JNCC Report 777

An assessment of the barriers, challenges and solutions to improving biological recording in Northern Ireland

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January 2025

ISSN 0963 8091

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This report was produced for JNCC under an external contract, by the British Trust for Ornithology.

This report should be cited as:
Barnes, A.E.[1], Lyall, S.[1], Pearce-Higgins, J.[1], Noble, D.[1], Lightfoot, P.[2], Green, L.[3] & Newton, N.[2] 2025. An assessment of the barriers, challenges and solutions to improving biological recording in Northern Ireland. *JNCC Report 777*, JNCC, Peterborough, ISSN 0963-8091.
https://hub.jncc.gov.uk/assets/923201e7-a076-4d9b-8588-f195261bc4c4

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Acknowledgments:
This work was supported by the Terrestrial Surveillance Development and Analysis Partnership, comprised of the UK Centre for Ecology & Hydrology, British Trust for Ornithology and the Joint Nature Conservation Committee. We would like to thank JNCC for funding this work, Diana Bowler and Michael Pocock (UKCEH) for their advice on the selection of questions for the interviews, Mark Wright (DAERA), Katherine Booth Jones and Ben Darvill (BTO) and several interviewees for their comments on earlier drafts of the report. Thanks especially go to all the interviewees and attendees of the workshop for giving us their time and answering our questions honestly and openly and to the Lough Neagh Discovery Centre for allowing us use of the centre and facilities for the workshop and for providing lunch, and to Jemma Davies and Hala Haddad (BTO) for facilitating at the workshop. Final thanks to Mark Wright, Chris Cheffings (JNCC), and Jemma Davies for final comments on the report.

JNCC EQA Statement:
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Summary

This report describes work undertaken in 2022 and 2023 under the JNCC's Terrestrial Surveillance Development and Analysis (TSDA) programme to assess the barriers and challenges to biological recording in Northern Ireland and to explore solutions. The work encompassed an initial questionnaire to stakeholders, semi-structured interviews, collation of information on biological recording in Northern Ireland, and a set of final workshops to discuss and verify findings and identify the most recommended solutions.

Biological Recording

The report first summarises by taxon, the information from interviews, supplemented by additional information from organisational websites and sources, on biological recording schemes and surveys which operate across Northern Ireland (NI), or across the UK. If schemes do not operate or are ineffective in NI, this includes the reasons why. The data currently collected, and data gaps, for each taxon are described along with the user needs of biological recording data.

Barriers

People from around 20 environmental organisations based across the UK and the island of Ireland were interviewed and asked a series of open questions to understand the potential barriers and challenges to citizen science biological recording in Northern Ireland. The interviews revealed that there are a wide range of barriers limiting biological recording in NI, with staffing issues being the one mentioned most often, be that lack of staff capacity to improve recording or the absence of staff altogether in NI. Staffing constraints have ramifications for engagement and training, and result in a poor network of support for participants in volunteer-based monitoring. Capacity of organisations is usually limited by funding and resources, which were identified as the main requirements to improve biological recording across NI, along with more staff and improved communication. Geographic barriers were also raised, including low population density in certain parts of NI (the west) or volunteers being unable to travel at all or to certain parts of the country.

Data flow is complex with data being stored in multiple repositories. The Centre for Environmental Data and Recording (CEDaR) is NI's environmental record centre which stores and disseminates data. However, CEDaR does not have access to all data held by individual organisations but can gain access if requested. The data required by stakeholders to maintain and monitor protected areas and conservation initiatives is predominantly focused on priority species and habitats, with information on the condition of species populations and habitats also a priority.

An in-person workshop was held to discuss the results collated from the interviews. Participants, drawn from statutory organisations, environmental non-governmental organisations (NGOs), volunteers and other stakeholders ranked the barriers in terms of importance, discussed solutions to the barriers and were tasked to formulate a rough proposal to spend differing amounts of money as a mechanism to identify priority actions. The most important barrier was the capacity of organisations, followed by social and cultural issues and technical/taxonomic expertise/experience as joint second. Data flow and access were deemed less important mainly because the other barriers constrained data from being collected in the first place, but were still issues once the others are resolved.

Recommendations and Solutions

The results from the interviews highlighted a number of recommendations, particularly around collaboration. Opportunities and initiatives, which already exist in some organisations, could be adopted by others. Working together, organisations can improve and maintain biological recording across NI, with potential for such approaches to be implemented in other parts of the UK. Land access could be collaboratively sought, rather than for each individual scheme, although this would require greater communication between organisations. Improved communication maintained between stakeholders who require data and who also often collect data, and the organisations that hold/collate and promote recording was also identified. Equally, increased collaboration and engagement through local biodiversity officers and Ulster Wildlife, for example, would benefit schemes who do not have capacity to engage, promote and maintain a volunteer base in NI themselves. BTO's Ripple Project is an exciting engagement programme that aims to increase interest in nature across NI and for all taxa. A number of organisations have a network of recorders who support, train and mentor other volunteers (Border *et al.* 2019). While there may be concerns about overloading existing recorders with additional requests and communications (so as not to deter them from recording), this network is vital to support paid staff.

The top-ranked solution to barriers at the workshop was to target more core, directional funding to increase staff capacity and support more volunteers, as a means for improving organisational capacity (the top barrier). Whilst this also included recognition of the potential for increased efficiency through improved use of analytical techniques and technologies, for example to extract data and for improved reporting, the widespread need for organisations to have more capacity, and for direct funding to the sector being a mechanism to achieve this, was a clear message from the workshop. Increased funding was also regarded as likely to help address all of the other barriers. It was suggested that ideally funding would be long-term, reducing the need for inefficient short-term contracts and making it much easier to deliver strategic objectives. Alongside increased funding, there was wide recognition that increasing staff capacity in NI and improving communication between organisations and government, and developing collaborative partnerships, could also improve capacity through more efficient working.

To tackle the next most important barrier of social and cultural issues, participants strongly prioritised the need to increase awareness of the natural environment amongst the wider public, and the role of biological monitoring and recording generally. Awareness around understanding species status and trends is particularly important to inform positive environmental management decisions. This would require education and improved access to environmental resources. Related to this, it was suggested that improved training opportunities were needed, not just to help people engage with nature, but to develop expertise in potential citizen scientists and enable them and stakeholders to better engage with the data available. Given the cross-cutting nature of many environmental issues, participants also valued inter-ministerial coordination.

Technical and taxonomic expertise and equipment availability were ranked equal second as a barrier, relating to the lack of experienced recorders and equipment to collect data in the field. A suggested solution to this barrier was increased interactions and collaboration between NGOs over events, training and advertising for schemes – re-enforcing other suggestions about the sector working better together. Investment in more training, particularly to enhance the number of trainers available to support events and ID (identification) courses, and a focus on understanding the uses of data, was also highlighted.

Mechanisms to increase access to natural areas – whether by addressing land access issues by securing access permission from landowners for the purposes of biological

surveillance, or by increasing transport links to rural areas, was also identified. Improving data flows across all-Ireland to provide better reporting at the local level to volunteers was also regarded as important to provide feedback back to participants and maintain motivation.

The workshop confirmed solutions identified from the interviews and highlighted a number of bespoke and interesting ideas. The main solutions that were frequently mentioned were increasing funding for staff to improve capacity and improving awareness of nature and the natural world starting in schools with adding a new subject to the curriculum. Collectively these measures would increase capacity from the eNGO sector to support volunteers and help run schemes to collect data, which would be well supported by government, recognising the cross-sectoral importance of such data. A significant education and awareness programme, supported by training, should help grow capacity to collect data in the longer-term for well-trained and equipped volunteers. Addressing land access and transport issues would make it easier for this volunteer workforce to collect the required data. Improving data flows and understanding of the use of the resulting data will make it maximally available and useful to volunteers, the public and to decision-makers.

Future Work/Conclusion

A final costing exercise in the workshop showed that whilst the precise ways of dividing up resources varied, there were common threads which resonated with the solutions from the interviews and earlier discussion. Collectively, four main areas of investment were identified to address the issues around biological recording:

- prioritise investment in the environmental sector to deliver a significant increase in large-scale engagement projects;
- increase coordination across the environmental sector to maximise opportunities;
- include large-scale educational programmes across society to generate wider interest and impact; and
- investment in infrastructure to maximise efficiency and improve data flows and reporting at both the national and local scale.

The workshop successfully brought together people from across the sector to achieve a common goal. It emphasised that whilst the report covered the barriers well, discussions revealed other issues extending to people not understanding/knowing about nature across NI, and that people had other more pressing issues/priorities than the natural environment. As the barriers were all interlinked, organisations within the sector do not have sufficient capacity to engage with the public at the level required to make improvements. Change needs to happen at every level in NI from schools and organisations to governments who put legislation in place to tackle the issues of greater environmental awareness. Those in the environmental sector understand the value of the environment and this needs to be communicated and understood more widely to ultimately increase the number and expertise of citizen scientists to collect biological recording data in NI. The resulting data would enable greater understanding of the environment in NI and allow the effectiveness of conservation efforts to be better measured. However, without investing in education and engagement, there will not be the growth in future citizen scientists required to help support environmental surveillance and monitoring. The report concluded with a number of more specific recommendations for next steps, including:

- An annual meeting to continue improving communications across the sector in NI.
- Continuing funding for engagement projects in NI across all taxa.
- Seek land access collaboratively across the sector.

- Collaborate on advertising and running training and engagement events.
- Update the CEDaR website with a clear links to the recording page, other recording schemes and useful information.
- Improve data sharing via CEDaR.
- Implement a roving/ad-hoc style survey for recording in remote or uninhabited areas.
- Improve the volunteer network/hub across schemes.
- Employ paid fieldworkers to supplement data collection until there are sufficiently trained volunteers to replace them.

Contents

1. Background

1.1 Biological Recording

Biodiversity is declining in the UK because of a number of factors particularly agricultural intensification and climate change (Burns *et al.* 2023). To understand changes in biodiversity we need to have robust monitoring which often involves volunteer "citizen scientists" recording wildlife and submitting data to an organisation that runs a survey, coordinates a scheme, and stores and uses that information. Monitoring is mainly coordinated by environmental NGOs (including multi-partnerships involving the Statutory Nature Conservation Bodies) and a suite of National Schemes and Societies (NSS) focused on specific taxa. Organisations such as Local Environmental Records Centres across the UK and the Centre for Environmental Data and Recording (CEDaR) for Northern Ireland, collate, store, maintain and disseminate biological recording data. These data can then be used in research to understand population changes and dynamics, demography, and phenology of populations. Data are collected locally, but generally reported at larger, national, or in some cases regional, scales. We can estimate population sizes and changes in abundance, or other metrics over time, to monitor and report changes which are used to set conservation priorities (e.g. Red Lists) and undertake appropriate conservation action to tackle threats and provide them with more protection. Monitoring can also reveal how well, or not, these initiatives and incentives to increase wildlife and biodiversity are doing, such as agri-environment schemes on farmland. Schemes and surveys may be structured (with sampling designs and protocols to minimise bias and maximise representativeness) but coverage of structured schemes can be sparse in some regions (Border *et al.* 2019).

A significant challenge to biodiversity assessments at scales smaller than national, including those for specific regions or landscapes, is the extent and quality of data available. Monitoring programmes are often designed to achieve broad but representative coverage of the larger national area, for both national and international reporting requirements on the state of biodiversity. Although these datasets can sometimes be disaggregated to conduct smaller scale evaluations, there is often a cost in the extent and potentially also the representativeness of the existing data.

1.2 Northern Ireland

Northern Ireland is one of four countries within the UK, it has its own devolved government and country-specific environmental policies and biodiversity strategy, which are implemented and monitored by the Department of Agriculture, Environment and Rural Affairs (DAERA) and the Northern Ireland Environment Agency (NIEA), an executive agency within DAERA. Biological recording data are required to develop and deliver these policies, strategies and monitor outcomes as part of the legal statutory requirements under The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (as amended), The Environment (Northern Ireland) Order 2002, The Marine Act (Northern Ireland) 2013, and the Environment Act 2021 which creates additional monitoring and reporting needs on Environmental Improvement Plans. However, Northern Ireland is considered to be relatively data-poor (Border *et al.* 2019) and this may hinder NI's ability to develop and deliver on environmental policy.

The population of 1.9 million people, compared to 67.3 million in the whole of the UK, is largely concentrated in the east of the country. Its land area is 14,130 km^2, which is just under 6% of the UK's land area of 243,610 km^2 and is the smallest country in the UK. The Northern Ireland Countryside Survey (NICS) has been ongoing since 1986 and has been used to assess changes in the type and extent of land cover and habitat types. The most recent UK National Ecosystem Assessment (UK NEA) shows broad habitat change between

1998–2007 of mainly increases in improved grassland, built-up areas and broadleaved woodland, replacing arable farmland and neutral grassland (Cooper *et al.* 2009; Christie *et al.* 2011). DAERA is currently funding the latest NICS, which is being undertaken by the UK Centre for Ecology and Hydrology (UKCEH), with reporting not expected before 2026. 77% of NI is used for agriculture (DAERA 2022b). The previous UK NEA showed that enclosed farmland is the largest broad habitat covering 44% of Northern Ireland (NI); this is predominantly pastoral agricultural land (79% of farmed area is grass), with very little semi-natural grassland (18% of NI) and more than 40% of NI is improved grassland (Cooper *et al.* 2009; Christie *et al.* 2011; DAERA 2022a). NI has important terrestrial and wetland habitats, such as blanket bogs, which cover 10% of NI (Christie *et al.* 2011), large inland and coastal water bodies make up 7% of NI, including Lough Neagh, the largest freshwater lake in the British Isles, which supports around 100,000 wintering waterbirds (Hayhow *et al.* 2019). Broadleaved woodland covers 6% of NI and coniferous plantations of mainly Sika spruce make up 4% of NI. The NI land classification from the last NICS can be found on the DAERA website, defined by a multivariate sampling approach to map attributes that represent a broad range of environmental parameters: climate, elevation and topography, vegetation, hydrology, settlement (anthropometric structures), geology and soils (Murray *et al.* 1992).

The island of Ireland, comprising Northern Ireland (NI) and the Republic of Ireland, holds a reduced subset of the native species of birds, mammals, reptiles, amphibians and invertebrates of the rest of the UK, as well as some species endemic to this region. The island is biologically different from the rest of the UK in terms of habitats and species. However, gaps in biological recording makes it difficult to assess the state of all aspects of biodiversity in Northern Ireland (Border *et al.* 2019; Burns *et al.* 2023).

1.3 Aims and scope

The Terrestrial Surveillance Development and Analysis (TSDA) partnership wanted to explore the barriers, challenges and solutions to biological recording to ensure that the UK schemes are delivering for all four nations and making use of data at smaller – landscape to local – scales. Northern Ireland was selected as a useful test case due to its small size and population, deficiency of environmental/biological data, important habitats and species compositions. Therefore, we aim to assess gaps in biological data coverage, identify constraints and explore solutions to improving recording in Northern Ireland. It was beyond the scope of this work to benchmark Northern Ireland against other countries in the UK for all taxa (although some BTO survey data has enabled this). However, it is worth noting that it is not only the numbers of species or habitats that are assessed that should be considered, but also the quality of the data supporting those assessments in terms, for example, of sample size and representativeness.

2. Approach and Methods

2.1 Interviews

Information on existing biological recording use of data, the gaps, barriers, and challenges as well as opportunities and solutions were directly sought and collated from the bodies responsible for either collecting biodiversity data and/or making use of it (stakeholders) through structured interviews. The resulting responses were a combination of factual information (e.g. on existing initiatives and programmes) and informed opinion (on gaps, barriers and potential solutions). Details of the factual information were subsequently bolstered, where feasible, through the examination of relevant websites and reports.

The interviews followed an earlier phase led by JNCC where a list of biodiversity stakeholders and responsible bodies were sent a questionnaire to gather responses on biodiversity monitoring requirements in Northern Ireland. The JNCC questionnaire received answers from 12 respondents, all except one being stakeholders. We touch on some of the results from that questionnaire here, but ultimately those answers informed the questions we asked in the interviews.

Two separate sets of interview questions were drawn up to capture relevant information and greater detail from each of the two sets of interviewees: stakeholders (in theory, largely data users) and scheme organisers (see Appendix 1, *Stakeholder Interview Questions* and *Scheme Organiser Interview Questions*, for the questions). The same 12 respondents to the JNCC questionnaire were approached to complete the interviews as well as a representative subset of the key organisations that coordinate surveys for a range of taxa in Northern Ireland (NI) or across the UK (e.g. BWARS, Plantlife, The Mammal Society; see Table 7 in Appendix 1 for the list of organisations). During the interview process and in correspondence with possible interviewees, other organisations were suggested as relevant to interview, such as the National Biodiversity Data Centre (NBDC) in the Republic of Ireland (RoI), and the Office for Environmental Protection (OEP). A total of 39 people from 30 organisations were contacted between 31 January and 8 March 2023, and 25 people from 19 organisations agreed and were interviewed online using the same video conferencing platform between 8 February and 8 March 2023. All interviews were conducted by Ailidh Barnes, with at least one additional person participating and taking notes (for most either David Noble or Sorrel Lyall). Two respondents from two different organisations answered the interview questions on paper; one was a supplement to a previous interview to extract more information and the other was from a separate organisation who was unavailable for interview. Additionally, three interviews had two people attending and for the analysis of responses these were treated as one interview respondent. In total there were 20 organisations, and we therefore treat this as 20 respondents including the one on paper.

2.2 Workshop

On 18 October 2023 approximately 50 people from 20 organisations attended the in-person workshop at Lough Neagh Discovery Centre in Northern Ireland, and (three organisations joined online). A draft of this report was sent to potential attendees ahead of the workshop as the purpose of the workshop was to discuss the initial findings from the interviews detailed in the first part of this report (Sections 6–8). Many of the organisations attending had previously been interviewed, however, some interviewed organisations could not attend the workshop and a number of organisations that did attend the workshop were not interviewed. There were introductory talks from JNCC and DAERA, and BTO presented the study's initial findings from the interviews.

Having received this information and a copy of the draft report, attendees were first asked to rank the six grouped barriers individually on a scale of 1–6, with 1 being the most important to the individual/their organisation, and 6 the least. They were then split into seven groups of mixed organisations, and after some group discussion, were asked to rank the barriers again, using the same 1–6 scale, with the importance scale focusing on the group's priorities and not individuals/individual organisation priorities. They were then asked to discuss the potential solutions laid out in the report and map them, and any others, to the six barrier groups located around the room. There were presentations on engagement and initiatives across NI from eight organisations: BTO, Buglife, Ulster Wildlife, CEDaR, BRC, BC, ARG and RSPB. For the third workshop exercise the attendees were split into six groups comprised of slightly different members to the previous groupings. Three of the groups were asked to envisage how the sector would hypothetically spend approximately £100,000 over a year, and the other three groups were asked how they would hypothetically spend £5 million over 5 years to improve biological recording across NI.

2.3 Structure of the report

Sections 3 and 4 summarise the background information on biological recording based on interviews supplemented with additional research. Sections 5–8 formally summarise responses to the interview questions including: user needs (Section 5); barriers and challenges to biological recording (Section 6); the solutions/opportunities to improve biological recording in NI (Section 7); and wider issues and opportunities across the UK (Section 8). Section 9 summarises the results from workshop which discussed the results from the interviews described/detailed in Sections 5–8. Conclusions and next steps are formulated in Section 10.

3. Existing biological recording in/available in Northern Ireland

3.1 Terrestrial Recording

Biological recording has a largely terrestrial remit, however, overlap with marine habitats can occur in highly mobile species like birds. This first section covers the mainly terrestrial schemes undertaken/coordinated by the organisations interviewed in this project, and as a result may be missing other recording schemes in NI. Section 4 contains more detail per taxon and includes schemes and organisations that were not interviewed but may have a remit in NI, therefore information was collated where accessible and available. The following table (Table 1) and the text in this section and the next (Section 4) is largely derived from the responses of the interviewees supplemented by additional information.

Table 1. The biological recording activities that the organisations interviewed for this project are currently undertaking/coordinating, and whether these apply to Northern Ireland, to the whole island of Ireland and/or the rest of the UK. Schemes/Activities marked with an asterisk (*) are surveys not in NI but have been included here because they were mentioned by the interviewee as an example of a successful initiative being used elsewhere in the UK. More detailed taxon-specific information is detailed in Section 4. Training initiatives are covered in Section 7.3–7.5 of this report. (See Table 6 Acronym list for abbreviations and Table 7 in Appendix 1 for full list of organisations contacted).

Organisation	Scheme/ Activities	More Information
Royal Society for the Protection of Birds (RSPB)	Red Kite Monitoring	Volunteer network over NI to monitor roost sites, sightings and nest sites.
	Farmland Bird Surveys	Volunteers monitor numbers of priority bird species at specific locations to provide targeted advice and conservation management.
	Breeding Wader Surveys	Monitoring conservation initiatives in NI. On Lough Erne yearly surveys between 2011 and 2015. Antrim Hills, Glenwherry project launched in 2011 with surveys carried out until 2014, mainly by RSPB.
	Statutory Conservation Agency and RSPB Annual Breeding Bird Scheme (SCARABBS)	An ongoing programme of periodic single-species surveys for conservation priority bird species not covered adequately by other schemes. Each survey, previously one or two per year, is supported by RSPB and the Statutory Nature Conservation Bodies (SNCBs) as well as other partners where interests overlap (e.g. BTO, Forestry Commission).
	RSPB reserves Monitoring	Biodiversity surveys carried out by RSPB staff
British Trust for Ornithology (BTO)	Breeding Bird Survey (BBS)	A structured UK wide survey of breeding birds (1994–present) of 152 squares in NI supplemented by professional surveyors. JNCC and RSPB are partners. Mammals are recorded during the bird surveys, and butterflies are recorded on a subset of BBS squares during a separate visit see WCBS below.

Organisation	Scheme/ Activities	More Information
British Trust for Ornithology (BTO)	Wetland Bird Survey (WeBS)	A structured, long-term, ongoing UK wide survey of wintering waterbirds. Main wetland sites well covered in NI, possibilities to improve. JNCC and RSPB are partners.
	BirdTrack	Unstructured surveying UK wide. RSPB, BirdWatchIreland, Scottish Ornithologists Club and the Welsh Ornithological Society are partners. Additional taxa also recorded: amphibians, butterflies, mammals, dragonflies, orchids and reptiles.
	Herons	A long-term, ongoing UK wide programme. Good coverage in all six regions in NI.
	Periodic Single Species Bird Surveys	For example, Woodcock Survey is a UK wide, structured survey every 10 years (2003, 2013 and 2023), partnered with the Game and Wildlife Conservation Trust.
	Seabird Monitoring Programme (SMP)	While this has been managed locally in Northern Ireland by the BTO since 2013, UK-wide coordination was transferred to BTO from JNCC in 2022. This is a long-term seabird monitoring scheme focusing on seabird abundance and productivity trends over time. JNCC and BTO are scheme partners, alongside associate partner RSPB.
	Goose and Swan Monitoring Programme (GSMP)	Coordination was transferred from the Wildfowl and Wetlands Trust (WWT) to BTO in 2022. GSMP is a UK-wide collection of structured surveys, with Greenland White-front and Light-bellied Brent Geese in Ireland included. Ongoing work to promote coverage across the UK. JNCC and NatureScot are partners.
	Garden BirdWatch (GBW)	Semi-structured UK wide weekly survey of garden birds. 73 users out of 293 actively reported in the last quarter. Additional taxa also recorded: amphibians, reptiles, butterflies, mammals, dragonflies and other selected insects.
	Ringing Scheme	Ongoing, long-term and Britain and Ireland wide. Schemes within ringing (Constant Effort Sites and Re-trapping Adults for Survival) are structured surveys. JNCC is a partner.
	Nest Record Scheme (NRS)	Unstructured surveys can record nests anywhere, long-term ongoing scheme across the UK. JNCC is a partner.
	Nesting Neighbours *	Like NRS but smaller and simpler and in gardens. Because of the need to license disturbing birds in NI, it is not promoted in NI.
People's Trust for Endangered Species (PTES)	Living with Mammals	Started in 2003, semi-structured, recording mammals near buildings (< 200 m) UK wide but poor coverage in NI.
	Mammals on Roads	Started in 2001, unstructured UK wide recording dead/alive mammals on a route using an app. Poor coverage in NI.

