Polar Bears Illustrate How Toxins Impact Arctic

Polar bears and people, at the chilly top of the Arctic's food chain, risk consuming a smorgasbord of industrial pollutants that have seeped into their habitat and pose potential health hazards.

Now a University of Florida researcher, aiming to better understand just how dangerous the chemicals might be to humans, has zeroed in on how effectively polar bears are able to rid themselves of environmental toxins consumed in the food they eat. It turns out the bears can completely eliminate only one of five of the classes of industrial contaminants they are exposed to, a finding that's bad news for the bears and other species who share their environment, according to Margaret James, an environmental toxicologist at UF.

"The polar bear has quite an efficient system for metabolizing these pollutants," said James, adding, "If they can't do it, then it's unlikely that other animals or persons can."

The UF study, published in the journal *Drug Metabolism and Disposition*, could help researchers learn more about the effects of pollutants on humans living in the Arctic who share the same staple diet as the bears.

Researchers have known since the 1970s that industrial byproducts are carried to the Arctic by trade winds and then settle in the subzero temperatures, incapable of re-entering the atmosphere and making them more likely to accumulate in the food chain.

Then in the 1980s and '90s, Canadian and Scandinavian scientists showed that the bodies of polar bears contained high levels of industrial pollutants. Learning more about the extent to which the bears could break down and eliminate the chemicals dovetailed with James' expertise in how the body metabolizes drugs.

"There is no difference to the body in metabolizing a drug or a pollutant," she said. "The process is the same."

In her research, James concentrated on five types of chemical contaminants known by the acronym POP, for persistent organic pollutants. They include compounds produced by a burning process; the pesticide methyl bromine, which was banned in 2004; TCPM, an industrial compound found in the Arctic but of unknown origin and toxicity; PCP, used as a wood preservative; and PCBs, industrial chemicals used for many years in electrical applications. All of these substances, with the exception of TCPM, are regulated or banned, but they persist in the environment.

Polar bears break down these fat-soluble chemicals in two steps, each of which makes the substances more water-soluble and therefore easier to excrete, said James. The first step, however, results in a compound that is more chemically reactive and therefore more harmful to living cells, with the potential for reproductive or neurological damage. The second phase, often slower than the first, determines how successfully the animals eliminate the toxins, she said.

Studying liver tissue samples obtained from the bears, James found that the animals were surprisingly efficient at metabolizing one of the types of industrial chemicals studied – those produced by a burning process, which are similar to the compounds that form when meat is cooked on a grill. The other pollutants, she determined, could not be fully excreted.

"This suggests that other species will metabolize the pollutants more slowly," said James. "When they are not sufficiently excreted, the levels go up."

One obstacle James faced in her research quest: how a Florida researcher might obtain a polar bear for scientific study. Her break came in 2003, when Canadian colleagues Stelvio Bandiera, professor of biomolecular and pharmaceutical chemistry at the University of British Columbia in Vancouver, and Robert Letcher, at Environment Canada in Ottawa, donated liver tissue samples from three adult male bears to UF. The bears were from a legally controlled hunt in 1993 by the Inuit people native to the Canadian Arctic.

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