Knowledge needs to support Nature-Based Solutions: Results from a survey of international experts
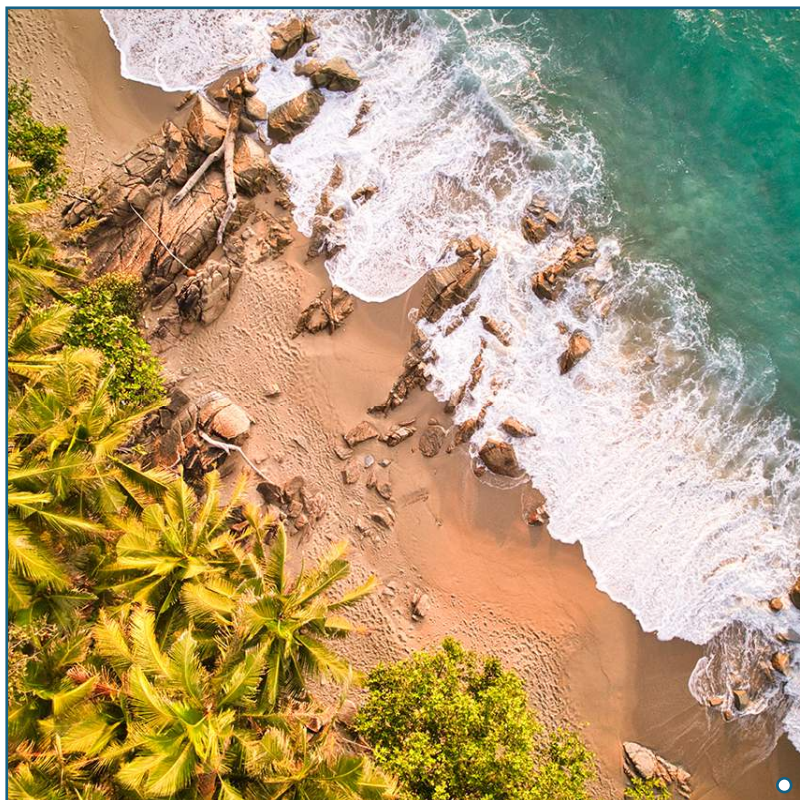
Authors: Kerry Waylen, Eilidh Dillon & Keith Marshall

Kerry.Waylen@hutton.ac.uk

Social, Economic and Geographical Sciences Department, The James Hutton Institute, Aberdeen, Scotland, AB15 8QH

Summary

Understanding how knowledge can support and strengthen Nature-Based Solutions (NbS) is an important subject. It is also a challenging one, given the holistic and inclusive remit of NbS projects, and the many and varied forms and sources of knowledge that may be relevant. For example, what are the multiple issues that we need to track and understand? How can we practically elicit and articulate different knowledge systems? How can we fairly discuss and connect different viewpoints? We know that we likely need to collect and connect a range of knowledges – from a range of sources, on a range of topics – in order to support NbS; and that doing so is unlikely to be simple or easy. However, there are no reports of practitioners' experiences that are focused on this subject.

This report provides the results of a first exploratory study on practitioners' views of knowledge in and for NbS. We share the results of a survey of 14 international experts with experience in developing projects according to the IUCN Global Standard on Nature-Based Solutions (IUCN, 2020b). We probed their experiences in collecting and using knowledge to support NbS. The Global Standard provides 8 criteria to guide the development of NbS projects, which together reflect best practices in adaptively working with society and nature; we therefore structured several of our questions according to these criteria. We also asked for general recommendations and reflections on supporting knowledge use for NbS. The survey was distributed in July-August 2025. It was distributed using Qualtrics and analysed to present simple descriptive statistics and summaries of the key themes in open text responses.

We found that all respondents valued mixing different forms of knowledge to support NbS. The sources of knowledge varied from local community surveys, through to scientific reports and models; however, the precise mix and topic varied by project. Furthermore, it seemed likely that some projects are more 'data rich' than others; and that some projects have more capacity and remit to find or collect new sources of information. However, no respondent had complete confidence in their understanding of all criteria of NbS, all of which must be considered in order to develop effective and equitable NbS. Furthermore, all respondents reported some challenges in finding the knowledge they needed. There was the least confidence in the topics of economics and trade-offs, whereas biodiversity and ecosystem integrity was the best understood topic.

Interim implications are that it would be valuable to provide any guidance or support that strengthens how project leads collect and work with different forms of knowledge. This may be especially valuable for the topics of economics and trade-offs. However, it is important that to balance attention to all topics and aspects of NbS; and to using knowledge across all aspects and phases of project development.

This report provides priorities for future discussion with these respondents, which will refine our understanding of the challenges and opportunities to strengthen knowledge use for NbS. We expect to carry out these discussions early in 2026. We will then identify more specific implications, including for Scotland, where the authors of this report are based.

Contents

Acronyms used in this report

CEM	IUCN Commission on Ecosystem Management
IUCN	World Union for Nature Conservation
NbS	Nature-based Solutions

1. Introduction

The creation and use of knowledge is a key issue in environmental governance (van der Molen, 2018). Understanding our environmental problems, their causes and potential responses is needed to inform and enable sustainable development. Over past decades this has spurred many areas of scientific research and enquiry. However, today it is increasingly appreciated that non-scientific sources of knowledge are important, as part of diverse nature-related knowledge systems (Diaz, 2015). Furthermore, it has become clear that mere availability of any knowledge does not automatically translate into action (O'Brien, 2013). So, better understanding what knowledges are needed, and how to share and use them, is important to help improve natural resource management.

Nature-Based Solutions (NbS) are a key concept in contemporary natural resource management. We define NbS as per the International Union for Conservation of Nature (IUCN), as "*actions to protect, sustainably manage, and restore natural or modified ecosystems, which address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits*" (IUCN, 2020b). In other words, NbS entail working with nature to tackle societal challenges. NbS are potentially very diverse, since this work can be carried out in a wide range of settings, anything from tundra to alpine forests to coasts; to tackle different challenges ranging from flood risk mitigation to improving agricultural climate resilience. However, in all cases it is important that NbS follow the 8 criteria established by the IUCN Global Standard (Figure 1), in order to reflect best-practice guidance about how to work with society in and for nature.

There is agreement that different forms and sources of knowledge will be required to enable NbS: in particular, the Global Standard emphasises the need for NbS to be evidence-based, and also to value and empower local and indigenous stakeholders and their values (IUCN, 2020a). However, knowledge has not been a strong focus for work on NbS, beyond calls to recognise different types of knowledge and perspectives, particularly local and indigenous ones (e.g. Cottrell, 2022; Yu & Mu, 2023). Given that working with multiple and dynamic knowledge systems can be very challenging (Cornell et al., 2013) it is important to understand more about knowledge needs and tactics that could help to strengthen knowledge sharing and use for NbS.

This is the challenge addressed by this study. Our objective is to provide a first exploratory study of the range of knowledges needed and sought and used in order to support all aspects of NbS. We do this by surveying NbS expert practitioners with a range of experiences, asking:

- Is there access to knowledge needed to support NbS?
- What types or sources of knowledge are used to support NbS?
- How is that knowledge found and used?

We explore these questions with expert practitioners who are already familiar with NbS (see section 2.1) to capture identify cross-cutting themes in knowledge use that may transcend different NbS contexts.

1.1. Background

This section briefly expands on why knowledge matters to NbS, and aspects that need more attention.

Knowledge is inherent to NbS, which seek to develop new interventions to work with nature. Their multifunctional, inclusive and holistic ethos implies a range of topics and types of knowledge should be relevant and used. A useful guide as to the range of topics relevant to NbS is indicated by the subject matter of the 8 criteria (Figure 1) that should be followed when developing NbS as per the Global Standard (IUCN, 2020a). For example, subjects or topics relevant to NbS may range from ecology, through to understanding local infrastructure problems, through to how to complete funding applications (Frantzeskaki et al., 2019). Expertise on these topics may come from anyone from local community members, through to policymakers,

to scientists (e.g. Sangha et al., 2025), entailing not only interdisciplinary but transdisciplinary approaches to understanding (Frantzeskaki et al., 2025). These insights may all be captured, articulated and shared in a variety of ways, from oral stories through to models, maps and written reports. Recognising all knowledges is important in order to reflect the ambitions of NbS to reflect and address local concerns, and to be inclusive and empowering for local communities.

