



Chinook Salmon

in the Georgia Basin

- **Why are Chinook salmon particularly important to BC's killer whales?**
- **What is the Chinook salmon life cycle?**
- **How are salmon, especially Chinook salmon, related to contaminants in killer whales?**

Why are Chinook salmon particularly important to BC's killer whales?

Studies have shown that adult salmon make up as much as 98% of resident killer whale diet (reference 1). Of these salmon, Chinook are by far the preferred species, making up as much as 65% of the spring and early summer diet. Even when other salmon species, such as Pink or Sockeye, are much more abundant in coastal waters, Chinook continue to dominate the diet. This preference for Chinook may be because Chinook are the largest of all the salmon species (reaching up to 45kg), they contain the most fat of all salmon species (therefore most energy per serving), and a significant number of Chinook salmon remain in coastal waters for their entire marine life (an unusual habit among salmon species, most of whom migrate far offshore) making them available to the resident killer whales year round.



Chinook salmon are the most important prey species for resident killer whales and are also important for the commercial, sport and native food fisheries.

Photo courtesy of Chris Garrett

What is the Chinook salmon life cycle?

Chinook are the largest and longest lived among the salmonids, attaining up to 50kg and living 4-7 years. Chinook occupy the highest trophic level among the salmonids, something that predisposes them to accumulating higher relative levels of persistent environmental contaminants. Chinook salmon are grouped into two types based on a significant variation in their life cycle. Like the other Pacific salmon species, Chinook are anadromous, meaning that they begin their lives in fresh water, migrate to the ocean to mature, and return to fresh water to spawn. One group of Chinook, called 'stream-type', remain a year or more in freshwater before migrating out to sea where they join the other salmon species migrating long distances around the North Pacific, returning some years later in the spring or early summer to spawn (this group is sometimes called 'spring Chinook' because of the return timing). 'Ocean-type' Chinook migrate to the sea within their first year, spend most of their life in the ocean and return in the fall to spawn (hence also called 'fall Chinook'). Ironically most of the 'ocean-type' Chinook do not migrate out into the deep offshore waters, but remain in coastal waters for their entire marine life. The majority of Chinook originating from streams and rivers in the Strait of Georgia are 'ocean-type' and it is these Chinook that are readily available as food for local killer whales in coastal waters all year round.

How are salmon, especially Chinook salmon, related to contaminants in killer whales?

The main pollutants of concern in killer whales are the Persistent Organic Pollutants (POPs). In addition to being persistent (long lasting) they are lipophilic which means that they are highly soluble in fats but not in water. As with salmon, the main route of exposure to POPs is through the consumption of prey (food). A number of studies have now shown that salmon accumulate most of their body burden of these compounds during their growth and maturation at sea. When they return as adults they bring these compounds in to coastal waters and even in to their natal streams and lakes and introduce their POPs into the coastal food chain. Although the concentrations of POPs in the salmon are not very high, indirect effects on their behaviour, development, or immune system may increase the chance of mortality.

Being a major prey item, salmon represent a source of contaminants to resident killer whales. Other, non-salmonid prey items (accounting for less than 10% of the annual estimated diet of killer whales) also represent a source of contaminants for killer whales. The higher degree of contamination of southern residents compared to northern residents may be attributed to two possible reasons i) southern residents eat more contaminated species of prey (salmonid or non-salmonid) or ii) southern residents eat more contaminated salmon. Higher contaminant concentrations in the diet of southern residents likely reflect their consumption of more contaminated prey, but it is unclear as to whether this is due to salmon or not.

Key References

1. Ford, J. K. B., Ellis, G. M., and Olesiuk, P. F. 2005. Linking Prey and Population Dynamics: Did Food Limitation Cause Recent Declines of 'Resident' Killer Whales (*Orcinus orca*) in British Columbia? Canadian Science Advisory Secretariat Research Document. 2005/042. Fisheries and Oceans Canada. Ottawa, Ontario. <http://www.dfo-mpo.gc.ca/csas>.
2. Healey, M. C. 1991. Life History of Chinook Salmon (*Oncorhynchus tshawytscha*). In Groot, C. and Margolis, L (eds.). Pacific Salmon Life Histories. Fisheries and Oceans Canada, Vancouver, BC, Canada. 311-393.
3. Ewald, G., Larsson, P., Linge, H., Okla, L., and Szarzi, N. 1998. Biotransport of organic pollutants to an inland Alaska lake by migrating sockeye salmon (*Oncorhynchus nerka*). *Arctic* 51: 40-47.
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5. Arkoosh, M. R., Casillas, E., Clemens, E., Kagley, A. N., Olson, R., Reno, P., and Stein, J. E. 1998. Effects of pollution on fish diseases: Potential impacts on salmonid populations. *Journal of Aquatic Animal Health* 10: 182-190.

Useful Websites

- The Pacific Fisheries Resource Conservation Council provides a lot of information on a wide variety of salmon issues <http://www.fish.bc.ca/index.php>
- Vancouver Aquarium salmon information site <http://www.vanaqua.org/salmon/tales/english/>
- Basic salmon information from Fisheries and Oceans Canada http://www.pac.dfo-mpo.gc.ca/species/salmon/salmon_facts/default_e.htm