Developing a thematic framework for Scotland's Biodiversity Research

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Workshop Report

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Background and aims

Natural capital and ecosystem service thinking are highlighting the vital role that nature plays in delivering goods and benefits to society, for example the food we eat, the greenspaces we enjoy for our recreation and health, and the conservation of rare and endangered species. At the same time we are experiencing a global biodiversity crisis which is already impacting on the delivery of ecosystem services worldwide[1,2]. Across all sectors there is recognition that conserving biodiversity, and understanding better the role of humans as a component of ecosystems, is central to dealing with other major environmental crises such as human-forced climate change and to delivering long-term sustainability. As noted by SNH's CEO Francesca Osowska, if we cannot solve the biodiversity crisis, we cannot solve the Global Climate Emergency, and *vice versa*[3]. These issues are true as much for Scotland as they are globally, and overall the state of Scotland's natural assets continues to decline due to drivers such as climate and land use change, pollution and non-native invasive pests and diseases[4].

Biodiversity research is critical to addressing these issues; it provides a central element of the knowledge base upon which natural capital and ecosystem service thinking can be developed, and a key source of information for understanding how we need to change management actions to rapidly deliver sustainable outcomes on the ground. However, because of the breadth of challenges facing the natural environment and the range of disciplines needed to address those challenges (from detailed studies of eDNA monitoring, to "classic" studies of species and habitat conservation and restoration, to social science studies of sustainable communities), the research base is itself at risk of fragmentation. This fragmentation makes it hard to deliver the transformative change[5] needed to address current global challenges.

The aim of this project - funded through the [SEFARI Gateway](#) Responsive Opportunity Fund as part of the 2016-2021 Scottish Government Strategic Research Programme - is to bring together key stakeholders with an interest in Scotland's biodiversity research to identify a number of major themes around which our biodiversity research effort can in future be structured. It addresses directly one of the major areas of feedback from the mid-programme review of the Scottish Government's Strategic Research Programme Natural Capital Theme, and is also timely in terms of being able to feed into current discussions about future developments of the Convention on Biological Diversity (CBD) post-2020, including its implementation within Scotland and associated research needs.

Process

A small group workshop with representatives from some of Scotland's main biodiversity research stakeholders was held on 1st July 2019 at the Royal Botanic Garden Edinburgh. The workshop consisted of 4 sessions:

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[1] https://www.ipbes.net/global-assessment-report-biodiversity-ecosystem-services
[2] http://www.fao.org/state-of-biodiversity-for-food-agriculture/en/
[3] https://www.theguardian.com/uk-news/2019/may/31/scotland-apocalypse-action-cut-emissions
[4] https://www.nature.scot/state-nature-scotland-report-2019
[5] Defined by IPBES as ""a fundamental system-wide reorganisation across technological, economic and social factors including paradigms, goals and values"

- **Session 1: Scotland's Biodiversity Research 2021-2026** – The big picture framework: 1 year; 5 year; 10 year. What do we want & need? Participants asked to think big – what do they feel are the key ideas/areas for biodiversity research in Scotland in particular?
- **Session 2: Identifying research priorities, needs and gaps.** Thinking of where we are now and where we want to be, and considering priorities, needs and gaps in more detail.
- **Session 3: Identifying major themes** – Develop a framework for biodiversity research in Scotland. What themes are emerging?
- **Session 4: Engaging stakeholders** – Where do we take this to next? Timeline for going forward and discussion of how to involve additional stakeholders and organisations.

This report summarises the information gathered during each of these sessions and represents a **summary of workshop content & priorities identified**. It also presents some initial conclusions and sets out the next steps for the project overall.

Session 1: Blue skies thinking

In the first session, workshop attendees were asked to consider the key biodiversity research needs and challenges for Scotland from two perspectives: 1) their own personal perspective as biodiversity research experts and 2) as a representative of their organisation. Participants, including representatives of government agencies and research organisations, were asked to think about society's biodiversity research needs over three timescales; short- (1 year), medium- (5 years) and long-term (10 years). Small group discussions identified commonalities and differences in responses and participants were encouraged to start to think about whether any major themes were emerging. There was considerable overlap of the wants/needs across the three timescales and these have been combined in the summary below. Participants agreed that research should be moving from understanding biodiversity to an action-based and solution-focussed approach.