However, recognising and connecting different knowledges is not likely to be a trivial challenge. Instead, tackling complex – even 'wicked' – sustainability challenges such as NbS requires the connection of multiple knowledge systems (Termeer et al., 2015) to span multiple topics and concerns, particularly when working inclusively or holistically to balance multiple goals (Sievers et al., 2024; Welden et al., 2021). Active efforts to support knowledge sharing and use are likely important, framed as a dynamic and complex process (Jasanoff, 2004). Put simply, it is not likely that the views of every stakeholder on every topic can be articulated, shared and perfectly merged and easily acted on. However, nor is it acceptable to ignore or under-value some sources and topics of knowledge. So, more attention to knowledge is needed. Better understanding how to work with knowledge may offer a key lever to enabling NbS that will be truly just and transformative (Diep & McPhearson, 2025).
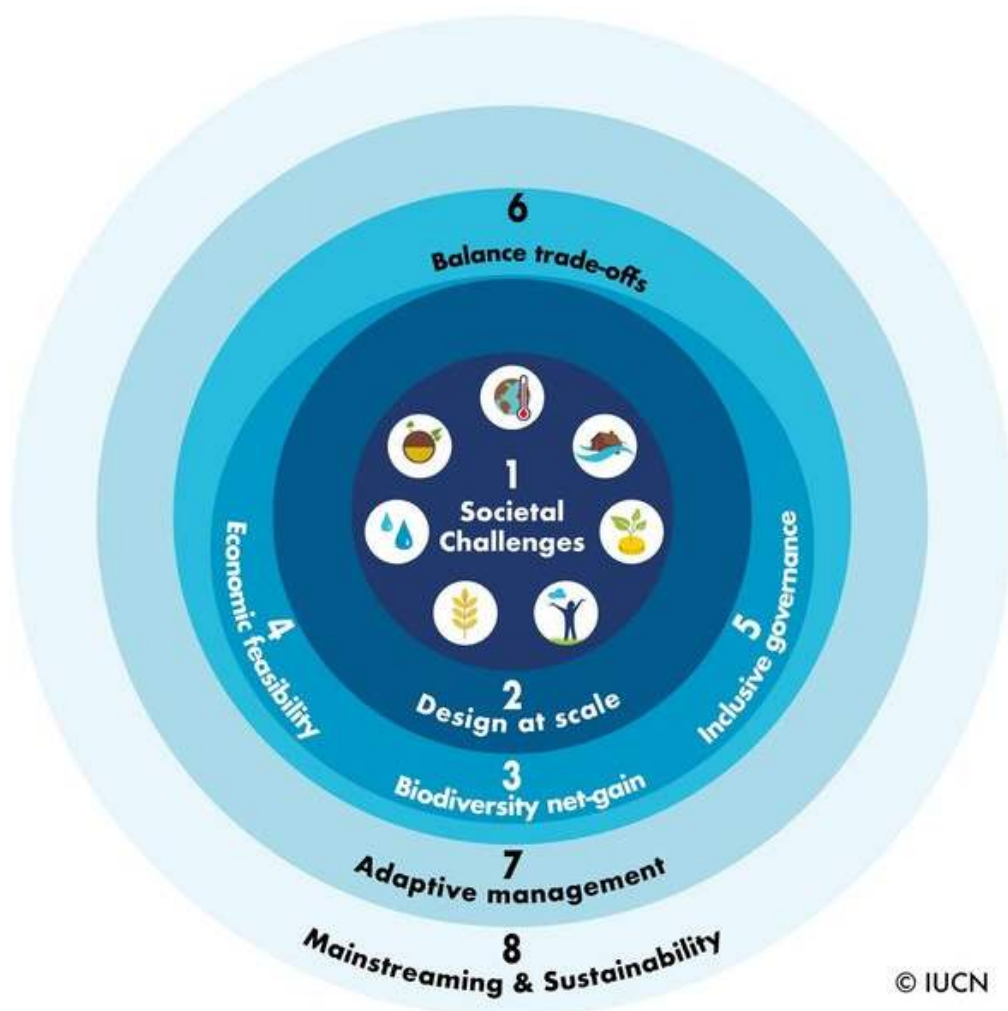

Figure 1 The eight Criteria that make up the IUCN Global Standard for NbS are all interconnected (© IUCN) Taken from the Guidance for using the IUCN Global Standard for Nature-based Solutions: first edition.

A variety of typologies of knowledge types exist (Díaz et al., 2015). They do not provide a single convenient guide to categorising different knowledges, but draw attention to potentially multiple and intertwined forms and aspects of knowledge, in terms of topics, sources, types and formats. For this study we suggest it is useful to distinguish between informal and formal knowledges. We define informal knowledge as local stakeholders' experience, expertise and 'know how; whilst formal knowledge is associated with information from scientists and professional agencies, usually in reports. This distinction is intended as a heuristic to prompt reflection on the range of knowledges, rather than a perfect or discrete categorisation of knowledge types. It primarily draws attention to the providers or sources of knowledge. However, it also relates to the formats by which knowledge is presented or articulated, as we expect that local and indigenous knowledges systems are less likely to be appropriately documented in a written format (Fernández-Llamazares et al., 2021). Furthermore, the distinction interrelates with topics, as we expect some topics or subjects are less likely to be formally captured in reports or thought of as information needed to plan NbS. It is known that ecology and natural science information tends to dominate what is thought of as 'data' that is relevant to planning projects, although wider knowledges are actually also needed (Waylen & Blackstock, 2017), such as 'know how' to operate machinery, or ability to apply for grants.

Therefore it is useful to explore the different types of knowledges that are in use in NbS. However, it is important to acknowledge that fully itemising knowledge needs and uses for any individual or project would be prohibitively exhaustive. Therefore, a simple structure or typology of knowledge types would be helpful; to prompt for a variety of knowledge uses, without requiring encyclopaedic descriptions. In this study we therefore distinguish between formal and informal sources and forms of knowledge; whilst to understand different knowledge topics we use 8 criteria of the first edition of the NbS Global Standard (Figure 1). Using the global standard will help understand if all aspects of NbS design are considered equally: it may also permit later identification of any links between knowledge needs and case study design and progress, which have been evaluated in terms of the same criteria (Cohen-Shacham et al., 2025).

2. Methods

This research design received prior approval (#0316) from the James Hutton Institute human ethics committee. All data collected were processed and managed in accordance with UK and EU GDPR.

2.1. Targeting international experts

Studying a range of NbS cases is useful to give understanding of the range of knowledge uses and needs relevant to NbS, and to help identify any cross-cutting themes. We therefore contacted experts linked to the development of the IUCN Global Standard for NbS by the IUCN Commission on Ecosystem Management[1] to seek their assistance in identifying a relevant range of case studies aligned with NbS. They agreed that the topic of knowledge was an important one, and they kindly offered to share our questions with contacts who had recently provided information on 21 cases to inform a study of NbS best practice. Using these contacts allowed us to target experts and also removed the need for us to decide or explain what 'qualifies' as NbS.

At the time that our research survey was designed and distributed, the report sharing details of the case studies had not been published; whilst to respect confidentiality, the Hutton authors of this report had no access to the detail of the data or draft IUCN report. The report was published in July 2025 (Cohen-Shacham et al., 2025) just as this report was being finalised. Therefore, the design of our survey was not influenced by any knowledge of these cases.

---

[1] https://iucn.org/our-union/commissions/group/iucn-cem-nature-based-solutions-thematic-group

2.2. Data collection and analysis

The purpose of the survey was to probe the range of knowledges used to support NbS, with a particular focus on each of the criteria of the IUCN Global Standard for NbS (IUCN, 2020b). The participants were expected to all be very familiar with the IUCN Global Standard, due to their prior experience of describing their case studies in these terms.

We chose to use a questionnaire survey in order to make our questions accessible to experts who did not all use English as a first language, and who were working in a range of settings and timezones. The design of the survey was finalised in collaboration with our IUCN CEM contacts. It was hosted on the Qualtrics platform.

An invitation and link to participate in the online survey was sent by our IUCN CEM contacts to those people who had previously worked with them to describe 21 case studies for the IUCN report (Cohen-Shacham et al., 2025). Respondents were free to leave and return to the survey. Invitations were sent in early June 2025, and the survey remained open until early July 2025. It was briefly reopened in early August to allow an additional respondent to add their views.

The main topics of the survey were understanding if they felt they had sufficient knowledge to support work for each criterion; we also explored views on how knowledge needs changed, different types of knowledge use, and recommendations for others seeking to strengthen NbS for knowledge use. We collected respondents contact details, the project they had described for the analysis of NbS cases in Cohen-Shacham et al. (2025), and their role in that project. We were aware that more detailed project information had already been described to inform the IUCN report; to reduce stakeholder fatigue, we did not collect any further information on the respondents or projects. Answer formats provided were a mix of Likert scale ratings, open text answers, whilst ratings of formal and informal knowledge use were prompted using a slider which generated answers on a 0-100 scale. Annex A (page 23) provides all questions and answer formats.

The resulting answers were imported into excel for data analysis. We used descriptive statistics to summarise the ordinal and categorical data, and carried out simple thematic analysis of open text responses. Due to the small sample size, we did not carry out statistical tests to look for associations between answers, but we did check for potential patterns using cross-tabular comparisons of categorical variables.

2.3. Who responded to this survey?

The survey was distributed to the contacts for the 21 projects represented in Cohen-Shacham et al. (2025). We received 14 separate responses to the survey. These responses referred to 12 unique projects; for 2 projects, they each had 2 respondents fill in the survey (Table 1).

