Southern resident killer whales at risk: Contaminant-related health risks

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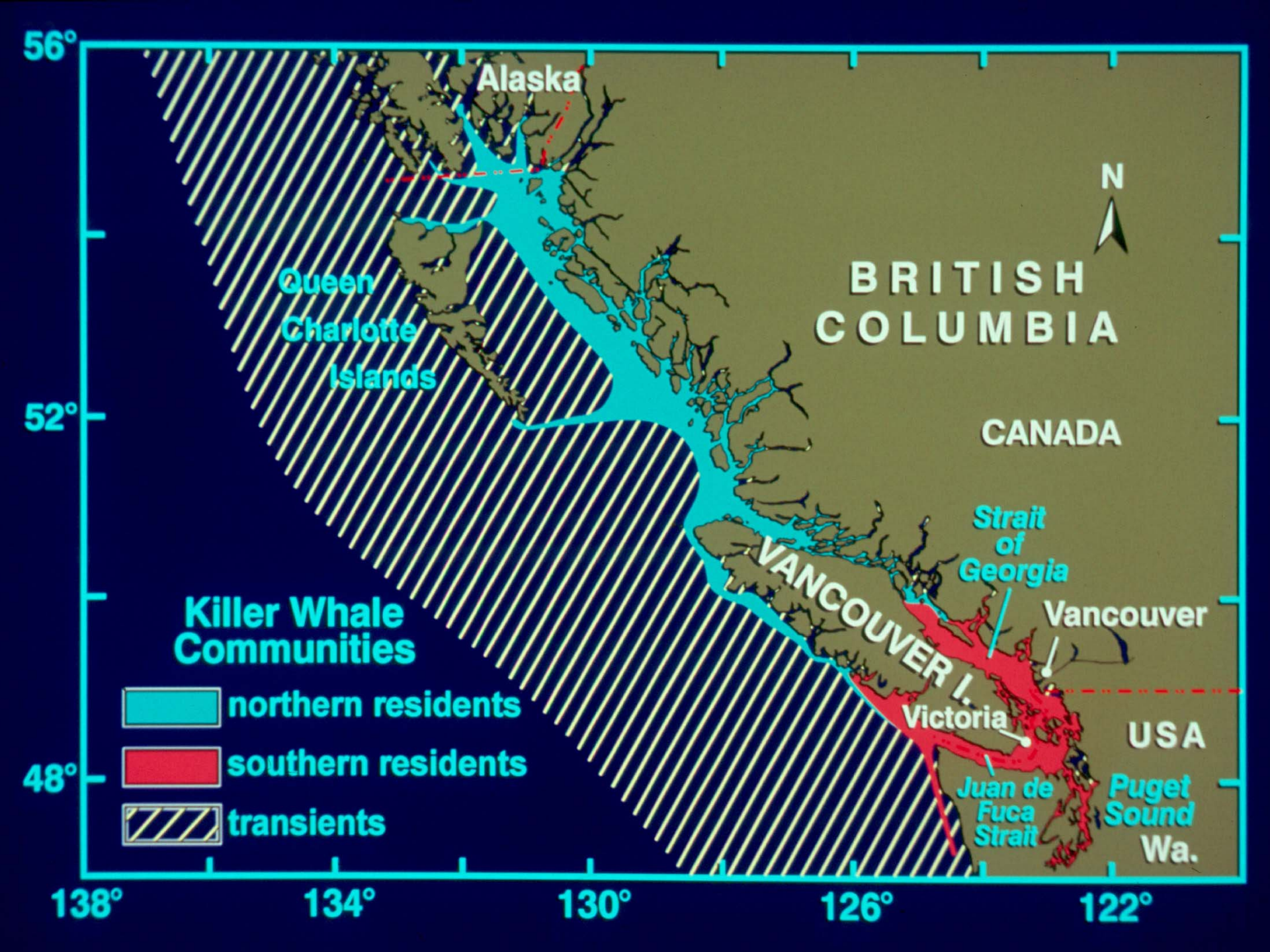
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Killer Whale
