

PCB-Contaminated Pacific Salmon Contaminating Region's Resident Killer Whales

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A study published in the January edition of Environmental Toxicology and Chemistry says that nearly 100 percent of pollutants found in Chinook salmon were acquired while the fish were growing to adulthood in the Pacific Ocean.

The research paper explains the process by which threatened and endangered killer whales in the waters off northwestern North America become contaminated with persistent organic pollutants, particularly polychlorinated biphenyls (PCBs), that are present in chinook salmon, the whales' primary food source.

To read the entire review, "Persistent Organic Pollutants in Chinook Salmon (*Oncorhynchus tshawytscha*): Implications for Resident Killer Whales of British Columbia and Adjacent Waters" (Vol. 28(1):148--161), visit http://www.allenpress.com/pdf/ENTC_28.1_148.pdf

The research says that southern killer whales are contaminated with higher concentrations of chemicals because 1) they eat more salmon than their northern counterparts and 2) southern salmon have higher levels of contaminants than northern salmon because the southern waters are more contaminated than the northern waters. In fact, PCB concentrations in southern salmon were almost four times those in northern salmon.

"Killer whales are among the most PCB-contaminated species on the planet," said Peter S. Ross, a research scientist (marine mammal toxicologist) with the Institute of Ocean Sciences (Fisheries and Oceans Canada) in Sidney, British Columbia, and corresponding author for the paper. He supervised the research and is adviser to doctoral candidate Donna L. Cullon, lead author of the paper.

The whales are long-lived -- as many as 85 years -- and wander the north Pacific freely. As a result they have plenty of time and opportunity to absorb contaminants such as PCBs, which are also long-lived.

The killer whales are also at the top of the food chain, swallowing contaminated species such as salmon, which make up an estimated 92 percent of their diet. Favored are chinook, which make up an estimated 65 percent of the whales' diet, Ross said.

"Chinook are the most POP-contaminated of all the salmonids" because of their, relatively, long life, Ross said.

It is known that salmon can lose as much as 80 percent of their lipid (fat) stores as they journey back to their natal streams, according to the study. Salmon stop eating during that time and draw energy from their lipid stores.

As a result they are less nutritious to whales than they would be otherwise. Furthermore, southern salmon were found to have lower lipid content than northern salmon. Whales therefore eat larger amounts of salmon and consequently are exposed to larger amounts of chemicals in the salmon, the study says. Southern whales, in particular, consume as much as 50 percent more salmon to compensate for the fact that their food is, per unit, less nutritious.

Salmon paradoxically help killer whales (food) and harm them (contamination), the study says.

"Dietary persistent organic pollutant (POP) concentrations and patterns have profound implications for killer whale POP accumulation and consequent related health risks," the paper says. "High trophic level marine mammals have shown susceptibility to adverse health effects such as immunotoxicity, endocrine disruption, reproductive impairment, and developmental abnormalities with elevated exposure to POPs."

The researchers measured POP concentrations in chinook salmon in order to characterize dietary exposure in the highly contaminated, salmon-eating northeastern Pacific resident killer whales. They estimate that 97 to 99 percent of PCBs, polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), dichlorodiphenyltrichloroethane (DDT), and hexachlorocyclohexane (HCH) in returning adult chinook were acquired at sea.

"... it is apparent that global sources acquired by salmonids during their time in the North Pacific Ocean also contribute substantially to their contamination," according to the research paper. "This has implications for wildlife, because POPs are delivered by salmon to coastal, freshwater, and terrestrial ecosystems.

"Salmon partly explain the POPs found in British Columbia wildlife, including resident killer whales and grizzly bears, though questions linger about their importance relative to other prey items."

"The killer whales are telling us, and the salmon are telling us, about the condition of the ocean," Ross said.

Two populations of resident killer whales frequent the coastal waters of British Columbia, Canada, and the state of Washington in the United States. The Canadian Species at Risk Act has designated northern resident killer whales as threatened, while the Species at Risk Act and the U.S. Endangered Species Act have designated southern residents as endangered.

The highly contaminated southern resident killer whales frequent the near-urban waters of the Strait of Georgia and Puget Sound, while northern resident killer whales ply the more remote waters of central and northern British Columbia.

The research involved measuring POPs -- including flame-retardants, industrial by-products, and organochlorine (OC) pesticides in ocean-migrating smolts and in returning adults from four stocks of chinook salmon from British Columbia and Washington. The objectives were to characterize in chinook salmon the POPs acquired locally as juveniles (i.e., prior to ocean migration) and the POPs acquired during time at sea.

British Columbia adult chinook salmon were collected from Johnstone Strait and near the mouth of the Fraser River in October 2000 and from central Strait of Georgia in August 2000. Washington adult chinook salmon were collected near the mouth of the Duwamish River and from the Tumwater Falls Hatchery on the Deschutes River in September 2001. Puget Sound chinook smolts were collected from the Green/Duwamish River and the Deschutes River during the period May through June 2001.

POP concentrations for Johnstone Strait chinook were used to calculate POP presence for northern residents and all four chinook stocks for southern residents.

Authors are Donna L. Cullon of the Institute of Ocean Sciences, Fisheries and Oceans Canada and the School of Earth and Ocean Sciences at the University of Victoria in British Columbia, Mark B. Yunker, Carl Alleyne of the Health Canada, Environmental Health Assessment Services, Neil J. Dangerfield of the Institute of Ocean Sciences, Sandra O'Neill of the Washington Department of Fish and Wildlife, Michael J. Whitticar of the University of Victoria and Peter S. Ross of the Institute of Ocean Sciences.

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