# WHO IS POLLUTING THE Arctic?

Pollution from Europe and Asia is hitting the Arctic hard. **Lindsay Vare** tracks down the culprits.

When you think of the Arctic what do you imagine? A place of natural beauty, covered in snow and ice, with fascinating creatures such as polar bears and seals? It is easy to think that the Arctic is one of the last pristine environments on Earth, unaffected by humans, little industrial activity and free from pollution.

Research here at the Scottish Association for Marine Science (SAMS) has proved that this idealistic vision is far from the truth. Contaminants from Europe and Asia, including pesticides used in agriculture, heavy metals (mercury, lead and cadmium) and even radioactive particles, are finding their way to the Arctic. Famously, the Greenland ice cores show when Europe moved from using leaded petrol to unleaded.

We have been looking at pollution levels in sediment cores from lakes, fjords and the shallow oceans in the Arctic. We want to know where the pollution is coming from because all these contaminants are detrimental to life here. They affect reproduction, growth, and the nervous systems of people, plants and animals.

We have found traces of pesticides, known generally as persistent organic pollutants which are by definition persistent and are slow to break down in the environment. They build up in an organism as there is no system for removing them, therefore levels increase as you go up the food chain, with the highest levels found in the top predators: polar bears and people. Reports by the Arctic Monitoring Assessment Programme have suggested that, as a result of this kind of pollution, some polar bears are unable to reproduce, and if they do manage to reproduce successfully, cubs have a lower survival rate.

We also know that other pollutants, for example, polychlorinated biphenyls, or PCBs, which are used in electrical devices, hydraulic fluids and as additives to paints, change the nesting behaviour and reduce adult survival rate in glaucous gulls. Scientists have found increasing levels of PCBs in maternal blood samples of Inuit women from Greenland, because their diet is so high in marine mammals.

> We could identify the source of the lead pollution: Europe.

Though persistent pesticides have now been banned or restricted in many parts of the world, industry has designed a whole new generation of pesticides, and, while most of these compounds are more readily degradable, scientists have detected substantial quantities in the Arctic, indicating further research is needed.

Scientists are worried about other contaminants reaching the Arctic including mercury. Levels of mercury are high enough to pose a threat to both Arctic wildlife and humans. Scientists have identified high concentrations in seabirds, whales, polar bears and a variety of fish. In mammals it can cause nerve and brain damage especially in the young, and in birds researchers have observed erratic behaviour along with weight loss. Mercury continues to rise in the Arctic with human activity creating a several-fold increase in mercury levels compared with pre-industrial times.

The sources of most of these metals are not local; they travel thousands of

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*Dr Kenny Black and the author retrieving a sediment core from Kongsfjorden, Svalbard.*

miles from mid-latitude industrial areas such as Europe and Eurasia and are usually the result of burning fossil fuels and other industrial processes. So how do they get to the Arctic? There are three main routes: the atmosphere, the ocean and ice. The importance of each route is not well understood, though most work has focused on the atmosphere.

Our work has looked at the oceans. We have found that they are one of the main routes for transporting lead into the Arctic. We collected a large selection of sediment cores from around the Arctic. The experience is one that I will never forget, travelling around on skidoos, with sandwiches placed neatly near the engines, the only sure way of an edible unfrozen lunch.

From this work we believe warm Atlantic currents bring lead from the south. Lead enters the Arctic Ocean from the Fram Strait, between Svalbard and Greenland, and the Barents Sea. Sinking sediment and decaying organic matter strip most of the lead out of the sea in the European basin around Svalbard and the southern Barents Sea. Sediment cores show a steady increase in lead concentration over the last two centuries, since the onset of the industrial revolution. Using computer models we could identify the source of the lead pollution brought in on ocean currents around Svalbard: Europe.

In contrast, cold-water currents coming from the Arctic through the Barents Sea were low in lead. Sediments showed virtually no change in lead concentrations and no change in the lead isotope ratio, indicating only a natural source.

The lead appears to be following a pattern associated with the ocean currents, the European Arctic receiving most of the lead from human activities such as burning of fossil fuels and waste incineration.

In some cores the lead concentrations have decreased over the last three decades, a result of policy makers banning lead in petrol. This is a positive outcome showing that through appropriate measures governments have been able to reduce concentrations, thereby reducing its impact on the Arctic environment.

The story of mercury is not so good; concentrations seem to be increasing in both lake and ocean sediments. Scientists have found elevated levels in the livers and kidneys of many marine animals and fish. Mercury can cause damage to the brain and the nervous system in mammals, in fish it can be associated with damage to gills, reduced sense of smell and blindness. The main question is: 'Are the increased levels of mercury in the upper part of lake and ocean sediments showing that human activity is adding to an existing burden of mercury in the environment?'

Our results show that, as with lead, the ocean could potentially be an important pathway, along with the atmosphere. Further studies on the increase in mercury, its sources and the biological effects are a high priority if the delicate balance of the Arctic is to be preserved.

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