Communities
northern residents
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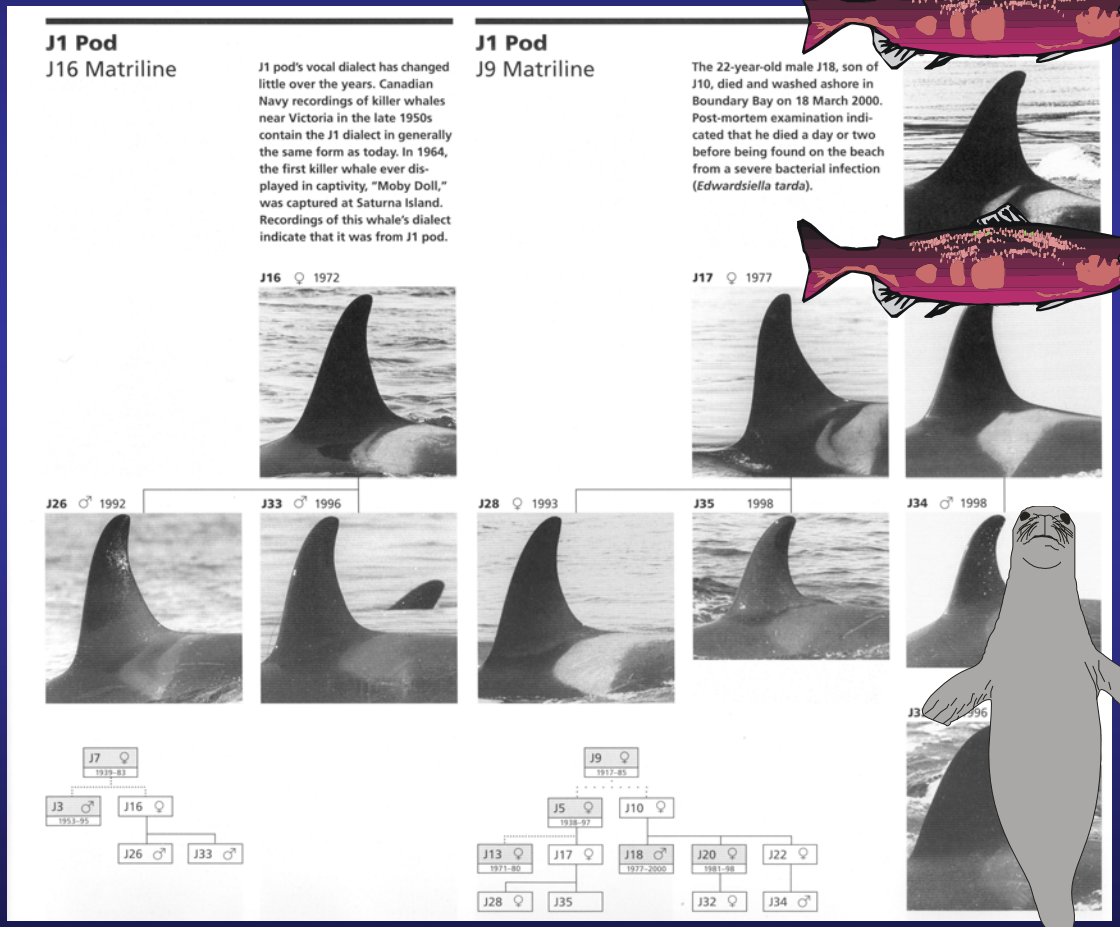
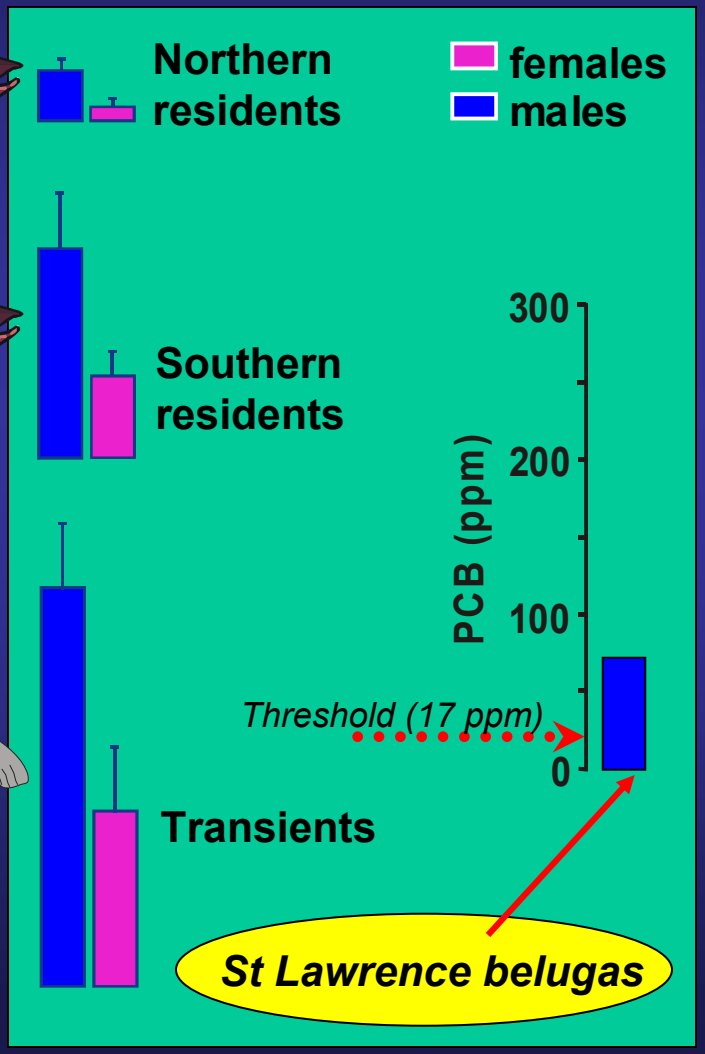
transients

