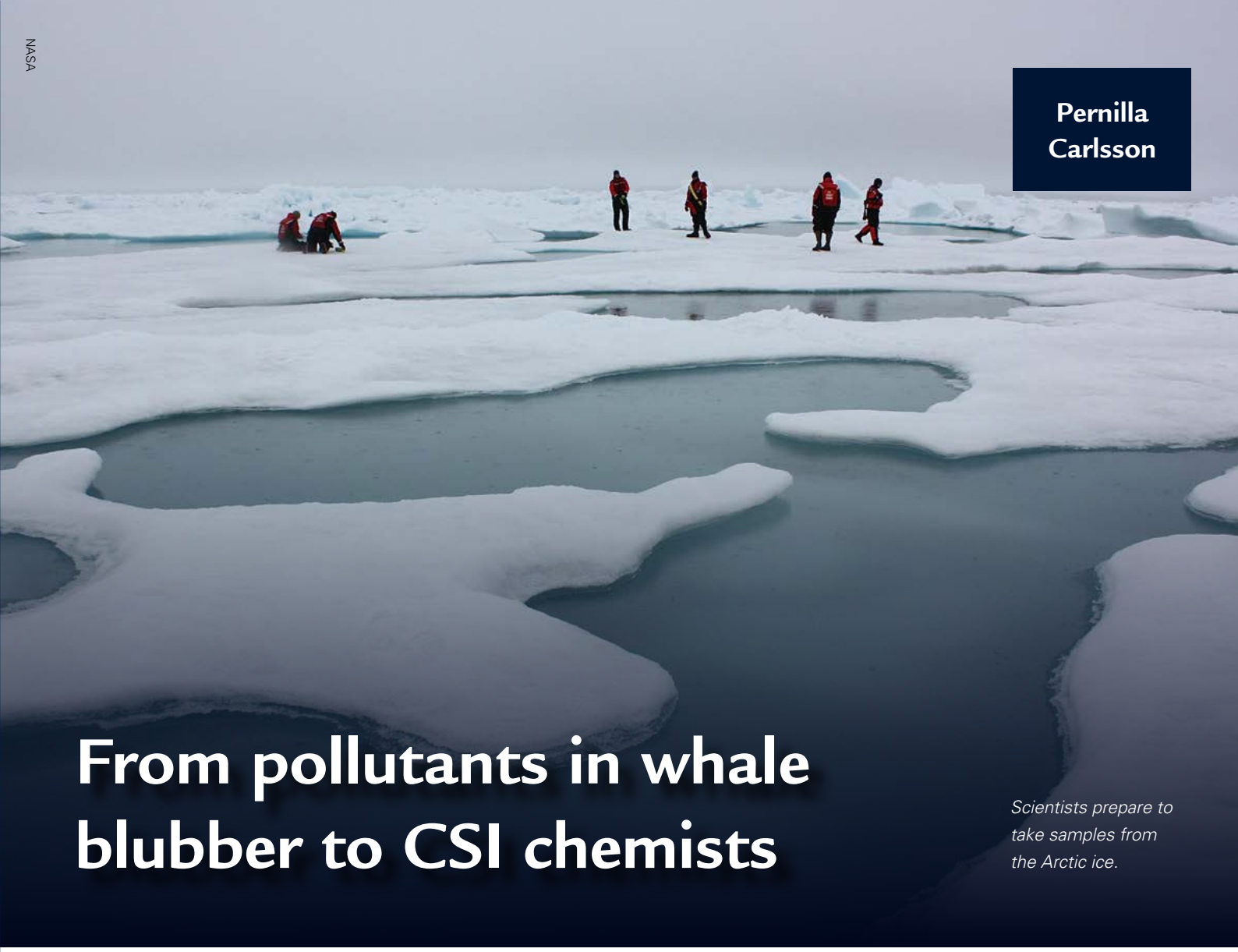

NASA

Pernilla Carlsson

From pollutants in whale blubber to CSI chemists

Scientists prepare to take samples from the Arctic ice.