Our respondents all had roles in (co)-initiating and coordinating the projects. Whilst we recognise that NbS can – and should – involve the participation of multiple stakeholders, especially local communities, we sought these views as best able to give an overview of the development of NbS projects.
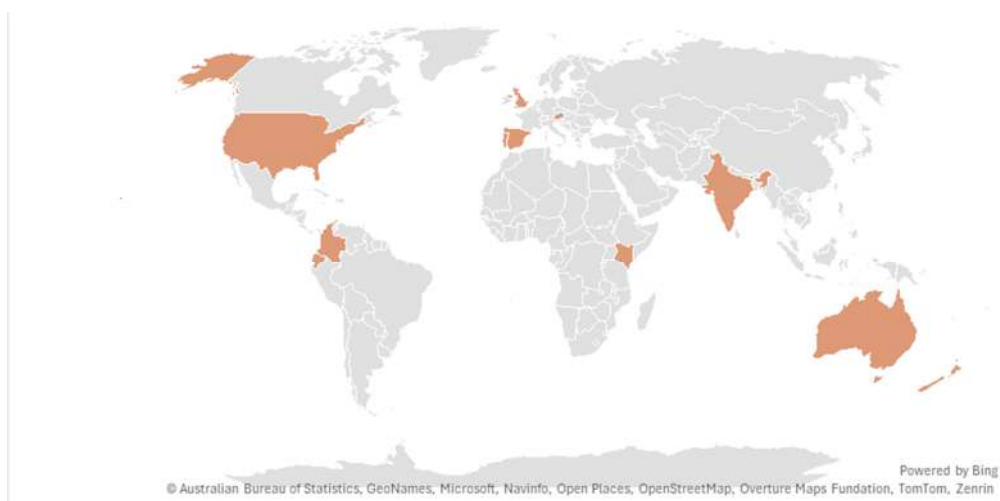
Figure 2 The location of different projects referred to by our 14 respondents.

The experiences represented are diverse. They come from 9 different countries, mostly from the Global North but also three in the Global South (Figure 2). The settings are often in rural landscapes (e.g. Spanish network grazing) but also encompass coasts (e.g. work to tackle coastal erosion in New Zealand), and urban settings (e.g. the urban greening in the city of Liverpool). The challenges addressed accordingly vary, from reducing wildfire risk, to improving the resilience of small-holder upland agriculture.

Table 1 Project experiences represented by our 14 respondents, with projects named as per the "Applying the IUCN Global Standard for Nature-based Solutions™: 21 case studies from around the globe" (Cohen-Shacham et al., 2025). Please see this publication for more information about these cases.

Project referred to by respondent	Respondents	Location
Adapting to the impacts of climate change on water regulation and supply – Chingaza-Sumapaz-Guerrero area	1	Colombia
Andean resilience: Strengthening small-scale agricultural production in areas vulnerable to climate change in the highlands of Ecuador	1	Ecuador
Coastal revegetation in New Zealand as a nature-based solution to natural hazards and climate change	1	New Zealand
Co-designing Atlantic landscapes management to address societal challenges relevant to the Paiva River watershed	1	Portugal
Enhancing the resilience of the sacred Mijikenda Kaya Forests, a UNESCO World Heritage site, Kilifi County	1	Kenya
Fodder bank model to address deforestation, soil erosion, slope stability, and women drudgery – Western Himalayas	1	India
Johnson Creek Restoration Plan – Portland, Oregon	1	USA
Living seawalls: Building marine infrastructure to benefit humans and nature – Sydney	2	Australia
Network grazing - Using extensive livestock for vegetation control under high voltage power lines – Calahorra, La Rioja	2	Spain
Restoration efforts of more than 25 years for a lifeline and international waterway – Danube River, east of Vienna	1	Austria
Urban GreenUP: Implementing and assessing the impacts of NbS in a highly urbanised environment – Liverpool	1	United Kingdom
Virginia Grassland Bird Initiative: Supporting bird-friendly practices on working lands, Virgina	1	USA
/12	*/14*	*/9*

3. Findings

In the summary below, we first explore confidence in understanding the different criteria that comprise NbS, before going on to consider if views on knowledge varied by project phases. We then explore experiences of finding and using knowledge; and finally summarise respondents' recommendations to others. In general, we focus on common themes across the dataset, but we also have noted where patterns in answers may relate to projects and personal differences.

3.1. Did people have the knowledge that they needed?

For each of the NbS criteria, we asked respondents if they felt confident that they knew enough on that topic, giving them opportunity to respond on a 4-point scale from 'we definitely had enough knowledge' through to 'we lacked knowledge and understanding'. Respondents varied in their ratings, but mostly selected the middle categories, a mix of 'we mostly had enough knowledge' and 'we needed more knowledge'.

Differences between respondents likely related to the different projects that they referred to. For example, the most confident response – selecting 'we definitely had enough knowledge' for half of the criteria – was from someone who stated, "*As a team we had collectively been working in [Site X] for around twenty years gathering scientific information about the local ecology and environmental conditions*". They stated this also meant they were known to other stakeholders, that helped to involve them and their insights into the new NbS project.

Where respondents were referring to the same project – we had two respondents each for a project in Spain, and a project in Australia – their answers to this question, and others, were not identical but mostly similar. It is likely that such differences relate to differing professional expertise and project roles. However, it is notable that for one of these respondent pairs gave contrasting ratings as to whether there was enough knowledge: one respondent in this pair gave more negative ratings for several criteria, and referred the lack of prior scientific studies specific to social issues; whereas the other respondent referred to workshops as having given sufficient understanding of the same topics. Thus, differing answers may also relate to differing views about what type of knowledge is adequate. Understanding the diversity of views by different team members on one project is beyond the scope of this project, but could be an important topic for future work.

3.1.1. Did understanding vary across the NbS criteria?

The distribution of answers across the 8 criteria are shown in Figure 3. It is clear that there are no 'easy' criteria for which all respondents were unanimously confident. However, most people felt they definitely or mostly had enough knowledge for criterion #3 – managing for biodiversity and ecosystem integrity; with nearly as positive answers for criterion # 7 – adaptive management and criterion #1 – societal challenges.

Conversely, there were no 'impossible to understand' topics, i.e. criteria which respondents felt they knew nothing; however, the criteria on economic viability, balancing trade-offs and mainstreaming (#4, #6 and #8)– were most likely to see selection of the most negative category 'we lacked knowledge and understanding'. In particular, nobody felt that they definitely had enough knowledge on economic viability. This lack of confidence in economics is also reflected by responses to a question probing what specific topics or issues they would have liked to learn about, if they needed more information. Responses to this question for the topic of economics (criteria #4) discussed a variety of topics where they had needed but had not obtained information on various aspects of the subject; whereas for the topic of biodiversity and ecosystem integrity (criterion #3) there were very few comments provided.
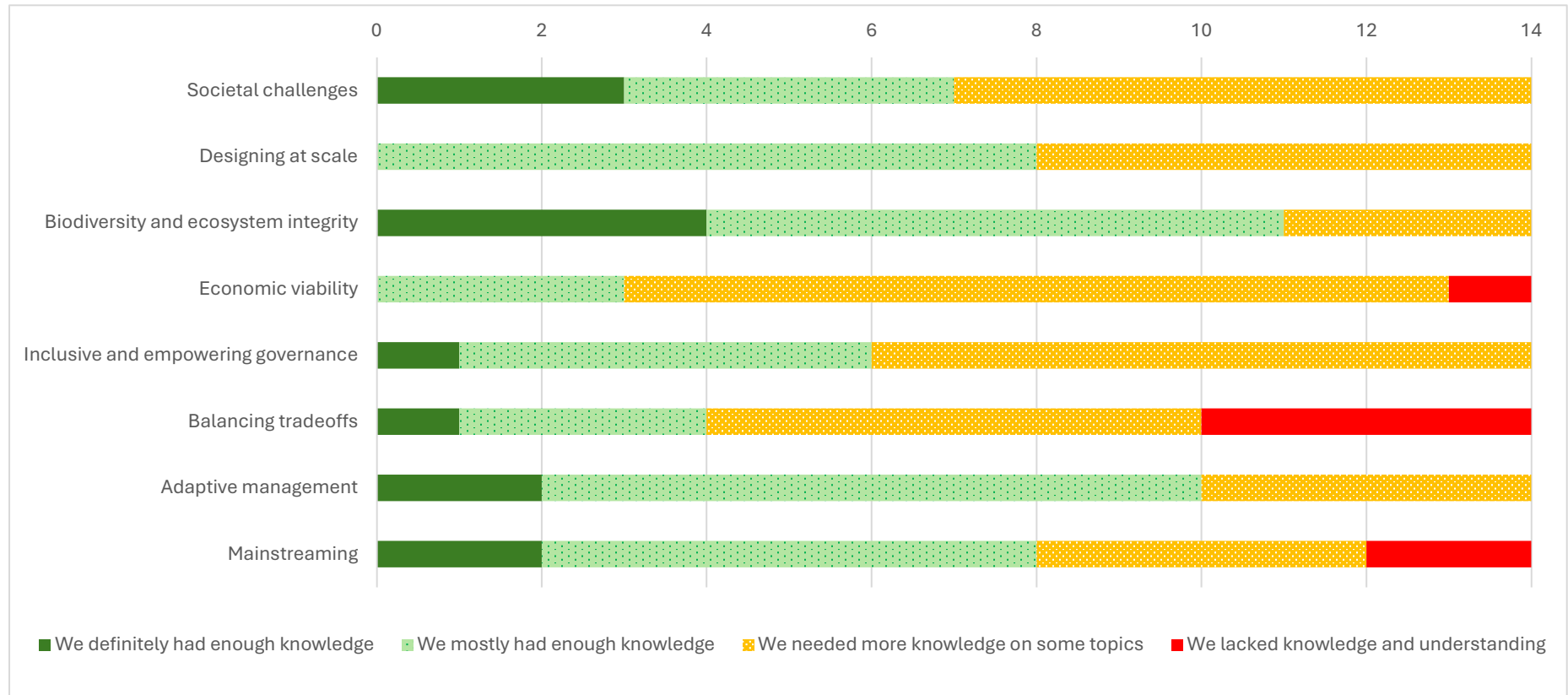
Figure 3 Count of answers to the question "Did you feel confident that you knew enough about..." for each of the NbS criteria, asked to select from the 4 Likert scale items shown above in the key. Criteria are shown on the left. N=14 for all criteria.