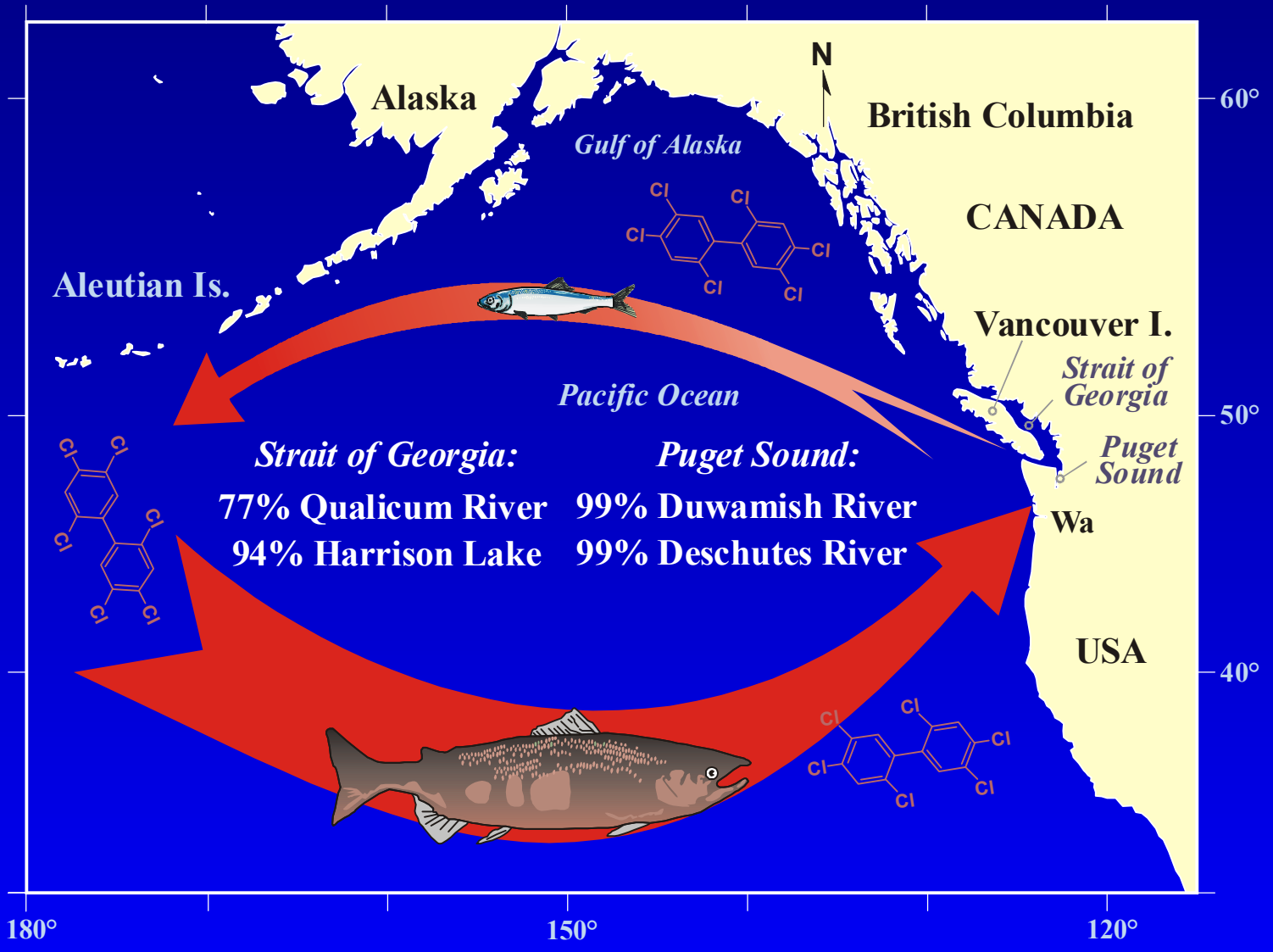
Biopsies from individual killer whales of known age, sex and dietary preference provided the foundation to carry out an ecosystem-based study of contaminants





