

Pre-reading for 20 March HSAC – evidence scoping for NERC proposal

We (Defra) want to increase the use of biological effects monitoring data in policy decision making and regulation. To do this, we will need to create a UK monitoring framework for biological effects. The first step in delivering this framework is to ensure we have the knowledge and tools available to do so.

We believe that the quantity of research required to deliver on this will require a budget larger than we can utilise in Chemicals, Pesticides & Hazardous Waste. Therefore, we believe a promising course of action is to input on a UKRI program run through the Natural Environment Research Council (NERC) to fund research into areas we need to understand better to produce this monitoring framework.

The first step in this process is to deliver to NERC a scoping document that highlights the best opportunities for academic research to provide tools and knowledge to achieve this goal.

Our research has revealed four major themes.

We would like to ask the HSAC for input on specific, key questions to help us refine our evidence scoping and make the best use of any secured funding.

1. Improving read-across through computational methods

We have comprehensive toxicity data for only a fraction of all substances in use, and very little on their effects on UK species.

Research can improve understanding of how chemicals cause organisms harm and how these processes are evolutionarily conserved. Together with phylotoxicology databases and modern computational tools, there is an opportunity to increase our ability to extrapolate the experimental data we do have and read across to other species more effectively.

Links to relevant tools and projects: [SeqAPASS](#) - [Darwin Tree of Life Project](#) - [CompTox](#) - [AOP-wiki](#)

Question: What criteria does read across data need to meet to be used in a monitoring system and what barriers do you see to that happening?

2. Better understanding of sublethal effects

Some thresholds we use in the H4 indicator account for sublethal effects, and Environmental Quality Standards (EQSs) take sublethal effects into account through Predicted No Effect Concentrations (PNECs). However, these data are limited and there is high uncertainty.

Firstly, we would like to make these data more robust and reduce uncertainty. One priority we might focus on is to further confirm observed lab-based effects in environmental settings. I.e. Does the effect have a real-world consequence for the organism in its environment, or are they adapting to mitigate these effects?

Our research indicates that answering these questions might rely on section 3; Emerging or underutilised biomarkers.

Secondly, we do not have a good understanding of the long-term consequences of persistent sublethal effects, including multi-generational effects, and population-level changes in response to these pressures.

Question: What are the main scientific challenges of transferring lab-work understanding to understanding real ecosystems? How far can we assume that sublethal effects observed in lab settings are also happening in the environment (and matter)?

Question: What options do we have to link long-term sublethal effects with monitored changes in populations over time?

3. Emerging or underutilised biomarkers

Detecting biomarkers of biological effects might be an effective way to start better causally linking chemicals with impacts on wildlife.

Reporting under the [OSPAR Convention uses effects-based methods](#) for marine monitoring – e.g. Lysosomal membrane stability measured from organisms collected in the field.

“Biomarker Bridges” link biomarkers with diagnosis but has challenges. [This study](#) states *“lack of mechanistic understanding of links ... from biomarker signals to whole organism responses (WORs)...means single biomarker measurements are not easily translated to a generic health indicator”*

Question: Are there emerging biomarker monitoring tools that we could help develop? Additionally, what existing biomarker monitoring tools exist that we are not using but could?

Question: What challenges are there to using biomarker monitoring in field tests?

Question: How will increasing adoption of NAMs facilitate uptake of emerging or underutilised biomarkers? How might increasing adoption of NAMs hinder this uptake?

4. Chemical mixtures

Synergistic mixtures are rarely (if ever) captured in thresholds and EQS.

Synergistic mixtures are estimated to account for 10-15% of chemical mixtures found in the environment.

Question: Is it possible to effectively link biological effects monitoring with monitoring of chemical mixtures?