Organisation	Scheme/ Activities	More Information
People's Trust for Endangered Species (PTES)	Hazel Dormouse Surveys *	A collection of surveys. Not in NI because it is non-native to Ireland.
	The Big Hedgehog Map	Unstructured UK wide hedgehog survey. 645 records in NI on NBN (National Biodiversity Network). Partnered with the British Hedgehog Preservation Society.
	The Great Stag Hunt	Stag Beetle Survey is by transects or one-off records, UK wide. People have registered in NI and RoI but not taken up widely.
The Mammal Society	National Water Vole Monitoring Programme *	Started in 2015, structured, GB wide. Not in NI. Partnered with PTES.
	Mammal Mapper App	Unstructured ad hoc records of mammals to be used at any site visited. Promotion in the GB and NI.
	National Harvest Mouse Survey	UK wide periodic unstructured (pick own site in suitable habitat) nest search surveys (1970s, 1990s, 2013–2014, 2021–2023) presence only records. Not in NI and presence is not known in the UK Islands.
	Greater White toothed Shrew *	Non-native in Ireland therefore it's not being monitored.
	Mountain Hare Survey *	Survey runs in Scotland using the mammal mapper app via ad-hoc records when in the uplands. Not operating in NI.
	Otter Survey	Could be Irish Otter Survey – National Otter Survey coordinated by National Parks & Wildlife Service (NPWS) supported by NBDC. See NBDC Website.
Amphibian and Reptile Conservation (ARC)	National Amphibian and Reptile Recording Scheme (NARRS)	NARRS began in 2007 and is being superseded by the National Amphibian and Reptile Monitoring Programme. The new scheme requires repeat visits and is either structured and randomly stratified sites allocated or suggest a site. Open to NI but NARRS was not well covered or promoted – problem with licences (See Section 4.6).
	Record Pool	Online recording tool, unstructured ad hoc records, also collates and makes data publicly available. Collaboration with ARG UK: running "What's in your pond?" (NI) recording common frogs and smooth newts in school and garden ponds. 399 records in NI out of a total 54,022.
Amphibian and Reptile Groups (ARG)	Dragons in the Hills	A partnership engagement project with Amphibian and Reptile Groups of the UK (ARG UK), Newry Mourne and Down District Council and The Herpetological Society of Ireland. Submit records using Record Pool.

Organisation	Scheme/ Activities	More Information
National Biodiversity Data Centre (NBDC)	Bumblebee Monitoring Scheme	Run by National Biodiversity Data Centre (NBDC) based in the RoI, supported by Bees, Wasps & Ants Recording Society (BWARS) and started in 2012. Structured All-Ireland Scheme, equivalent of BeeWalk in GB.
Botanical Society of Britain and Ireland (BSBI)	Plant Atlas 2020 and BSBI Distribution Database	BSBI Distribution Database: The BSBI operates a Distribution Database (DDb) as a central store for records of plants and charophytes in the UK and Ireland. It contains over 50 million biological records and is growing by several million records every year. The BSBI has eight vice-county recorders across NI who coordinate local plant recording effort and submit records to the DDb. Plant Atlas 2020 is a website and book based on this data and includes UK and Ireland surveys of wild and naturalised plants between 2000 and 2019. Previous Atlases were based on surveys undertaken 1987–1999 and in the 1950s. BSBI's New Year Plant Hunt participants record species in flower around the New Year, contributing to understanding of how wild and naturalised plants across Britain and Ireland are responding to a changing climate.
Plantlife	National Plant Monitoring Scheme (NPMS)	Structured, UK wide survey. 230 squares allocated in NI but only 10–20 squares completed a year, with a total of 60 squares having had data submitted. Partnership with BSBI, Plantlife, UKCEH and JNCC.
UK Centre for Ecology and Hydrology (UKCEH)	BRC	BRC engage with 107 national schemes and societies, including 90 recording schemes and societies, nine monitoring schemes and eight others (study groups, etc.). They also run/coordinate iRecord an online platform for ad-hoc recording of wildlife.
	Pollinator Monitoring Scheme (PoMS)	UK-wide collection of surveys: either structured systematic approach using pan-traps 1 km transects or semi-structured Flower-Insect Timed Count (FIT Count). Promoted in 2020 to get more people in NI. Multiple partners.
Butterfly Conservation (BC)	Butterfly Monitoring Scheme (UKBMS)	Structured, UK-wide transect surveys of butterflies visited weekly for 26 weeks. This is a partnership between BC, UKCEH, BTO and JNCC.
	Wider Countryside Butterfly Survey (WCBS)	Structured surveys on BBS transects, started in 2009. Two to four visits. In collaboration with BTO, UKCEH and JNCC.
	Garden Butterfly Survey	Unstructured survey started in 2016 to record butterflies all year round in gardens/allotments.

Organisation	Scheme/ Activities	More Information
Butterfly Conservation (BC)	Garden Moth Scheme	Started in 2003 using a moth trap one night a week to record moths. Contributes to the National Moth Recording Scheme. Only one County Moth Recorder in both NI and RoI.
	Big Butterfly Count	Semi-structured count at the same time of year each year. Chose a spot to record butterflies for 15 minutes.
	Moth Count	Like above, using a moth trap in NI to catch and ID moths and send into BC.
	Moth Night	Organised by Atropos, UKCEH and BC, engagement incentive to raise awareness and get people recording moths on three consecutive nights in the summer.
	Single Species Surveys	Marsh Fritillary Monitoring Scheme – working with NBDC, All-Ireland and UK scheme and Large Heath.
	iRecord for Butterflies	Unstructured input of ad hoc data into a free app. Partnered with UKCEH and JNCC.
Ulster Wildlife (UW)	Red Squirrels	Ad hoc sightings submitted via the UW website. With Local Red Squirrel Groups recording and conservation. See Section 4.3 for more information. New database produced in 2023. Data shared with CEDaR and NIEA monthly. Also, presence/absence survey carried out every 2 years.
	Grey Squirrels	Ad hoc sightings submitted via the UW website. With Local Red Squirrel Groups recording and conservation. See Section 4.3 for more information. New database produced in 2023. Data shared with CEDaR and NIEA monthly. Also, presence/absence survey carried out every two years.
	Barn Owls (and long-eared owls)	Ad hoc sightings submitted via the UW website. Barn Owl data was analysed by BTO Scotland on top of the annual national survey which takes place each summer. Data sent to the Barn Owl Trust for their annual reporting. Ulster Wildlife analyse and produce an annual report. New recording database launched in 2022; records shared with CEDaR.
	Pine Marten	Ad hoc sightings submitted via the UW website. Also presence/absence survey carried out every 2 years during the red squirrel survey.
	Hedgehog Survey	All-Ireland survey of ad hoc records along with footprint tunnels and camera trapping coordinated in NI by Ulster Wildlife alongside the National University of Ireland (NUI) Galway and NBDC.
	Sharks, Skates and rays	With the Sea Deep department in UW. Submit records of tags or egg cases found which are then submitted to CEDaR.

Organisation	Scheme/ Activities	More Information
Ulster Wildlife (UW)	Blue Carbon Habitat	Funded by DAERA and in partnership with the National Oceanography Centre and the University of Hull. Located blue carbon habitats including seagrass meadows, kelp forests, saltmarsh and shellfish beds around NI, and identified areas for restoration or habitat creation work.
	Ulster Wildlife Reserves Priority Species Monitoring	A range of species and habitat surveys carried out by Ulster Wildlife staff. Also monitoring by staff as part of facilitation of a EFS Group programme. This is to offer practical advice, support and training to help groups of farmers address the issues and challenges of farming within environmentally designated lands and help them put in place the management that is required to improve or safeguard these sites for the future.
CEDaR	Monitoring Designated Sites	Coordinate non-vascular plant monitoring on designated sites and starting to record invertebrates on designated sites. Data used for Monitoring Designated Sites was from CEDaR, DAERA and JNCC, but the proportions of data collected by staff compared with volunteers is unclear.
	CEDaR Online Recording	CEDaR also collate and encourage ad hoc recording of biodiversity generally via their website.

3.2 Marine Recording

DAERA/NIEA monitor the Marine Protected Areas (MPA) as part of the Common Standards Monitoring (CSM), for climate change surveillance and wider biodiversity in areas up to 12 nautical miles around the coast of NI. They work with statutory agencies (such as National Parks and Wildlife Service, NPWS) in RoI on assessments to the OSPAR Convention, and with the UK and JNCC. They collect data to assess new designations of MPAs which covers: Blue Carbon Initiatives; priority marine features; extent of biotope composition; the spatial extent and changes in, for example Seagrass coverage; key habitats; conservation species; water quality as part of the Water Framework Directive; diversity and change over time; and distribution of species, including Harbour Porpoise and Black Guillemots which are a designated Marine Conservation Zone (MCZ) feature. The Blue Carbon Initiative focuses on restoring coastal and marine habitats/ecosystems to mitigate climate change. This information on condition assessment feeds into bigger assessments and reporting obligations at a national and international level, including the OSPAR Convention, Marine Strategy assessments, and the Bern Convention for habitats. DAERA stated that they would also like to be able to assess the effectiveness of measures already in place, as current monitoring is not extensive.

Other departments in DAERA work on coastal surveys using satellite imagery (and will soon collect biological recording data), intertidal work, and may be commissioned by stakeholders on specific projects. Data were collected by trained professionals and divers, subcontracted to Universities or the Agri-Food and Biosciences Institute (AFBI), although DAERA now have their own vessel for collecting and analysing data. With the exception of the Seabird Monitoring Programme (SMP), citizen science recording in the marine environment tends to be more ad-hoc surveying of differing standards which can be considered in MPA assessments. Volunteers through Seasearch can also collect data outside MPAs, which DAERA do not have the capacity to monitor, and record sightings on the DiveNI website.

DAERA are reviewing their MPA strategy and guidance on monitoring and will be looking into how citizen scientists can help with marine biological recording. The raw data collected by DAERA's Marine team (excluding bird data) are sent to CEDaR, who host and upload the data on to Marine Recorder. These data are merged with contributors such as citizen science data from Seasearch, Ulster Wildlife, Universities and professionals. CEDaR send a copy of the NI data to JNCC every six months, and JNCC also have access to Marine Recorder for UK assessments. The Marine Map Viewer is where most marine biodiversity data are held and reported. It can be viewed and used as a marine planning tool for decision making, and provides publicly available information, including on species with protected status.

Breeding seabird abundance and productivity are collected as part of the Seabird Monitoring Programme (SMP) in Northern Ireland, coordinated by a BTO-held post funded by NIEA. Data are collected by a combination of volunteers, agency staff, professional surveyors and eNGOs, and are presented annually in the Northern Ireland Seabird Report (Booth Jones 2023). Data are submitted and held in the SMP database, administered by the BTO since 2022.

4. Coverage of key taxa and an assessment of gaps

4.1 Birds

Birds tend to be reasonably well covered compared to other taxa in NI (Border *et al.* 2019); however, an increase in coverage is still required to produce trends for more bird species. It should be noted that the Breeding Bird Survey (BBS) has been supplemented in NI by paid professional fieldworkers funded by NIEA since 1996, with 52 squares out of the 152 covered by professionals in 2021, whilst the remaining 100 squares were covered by volunteers. This coverage has enabled trends for 38 species to be calculated for Northern Ireland, which compares to 68 species in Scotland, 60 species in Wales and 114 species in England (Harris *et al.* 2022). BBS in Scotland was also supplemented by professional field workers for the first five years of the scheme (1994–1999) until coverage provided by volunteers had grown across Scotland.

Bird Indicators for the UK and England are produced annually by BTO for the Department for Environment, Food and Rural Affairs (Defra), reflecting Defra's remit, and are commissioned annually in Scotland by NatureScot and in Northern Ireland by DAERA. There is currently no official bird indicator in Wales although they have been produced previously for the State of Birds in Wales (Bladwell *et al.* 2018). Due to BBS data limitations, especially in Wales and NI, countries use different approaches to indicators, and they differ in the number of species included. The State of Nature Report 2019 and 2023, which uses other data sources including BBS, was unable to produce a single combined abundance indicator for NI due to poor taxonomic coverage. However, the 2019 Report shows that there has been a 66% increase in abundance of 41 breeding bird species from 1994 to 2016, although, 36 species of wintering water birds have shown declines in abundance of around 38% between 1988 and 2016 (Hayhow *et al.* 2019) and 30% by 2019 (Burns *et al.* 2023). The 2023 Report has enough data to produce indicators for woodland and farmland birds separately, which have declined by 18% (2011–2021) and 43% (1996–2021), respectively, whereas the other breeding birds, that includes many wetland species, have increased by 30% (Burns *et al.* 2023). This compares with the combined bird indicator for England consisting of 171 bird species with an increase of 23% from 1970, for Scotland 143 bird species have shown a 4% decline since 1994 and in Wales 83 bird species have increased by 37% since 1994 (Hayhow *et al.* 2019).

Wetland Bird Survey (WeBS) data have been used to calculate population trends over the short, 10-year and longer 25-year trends for non-breeding waterbirds for 39 species (37 over 25-years) in NI, 45 (43 in the 25-year trend) in Scotland, 48 in England (47 over 25-years) and 43 species in Wales (41 in the 25-year trend), with the added species in the short-term trend mainly being little egret and moorhen (Frost *et al.* 2021). This suggests that coverage of wintering waterbirds by WeBS is broadly comparable in NI. There is regularly good coverage of herons in all six regions in NI. Goose and Swan Monitoring Programme (GSMP) is in the early stages of coordination at BTO so increasing coverage across the UK is a priority.

The RSPB led species specific surveys (Table 1) are unclear how well they are covered by the volunteer network as opposed to paid staff. The reintroduced red kite population in NI is at 24 breeding pairs compared to 900 breeding pairs in Wales, it is unclear whether there are actually 24 pairs or if recording coverage of this species is lacking (RSPB 2023a). NI Raptor Study Group (NIRSG) coordinate raptor monitoring in NI (including SCARABBS) and accept ad hoc sightings. Coverage of periodic surveys like woodcock has had consistently poor coverage in NI.

Garden BirdWatch (GBW), managed by BTO (Table 1), has 293 active users in NI, 73 of which have submitted data in the last quarter (25%) and an average of 7 people submitted data from the Republic of Ireland. In 2022 the average weekly submissions in NI was 63, compared with 393 in Wales, 479 in Scotland and 5,305 in England (Table 2; GBW 2023). Table 2 suggests that per capita these figures are higher in Wales (0.013%), followed by England (0.009%) and Scotland (0.009%) and then NI (0.003%) with the fewest submissions per capita. However, Figure 1 shows that participant numbers have been increasing in NI since 2020, possibly with the change in 2020 to sign up to GBW for free, renewed focus on sign-up, plus the effects of COVID-19 on people's activities. Figure 2 displays the number of active participants by region in NI, with the highest in County Down followed by Antrim.

Table 2. The average weekly Garden BirdWatch(GBW) submissions in 2022 and the number of ringing permits issued in 2022 and per capita of both per country in the UK and Republic of Ireland.

Country	England	Scotland	Wales	Northern Ireland	Republic of Ireland
Average Weekly GBW Submissions	5,305	479	393	63	8
Average weekly GBW submissions, percentage (%) per capita	0.0094	0.0087	0.0127	0.0033	0.0002
Number of ringing permits issued in 2022	2,173	481	183	61	104
Number of ringing permits issued in 2022, percentage (%) per capita	0.0038	0.0088	0.0059	0.0032	0.0020

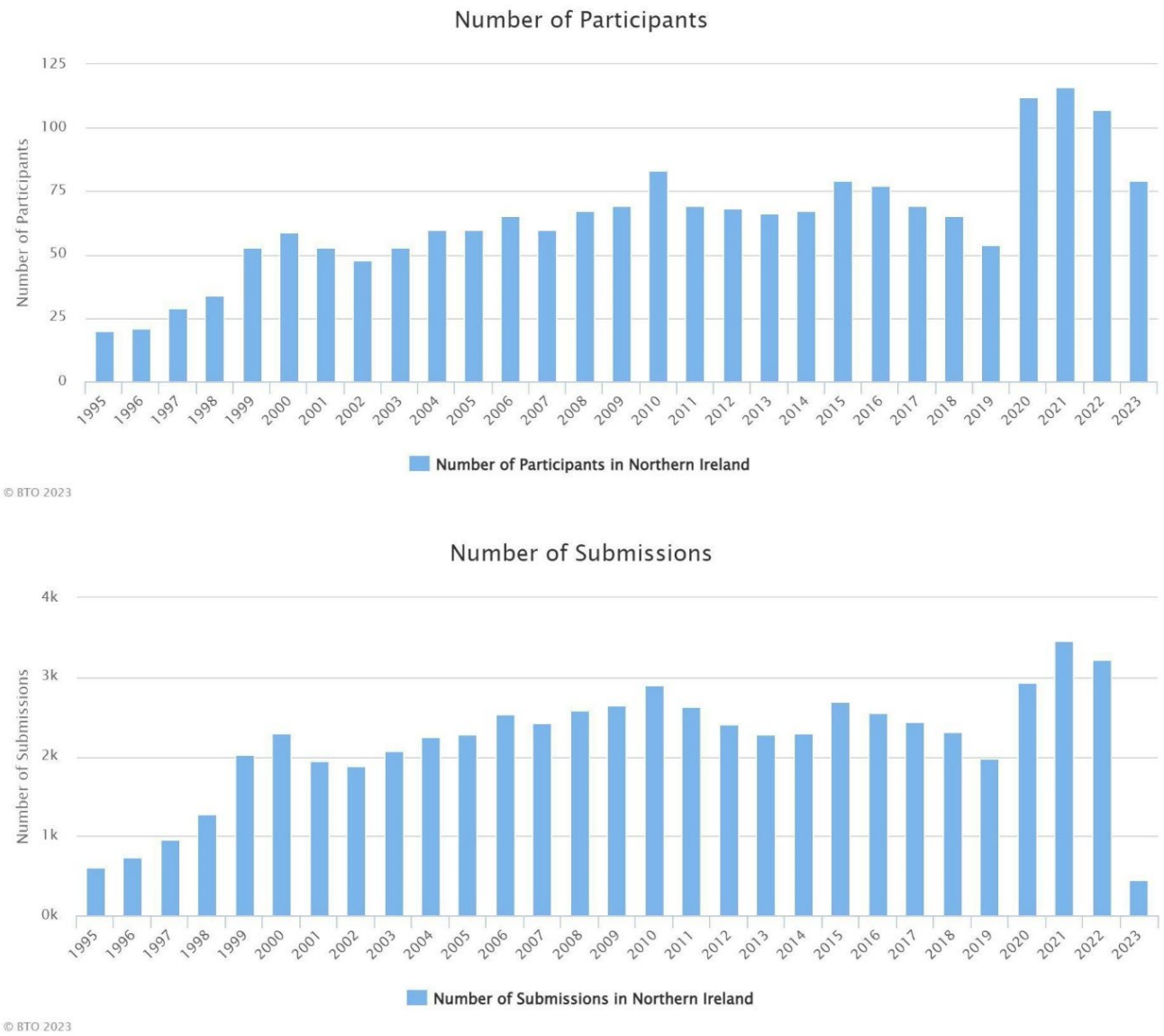

Figure 1. The number of Garden Birdwatch (GBW) participants (top) and records submitted (bottom) in Northern Ireland from 1995–2022.

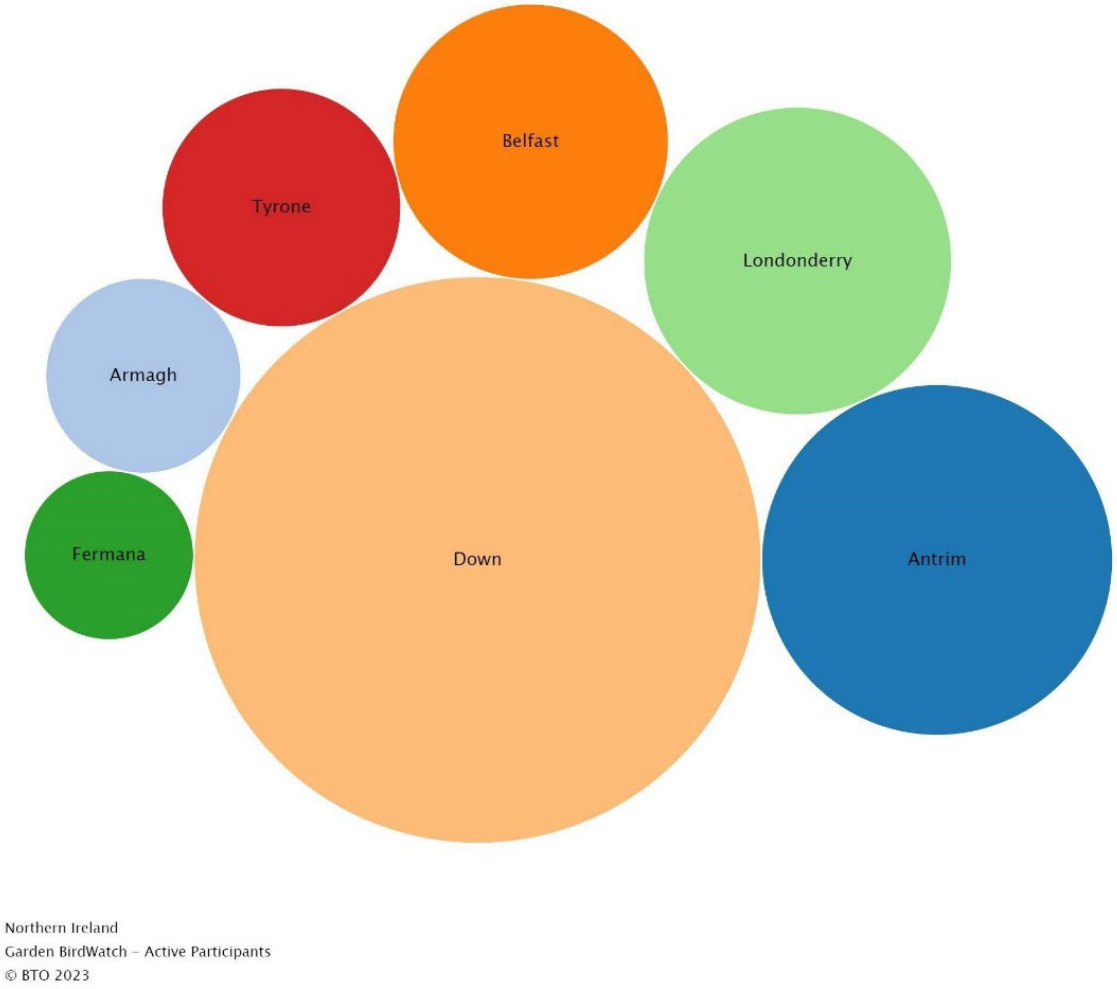

Figure 2. The number of active Garden BirdWatch (GBW) participants in each BTO region in Northern Ireland (note that Fermanagh has been shortened to Fermana to fit in the circle).

Only for this species group, we have the information available to relate the number of recorders, records and licences for recording birds between the four, and in some cases five, countries in schemes coordinated by the BTO. The number of bird ringing permits of any category issued in 2022 in NI was low (61), it was higher in the Republic of Ireland (104), increases to 183 in Wales, 481 in Scotland and 2,173 in England (Table 2). Per capita, Scotland had the most ringing permits issued in 2022, with NI not far behind England (Table 2). NRS uptake between 2007–2022 and BirdTrack uptake in the last three years in NI is significantly less than in the other four countries (Tables 3 and 4). Table 3 shows that the Nest Record Scheme (NRS) had an average of 7 people who submitted 268 Nest records a year in NI between 2007–2022, with a maximum number of 13 people who submitted 459 nest records in 2022. A similar number of people in the RoI submitted fewer nest records a year (Table 3). This compares to 65 people submitting 4,149 nest records on average in Wales between 2007–2022 (maximum 85 people and 5,820 nest records in 2019), 93 people submitted 3,439 nest records on average in Scotland between 2007–2022 (maximum 110 people and 4,253 nest records in 2015), and an average of 537 people submitting over 32,000 nest records in England between 2007–2022 (maximum 614 people in 2022 and 37,709 submissions in 2015).