Point sources, atmospheric transport and food webs are key considerations when considering mitigative strategies to reduce exposure for killer whales

Resident killer whale diet: Proportion of PCBs that Chinook salmon obtain from the 'open' Pacific Ocean (% body burden)



(Ross et al 2003)

Local habitat quality in British Columbia and Washington coastal waters is important for killer whales:

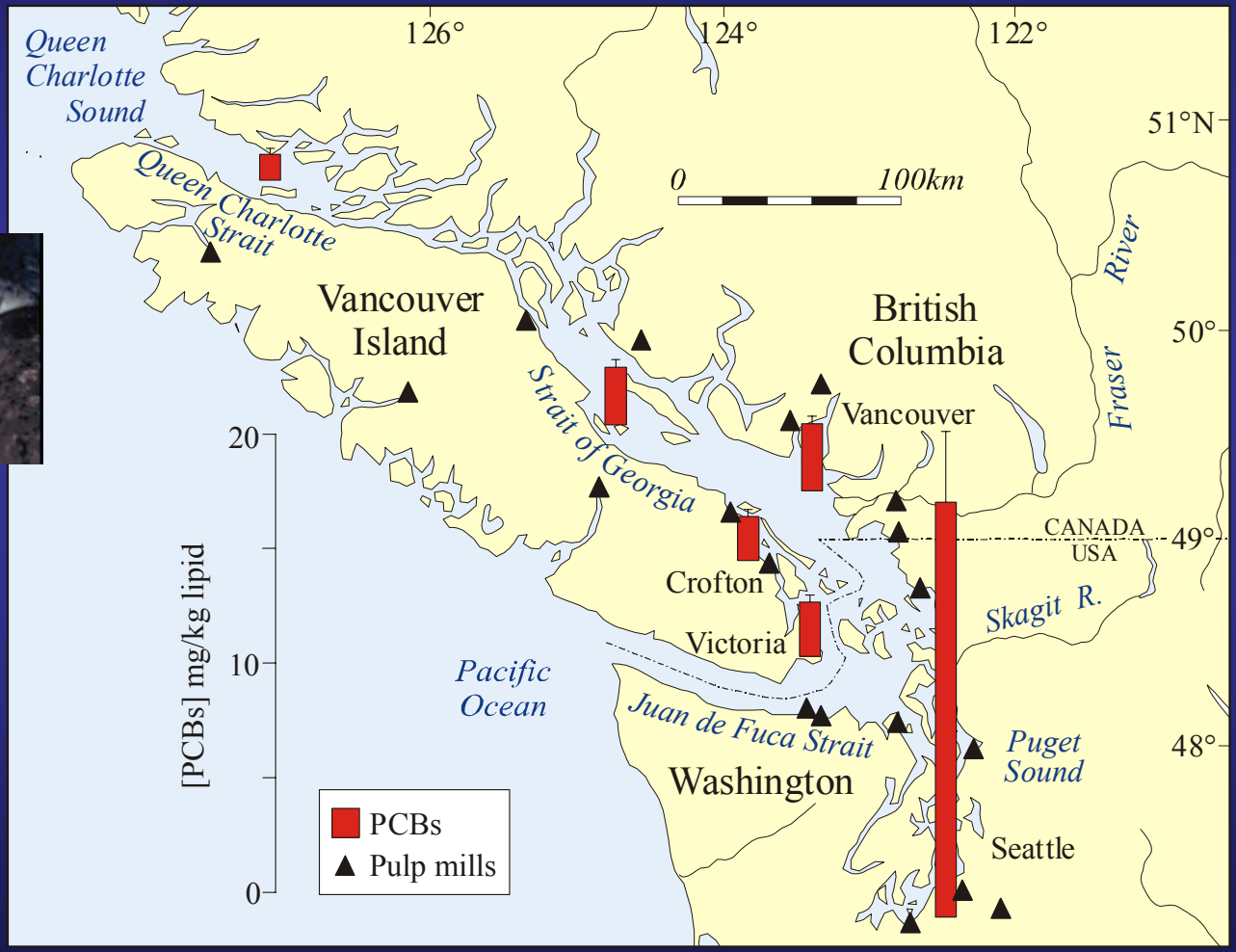
- *killer whales*
- *harbour seals, fish, water, sediments, air*
- *transboundary collaborations*

