CITIZEN SCIENCE:
THEORY AND PRACTICE

Increasing Inclusivity in Biological Recording in the United Kingdom: Progress to Date and Future Priorities

MEETING REPORT

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ABSTRACT

Volunteer biological recording generates valuable data for developing ecological understanding and informing environmental decision making. For volunteers, it offers the chance to build knowledge and skills, connect with nature and each other, and enhance wellbeing. As with other forms of citizen science there are demographic biases, with current participants being predominantly white, well-educated, older and more affluent. Increasing inclusivity is important for equitable distribution of environmental and social benefits. Questions remain, however, about how best to engage demographic groups that are currently underrepresented. In June 2024, eight organisations responsible for running biological recording schemes in the United Kingdom (UK) took part in a workshop to share hitherto implemented actions to increase inclusivity and discuss future priorities. Progress to date includes equality, diversity, and inclusivity investment and planning at an institutional level; surveys and focus groups to understand demographics and motivations of participants; accessibility reviews of training, written materials and equipment; and the creation of varied volunteer roles appealing to different skill levels and interests. Engagement with underrepresented groups at a local level has been particularly effective where investment in building relationships with communities has been possible. Future priorities include further understanding motivations for and barriers to participation as well as investigating opportunities for more fundamental changes, such as those offered by new technologies, that could make biological recording more inclusive. Understanding and overcoming barriers and challenges within organisations and the existing recording community and collaboration to tackle the issues identified is needed to make change happen.

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INTRODUCTION

In its simplest form, biological recording describes the process of collecting observations of wildlife, with records typically comprising four key components: what was seen, where, when, and by whom. Much of the biological recording that takes place is done by volunteers as part of a recording scheme, a form of citizen science (Pocock et al. 2015). A variety of approaches exist: In structured schemes, volunteers visit an assigned location (often repeatedly, from weekly to annually) and follow a set recording protocol, such as a transect walk or quadrat survey; in semi-structured schemes, a set protocol is followed but participants freely select the location; and in opportunistic schemes, volunteers record species at any time or location without a fixed protocol. The large volume, broad spatial and temporal coverage, and fine spatial resolution of biological recording datasets make them a hugely important resource for understanding the natural environment and empowering biodiversity conservation (Fraisl et al. 2022), offering far greater potential than data gathered by professional researchers alone.

Recently, attention has turned to the benefits participants derive from biological recording. These include gains in knowledge, skills, and science capital (Edwards et al. 2018), as well as enhanced nature connectedness, wellbeing, and environmental stewardship (Ellis and Warterton 2004; Peter et al. 2021; Pocock et al. 2023; Butler et al. 2024). As for environmental citizen science in general (NASEM 2018; Pateman et al. 2021), biological recording struggles with a lack of participant diversity. Studies in Europe, The United States, South Africa, Australia, and New Zealand have shown volunteer biological recorders to be predominantly white, well-educated, older, and more affluent (e.g., Wright et al. 2015; Mac Domhnaill et al. 2020; Peter et al. 2021; Allf et al. 2022). There is also typically a male bias, which is more pronounced in initiatives with increasing levels of commitment, responsibility, and competitiveness (Cooper and Smith 2010; Richter et al. 2018).

There are myriad potential consequences of this lack of diversity (Pateman and West 2023). For example, spatial patterns in population demographics could result in systematic data gaps (Grade et al. 2022), potentially leading to biases in environmental protection that risk exacerbating environmental injustices (Blake et al. 2020; Schell et al. 2020; Grineski et al. 2022). People living in areas of higher deprivation are more likely to suffer from poor physical/mental health (Marmot et al. 2020), are less likely to spend time in nature (IFF Research 2023), and tend to be missing out on the opportunities for improved wellbeing and nature connectedness available through citizen science participation. In addition, citizen science participation can be a step into a related career, but biases in who participates limits this as a route to diversifying the environmental charity and science workforces that suffer from the same biases (The Royal Society 2014; RACE 2025).

Making biological recording, and citizen science in general, more inclusive could, therefore, simultaneously improve scientific, environmental, and societal outcomes. Scholars, practitioners, and data users have called for action (e.g., Cooper et al. 2021; JNCC 2024), but there is limited evidence of effective strategies. While co-created or community-based approaches (e.g., Ramirez-Andreotta et al. 2015; Davis et al. 2020) have proven effective, less has been reported on how inclusivity can be achieved in initiatives that engage large numbers of people over wide geographic areas (Lin Hunter et al. 2023), as is typical of biological recording.

