but their long-term impact is questionable, and their outreach is often contingent on the pre-existing networks of the organizers.
- The assessment of existing initiatives also indicated that they are often not clearly targeted. For instance, regarding their audience, many of the analysed examples give a very broad indication that everyone interested can participate, but do not delineate clearly who the main target groups are. Furthermore, only very few cases were found where the targeted skills and competences were clearly communicated, and expected learning outcomes were outlined. One reason for this could be simply a communication failure (i.e., background details are not shared on the public websites) but can also indicate that sometimes ad hoc decisions steer capacity development.

In sum, the landscape of capacity development is characterized by several small-scale (often time-bound, project-related) initiatives, which operate within their own circles in a fragmented way. Even if there is an increasing number of initiatives, they could not yet reach a broad enough audience, and due to loose targeting they might have missed opportunities to achieve long-lasting impacts. Consequently, the growing number of initiatives is still insufficient to address long prevailing capacity development needs.

On the other hand, some of the capacity development needs identified in this report were less frequently mentioned in SPSI literature, or if mentioned, they were not conceptualized as capacity needs (e.g. diverse values and worldviews, or vested interests). The reason why such topics emerged in this report as needs is that we applied an explorative approach to the interviews (i.e., experts could freely talk about their perceptions and suggest new

topics for discussion), and at the same time used a solution-focused approach to the analysis (i.e., we labelled broader challenges as needs to highlight that BioAgora could and should act to resolve them). This broader conceptualization of capacity needs allowed us to identify interrelations between individual, organizational, and system-level needs. Using this lens for the analysis of existing capacity development initiatives allowed us to observe that existing initiatives focus mostly on the individual level and on the researcher side, while organizational capacities and especially system-level requirements are often disregarded. This, however, can lead to lock-ins: even if individual capacities are successfully enhanced, impacts often cannot reach beyond the individual participants or last over the long-term if organizational and institutional barriers are not removed. As a result, capacity development remains inefficient in terms of addressing overarching challenges and inducing systemwide transformations.

7.2. Emerging topics

7.2.1. Varying capacity needs

An important finding of this deliverable is that different SPSI actors who belong to different thematical areas and stakeholder groups have different capacity needs. This is significant because it entails that capacity development efforts need to be tailored to be truly transformative and move beyond the level of generalities. While most of the identified capacity needs appear in every DC, there are differences in emphasis in terms of what needs are most prevalent or urgent.

For instance, tensions around worldviews have been frequently mentioned in the pollination DC, where there is a need for increased understanding across the different sectors impacting pollinator habitats and agricultural practices. Whether knowledge generated outside academia, e.g. in the agricultural sector or by other industries, can be trusted as reliable was also a central dilemma. Addressing these issues may require very different capacity development efforts than, for instance, the ones that were most often highlighted by freshwater actors, such as communicating scientific results to a lay or policy audience or filling knowledge and data harmonization gaps regarding freshwater insects. In comparison, the NbS sector highlighted inter- and transdisciplinary as their major dilemma, along with the harmonization of timelines across sectors and industries. Sectoral collaboration is key in the field in part to avoid duplications and to best manage financial resources. This means that capacity development needs to consider the differing needs of various sectors and disciplines.

Capacity needs also vary across age groups. While younger scientists tend to be better trained in inter- and transdisciplinary research methods and have more experience in various forms of engagement processes, it is generally the senior scientists who make decisions about funding and collaborations. This means that capacity development needs to be tailored not only between sectors but also within them. Moreover, most capacity development initiatives target natural scientists, and few acknowledge the need to involve social scientists or the humanities in the SPSI and address their specific needs. This is especially striking as most biodiversity-related questions have strong social, economic, and cultural implications and effective biodiversity policy needs to reflect these.

Finally, there are significant differences between geographical and cultural regions in dealing with biodiversity-related issues, engaging stakeholders, or being involved in SPSIs. Rules and practices differ on how hierarchically knowledge is transmitted or how to communicate with diverse stakeholders and what the rules of engagement are. BioAgora needs to pay more attention to these differences and think about the kind of SPSI model that could effectively reflect and respond to the diverse needs of European regions, including Eastern Europe, the Balkans, or the Mediterraneum.

7.2.2. Stereotypes among SPSI actors

Another important finding of our analysis is that major actors within the SPSI such as researchers, policymakers, and businesses, all carry prejudices and stereotypes about other SPSI actors and their needs, and these prejudices can limit stakeholders' capacity and willingness to engage with others in the interface. If not addressed openly,

biased perceptions can also make it more difficult to design effective capacity development initiatives for various SPSI actors. These prejudices present in two different ways.

On the one hand, scientists who did not have previous SPSI experience believe that the scientific process is not well understood, that research is not policy relevant enough, and that there is a considerable time discrepancy between science and policy, hindering the uptake of scientific facts by policy. Researchers, however, who already engaged in SPSIs found these issues less significant and had an overall more positive view about the impact they leave on policy. This suggests that some of the reflections about capacity needs may be rooted in pre-existing worries and perceptions rather than direct experience with policymakers or the policymaking process.