Table 3. The average and maximum numbers of nest recorders and nest records submitted between 2007 and 2022 for each country in Great Britain and Ireland / in the UK and RoI.

Data type	England	Scotland	Wales	Northern Ireland	Republic of Ireland
Average Number of Recorders	537	93	65	7	7
Percentage (%) of Average Number of Recorders per capita	0.0009	0.0017	0.0021	0.0004	0.0001
Maximum Number of Recorders	614	110	85	13	12
Percentage (%) of Maximum Number of Recorders per capita	0.0011	0.0020	0.0027	0.0007	0.0002
Average Number of Records	32,089.1	3,439.3	4,148.8	268.3	181.4
Percentage (%) of Average Number of Records per capita	0.0568	0.0628	0.1336	0.0141	0.0035
Maximum Number of Records	37,709	4,253	5,820	459	332
Percentage (%) of Maximum Number of Records per capita	0.0667	0.0776	0.1874	0.0241	0.0065

Table 4. BirdTrack users and submissions for the last three years in each of the four UK countries.

Data Type	Year	England	Scotland	Wales	Northern Ireland
Users	2020	6,501	1,584	802	125
	2021	6,611	1,834	1,065	120
	2022	7,462	2,101	1,201	159
Percentage (%) of Users per capita	2022	0.0132	0.0383	0.0387	0.0083
Submissions	2020	6,534,054	997,279	401,012	28,770
	2021	6,628,629	1,048,539	444,776	34,570
	2022	6,638,344	1,141,171	421,004	32,784
Percentage (%) of Submissions per capita	2022	12	21	14	2

4.2 Butterflies

Coverage of the two main components of the UK Butterfly Monitoring Scheme (UKBMS), the UKBMS transect surveys and the Wider Countryside Butterfly Survey (WCBS) which is a joint partnership with Butterfly Conservation, UKCEH, BTO and JNCC (Table 1), is shown in Figure 3, and more details can be found on the UKBMS web page. Butterfly recording coverage is steadily increasing in NI, with trends now being produced for around half of Ireland's butterfly species. The State of Nature Report 2019 reports on nine butterfly species in the abundance indicator, which have declined by 43% since 2006 (Hayhow *et al.* 2019) and 14 species have declined by 16% in the latest State of Nature 2023 (Burns *et al.* 2023). The recent State of the UK's Butterflies 2022 produced long-term trends for 14 species of butterfly, half of the resident and regularly breeding butterfly species in NI and shows that butterfly abundance has declined by 17% between 2006–2019, with nine species decreasing and five species increasing (Fox *et al.* 2023). Although, as a result of insufficient data, reliable trends were not produced for many rarer species, including habitat specialists such as the large heath, small blue and dingy skipper (Fox *et al.* 2023). In comparison, trends were able to be produced for 25 species in Scotland since 1979, which in terms of area is similar in coverage to NI, just on a shorter timescale. The number of species trends increases to 33 in Wales, and 55 species in England, but it is worth noting that NI (and Scotland) has a reduced suite of butterfly species compared to England, although one species, the cryptic wood white (*Leptidea juvernica*), is only found in NI.

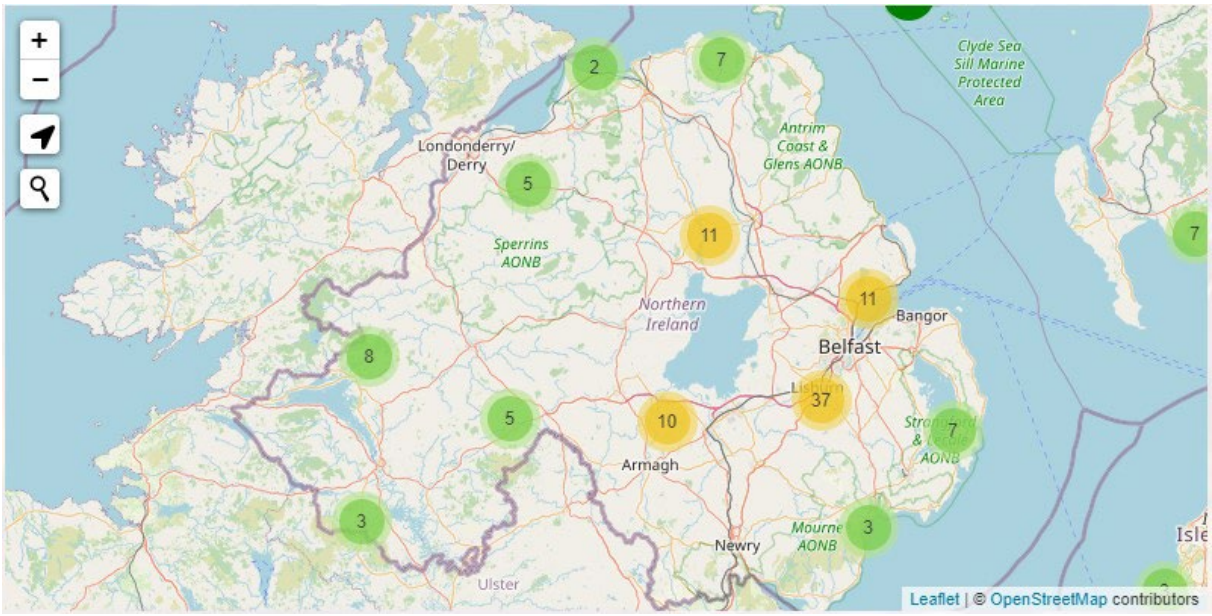

Figure 3. Broad locations and numbers of UKBMS transects and WCBS squares across Northern Ireland. For more detailed information, zoom in on locations via the UKBMS website.

4.3 Mammals

There are fewer mammal species in NI and the island of Ireland as a whole than in Great Britain (GB), although some native GB species have been found on the island of Ireland as a non-native species, for example hazel dormouse (*Muscardinus avellanarius*) which is endangered in GB. There are several schemes for recording mammals in the UK run by The Mammal Society and the People's Trust for Endangered Species (PTES, Table 1); however, very few currently operate in NI, mainly because these are single species surveys of species not found or non-native in Northern Ireland. Of the surveys that do run in NI, such as the "Hedgehog Survey", "Living with Mammals" and "Mammals on Roads", coverage is low with

only 645 records of hedgehogs (*Erinaceus europaeus*) in NI sent to the National Biodiversity Network (NBN) Atlas, with the earliest record from 2014 and the most recent in 2022 (NBN Atlas 2023). In fact, hedgehogs are the only NI mammal record available on the NBN Atlas, which may be an issue with data flow. The Irish Hedgehog Survey has been running since 2021 to collect baseline data on hedgehogs in Ireland. Ulster Wildlife have led this project in NI and carried out a country-wide survey using footprint tunnels, camera traps, and collecting ad hoc sightings.

Derry City and Strabane District Council along with Ulster Wildlife, The Mourne Heritage Trust (MHT) and local volunteers, mapped and surveyed both red and grey squirrels (*Sciurus vulgaris*, *Sciurus carolinensis*, respectively) in the council area in 2010, which led to the "NW Red Squirrel Group" who then led on recording. There are now 14, soon to be 15, Red Squirrel Volunteer Groups across NI (Figure 4). NI-wide recording of red squirrels has been undertaken by a single individual since 2014/15 (Ulster Wildlife 2022). The UK-wide Red Squirrels United (RSU) project took place between 2016 and 2020 (delivered by Ulster Wildlife in NI), which coordinated annual surveys and grey control efforts. Since completion, UW has committed to continue coordinating surveys every two years, logging sightings, helping the volunteer groups and providing training (e.g. on grey control). Ulster Wildlife also produced a new database for these sightings (Figure 5) which is shared with NIEA and CEDaR and contains a large dataset on presence-absence data for red squirrel, grey squirrel and pine marten (*Martes martes*) for Northern Ireland (Ulster Wildlife 2022).

Most of the National Bat Monitoring Programme (NBMP) surveying is carried out by Irish groups who do all-Ireland surveying and share the Northern Ireland data with the Bat Conservation Trust (BCT) to feed it into NBMP, although there are some surveyors who are attached to BCT directly and supply data via the usual data submission routes. According to the NBMP website BCT has a number of surveys in NI that are run with Bat Conservation Ireland and the Northern Ireland Bat Group (NIBG) and supported by CEDaR: Summer Roost Counts; Daubenton's Waterways Survey; Car-based Bat Monitoring; BATLAS 2020 which is run across all-Ireland by Bat Conservation Ireland and covers five bat species; Hibernation Survey and Bat Box Surveys. However, only the Waterways Survey produces enough data to produce trends. As a result, a UK trend is only able to be produced for the Daubenton's bat (*Myotis daubentonii*). Although the Northern Irish data feed into NBMP, it is a separate data sharing arrangement between BCT and the Irish groups, and so is outside the NBMP agreement.

The State of Nature Report 2019 has an abundance indicator for Northern Ireland comprised of five mammal species: four bats and rabbit (*Oryctolagus cuniculus*), due to a lack of wider mammal reporting. This combined indicator shows an increase of 91% from 1998 to 2016 (Hayhow *et al.* 2019). The latest State of Nature Report 2023 provides an indicator with six bat species and has removed rabbit and suggested caution in interpreting the results due to low survey coverage (Burns *et al.* 2023). In Wales the indicator in the State of Nature Report 2019 is only produced for seven mammal species, six bat species and rabbit, and also shows an increase of 43% since 1998, whereas the nine mammal species in the abundance indicator for Scotland have declined by 9% since 1998. The abundance indicator for England contains 15 mammal species and showed increases of 21% since 1998 (Hayhow *et al.* 2019).

BBS mammal records have allowed for short- and medium-term (10 year) NI trends to be calculated for two species, mountain/Irish hare (*Lepus timidus*) and rabbit (and a long-term (24 year) trend for rabbit). This compares with trends for two species in Wales (grey squirrel and rabbit); four species in Scotland (brown hare (*Lepus europaeus*), rabbit, red (*Cervus elaphus*) and roe deer (*Capreolus capreolus*)); and seven species in England (brown hare, rabbit, grey squirrel, red fox (*Vulpes vulpes*), roe and fallow deer (*Dama dama*), and Reeves' muntjac (*Muntiacus reevesi*)).

Figure 4. The locations of the 14 Local Red Squirrel Groups in Northern Ireland as of 2022 (Ulster Wildlife 2022).

Figure 5. All records of Red and Grey Squirrels and Pine Marten across Northern Ireland from the Ulster Wildlife website, with sightings since 2018/2019 (Esri, USGS | Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS).

4.4 Plants

The National Plant Monitoring Scheme (NPMS) is a UK scheme and a joint partnership between Plantlife International, BSBI, UKCEH and JNCC. There are 230 one-km squares allocated to NPMS volunteers in NI, which contain around five survey plots in each, out of a possible 270 (Figure 6), although data are only regularly submitted for around 10–20 squares a year with a cumulative total of 60 squares having data submitted. In 2022, NPMS data were submitted for seven squares with data returns for a total of 65 squares, representing a total of 215 plots, used in the publication of the annual report. There were 5,648 records from the NPMS on the NBN Atlas between 2015 and 2022.

The Biological Records Centre (BRC) and the British Bryological Society actively promote bryophyte recording, covering both the UK and all-Ireland, documenting species occurrence by vice-counties and producing an Atlas of British and Irish Bryophytes. Northern Ireland was much better recorded in the most recent *Atlas of British and Irish Bryophytes* (Blockeel *et al.* 2014), than in the previous edition, with thanks to efforts by Richard Weyl the vice-county recorder and NIEA staff, and the inclusion of records from the *Rare and threatened bryophytes of Ireland* (Lockhart *et al.* 2012) funded by the Northern Ireland Environment Agency. The spatial coverage and total number of bryophyte records in the BBS database since 2014 is relatively lower in NI (as for Ireland) than other UK countries (Amy & Pescott 2022), and the BBS would welcome new Regional (vice-county) Recorders for bryophytes in NI.

The BSBI operates a Distribution Database (DDb) for recording all naturalised and native plants in grid squares, down to 100 m resolution by BSBI recorders across the whole of NI. These are mainly collected by vice-county recorders who aim to achieve complete coverage of each vice-county in terms of species and grid squares (at varying resolutions) as the bases of county and national floras and distribution atlases. These are collated centrally by the BSBI in the DDb, which currently holds 1.8 million records for NI.

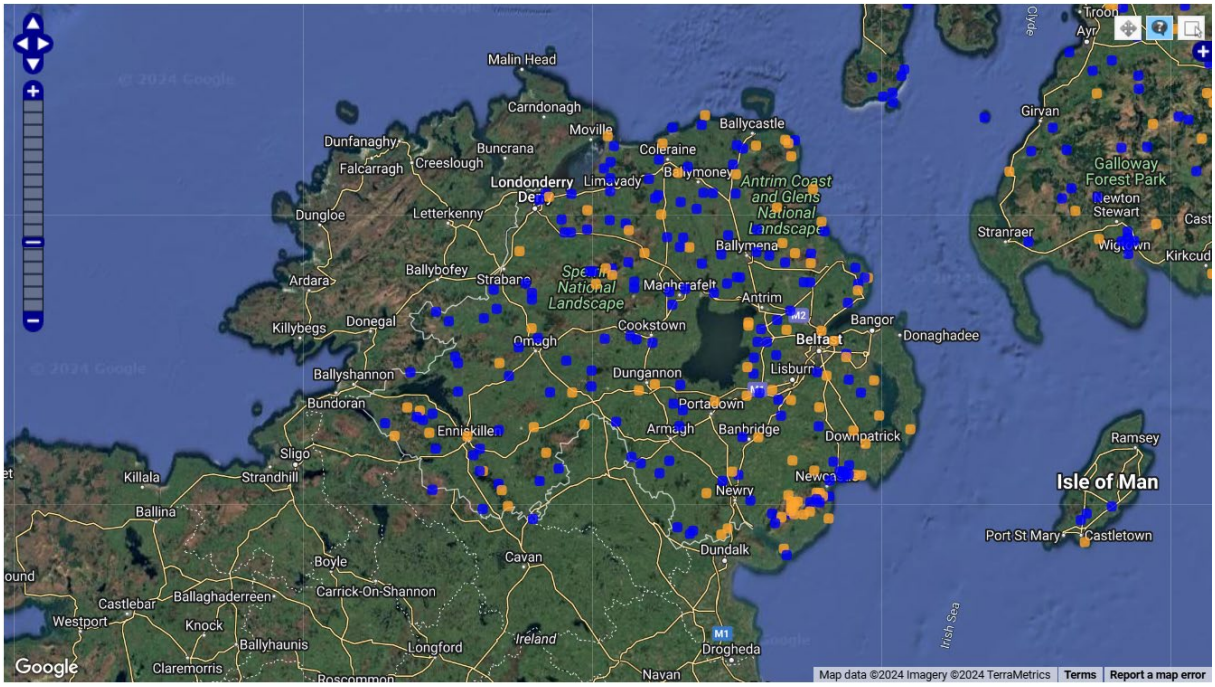

Figure 6. NPMS coverage across Northern Ireland (Feb 2023). Blue squares are vacant and yellow taken/covered. (©2024 Imagery ©2024 TerraMetrics, Google Terms).

4.5 Other insect groups including pollinators

The Pollinator Monitoring Scheme (PoMS) started in 2017, and in 2021 engagement incentives in NI, which included an initial pilot of pan trapping surveys to get more recorders, resulted in 20 one-km squares covered in 2022 (Table 1). Figure 7 shows the locations and uptake of current squares in 2023. PoMS has provided an option in their app where you can specify if you're in GB or the island of Ireland and hence tailor the species list to the appropriate region.

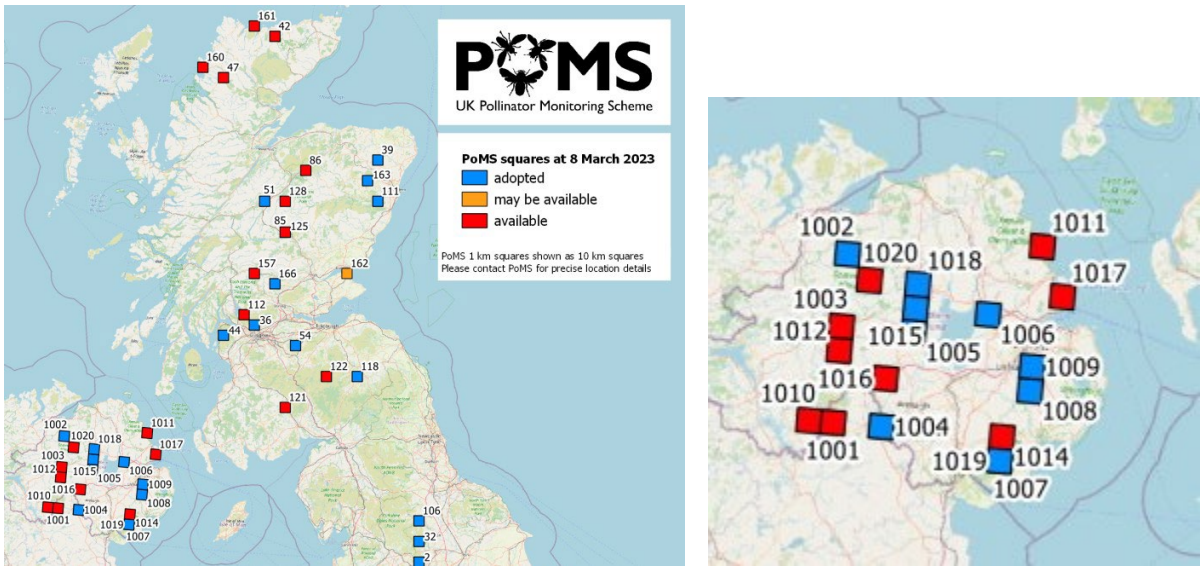

Figure 7. PoMS 1 km square locations in Scotland, northern England and Northern Ireland (insert right), colour indicates whether they have yet been adopted for 2023 as of 8 March 2023.

The Biological Records Centre (BRC) works with many national recording schemes and societies across the UK, and the Republic of Ireland in some cases. BRC provides data management support where required; develops and maintains online support for recording schemes (including websites and recording apps); and helps disseminate data across the research and conservation communities. They also carry out research, often in partnership with the schemes. The BRC website lists 107 national schemes and societies, including 90 recording schemes and societies, nine monitoring schemes and eight others (study groups, etc.). Apart from representatives of organisations with taxonomic specialisations, we interviewed only one of the completely-volunteer national schemes and societies that contribute to the Biological Record Centre, as most are very small and not based in Northern Ireland. BWARS (Bees, Wasps & Ants Recording Society) has a UK remit and is based in Great Britain and will accept records from anywhere in the island of Ireland, although has relinquished responsibility for recording in NI to the NBDC at an all-Ireland scale. Only bees are recorded across all-Ireland via Bee Walks which is organised, and data are collated by NBDC rather than BWARS, however, data are shared between both organisations upon asking and they have a good working relationship. The data that are reported to BWARS from all-Ireland are used in their Atlas and are available directly to the NBDC.

4.6 Amphibians and Reptiles

Amphibian and Reptile Conservation (ARC) originally ran NARRS (National Amphibian and Reptile Recording Scheme) which ran from 2007 and was open to participants in NI, but the new scheme (National Amphibian and Reptile Monitoring Programme NARMP) was not up and running at the time of the interview. The Herpetological Society of Ireland (HSI), based

in the Republic of Ireland works cross-border in NI and RoI. Newry, Mourne and Down District Council in partnership with Amphibian and Reptile Group (ARG) UK and the HSI, ran "Dragons in the Hills" which is an engagement and monitoring short term project recording submissions on Record Pool, an online recording tool (Table 1).

There are no species of snakes found on the island of Ireland and there is only one native reptile, the common lizard (*Zootoca vivipara*), one native newt, the smooth newt (*Lissotriton vulgaris*) and two other native amphibian species, the common frog (*Rana temporaria*) and natterjack toad (*Epidalea clamita*) which is the island of Ireland's rarest and most endangered amphibian. The common toad (*Bufo bufo*) and slow worm (*Anguis fragilis*) are present but non-native on the island of Ireland and the Herpetological Society of Ireland are running a "Toad in the Hole Campaign" asking members of the public to record sightings of the common toad. The NBN Atlas has 146 records from 2003 to 2023 of three common native species in NI: common frog, common lizard and smooth newt.

5. User needs in Northern Ireland

5.1 Overview of interview responses to user data needs

In this section, we summarise the user needs identified from answers to the first five questions in the questionnaire by the stakeholders and the subsequent interviews (see Appendix 1: *Stakeholder Interview Questions* and *Scheme Organiser Interview Questions* for both full sets of questions). Results are summarised for the first five stakeholder interview questions in Figure 8a–e. Nine stakeholders from across Northern Ireland were interviewed in total.

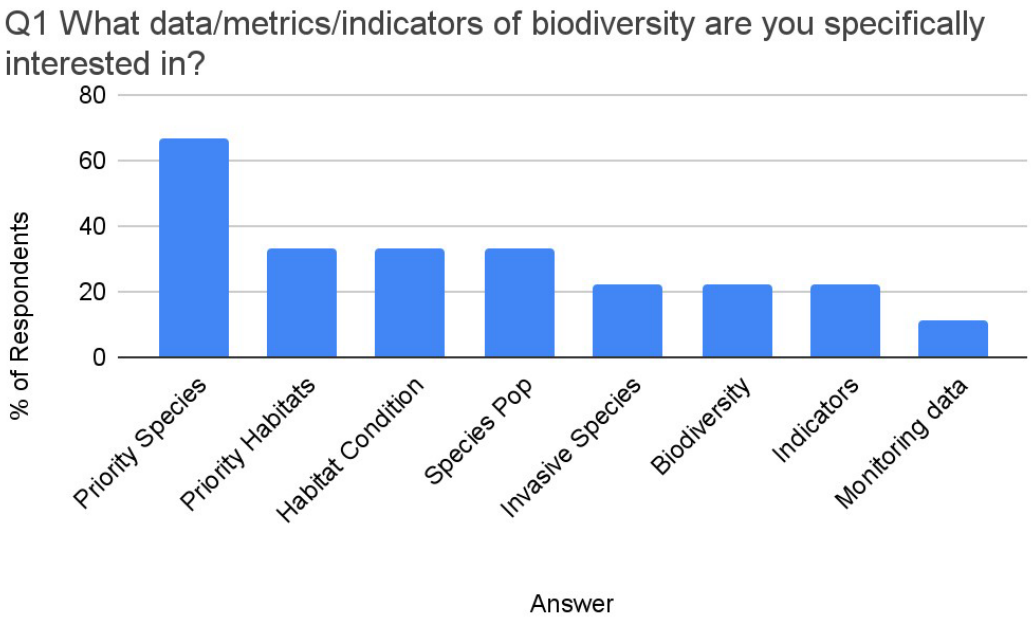

Figure 8a. Summary of responses to Question 1: What data/metrics/indicators of biodiversity are you specifically interested in?