3.1.2.Did knowledge needs vary across project phases?

Our respondents clearly felt that knowledge needs changed as their NbS intervention progressed (Figure 4). Of the 14 respondents to this question, 9 also added comments about how their knowledge needs changed. These descriptions presented initial knowledge needs as often quite holistic, with a focus on building understanding of both ecological settings and social challenges, especially local community needs, even using historical data.

Knowledge needs could emerge even within what might appear as a single phase: for example, a respondent discussed how a scenario planning process to decide on priorities, then highlighted additional knowledge needs for planning. Other comments noted how needs emerged as teams moved from planning to implementation, some noted that more specific engineering, scientific or industrial design knowledge was also needed e.g. to provide new plant cultivation techniques. Trying to establish practicable innovative solutions could be challenging: one respondent mentioned that in an urban setting they had trouble finding a contractor who could design and supply the solutions they needed. Lastly, one respondent noted that mainstreaming and scaling up required more knowledge of policy. We had fewer comments about specific needs during monitoring, but one mentioned that this phase was more holistic in terms of considering ecological, social and governance changes, drawing on a range of knowledge systems. Intriguingly, one respondent answered this question by saying 'more interactive' which may imply that different knowledges became more intertwined in discussion over time.
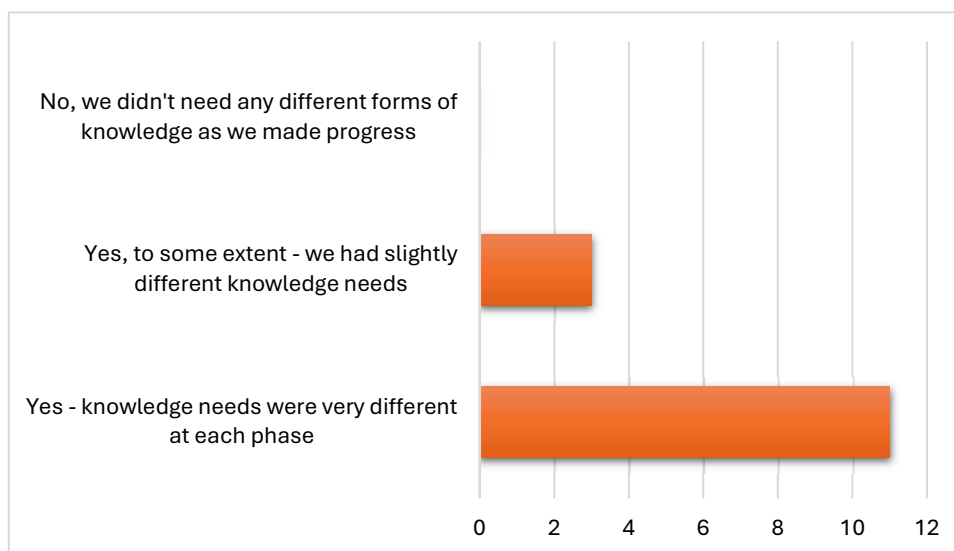
Figure 4 Count of responses to the question "Did you need different forms of knowledge across different phases of the NbS intervention?", selected from a three-point likert scale. N=14

3.2. What types and sources of knowledge were used?

For each of the 8 NbS criteria, we asked respondents to describe the mix of knowledges they used to understand that topic, and to move a slider to show the extent to which they relied on 'informal' and 'formal' knowledge. We defined informal knowledge as local stakeholders' experience, expertise and 'know how; whilst formal knowledge was described as information from scientists and professional agencies, usually presented in reports and written documents.

In general, a mixture of knowledge sources and types were used by most respondents to understand most topics (Figure 5). In other words, nobody relied 'just' upon scientific reports, nor community experiences.

> *"The scientific knowledge is super useful to get facts and statistics about the issue, but for the human aspect of it, the stakeholders consultations were more insightful."*

However, it was notable that for some criteria the balance of informal versus formal knowledge use differed, which respondents had indicated by moving a slider between 0 (for not useful) to 100 (very useful). In particular, understandings of biodiversity and ecosystem integrity (criterion #1) relied more on formal knowledge: for this topic, , the mean slider score was 94 as most respondents had moved the slider to 100 position and none gave a score of less than 75; whereas the lowest ratings of informal knowledge use were given for this topic, one even giving a score of 0, resulting in a mean slider score of 58. By contrast, understanding inclusive and empowering governance (criterion #5) showed the opposite pattern, relying more on informal knowledge (mean score 83) than formal knowledge (mean score 57), which was the lowest score given for formal knowledge use.

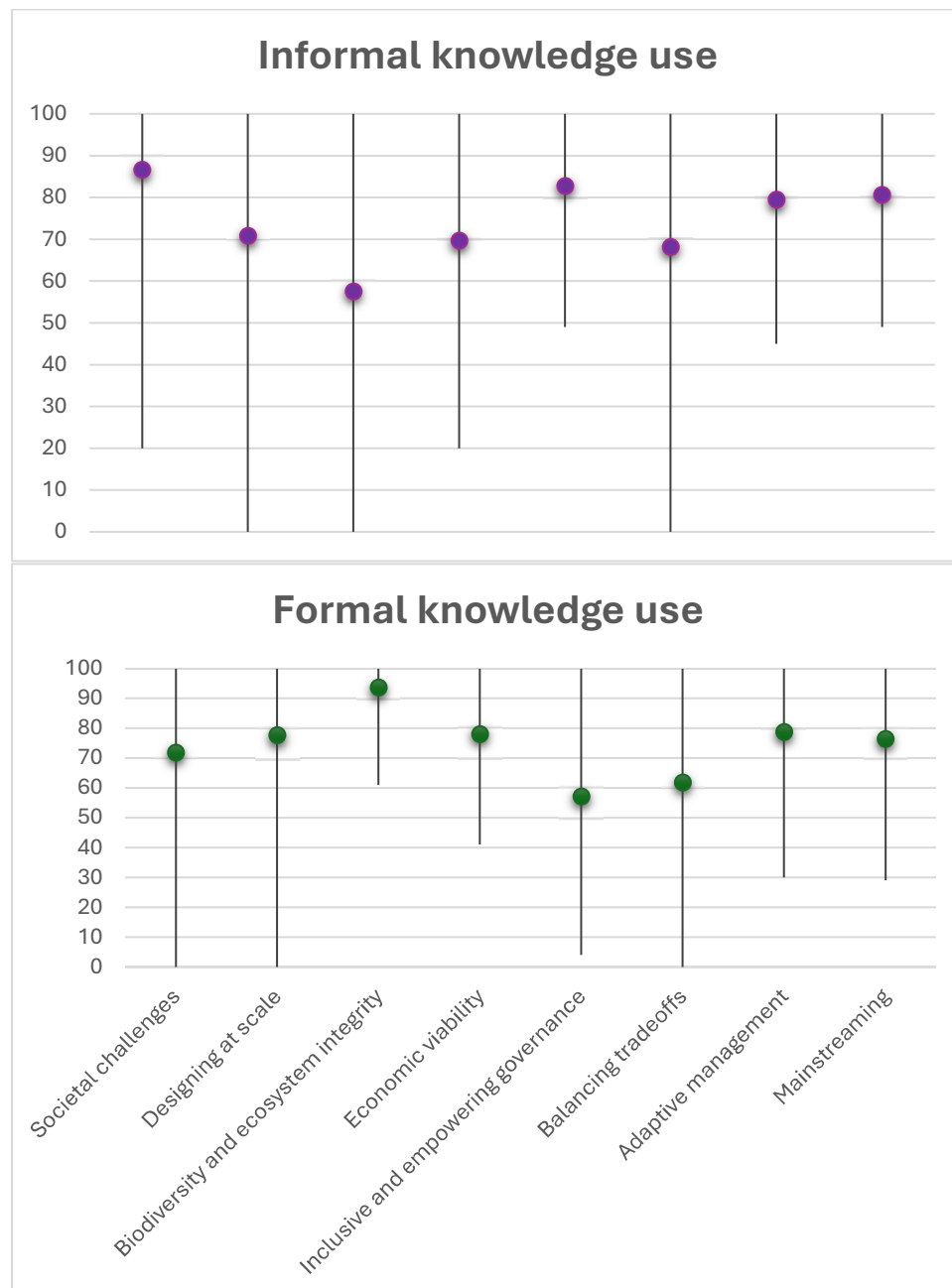Figure 5 Summaries of scores given when respondents were asked to move a slider between 0 and 100 to show how useful they rated informal and formal knowledges in order to build understanding on each criterion: each dot shows the mean, and its bar shows the range. N= 14 for all criteria and ratings; except N=13 for formal knowledge use on the criteria #1, #6, #7 and #8; and N=13 for informal knowledge use for criterion #6.

Several commented that scientific reports could be quite generic. To obtain site-specific insights that were not available from the academic literature, consultancy reports were used by some, and others made observations and surveys of local communities. The expertise of engineers or agronomists could also be sought, to implement measures well suited to the local context. Conversely in other cases, local people's reports of local challenges or ideas would prompt new searches for reports or scientific literatures to help respond to those challenges. Thus, on any topic it seemed common to sequentially search for different sources and types of information, but the exact mix varied widely between cases.