On the other hand, stereotypes have to do with the actors' perceptions of each other's motivations and trustworthiness. For instance, the private sector is often seen as directly opposed to environmental causes and as actively hindering the goals of biodiversity conservation. Moreover, the question whether privately funded scientific knowledge production should be trusted frequently arises. Business actors on the other hand express frustration with these views, highlighting the strict transparency rules they must comply with and the various commitments of some actors to directly support conservation goals. Similar questions arise around the role of scientists and policymakers in the SPSI. Should, for instance, scientists stay entirely neutral in their engagement with the interface, or should they advocate for certain, scientifically backed solutions to biodiversity issues? In other words, whether scientists should act as honest brokers or issue advocates in the SPSI remains an open question and can fundamentally shape the way scientists are perceived by other stakeholders. Policymakers, on the other hand, are frequently viewed as less knowledgeable about scientific findings and/or the scientific process itself and that they are unable or unwilling to accept the problem of uncertainty in science.

The issue of pre-existing stereotypes is frequently neglected in our efforts to better understand the functioning of SPSIs. This also entails that there are no capacity development initiatives that would aim to address this problem. It is, however, critical to attend to this question because knowledge co-production can be seriously hampered by a lack of trust and understanding among stakeholders. Overcoming these challenges requires concerted efforts to foster collaboration across the different spheres and to address underlying personal and institutional factors.

7.2.3. Inclusion

The question of inclusion was already raised during the literature review, but expert interviews and project workshops put it into an even more prominent place, sometimes also linked to the above discussed topic of stereotypes. Recent literature on SPSIs emphasizes the need to apply a broader and more inclusive approach when defining who holds relevant knowledge and who the key actors are in the science-policy-society interactions. Project-related publications published earlier (Kelemen et al., 2023, Westerink et al., 2023) state that a fundamental feature of transformative networks is their capacity to engage various actors. The need for inclusion was also highlighted by several interviewees, and the capacity need category 'Inclusion' was among the ones selected by consortium members as the most relevant areas for capacity development offered by the Science Service.

On the other hand, the persona exercise indicated that the BioAgora consortium feels more comfortable to engage with the usual suspects (i.e., researchers, policy makers, public administrators) than with societal and business actors, especially if those actors might have conflicting interests and values. Follow-up discussions in the project team brought different opinions to the surface and highlighted a potential trade-off between inclusivity and scientific neutrality. Public debate on biodiversity implies the clash of multiple (and sometimes incompatible) visions of a good society, which is not free from power asymmetries. Creating a fully inclusive Science Service means that such power struggles can enter science-policy-society interactions, making it hard (or even impossible) for researchers to stay in the role of the honest broker. In situations where power holders disrupt or manipulate processes, full inclusion might be even counterproductive (Jacobs et al., 2023).

Considering all these contradictions, we suggest the following questions to be assessed by Task 5.3 and make joint decision within the consortium:

- Who are the primary and the secondary stakeholders of the Science Service?
- Are businesses considered as primary or secondary stakeholders of the Science Service? If yes, all businesses or only those which meet some specific requirements?

- Are citizens and other societal actors (e.g. activist or youth groups) considered as primary or secondary stakeholders of the Science Service? Can they directly participate in the processes of the Science Service or only through the representation of NGOs?
- If considered as stakeholders, what is the role of non-scientific and non-policy actors in the Science Service? Can they join topical networks and share their knowledge, or only observe the processes, or only use the outputs of the Science Service, etc.?
- If considered as stakeholders, which institutionalized processes should guarantee the rightful involvement of non-scientific and non-policy actors in the Science Service?
- If considered as stakeholders, which incentives could guarantee that non-scientific and non-policy actors are willing to and capable of participating in the Science Service?
- Which guidelines, tools and techniques can be used to manage conflicts which might emerge in fully open and inclusive Science Service?

7.3. Study limitations

At the end of the discussion section, we also need to acknowledge the limitations of our approach. During the literature review and desk research we screened mostly for recent literature and newly emerging capacity development initiatives, although did not run a fully comprehensive search. Therefore, the screening of capacity development opportunities must be continued after the submission of this deliverable.

Considering the interviews, we encountered some difficulties with contacting specific actors – we found business representatives and policy actors hard to reach, especially if no prior links have been established with their organizations earlier. Interviewees were often recruited through personal networks and snowball sampling, which increases the risk of staying in our own bubble and not being able to discover the full diversity of perspectives. A further difficulty was the language used in the interviews. We used English as our lingua franca, while most of our respondents (and the interviewers, too) were not native English speakers. This might have a negative influence on the richness of the dialogues. In addition, the interview questions used technical (social scientific) language. Therefore, some of the topics covered by the interviews, or the language used in the questions, might have been complicated for respondents not familiar with that scientific background, which could also contribute to the loss of details.

During the whole process, from data collection to data analysis, several people from different organizations and countries, and with different disciplinary backgrounds, worked together. This diversity within our team increased the risk of interpreting the questions and the respondents differently. To avoid such discrepancy, we co-created and discussed the interview approach with all team members, we used standardised questions during the interviews, we used the full transcripts for the analysis, we co-created and discussed the analytical template for the analysis, and we validated the codes and categories created during the analysis with team members. These efforts to unify data collection and analysis and to cross-check the results helped us increase the reliability of the study.