- **Climate change**: Improved C accounting – including: a) responding to the climate emergency; b) transformative land use change and adaptation; c) nature rich future. How do we promote the benefits of carbon capturing habitats/species?[6] Consideration of both resilience and adaptation strategies as well as mitigation. Win-win scenarios for both climate and biodiversity. Understanding species range shifts. Interactions with land management. Improved quantitative data and analytics on soil C emission and sequestration rates, and vegetation change.
- **Biodiversity targets**: What do we need to deliver ecosystem goods and services for society, and to preserve biodiversity for its own sake? Improved understanding of species success/failures and associated traits. Is species abundance more important? How much land/sea needs to be protected? Better metrics. Monitoring of Biodiversity Net Gains at appropriate spatial and temporal scales.
- **Biodiversity indicators:** Effectiveness. Linking to ecosystem health. Incorporating genetics, species and ecosystems. Which indicators prove useful when setting biodiversity targets? Exploring the functional usefulness and intrinsic limitations of biodiversity indicators. To what extent and how effectively, can biodiversity knowledge be aggregated down into simple indicators, and what set of indicators gives the most useful steer for policy makers. How can 'shifting baseline issues' be best addressed? To improve outcomes we need to benchmark how we are doing against targets. Targets come first and then derive key performance indicators (KPIs).
- **Management of biodiversity**: Large-scale/systematic approaches for adaptation, resting, restoring and regenerating. Integrated land management. Global-scale changes as they apply to Scotland. Peatland restoration?, Woodland creation/expansion, seabed restoration. Effects of MPAs and marine spatial planning. Successes/failures of mitigation measures for biodiversity implementation through development. Define when and where terminal declines are occurring. Where should resilience-building, and where should helping adaptation, be the priority. Objective evidence needed to evaluate conventional wisdom and current conservation management practices (e.g. rope bridges, amphibian ramps). Socio-economic issues relating to changing business models and traditional practices around managing deer/grouse management. Biodiversity implications of reviewing the designated sites system to better meet the challenge of climate emergency. Can we look at flexibility in the current, rather binary, designated/ non-designated system, to include a more mainstreaming, landscape-scale approach in the context of what the impacts on overall biodiversity might be?[1]

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[6] Purple text denotes comments provided during the wider consultation, not during the workshop.

- **Agriculture**: Effect of changes in the Common Agricultural Programme (CAP). Better monitoring. Outcome-based agri-environment schemes – how to ensure metrics reflect biodiversity needs and gains.
- **Connectivity and ecological networks**: Improved coordination and thinking. Genetic implications. National Ecological Network (NEN) establishment, expansion and what it could deliver in terms of integrating biodiversity thinking across land use sectors. Microbial-biodiversity interactions. Patch dynamics and connectivity. Do wildlife corridors work in northern Britain? What is the evidence base for corridors for wildlife migration in the context of climate change. Climate change and species choice in landscaping going forward – what should we be favouring in landscaping?
- **Genetics and genomics:** Analysing change. Conservation opportunities. Good and bad practice. Access to transformative data.
- **Non-rural landscapes**: Consider urban/semi-urban, green infrastructure and abandoned land.
- **Biosecurity/Invasive & Non-native Species (INNS)**: Effective monitoring schemes and new technology (eDNA); have control measures worked? Are there more cost-effective options? Links to ecological networks. Restoration following INNS removal. How to reflect and inform the CBD and EU IAS Regulation hierarchy of Prevention. Early Warning/Rapid Response. Management in the longer term. How will climate change influence the future establishment and spread of INNS in Scotland?
- **Marine-terrestrial:** Improved links and coordination over relevant topics (e.g. INNS, adaptive management).
- **People and nature**: Reconnecting people and their environment. Lessons from response to marine plastics. Biodiversity, health and well-being links. Human activities in relation to biodiversity. Citizen science.
- **Monitoring tools**: Long-term. Mapping rare species. Innovative monitoring. Real time monitoring.
- **Data management**: Coordination. New technologies. New data. Infrastructure. Improved analytics. Improved and integrated data flows. Data interrogation tools. Open data to encourage radical thinking. Integration of research and commercial data. eDNA/biomonitoring protocols. National Centre of Biodiversity Data Excellence.
- **Knowledge exchange:** Different stakeholder needs (industry/farmers/governances/ parliament/public). Transformative change. Co-constructed projects. Accessed not just accessible research.

Session 2: State of play and priorities, needs, and gaps

Session 2 focussed on the current state of play, mapping this to the blue skies thinking of Session 1, addressing the issue of how we move from the current situation to Session 1's aspirations. Three key questions guided thinking: 1) What are we doing right? 2) What do we need more of? 3) What do we need less of? The session involved small group discussions, followed by feedback to the whole group, and then open discussion including all workshop attendees. The following is a summary of points raised during the session. Note that not all points raised are about future research priorities or themes – some are about ways of working. We have brigaded the comments accordingly.

What are we currently doing well?
Research
- Working beyond species, considering systems.