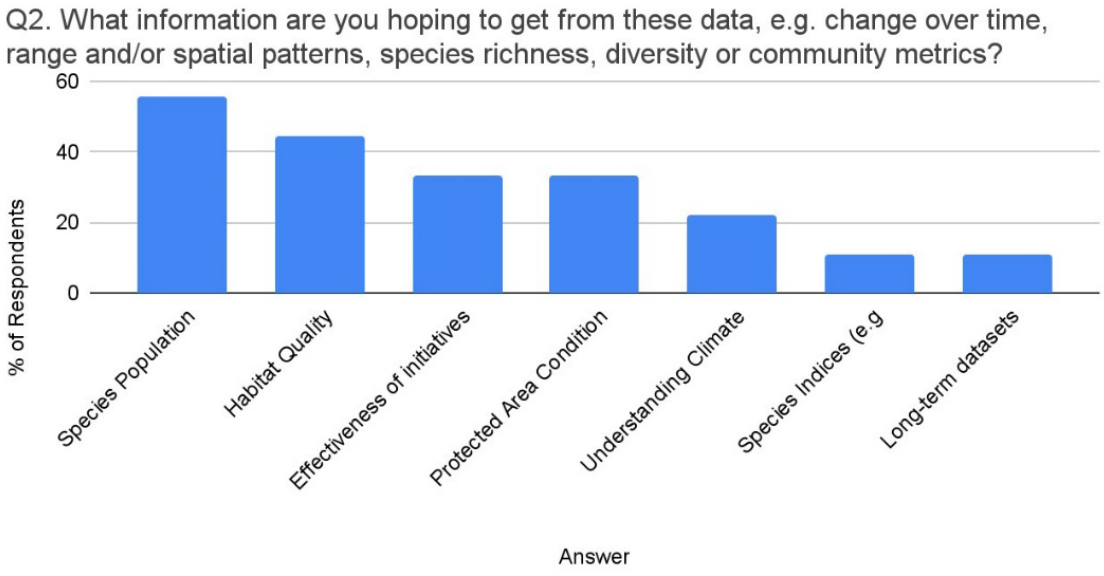

Figure 8b. Summary of responses to Question 2 of the stakeholder interview questions: What information are you hoping to get from these data (e.g. change over time, range and/or spatial patterns, species richness, diversity or community metrics?

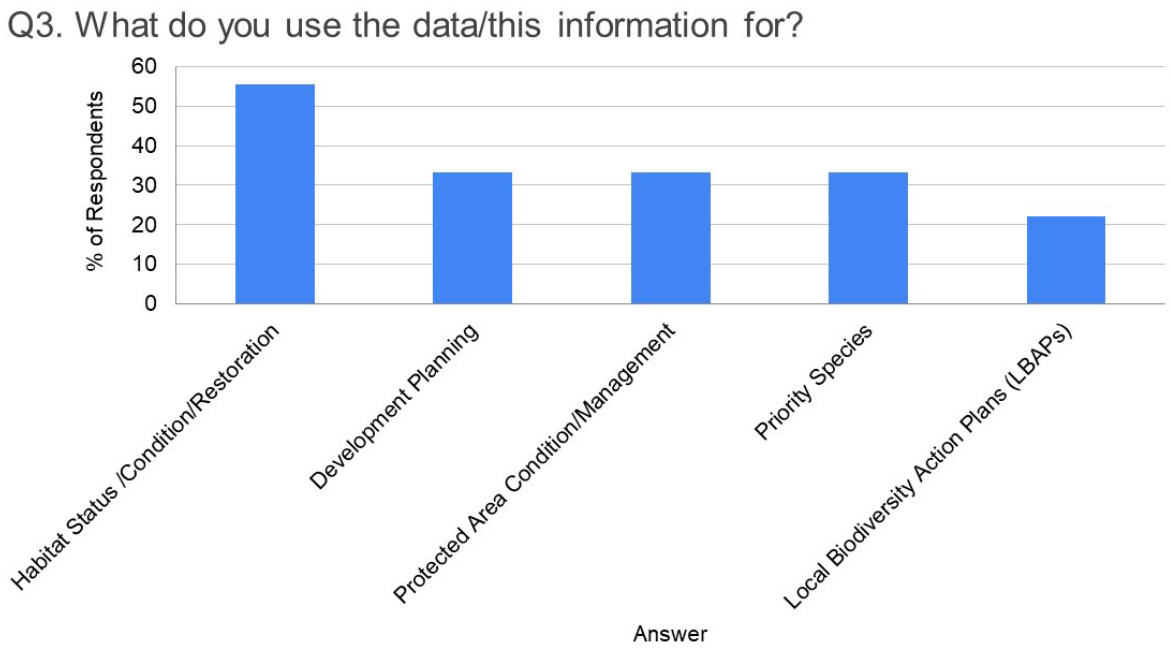

Figure 8c. Summary of responses to Question 3 of the stakeholder interview questions: What do you use the data/this information for?

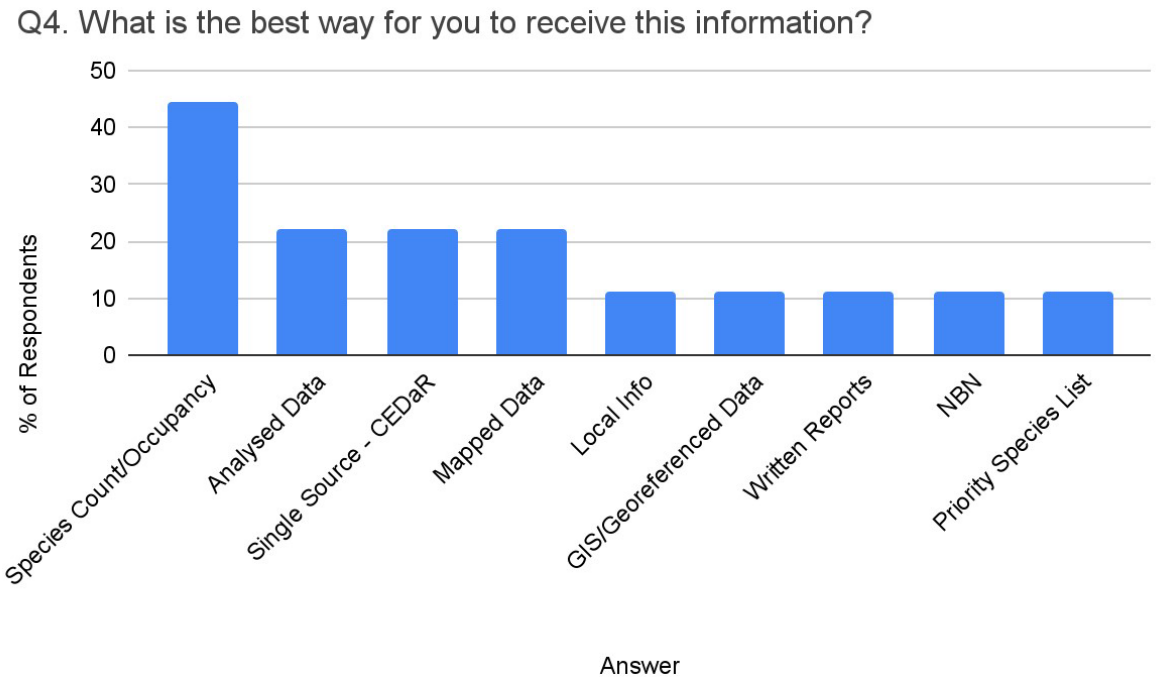

Figure 8d. Summary of responses to Question 4 of the stakeholder interview questions: What is the best way for you to receive this information?

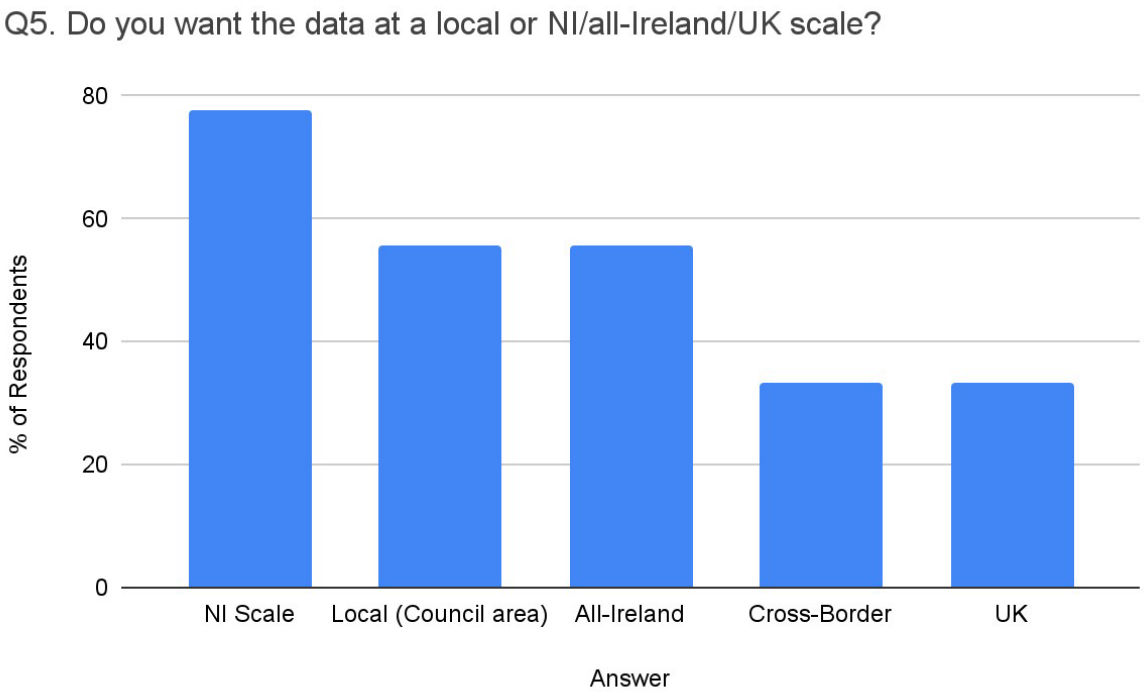

Figure 8e. Summary of the responses to Question 5 of the Stakeholder interview questions: Do you want the data at a local or NI/all-Ireland/UK scale

A majority of the data required by stakeholders in NI (e.g. Local Council Biodiversity Officers, CEDaR, DAERA/NIEA), as identified in the interviews, are used to assess species trends; distributions; population size estimates; priority species lists; whether the species has been recorded or not; and to help infer where it is present or absent across NI. The priority species list for NI was previously a subset of the UK list, however, in February 2023 DAERA published a Northern Ireland-specific priority species list. DAERA has a duty to publish and regularly review these lists as part of the Wildlife and Natural Environment Act (Northern Ireland) 2011. These priority species and habitats require conservation action by public bodies in NI because of their decline, rarity, and importance in an all-Ireland context. The lists provide species to target for the Convention on Biological Diversity and associated targets in the Climate Change Act (DAERA 2023).

5.2 Data needs and uses

Figure 8a (Question 1) shows that priority species, whether those in decline or on the priority species list for NI, are the most important metric that stakeholders are interested in. Stakeholders require this information to monitor Protected Areas, Protected Habitats, and species under the Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (as amended), the Environment (Northern Ireland) Order 2002, and the Marine Act (Northern Ireland) 2013, and to assess the effectiveness of agri-environment schemes (AES) such as the Northern Ireland-specific Environmental Farming Scheme (EFS). This is reflected in Figure 8b (Question 2) with the greatest percentage of stakeholders requiring information on species population trajectories, followed by habitat quality, which is used for assessing habitat status/condition and restoration (Figure 8c, Question 3). Developers might also ask local councils for data for planning purposes, therefore requiring local councils to have access to environmental data or knowing where to get them from (e.g. CEDaR or specialist organisations).

5.3 Preferred data format

The majority of stakeholders require data to be in the format of species counts or occupancy data (Figure 8d, Question 4). Data need to be easily accessible: it was suggested that a quarter of the councils do not have access to GIS software and licences from Esri, meaning they may be unable to access data this way, particularly if they do not have the expertise to use free spatial and/or analytical software (e.g. QGIS or R). There were nine different ways the stakeholders preferred to receive data (Figure 8d, Question 4), suggesting that no one way suits all, or equally there are a variety of methods of producing and disseminating data depending on use or needs of the stakeholder. For example, CEDaR requires raw records as they collate and verify data for dissemination, but not for all taxa and this is a barrier to accessing data for some (see Section 6.3). Monitoring of protected areas and initiatives such as AES or "Don't Mow let it Grow", for example, is also lacking. The result of this is that organisations, be it government, local councils, or farmers making quotas, cannot assess whether conservation management initiatives are achieving their objectives. However, this is not unique to NI. Furthermore, any assessment carried out by NIEA is not publicly accessible; beyond publishing top-level statistics in the environmental statistics report they do not provide condition data online (unlike Natural England site portal). Also, these data are not frequently (or commonly) reported to landowners meaning monitoring is having little impact.

5.4 Required scale of data

Looking across all 20 interview respondents, Figure 8e (Question 5) shows that the highest percentage are operating at the NI scale presumably to particularly report on the status of priority species (Questions 1 and 2). More than half wanted data at either an all-Ireland or local level, the former, for example, to help monitor protected sites and habitats. The Councils make up the majority of organisations working at the local scale and provide an important tier of need, with a small number of these working cross-border. Almost half of respondents wanted data for the UK, that would ideally encompass a subset for NI. The percentage of respondents working only in Britain is small and tends to be the schemes without a remit or capacity in NI or RoI. The scale at which data are required are reflecting stakeholders' interest as they have remits within NI but some also work cross-border, and others (e.g. CEDaR), work across NI (Figure 8e, Question 5).

5.5 Data gaps

Dealing with gaps in data is an important issue for those engaged in biodiversity conservation in Northern Ireland. Data gaps cause problems in assessing the distribution or presence of particular species or habitats and their condition, because absence of a record does not necessarily mean it is not present. A good example from the interviews was of the Seven-spot Ladybird: in one region in NI only a small number (11) were thought to have been recorded, despite being common and widespread. Its ubiquity seemed to have resulted in people not recording it; there are now a total of 316 records available on the NBN Atlas (Figure 9), but it is still not recorded that often. Records may also reflect the locations and activities of the observers or the taxonomic specialists rather than the species.

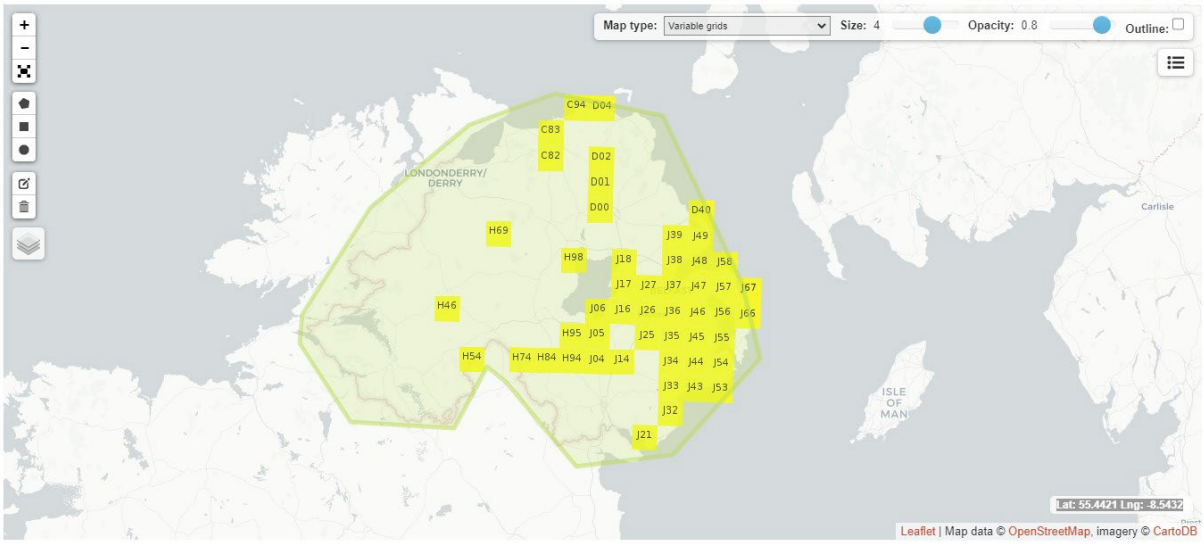

Figure 9. Seven-spot Ladybird records and coverage in 2019 from NBN Atlas Website (Map data © OpenStreetMap®, imagery © CartoDB).

6. Barriers/Issues to biological recording in Northern Ireland

6.1 Challenges and barriers overview

In this section, we summarise one of the responses to the JNCC questionnaire (Figure 10), and the interviews conducted by BTO about barriers to biological recording (Figure 11) and discuss the key issues that emerged from the interviews. Interview respondents were asked open questions so had the opportunity to identify multiple barriers.

The 12 respondents to the JNCC questionnaire (Figure 10), all except one were stakeholders, cited a lack of resources, knowledge and confidence, legislative barriers and a lack of governance, land and data access issues as barriers to biological recording in NI. The answers to the JNCC questionnaire informed the questions for the BTO interviews of 20 respondents, which gathered a wider range of barriers presented in Figure 11. Geographical or physical barriers and staffing shortages were the barriers most often stated in the interviews (by 65% of the people interviewed). This was closely followed by lack of engagement, data sharing/access problems and technical expertise missing or not being passed on, which were the barriers suggested by 50% of people interviewed, and land access problems were suggested by 40%. The results from the interviews were largely in line with the answers from the JNCC questionnaire, albeit contained more detail and possibly different priorities.

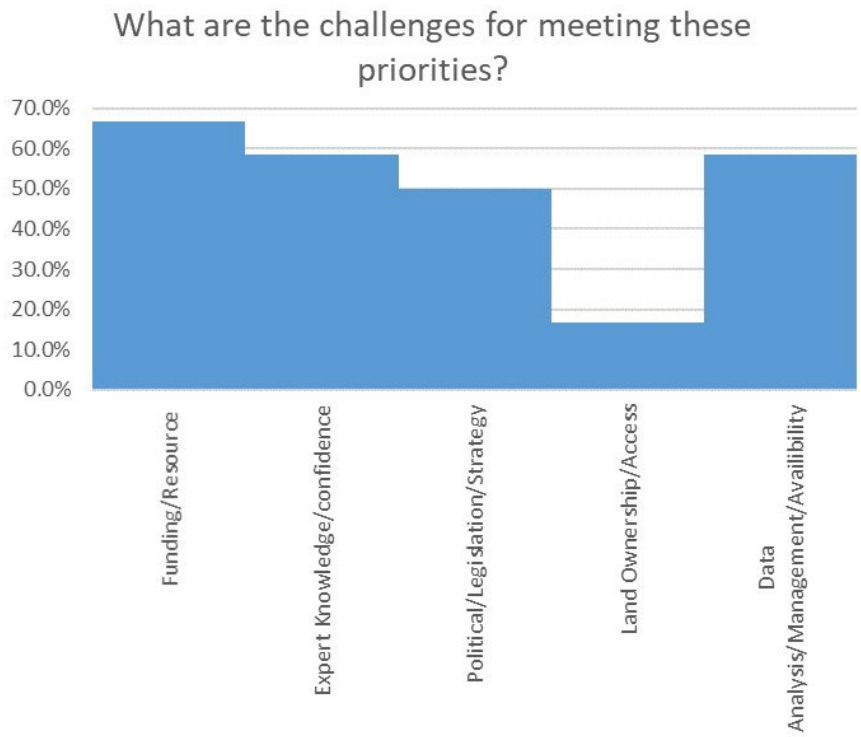

Figure 10. Percentage of respondents to the JNCC questionnaire (out of 12) to grouped examples of barriers to biological recording initiatives in Northern Ireland.

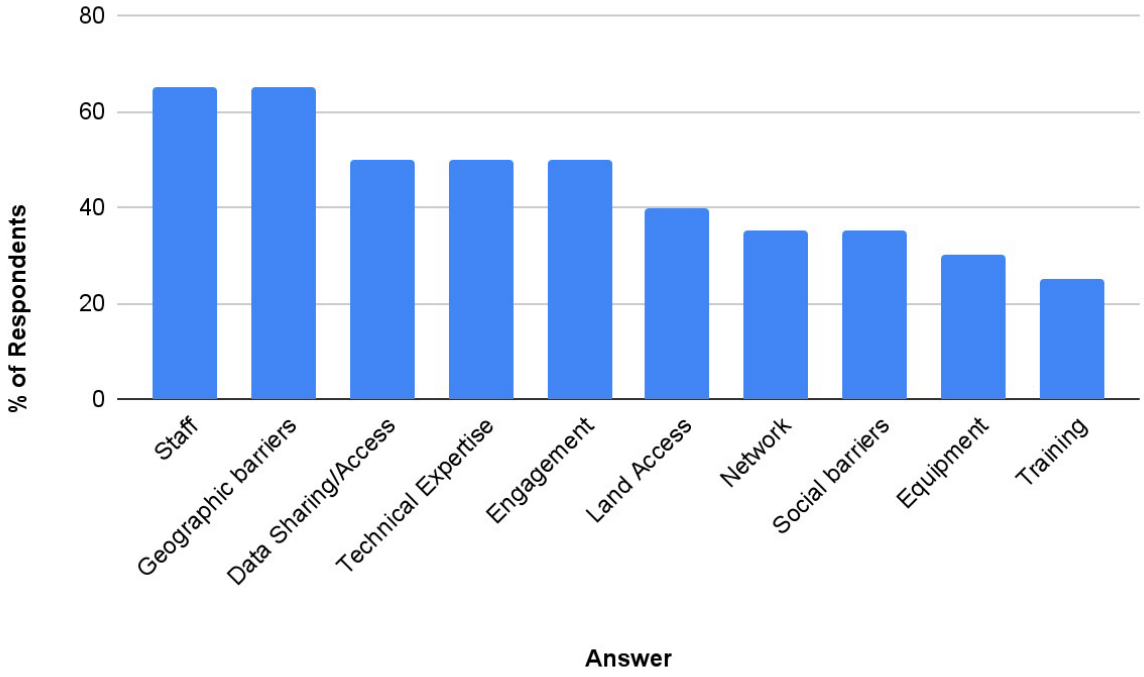

Figure 11. Answers to the interview question about barriers to biological recording in Northern Ireland (see Appendix 1, *Stakeholder Interview Questions* Q6 and *Scheme Organiser Interview Questions* Q4) grouped into 10 categories and the percentage of respondents that mentioned each barrier (out of 20 interviewees).

6.2 Capacity of organisations

Lack of engagement often resulted from a shortage of organisational staff, within both governmental and non-governmental organisations, and on the ground in Northern Ireland and/or no volunteer network of support (e.g. regional/local organisers) to help engage, promote and support new and existing volunteers. We found that some UK schemes did not have a dedicated NI member of staff in place, and therefore NI was sometimes excluded from initiatives, particularly where there were insufficient resources to target engagement, training and therefore monitoring in NI. This was often the case where funding was limiting employment in an organisation and/or capacity was limiting the ability to use volunteers to supplement such roles. We were also told that expertise and trained individuals, either in identification skills or technical skills, are lacking in certain areas and existing experts may retire without passing on or sharing knowledge that is vital to help train new or beginner recorders. This seemed particularly evident in botanical and invertebrate recording.

6.3 Data access issues

Data sharing and data access issues arise in the first instance with the recorders, as they either may not submit records, or not know where the best place is to submit their data. It was indicated that multiple organisations or applications collecting similar data may confuse recorders who then either submit their data to all available recording schemes to cover all bases, or none, resulting in data being duplicated or, more importantly, lost. Delays in the flow of data, for example due to processing or verification, may mean that recorders believe that their records do not flow through to CEDaR. Having a published map of data flows (Section 6.3) would help address this. Data duplication was suggested to be less of an issue as technology can solve this in occurrence databases but would be more of an issue in abundance databases, and recorders should be encouraged and enabled to submit records

quickly and with ease. Equally, if submission is difficult because of the technology used, difficult to understand, or it takes a lot of time to input data, this may also deter potential contributors.

Stakeholders, for example, councils, that submit data and use the data, find that the data flow and sharing permissions are often complicated by issues such as GDPR. Additionally, some found that they had to pay an NGO to access data which they themselves had submitted for another purpose, such as part of a scheme (e.g. for the Wetland Bird Survey). Furthermore, we were told that verification problems either through lack of expertise, resources and/or volunteers leads to further problems with slowing data flow and access and can lead to data not being used at all if it cannot be verified. Due to capacity issues, data required by stakeholders may also be missing or not up to date (e.g. priority habitat inventories). These capacity issues particularly affect monitoring on protected areas, and there is often a focus on specific species through Common Standards Monitoring (CSM) rather than biodiversity overall, which may not detail the complete picture.