Finally, during the workshops – and especially when talking about needs and expectations of different SPSI actors – we observed that consortium members might have projected their enthusiasm to other stakeholders, so they might nurture a more positive than realistic image of what it takes to engage diverse knowledge- and stakeholders in the future Science Service.

8. Recommendations for the Science Service

As the Discussion section highlighted, despite their large number, already available capacity development options cannot fully address the needs of diverse actors of the SPSI. To meet the demand more effectively, capacity development initiatives could be better targeted and coordinated, and perhaps slightly reconfigured. We have also learned from this deliverable that the BioAgora project and the Science Service alone cannot meet all capacity

needs. It is therefore important to prioritise the needs, select the most pressing and relevant subset to be addressed by BioAgora, and build collaborations to tackle the remaining ones through existing networks and initiatives. Below we list four main considerations which should be addressed when the capacity development function of the Science Service is designed. Afterwards we outline how a combination of functions of the Science Service and specific capacity development activities carried out by existing initiatives and BioAgora could offer targeted solutions to most of the capacity needs identified in this deliverable.

8.1. Key considerations to launch capacity development for SPSIs

Prioritizing capacity development needs. When discussing this deliverable with Bioagora project partners, we asked them to pick the most important capacity needs that should be addressed by Bioagora and the SSBD. When selecting the most important needs, several aspects were worth for consideration: whether a certain need was novel, whether it was feasible to resolve by Bioagora capacity development or through the functions of the SSBD, or if it was a relevant need for partners and the project. Capacity needs from all layers of the onion figure were considered and received at least one vote, with 'Inclusion' and ' Knowledge and data hub' receiving the most.

Clear targeting. Our research has made it clear that there are significant differences between the capacity needs of certain stakeholders, therefore, considerations should be made regarding the target audience and target competencies of planned capacity development activities. It is also important to decide whether the focus should be on specific topics (which means related to the DCs) or on general competencies – interviews related to a certain field have revealed that although almost all capacity needs were identified by the experts, they definitely have varying importance for a given topic.

Coordinating with other actors and across functions of the SSBD. Additionally, a clear distinction is needed between tasks to be undertaken by Bioagora and those to be handled by others. It is advised to avoid duplications with existing initiatives and not attempt to cover every aspect independently. A question arose during discussions about whether capacity development should be a separate function or if it would be more beneficial to merge it with the networking function. The advantages and disadvantages of forming a joint function, supporting a responsive network of networks, need to be further explored.

Selecting tools and techniques. Based on the persona workshop, the core tools and techniques identified for capacity development include networking, filling knowledge gaps in topical areas, training on how the Science Service works, and providing support for early career researchers through small funds. This selection can be complemented and tailored to specific needs based on lessons learned from best practice examples.

8.2. Capacity needs addressed by Science Service functions

The Science Service could play a pivotal role in addressing various capacity needs within and beyond the scientific community. This section aims to distinguish between the capacities that can be automatically fulfilled through the SSBD's functions and those requiring further targeted initiatives. Nevertheless, we need to acknowledge our limitations and discern instances when relying solely on an SPSI may not be enough to address certain capacity needs, necessitating a systemic change for resolution (Table 3).

The first focal point is developing the functions of the Science Service in a way that they can effectively address certain capacity needs through their internal mechanisms. Receiving requests from policymakers, and tailoring research outputs to these incoming questions – as the basic feature of the Science Service – can enhance relevance. The urgent request function (co-creating quick responses to policy queries) can help in harmonising scientific and

policy timelines. The topical network function can help bring together diverse stakeholders and can also harbour more inclusive collaborations between science, policy and society. Searchable databases of previous projects, and horizon scanning for emerging research questions, can help eliminate research gaps, and together with the online platform they can offer a knowledge and data hub for all interested users. Reliability can also be enhanced by applying trusted knowledge synthesis processes.

Another key aspect under consideration is the role of interaction as a capacity development tool and looking at SPSIs as an ongoing learning experience. This iterative nature allows for dynamic adjustments, facilitating the enhancement of capacities over time, not just within the BioAgora consortium, but also beyond through the activation of topical networks. Since providing a detailed guide on how capacity needs can be assessed and developed iteratively would stretch the limits of this deliverable, the WP5 team will continue working on such a guidance document to support collaborative work in the topical networks.

Despite the automatic solutions offered by the SSBD, these findings suggest that certain capacity needs require further targeting. This could either be achieved through capacity development by BioAgora or via collaboration with other existing initiatives such as those offered by JRC, CIHEAM or Future Earth. By identifying and addressing these specific needs, a more comprehensive and effective capacity development strategy can be established.

8.3. Capacity needs addressed by targeted capacity development activities

Based on the four considerations listed in section 7.1 and the best practice examples explained in section 5.2, we suggest three different types of capacity development activities to be pursued by the future Science Service. Two of them could be co-organized with external partners, while the third option could be inherent to BioAgora and the future Science Service.