Do you eat a lot of whale blubber? Probably not, but if you lived in northern Canada or in Greenland, you would probably have answered 'yes' to this question. In Inuit communities, whale blubber is well known for its health benefits. Today, local food such as whale, seals, fish and seabirds contributes about 20% of the Greenlandic everyday cuisine. Back in the days when it was very expensive and difficult to get fresh vegetables and fruits to Greenland, they had to get vitamins and minerals from somewhere else. Many glands in animals are rich in vitamin C; the testicles can be around 70 mg/100 g, while adrenal glands may contain up to 130 mg/100 g. For comparison, oranges have about 50 mg vitamin C per 100 g fruit.

Jan Mansson

Blubber from a beluga whale, hung to dry in Alaska

Many Greenlanders were very healthy during the early 20th century. Scurvy was not present, and neither was diabetes. However, during recent decades, more and more Greenlanders have accessed Western food, and not only fruit and vegetables, but also soda, chips and sweets. In addition, environmental chemists have begun to discover high concentrations of heavy metals and persistent organic pollutants (POPs) in fatty food from high up in the food chain. So, not only did people get access to sugar-rich food, they also became aware of recent risks with their traditional diet.

Persistent organic pollutants

POPs are man-made, toxic and very stable molecules which accumulate in fatty tissues. This means that, once out in the environment, they stay there for a long time. POPs biomagnify in nature, meaning that the higher up in the food chain the higher the levels of POPs will be.

Some of these compounds were used as flame retardants or pesticides while others are by-products formed during combustion. In 2002, several countries signed the Stockholm Convention and promised to phase out these compounds and ban production. This was good news for everyone

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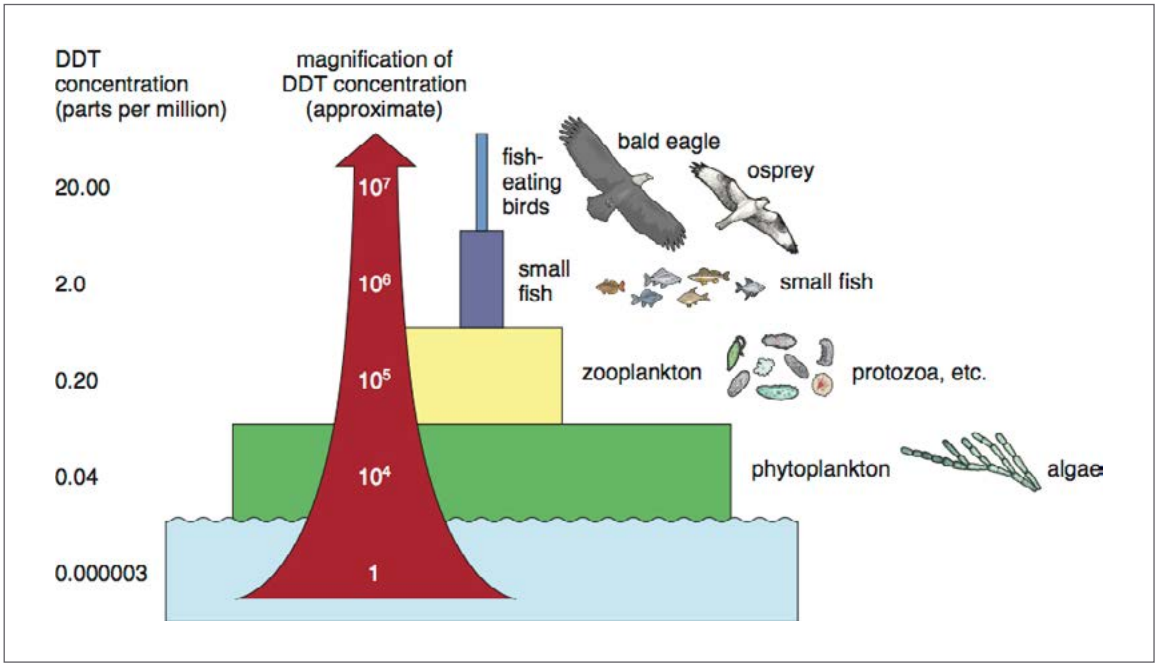
– not only for those who ate lots of whale blubber and fish, but also for you and me, because we are exposed as well.