The scale at which recording occurs could also cause issues, including what scale data sources are derived or wanted. For example, recording done at an island of Ireland scale can become hard to disaggregate at NI level, such as the State of Nature extinction risk data.

6.4 Data flow

Data flow was identified as a key challenge by many interviewees. Biological recording data can flow between recorders, be that volunteers or staff, collecting the data, which are then submitted to the organisation collating the data, then to the organisation analysing/assessing the data which then report it. The organisations collating, analysing and reporting on the data may or may not be the same, creating issues and complexities. For example, BRC collate data from volunteers for their own schemes and provide infrastructure, such as websites or recording apps, for many smaller schemes under the BRC umbrella. They also submit data on behalf of some schemes to NBN who collate and provide open access data via the NBN Atlas. Other schemes are run independently by organisations (e.g. BTO and BirdWatch Ireland), which collate, validate, verify and submit data to NBN themselves (Figure 12), and often are partners with other organisations for specific schemes. Other schemes are run at an all-Ireland scale (e.g. Bee Walks) and data from these are not submitted via CEDaR or BRC but are collated by the National Biodiversity Data Centre (NBDC) based in the Republic of Ireland which collates, verifies, stores and disseminates data across all-Ireland (Figures 12–14).

Due in part to capacity and the complexities of data sharing agreements, processing and verification, not all data flow as in Figure 12 and hence data are often stored in a number of places depending on the type and the capabilities of storage and the organisation (Figure 13). In fact, although there is an aspiration that all NI data should be submitted to NBN, this is not always the case due to its capability particularly for certain taxa, or data are only available at a coarse resolution (e.g. 10 km). Additionally, only occurrence data are stored in the NBN Atlas so if, for example, abundance data are needed, these must be requested from either CEDaR or NBDC, or in some cases, as mentioned above, the original scheme organisers.

Furthermore, systems and technology may also hinder data flow, with complaints about the CEDaR website being inaccessible, unreliable or slow to upload data to, difficult to find, and many submitters report data going into CEDaR but never coming out or coming out as a subset of what was originally submitted, if requested, for no apparent reason. These data flow issues, which result in delays and missingness between collecting, analysing/assessing and then reporting, ultimately create issues for decision making.

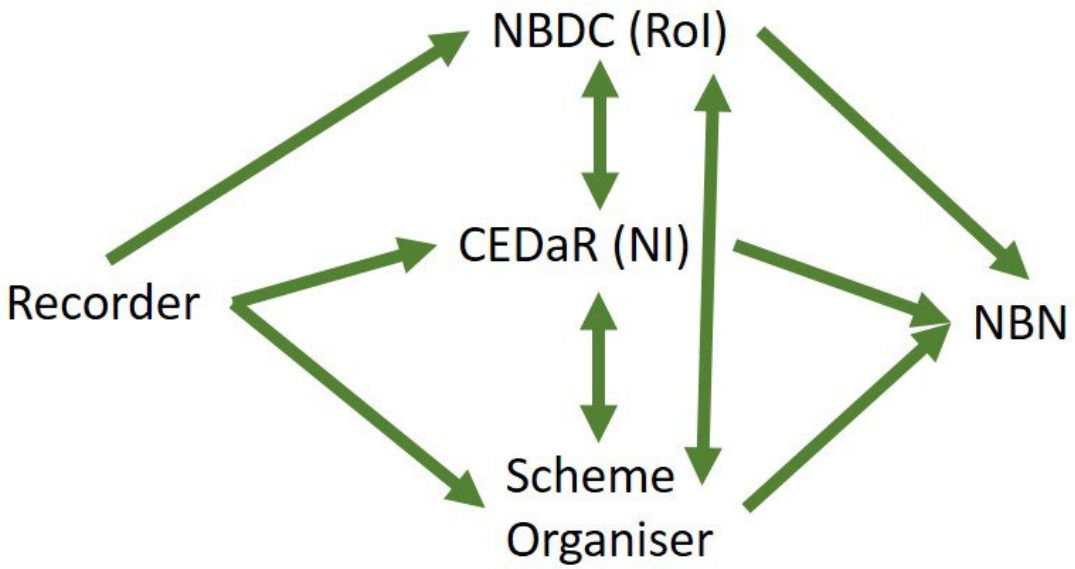

Figure 12. A simple idealised data flow diagram in Northern Ireland. The recorder collects data, submits it to an organisation who processes and verifies it and then sends the record to NBN to allow others to access it. However, for some schemes/data this is more complicated and not all data flow to NBN.

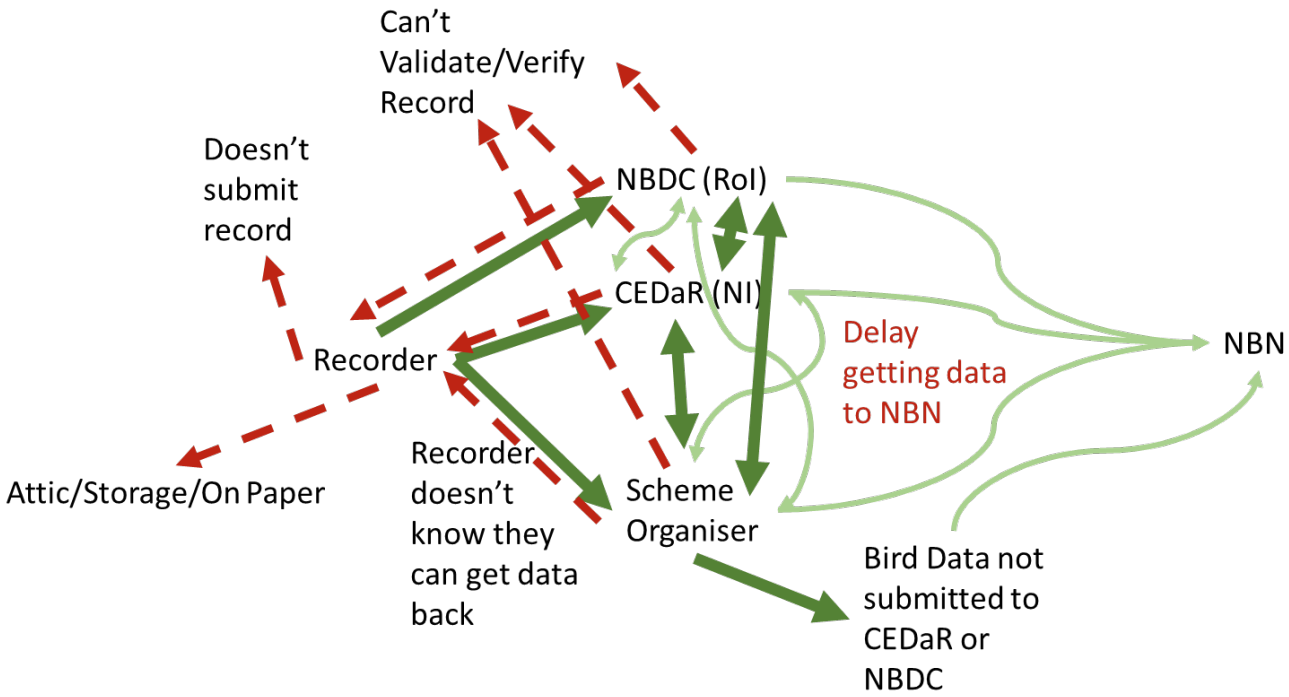

Figure 13. Provisional more realistic version of a data flow (in thick, solid (green) arrows) diagram showing where data are not submitted or not known about and therefore lost (in red (dashed) arrows), are held independently and/or otherwise do not flow smoothly through the usual channels to key repositories (in wavy, thin (light green) arrows), to highlight the complexities in data flow.

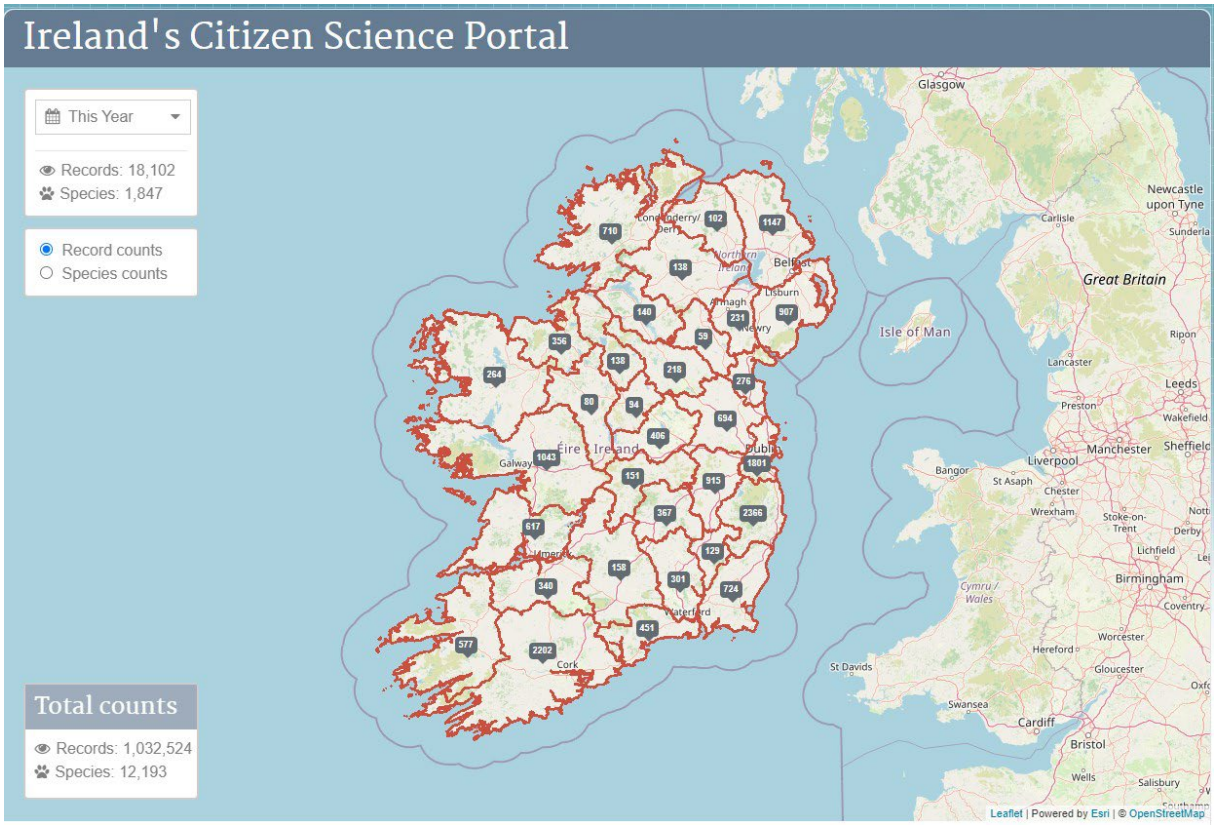

Figure 14. A map of the number of records submitted in each county to the National Biodiversity Data Centre (© OpenStreetMap).

6.5 Attitudes and cultural/societal issues

Social barriers in Figure 11 also encompass political barriers to biological recording that were mentioned in the interviews. These included: people having "*less interest in wildlife generally*" and "*less of a volunteer recording culture in NI than elsewhere in the UK*", with "*more traditional households volunteering in different ways*" which was suggested that "*it can lead to underrepresentation of certain communities*". The extent to which the latter (the societal representativeness of those undertaking biological recording) could affect the quality of data, is a discussion for elsewhere but most environmental NGOs are currently committed to improving Equality/Equity Diversity and Inclusion (EDI) across their initiatives for many different reasons. The prevalence of amateur naturalists in the UK generally is considered to date back to the activities of Victorian naturalists but this pattern may differ among different regions of the UK.

Another suggestion arising from the interviews was that a "*lack of interest in wildlife could relate to the fact that farming is the largest employer with a higher proportion of land farmed in NI, and attitudes towards conservation may be contradictory*". In Northern Ireland, 1,023,000 hectares are farmed and 48,423 people were employed as farm workers in 2020 (Northern Ireland Executive 2020), which increased to 51,760 in 2022 (DAERA 2022b). This is 3.5% of the total workforce – albeit a small number but well above the UK average of 1.2% (RSPB 2023b), whereas only 1.94% of total jobs are referred to as "Green Jobs" in NI (The Irish News 2022). Although, it was noted by the interviewee that "*this could be reversing in recent years with the importance of nature*" for our wellbeing being highlighted during the Covid-19 pandemic and with more recognition of the importance for the environment. Although evidence of longer-term changes in attitude is lacking. Some research suggests that whilst attitudes towards wellbeing and issues related to nature locally have changed, people are not more likely to be aware of environmental issues such as climate change

(Rousseau & Deschacht 2020). Furthermore, from the JNCC questionnaire, NIEA staff highlighted a lack of engagement with nature at all levels, from local communities to government, and mentioned that NIEA had had their engagement/education remit removed and that field centres had closed or been reduced.

6.6 Physical and land access barriers

Geographic barriers were said to mainly result from a lack of volunteers in certain areas due to lower human population density, particularly in the west of the province. Fewer people are available to cover certain areas for the biological recording schemes, and some people are not able to travel due a poor public transport links, lack of funding with the cost of living, and cost of travel by car is particularly a barrier for younger people. It also was suggested that some of the under-recorded areas are not as interesting, hard to get to and difficult to survey (e.g. blanket bogs), they may even be perceived as dangerous.

Land access was reported as another main barrier to biological recording in NI as there is no legal right to roam and fewer public footpaths than other UK countries. Land ownership was said to be politically and socially contested, often making it difficult to find the owner to ask permission to access the land. With the west of NI also being largely agricultural this consolidates the land access issue. It was also indicated in a couple of the interviews that the legacy from the Troubles has also resulted in people being less likely to venture into or feel comfortable surveying areas they do not know.

6.7 Taxon-specific barriers

Barriers to biological recording could also be taxon specific. It was stated in the interviews that botanical surveys are more difficult than other types of nature recording, and this is not limited to one specific place or region. It was also stated in the interviews that the small likelihood of actually observing small or cryptic species may put people off, for example if you survey birds or butterflies you are more likely to see them when you're out surveying, whereas for more elusive taxa like reptiles or mammals you often just observe clues to their presence (e.g. scats and tunnel openings), if you observe them at all, and this may deter people from recording. Another taxon specific barrier in NI identified in the interviews is that for reptiles, surveyors need a licence, and ARC has an organisational licence for England, Scotland and Wales but not in NI. This effectively limits people from being able to search for and record reptiles due to the risk of causing disturbance, which would need to be licensed on an individual basis, creating more work and is a barrier to participation. This disturbance issue also relates to nest recording of birds. Whilst DAERA have licensed volunteers for the Nest Recording Scheme: *"Permit-holders and participants in the Nest Record Scheme may handle eggs or chicks for brief nest examination purposes or for ringing and marking.",* this license does not equate to participants of the simpler Nesting Neighbours scheme, where disturbance from visiting is an issue rather than handling and both are illegal in NI.

7. Solutions to barriers of biological recording in Northern Ireland

7.1 Resources required to improve monitoring capacity

This section summarises the resources and needs identified by the interviewees to improve biological recording in Northern Ireland, from their perspective. Question 9 in the interviews asked: "What help/resource do you need to improve/promote/support biological recording to the level required?".

The most common resource required to improve biological recording in Northern Ireland was staff on the ground to continuously engage, promote, train and maintain volunteer recorders (Figure 15). This is limited by funding, which in the view of most interviewees, was the underlying requirement. Better communication and collaboration between scheme organisers, local councils and government bodies like CEDaR and DAERA was the second highest resource identified in the interviews. For example, communication around training, schemes and opportunities provided by one organisation and shared, disseminated and attended by other organisations would be a simple way to help promote biological recording and engage both new and existing volunteers, which feeds back to the staff requirement indicated by the majority of the organisations interviewed.

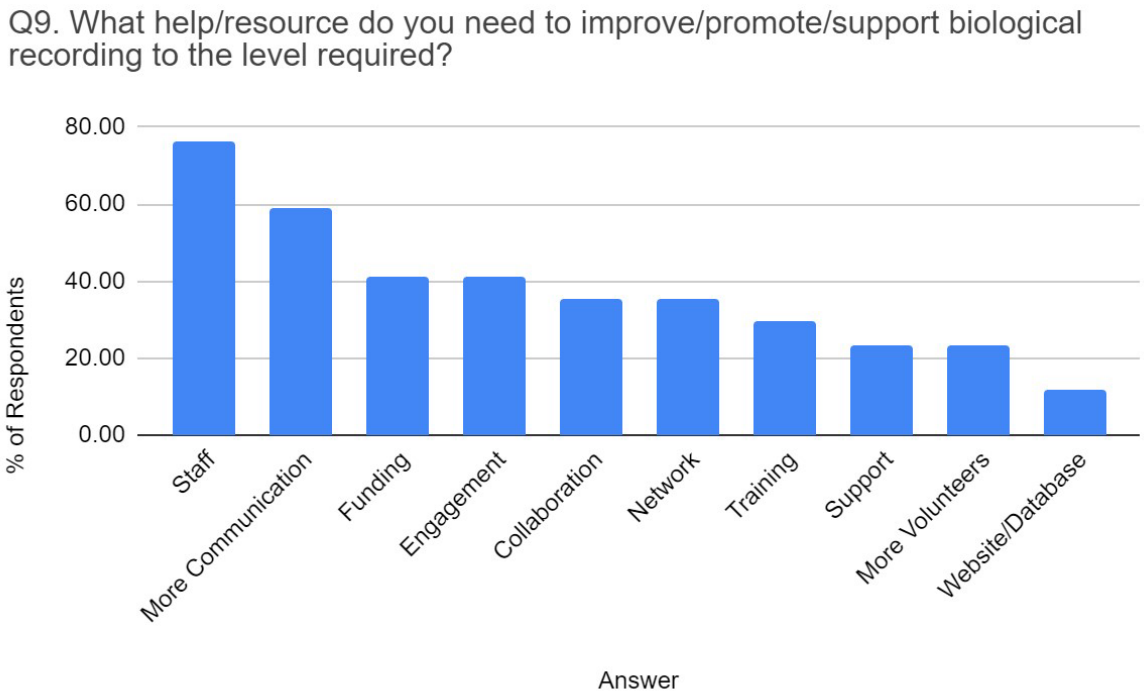

Figure 15. Collated answers to interview Question 9 on resources required to improve biological recording, as a percentage of responses (out of 17 interviewees).

7.2 Opportunities/Solutions and examples to improve biological recording

This section details the opportunities or solutions to address the barriers in Section 6 for improving biological recording. These details are provided from answers in the interviews to: Question 7 "What approaches have you tried to improve biological recording in your remit? Do you have any examples of trialling citizen science initiatives in NI (e.g. data collection,

engagement projects, use of new technologies or training?)" for the stakeholders; and Question 6 "What approaches have you tried to improve biological recording in your remit? Do you have any examples of trialling citizen science initiatives in NI (e.g. data collection, engagement projects, use of new technologies or training)?" for scheme organisers (*Stakeholder Interview Questions* Q7 and *Scheme Organiser Interview Questions* Q6).

7.2.1 Organisational collaboration

To address the barrier of land access, it was suggested that one area for collaboration could be between Councils and the RSPB for viewing access to RSPB-owned land for surveys such as WeBS. Some scheme organisers are working with NIEA/DAERA to gain access to land, for example for PoMS surveys, but instead of only one scheme gaining this access it could be sought or shared for across schemes. One positive conservation initiative of collaboration and engagement mentioned in the interviews was the Red Squirrel Groups across NI, which started as a collaboration between Derry City and Strabane District Council, Ulster Wildlife, The Mourne Heritage Trust and local volunteers. These groups now span NI with local volunteers and local groups encouraging, promoting, recording and monitoring not only red squirrels but also recording grey squirrel and pine marten populations across NI, with Ulster Wildlife hosting the sightings database and providing training (see Section 4.3 for more details).

Stakeholders such as council biodiversity officers are keen to collaborate with NGOs to promote and engage people in biological recording. One easy way is through promoting the unstructured mobile apps like BirdTrack, iRecord, and the Irish Biodiversity Recording site app (depending on the taxa of interest) or accessible, entry level/beginner friendly schemes such as GBW, Nesting Neighbours, Pollinator FIT counts or Big Butterfly Counts (Table 1).

7.2.2 Shared database

There are multiple locations to submit data and apps to use/promote, depending on the taxa of interest, the user and the location of recording, for example which country or county you're in, which may be confusing to recorders. However, there is not an easy solution to this confusion as it arises due to the data being collated by various organisations, which differ across taxa with taxon-specific methods of recording to capture the correct information. One solution to aid understanding of the various schemes could be promotion more broadly such as a table/leaflet detailing the websites and apps for each taxon, possibly on the CEDaR website, however this may be difficult to keep up to date. The CEDaR website could also link to the list of recording schemes on the BRC website and the NBDC website.

It was suggested that having one database for all data would allow for easier access. This is difficult for many reasons, including existing investment by organisations, organisational profiles, data ownership issues, capacity, verification requirements and GDPR, but CEDaR is an obvious candidate. One data portal managed by CEDaR may be more feasible but could also be susceptible to capacity and storage issues with data collection and verification varying with taxa. Data access problems could be mitigated by providing access to the stakeholders (e.g. local biodiversity officers), who take part in surveys and submit data, free of charge with more collaboration with organisations. Similarly, Councils collect data themselves and often employ, either themselves or a company with ecological consultants to collect data for planning purposes. Those data could be sent to CEDaR, or the relevant database, for use elsewhere as part of the contract, increasing the value, coverage and usage of data collected across NI. Any new initiative should involve co-design and collaboration between those collecting the data and those who need/use the data. Moreover, issues with the verification process and timing would be rectified by having more volunteer verifiers, however, this is a long-term process of engaging, recruiting and training more skilled volunteers for all taxa.

7.2.3 Targeted engagement projects

As an example of an initiative to tackle biological recording gaps in NI, the BTO currently have one staff member commissioned under the Ripple NI project. This is part of The Covid Recovery Programme (funded by the Department for Communities and administered by The Heritage Fund in Northern Ireland), which started in 2022, and is set to run for 3 years. The project aims to promote biological recording by first engaging new people in their local nature through events such as bird and bat walks and moth trapping, working with communities, local councils and other organisations. In the longer term, BTO would build engagement and encourage them to volunteer to take part in biological recording or may simply educate them on more wildlife friendly practices/gardening. People who engage with the Ripple NI Project will continue to receive communications for those schemes/surveys after the project has ended, and those that do not initially get involved will thereafter be stewarded by BTO's Engagement Coordinator in NI to encourage them to attend further training and events, all with a view to getting involved.

An example of a positive engagement initiative was the NBDC's Farmer Moth Monitoring Project which encouraged and educated farmers about the moth species on their farms and what they can do to provide habitat to promote more moth species to their land. However, once engaged, trained and started on "entry-level" schemes, ongoing engagement with volunteers can decline, with scheme contact reducing to once a year before the survey season starts due to a lack of capacity. However, ongoing training and engagement is vital to improve and retain volunteers and ultimately progress them on to more skilled surveys. This could be achieved by volunteer coordinators (e.g. Regional Coordinators/Organisers (in NPMS and BTO, respectively)), along with paid staff maintaining support through a network of volunteers and experts (Border *et al.* 2019). This network would provide support, help with ID, location of surveys and feedback, whether through a simple email, a summary of personal records or a complete magazine with regional and/or national information. Examples of where this has had a positive impact in NI includes individual people providing their time and expertise to improve coverage of certain schemes/surveys such as for red squirrels (Section 4.3) and non-vascular plants (Section 4.4). An example of feedback from scheme organisers is the BirdTrack summary via email that started in 2021, of the records that volunteer recorders sent into BirdTrack throughout the year (Figure 16). This allows the recorder to view some summary data/statistics that they can compare to their previous year, or they can share on social media and can compare with others, but this will hopefully motivate recorders to submit more records than their previous year.

Figure 16. A sample BTO BirdTrack summary for a recorder for 2022 (Image credit: Paul Hillion/BTO).