This report details a knowledge-exchange workshop involving eight organisations that run biological recording schemes in the UK, a country with a long history of the approach (Pocock et al. 2015). Attending organisations shared actions they have taken to increase inclusivity in schemes and discussed future priorities for tackling this issue. Our aim here is to share these discussions more widely to support others who are considering action and to influence further research.

WORKSHOP DESIGN AND AIMS

The workshop was designed by three authors—RP, a university-based citizen science researcher, and RF and KM from the environmental charity Butterfly Conservation—and arose from a knowledge exchange project focused on recruitment and retention of diverse citizen scientists. The workshop lasted three hours and was held online via Zoom on 11 June 2024. There were 17 individuals in attendance, representing species-focused conservation charities Amphibian and Reptile Conservation, Bat Conservation Trust, British Trust for Ornithology (BTO), Bumblebee Conservation Trust, Butterfly Conservation, Plantlife, and the Royal Society for the Protection of Birds (RSPB), as well as the UK Centre for Ecology & Hydrology (UKCEH), an independent research institute that supports UK biological recording and conducts citizen science research.

First, representatives from each organisation delivered a short pre-prepared presentation on initiatives they have carried out to increase inclusivity in biological recording. After a short break, the group split into two breakout rooms and discussed priorities for the future, guided by three questions: (1) What are the key barriers or challenges to recruiting more diverse citizen science participants? (2) Going forward, what is needed to address these

challenges? Are there opportunities that can be utilised? (3) What gaps in understanding need to be addressed?

Facilitators took notes and participants could add comments directly to an online whiteboard (Mural, www.mural.co). Following the workshop, RP reviewed recordings, transcripts from the Zoom chat function, facilitator notes, and the Mural board. The key themes that emerged are presented under two broad areas: activities to date and future priorities. All attendees were invited to contribute to this manuscript, as well as co-author NN from the Joint Nature Conservation Committee (JNCC), advisor to the UK Government on nature conservation, who was invited because of their role in supporting efforts to increase inclusivity in biological recording.

ACTIVITIES TO DATE

Organisations have made progress under three themes—organisational strategy, knowledge generation, and action—with different organisations having made different levels of progress within each. These are summarised below alongside illustrative case studies.

ORGANISATIONAL STRATEGY

A key starting point has been to embed equality, diversity, and inclusivity (EDI) at an institutional level through a wide range of activities. These are seen as foundational for thinking about and subsequently taking action toward inclusivity in citizen science schemes, and they include:

- embedding inclusivity within organisational core values;
- developing organisational EDI statements of intent, blueprints, strategies, and action plans;
- increasing investment in staff with EDI responsibilities and establishing EDI working groups;
- providing EDI training for staff and creating codes of conduct to promote inclusivity (case study 1);
- establishing youth advisory panels to provide input to or feedback on organisations' work, including inclusivity (case study 2);
- contributing data to the Racial Action for the Climate Emergency (RACE) Report which scrutinises racial diversity of employees across the UK environment sector.

Case study 1: BTO strategy, core values and code of conduct.

BTO operates a suite of bird monitoring surveys where most data are collected by volunteers. The 2023–2030 BTO Strategy highlights two key objectives, impact and inclusion, acknowledging the equivalent importance of the science and the people contributing to it. Building and maintaining a strong community of volunteers is essential for the collection of long-term datasets, providing peer support that aids recruitment, upskilling, and retention. On both moral and practical grounds, BTO felt this community must be as inclusive as possible and, in 2023, published a Code of Conduct (https://www.bto.org/about/how/promises-policies/code-conduct) that all staff, volunteers and members are asked and expected to abide by. The Code i) clearly states a zero-tolerance policy on discrimination, ii) outlines the aim to create a safe space free of harassment, iii) provides examples of behaviour that would be considered inappropriate, iv) details the mechanisms for reporting such behaviour, and v) outlines the steps taken to investigate reports and potential sanctions arising.

Case study 2: Butterfly Conservation's Youth Panel. Butterfly Conservation is committed to supporting more people, from more varied backgrounds, to take action for butterflies and moths. Younger people are significantly under-represented among its audiences (1% of supporters and <1% of volunteers are aged 24 or under). In response, a Youth Engagement Officer was employed, and in 2024, a Youth Panel was established to help formulate an approach to involving more young people in Butterfly Conservation's work. The panel comprises 10 young people aged 16–25, who meet monthly online and in person at an annual residential and other key events (Figure 1). The panel has devised a Youth Involvement Action Plan, which sets out some early priorities, including a quarterly newsletter and programme of events and outreach. Staff are proactive in including or consulting the panel in the development of new and existing projects. There has been a steep learning curve in the first year of the panel's existence. Initially, the young people were at times frustrated at the pace of progress as the organisation established new processes and ways of working, but overall, feedback from staff and the panel has been extremely positive, and work will continue to embed youth inclusion at Butterfly Conservation.