> "*In order to comprehend and develop solutions to local social difficulties and make sure we are tackling the right problem, I have employed both traditional and local knowledge systems in this instance, followed by the greatest scientific information available based on our highly customized approach...*"

There is also a mix of 'formal' and 'informal', with the distinction being more a means to elicit reflection on the diversity of knowledges used, rather than real dichotomy. For example, different sources of knowledge were combined to make plans: such as science-driven field observations and sampling, modelling, local reports of what locals they rely on, locally-based professional with ecology or engineering expertise, was useful. Monitoring strategies could be designed using scientific knowledge but potentially carried out by communities themselves (citizen science) to support adaptive management.

Many of the above descriptions of what formal and informal knowledges were used included description of *how* knowledge was collected, which connects with the next section of this report. In particular, descriptions of informal knowledge included several mentions of community surveys e.g. to understand natural resources, local needs and aspirations; but additionally many indicated that it is important to build connections with these stakeholders, and spending time with them could build better appreciation of local knowledge and issues. Workshops – both with professionals and community members – were often mentioned as useful ways to understand pre-existing understandings, and to bring out marginalised voices.

3.3. How is knowledge found and used?

A majority of respondents – 11 of 14 – answered 'yes' when asked a broad question "Were there any challenges in finding, sharing or using knowledge?". Ten of those left comments explaining their problems. Two noted that information existed but might be hard to access, potentially linked to language barriers. Other respondents noted that information they desired simply often did not exist: two noted it didn't cover all relevant issues and indicators that they needed for NbS, and another noted problems in finding it at the appropriate spatial resolution for their project. One noted that information was linked to the legacy of past projects and datasets:

> "*you always have to find indirect data to apply the indicators because the projects are not designed with the NbS standard in mind.*"

The time and staff capacity needed for stakeholder engagement, to share and discuss knowledge was also noted by three respondents. Lastly one respondent cautioned against collecting knowledge that there was not time to use or permissions to act on: information collection should be planned within the constraints of a project's remit.

3.3.1.Experiences of finding knowledge

We asked how easy it was to find information on each criterion. In general, for all topics except biodiversity and ecosystems and adaptive management, 'difficult' was the most common response (Figure 6).
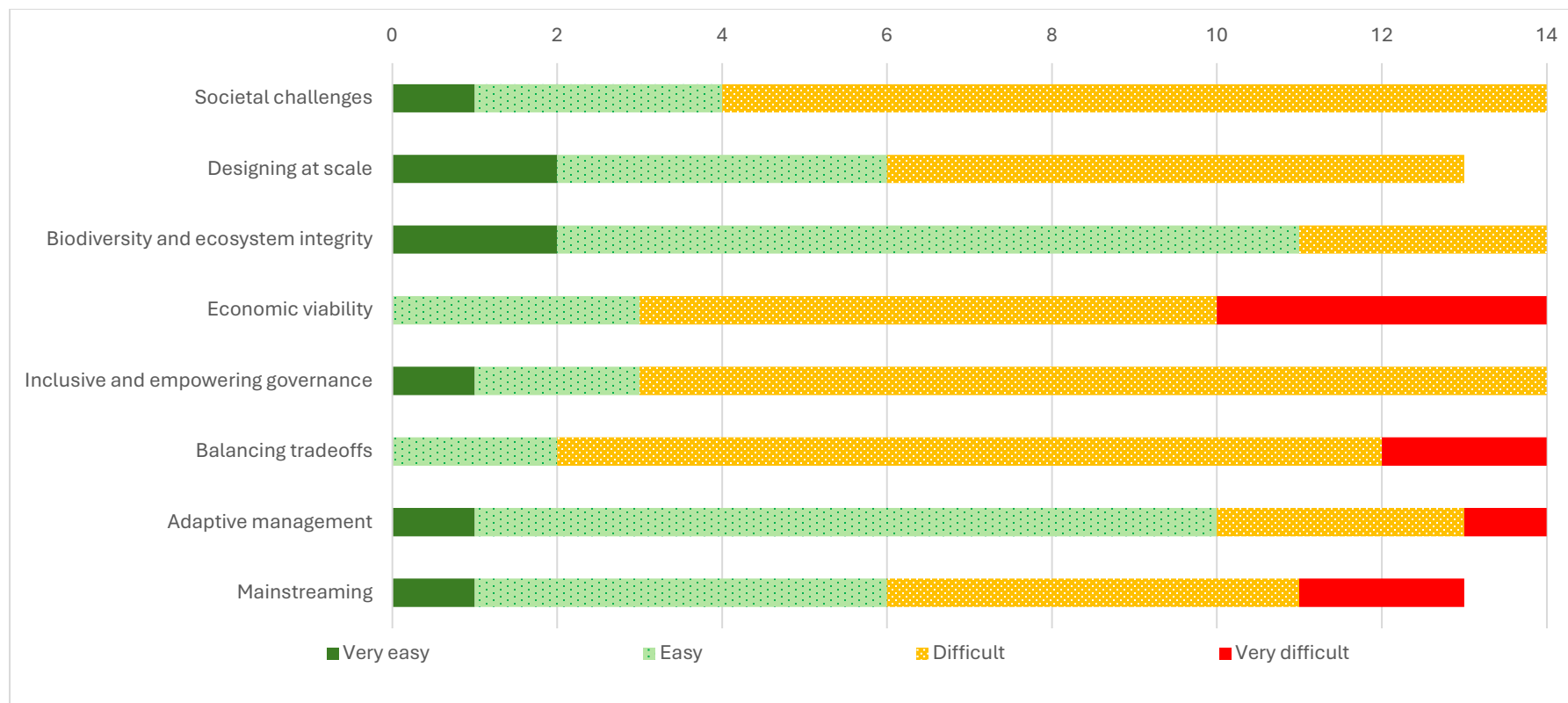
Figure 6 Counts of responses to the question "How easy was it to find the knowledge that you needed on this topic?" for each of the NbS criteria, answered on a 4-point Likert scale shown on the key, with criteria shown on the left. N=14 for all criteria; except N=13 for designing at scale and mainstreaming.

Finding information on biodiversity and ecosystem integrity (criterion #3), was most often felt to be 'very easy' or 'easy'. By contrast, understanding economic viability, governance, and trade-offs (criteria #4, #5, #6) were mostly likely to be reported as difficult or very difficult. This echoes their rating in which criteria they felt most confident in understanding (Figure 3).

The widest range of responses were given on the topics of mainstreaming and adaptive management (criteria #7 and #8), where answers ranged from 'very easy' to 'very difficult'. One respondent explained that they did not even give any rating for mainstreaming as they felt the topic itself was so unclear.

Where respondents said it was easy to find information, they often explained this was because they had past experience in working in the site. In other cases, they referred to their own professional expertise, with academics especially confident in obtaining information (at least for their own disciplinary topics). In one case, the respondent explained that as the project was a pilot, it had additional resources to commission and find data.

Where respondents said it was difficult to find information, many comments were mirror images of the above explanations of what had been easy: they referred to the difficulty of navigating large and complex fields that were new to the team, the difficulty in implementing an NbS approach where this was quite new and distinct from whatever had been implemented before. In addition, several noted that it was possible to find general reports, but harder or impossible to find site-specific information – especially for quantification of costs and benefits, to support discussion of economics and trade-offs.

> *"The team had expertise in biodiversity and ecosystem integrity.... None of the team members knew economics, and we also did not consult an economist"*

Understanding of relevant organisations and people were noted as helpful, but networking often took time to establish. This could enable the 'know how' of knowing which administrative procedures must be followed and how to efficiently obtain permits etc, through to understanding who it would be relevant to promote or exchange case studies with. To fully understand a situation, a project team had to first build relationships with communities or local practitioners, as well as higher-level agencies and organisations.

3.3.2. Was new information collected in NbS projects?

Twelve of our respondents stated that new information was collected by their projects. This was most often reported for understanding societal challenges (criterion #1) and biodiversity and ecosystem integrity (criterion #3). This reflects the earlier report of which topics were most confidently understood (Figure 3). New data collection was least commonly reported for economic viability (criterion #4), and mainstreaming (criterion #8) by 4 and 6 respondents respectively.
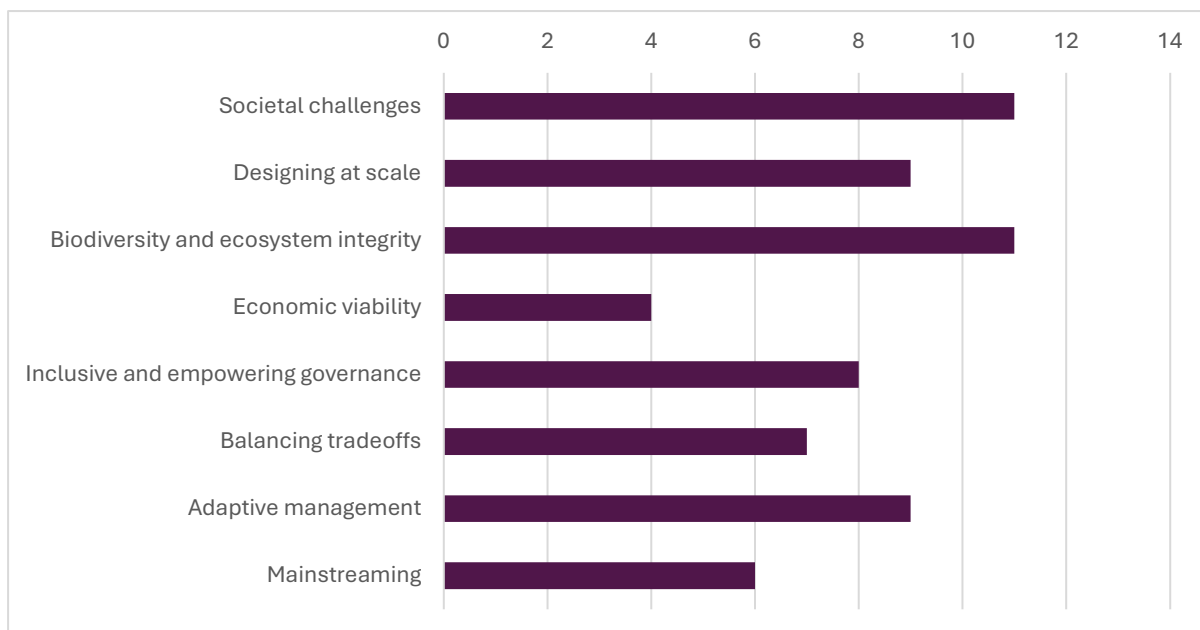
Figure 7 Counts of respondents that chose "Yes" when asked if new data collection was carried out on each of the NbS criteria, when given a choice of yes or no. N=14 for all criteria.

