House of Commons Environmental Audit Committee: Biodiversity and Ecosystems inquiry

Written evidence submitted by the Microbiology Society

Introduction

1. The Microbiology Society is a membership charity for scientists interested in microbes, their effects and their practical uses. It is one of the largest microbiology societies in Europe with a worldwide membership based in universities, industry, hospitals, research institutes and schools. Microbiology is the study of all living organisms that are too small to be visible with the naked eye. This includes bacteria, archaea, viruses, fungi, prions, protozoa and algae, collectively known as 'microbes'.
2. Our principal goal is to develop, expand and strengthen the networks available to our members so that they can generate new knowledge about microbes and ensure that it is shared with other communities. The impacts from this will drive us towards a world in which the science of microbiology provides maximum benefit to society.
3. The Microbiology Society welcomes the opportunity to inform the Committee's timely inquiry. In July 2020, the Microbiology Society held a series of workshops focusing on how microbiology can help to achieve the United Nations Sustainable Development Goals (UN SDGs)[1]. The discussions held during the workshops provided valuable insight into how microbiology is contributing to achieve a more sustainable future and have informed our response to this consultation.

The state of biodiversity

Where should the four nations prioritise resources to tackle biodiversity loss?

4. Micro-organisms are everywhere and support the existence of all higher trophic life forms. To understand how humans and other life forms on Earth can withstand anthropogenic climate change, it is vital to incorporate knowledge of the microbial 'unseen majority'[2]. We must seek to unlock the potential of micro-organisms as crucial allies in tackling biodiversity loss. To achieve this, the four nations should prioritise resources in the following two areas:

[1] Microbiology Society (2020) 'A Sustainable Future' project: https://microbiologysociety.org/our-work/75th-anniversary-a-sustainable-future.html

[2] Cavicchioli, R., Ripple, W.J., Timmis, K.N. *et al.* Scientists' warning to humanity: microorganisms and climate change. *Nat Rev Microbiol* 17, 569–586 (2019). https://doi.org/10.1038/s41579-019-0222-5

5. **Soil Health**:

5.1 Soils are one of the most biodiverse habitats on Earth, with an estimated 40,000 to 50,000 species of micro-organism per gram of soil. Soils are home to a quarter of the world's biodiversity[3]. There are considerable concerns about the number of viable growing cycles remaining in global soil stock, which will precipitate microbial habitat and diversity loss, leading to further decline in soil health.

5.2 The soil microbiome – the interactive, living component of the soil including bacteria, fungi, protists and other single-celled organisms – is key for maintaining soil health and can help halt biodiversity loss of other organisms through increased nutrient availability and the breakdown of organic matter[4].

5.3 Continued technological innovation within the field of soil health and engagement across a broad range of stakeholders to implement the novel technologies will be critical to tackle biodiversity loss at a UK-wide level.

6. **Circular economy**:

6.1 The circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems. Micro-organisms are crucial in creating a circular production cycle for plastics, where these can be re-used, recycled and upcycled through their conversion into biodegradable polymers. Microbial components also affect anaerobic digestion – the process by which organic matter such as animal or food waste is broken down to produce biogas and biofertiliser. Finally, the nutritional versatility of micro-organisms can be exploited for biodegradation of pollutants, a process termed as bioremediation[5].

6.2 Positive behavioural shifts, such as reduction of single-use plastic, have been reversed due to the COVID-19 pandemic and therefore public engagement across the UK should be prioritised to halt plastic pollution which could lead to biodiversity loss.

Co-ordination of UK environmental policy

How can policy be better integrated to address biodiversity, climate change and sustainable development?

7. To tackle biodiversity, climate change and sustainable development, soil health needs to be viewed from an ecosystem perspective, as soil is not only important for landowners

[3] Food and Agriculture Organization of the United Nations (2015) Soils and Biodiversity report: http://www.fao.org/documents/card/en/c/43b565e7-57c2-43c6-b4f0-812091486ed3/

[4] Microbiology Society (2020) Explainer: Soil Health https://microbiologysociety.org/uploads/assets/f0266831-5df8-438a-bc2bebdd22de9f5f/Soil-Health-Explainer.pdf

[5] Microbiology Society (2020) Explainer: Circular Economy https://microbiologysociety.org/uploads/assets/67c1114e-9fe2-49f7-bfd446f6ce051bd0/Circular-Economy-explainer.pdf

and users, but also provides societal benefits through ecosystem services such as carbon storage, water quality and crop yield, and this should be reflected in environmental policy.