- Some strong examples of public engagement and citizen science with their importance recognised.
- Good case studies of the application of adaptive management.

Ways of working
- World class, innovative research.
- Wide and strong volunteer base.

What do we need more of?

Research
- Consider collective agreeing 5 big priority actions to take forward.
- Addressing the question of what we want from our biodiversity: where should we be going?
- Biodiversity research priorities related to the urban environment, including green infrastructure for human wellbeing.
- Landscape-scale biodiversity processes and links to adaptation, mitigation, NEN etc.
- Detecting hotspots for degradation of services.
- Human activity and behaviour monitoring – demonstrate that humans drive degradation.
- Agroecology – biocontrol and integrated pest management.
- Evidence based planning based on future scenarios and visions.
- More work on the links to climate change and human health and well-being.

Ways of working
- Collaboration – synergy in research activity; disciplinary and sectoral collaboration; links to HEIs.
- Working with stakeholders: better engagement; volunteer support; information that provides. guidance and empowerment and delivers against stakeholder needs; a citizen science strategy.
- Research/practitioner exchange. Scientists taking responsibility for findings.
- Responsive action linked to up to date, current, and comprehensive evidence.
- Data – integrated open data; better biological data infrastructure/national hub (biodiversity data innovation centre); use of advanced analytics; what are our priority research needs?
- Stories – what big stories do we have to match the e.g. marine plastics.
- Need to look beyond the conventional public sector to build capacity – who do we work with and who do we need to work with?
- Action-based research to achieve transformative change.

What do we need less of?

Research
- Research that does not inform timely and effective action – e.g. which is unnecessarily repetitive or retrospective with little new insight.

Ways of working
- Convoluted duplicated systems and silos of data.
- Vested interest protectionism; dovetailing not 'shovetailing'; sectoral decisions/budgets.
- Reporting/chasing small pots of funding.

Session 3: Identifying major research themes

In session 3, participants were asked to start identifying major research themes developing from the workshop. Focusing particularly on the research priorities for the next one, five and ten years outlined in the session 1, participants identified the common themes from the responses, and were

encouraged to reflect on what (if any) areas of biodiversity research had not yet been highlighted in discussions[7].

The major overarching issues for biodiversity research in Scotland identified so far:

The _sense of emergency_: biodiversity and climate change are now high-profile issues in the public sphere and are increasingly seen as requiring urgent action. This emergency will require biodiversity researchers to change from monitoring and identifying the effects of climate change on biodiversity, to responding to and providing advice about climate adaptation and resilience.

The _need for transformative research for transformative change_: with more work needed to define what that should look like from an integrated climate and biodiversity perspective. How can we maximise the effectiveness of Nature-based Solutions for C sequestration.

A need to _identify the major priorities for biodiversity research_: what are the big, bold research needs for biodiversity research? How can researchers come together around a unified vision or a collective set of research goals? What would they be?

The impact of _data innovation_ - eDNA, data analytics, artificial intelligence, remote sensors, crowd-sourcing of data, access to data, opportunities for coordination of data collection, etc. will have a major impact on future biodiversity research.

A need for _greater coordination_ of research effort, including crossover between marine & terrestrial biodiversity research; between research funding and policy sectors; across ecological networks.

Thematically, a number of key topics were highlighted:

- Greater understanding of what our biodiversity targets should be.
- Assessing and understanding biodiversity at the landscape scale, including the efficacy of habitat restoration/conservation measures/changes in land use policy across landscapes.
- Nature-based solutions:
    - In a way that works for the climate and for nature
    - How they link with resilience & climate adaptation
    - Understanding of how to 'build' landscapes with nature-based solutions
    - Trade-offs
- Genetic conservation.
- Increased social science to better understand citizen science, people-nature interactions, and behaviour change.
- Management practices and adaptive management of land and aquatic environments.
- Consideration of the balance of rural/urban research and greater awareness of biodiversity needs and opportunities in urban areas.
- Monitoring:
    - Long terms
    - eDNA and other novel research/monitoring techniques.
- Ecological networks including NEN, Scottish Planning Policy, ecosystem, genetics.

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[7] A number of research topics were suggested after the workshop but have not been included in the main text because the authors felt they were not clearly biodiversity research issues. However, for information they are: Air quality impacts and mitigation; Improved spatial mapping of soil carbon sequestration potential and carbon loss risk; Assessing and conserving soil carbon at the local (e.g. NNR) scale; Updated guidance on land management for (carbon rich and non-peat) soils.

Conclusions

Several major research themes have emerged from the workshop discussions (see Section 3). The next step is to consult more widely as to a) whether we are missing any major research themes, and b) what would be the priority research questions within each of these themes.