1) General training on SPSI skills and competencies (already available through JRC)
   - Target groups: researchers and policymakers at all levels of seniority
   - Addressed needs: communication, inter- and transdisciplinarity, policy literacy, relevance, personal time management
   - Expected outcomes: improved understanding of how science-policy-society interactions work, improved skills and competences to co-produce knowledge and communicate across knowledge domains
   - Modalities: online or offline interactive trainings for a few days accompanied by various online materials, costs covered by the organization whose employees participate in the training
   - Rationale: the JRC Evidence4Policy has a well-structured training opportunity which is now available not just through JRC but through a network of trainers operating all over Europe and trained by JRC. BioAgora and the future Science Service could advertise this learning opportunity among scientists and policymakers joining the topical networks as a great starting point to get more acquainted with science-policy-society interactions.
   - Potential enhancements: through collaboration with JRC it could be possible to add a short session on how the Science Service works in general, and what possibilities exist to participate in it.

2) Topic-centred capacity development to enhance the implementation of the BDS2030 (in collaboration with already existing training programmes)
   - Target groups: policymakers, public administration officers, practitioners
   - Addressed needs: knowledge and data hub, eliminating research gaps, bringing people together, relevance
   - Expected outcomes: best available scientific knowledge is channelled directly into the implementation of BDS2030, enhanced on-the-ground implementation of biodiversity policies

- Modalities: self-financed, in-person interactive trainings for a few days focusing on key topical issues (i.e., knowledge, tools, techniques to be used to support the implementation of specific BDS2030 targets)
- Rationale: BioAgora demonstration cases and topical networks can offer scientific insights across various topics (e.g., freshwater conservation, pollination, marine ecosystems, urban nature-based solutions) that are relevant for those actors who are directly involved in the implementation of the BDS 2030. While existing networks offer several different topical capacity development options, these are often weakly targeted and not effectively reaching the on-the-ground implementers. On the other hand, long-established training centres have wide networks, well-designed processes and existing infrastructure. Therefore, BioAgora could forge collaborations with such training centres (e.g., CIHEAM) and launch joint trainings where the content and trainers are provided by DCs or topical networks of the SSBD, while professional organization is offered by training centres.
- Potential enhancements: reduced rates or free participation could be offered for disadvantaged participants (e.g., eastern European participants, small businesses or representatives of societal groups)

3) Raising a new cohort of boundary spanners
   - Target groups: mid-career researchers and policymakers
   - Addressed needs: complexity, inclusion, bringing people together, diverse values and worldviews, inter- and transdisciplinarity, competences to co-produce knowledge, institutional support
   - Expected outcomes: increased number of experts (boundary spanners) who can co-ordinate and manage inclusive and impactful science-policy-society interactions, enhancement of both individual and organizational capacities
   - Modalities: in-person interactive training for a few days using real-life examples and focusing not just on individual skills but also on developing shared understandings and changing mindsets. Trainings could be offered to a limited number of engaged participants on a yearly basis and complemented with online mentoring.
   - Rationale: several interviews highlighted the lack of human resources, the lack of skilled facilitation and clear procedures to co-create knowledge, the lack of common understanding and language etc. as key barriers to effective science-policy-society interactions. Overcoming these obstacles require enhanced individual skills but at the same time improved organizational capacities, too. An in-depth training could be launched which could focus on raising a new cohort of boundary spanners: skilled researchers and policymakers who know both worlds and who are also skilled to engage with societal actors, and who could be employed later in boundary organizations (e.g., the SSBD or the KCBD itself, or intergovernmental science-policy initiatives, or national policy labs).
   - Potential enhancements: the training could be paired with paid fellowship at the Science Service (or KCBD) to also enhance institutional capacities; collaboration with the IPBES capacity building task force, Future Earth and similar intergovernmental initiatives could be fostered (i.e., joint trainings, or short-term visiting fellowships could be offered)

Table 3 Potential ways of addressing capacity needs through BioAgora and the SSBD. The number of smiles indicate how well-suited are the specific functions or capacity development activities are to address the given need (based on authors' expert opinion).

Capacity development needs	SSBD functions on...				Capacity development targeting...		
	Answering requests	Topical networks	Database & online platform	Horizon scanning	General SPI skills	Implementation of BDS2030	Boundary spanners
Communication		☺	☺		☺☺☺		☺
Diverse values and worldviews							☺☺☺
Bringing people together		☺☺☺				☺☺	☺☺
Inclusion		☺					☺☺☺
Personal time management					☺		
Transparent decision making	*SSBD has indirect or no influence*						
Vested interests	*SSBD has indirect or no influence*						
Inter- and transdisciplinarity					☺☺☺		☺☺☺
Reliability	☺☺☺	☺☺☺	☺☺				
Institutional support					☺		☺☺
Complexity							☺☺☺
Harmonized timelines	☺☺☺					☺	
Competences to co-produce knowledge							☺☺☺
Policy literacy					☺☺☺		
Relevance	☺☺☺			☺☺☺	☺☺	☺☺☺	
Knowledge and data hub			☺☺☺			☺☺☺	
Funding	*SSBD has indirect or no influence*						
Eliminating research gaps			☺☺	☺☺☺		☺☺	

8.4. Reflections and next steps

One of the most important lessons learned from preparing this deliverable is that the starting point for capacity development should be to work on the capacity needs of project participants, i.e. us. It should begin with internal collaboration, especially with the inclusion of DC leaders into compiling deliverables, which has already proven to be a great start. The preparation of this deliverable was a first attempt to show how such internal collaboration and learning can be integrated into the processes of the Science Service.