8. Monitoring soil health is essential to assess the state of UK soils and should be at the heart of environmental policy. Despite the importance of healthy soils in tackling global challenges, there is currently a lack of policy directive and measurable targets for soil health. This has led to an under-investment in soil monitoring compared to other areas such as water quality, as revealed in the Sustainable Soil Alliance's report[6] according to which soil accounts for just 0.41% of money invested in environmental monitoring in England.

9. There is a need for better policy coherence and integration between food and agriculture, energy, waste and trade sectors in order to enable the transition to a circular economy. The Wellbeing of Future Generations Bill[7], which has garnered cross party support in its call for public bodies to act in pursuit of the environment, social, economic and cultural well-being of the UK, is recognised as a positive step towards beginning to address the greatest threats facing future generations.

How can biodiversity and ecosystems help achieve the air, soil and water quality objectives in the 25 Year Environment Plan?

10. The Government's '25-year Plan' set out a goal to improve England's soils by 2030[8] and microbial soil ecosystems are key in achieving this goal, as they play fundamental roles in numerous ecosystem processes, including plant growth, nutrient absorption, disease resistance and soil structure[9].

11. Importation of damaging plant and animal pathogens increases the risk of disease introduction and reduces our ability to maintain and protect the UK's resources. The changing profile of trade agreements will be key over the coming years and we must keep protecting the biodiversity of native organisms by maintaining stringent import guidelines.

12. Healthy soil ecosystems also help to achieve better air and water quality, due to natural ecosystems being interconnected. Soil microbiomes directly and indirectly impact air quality through greenhouse gas production, nitrate runoff, carbon storage and water quality through bioremediation of waste and pollutants.

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[6] Sustainable Soils Alliance (2020) Soil monitoring in England: https://sustainablesoils.org/foi-request-soil-monitoring

[7] Wellbeing of Future Generations Bill [HL] 2019-21: https://services.parliament.uk/bills/2019-21/wellbeingoffuturegenerationsbill.html

[8] Department for the Environment and Rural Affairs (2018) 25-year environment plan: https://www.gov.uk/government/publications/25-year-environment-plan

[9] Parliamentary Office for Science and Technology (2019) Sustaining the Soil Microbiome: https://post.parliament.uk/research-briefings/post-pn-0601/

13. Many of these objectives could be achieved by shifting away from the 'throw-away' society that we currently know. For example, re-designing food systems based on the principles of circular economy could help address the food waste challenge and the associated pressures on natural resources by making food value chains shorter and more resource-efficient.

Economics and biodiversity

What are the possible approaches to balancing economic growth and conservation of nature and its contributions?

14. Creating green jobs will help drive economic growth whilst addressing climate change and biodiversity loss. Developing novel technologies for nitrogen fixation and carbon storage, that help tackle biodiversity loss, requires a whole-systems approach and therefore investment in these technologies offers employment opportunities across a wide range of disciplines and sectors.

15. Broadening the scope of microbiological research funded in the UK and focusing on non-health expertise, within fields like soil health and the circular economy, will help to reduce biodiversity loss and provide economic benefit. For example, further microbiological research into soil health could lead to long-term economic benefit from reduced fertiliser applications as soil health improves and therefore provide an opportunity for biodiversity to flourish whilst allowing farmers to benefit economically.

16. Successful transfer of appropriate technologies and organisational learning are key to enhancing sustainability. Collaborative networks of experts achieve more impact when they are given access to dynamic infrastructures that enable knowledge exchange rather than when operating in isolation. Workshop attendees welcomed UKRI's support to the creation of up to five Interdisciplinary Circular Economy Centres[10] and highlighted the importance of microbiology within such multi-sectoral endeavours.

Pairing nature-based solutions to climate change with biodiversity

Which nature-based solutions are most effective in achieving both climate and biodiversity goals?

17. Microbiology must play a leading role in ensuring a sustainable future for diverse global societies. Because of the multiple mutual interactions between climate and micro-organisms, it is not possible to tackle the global challenges on climate change and biodiversity without microbiological knowledge.