KNOWLEDGE

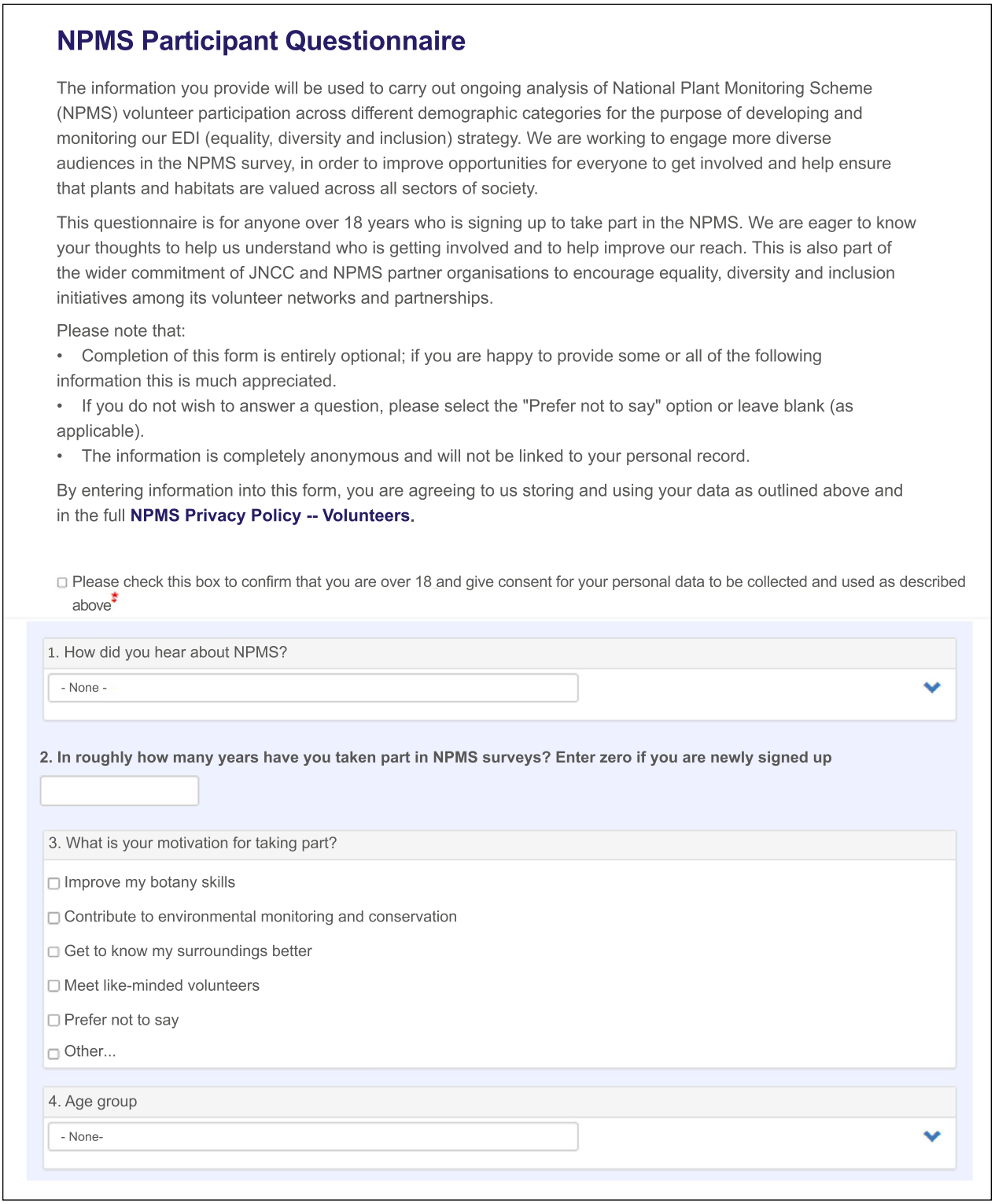
Understanding the demographics and experiences of current participants has also been seen as foundational. JNCC, for example, is a partner in many of the schemes represented and provided support to conduct surveys of volunteers to enhance understanding of participant demographics (case study 3). This information has been used in various ways, for example to inform EDI strategies and to identify audiences for targeted engagement.

Figure 1 Butterfly Conservation's Youth Panel. Credit: Felix Littlechild.