There was clear variability in the extent to which new information had been collected in the projects described by our respondents: two respondents, referring to the same project, reported that it had no new data collection; whilst at the other extreme, two reported collecting new information on all 8 criteria. This suggests that projects vary greatly in their remit to commission and elicit new knowledge. There did not seem to be a clear pattern that projects in the Global North were better resourced for this than those in the Global South: both of the projects able to collect new information were based in the Global North (Portugal and USA) but so was the project with no new data collection. We speculate that new data collection may depend more on the mandate and resources specific to different funders and programmes.

Often there was a mix of activities carried out to build understanding, rather than a single special method that was favoured:

> *"Working in the field for a long period and having informal interactions with communities provided the most significant knowledge for this effort. The efforts were aided and reinforced by ongoing observations, field-based data gathering, and participatory questionnaires. The importance of local and traditional knowledge systems is another point I would like to make..."*

The detail of what information was sought out varied greatly between and within each criterion, likely reflecting the varied challenges and contexts of different projects. It was not possible to partition some topics as being 'just' about ecological information collected, or others as 'just' about collecting information on society – different responses on understanding societal challenges (criterion #1) spanned both (perhaps reflecting the expertise of respondents). That said, the understanding of economic viability and governance (criteria #4 and #5) had more answers that involves surveys and workshops, whilst understanding of biodiversity and ecosystem integrity focused more on ecological and hydrological samples and modelling. Adaptive management also tended to be associated with these techniques. Overall, the range of methods varied from e-DNA monitoring and habitat sampling, through to climate risk forecasting and modelling, through to

community workshops and visitor surveys. For those who reported information collection on mainstreaming, few details were given, but it was associated either with formal policy analysis or with less structured discussions with policymakers.

We explored for links with other answers and noted that for some topics, there was some indication that confidence in a topic was positively linked to carrying out new data collection on the topic. For example, for the topic of economics (criterion #4); ten respondents reported they either lacked knowledge or needed more knowledge, and only two of these reported new data collection; whereas of the three who mostly had enough knowledge, two collected new data. Conversely, most respondents reported new data collection on the topic of biodiversity and ecosystem integrity, a topic that was generally better understood.

3.3.3. How was knowledge shared and used?

We asked 'what helped knowledge to be shared and used?' and the responses all mention a wide variety of approaches and methods.

Written reports were mentioned by most, with content ranging from 'how to' guides through to case study reports, or modelling results. Databases were also used by several. Sharing within teams often used email but sharing with wider publics was also mentioned, by using television, print media or social media.

Many respondents emphasised the importance of face-to-face interactions and collective meetings. This could range from one-to-one meetings to share and discuss how to understand and respond on a specific issue, through to wider stakeholder or partner meetings, site visits, ecological tours and community workshops. Although some of these meetings might focus on dissemination – e.g. giving lectures or providing training, these meetings were also valued for allowing space to deliberate and decide.

> "Public meetings and site visits were always critical components. Emails and reports were essential and helpful but the projects would have faced high opposition and conflict without the former".

Of course, meetings and workshops need skilled individuals to ensure meaningful interactions – one respondent emphasised they have "ensured two-way listening". A couple of respondents mentioned the role of individuals – project managers, champions – who have the skills and 'know how' both to find out and to share information. Some projects became "*more interactive*" as they progressed.

3.4. Respondents' recommendations for strengthening knowledge use

Our final questions in the survey asked if they had 'top recommendations would be for anyone planning to collect and share knowledge to inform a new NbS intervention' and also provided opportunity to leave any other comments. Thirteen respondents answered these questions.

Interdisciplinarity was a key word across this set of responses, reflecting the need to understand a range of topics (e.g. ecology and social systems) from design and planning through to indicator selection for monitoring. More specifically, two respondents suggested that particular priorities for knowledge collection could be around economic viability, tradeoffs, cost-benefit analyses; with another identifying modelling and upscaled scenarios as useful.

> "Look at it as a package that spans social and ecological aspects and try not to get lost in too much detail on any one aspect (at the expense of others) along the way."

Additionally, balancing different types of information in terms of sources was noted by several, going beyond interdisciplinarity to transdisciplinarity. Understanding the activities and internal dynamics local communities could be challenging: by comparison, scientific information was "easy to deal with". Information derived from communities, science and other sources then also needs to be connected and shared across different groups – several respondents made comments emphasising the need to "*cross-walk the data*", or "*hybridising knowledge systems*".

This in turn reflects several recommendations to invest significant energy and time in the activities of collecting and sharing knowledge, valuing people with the skills to do so. One described the processes as 'interactive' and another framed it in terms of 'co-production', describing discussions on knowledge as an investment to prioritise early on. One suggestion was to avoid any jargon. Investing in these discussions can help ensure societal challenges are well understood by project leaders, and share other information with communities and other stakeholders, to support the long-term success of a project.

> *"NBS is not a "solution" if it doesn't solve challenges that the community sees as important. And if there is a major environmental issue that they don't think is important, but you have the data to say it is, take the time to help the community to understand that issue and how it might be affecting them."*

Overall, the set of recommendations and comments implies that there are two key challenges for those seeking knowledge for NbS: firstly, widening the range of knowledges sought out and used, versus other approaches or previous projects; secondly, ensuring local communities and other stakeholders views and knowledges are well represented in the knowledge mix used to plan and implement NbS. Two respondents recommended learning from other people who have tried to implement beforehand, implying a perceived lack of support and case studies on this topic.

4. Discussion

This survey provides a first insight into the range of knowledges used and needed to support NbS. All our respondents had experience in using different forms of knowledge to inform their NbS projects. Using a mixture of knowledge formats and sources was considered universally important, combining a mix of sources; such as reports by scientists or agencies together with local expertise and views derived from surveys, observations or workshops with local people. It is positive that knowledge and its use is a subject has been given attention by NbS project managers.

However, collecting, commissioning and connecting different sources of knowledge can be challenging. Not all project managers were able to commission collection of new knowledge, whether via community surveys, or ecological fieldwork. For example, some project teams have research as part of their remit; others lack time and capacity even to collect existing documented knowledge. Furthermore some settings may be more 'data rich' than others, so that project managers vary in their access to site-specific knowledge that is already documented. Additionally some forms of knowledge – such as large-scale studies – were not easily related to specific sites or proposed NbS interventions. As a result, all of our respondents reported a lack of confidence in their understanding one or more topics needed to implement NbS. There was especially often a lack of confidence for topics related to economics and trade-offs.

Since challenges are commonly reported, potential implications of this work are that NbS project teams would likely benefit from more support on collecting and using knowledge. It may be useful to provide examples of guidance and strategies for knowledge collection, collation and sharing strategies that others have found useful. Focusing any such guidance on the topics of economics and trade-offs is likely to be most valuable; for although all NbS projects vary, this was generally the topic in which respondents were least confident and least likely to find or collect new knowledge. In all cases it is always appropriate to reflect carefully what topics and sources are needed and will be used, in order to support NbS implementation that balances attention on all aspects or criteria. It also looks likely that guidance may need to be differentiated by project stage. However, the findings of this survey require further elaboration to refine specific implications – therefore we intend to meet with the survey respondents to refine and consolidate these themes.

4.1. Limitations

This section notes limitations of this study and notes how they could be mitigated or redressed through alternative research designs.

This study appraised the experiences of those responsible for very different types of projects, tackling varied challenges across the world. This was a deliberate choice, to understand the range of experiences, but this mix also make it challenging to identify any common themes, especially as we have a relatively small sample size. A potential response would be to focus more on specific types of NbS, i.e. projects that share a common setting, or that share a focal challenge (such as flood risk management).   In addition, or alternatively, surveying a larger sample would also help to disentangle the common themes and challenges. However, we would not be able to assume easy familiarity with the global standard if not working with those who contributed cases to Cohen-Shacham et al. (2025), so any such survey would need to be re-formulated.