7.2.4 Promotion of recording through CEDaR

In the interview with a representative from CEDaR it was communicated that a large part of CEDaR's role is to promote biological recording and support recorders. CEDaR are keen to improve engagement and encourage local interest in wildlife, especially with younger people and also the farming community. They also help at BioBlitzes, where the public and experts come together for a short period in the same location to record as much biodiversity as they can. CEDaR cover the data side and collaborate to improve engagement and encourage local experts to go along. CEDaR encourages people to check and survey non-designated and under-recorded sites to gain better understanding of the biodiversity and the relevant indicators to use in the wider countryside. CEDaR do not develop apps themselves but use, and are keen to promote, apps developed by others and encourage and support collaborations with groups to run projects and engagement. The CEDaR website is hosted by National Museums NI. Depending on whether it gets viewings, this might be a good place to advertise all apps and schemes available in NI (e.g. BirdTrack, PoMS, etc.), as at the moment it only advertises iRecord. It could also have links to the BRC and NBDC websites. Further promotion of BirdTrack across the Republic of Ireland is also recommended as it was suggested that uptake of both eBird and BirdTrack is limited. Another recommendation would be to update and maintain relevant websites, as a number of links to DAERA and NBDC sites to contact for recording did not work at the time of writing (e.g. PoMS Link to contact DAERA). Additionally, with the CEDaR website being part of the National Museums NI, this may confuse or deter people from engaging with them and may benefit from some more obvious branding across the web pages and a link on this webpage to their recording site.

7.2.5 Development of all-Ireland initiatives

Northern Ireland is a particular case study to investigate gaps in and barriers to biological recording, due to its physical separation from the other countries in the UK and having a devolved government. There are several schemes that run in NI and some that are intended to be UK wide but may not have the resources to effectively include NI in that remit. Other schemes are led by the NBDC in the Republic of Ireland, such as the Bumblebee Monitoring Scheme, and have an all-Ireland remit. Similarly, the scheme organisers, CEDaR and local councils run training opportunities, often in collaboration with one another, that aim to address the barriers for biological recording in NI. All-Ireland initiatives can be as helpful to NI as UK initiatives; BSBI has an "All-Ireland" Committee and Ireland Officer, which means County Recorders in NI benefit with networking, training, projects and support across the whole island of Ireland.

7.3 Training

As well as recording initiatives/schemes, one of the questions in the interviews asked whether training is provided by schemes or whether stakeholders have trialled or would be willing to help/support/promote training (see Appendix 1 *Stakeholder Interview Questions* Q7 and *Scheme Organiser Interview Questions* Q1 & Q8). Training and improving engagement in biological recording are potential solutions to some of the barriers identified. The responses to these questions are reported and discussed in this section with Table 5 summarising existing training divulged in the interviews, and the following sections contain more detail including potential training opportunities that the interviewed organisations would like to pursue.

Table 5. Training that interviewed organisations told us they currently provide and schemes they can be used for (where applicable).

Organisation	Training	Schemes Covered
BTO	Bird ID Skills (online)	BBS, BirdTrack, WeBS, GBW
	Nest Finding	Nest Record Scheme
ARC and ARG UK	Provided training in 2018 with CEDaR and Herpetological Society of Ireland (RoI)	Adapted NARRS recording form
BWARS	ID skill Workshops and 1:1s.	Not in NI but are happy to help identify/arrange for experts if funding/expenses is supplied.
PoMS/UKCEH	Training day planned for NIEA staff. Video for FIT count training.	-
CEDaR	ID training courses across the country for around 12 species targeting popular taxa (for up to 20 people) and obscure taxa (for up to 10 people) (e.g. for pollinators, moths and plants which is directly linked to NPMS). Train the trainer courses.	For example, NPMS and PoMS partnered
NPMS/Plantlife	Field Method and ID – online webinar	NPMS
	Botanical Key Workshops in person	-
BSBI	**Current**: Field meetings in NI and training such as Aquatic Plant workshops, plus access to BSBI online and Ireland training, conferences and events (e.g. Spring and Summer meetings in National Botanic Gardens Glasnevin (Dublin)).	BSBI Distribution Database, Plant Atlas 2020
	Current: Identiplant course: online modular course with local tutor – for people who have some knowledge of plants and are ready to advance to a systematic approach, learning to use keys, written descriptions and scientific names.	As above plus NPMS
	New: Botanical Skills and Evidence project (DAERA funded) starts October 2023 for 4.5 years – supporting further training, field recording events and NPMS participation.	-

Organisation	Training	Schemes Covered
NBDC	Face-to-face and online training for taxonomic upskilling of (e.g. hoverflies, spiders and moth ID).	-
Mammal Society	Training officer not replaced yet. Online since covid.	Covered British Isles
Butterfly Conservation	Butterfly ID – transects level or basic/common	UKBMS
	Online ID videos on YouTube	Butterflies in NI
	BRC online course free partnership with NI butterflies	-
	Online training on how to ID UK butterfly species and distinctive butterfly species, and easy to ID moth species.	-
	Verifications and data processing	-
	Habitat management	-
	Dual in person training event	Marsh Fritillary and Large Heath Surveys
	Skills building – risk assessments safety tools	-
PTES	No training in NI	Absence of species in NI, training in England on dormice and now small population in NI not known about
RSPB	Training on reserves	Breeding wader surveys, waterfowl ID, invertebrates and plants
Ulster Wildlife	Dependent upon projects / engagement. ID training on red and grey squirrels, pine marten and barn and long-eared owl	-
Local Councils	Birds, bees, moths and bat ID	-
DAERA	Fund workshops and training, provide ID Guides and Gene libraries.	Marine recording

7.4 Existing/Previous training

A number of organisations provide training (see Table 5 for more information and answers from the interview question), but many see training provision as a key remit of organisations such as CEDaR who are given funding by NIEA to run training courses. NPMS and BSBI offer botanical ID/survey training with engagement from DAERA, and training is also

provided by CEDaR. ARC have provided training in the past in collaboration with CEDaR and the Herpetological Society of Ireland. CEDaR run training courses across NI, particularly for less well recorded taxa., However these are usually one-off course and there is little follow up or support afterwards; CEDaR would like to provide ongoing support and mentoring but lack the capacity. They also run "train the trainer" courses to encourage attendees to share their knowledge by training other volunteers. However, CEDaR do not provide training on all taxa; taxa such as bryophytes and water beetles, for instance, are regarded as technically difficult and adequate training requires a longer period of time which is best served through university programmes, such as Queen's University Belfast. Local Council Biodiversity departments often run training courses in collaboration with CEDaR on less well recorded taxa, butterfly and moth ID, bird and bat walks and beginner bird ID.

The BTO offers online bird ID skills, survey method training and also commercial surveyors' courses across the UK. The doubling of the number of WeBS counters in NI after training and engagement in 2020 (Figure 17) is evidence of the benefits to training. This training and engagement also increased the number of smaller inland sites covered by WeBS in NI. However, signing up to a scheme does not necessarily equate to submission of records, and retention of volunteers from training and engagement drives can be more difficult to quantify. Of the 46 new recruits to WeBS in Northern Ireland in 2020/21, 18 did not submit data in the subsequent two years, 10 submitted data in one of the subsequent two years (in all but one case this is for 2021/22) and 18 have submitted data in both the subsequent years (2021/22 and 2022/23). Therefore, 39% of the new recruits were lost in the first year and another 20% in the second year, retaining 41% of the original intake after two years, which represents 20% of the total number of active WeBS volunteers in NI.

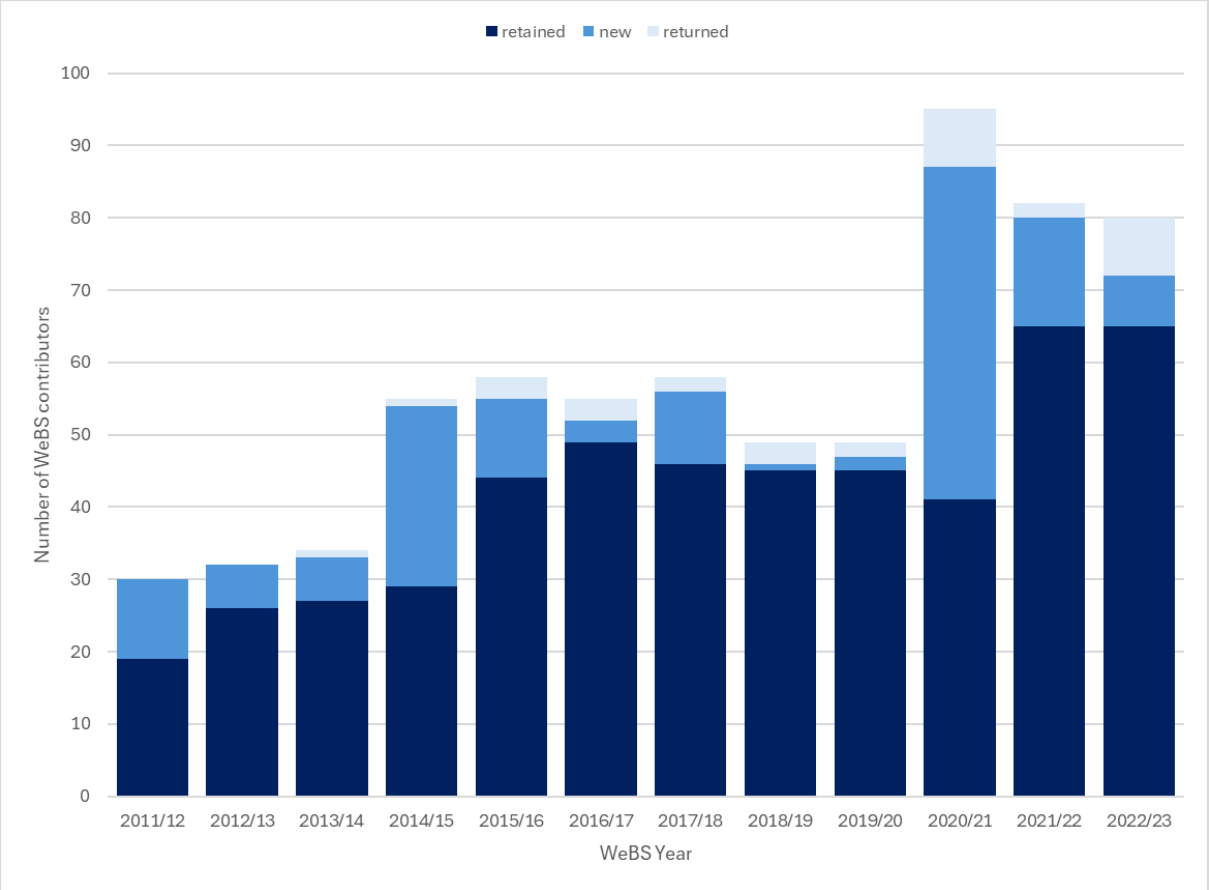

Figure 17. The numbers of WeBS counters in Northern Ireland each year with the number of new counters doubling after training was provided in 2020/21.

DAERA provide funding for marine recording including genetic reference libraries and ID guides/catalogues and training, and online workshops to divers. Along with Seasearch, DAERA are starting to provide training for intertidal recording and Shore NI with Ulster Wildlife's Bioblitz. They also provide experts and WhatsApp groups for Q&A for ongoing support which is funded by DAERA.

7.5 Other possible sources of training

Many other organisations, such as PTES and RSPB, provide training across the UK but do not specifically target NI, although this could be promoted to NI with more resources, increased engagement and even NI specific training. Ulster Wildlife also has scope to provide training, provided it aligns with specific projects or with school/community engagement. BWARS is happy to facilitate connections between interested organisations and skilled identifiers but prefers an all-Ireland approach to recording and similarly with training.

Local councils also support and provide engagement opportunities for biological recording, such as setting up initial or pilot surveys, organising bird/bat walks, have regular moth recording and training sessions, and may even lend out equipment. NBDC ran an engagement initiative Farmer Moth Monitoring Project to get farmers engaged and interested in the moths present on their farms, which appeared to work as far as engagement and education at the time, but there is little evidence of any ongoing results.

8. Wider issues across the UK

8.1 Taxon-specific barriers

As mentioned previously, the taxon-specific barriers mentioned in the interviews are not necessarily limited to NI. Some species/taxa, such as botany and invertebrates, are difficult to survey and ID with hundreds, sometimes thousands of species across the UK and Ireland. Trends for species in other parts of the UK are missing due to gaps in data recording or sparse data. This is evident in several schemes for a variety of taxa that are not able to calculate trends for every species in the UK and are less likely to be able to produce separate trends in each of the four countries. This includes birds: for certain species, particularly rare species such as hawfinch (*Coccothraustes coccothraustes*) and firecrest (*Regulus ignicapilla*), there are not enough data to calculate population trends from BBS data in the UK, and so population is estimated by the Rare Breeding Birds Panel for hawfinch and through the Avian Populations Estimates Panel (APEP) for firecrest, with the last estimate in 2017 (Woodward *et al.* 2020). BWARS notes that users have struggled to calculate trends across the whole of the UK when the model requires repeat observations which is only achievable where there are dense data points and coordinated sampling.

8.2 Data Issues

It was also evident from the interviews that there are data sharing issues across the UK. For example, BWARS does not receive data from certain organisations, creating gaps in their database. Data flow is not obvious within all schemes across the UK, whether it is collated by local environmental records centres or independently within organisations. There is also uncertainty whether all data are sent to NBN, and subsequently appear on the NBN Atlas, due to verification issues or capacity within organisations to verify all taxa and records. iRecord also experiences verification issues with hundreds of recordings needing to be manually verified, often by volunteers, leading to delays and possibly records going unverified. This, therefore, delays data flow to NBN, who provide open access to the data but at a lower resolution (10 km or finer) of occurrence data, which may not be suitable for all users. The issue of multiple organisations collecting and receiving similar data, as well as a variety of applications or web pages to use, may also be restricting usage and recorder confidence which could be clarified with more engagement and promotion of schemes.

8.3 Geographical Barriers

Other areas such as upland Scotland, also have a lower population density and greater access difficulty, reducing the availability of recorders. Therefore, organisations such as the BTO have adopted ways to increase coverage through the Upland Rovers scheme. This allows people to participate with a lower commitment, for example by only making one visit to a survey location while they are hillwalking or on holiday in that area with a BBS square. NPMS have also trialled ways to increase recording coverage in remote upland areas by contacting the Mountain Training Association to train their new recruits to survey NPMS squares on more remote areas. The MoD also survey NPMS squares on their land which has restricted access to the public. This roving style of sampling could be trialled in NI to increase coverage of people on holiday/hillwalking.

8.4 Other barriers and recommendations

Habitats that are often perceived to be less interesting and contain fewer species also exist in other parts of the UK (e.g. city centres or intensive farmland areas). Volunteers are less likely to want to survey these areas, but they are vital for our understanding of these habitats and the species that are present there. Cryptic or challenging taxa such as reptiles, some

mammal species and nocturnal species are likely to go undetected by recorders, and therefore may also be a barrier to recording in other areas/countries by deterring volunteers.

Northern Ireland may have reduced coverage for many taxa compared to the rest of the UK, however, as we've shown, gaps also exist in other geographical regions and taxa, particularly in other parts of the UK with similar issues of low population density and organisational capacity. As a result, many of our recommendations can be used elsewhere. Investigating and understanding the reasons for the gaps is vital to implementing the correct recommendation. For example, is the area remote and hard to get to, then the recommendation would be a roving/ad-hoc/one off style recording. If lack of volunteers is the barrier, then increasing engagement to the wider public about the importance of nature, if there is a lack of expertise then training and train the trainer courses to improve skills and confidence. These barriers are not all unique to NI and can be implemented elsewhere, evidence of the situation must first be assessed before implementing the suitable solution.

9. Workshop

An earlier draft of the preceding sections of this report were provided to the attendees prior to the in-person workshop. The results collated from the interviews in Sections 3–8 of this report were used to formulate the discussions, rankings and solutions. The following section details the findings provided by the attendees of the workshop (see Section 2 for methods and more details), culminating in discussions, the costing exercise and overall recommendations provided by the attendees.

9.1 Ranking the barriers

The workshop attendees were presented with summarised results from the interviews detailed in Section 6 and were first asked to rank the barriers individually from 1–6 (1 being most important and 6 least important). Figure 18 shows that individuals ranked capacity of organisations highest in importance, followed by technical/taxonomical expertise and equipment. There were a wide range of rankings for social and cultural issues. Data flow was regarded as least important (Figures 18 and 19). By considering scores individually, we were able to compare scores between individuals who work for governmental or non-governmental organisations (NGOs). Attendees from governmental organisations ranked capacity of organisations similarly to the overall trend, whereas NGOs ranked capacity of organisations as equally important as social and cultural issues which were regarded as more important than from government organisations (Figure 20). Individuals from government organisations also tended to score data flow issues higher than those from NGOs.

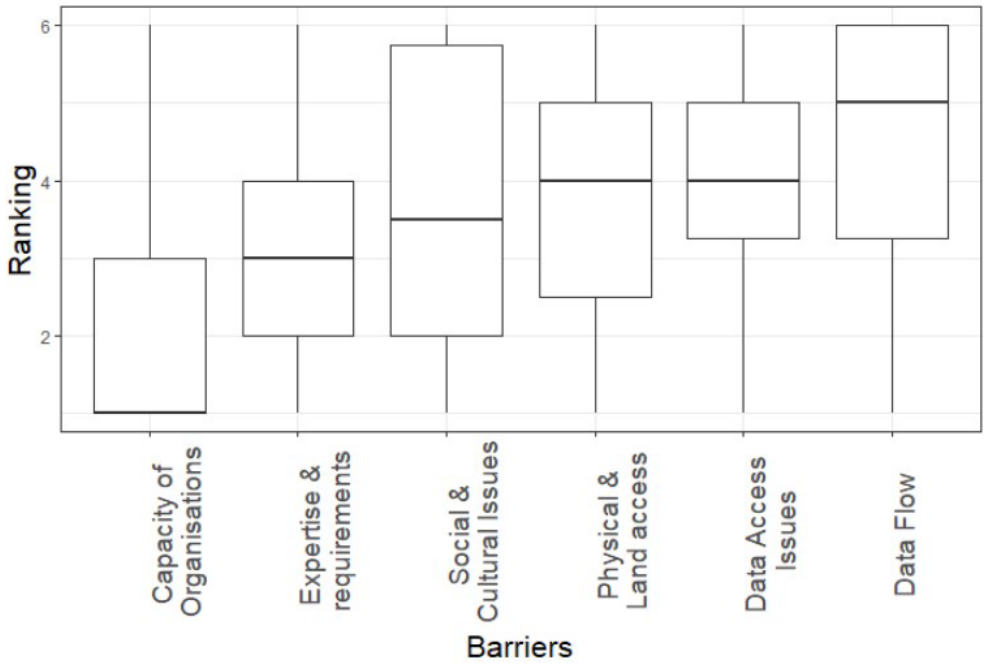

Figure 18. Median and range of rankings of the six summarised barriers from individuals at the workshop (1 being the most important to 6 the least important).

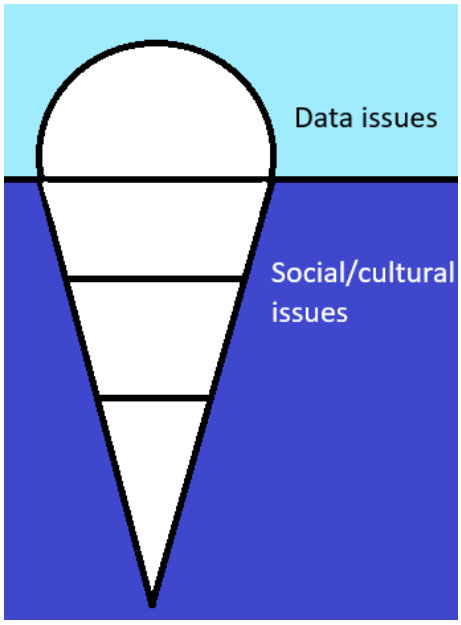

Figure 19. Concept developed through workshop discussions depicting issues/barriers covered and their size and importance to one another as an iceberg with social and cultural issues deep rooted and below the surface.

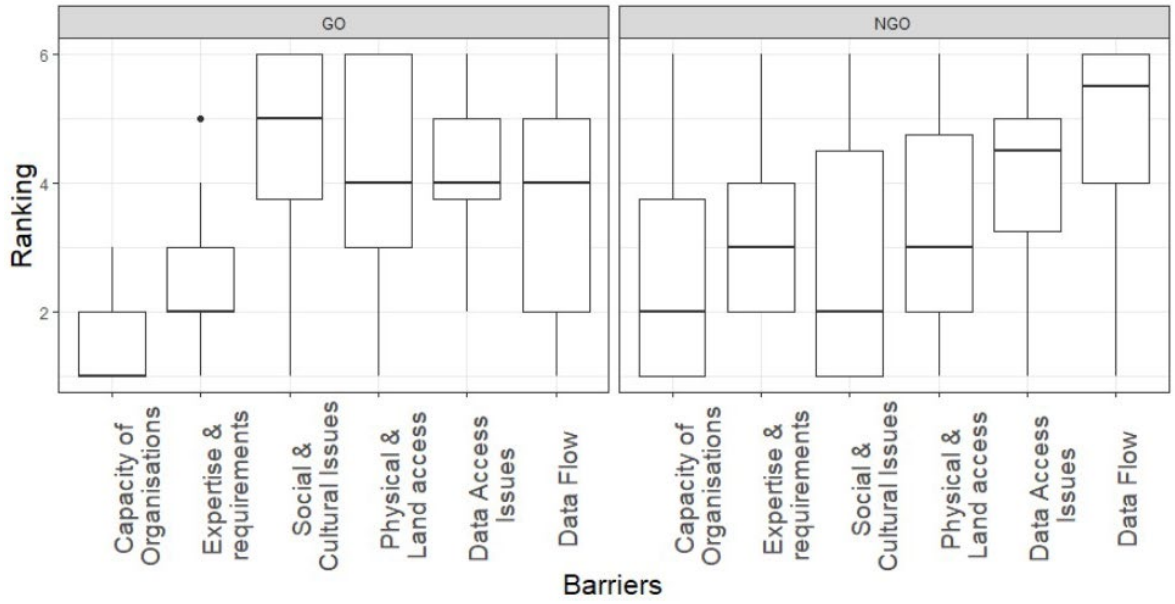

Figure 20. Mean and median rankings of the six summarised barriers from individuals spilt into Government Organisations (GO) or Non-Government Organisations (NGO) at the workshop (1 being the most important to 6 the least important).

The groups discussed their individual scores and came up with an agreed ranking per group. Reviewing these confirmed that the most important barrier remained the capacity of organisations with both technical/taxonomical expertise and equipment and social and cultural issues being equally second most important (Figure 21). Issues of land access and data access were equally scored as the least important.

