

## Earth & Space

# Shrimp on cocaine – what's the big deal?

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### ABSTRACT

*The environment is under significant pressure from multiple issues that stem from human activity. One important issue that many individuals are unaware of is the potential risk of chemical contaminants in the environment.*



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The environment is facing a seemingly endless number of problems. From climate change to extinction-level biodiversity losses, the spread of antibiotic resistance, harmful algal blooms, and pollution from multiple chemicals, to name just a few. The consequences and impacts of these issues are far-reaching for the health of both humans and wildlife. We will require long-term multi-collaborative efforts to minimize and prevent further adverse effects. While these issues are all important, as environmental toxicologists, we are mainly focussed on studying the impact of chemical contaminants on wildlife. Many of the chemicals in the environment stem from products that have every-day use such as medicines and cosmetics or could be industrial products such as those used in pest control for agriculture. For some of these chemicals, there have already been some very

concerning effects. Sex changes of aquatic animals by compounds like the human contraceptive pill and marine antifouling agents; near-extinction of several vulture species in India and Pakistan from exposure to a pharmaceutical; and population collapse of killer whales exposed to coolants. For some of these compounds, they have been banned for several decades by most countries around the world. Yet, we are still witnessing the effects today, demonstrating the potential persistence of chemical pollution in the environment.

Toxicology can be broadly split into two categories that are "exposure" and "effect." Exposure science aims to determine the fate of chemicals in the environment, and the exposure to these various contaminants over an organism's entire lifecycle is referred to as the exposome. By being able to

characterize the exposome, we can identify contaminants that end up in different organisms, including chemicals that have not been previously found. Our recent study was aimed at detecting pharmaceuticals, recreational drugs, and pesticides in an essential species of freshwater crustacean (*Gammarus pulex*), which is in essence a small shrimp. By measuring which of these chemicals are present in these animals and at what levels, we can start to estimate the potential for effects to occur. Assessing whether an outcome is likely to happen helps us to prioritize chemicals that could be of concern in the environment so that we can direct future research efforts.

In July 2018, we collected water and animal samples from 15 different sites that covered five different river catchments in Suffolk. From these samples, we extracted chemicals that we specifically targeted for and then measured using a technique known as liquid chromatography-mass spectrometry. This technique is used to separate a mixture of compounds and then measure the molecular weight of a chemical to give structural information that enables us to identify it. Using the measured levels of the chemicals found in the samples collected in Suffolk, we then estimated the likelihood of an effect occurring in these animals.

If you followed the news, you might have seen that cocaine was detected in every animal and water sample that was collected. This was an unexpected result as Suffolk is a less urbanized area than compared with a city like London, where we regularly detect multiple recreational drugs in water. A question we saw and were asked a lot after this study was, "so what?". It was argued that there are more pressing issues facing the environment than cocaine detected in shrimp. Nevertheless, this is an important question, and the bigger picture is sometimes not always easily visible. Cocaine found in shrimp suggests that it might be present in most wildlife living in these freshwater habitats. Thus, cocaine is one more contaminant that adds to a long

list of chemicals present in wildlife. Furthermore, cocaine was not the only compound detected here. We found other recreational drugs, pharmaceuticals, and pesticides, of which several have been banned for over a decade in the EU. A total of 56 different chemicals were determined in the shrimp, and it is essential to note that we only looked for a relatively small set of compounds in this study. The entire exposome could consist of thousands of chemicals, which will require a vast pool of resources and effort to identify each one.

The problem highlighted here is that the exposome is poorly characterized, and our current understanding of the risk for a majority of these chemicals is minimal. Simply put, these contaminants add to a large number of potential stressors for organisms that are already under significant pressure from multiple issues facing the environment. With this in mind, perhaps a more prudent question to ask is; what can we do to prevent this?

## References

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