Where are these chemicals coming from…?

Harbour seals (Phoca vitulina) as local sentinels of POP contamination in coastal food webs

- harbour seals are small pinnipeds that are widely distributed along the temperate coastlines of the northern hemisphere;
- they are relatively abundant, ‘easy to handle’ and have been extensively studied by scientists in different disciplines;
- they are omnivorous, but have a strong preference for herring, hake and local fish and invertebrate prey species;
- the harbour seal has become the “laboratory animal” of the oceans for toxicologists interested in marine mammals.

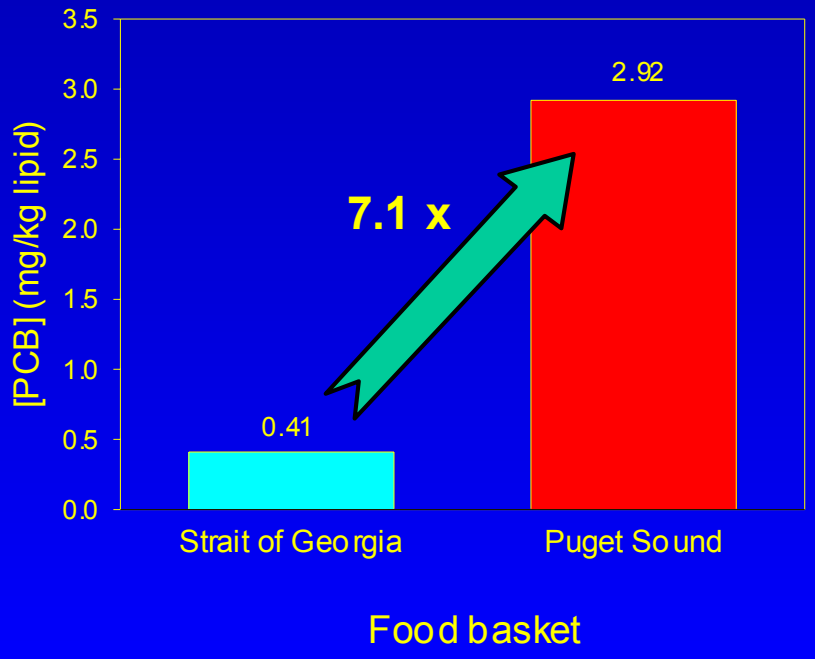
Local sources: Our seal (and other) research shows that Puget Sound is a regional PCB 'hotspot', thereby contaminating food chains and some local killer whale prey items



(Ross et al 2004)

Harbour seals in Puget Sound are exposed to higher levels of dietary PCBs than their BC counterparts