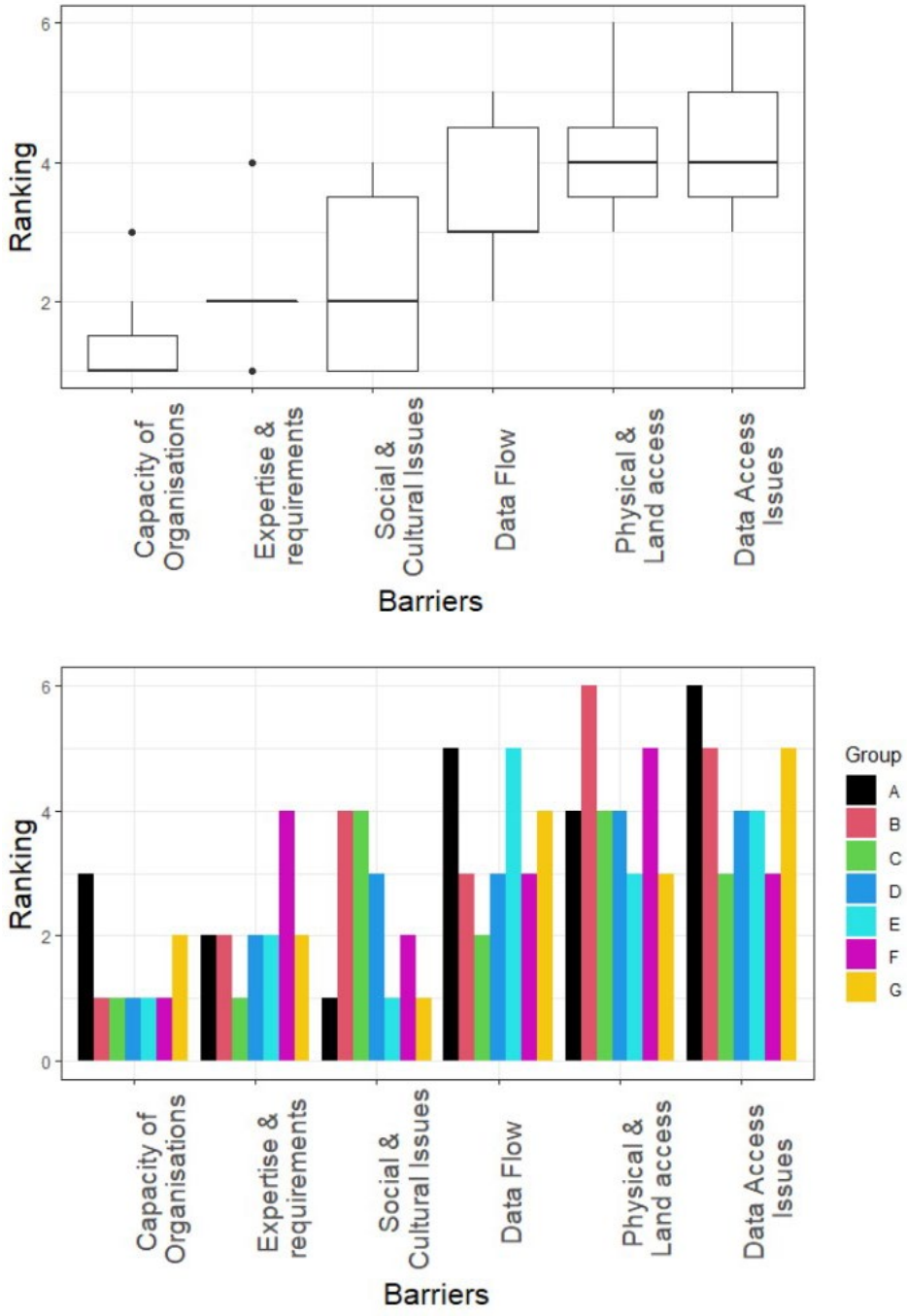

Figure 21. The mean and median rankings (top) and individual group rankings (bottom) of each the six summarised barriers from the seven groups after group discussion (.1 is most important and 6 least important).

9.2 Mapping the solutions to the barriers

For this exercise the attendees were asked to map possible solutions, either out of the ones presented at the workshop or provide more detailed/different solutions, on to the six summarised barriers (Table8, Appendix 2). The capacity of organisations and social and cultural issues were the barriers with the greatest number of suggested solutions (31), technical/taxonomical expertise and equipment had half the number of suggested solutions, and the last three barriers had 8/9 solutions each. The top solutions suggested by the attendees of the workshop are summarised as follows for each barrier (see Table 8 in Appendix 2 for all suggested solutions) and are ranked in order of the number of suggestions

(given in parentheses), these are also presented in Figure 22. Figure 23 maps the six summarised barriers to the seven summarised solutions, detailing visually that multiple solutions can be used to address multiple barriers. For the full list and details of each solution see Appendix 2 Table 8.

9.2.1 Capacity of organisations

- Targeted more core, directional funding for more staff and volunteers, and developing best analysis techniques/technologies (10)
- Improve/increase staffing use their time more efficiently and at least one manager/staff and engagement officer in NI (5) – less reliance on one individual (e.g. single biodiversity council officers)
- More and better communications and collaborations with partnership working across organisations and other government departments, steering groups (5)
- Longer term funding, reduce short term contracts and that funders are aware of strategic plans with simpler processes (5)
- Work with the media to raise awareness around nature (2)
- Establish clear objectives (1)
- Create an independent environment agency (1)

9.2.2 Social and cultural issues

- Increasing awareness of the natural environment and recording through education, by promoting green jobs/career paths, etc. and access to environmental resources (7)
- Inter-ministerial co-ordination to include importance of environmental work, de-emphasise farming and consider nature across infrastructure, agriculture and education (e.g. in curriculum) (6)
- Improving training opportunities especially in the west, providing taster sessions and training on data usage (4)
- Mentors, buddy system, network of volunteers for support (3)
- Increase funding for engagement which will increase volunteers without overloading existing volunteers (2)
- Valuing nature awareness and better ways of measuring engagement (2)
- Set up more wildlife groups (1)

9.2.3 Technical/taxonomical expertise and equipment

- Interaction between eNGOs for events, training and advertising other schemes (3)
- Train the trainer courses, mentoring and data quality training (3)
- ID courses for multiple taxa (2)
- Education curriculum containing natural history/ecology or training for teachers (2)
- Links on CEDaR website and central place to find information (2)
- Need ways to measure engagement (1)
- Funding opportunities for private and corporate sponsorships (1)

9.2.4 Physical and land access issues

- Increased support from staff (funding) and changes in legislation for obtaining land access with better access to natural areas and transport links (4)
- Financial and training incentives (2)
- Build relationships with farmers and landowners to be able to do surveys on their land (1)

9.2.5 Data access issues

- Better communication between organisations (2)
- Data accessible to the public from a central location (2)
- Improve/increasing staffing (1)
- Get access to data collected by ecological consultants (1)
- Making funding objectives more effective (e.g. setting aside time for developing correct analysis/coding behind initiatives/reports to get the best out of funding exercises) (1)

9.2.6 Data flow

- All-Ireland scale data flow and reporting at local level fed back to volunteers (3)
- Better communication and collaboration between organisations (2)
- CEDaR maintaining one database for all records, can ask other organisations for data (2)
- Making use of new technologies to reach national scale coverage (e.g. DNA, machine learning, bioacoustics with passive acoustic monitors and automated sound classification, drones), increased and more effective camera trapping, conservation detection dogs, better use of Sentinel-2 raw data (1)

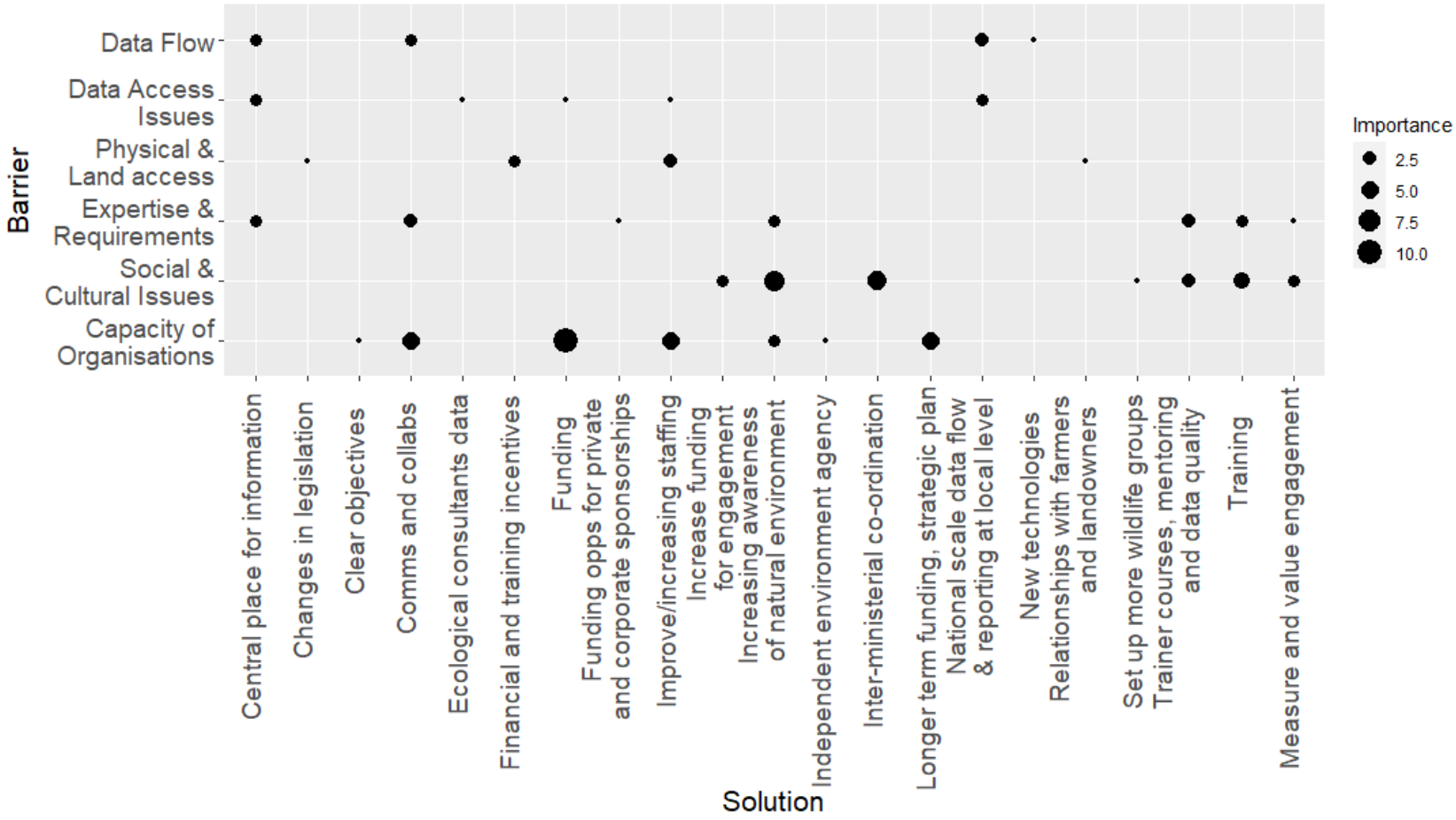

Figure 22. Importance of each of the solutions in relation to the barriers. The size of the filled circle reflects how many times it was suggested at the workshop signalling importance –higher values (larger circles) represent higher importance.

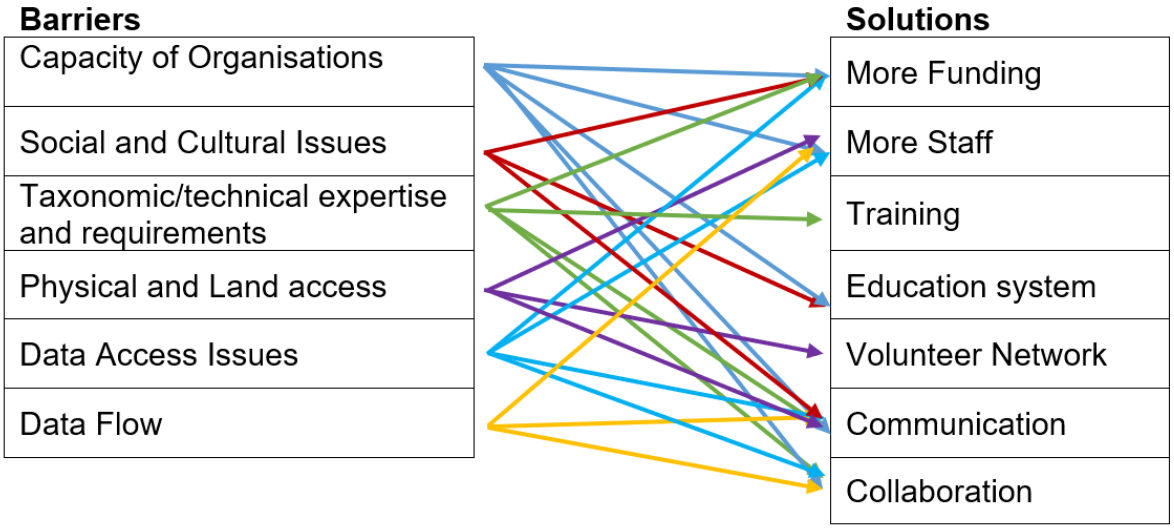

Figure 23. Mapped barriers to the previously summarised solutions showing that multiple barriers require multiple solutions.

The top-ranked solution to barriers was to target more core, directional funding to support more staff and volunteers (Figure 22), as a means for improving organisational capacity, which was also the top barrier (Figures 18, 20, 21). Whilst this also included recognition of the potential for increased efficiency through improved use of analytical techniques and technologies, for example to extract data and for improved reporting, this clearly identifies a clear and widespread need for organisations to have more capacity, and for direct funding to the sector as being a mechanism to achieve this. Increased funding was also seen as a solution to support all of the barriers. The second most ranked solution under organisational capacity was for that funding to be long-term, reducing the need for inefficient short-term contracts and to make it much easier to deliver strategic objectives. Alongside increased funding, there was wide recognition that also increasing staff in NI and improving communication between organisations and government, and developing collaborative partnerships, would also be a key mechanism to improve capacity, through more efficient working – ranked equal second.

The next most important barrier was social and cultural issues (equal with technical and taxonomic expertise and equipment). Participants therefore strongly prioritised the need to increase awareness of the natural environment (Figure 22), and the role of biological monitoring and recording, presumably to understand status and trends specifically, and to inform positive environmental management decisions. This would require education and improved access to environmental resources. Related to this, providing improved training opportunities, not just to help people engage with nature and develop expertise but also to engage with the data available, was highlighted by four suggestions. Given the cross-cutting nature of many environmental issues, the value of inter-ministerial coordination was highlighted by six people and is the second highest solution to this barrier (Figure 22).

Technical and taxonomic expertise and equipment availability was ranked equal second as a barrier, relating to the lack of experienced people and equipment to collect data in the field. This was suggested to be addressed by increased interactions and collaboration between NGOs over events, training and advertising for schemes – reinforcing other suggestions about the sector working better together. Investment in more training, particularly to enhance the number of trainers available to support events and ID courses, and also focussed on understanding the uses of data, was also highlighted.

Mechanisms to increase access to natural areas – whether by addressing issues of securing access permission from landowners for the purposes of biological surveillance, or by increasing transport links to rural areas – was identified and suggested by four people. Improving data flows across Ireland to provide better reporting at the local level to volunteers was also identified as important to improve data flows.

The exercise was useful as it supported the solutions identified in Section 7 of this report and highlighted a number of bespoke and interesting ideas. The main solutions that were mentioned regularly were increasing funding for staff to improve capacity and improving awareness of nature and the natural world in society, which could start in schools by adding a new subject to the curriculum.

Collectively these measures would increase capacity from the eNGO sector to support volunteers and to run schemes to collect data, well supported by government recognising the cross-sectoral importance of such data. A significant education and awareness programme, supported by training, should help grow capacity in the longer-term for well-trained and equipped volunteers to collect data. Addressing land access and transport issues would make it easier for this volunteer workforce to collect the required data. Improving data flows and understanding of the use of the resulting data will make it maximally available and useful to volunteers, the public and to decision-makers.

9.3 Costings exercise

With these solutions and presentations of engagement opportunities already being implemented across NI freshly in people's minds, the next session involved thinking and discussing how they would use a certain amount of money to improve biological recording across the sector in NI. The groups were changed slightly, and half of the groups were asked to complete exercise 1 (approximately £100,000 in a year) and the other half exercise 2 (£5 million in 5 years).

It is worth noting that the discussions during this exercise were mainly in the context of addressing the societal and organisational barriers previously identified in the workshop, and so did not really consider the potential role that paid professionals could play in delivering targeted and specific evidence needs, which were regarded as the later steps in the process.

9.3.1 Results from Exercise 1: "If the sector was provisioned ~£100 k in one year to improve biological recording, how should that be spent?"

9.3.1.1 Group A

To set-up free engagement initiatives such as BioBlitz across NI in each of the six regions plus the six marine regions (£10,000, staff). These would need to be advertised on the radio and leaflets to coincide with after BBC's SpringWatch on the TV and seasonal throughout the year (£1,500) and coordinated across organisations with councils providing insurance and Ulster Wildlife providing equipment. CEDaR would process the data and link to training on how data is used in real time (£15,000). Training would be provided on which apps/recording to use for what data (£5,000). Total cost to deliver a range of engagement activities: £31,500+.

9.3.1.2 Group B

To invest in a coordinator/consultant post to bring all sectoral groups together (£40–50,000) to identify key actions and support the planning of much larger collaborative funding bids across the sector to provide a long-lasting legacy. The aim of this would be to support the targeted collection of data across taxa at specific sites of importance. Additional funding would support volunteer groups to coordinate this work (£10,000) and their training and equipment needs (£30–40,000).

9.3.1.3 Group C

To fund two full time extra staff to address the key constraints of data flow, data verification, recording mechanisms and education. A one-year project would address infrastructure, requiring a business analyst to look at the data flow between CEDaR, NBN and the recording schemes to identify the issues that cause delays in data flows and create a more streamlined transfer of data.

9.3.1.4 Group D

This would fund a short-term pilot project to show quick results so we can secure more funding in the future. The aims of this would be to provide transport for surveyors to improve accessibility, create technology that would make it easier to input and access data to focus on increasing recording activity in a specific area to test out new engagement methods.

Collectively, two of the groups focus on exemplar or pilot projects to increase engagement at either a range of sites (Group A) or in a more intensive single short-term project (Group D). The other two suggested improving capacity, either to use the resource as seed corn funding for larger bids (Group B), or to support infrastructural improvement (Group C), focussing on the key challenge of data flows.

9.3.2 Exercise 2: "If the sector was given £5 million over five years to improve biological recording, how should that be spent?"

9.3.2.1 Group E

With £5 million, a large-scale project was envisaged to support a significant upscaling of capacity and surveillance effort across Ireland. This would require centralised data coordination and flows for specific outputs and indicators towards recovery of nature targets (£1 million), large-scale funding to the sector to support NGOs with their engagement activities and running/growing of schemes (£2.5 million) but critically coordinated by staff (JNCC/NIEA) to maximise collaboration and minimise competition between organisations and to ensure it delivers as required (£0.5 million), with potential to operate across all of Ireland and within the UK. Remaining resource would support a large-scale publicity communication campaign and work with schools, youth groups, retired groups, churches, etc. to grow societal interest and capacity.

9.3.2.2 Group F

The key aim of funding was to address the underlying need of improved working together across the sector. £3.5 million would be used to develop and implement a nature monitoring/evidence initiative in the education sector, working with a wide range of stakeholders, and including science education. This could be under the banner of developing the citizen scientist of the future. Remaining funding would be to support a NI monitoring specific website to direct people to all they need to know covering schemes, data source/access, protocols/apps supported by two staff to maintain and oversee.

9.3.2.3 Group G

In the first year, funding would be invested in regionally based staff running in-person training on ID and surveys at local sites (£30,000 x 6 regions x 5 years = £960,000 = £1 million). In years 2 and 3, additional investment would cover the following range of activities:

- identify key volunteers to lead local groups that meet to birdwatch and survey
- collaborate with other organisations to run joint training events
- regionally based staff running in-person introductory engagement (£1 million)
- staff time to engage with local farmers and landowners to establish relationships for surveys and encouraging education
- build infrastructure to coordinate data collections, capture and verification
- annual gathering of staff across taxa to coordinate efforts
- analysis at regional and NI level and promote/make public the findings

Whilst the precise ways of dividing up the resources to deliver this varied between groups, there were common threads between the three groups that considered this question, and that supported the outcomes from the previous activities. Collectively, projects should prioritise investment in the sector to deliver a significant increase in large-scale engagement projects; increased coordination across the sector to maximise opportunities; large-scale educational programmes across society to generate wider interest; and impact and investment in infrastructure to maximise efficiency and improve data flows and reporting.

Having an in-person workshop allowed people from a variety of organisations across the sector to come together to discuss issues and network over a whole day, to work to achieve a common goal. It emphasised that whilst the report covered the barriers well, discussions around the main issues revealed that issues also extended to people not understanding/ knowing about nature across NI, and that people had other more pressing issues/priorities than the natural environment. Lack of capacity was the main issue, and as the barriers are all interlinked, this results in organisations not having the capacity to engage with the public as much as those who are involved the environmental sector in NI want to. Change needs to happen at every level in NI from schools and organisations to governments who put legislation in place to tackle the issues at the heart of NI. We, in the environmental sector, understand the value of the environment to our wellbeing, health and to live, and this needs to be communicated and understood by all levels in order for these changes to take place.

10. Conclusion

Responses from the interviews show that there is a wide range of barriers limiting biological recording in NI and the barrier being mentioned the most was staffing issues, whether that be lack of staff capacity to improve recording in NI or the absence of staff altogether in NI. Lack of staffing results in the barriers of poor engagement, absence of a network of support and training, which were all barriers mentioned in the interviews. Capacity of organisations was ranked as the most important barrier at the workshop and is usually limited because of limited funding, which was the top solution suggested at the workshop, and resources which were mentioned in the questionnaire and were expressed as the main requirements along with more staff and improved communication to improve biological recording across NI. Geographic barriers, either population density in certain parts of NI (the west) or volunteers being unable to travel at all or to certain parts of the country, was also a major barrier to recording in NI, with added NI specific barriers of The Troubles meaning people can still feel unsafe travelling to unknown areas.

Data flow is complex, with data being stored in multiple repositories. CEDaR does not have access to all data held by individual organisations but can gain access if requested. The data required by stakeholders to maintain and monitor protected areas and conservation initiatives are predominantly concentrated on priority species and habitats, with information on the condition of species populations and habitats also being a priority to maintain those species on the updated list.

One recommendation from this report is collaboration, opportunities and initiatives which already exist in some organisations could be adopted by others. Working together, organisations can improve and maintain biological recording across NI and can be implemented in other parts of the UK. Firstly, an easy win would be for land access to be collaboratively sought, rather than for each individual scheme. Greater communication between stakeholders requiring data and often collecting the data, and the organisations that hold/collate and promote recording is vital to improve the situation in NI. Equally, engagement through local biodiversity officers and Ulster Wildlife, for example, would benefit schemes who do not have capacity to engage, promote and maintain a volunteer base in NI. A number of organisations have a network of recorders who support, train and mentor other volunteers (Border *et al.* 2019). While there may be concerns about overloading existing recorders with additional requests and communications (so as not to deter them from recording), this network is vital to supplement the organisational staff. Upland Rovers style recording or utilising people going to or already in areas with low coverage (e.g. NPMS using Mountain Training Association, or the MoD) could supplement gaps in recording. In the short term, paid fieldworkers could also supplement recording until sufficient volunteers are able to replace them, as BTO have done in Scotland and currently do in NI. Additionally, the BTO's Ripple Project is an exciting engagement programme that aims to increase engagement and interest in nature for all taxa across NI but currently has finite funding.

The workshop was a valuable method to discuss and better understand the barriers and solutions and confirmed that the main barrier was capacity of organisations. The top solution, with the greatest number of suggestions, was funding. Social and cultural issues were ranked as equally important to technical/taxonomic expertise and equipment, but the second most suggested solution was increasing awareness of the natural environment. For example, through a GCSE level programme in Natural History as is being implemented in England. Discussions at the workshop highlighted that these two issues are of greatest importance to those working in the environmental sector, who do not have the capacity to engage with the public or increase awareness on their own. Future projects should therefore prioritise investment in the sector to deliver a significant increase in large-scale engagement projects, increase coordination across the sector to maximise opportunities, large-scale

educational programmes across society to generate wider interest and impact, and invest in infrastructure to maximise efficiency and improve data flows and reporting.

Change needs to happen at every level in NI from schools and organisations to governments who put legislation in place to tackle the issues of greater environmental awareness. We, in the environmental sector, understand the value of the environment to our health and wellbeing, via a range of ecological services, and this needs to be communicated and understood by all levels of society for these transformative changes to take place. These changes are required to increase citizen scientist efforts to collect data, to improve understanding of the environment in NI and to facilitate the effectiveness of conservation efforts. Without data we will not know if things are improving, but without people's environmental awareness we will not have volunteer citizen scientists providing the data.