Throughout the research process, we held online workshops with DC leaders to identify their perceived capacity needs and then brainstormed interview questions together. Then we also compiled the list of interviewees together, and the relevant DC leader always joined the interviews – this, in itself, was a networking exercise, responding well to the Bringing people together and Communication capacity needs, and in some cases also allowing for a better understanding of each other's values and worldviews, e.g. between scientists and business actors. In addition, DC leaders were able to present the project and the topical network of DCs, thus these

discussions provided them a safe space to test and to get expert ideas for further development. The face-to-face persona workshop also provided a platform to test our preliminary research findings, where we were able to brainstorm with our project partners on the role of potential stakeholders in the Science Service. Moreover, to write this conclusion, we also held two online open offices where we could brainstorm together on the main lessons learned and answer any questions from our partners, including DC leaders. Collaborative work will continue after this deliverable has been submitted: we will test and further develop our findings in workshops held at conferences. These were also co-designed and -created with DC leaders, providing opportunities for interdisciplinary collaboration between natural and social scientists to enrich each other's knowledge, e.g. in facilitation.

In summary, the SSBD's dual approach, encompassing both inherent functionalities and targeted initiatives, could be essential in addressing diverse capacity needs. Recognizing the Science Service as an iterative learning process and evaluating its automatic solutions paves the way for a nuanced understanding of how capacity development can be optimized in SPSIs.

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8. Appendix

8.1. BioAgora Task 5.1 interview guide for scientists

My name is XY [name and organisation of the interviewer] and I would like to ask your help to share with me your insights about what conditions impede effective and well-functioning interactions between science and policy

regarding biodiversity. I am participating in a Horizon Europe project, BioAgora, which aims to set up a European Science Service to help ratchet up the EU Biodiversity Strategy by providing timely and relevant scientific knowledge for decision-makers. As one of the starting points of this project, we assess the capacity gaps of different actors to ensure openness and diverse ways of participation and use of the Science Service for different stakeholders. Beside analysing official documents and the scientific literature, we would also like to talk to experts who work in relation to our main demonstration cases: pollination, freshwater and nature-based solutions. Considering your experience in the field of [...], we believe your views would be highly beneficial for our understanding. The interview would last for approximately 1 hour, and the interview notes will be anonymised before further analysis (your name and position will not appear in any written material, nor will replies be easily tracked back to you). Before starting the interview, please read and sign the GDPR consent form.

Introduction

- Could you please briefly introduce yourself and your work?
    - If not mentioned: Do you have direct experience with science-policy interactions, e.g., supporting your national government as an advisor, or participating in IPBES or Eklipse?
    - If not mentioned: How does your work relate to biodiversity?
- In your opinion, how much does your work influence biodiversity-related policy decisions? (e.g. Do you participate in or influence the formulation of policies; produce knowledge for, or disseminate knowledge to policymakers, etc.)?
    - Is there a specific project that you can think of that was really impactful policy-wise? What made it impactful?
- How do you think your work should influence biodiversity-related policy?
- How do you see the role of society (grassroots, INGOs) in the science-policy interface?

Capacity gaps based on personal experience

- Do you encounter any difficulties working across disciplines and/or with different knowledge types for biodiversity conservation? If yes, could you give some examples?
- Do you encounter any difficulties understanding or influencing the policy process? If yes, could you give some examples?
- What would you like policymakers to better understand about the scientific process/ knowledge-production process/the way science works?

Capacity gaps more generally

- What capacity gaps can you identify, when you think of capacities that enable knowledge co-production at the science-policy interface?
    - Who are those actors that especially lack these capacities?
    - Please think on both personal skills and institutional resources.

Way forward

- What abilities, skills, or tools can you identify that would help the Science Service foster the co-production of knowledge between scientists and policymakers and other relevant actors (business, civil society)?
- Do you have any best practice examples on how to improve these abilities/skills; or have you been part of capacity-building trainings that were impactful in this regard?

Potential interviewees

- Who do you think we should interview (what company, NGO, or specific individuals)?

Closing section

- We are approaching the end of our discussion. Is there anything else you would like to add, e.g. something you think is important but we haven't discussed it yet?
- If not, then I would like to thank you for your time. If you have any further questions or ideas, please, do not hesitate to reach out to us.

8.2. BioAgora Task 5.1 interview guide for policymakers

My name is XY [name and organisation of the interviewer] and I would like to ask your help to share with me your insights about what conditions impede effective and well-functioning interactions between science and policy regarding biodiversity. I am participating in a Horizon Europe project, BioAgora, which aims to set up a European Science Service to help ratchet up the EU Biodiversity Strategy by providing timely and relevant scientific knowledge for decision-makers. As one of the starting points of this project, we assess the capacity gaps of different actors to ensure openness and diverse ways of participation and use of the Science Service for different stakeholders. Beside analysing official documents and the scientific literature, we would also like to talk to experts who work in relation to our main demonstration cases: pollination, freshwater and nature-based solutions. Considering your experience in the field of [...], we believe your views would be highly beneficial for our understanding. The interview would last for approximately 1 hour, and the interview notes will be anonymised before further analysis (your name and position will not appear in any written material, nor will replies be easily tracked back to you. Before starting the interview, please read and sign the GDPR consent form.

