

Introduction

The Society for Applied Microbiology (SfAM) welcomes the opportunity to respond to the British Ecological Society and appreciates its collaborative approach to the future of ecological research in the UK.

SfAM represents a global scientific community which draws upon its collective expertise in the application of microbiology to promote, for the benefit of the public, human health, and safety.

What do you believe are the pure and applied research priorities for UK-based ecologists, as applied to a UK environmental context?

SfAM recommends that UK-based ecologists prioritise understanding the impacts of antimicrobial waste in the environment, e.g. water and soil. As SfAM's 2021 antimicrobial resistance (AMR) in the Environment case study explores, industrial contaminants; agricultural, municipal, and healthcare wastewater; and antibiotic use in livestock are just some of the ways in which antibiotic compounds and resistant bacteria enter and proliferate in the environment, but the ecological impact of this is unknown.¹ Even at sub-inhibitory concentrations, antibiotic compounds are known to be biologically active. Their increasing presence in soil and freshwater is likely to disturb established microbial communities, potentially favouring microbes that are either intrinsically resistant or have acquired resistance. In the presence of metals and pesticides, there can be a selective advantage if a bacteria has an antibiotic resistance gene. Likewise, in the presence of antibiotics there can be a selective advantage if a bacteria has metal or pesticide resistance genes. This makes it very hard to predict the possible future of soil and freshwater microbiomes in increasingly polluted natural environments.

Why it is a clear priority?

There is currently no structural, statutory surveillance dedicated to assessing the levels of antimicrobial residues in the environment in the UK. There are no established 'safe' levels. As microbes underpin many food webs and ecosystem services, understanding the impact of increasing antimicrobials in the natural environment is critical to building an evidence base from which to establish what is 'safe' and any particular areas that need urgent mitigation. For example, whether microbial community changes near hospital effluent or wastewater treatment plants show significant change likely to impact on the ecosystem downstream.

What will it lead to in terms of societal impact?

We know that the presence of antimicrobial compounds in soil and water is a risk factor for driving AMR more widely in the environment, which then has the potential to spill over into the clinic. Approximately 1.2 million people died in 2019 from antibiotic-resistant bacterial infections.² AMR has been referred to as the "silent pandemic". To combat the rise in resistant infections, we need to urgently deploy resources into

¹ SfAM AMR in the Environment Case Study, November 2021, <https://sfam.org.uk/resource/amr-case-study--amr-in-the-environment.html>.

² Christopher JL Murray, Kevin Shunji Ikuta, Fablina Sharara, et al, Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis, The Lancet, January 19 2022. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(21\)02724-0/fulltext?dgcid=raven_jbs_etoc_feature_gbd22#%20](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)02724-0/fulltext?dgcid=raven_jbs_etoc_feature_gbd22#%20).

understanding and mitigating against factors potentially driving this. In addition, as microbes underpin nutrient cycles and many other ecosystem services, understanding what changes are occurring in the soil and freshwater microbiomes as a result of increased antimicrobial compounds is key to ensuring protection through monitoring and surveillance for these vital microbial communities.

Landscape and Biodiversity

In addition to AMR in the environment, SfAM members also suggest the following areas for the British Ecological Society to prioritise for future research:

- Landscape scale strategies to develop and maintain ecologically coherent networks
- How to rewild the UK at the landscape scale in a manner which supports both biodiversity and society.
- To understand the efficacy of mitigation strategies designed to protect biodiversity
- How can biodiversity change and ecological function be measured and monitored robustly at scale across space and time?

Given climate change is increasingly impacting Britain's landscapes and biodiversity, it is imperative that ecological research investigates these areas to better ascertain what adaptation measures are successful and/or mitigation steps will need to be implemented to protect our ecosystems.