Some organisations have also researched barriers to and motivations for participation, using this to inform action to increase inclusivity (case study 4).

Case study 3: National Plant Monitoring Scheme (NPMS) registration process.
The NPMS partnership of JNCC, UKCEH, Plantlife, and the Botanical Society of Britain and Ireland is committed to working to create an accessible, inclusive, and equitable environment for current and potential volunteers. In 2022, supported by funding from JNCC, an EDI review of the scheme was conducted, including a volunteer survey to generate a snapshot of participant demographics and to identify existing barriers to participation. This experience helped to inform the development of an NPMS EDI strategy and incorporation to annual workplans. The volunteer registration process was also updated to enable ongoing understanding of participant demographics. Now, participants opt in or out of completing optional anonymous questionnaires about their demographic characteristics, motivations, and experiences with the scheme when they register. If they opt in, their homepage shows a reminder and link for an NPMS participant questionnaire (Figure 2), which remains until the form is submitted. Volunteers are fully briefed on the purpose of the questionnaire before they complete it (Figure 2). Providing a separate questionnaire instead of integrating questions with the sign-up process ensures responses remain anonymous. In developing the survey, a Data Protection Impact Assessment (DPIA) and research ethics review were completed to ensure appropriate data collection and management.

Case study 4: RSPB focus groups with young people.
Volunteer Monitoring of Farmland Wildlife (VMFW) is an RSPB initiative connecting farmers who want to help wildlife thrive on their land with volunteers who can conduct farmland bird surveys. VMFW crucially provides an opportunity for farmers, volunteers, and conservationists to share knowledge, and to train younger, less-experienced people in surveying. To increase volunteer diversity, RSPB social scientists researched the influences on young people's engagement with citizen science. Constant and Hughes (2023) identified factors such as career development, learning something new, and meeting role models/mentors as motivators for those without previous environmental citizen science experience. The VMFW team used these results to foster a culture of inclusivity by prompting explicit discussions about experiences and barriers to participation for younger adults, and identifying workable solutions. Consequently, the 2023 VMFW volunteer cohort was younger than is typical for RSPB: 25–34 year olds formed 13.9% of volunteers compared with an average of 8.3% for RSPB schemes.



NPMS Participant Questionnaire

The information you provide will be used to carry out ongoing analysis of National Plant Monitoring Scheme (NPMS) volunteer participation across different demographic categories for the purpose of developing and monitoring our EDI (equality, diversity and inclusion) strategy. We are working to engage more diverse audiences in the NPMS survey, in order to improve opportunities for everyone to get involved and help ensure that plants and habitats are valued across all sectors of society.

This questionnaire is for anyone over 18 years who is signing up to take part in the NPMS. We are eager to know your thoughts to help us understand who is getting involved and to help improve our reach. This is also part of the wider commitment of JNCC and NPMS partner organisations to encourage equality, diversity and inclusion initiatives among its volunteer networks and partnerships.

Please note that:

- Completion of this form is entirely optional; if you are happy to provide some or all of the following information this is much appreciated.
- If you do not wish to answer a question, please select the "Prefer not to say" option or leave blank (as applicable).
- The information is completely anonymous and will not be linked to your personal record.

By entering information into this form, you are agreeing to us storing and using your data as outlined above and in the full **NPMS Privacy Policy -- Volunteers**.

☐ Please check this box to confirm that you are over 18 and give consent for your personal data to be collected and used as described above*

1. How did you hear about NPMS?

- None -

2. In roughly how many years have you taken part in NPMS surveys? Enter zero if you are newly signed up

3. What is your motivation for taking part?

- ☐ Improve my botany skills
- ☐ Contribute to environmental monitoring and conservation
- ☐ Get to know my surroundings better
- ☐ Meet like-minded volunteers
- ☐ Prefer not to say
- ☐ Other...

4. Age group

- None-

Figure 2 Screenshot of the NPMS questionnaire showing information for respondents and the first questions. Other questions relate to gender, ethnicity, employment status, and disability.

ACTION

Organisational EDI work and information-gathering about current participants have laid the groundwork for action. Organisations have increased the accessibility of resources, including providing online as well as in-person training, using inclusive language in role descriptions, and making webpages easier to navigate so people can more easily access the opportunities that suit them (case study 5). At a practical level, equipment used by volunteers has been reviewed (e.g., BTO has produced adapted bird ringing (banding) pliers for people with smaller hands).

