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Emerging Contaminants: Informing Scotland's strategic monitoring and policy approaches on substances of increasing concern

Karin Helwig¹, Amy Cooper², Eulyne Pagaling², Fiona Henderson¹, Lisa Avery²,
Joanne Roberts¹, Sennan Mattar¹, Sandhya Devalla², Colin Hunter¹,
Gabriele Frascaroli¹, Ole Pahl¹, Ania Escudero¹, Orla Shortall², Zulin Zhang²,
Mads Troldsborg².

¹Glasgow Caledonian University, Cowcaddens Road, Glasgow G4 0BA

²James Hutton Institute, Craigiebuckler, Aberdeen AB15 8QH

Aim of the project

The aim of this project was to inform, prioritise, and coordinate actionable monitoring and policy-based approaches to understand and address risks from substances of increasing concern to Scotland's water environment.

The project objectives were:

1. To identify the key substances or groups of substances of increasing concern in Scotland's waters
2. To identify the risks of these substances to Scotland's water environment including human health.

Background

Contaminants of increasing concern (CICs) comprise a diverse range of substances and organisms, including chemical groups such as pharmaceuticals and pesticides; biological contaminants such as pathogens and antimicrobial-resistant (AMR) genes; nano-materials; and microplastics. CICs include compounds and organisms that are 'new' or increasing in presence in the environment or compounds or organisms already known to be present for which new information

becomes available, e.g. on how they behave in the environment or on their toxicities. Substances and groups considered CICs therefore evolve over time, due to new insights or new patterns of use.

For most CICs, significant uncertainties exist about their presence in the environment and the risk they pose to humans or other organisms. Often, it is not clear how they move through the environment, how long they persist, or how toxic they are. Risk assessment is rendered even more complex by limitations in our understanding of 'the cocktail effect': water environments typically receive a mixture of contaminants, for example in sewage effluent, and the risks posed by such mixtures are not well understood.

Generally, CICs are not yet fully addressed in policy, regulation and monitoring programmes.

Key findings

A wide range of contaminant groups with potential relevance for Scotland was identified. They include pharmaceuticals, nanomaterials, microplastics, per- and polyfluoroalkyl substances (sometimes called "forever-

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chemicals” due to their persistence in the environment) and substances associated with antimicrobial resistance. Concerns were also raised about the potential relevance for Scotland of certain pesticides, flame retardants, tyre particles, and a number of other substances, including several that have never been investigated for Scotland but are known to be a concern elsewhere. Each of these contaminant groups can contain hundreds or even thousands of different substances.

Treated and untreated sewage effluent from domestic and industrial sources; agriculture and aquaculture; landfill leachate; road run-off and litter were common pathways across most contaminant groups. Our understanding of sources, pathways, and effects varies significantly for the different substances and specific research gaps were identified for the main contaminant groups.

Scotland is not alone in focusing on policy, regulation and monitoring options to address the complex issues around CICs and several useful approaches and data sources were identified, which could be explored for applicability to Scotland.

To address the science-policy interface, the following areas should be considered:

- Data sharing, data sufficiency, and cross-organisational working
- The role of climate change, including adaptation and mitigation measures, on future trends
- Understanding and managing sources, path-ways and interactions
- Research infrastructure and capacity.

Recommendations

Based on the findings of the project, the following recommendations were developed (see main report and logic model for further details):

1. That no emerging contaminant groups can be discounted for Scotland on the basis of the evidence we found;
2. That many national and international databases are available to aid understanding of emerging contaminants; these should be reviewed and consolidated for Scotland;
3. That the current organisational infrastructure of teams (academic, government, committees, partnerships, non-governmental organisations) working on emerging contaminants in Scotland is reviewed and assessed for comprehensiveness with respect to the water environment;
4. That new partnerships are considered for contaminant groups as required;
5. That such new or existing partnerships refine the knowledge gaps in collaboration based on the knowledge needs of water policy teams;
6. That funding is made available to address the knowledge gaps;
7. That an international review of policy options is conducted, in particular for integrated approaches and approaches to mixtures, including effect-based monitoring;
8. That capacity is expanded both in research teams and policy teams.