Another limitation also arises from having one respondent (occasionally two) who represented each project. Given that NbS projects should be inclusive and normally do involve a multitude of stakeholders, it would be appropriate to understanding the point of view of multiple partners involved in NbS, not relying solely on one individual's view. This could be redressed by a more in-depth research design that collects multiple points of view for one initiative – though this would not likely be feasible to also have a large sample size, and would also place greater importance on working in local languages for case studies in non-English speaking countries, to ensure those not fluent in English have their experiences equally represented.

The methodological approach of using a survey was again a considered choice – to allow input across time-zones and ease input for non-native speakers of English – but it also created limitations. An alternative approach would be to collect data in a way that allows for more narration, explanation and conversation, that build a richer picture of the factors shaping knowledge needs and uses. These qualitative methods of data collection can be more time consuming in data collection and analysis, but permit more insights into nuance and underlying explanations. In the future work planned by this project we are planning two online workshops that will allow opportunity to enrich our understanding of participants' views.

4.2. Next steps

We will share these results with the respondents who originally contributed to the survey. We will also invite these respondents to discuss the key themes in early 2026, mindful of collective scheduling constraints across time-zones. In parallel, over the coming months we will also review

Cohen-Shacham et al. (2025) to understand more about the set of experiences drawn on, and explore potential links between project attributes and knowledge needs.

Potential topics for future discussion:

- **Project context-** e.g. How do knowledge needs and challenges vary according to pre-existing project work, NbS goals, project timescales, geographical scope?
- **Personal context –** e.g. How does background and expertise of the teams who lead NbS affect the views and experiences on knowledge needs?
- **Project phases –** e.g. How do knowledge needs vary throughout the development of a project from conceptualisation through to implementation and monitoring? If and how do these relate to different NbS criteria?
- **Priority support needs –** e.g. Are there any priority recommendations or advice that are generalisable across NbS contexts and teams? How much effort to focus on collecting new and existing knowledge versus sharing and deliberating for knowledge use?

We intend the results of this discussion to be prepared for publication in report format and also submitted for academic publication later in 2026, inviting all the contributors to be co-authors. We will also reflect on the implications for the specific context catchment-related NbS in Scotland, which has provided the impetus and funding to enable this study of NbS and knowledge.

5. References

Cohen-Shacham, E., Cabecinha, E. and Andrade Pérez, A. (2025). *Applying the IUCN Global Standard for Nature-based Solutions: 21 case studies from around the globe*, IUCN, Gland, Switzerland. https://doi.org/10.2305/RFTD6180 [Accessed 11 August 2025]

Cornell, S., Berkhout, F., Tuinstra, W., Tàbara, J. D., Jäger, J., Chabay, I., de Wit, B., Langlais, R., Mills, D., Moll, P., Otto, I. M., Petersen, A., Pohl, C. and van Kerkhoff, L. (2013). Opening up knowledge systems for better responses to global environmental change, *Environmental Science & Policy,* **28**(0)**,** 60-70. http://dx.doi.org/10.1016/j.envsci.2012.11.008

Cottrell, C. (2022). Avoiding a new era in biopiracy: Including indigenous and local knowledge in nature-based solutions to climate change, *Environmental Science & Policy,* **135,** 162-168. https://doi.org/10.1016/j.envsci.2022.05.003

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

Diep, L. and McPhearson, T. (2025). Empowering cities globally: Four levers for transformative urban adaptation with nature-based solutions, *Proceedings of the National Academy of Sciences,* **122**(29)**,** e2315912121. https://doi.org/10.1073/pnas.2315912121

Fernández-Llamazares, Á., Lepofsky, D., Lertzman, K., Armstrong, C. G., Brondizio, E. S., Gavin, M. C., Lyver, P. O. B., Nicholas, G. P., Pascua, P. a., Reo, N. J., Reyes-García, V., Turner, N. J., Yletyinen, J., Anderson, E. N., Balée, W., Cariño, J., David-Chavez, D. M., Dunn, C. P., Garnett, S. C., Greening , S., , S. J., Kuhnlein, H., Molnár, Z., Odonne, G., Retter, G.-B., Ripple, W. J., Sáfián, L., Bahraman, A. S., Torrents-Ticó, M. and Vaughan, M. B. (2021). Scientists' Warning to Humanity on Threats to Indigenous and Local Knowledge Systems, *Journal of Ethnobiology,* **41**(2)**,** 144-169. https://doi.org/10.2993/0278-0771-41.2.144

Frantzeskaki, N., McPhearson, T., Collier, M. J., Kendal, D., Bulkeley, H., Dumitru, A., Walsh, C., Noble, K., van Wyk, E., Ordóñez, C., Oke, C. and Pintér, L. (2019). Nature-Based Solutions for Urban Climate Change Adaptation: Linking Science, Policy, and Practice Communities for Evidence-Based Decision-Making, *BioScience,* **69**(6)**,** 455-466. https://doi.org/10.1093/biosci/biz042

Frantzeskaki, N., Wijsman, K., Kabisch, N. and McPhearson, T. (2025). Inter- and transdisciplinary knowledge is critical for nature-based solutions to contribute to just urban transformations, *Proceedings of the National Academy of Sciences,* **122**(29)**,** e2315911121. https://doi.org/10.1073/pnas.2315911121

IUCN (2020a). *Guidance for using the IUCN Global Standard for Nature-based Solutions: first edition*, IUCN, Gland, Switzerland. https://doi.org/10.2305/IUCN.CH.2020.09.en [Accessed 16th March 2021]

IUCN (2020b). *IUCN Global Standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of NbS. First edition*, IUCN, International Union for the Conservation of Nature, Gland, Switzerland. https://doi.org/10.2305/IUCN.CH.2020.08.en [Accessed 16th March 2021]

Jasanoff, S. (Ed.) (2004). *States of Knowledge. The Co-Production of Science and Social Order,* Routledge, London and New York.

O'Brien, K. (2013). Global environmental change III:Closing the gap between knowledge and action, *Progress in Human Geography,* **37**(4)**,** 587-596. https://doi.org/10.1177/0309132512469589

Sangha, K. K., Ahammad, R., Russell-Smith, J. and Woolley, L.-A. (2025). A nature-based solutions assessment framework integrating indigenous biocultural and ecosystem services perspectives: An Australian example, *Ecological Indicators,* **172,** 113230. https://doi.org/10.1016/j.ecolind.2025.113230

Sievers, E., Spierenburg, M., Jhagroe, S. S. and van Oudenhoven, A. P. E. (2024). Place-based knowledge transfer in a local-to-global and knowledge-to-action context: key steps and facilitative factors, *Ecology and Society,* **29**(3). https://doi.org/10.5751/ES-15024-290308

Termeer, C. J. A. M., Dewulf, A., Breeman, G. and Stiller, S. J. (2015). Governance Capabilities for Dealing Wisely With Wicked Problems, *Administration & Society,* **47**(6)**,** 680-710. https://doi.org/10.1177/0095399712469195

van der Molen, F. (2018). How knowledge enables governance: The coproduction of environmental governance capacity, *Environmental Science & Policy,* **87,** 18-25. https://doi.org/10.1016/j.envsci.2018.05.016

Waylen, K. A. and Blackstock, K. L. (2017). Monitoring for Adaptive Management or Modernity: Lessons from recent initiatives for holistic environmental management, *Environmental Policy and Governance,* **27**(4)**,** 311-324. http://dx.doi.org/10.1002/eet.1758

Welden, E. A., Chausson, A. and Melanidis, M. S. (2021). Leveraging Nature-based Solutions for transformation: Reconnecting people and nature, *People and Nature,* **3**(5)**,** 966-977. https://dx.doi.org/10.1002/pan3.10212

Yu, R. and Mu, Q. (2023). Integration of indigenous and local knowledge in policy and practice of nature-based solutions in China: Progress and highlights, *Sustainability,* **15**(14)**,** 11104. https://doi.org/10.3390/su151411104

Annex A: Survey questions

Links to more information about NbS, knowledge and the indicators that link to each of the eight criteria were provided as part of the survey but are not shown below.

Question	Question Answer Format
Participant details	
Your name	Open text
Your email address	Open text
The main NbS intervention (or programme) that you have expertise in?	Open text – Please provide the title of the NbS case study that you are associated with in the forthcoming IUCN CEM publication (on the Application of the Global Standard for NbS in Case Studies around the Globe).
Briefly, what was your role in relation to that project?	Open text
Criteria #1 **Societal Challenges**	
Did you feel confident that you knew enough about the societal challenges related to your case study to inform NbS planning and delivery?	Likert Scale Options: 1. We definitely had enough knowledge. 2. We mostly had enough knowledge. 3. We needed more knowledge on some topics. 4. We lacked knowledge and understanding of this topic.
If you needed more information, what specific topics or issues would you have liked to have learn about?	Open text
Please tell us more about what forms of knowledge were useful, in order to understand how to tackle societal challenges: informal knowledge and exchanges e.g. local stakeholders' experience, expertise and 'know how'.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Please tell us more about what forms of knowledge were useful, in order to understand how to tackle societal challenges: formal reports e.g. from scientists, professional agencies.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Do you have any comments about the forms or types of knowledge that were particularly useful for informing your work on this topic?	Open text
How easy was it to find the knowledge you needed on this subject?	Likert Scale Options: 1. Vert easy. 2. Easy. 3. Difficult. 4. Very difficult.
Why?	Open text
Did you carry out any new data collection in relation to this topic, e.g. to help improve plans or monitoring?	Yes/No
If yes, what data did you collect?	Open text
Criteria #2 Design at Scale	
Did you feel confident that you knew enough about the societal challenges related to your	Likert Scale Options: 1. We definitely had enough knowledge. 2. We mostly had enough