Case study 5: Bat Conservation Trust webpages.
Many people's journey into wildlife monitoring starts online. Clunky, hard-to-navigate webpages create unnecessary barriers and deter people before they start. To support potential volunteers with a more user-friendly approach, the Bat Conservation Trust reviewed their survey webpages, incorporating volunteer feedback, for example, "*site could be improved by more clearly indicating levels of experience needed for each survey*" (Adams 2021a). The "Getting started" page uses simple categories, making it easy for people to identify the most suitable survey, without overwhelming them with technical detail (Figure 3):

- I am looking for an easy way to get started.
- I have a bat roost at or near my home.
- I already know how to use a bat detector.
- I am a licensed bat worker or member of a bat group.

Each category includes a brief overview of the surveys and links to more information. The follow-on pages use simple language and explain the process step-by-step to make it as easy as possible (Adams 2021b). Similar improvements have also been applied to the survey platform where volunteers submit their results.

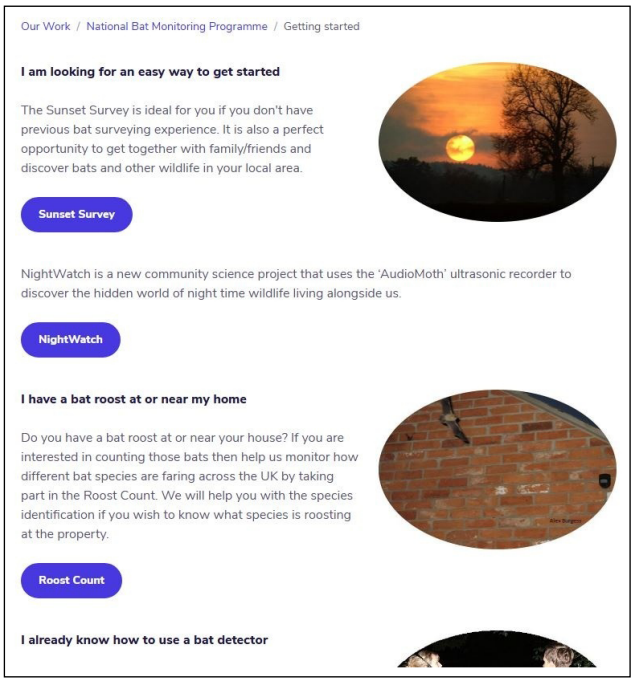


Figure 3 Screenshot of Bat Conservation Trust webpage introducing volunteering opportunities.

Organisations have reviewed and modified the citizen science opportunities they offer to increase inclusivity. For example, entry-level activities have been developed to engage new audiences (case study 6); surveys have been modified to meet additional motivations and broaden their appeal (case study 7); and organisations have created a greater variety of opportunities to engage people with varied interests and skillsets (case study 8).

Case study 6: Amphibian and Reptile Conservation's Garden Dragon Watch.
ARC's Garden Dragon Watch features in the National Amphibian and Reptile Monitoring Programme portfolio of surveys. Developed in 2020, it was designed to encourage people to record amphibians or reptiles they encountered in a garden or allotment. The primary target audience was families seeking to learn about and experience nature in their immediate home environment. This was necessitated by COVID lockdown restrictions on travel but importantly raises awareness of the relevance of gardens to herpetofauna species. Participants are asked to spend around 10 minutes searching for amphibians or reptiles and submit observations online, including features of the garden and surrounding environment. Photographs can be uploaded to enable record verification, and weblinks are provided to identification guides. Species records are displayed immediately on a map, but at a coarse resolution to protect participant identity and address issues of species sensitivity. Verified data contribute to species distribution and status assessments. Participants are encouraged to explore further opportunities to develop their knowledge and take part in surveys or practical conservation action.

Case study 7: UKCEH citizen science surveys to enhance nature connectedness.
Pocock et al. (2023) demonstrated the wellbeing and nature connectedness benefits of intentional engagement with nature, such as through pollinator citizen science. Following this, a team of researchers and practitioners trialled an approach to modify an existing pollinator citizen science protocol (https://ukpoms.org.uk/fit-counts) to intentionally engage the five pathways to nature connectedness, that is, senses, emotion, beauty, meaning, and compassion (Lumber et al. 2017). The activity proved a great addition to outreach events run by the Cumbria Wildlife Trust in 2023 in areas of high deprivation. Intentional design of citizen science to boost nature connectedness has been developed further with

the Rivers Trust in the Big River Watch (https://theriverstrust.org/take-action/the-big-river-watch). In this UK citizen science activity, participants were asked to record river quality indices and, inspired by Richardson and Sheffield (2017), to "note down three good things that you've noticed by the river today." Intentionally designing citizen science to enhance nature connection has the potential to boost people's positive engagement with nature and could support accessibility of and recruitment and retention in citizen science.