Introduction

- Could you please briefly introduce yourself and your work?
- How does your work relate to biodiversity?
- In your opinion, how much can knowledge holders (incl. science but also other societal actors) influence biodiversity-related policy decisions?
    - Could you briefly explain how you see the interaction between science and policy in your own field?
    - How do you see an effective relationship between science and policy?
    - What do you think serves the best interest of effective policymaking for biodiversity and society – a more linear approach to science-policy interactions (i.e., where science provides data and knowledge upon request) or a more co-production approach (i.e., where scientists, policymakers and practitioners learn from each other and work together to solve specific problems), or something in between these two?
    - How do you see the role of society (social actors) in the science-policy interface?

Capacity gaps

- What impedes the integration of knowledge in policymaking?
    - You can think of knowledge integration across sectors and scales
    - You can think of how to break down silos of knowledge
    - How to facilitate the co-production of knowledge
- What is it that scientists would need to better understand about your work / do not understand about your work (or the policy process)?
- What is it that you would need to better understand about the work of scientists?
- Are there any skills, tools, or knowledge that would aid effective science-policy interaction but that are currently missing – either at the side of the knowledge provider or the knowledge user?
- Are there institutional capacities that are missing / would need to be strengthened?

Potential interviewees

- Who do you think we should interview (what company, NGO, or specific individuals)?

Closing section

- We are approaching the end of our discussion. Is there anything else you would like to add, e.g. something you think is important but we haven't discussed it yet?
- If not, then I would like to thank you for your time. If you have any further questions or ideas, please, do not hesitate to reach out to us.

8.3. Bioagora Task 5.1 interview guide for NGO representatives

My name is XY [name and organisation of the interviewer] and I would like to ask your help to share with me your insights about what conditions impede effective and well-functioning interactions between science and policy regarding biodiversity. I am participating in a Horizon Europe project, BioAgora, which aims to set up a European Science Service to help ratchet up the EU Biodiversity Strategy by providing timely and relevant scientific knowledge for decision-makers. As one of the starting points of this project, we assess the capacity gaps of different actors to ensure openness and diverse ways of participation and use of the Science Service for different stakeholders. Beside analysing official documents and the scientific literature, we would also like to talk to experts who work in relation to our main demonstration cases: pollination, freshwater and nature-based solutions. Considering your experience in the field of [...], we believe your views would be highly beneficial for our understanding. The interview would last for approximately 1 hour, and the interview notes will be anonymised before further analysis (your name and position will not appear in any written material, nor will replies be easily tracked back to you). Before starting the interview, please read and sign the GDPR consent form.

Introduction

- Could you please briefly introduce yourself and your work?
- How does your work relate to biodiversity management?
- In your opinion, how much can (and should) knowledge holders (incl. science but also other societal actors) influence biodiversity-related policy decisions?
- How do you think policymakers consider and operationalize science in the policy process?
- How do you use scientific results to influence policymaking? / How do you use knowledge in your work processes to influence policy making?
- What is the role of science and other social actors (incl. NGOs, business, society at large) in effective policymaking?
- What do you think serves the best interest of effective policymaking – a more linear approach to science-policy interactions (i.e., where science provides data and knowledge upon request) or a more co-production approach (i.e., where scientists, policymakers and practitioners learn from each other and work together to solve specific problems), or something in between these two?

Capacity gaps

- Do you encounter any difficulties when interacting with scientists or policymakers in your work in biodiversity management (or else, if their focus is different)?
- What would you like scientists and policymakers to understand about your work?
- How much does your work influence biodiversity-related policy decisions? In what way? (e.g. Do you participate in knowledge production, sharing, or policy formulation/implementation?)
- Is there anything that hinders your capacity to effectively participate in the co-production of knowledge related to your field (either at the policy or the science side – contributing to biodiversity knowledge production or policy formation)?
- What capacities are lacking that could enable knowledge co-production for better decisions on biodiversity [i.e. freshwater, pollination, NbS]?

Potential interviewees

- Who do you think we should interview (what company, NGO, or specific individuals)?

Closing section

- We are approaching the end of our discussion. Is there anything else you would like to add, e.g. something you think is important but we haven't discussed it yet?

- If not, then I would like to thank you for your time. If you have any further questions or ideas, please, do not hesitate to reach out to us.

8.4. BioAgora Task 5.1 interview guide for business actors

My name is XY [name and organisation of the interviewer] and I would like to ask your help to share with me your insights about what conditions impede effective and well-functioning interactions between science and policy regarding biodiversity. I am participating in a Horizon Europe project, BioAgora, which aims to set up a European Science Service to help ratchet up the EU Biodiversity Strategy by providing timely and relevant scientific knowledge for decision-makers. As one of the starting points of this project, we assess the capacity gaps of different actors to ensure openness and diverse ways of participation and use of the Science Service for different stakeholders. Beside analysing official documents and the scientific literature, we would also like to talk to experts who work in relation to our main demonstration cases: pollination, freshwater and nature-based solutions. Considering your experience in the field of [...], we believe your views would be highly beneficial for our understanding. The interview would last for approximately 1 hour, and the interview notes will be anonymised before further analysis (your name and position will not appear in any written material, nor will replies be easily tracked back to you). Before starting the interview, please read and sign the GDPR consent form.