18. Microbiology has the potential to be harnessed into nature-based solutions to tackle both climate change and diversity loss, through microbial processes such as

[10] Engineering and Physical Sciences Research Council (2020) Circular Economy Centres – Full Proposals: https://epsrc.ukri.org/funding/calls/circular-economy-centres-full-proposals/

bioremediation to decontaminate soil and increase biodiversity, carbon storage, waste decomposition and nitrogen fixation.

19. Although there is an opportunity to develop novel nature-based solutions from microbial processes, there is still a gap in understanding biochemical cycles underpinning new technologies and in translating the current knowledge in order to increase uptake from industry. This limits our ability to determine the most effective solutions and emphasises the need for further investment in broader microbiological research.

What would constitute clear indicators of progress and cost-effectiveness of nature-based solutions and how should trade-offs and co-benefits associated with nature-based solutions, biodiversity and socioeconomic outcomes be considered?

20. The United Nations Framework Classification for Resources (UNFC) is a universal standard for the management of all energy and raw material resources, including specifications for the recovery of value from residues or wastes generated by human activities ("Anthropogenic Resources") which supports the circular economy and provides clear indicators of progress[11].

21. Whilst clear indicators of progress for air and water quality exist, there is a lack of soil health indicators that could be used to develop new policies or guidelines. Initiatives to define clear indicators are currently being developed, such as the Agriculture and Horticultural Development Board's scorecard approach to measure physical, chemical and biological indicators of soil health[12]. However, further engagement with industry is needed to define meaningful indicators.

22. Changing practices to promote nature-based solutions requires appropriate incentives and support. Although farmers may be interested in making large scale changes and move towards sustainability, they can have barriers to progress and limitations on investments that do not yield immediate returns, which limits the implementation of nature-based solutions. Development of nature-based solutions needs to be aligned with the end-users for implementation to be achieved.

How can funding be mobilised to support effective nature-based solutions to climate change? How can the private sector be encouraged to contribute to funding?

23. Investment in soil microbiology is vital to support effective nature-based solutions to climate change and biodiversity. The link between microbial diversity and function requires further detailed investigation to facilitate the development of nature-based solutions.

24. To develop effective nature-based solutions to climate change, it is crucial to fund interdisciplinary science, to allow better understanding of biogeochemical cycles and

[11] United Nations Economic Commission for Europe: United Nations Framework Classification for Resources: https://www.unece.org/energy/se/reserves.html

[12] Agriculture and Horticultural Development Board (2019) Testing the soil health scorecard: https://ahdb.org.uk/knowledge-library/testing-the-soil-health-scorecard

how they work and translate this knowledge into biotechnologies that can be implemented. Joint initiatives between research councils should be promoted in order to develop interdisciplinary collaboration between all scientists interested in soil.

25. To encourage the private sector to contribute to funding, researchers developing nature-based solutions need to improve communication with the private sector. In the field of soil health, this is particularly important in order to manage expectations as to the timescale at which molecular methods will have field applications. Networks such as Innovate UK and the Knowledge Transfer Network are extremely valuable for creating collaborations and continue support of these networks is vital to facilitate engagement with the private sector.
26. The private sector often finds it difficult to invest in nature-based solutions tackling soil health due to the research community being too fragmented. Before engaging with the private sector, the soil healthy community urgently needs financial and infrastructure support to build a strong and resilient community capable of collaborating to develop novel nature-based solutions to climate change and biodiversity.
27. To support the implementation of nature-based solutions, there needs to be a funding mechanism to enact, encourage or reward good management of the environment. For example, the EU are developing payments for farmers linked to sustainability and preserving natural resources, which could help incentivise the industry to adopt better practise[13].
28. The Nexus 2020 report has highlighted that it is not just market and financial instruments that can motivate action but changes in regulatory systems: “Until activities are creating value, and governance structures recognise the importance of investing in these activities, it is hard to create the impetus for business to undertake costly action”[14].

[13] European Commission: Sustainable land use (greening) https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/income-support/greening_en

[14] Nexus 2020: The most important research questions for business sustainability, https://www.cisl.cam.ac.uk/resources/publication-pdfs/Nexus2020