Case study 8: NPMS volunteer roles.
In line with the NPMS EDI strategy, scheme partners have explored new ways to make plant monitoring more accessible and inclusive. Consequently, NPMS volunteer roles have expanded beyond plant surveyors:

- **Photography volunteers** are building a library of high-quality images that are used in survey resources, training modules, and scheme promotion.
- **Verification volunteers** are trained to support and complete automated processes to determine whether submitted records are correct. This offers experienced botanists an opportunity to contribute to the scheme, even if they are unable to access survey sites, or require flexibility in the timing of their contribution.
- **Data entry volunteers** support participants who are unable to submit their data online. This offers a flexible, desk-based opportunity to take part, gain experience and skills, and access training opportunities. During the Plantlife "Vibrant Volunteering Virtually Everywhere" project, supported by the National Lottery Heritage Fund, among several new digital volunteer roles, five data entry volunteers were recruited, trained, and provided with support from the NPMS team.

Recognising that a lack of social contacts in citizen science and environmental spheres can be a barrier to participation, focus has been given to fostering a sense of community amongst volunteers and providing more peer-to-peer support. This, however, creates challenges, for example, around General Data Protection Regulation (GDPR) and safeguarding, which need to be addressed (case study 9).

Case study 9: BTO online tool for joining up volunteers.
BTO's volunteer surveys can operate at their current scales only with the aid of peer-to-peer support, which vastly increases volunteer recruitment, upskilling, and retention. This community support model has challenges, however, as it can create power imbalances, and managing volunteer behaviour can be more challenging than managing that of employees. Risks include experienced volunteers becoming self-appointed gatekeepers, and negative interactions between volunteers out of sight of staff. To combat the latter, BTO developed online functionality to facilitate direct peer-to-peer contact in a manner that identifies which pairs of volunteers have initiated contact and when, giving staff oversight of those interactions. Under-18s are not permitted to use these systems, and an overarching Safeguarding Policy was developed for all members and volunteers interacting with BTO. An additional Safeguarding in Ringing policy is in place, acknowledging the formal training responsibilities bestowed upon some volunteers. A formalised complaints system has also been developed, with details readily accessible on the BTO website.

The most tangible successes in increasing participant diversity have emerged from community-based projects, where organisations had time and resources to engage deeply with new audiences (case studies 10–12). Partnering with organisations already working directly with communities proved very effective. Biological recording is often not the primary focus of these initiatives but is tied in with other activities to provide opportunities for people to connect with nature and try out surveying.

Case study 10: Bumblebee Conservation Trust: Buzzing in the East End.
London, as a multicultural city, is the perfect place for Bumblebee Conservation Trust to recruit diverse citizen scientists for BeeWalk, a national recording scheme monitoring bumblebee abundance. Buzzing in the East End collaborates with underrepresented community groups, working closely with community leaders to deliver bespoke sessions that are accessible and culturally relevant. Understanding that different cultures have varying relationships with nature, events are held that connect bumblebee conservation to faith teachings, cultural traditions, and wellbeing benefits. Bumblebee Conservation Trust partners with trusted community leaders and organisations to co-host events, ensuring participants feel welcomed. To support new volunteers, taster (i.e., short, introductory) surveying sessions, Bumblebee Blitzes, are offered alongside free in-person and online training. Training is delivered through local community groups, with additional open sessions held in accessible locations and volunteer travel expenses reimbursed. With BeeWalk surveys requiring

just one survey per month, and volunteers choosing their own routes and dates, participation remains flexible and easy to fit into different lifestyles.

Case study 11: Bat Conservation Trust: Bhangra in the Park.

Bhangra in the Park: Bats Edition was a 2023 event co-designed by Bat Conservation Trust's National Bat Monitoring Programme (NBMP), Bounce Bhangra, and The Royal Parks. This offered an energizing Bhangra (a traditional Indian folk dance) workshop, following an educational bat walk in Hyde Park, London. Through co-creation, this event helped attendees and organisers to learn more about Bhangra, bats, the amazing link between the two, and how urban areas are home to undiscovered nighttime wildlife. Bhangra is rooted in harvest celebration and embodies gratitude for the land and nature. The "bat bhangra move" choreographed by Bounce Bhangra inspired attendees to learn more about bats, the environment, and conservation in a fun-filled way. Fewer than 20% of participants had previously attended a bat walk or event in The Royal Parks. Attendees said they enjoyed the community vibe, Bhangra, and seeing/listening to bats. Recognition of the enjoyment green spaces can bring and the impact they can have on people's physical and mental wellbeing was a key take-home message.