10.1 Caveats to this study

The responses in this study come from a selection of organisations and stakeholders with representatives from three councils attending the interviews and one answering the questions on paper out of a total of nine councils who were contacted, therefore this is only a subset of opinions and answers. A selection of 15 organisations were contacted out of a possible 85 or more included in BRC as it was not practical or feasible to interview all 85 in the time available, some of which will have no contributors in Northern Ireland. However, we were keen to interview organisations across a range of taxa and with varying levels of reach in NI, as shown in the report.

Interviewees ranged from those physically in Northern Ireland or the Republic of Ireland to those situated elsewhere, mainly in Great Britain with the organisation they represented often also based in Great Britain. This may have influenced the answers to the interview questions and the interviewees' understanding of issues specific to NI. However, as they were provided with the interview questions/topic guide in advance of the interview, they had the opportunity to ask colleagues who may or may not have been stationed in NI. It was obvious that a number of interviewees had done this. We are therefore unable to easily quantify the effect of bias due to the location of interviewee. It was equally evident that a number of interviewees were not themselves from Northern Ireland, nor even based in Northern Ireland but these were the people selected by us or self-selected to best answer the questions and in any case had been in the role and or lived in NI long enough to have a good understanding of the issues.

10.2 Further work

Some of the issues highlighted in this report and the subsequent recommendations can be implemented in other parts of the UK and are not only specific to Northern Ireland. At the recent Terrestrial Evidence Partnerships of Partnerships (TEPoP) Festival led by JNCC, we ran an online workshop on a much smaller scale but at a UK context. After presenting some of the preliminary results of this report, the workshop focused on the costing exercise with larger amounts of money over a longer period to enable scaling up. The outcomes of that workshop mirror those from the NI workshop with some extra nuances depending on taxa and area, indicating that these recommendations to improve biological recording can be implemented elsewhere. Additional suggestions, if funding was not a limiting factor, included building more efficient infrastructure for data management; reimbursing volunteer's expenses; paying staff more and having paid fieldworkers/professionals to fill in data gaps; having more training incentives for volunteers and improving training to cover rarer and more difficult to ID species; providing more equipment; invest in new technologies; engage multicultural communities; and create sharing hubs.

Future work could involve identifying other areas across the UK with gaps in biological recording, identifying and understanding if there are any bespoke barriers, implementing the solutions and monitoring the outcomes. For example, monitoring whether uptake in biological recording volunteering is reflected in areas providing the Natural History GCSE in England, particularly those with recording, and therefore data, gaps, and outcomes of the BTO's Ripple NI Project.

There is some evidence of a positive future for biological recording in Northern Ireland. BSBI have recently received funding for a five year grant from DAERA to grow botanical skills and evidence for nature recovery in NI through training, recording and monitoring activities and for providing targeted science and data advice and support. This includes a new member of staff in NI and will seek to improve data support and flow and provide targeted conservation. BTO have also recently been approved for continued funding from NIEA. Nevertheless, the National Lottery funded Ripple Project is due to finish soon with funding running out by August 2025, requiring decisions on its future and further funding to be made to continue this and other engagement work. DAERA have also started a review into CEDaR and seek to utilise the findings in this report to guide changes and make improvements, which will hopefully provide benefits to data sharing, flow and access to all involved.

10.3 Next Steps/Priorities for Northern Ireland

The culminating results from this report suggest the following recommendations as the more immediate next steps to improve biological recording in Northern Ireland:

- Arrange an annual meeting to continue improving the communications across the sector in NI to identify priorities and ways forward. This would be not limited to updating and discussing initiatives, events and data sharing, highlighting improvements, collaboratively learning what works and what doesn't, and collectively deciding ways forward. The workshop held fostered positive discussion, communication and interaction with a wide range of individuals and organisations that would be good to replicate in future.
- Continue the funding for the Ripple Project which engages people in NI across all taxa and for organisations to continue working collaboratively to achieve further engagement of other communities and more potential volunteer recorders and consider developing other similar approaches to grow the potential to engage individuals across society with nature and with biological recording/monitoring.
- Seek land access collaboratively across the sector, reducing the barrier that this poses to volunteers.
- Collaborate on advertising and running training and engagement events with CEDaR, Ulster Wildlife, local Biodiversity Council Officers and scheme organisers, to increase the scale of what is possible, and provide a more coherent offering to individuals, many of which might be likely to engage with multiple events/taxa.
- Update the CEDaR website to clearly display the recording page and links to other recording schemes and useful information.
- Improve data sharing via CEDaR – clear communications around what CEDaR can hold and do and where data can be accessed from, including being clear about data flows.
- Implement a roving/ad-hoc/one off style survey for both unstructured and structured recording when people are travelling in NI, particularly to encourage recording in parts of the country with lower population densities.

- Improve the volunteer network/hub for all schemes to share the organisation of volunteers, many of whom may engage with multiple organisations.
- Employ paid fieldworkers to supplement data collection until there are sufficiently trained volunteers to replace them.

Longer-term ambitions would be to include natural history in the curriculum as a mechanism for improving environmental and biodiversity education, and for governments to continue to lead on environmental improvements, reflecting its cross-cutting remit in the both the educational and environmental sectors. Training opportunities might be a quick win, although with the lack of interest and engagement this might also be considered a longer-term task, which highlights the importance of engagement initiatives, for example, the Ripple Project and projects coordinated by Ulster Wildlife, etc. DAERA's review into CEDaR will hopefully improve infrastructure to maximise efficiency and improve data flows and reporting, but it may take time to resolve all the issues.

10.4 Review approach used and lessons learned

The interview questions used in this study were open and acted as a guide to allow respondents the freedom to answer with as much detail as possible, allowed a conversation to develop to improve understanding and for the interviewees to provide examples. The respondents who answered the questions on paper were more constrained, often providing shorter, less developed and to the point answers and were not able to elaborate where needed; this supports the importance of carrying out the interviews. If a questionnaire is to be used instead of interviews, then carefully constructed questions allowing for capture of extra detail must be included.

The workshop was a valuable exercise to bring together people from across the sector in NI for a common goal. It emphasised that whilst the report covered the barriers well, discussions around the main issues revealed other overarching, societal issues. Having had an initial workshop, future work in NI could build on this and may be supported additionally through on-line meetings. Whilst online meetings could also be used to replicate this approach elsewhere, there was a benefit to gathering individuals in-person to allow them to network as well as work together. This would be our recommended approach to tackle similar gaps in other areas. Such events could follow our approach of firstly identifying barriers, and then collectively seek to tackle issues utilising the relevant solutions to that area identified in this report, or bespoke solutions if required, and finally identify initiatives to take forward with a pre-defined budget (costing exercise).

Many of the barriers identified in this report are not unique to NI and the same solutions can probably be implemented elsewhere (and in some cases are – such as Upland Rovers for the BTO/JNCC/RSPB Breeding Bird Survey). Investigating and understanding the reasons for the gaps (barriers) is vital before identifying and implementing the correct/suitable recommendation (solution). For example, if an area is remote and hard to get to, then the recommendation would be a roving/ad-hoc/one off style recording. If lack of volunteers is the barrier, then increasing engagement to the wider public about the importance of nature, or if there is a lack of expertise then training and train the trainer courses to improve skills and confidence. We recommend following a similar approach to other areas of the UK with biological recording data gaps.

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Glossary

Table 6. Acronym List

Acronym	Description
AES	Agri-Environment Schemes
AFBI	Agriculture, Food and Biosciences Institute
ARC	Amphibian and Reptile Conservation
ARG	Amphibian and Reptile Group
BBS	Breeding Bird Survey
BC	Butterfly Conservation
BCT	Bat Conservation Trust
BDS	British Dragonfly Society
BSBI	Botanical Society of Britain and Ireland
BRC	Biological Records Centre
BTO	British Trust for Ornithology
BWARS	Bees, Wasps & Ants Recording Society
CEDaR	Centre for Environmental Data and Recording
CSM	Common Standards Monitoring
DAERA	Department of Agriculture, Environment and Rural Affairs of Northern Ireland
Defra	Department of Food, Environment and Rural Affairs
DDb	Distribution Database
EFS	Environmental Farming Scheme
eNGO	environmental Non-Government Organisation
FIT Count	Flower-Insect Timed Count
GB	Great Britain
GBW	Garden BirdWatch
GDPR	General Data Protection Regulation
GSMP	Goose and Swan Monitoring Programme
HSI	Herpetological Society of Ireland
ID	Identification
JNCC	Joint Nature Conservation Committee
MCZ	Marine Conservation Zone
MHT	Mourne Heritage Trust
MoD	Ministry of Defence
MPA	Marine Protected Area
NARMP	National Amphibian and Reptile Monitoring Programme

Acronym	Description
NARRS	National Amphibian and Reptile Recording Scheme
NBMP	National Bat Monitoring Programme
NBN	National Biodiversity Network
NBDC	National Biodiversity Data Centre
NI	Northern Ireland
NIBG	Northern Ireland Bat Group
NIEA	Northern Ireland Environment Agency
NIRSG	Northern Ireland Raptor Study Group
NGO	Non-Governmental Organisation
NPMS	National Plant Monitoring Scheme
NPWS	National Parks and Wildlife Service
NRS	Nest Record Scheme
NSS	National Schemes and Societies
NUI	National University of Ireland
OEP	Office for Environmental Protection
OSPAR	Oslo and Paris Convention
PoMS	Pollinator Monitoring Scheme
PTES	People's Trust for Endangered Species
Q&A	Questions and Answers
RoI	Republic of Ireland
RSPB	Royal Society for the Protection of Birds
SCARABBS	Statutory Conservation Agency and RSPB Annual Breeding Bird Scheme
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Bodies
TEPoP	Terrestrial Evidence Partnerships of Partnerships
TSDA	Terrestrial Surveillance Development and Analysis
UK	United Kingdom of Great Britain and Northern Ireland
UKBMS	UK Butterfly Monitoring Scheme
UKCEH	UK Centre for Ecology and Hydrology
UK NEA	UK National Ecosystem Assessment
UW	Ulster Wildlife
WCBS	Wider Countryside Butterfly Survey
WeBS	Wetland Bird Survey

Appendix 1

Table 7. Summary of organisations who filled in the JNCC questionnaire, were interviewed by BTO and attended the workshop. Note that the same person was not necessarily involved in all stages.

Organisation	Number of people who filled in JNCC Questionnaire	Number of people contacted	Number of people interviewed	Number of people who attended the Workshop
Amphibian and Reptile Conservation (ARC)	0	3	1	1 (online)
Amphibian and Reptile Groups (ARG)	0	0	0	1
Bat Conservation Ireland	0	0	0	1
BCT/UKBMS	0	1	0	0
Butterfly Conservation (BC)	1	2	2	1
British Dragonfly Society (BDS)	0	0	0	0
Biological Records Centre (BRC)	0	1	1	2
Botanical Society of Britain and Ireland (BSBI)	1	1	1	3
British Trust for Ornithology (BTO)	0	1	1	6
Buglife	0	1	0	2
Bees, Wasps & Ants Recording Society (BWARS)	0	1	2	1
Centre for Environmental Data and Recording (CEDaR)	2	1	1	3
Department of Agriculture, Environment and Rural Affairs (DAERA)	3	4	2	5
JNCC	0	0	0	3
Mammal Society	0	2	1	0
National Biodiversity Data Centre (NBDC), Ireland	0	1	1	0
National Trust	0	1	0	0

Organisation	Number of people who filled in JNCC Questionnaire	Number of people contacted	Number of people interviewed	Number of people who attended the Workshop
National Biodiversity Network (NBN)	0	3	0	1
Northern Ireland Environment Agency (NIEA)	1	1	1	2
NI Raptor Study Group (NIRSG)	0	1	0	0
National Plant Monitoring Scheme / Plantlife	0	2	1	1
Office for Environmental Protection	0	1	1	1
People's Trust for Endangered Species (PTES)	0	2	1	0
Pollinator Monitoring Scheme (PoMS)	0	1	1	0
Royal Society for the Protection of Birds (RSPB)	0	4	2 (1 on paper)	2
Ulster Wildlife	1	1	1	5
Woodland Trust	0	3	0	0
Local Councils	3	10	4 (1 on paper)	9 (5 councils)

Stakeholder Interview Questions

Topic Guide for semi-structured interview: Stakeholders

Intro: This is a small JNCC-funded project within the Terrestrial Surveillance, Development and Analysis Programme looking at biodiversity data requirements, use and availability in Northern Ireland for a range of stakeholders and scheme organisers. It originated as a proposal on how to improve the effectiveness of biodiversity monitoring at smaller spatial scales more generally, with Northern Ireland as a special case due to national/country responsibilities. We'd like to know more about your involvement in biological recording in NI, your ambitions, if any, to develop and improve biodiversity recording in NI and where the challenges and opportunities lie from your perspective. Following further consultation, the assessment and recommendations will be reported back to JNCC and subsequently the wider recording community with the aim of improving biological recording in NI, by combining ambitions and looking for solutions to shared problems wherever possible.

1. What data/metrics/indicators of biodiversity are you specifically interested in?
2. What information are you hoping to get from these data (e.g. change over time, range and/or spatial patterns, species richness, diversity or community metrics)?

3. What do you use the data/this information for?
4. What is the best way for you to receive this information? For example, as raw data, or already analysed to address specific issues or initiatives (e.g. written reports/academic papers).
5. Do you want the data at a local or NI/all-Ireland/UK scale?
6. Are there any gaps/are you getting enough data? What, if any, are the barriers/challenges to getting the data you need? Is this because there aren't any data or because the right data are hard to locate or there are issues with access or its complexity (from your perspective)?
7. What approaches have you tried to improve biological recording in your remit? Do you have any examples of trialling citizen science initiatives in NI (e.g. data collection, engagement projects, use of new technologies or training)?
8. Would you be willing to help/support/promote biological recording/training in your area? (Country/county level)
    a. Do you currently or would you be willing to provide training initiatives?
9. What help/resource do you need to improve/promote/support biological recording to the level required?
10. What do you hope to gain from better information/biological recording? What would it enable you to answer?

Scheme Organiser Interview Questions

Topic Guide for semi-structured interview: Scheme Organisers

Intro: This is a small JNCC-funded project within the Terrestrial Surveillance, Development and Analysis Programme looking at biodiversity data requirements, use and availability in Northern Ireland for a range of stakeholders and scheme organisers. It originated as a proposal on how to improve the effectiveness of biodiversity monitoring at smaller spatial scales more generally, with Northern Ireland as a special case due to national/country responsibilities. We'd like to know more about your scheme/involvement in biological recording in NI, your ambitions, if any, to develop and improve biodiversity recording in NI and where the challenges and opportunities lie from your perspective. Following further consultation, the assessment and recommendations will be reported back to JNCC and subsequently the wider recording community with the aim of improving biological recording in NI, by combining ambitions and looking for solutions to shared problems wherever possible.

1. What activities (surveys and/or engagement/training) are you currently undertaking in Northern Ireland?
    a. How do these compare to other parts of the UK?
    b. Do you know of any training/surveys in your area/taxa by other schemes?
    c. If none - is there a plan to start?
2. What do you hope to achieve from those? What is the ultimate aim, from your perspective?
    a. Do you have a set goal (e.g. increase volunteers by, or to collect more/structured data)?

3. How well are you achieving your ambitions/targets in NI and why? (volunteers/trend/species/data)
    a. What do you hope to gain from increasing coverage? What would it enable you to answer?
4. What are the barriers to recording/increasing coverage (geographically, taxonomically, etc.) in NI?
    a. In regions with less data, how are you thinking of getting it? (e.g. upland rovers)
5. Do you have any examples of trialling citizen science initiatives in NI (e.g. data collection, engagement projects, use of new technologies or training)?
6. What are your strategies to overcome barriers? What (if anything) have you already tried and what other approaches would you like to try?
7. How do you engage and recruit people/volunteers? Are there any additional challenges to recruiting in NI?
8. Do you currently or would you be willing to provide training initiatives?
9. What help/resource do you need to improve recording/increase coverage to the level required (if coverage is limiting)?
10. Would you be willing to promote wider biological recording in your area be it of the Country/county or area of expertise (i.e. particular taxa of interest)?
11. Do you have a scheme coordinator in NI? Would you be able to work at the local and/or national level? (this could lead into the Ripple project, if local but scheme organisers if national.)

Appendix 2

Table 8. Results of the solution mapping workshop exercise.

Capacity of Organisations	Taxonomic/technical expertise and requirements	Social and Cultural Issues	Physical and Land access	Data Access Issues	Data Flow
Partnership working	Need/ways to measure engagement	Training on the ground in the west/over the country. Trainers and Mentors	Financial incentives for recording	Improve/increase staffing - have people who can investigate data access	Collaboration between organisations to focus on habitats rather than species
Improve/increase staffing and volunteers - improve staff efficiency and use of their time	Link with other ENGOs where possible/more often/AGMs/Training/Events	Engagement > funding > volunteer > engagement	Training incentives and accreditation	Better publicity of accessible recording route to Joe public (e.g. iRecord)	CEDaR should be a "one stop shop" for all the schemes
Training - ensuring volunteers aren't overloaded and can share their knowledge with others	Mentoring opportunities for dedicated recorders	Environmental Recording training (BTO/RSPB/CEDaR) to explain what, why and how we use the data	More support for obtaining land access	All data to go to central source where accessible without paywall to those who collected it and want to use it	Data to CEDaR, CEDaR to ask for it
Targeted funding for more jobs	Education curriculum - school (primary + secondary), Uni	Improve training opportunities	Mini bus for Oxford Island from Lurgan	Communication between CEDaR and BTO, NIEA and CEDaR and BTO	Submitting all records to one database
Core funding	ID for multi-taxa	Inter-ministerial co-ordination to consider nature across education, infrastructure, agriculture, etc.	Changes in legislation for access to land	Better communication and collaboration - between organisations to share volunteer bases and improve capacity	Better communication and collaboration - Inclusive social gatherings between scheme organisers and data recorders

Capacity of Organisations	Taxonomic/technical expertise and requirements	Social and Cultural Issues	Physical and Land access	Data Access Issues	Data Flow
Staffing = funding - regional hubs to make people aware of what is available	Clear and coherent development journeys that can take people from absolute beginners through to wherever they (we) want to get to	Cooperate volunteering days - collaboration between eNGOs and Statutory bodies - gain funding to publicise a day to record species - train in iRecord - health and wellbeing/rewards	Improve/ increase staffing - have more people looking at land access	Making funding objectives more effective (e.g. setting aside time for developing correct analysis/coding behind initiatives/reports to get the best out of funding exercises)	Stop fixing the UK Data flow - look at an all-Ireland data flow and reporting system
Funding - need to get funds for development phase and longer-term plan (e.g. for staffing costs and quicker repayment)	Interaction between eNGOs	Influence education for more nature engagement in schools	Bring back F.S.C. to N Ireland/RoI	Get access to data collected by ecological consultants. Permission from data owners	Improved reporting at a local level and feeding back to volunteers
Need manager for NI to build a team	Multiple advertising - advertising scheme to advertise others too (e.g. Big Garden Bird Watch promote GBW)	Public recognition for environmental work (e.g. prize giving on TV) - raising profile and pride in environmental wins	Build relationships with farmers and landowners to be able to do surveys on their land - this takes time, high staff turnover (e.g. in MEA) makes this hard		Reducing pressure on experts and increasing to national scale coverage by making use of developing "newer" technologies such as: DNA (machine learning), Bioacoustics with passive acoustic monitors and automated sound classification, drones, increased and more effective camera trapping, conservation detection dogs, better use of Sentinel 2 raw data

Capacity of Organisations	Taxonomic/technical expertise and requirements	Social and Cultural Issues	Physical and Land access	Data Access Issues	Data Flow
Funders being aware of long-term strategic plan	Link on CEDaR website	Increased visibility of recording in environmental teaching (e.g. universities and colleges)	-	-	-
Clear objectives	Better education for teachers to teach environmental education	Councils engaging with local businesses (volunteering time) and schools (biodiversity on school sites)	-	-	-
funding - simplifying the grant process regarding bureaucracy	More citizen science recording training on data quality	Reducing volunteer burn out	-	-	-
Other associations (e.g. AONBs)	Funding - potential opportunities for private funding and corporate sponsorships	Reducing asks for volunteers (e.g long-winded forms)	-	-	-
Funding - staff, resource, infrastructure	Focusing on small project makes goals more attainable and leaves funding for other projects	Set up more local wildlife groups for recording. Wider range of species groups (e.g. Co Armagh Wildlife Society)	-	-	-
Working groups from multi-organisations that could sit within a central organisation like CEDaR (e.g. like covid working groups between organisations)	Support of one central place for information (signposted) for Joe Public and consistent funding and development (e.g. earth hub (KNIB))	Public and some staff are more interested in species than habitat. Might be a good motivator	-	-	-

Capacity of Organisations	Taxonomic/technical expertise and requirements	Social and Cultural Issues	Physical and Land access	Data Access Issues	Data Flow
More and better communication and collaboration	ID courses - improve technical expertise (in one person's head)	Reinforcing communities - connecting volunteers to other volunteers (e.g. POMS FIT count) - building networks and support	-	-	-
Land owners from big NGOs, government and others	Train the trainers in the west to get vols, maybe pay to deliver training	If you don't love something you're not going to protect it/take action - Why protect it? Must be multi-organisational	-	-	-
Increase staffing and more funding - to improve data collection and staff expertise	-	Better access to environmental resources - in schools and libraries – (e.g. Irish Naturalists Journal)	-	-	-
Longer term funding cycles in government - also in EFS	-	Developing NRNs as a means of centralising recording engaging and exercises - Developing the background culture and awareness as well as enabling more effective engagement	-	-	-
"More funding" need to be directional	-	Valuing awareness and an increased understanding as an equally important outcome of training courses/talks as getting dedicated recorders	-	-	-

Capacity of Organisations	Taxonomic/technical expertise and requirements	Social and Cultural Issues	Physical and Land access	Data Access Issues	Data Flow
Independent environmental agency part of the solution - not the golden ticket	-	Increased status and importance of environmental work amongst public - responsibility of politicians, need political will – (e.g. de-emphasise farming) - environmental not just DAERA's issue but underpins all politics	-	-	-
More funding - Improve staffing, technical staffing and consolidating data	-	Make nature more normal and every day for more people - education, promoting green jobs, community engagement	-	-	-
Work with media to make it all more familiar, friendly, etc.	-	Enhance status of environmental work amongst workforce - seasonal and short-term contracts - more competitive pay - appreciating the skills required - reduced requirement for volunteering experience - reduce turnover of staff (e.g. in DAERA employees can move departments without expertise)	-	-	-
raise awareness and improve comms around the story of nature, nature recovery	-	Better communication and collaboration - people realising the value of their effort	-	-	-

Capacity of Organisations	Taxonomic/technical expertise and requirements	Social and Cultural Issues	Physical and Land access	Data Access Issues	Data Flow
Increasing priority and urgency in organisations for dedicated programmes of work	-	Need for GCSE/A Level in Ecology/Natural History/conservation - make career paths obvious	-	-	-
More coordination and collaboration between organisations - more partnership projects	-	Student Open days	-	-	-
Funding for developing best analysis techniques/ technologies	-	Mentors/ budding up	-	-	-
Funding engagement properly - 1 engagement officer per organisation/scheme at least	-	Buddy system	-	-	-
Linking with other government departments to deliver projects pm the ground though council - communication between departments and organisations	-	How to measure engagement - need to get better - include as a target in organisations work plans	-	-	-
Less reliance on individuals (e.g. single biodiversity officers in local councils)	-	Better awareness of what nature and natural is (e.g. not forestry and neat hedges)	-	-	-

Capacity of Organisations	Taxonomic/technical expertise and requirements	Social and Cultural Issues	Physical and Land access	Data Access Issues	Data Flow
Longer term environmental funding - reduce short term contracts	-	Taster sessions	-	-	-
Need legal obligation to monitor protected sites (then can implement funding and staff time) - DAERA has obligation to fund the monitoring work	-	Systemic change - create an environment for private companies to invest - create a value or token to encourage	-	-	-