It is worth noting (and as discussed at the workshop) this is not the first process attempting to identify major research areas/themes for Scottish Biodiversity Research. The Scottish Biodiversity Strategy (SBS) Science Support Group produced the CAMERAS[8] biodiversity evidence delivery plan[9] which identified the following 10 major themes:

1. Understanding links between bio- and geo-diversity and delivery of ecosystem functions and services
2. Provide management recommendations to increase ecosystem resilience to climate change (including for coastal systems), through integrative research that scales from genes, to species, to habitats
3. Developing guidance in management of priority habitats including restoration of habitats and ecosystem services, and translocation of key species.
4. Identification of priority sites for conservation and enhancement.
5. Develop a better understanding of the impacts of different spatial arrangements of habitats for system functions (incl. habitat connectivity) in order to assess different options for land use and habitat management/restoration.
6. Further developing methods to manage and resolve conservation management conflicts.
7. Understanding public perceptions, benefits and attitudes to biodiversity.
8. Review and develop our understanding of diversity hotspot areas, or species groups for which we have world hot spots e.g. bryophytes on the west coast.
9. Better targeting of SRDP for biodiversity benefit
10. Mapping Scotland's habitats. There is a requirement for dynamic habitat mapping and carbon accounting, with higher-resolution metrics than currently available through LULUCF estimates (e.g. for terrestrial ecosystems, hi-resolution EO habitat and vegetation structure mapping for natural capital and carbon accounting).

There seems to be some overlap between this older process and the outcome of our workshop. In Appendix 1 we have attempted to show where there is overlap, and where there is a mismatch. Mismatch may be due to a genuine change in focus or because of oversight during the workshop process.

However, it is interesting that this comparison suggests a new focus on nature-based solutions rather than simply trying to understand the link between bio- and geodiversity and ecosystem function, and a lack of explicit mention of the Scottish Rural Development Programme (SRDP) in the workshop-based themes. The former may reflect the new sense of urgency felt by many at the workshop, and the latter current uncertainty about SRDP and CAP in the Brexit context. Newly emerging themes also include the desire for unifying biodiversity targets and a greater focus of biodiversity research in urban areas.

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[8] **C**oordinated **A**genda for **M**arine, **E**nvironment and **R**ural **A**ffairs **S**cience
[9] https://www.nature.scot/sites/default/files/2018-02/Scotland%27s%20Biodiversity%20Strategy%20-%20Evidence%20Delivery%20Plan%20Report%20-%20August%202016.pdf

Linked to the identification of major themes, an important future activity could also be a SWOT analysis for Scotland's research capacity and capability to deliver this research.

Acknowledgements

Appendix 1.

Links between workshop-identified research themes and (in italics) themes from the CAMERAS biodiversity evidence plan

- Greater understanding of what our biodiversity targets should be.
- Assessing biodiversity at the landscape scale, including the efficacy of habitat restoration/conservation measures/changes in land use policy across landscapes.
  5. Develop a better understanding of the impacts of different spatial arrangements of habitats for system functions (incl. habitat connectivity) in order to assess different options for land use and habitat management/restoration.
- Nature-based solutions:
  - o In a way that works for the climate and for nature
  - o How they link with resilience & climate adaptation
  - o Understanding of how to 'build' landscapes with nature-based solutions
  - o Trade-offs
- Genetics:
  - o eDNA and other novel research/monitoring techniques
  - o Genetic conservation
- Increased social science to better understand citizen science, people-nature interactions, and behaviour change.
  6. Further developing methods to manage and resolve conservation management conflicts.
  7. Understanding public perceptions, benefits and attitudes to biodiversity.
- Management practices and adaptive management, including management of land and aquatic environments.
  2. Provide management recommendations to increase ecosystem resilience to climate change (including for coastal systems), through integrative research that scales from genes, to species, to habitats.
  3. Developing guidance in management of priority habitats including restoration of habitats and ecosystem services, and translocation of key species.
- Consideration of the balance of rural/urban research and greater awareness of biodiversity needs and opportunities in urban areas.
- Monitoring (long term and innovative).
  8. Review and develop our understanding of diversity hotspot areas, or species groups for which we have world hot spots e.g. bryophytes on the west coast.
  10. Mapping Scotland's habitats.
- Ecological networks including NEN, Scottish Planning Policy, ecosystem, genetics.
  4. Identification of priority sites for conservation and enhancement.

CAMERAS evidence plan themes without a direct analogue in the workshop-identified list

1. Understanding links between bio- and geo-diversity and delivery of ecosystem functions and services

9. Better targeting of SRDP for biodiversity benefit