Case study 12: Butterfly Conservation: Big City Butterflies.

Big City Butterflies was delivered over four years across 17 Inner London boroughs. With both conservation and community engagement objectives, the project offered new opportunities for Butterfly Conservation to connect with underrepresented communities. Collaborations with community-centred groups proved successful. Key features of these partnerships are:

- project funding to pay group leaders and facilitators for their time;
- co-creation of activities;
- embracing creative and emotive means of connecting to nature; and
- sufficient time to build and sustain relationships.

A partnership with Sustainably Muslim (an organisation that inspires Muslims to protect the environment) saw the co-creation of community events. Supported by the project, Nazia Sultana, founder of Sustainably Muslim, curated a programme of events, each with a different facilitator from the local Muslim community. These included spoken word workshops, journalling and planting a community space with butterfly-friendly plants (Figure 4).

Figure 4 People taking part in a butterfly-inspired creative workshop, designed and run by Sustainably Muslim and supported by Butterfly Conservation. Photo credit: Chris O'Donovan.

Sultana said, "It was great that we had autonomy over what we wanted to deliver for our community. Our goal was to empower Muslims to explore butterflies and moths, fostering greater engagement in conservation... Acting as a bridge, Sustainably Muslim increases attendance and engagement by leveraging its reputation within the Muslim community, which might not be the case if Butterfly Conservation operated alone. Our partnership achieves a synergistic balance, merging community outreach with conservation expertise."

LOOKING FORWARD

While progress has been made, workshop attendees acknowledged much is still to be done before more equal representation of society is seen within the biological recording community. The following themes emerged as priorities for future action. Within the "big tent" (Cooper et al. 2021, p.1386) of citizen science approaches, here we present the perspective of UK-based, institution-led, wide-scale biological recording. However, our priorities align well with the key concepts for inclusivity in citizen science presented by Foo and Stanlick (2025), showing the importance of language, tools, procedures and processes, and cultural/organisational norms.

UNDERSTANDING PARTICIPANT DEMOGRAPHICS, BARRIERS, AND MOTIVATIONS

Understanding of who currently participates is incomplete. Some dimensions of diversity, such as disability and sexual orientation, are underexplored, as is the issue of intersectionality, that is, how different demographic characteristics interact to affect participation. Building this understanding is crucial for informing engagement strategies, but best practice guidance is still lacking for citizen science on how to gather the required data while respecting privacy and without overburdening or deterring participants.

While some potential barriers to participation for people from underrepresented groups have been identified (those discussed in the workshop included lack of time and financial resources, social capital, access to nature and confidence), research is needed to understand additional barriers, interactions between them, and how they may differ between schemes, for example, due to protocols (e.g., day or night surveying), equipment needed, and cultural associations with species groups. Furthermore, while "entry level" schemes exist, which have the intention of bringing people into biological recording, questions remain around who has the required knowledge and skills to participate in these.

Understanding motivations and priorities of underrepresented groups is also needed to create appealing opportunities with mutual benefits for participants and data generation. Drawing on existing research, potential avenues include promoting biological recording to younger people for career development or as a form of ecoactivism (West et al. 2021; Constant and Hughes 2023); or aligning surveying with local and community-based issues (drawing on the concept of "centering in the margins" [Cooper et al. 2021, p.1388]), such as food growing or creating accessible green spaces. Creating entirely new, inclusive spaces allows people to engage in a way that is aligned with these local interests and tailored to their needs and circumstances. These spaces can also provide a welcoming environment, avoid comparison with more experienced volunteers, and create a strong sense of ownership.

However, while locally facilitated and supported activities have been shown to be effective at engaging new audiences (as detailed in case studies 10–12), they are resource intensive and thus limited in scale and the long-term impacts on bringing people into sustained biological recording are unknown. Methods for supporting people to move from these activities to independent recording need exploration. This may require even greater investment in support for initial recording activities than currently happens, as well as clear signposting to further opportunities. Self-sustaining communities of peer-to-peer support that work in partnership with national scheme organisers could provide a potential solution, but this could also create extra challenges around data privacy, safeguarding, ensuring spaces are safe and inclusive, and establishing where responsibilities lie (see case study 9).

Central to building this understanding is increased dialogue between organisations that run schemes and these groups. A future priority is to work with facilitator individuals and organisations (i.e., those that represent and have existing relationships with underrepresented groups) to broker this dialogue. Time and resource investment from organisations leading schemes is needed to build relationships with potential collaborator organisations, often also charities, and prove they are reliable and trustworthy long-term partners.