case study to inform NbS planning and delivery?	knowledge. 3. We needed more knowledge on some topics. 4. We lacked knowledge and understanding of this topic.
If you needed more information, what specific topics or issues would you have liked to have learn about?	Open text
Please tell us more about what forms of knowledge were useful in order to understand how to design NbS at scale: informal knowledge and exchanges e.g. local stakeholders' experience, expertise and 'know how'.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Please tell us more about what forms of knowledge were useful, in order to understand how to design NbS at scale: formal reports e.g. from scientists, professional agencies.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Do you have any comments about the forms or types of knowledge that were particularly useful for informing your work on this topic?	Open text
How easy was it to find the knowledge you needed on this subject?	Likert Scale Options: 1. Vert easy. 2. Easy. 3. Difficult. 4. Very difficult.
Why?	Open text
Did you carry out any new data collection in relation to this topic, e.g. to help improve plans or monitoring?	Yes/No
If yes, what data did you collect?	Open text
Criteria #3 Biodiversity & Ecosystem Integrity	
Did you feel confident that you knew enough about the societal challenges related to your case study to inform NbS planning and delivery?	Likert Scale Options: 1. We definitely had enough knowledge. 2. We mostly had enough knowledge. 3. We needed more knowledge on some topics. 4. We lacked knowledge and understanding of this topic.
If you needed more information, what specific topics or issues would you have liked to have learn about?	Open text
Please tell us more about what forms of knowledge were useful in order to understand how to incorporate net gain to biodiversity & ecosystem integrity: informal knowledge and exchanges e.g. local stakeholders' experience, expertise and 'know how'.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Please tell us more about what forms of knowledge were useful, in order to understand how to incorporate net gain to biodiversity & ecosystem integrity: formal reports e.g. from scientists, professional agencies.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".

Do you have any comments about the forms or types of knowledge that were particularly useful for informing your work on this topic?	Open text
How easy was it to find the knowledge you needed on this subject?	Likert Scale Options: 1. Vert easy. 2. Easy. 3. Difficult. 4. Very difficult.
Why?	Open text
Did you carry out any new data collection in relation to this topic, e.g. to help improve plans or monitoring?	Yes/No
If yes, what data did you collect?	Open text
Criteria #4 Economic Viability	
Did you feel confident that you knew enough about the societal challenges related to your case study to inform NbS planning and delivery?	Likert Scale Options: 1. We definitely had enough knowledge. 2. We mostly had enough knowledge. 3. We needed more knowledge on some topics. 4. We lacked knowledge and understanding of this topic.
If you needed more information, what specific topics or issues would you have liked to have learn about?	Open text
Please tell us more about what forms of knowledge were useful in order to understand how to incorporate net gain to biodiversity & ecosystem integrity: informal knowledge and exchanges e.g. local stakeholders' experience, expertise and 'know how'.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Please tell us more about what forms of knowledge were useful, in order to understand how to incorporate net gain to biodiversity & ecosystem integrity: formal reports e.g. from scientists, professional agencies.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Do you have any comments about the forms or types of knowledge that were particularly useful for informing your work on this topic?	Open text
How easy was it to find the knowledge you needed on this subject?	Likert Scale Options: 1. Vert easy. 2. Easy. 3. Difficult. 4. Very difficult.
Why?	Open text
Did you carry out any new data collection in relation to this topic, e.g. to help improve plans or monitoring?	Yes/No
If yes, what data did you collect?	Open text
Criteria #5 Inclusive & Empowering Governance	
Did you feel confident that you knew enough about the societal challenges related to your case study to inform NbS planning and delivery?	Likert Scale Options: 1. We definitely had enough knowledge. 2. We mostly had enough knowledge. 3. We needed more knowledge on some topics. 4. We lacked knowledge and understanding of this topic.

If you needed more information, what specific topics or issues would you have liked to have learn about?	Open text
Please tell us more about what forms of knowledge were useful in order to understand how to incorporate inclusive and empowering governance: informal knowledge and exchanges e.g. local stakeholders' experience, expertise and 'know how'.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Please tell us more about what forms of knowledge were useful, in order to understand how to incorporate inclusive and empowering governance: formal reports e.g. from scientists, professional agencies.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Do you have any comments about the forms or types of knowledge that were particularly useful for informing your work on this topic?	Open text
How easy was it to find the knowledge you needed on this subject?	Likert Scale Options: 1. Vert easy. 2. Easy. 3. Difficult. 4. Very difficult.
Why?	Open text
Did you carry out any new data collection in relation to this topic, e.g. to help improve plans or monitoring?	Yes/No
If yes, what data did you collect?	Open text
Criteria #6 Balance Trade-Offs	
Did you feel confident that you knew enough about the societal challenges related to your case study to inform NbS planning and delivery?	Likert Scale Options: 1. We definitely had enough knowledge. 2. We mostly had enough knowledge. 3. We needed more knowledge on some topics. 4. We lacked knowledge and understanding of this topic.
If you needed more information, what specific topics or issues would you have liked to have learn about?	Open text
Please tell us more about what forms of knowledge were useful in order to understand how to incorporate adaptive management: informal knowledge and exchanges e.g. local stakeholders' experience, expertise and 'know how'.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Please tell us more about what forms of knowledge were useful, in order to understand how to incorporate adaptive management: formal reports e.g. from scientists, professional agencies.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Do you have any comments about the forms or types of knowledge that were particularly useful for informing your work on this topic?	Open text
How easy was it to find the knowledge you needed on this subject?	Likert Scale Options: 1. Vert easy. 2. Easy. 3. Difficult. 4. Very difficult.
Why?	Open text

Did you carry out any new data collection in relation to this topic, e.g. to help improve plans or monitoring?	Yes/No
If yes, what data did you collect?	Open text
Criteria #7 Adaptive Management	
Did you feel confident that you knew enough about the societal challenges related to your case study to inform NbS planning and delivery?	Likert Scale Options: 1. We definitely had enough knowledge. 2. We mostly had enough knowledge. 3. We needed more knowledge on some topics. 4. We lacked knowledge and understanding of this topic.
If you needed more information, what specific topics or issues would you have liked to have learn about?	Open text
Please tell us more about what forms of knowledge were useful in order to understand how to incorporate adaptive management: informal knowledge and exchanges e.g. local stakeholders' experience, expertise and 'know how'.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Please tell us more about what forms of knowledge were useful, in order to understand how to incorporate adaptive management: formal reports e.g. from scientists, professional agencies.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Do you have any comments about the forms or types of knowledge that were particularly useful for informing your work on this topic?	Open text
How easy was it to find the knowledge you needed on this subject?	Likert Scale Options: 1. Vert easy. 2. Easy. 3. Difficult. 4. Very difficult.
Why?	Open text
Did you carry out any new data collection in relation to this topic, e.g. to help improve plans or monitoring?	Yes/No
If yes, what data did you collect?	Open text
Criteria #8 Mainstreaming	
Did you feel confident that you knew enough about the societal challenges related to your case study to inform NbS planning and delivery?	Likert Scale Options: 1. We definitely had enough knowledge. 2. We mostly had enough knowledge. 3. We needed more knowledge on some topics. 4. We lacked knowledge and understanding of this topic.
If you needed more information, what specific topics or issues would you have liked to have learn about?	Open text
Please tell us more about what forms of knowledge were useful in order to understand how to mainstream NbS: informal knowledge and exchanges e.g. local stakeholders' experience, expertise and 'know how'.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".

Please tell us more about what forms of knowledge were useful, in order to understand how to mainstream NbS: formal reports e.g. from scientists, professional agencies.	Slider running from 0 to 100, with 0 marked as "Not useful" mid point as "Slightly useful" and 100 marked as "Very useful".
Do you have any comments about the forms or types of knowledge that were particularly useful for informing your work on this topic?	Open text
How easy was it to find the knowledge you needed on this subject?	Likert Scale Options: 1. Very easy. 2. Easy. 3. Difficult. 4. Very difficult.
Why?	Open text
Did you carry out any new data collection in relation to this topic, e.g. to help improve plans or monitoring?	Yes/No
If yes, what data did you collect?	Open text
General Reflections	
Did you need different forms of knowledge across different phases of the NbS intervention? (i.e. as a team moves from visioning & planning, implementation, monitoring & evaluation - see project cycle diagram here: https://nbsguide.org/Learn-more/General-guidance-for-NbS).	Closed Options: 1. Yes – knowledge needs were very difficult at each phase. 2. Yes, to some extent – we had slightly different knowledge needs. 3. No, we didn't need any forms of knowledge as we made progress with the intervention.
If yes, can you comment on how your needs changed?	Open text
What helped knowledge to be shared and used for the NbS intervention? (You might like to mention practical approaches, ranging from email, to printed reports, managing databases, or hosting meetings, or you might like to mention strategies for communication and discussion that you found useful.)	Open text
Were there any challenges in finding, sharing or using knowledge?	Yes/No
If yes, please describe the challenges you faced.	Open text
What would your top recommendation be for anyone planning to collect and share knowledge to inform a new NbS intervention?	Open text
Do you have any other comments about what knowledge can help to support and strengthen NbS?	Open text