Introduction

- Could you please briefly introduce yourself and your work?
- How does your work relate to biodiversity management?
- In your opinion, how much can (and should) knowledge holders (incl. science but also other societal actors, including business actors) influence biodiversity-related policy decisions?
- In your opinion, how should policymakers include/use science in their work?
- How do you use scientific knowledge to influence policymaking on biodiversity?

Capacity gaps

- Do you have any interactions with scientists and/or policy makers in your work? If yes: Do you encounter any difficulties when interacting with scientists or policymakers in your work in biodiversity management (or else, if their focus is different)?
- What would you like scientists and policy makers to understand about your work?
- How much does your work influence biodiversity-related policy decisions? Why? (e.g. Do you participate in knowledge production, sharing, or policy formulation/implementation?)
- What capacities (personal or institutional) would be needed to mainstream biodiversity conservation (or freshwater protection, etc.) in the business sector?
- Is there anything that hinders your capacity to effectively participate in the co-production of knowledge related to your field (either at the policy or the science side – contributing to biodiversity knowledge production or policy formation)?
- What capacities are lacking that could enable knowledge co-production between businesses, scientists, policymakers and other relevant social actors for better decisions on biodiversity [i.e. freshwater, pollination, NbS]?

Potential interviewees

- Who do you think we should interview (what company, NGO, or specific individuals)?

Closing section

- We are approaching the end of our discussion. Is there anything else you would like to add, e.g. something you think is important but we haven't discussed it yet?

- If not, then I would like to thank you for your time. If you have any further questions or ideas, please, do not hesitate to reach out to us.

8.5. BioAgora interview guideline for key informants in Task 4.1

BioAgora aims to set up the Science Service on Biodiversity for the European Union. Before deciding on the main functions and processes of this Science Service, we would like to learn from the experience of other organizations being active in this field. This expert interview aims to understand your organization's position, best practices and expectations to develop a well-functioning Science Service.

Position of the organization in the SPI landscape

- How would you explain your organisation's role in relation to the EU Biodiversity Strategy?
- Does your organization interact with the EU Biodiversity Platform? If yes, could you briefly explain how?
- Who are those actors with whom you're collaborating the most?
- Are there any relevant actors whom you are missing a strong connection with, or whom you would like to develop a stronger collaboration?

Governance mechanisms

- Could you explain some of your organization's best practices to achieve (policy) impact?
- Do you have any best practices that ensure the inclusivity of knowledge generation / knowledge sharing processes?

Capacities

- Have you experienced any capacity gaps (i.e., lack of individual skills and competences or lack of institutional resources and conditions) that hinder effective science-policy interactions with regard to biodiversity issues? If yes, could you provide some examples?
- Which types of capacity development initiatives does your organization have, if any? What do these initiatives hope to achieve?

Future expectations

- In your opinion, what is missing in the Biodiversity SPI landscape to change the status quo / achieve institutional transformation?
- How do you imagine a new actor like the science service could help you achieve your organization's mission with regard to biodiversity mainstreaming?
- Do you have any specific expectations or suggestion in terms of which functions or services should be provided by the science service? If yes, please briefly explain.

Social Network Analysis

- Before closing the interview, we would like to go through a quantitative question, which help us assess the landscape of actors at the science-policy interface. Therefore, we would like to ask a multiple-choice question where relationships between your organization and other relevant organizations could be mapped. We will do this by using an online platform, to more easily administer your responses.

Closing

- We would like to keep in touch with you and engage your organization in developing the Science Service, therefore we would like to know if there are other colleagues within the organization whom we can potentially contact later on. The interview should end by asking whom we should contact if we need further

information about the themes of the different tasks, so that we also imply that it would be an ongoing conversation.

- It's important to know what type of research needs to be conducted to reach the BDS goals. Is your organization involved in any activities that help defining such research needs? (These activities could, for example, involve identifying important knowledge gaps by searching literature, by interviewing stakeholders, by organizing workshops or by scanning for future threats in the horizon.) If yes, Please, provide a name for a contact person we could invite for a further interview of the topic.
- We are also interested whether you identified knowledge gaps about how previous data, tools, projects fed into the Biodiversity Strategies implementation. Or maybe you have personal experience with EU projects/ data that helped the BDS strategies? If yes, Please provide a name for a contact person we could invite for a further interview of the topic.
- Do you have any other people in mind within or beyond your organization you think would be important for us to contact? If yes, please provide a name for the contact person(s)

8.6. BioAgora Task 5.1 – Capacity Building Questionnaire

We are researchers working on the Horizon Europe project BioAgora, which aims to set up a European Science Service to help ratchet up the EU Biodiversity Strategy by providing timely and relevant scientific knowledge for decision-makers.

We would like to ask for you to share with us your insights about what conditions impede effective and well-functioning interactions between science and policy regarding biodiversity. As one of the starting points of this project, we assess the capacity gaps of different actors to ensure openness and diverse ways of participation/use of the Science Service for different stakeholders. Besides analysing official documents and the scientific literature, we would also like to engage experts directly through this questionnaire. We believe your views will be highly beneficial for our understanding. The questionnaire is approximately 10 minutes long, and it is anonymous. If you have any questions, feel free to reach out to us.