RETHINKING ENGAGEMENT

Some species-level biological recording schemes have operated for several decades. Questioning the status quo, in terms of how they operate and the purpose they serve, and being open to reassessing approaches, might create opportunities for greater inclusivity. Again, bringing underrepresented groups into these conversations could foster creativity, challenge current thinking, and generate new ideas for the sector.

Technological, societal, and environmental changes have taken place since the blueprint for biological recording was established, presenting challenges and opportunities. Technological advances in remote sensing, automated recording, and AI species identification may present opportunities for new forms of participation, reducing barriers and creating opportunities for people to contribute different skills (Sheard et al. 2024). Technological advances also present opportunities for automating feedback and building communities of support, although the potential pitfalls of these, such as lacking human reassurance or bugs in automations, need to be carefully considered and mitigated.

Continued environmental degradation, disconnection from nature and loss of natural history knowledge present challenges in terms of the number of people with the interest and skills to participate in schemes. This raises fundamental questions regarding the sector's motivation for increasing participant diversity. Is the aim to achieve more inclusive engagement with citizen science or with nature more generally? Understanding of how to achieve these aims (e.g., by mapping the journeys existing participants have taken) is needed. While it is natural to seek to build connection with nature and skills to enable people to participate in citizen science, citizen science participation itself can boost nature connectedness and skills development through learning by doing (Lumber et al. 2017; Oh et al. 2025).

OVERCOMING BARRIERS TO CHANGE

Making progress on the priorities identified above requires internal reflection by organisations. Resource limitations will constrain investment. Where an organisation is in its EDI journey will determine structures and capacities available to support this work. Communication barriers in organisations need to be addressed. For example, in many organisations there are separate engagement/communication and science teams that approach citizen

science with somewhat different priorities and perspectives. Effective efforts by organisations to increase inclusivity require all involved to value it and feel able to act.

Finding ways to address resistance to change within the existing volunteer recording community is also critical. A warm welcome to all new participants is essential, and this is particularly critical for people from underrepresented groups (Constant and Hughes 2023). Some existing recorders (e.g., verifiers) play a crucial role here as they are often the first points of contact for new participants. There is, however, a perception amongst some that increasing the number of people involved in biological recording will reduce data quality. There are potential challenges here (e.g., increased time needed for verification) that need to be fully understood. Organisations also need to foster dialogue to build transparency and confidence, showing new participants why verification is needed and working with verifiers to identify and overcome concerns they may have.

Finally, increased collaborative working across the biological recording sector is also needed to accelerate change. In addition to this workshop, efforts include the UK Terrestrial Evidence Partnership of Partnerships' provision of a long-term forum for organisations running schemes to share lessons learned from initiatives aiming to engage new volunteers. This has helped promote and prioritise the consideration of volunteer diversity, and has led to more efficient shaping of strategy and action within and across schemes.

CONCLUSION

It is important to make citizen science more inclusive (West and Pateman 2023)— indeed, this aligns with the call for citizen science to contribute to environmental justice—but evidence for strategies that effect change is currently limited (Foo and Stanlick 2025), especially for mass participation citizen science like biological recording schemes (Lin Hunter et al. 2023). To tackle this, the voices of underrepresented groups within the design, implementation, and running of schemes is vital, and consideration needs to be given to how this is done authentically and equitably (Foo and Stanlick 2025). We should aspire to activities that are designed (or re-designed) with inclusivity as one of the core principles, in addition to scientific rigour, rather than as a later add-on (Cooper et al. 2021). Increasing inclusivity will provide multiple benefits for individual participants and organisations, enhance environmental data for science and decision-making, and ultimately lead to greater action for nature. By highlighting activities towards this goal, priorities for future development, and the importance of evaluation and research, we seek to inspire action to open up citizen science to all.

ETHICS AND CONSENT

Ethical approval for the workshop was provided by The University of York Environment and Geography Department Ethical Review Committee (DEGERC/Res/23042024/1).

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COMPETING INTERESTS

RMP and MJOP are Associate Editors for Citizen Science: Theory and Practice.

AUTHOR CONTRIBUTIONS

The study was conceptualized and designed by RMP, RF and KM. RMP and RF facilitated the workshop. RMP drafted the manuscript with contributions from RF, KAH, JH, LK, EIL, KM, RDM, MJOP, PV, NW and SW. All authors contributed to reviewing and editing the manuscript. Funding acquisition was led by RMP, supported by RF and KM. The project was managed by RMP and RF.

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