POPs are quite volatile and can be transported long distances. This means that POPs will evaporate from southern areas where they are used and move all the way up to the Arctic. The Arctic food web is very fatty – if you want to survive the cold, harsh conditions here, you had better have some extra insulation. This is perfect for the POPs and they will bioaccumulate in the fat of plankton, via fish to marine mammals and to humans. The molecular structure of POPs is similar to some of our hormones, and they can therefore disturb our hormone systems. Children and foetuses are especially vulnerable and since POPs stay in your body for a long time, so that young women who eventually want to give birth are vulnerable too.

biomagnify throughout the food web. In addition, old POPs are being replaced with several new chemicals. The world still needs flame retardants and insecticides. Several new compounds are now being found in Arctic air and in animals. Screening for new substances in Arctic animals reveals compounds from Gore-Tex jackets and frying pans in polar bears, and compounds from deodorants have been found in the air of the Arctic archipelago Svalbard at 79°N.

In addition climate change affects transport of POPs, both to and within the Arctic. Higher air temperature can lead to evaporation of heavier molecules than before. Run-off of melting water drains the soil and snowcaps of buried POPs and transports them out to the ocean. However, higher temperatures can also lead to increased degradation of these compounds.



Biomagnification of a pesticide (DDT) along a food chain from phytoplankton to eagles and ospreys. Tiny amounts which would be harmless to the birds are magnified to harmful levels. Source: SmartScience: KS3 Student's Book

Thanks to bans around the world, concentrations are decreasing in nature and so there are fewer restrictions on eating certain types of fish in countries such as Norway. Food advice in Greenland and northern Canada focuses not only on the risks associated with POPs in whale and seal blubber, but also on the benefits of nutrients and the social aspects of eating traditional food. Advice nowadays is to be a bit more careful with food items such as liver and blubber from marine mammals when you are young, pregnant or planning to have a baby, while if you are older, or a man, you can eat more of these food items.

Novel chemicals

Sadly, this is not the end of the story and environmental chemists are facing new challenges. POPs that were produced before the bans still leak from land to the marine environment, where they

To detect new compounds in the Arctic, chemists are using very sensitive instruments. We want to find out how these compounds behave in the environment, preferably before any environmental damages happen. The instruments can analyse trace levels and operate at the picogram scale (10^{-12} g). Samples have to be handled very carefully to avoid contamination because many of the new compounds are present in everyday life. This is why we go to remote areas to sample, wear gloves and leave our Gore-Tex jackets at home. To find out if, and how, chemical compounds accumulate in the Arctic marine food chain, we dive under the sea ice and collect plankton living there. Air samplers have been erected in remote areas, such as Zeppelin station in Ny-Ålesund, Svalbard, and we go to the local market to buy everyday food to find out how much POPs it contains.

Ice diving North of Svalbard on an research expedition with Norwegian Polar Institute

This map shows several bases used for scientific studies of the Arctic environment. Pernilla has worked on Svalbard, a Norwegian archipelago.

Students at UNIS (UNiversity Centre in Svalbard) putting out baits for amphipods (small, benthic crustaceans) that will be analysed for POPs)

Field data from my research showed that pesticides can be stored in snow packs and ice in the Arctic, but arethey will be washed out to the ocean when the snow melts. We could also use the distribution pattern of some pesticides in zooplankton to investigate relevant processes for uptake of POPs. The contribution of POPs from the air and ocean currents is important for the amount of POPs we find in zooplankton, but also what comes from land. Some POPs that are first buried in the sediment can be released some years later to the water again.

Finally, the levels of newer POPs, e.g. perfluorinated octane sulfonate (PFOS) and polybrominated diphenyl ethers (PBDE), were low in selected fish and marine mammals from the west coast of Greenland. So, you can keep on eating fish for dinner!

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