Thank you in advance for filling out the questionnaire!

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Introduction

1) What is your disciplinary background?
    - natural science
    - social science
    - legal
    - transdisciplinary
    - other:.....
2) What is your institutional background?
    - governmental body
    - university / independent research organization
    - business organization (e.g. consultancy, etc.)
    - NGO
    - other, please explain:
3) In your opinion, how much does your work influence biodiversity-related policy decisions? (e.g. Do you participate in or influence the formulation of policies; produce knowledge for, or disseminate knowledge

to policymakers, etc.)? Please, indicate your perceived influence on a scale from 1 to 6, where 1 means that you think your influence is not relevant at all, and 6 means that you think it is highly relevant in biodiversity-related policy decisions.

Participation in SPI(s)

4) Have you ever been involved in a science-policy interface (SPI) as a scientist?
    - Yes
    - No
    - I don't know
5) If the answer to the previous question is 'yes': Can you share the name of the SPI(s) or describe it in a few words? ...
6) If the answer to the 4th question is 'yes': Have you noticed any capacities listed below missing when participating in the SPI(s)? You can select more options from the list. (multiple choice)
    - Communication and networking abilities and opportunities between scientists and policymakers
    - Scientists' competences to co-produce knowledge across different disciplines and knowledge types (e.g., skills to conduct transdisciplinary research)
    - Scientists' understanding of the policy process and of how and at which points the policy process can be influenced
    - Policymakers' understanding of scientific concepts and processes (e.g., different levels of uncertainty)
    - Motivating and rewarding institutional structures (e.g., efficient incentive systems) for scientists
    - Sufficient time allocated for collaborative work (knowledge synthesis, co-production) between experts or between experts and requesters
    - Other, please explain:

Existing Capacity Gaps

7) In your opinion, what makes it difficult to build the latest scientific results into the design and implementation of biodiversity policies? Please assess the relevance of the following difficulties on a scale from 1 to 6, where 1 means that the given difficulty is not relevant at all, and 6 means that the given difficulty is highly relevant.
    - Policy decisions are done much quicker than the lifecycle of science, which puts a high pressure on research and evidence synthesis.
    - Policy decisions need to consider several different arguments, science is only one of those and not necessarily always the priority.
    - There are not enough opportunities to discuss relevant questions face-to-face, including both for scientists and policymakers.
    - Policymakers do not grasp the complexity of scientific work.
    - Policy decision-making focuses on different questions than scientific research.
    - Scientific results are not easily accessible for policymakers (i.e. published in journal articles or long research reports which are hard to find / understand).
    - It is difficult to synthesize different knowledge types for biodiversity conservation.
    - It is difficult to understand the policy process and to know where and how scientists could best influence decision-making.

Capacity building solutions

8) What capacity building methods would you find most useful for improving the functioning of the SPI/ co-production of knowledge between scientists and policymakers? (Rate the options from 1 to 6 where 1=not efficient and 6=highly efficient way of building capacities. Write 0, if you do not know the method.)
    - Tailor-made online training materials on specific topics
    - Online handbooks

- Multi-stakeholder platforms for regular science-policy interactions
- Immersive capacity development activities (e.g. summer schools, residencies)
- Longer term mentoring programs or fellowships
- Scientific study trips for policymakers
- Face-to-face dialogue or trialogue processes between science, policy, and practice
- Organized field trip with different stakeholders
- Organizational development (i.e., programs that can influence organizational culture or processes)
- Multi-disciplinary communities of practice (e.g. CIRIA Biodiversity Community of Practice)
- Open day for knowledge sharing about scientific and policy work (What does a scientist/policy maker do in a day?)

9) Is there other capacity building methods that you find useful but were not included in the list? …
10) According to your opinion, in a scale from 1 to 6 (max), what is the best incentive for scientists to dedicate their time and expertise in a science-policy interface regarding biodiversity and ecosystem services?
    - Focus on a thematic area close to their scientific interests
    - Opportunity to work closely for/with policymakers or key stakeholders to achieve knowledge-based policy impact
    - Publish peer-reviewed papers and policy relevant reports
    - Network and collaborate with other experts working in the same scientific area
    - Valorisation of activities in career
    - Network and collaborate with other experts working in other scientific areas
    - Network and collaborate with other knowledge holders as local or indigenous knowledge holders and practitioners
    - Support from institution
    - Financial support or reward

8.7. BioAgora Task 2.1 survey questions on capacities

This is only an excerpt of the online questionnaire used in Task 2.1. For the full questionnaire please check Deliverable D2.1 (D'Amato et al., 2023).

- What hinders the effective use of available knowledge towards the implementation of the EU Biodiversity Strategy 2030?
- How do you imagine the Science Service could support or hamper the implementation of the EU Biodiversity Strategy 2030?
- What kind of actors should participate for the Science Service to be effective, credible and inclusive?
- What relations could your organization have with the Science Service, and at which conditions?
- What measures would enable the effective participation of your organization and its members in the Science Service, including in terms of capacity building?
- If your organisation is involved in a) horizon scanning, b) capacity building, or c) identifying knowledge needs/research gaps, please suggest people within your organization who can be contacted for further information about these activities.
- Do you have any other comments?