

Traces of antidepressants and painkillers found in crustaceans

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Researchers from SINTEF, the Norwegian Polar Institute and the University Centre in Svalbard have collected samples from Arctic crustaceans close to the settlement of Ny-Ålesund on the west coast of Spitsbergen. During the spring and summer, they discovered a number of drugs in a variety of different concentrations.

"These included ibuprofen from Ibus, diclofenac from Voltaren, antibiotics and an antidepressant," says SINTEF researcher Ida Beathe Øverjordet.

The aim of the project is to study our footprint on the natural world—to measure how much material is discharged, and what significance this has. The results may have an impact on the way in which we manage the Arctic regions in the future.

"It's easy to assume that this won't be an issue because there are so few people living in this area. However, the fact is that we found many traces of drugs in the animals," says Øverjordet.

Surprising discoveries

The first thing that the researchers noticed was the high levels of ibuprofen in all the animals.

"Ibus is a commonly used drug with quite a long lifetime in the environment compared with medications such as paracetamol, which often breaks down very rapidly. So this wasn't such a surprising discovery," says Øverjordet. "However, what did surprise us was that the concentrations of the drug were so high, considering that the area is so sparsely inhabited."

Since crustaceans, such as copepods, occupy the lowest levels of the food pyramid, compounds in the drugs will be passed upwards to larger animals. Copepods constitute the basis for much of the life in the Arctic because they are rich in fats, and are thus essential to building and maintaining the fat reserves of Arctic fish and seabird species.

Similarly, finding traces of drugs such as antibiotics and diclofenac wasn't so strange, since these medications are also in common use.

"Somewhat more surprising was that we discovered less commonly used drugs such as antidepressants," says Øverjordet.

Only 30 permanent inhabitants

Ny-Ålesund is populated by service personnel and researchers from ten different countries. There are only 30 permanent inhabitants, but in summer, visiting researchers and seasonal workers can boost the population to as many as 200 people, all of whom are between the ages of 20 and 70, and are generally healthy and in good condition. There will also be some tourists visiting for short periods—the majority just for day trips.

"One of our next steps will be to find out what drugs are used in the area, and to compare the results with what we find in the local sewage and living organisms," says Øverjordet. "We're particularly interested in examining seasonal variations in order to get an idea of what medications are taken locally compared with what is brought in by the tourists who are only making short visits," she says.

Same concentrations as in Tromsø

This study is part of a research project called PharmArctic, which is being funded by the flagship research program Miljøgifter at the Fram Research Centre in Tromsø. The program focuses on generating knowledge about the impacts of environmental toxins on Arctic ecosystems, and is looking into the links between the concentrations of pharmaceutical drugs and cosmetic products and discharges from settlements and tourism in the Arctic.

In an earlier study of sewage from the town of Longyearbyen, also on the west coast of Spitsbergen, it was shown that the concentrations of

some drugs were equivalent to, or even higher than, those recorded for cities such as Tromsø, which has a much higher population.

The general lack of sewage decontamination due to permafrost and low temperatures is a constant problem in the Arctic, including on Svalbard.

"Only 2,500 people live in Longyearbyen, but each year, many thousands of tourists visit for long or short stays, all making their contribution to the substances that get discharged in the sewage," says Øverjordet.

"However, the main reason for the high concentrations is the lack of sewage decontamination in Longyearbyen. Everything is simply discharged straight into the fjord."

The general lack of sewage decontamination due to permafrost and low temperatures is a constant problem in the Arctic, including on Svalbard.

Ny-Ålesund installed a very basic raw sewage decontamination system in 2018, and as part of their future work, researchers will be studying differences in drug concentrations in the samples collected before and after decontamination was introduced.

Impact on regulatory governance

The project's findings may be used to influence the future management of the Arctic regions, as well as national and international regulatory governance, both on land and at sea.

"It's true that cruise ships are not permitted to discharge their sewage close to land, but if the compounds have a long environmental lifetime, they may still cause problems," Øverjordet explains.

At the moment, we know very little about the concentrations and levels of exposure that Arctic wildlife have to pharmaceutical drugs, and how

big this problem really is.

Are pharmaceutical drugs hazardous to wildlife?

The crustaceans from which samples were taken are small planktonic organisms called copepods and amphipods, which live on the seabed and in the water column.

"These animals have different ways of life, which in turn influence the types of environmental toxins to which they are exposed and thus how much they ingest," says Øverjordet. "Amphipods, for example, are benthic organisms that feed on carrion and other organic material that is deposited on the seabed, and may thus be exposed to more of the environmental toxins that accumulate there," she says.

To date, the research team has not identified any [drug](#) concentrations as being hazardous to Arctic wildlife, though it has been shown that the drugs clearly are ingested.

"Since these crustaceans occupy the lowest levels of the food pyramid, compounds in the drugs will be passed upwards to larger animals," says Øverjordet. "Copepods constitute the basis for much of the life in the Arctic because they are rich in fats and are thus essential to building and maintaining the fat reserves of Arctic fish and seabird species."

The drugs in question may impact wildlife in a number of ways. Various other studies have shown that antidepressants alter the behavior of zooplankton and fish, and that this may have an impact on their survival, as well as a number of other effects.

"We don't know what the tolerance levels are for Arctic wildlife species," says Øverjordet. "This is something we will be studying in the future."

Too little data and knowledge

In the future, the researchers will be analyzing the sewage samples from Longyearbyen and Ny-Ålesund that were collected at intervals during the summer of 2020.

"Samples of both sewage and seawater have been taken to measure the concentrations of drugs in the water," says Øverjordet. "The [sewage](#) samples will give us an indication of how much is discharged from the settlements during a given season. We have very little data on Arctic wildlife species, so we're hoping that the results from our initial project will provide a basis for more research in this area," she says.

The researchers have applied to expand their studies both on Svalbard and in Greenland.

Provided by SINTEF

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