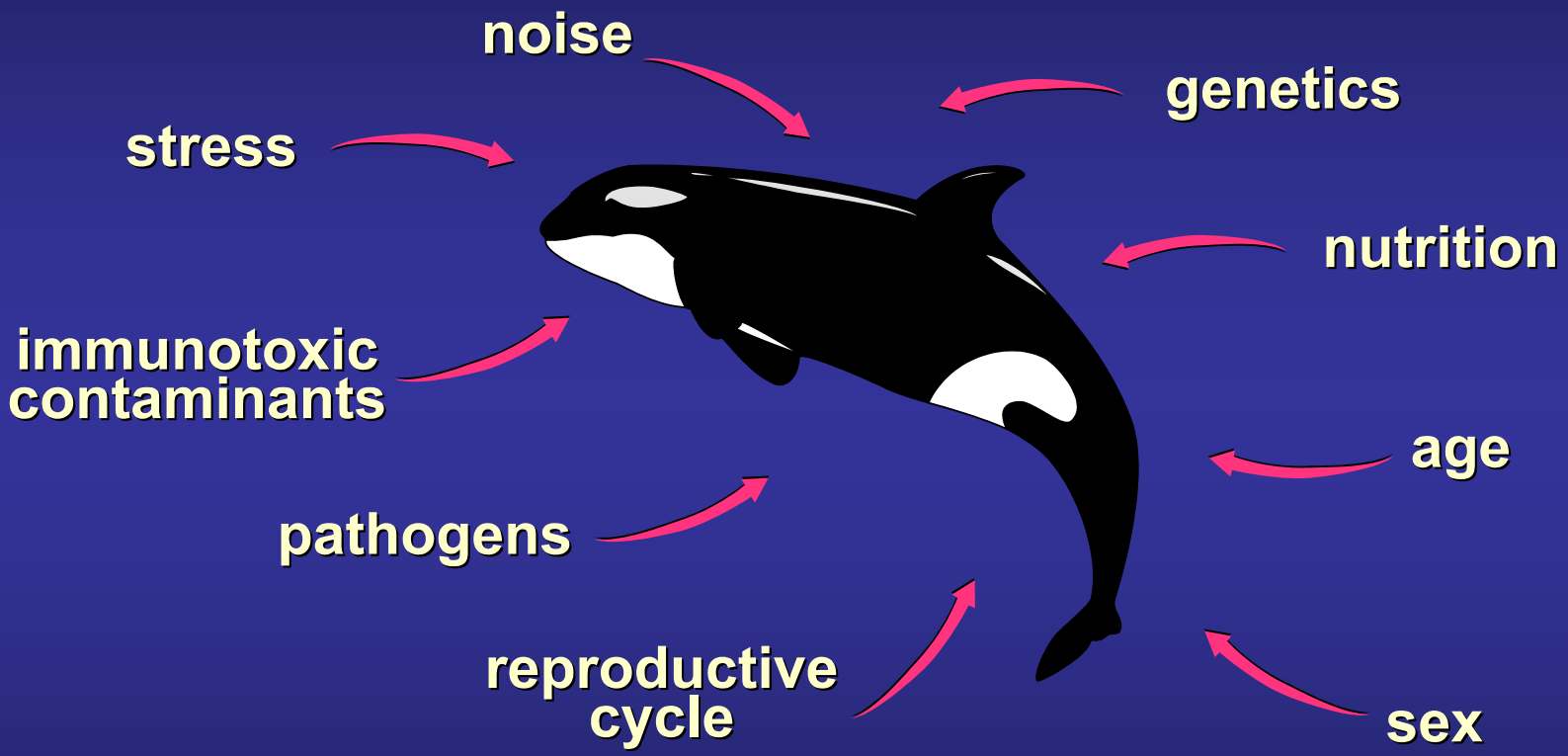
- Strait of Georgia harbour seal diet
  - 43% hake
  - 32% herring
  - 4% salmon
  - 3% plainfish midshipman



- Puget Sound harbour seal diet
  - 36% Pacific tomcod
  - 18% herring
  - 9% English sole
  - 9% plainfish midshipman
  - 5% hake
  - 5% shiner surfperch

(Cullon et al. 2001)

Many factors affect the health of free-ranging killer whales



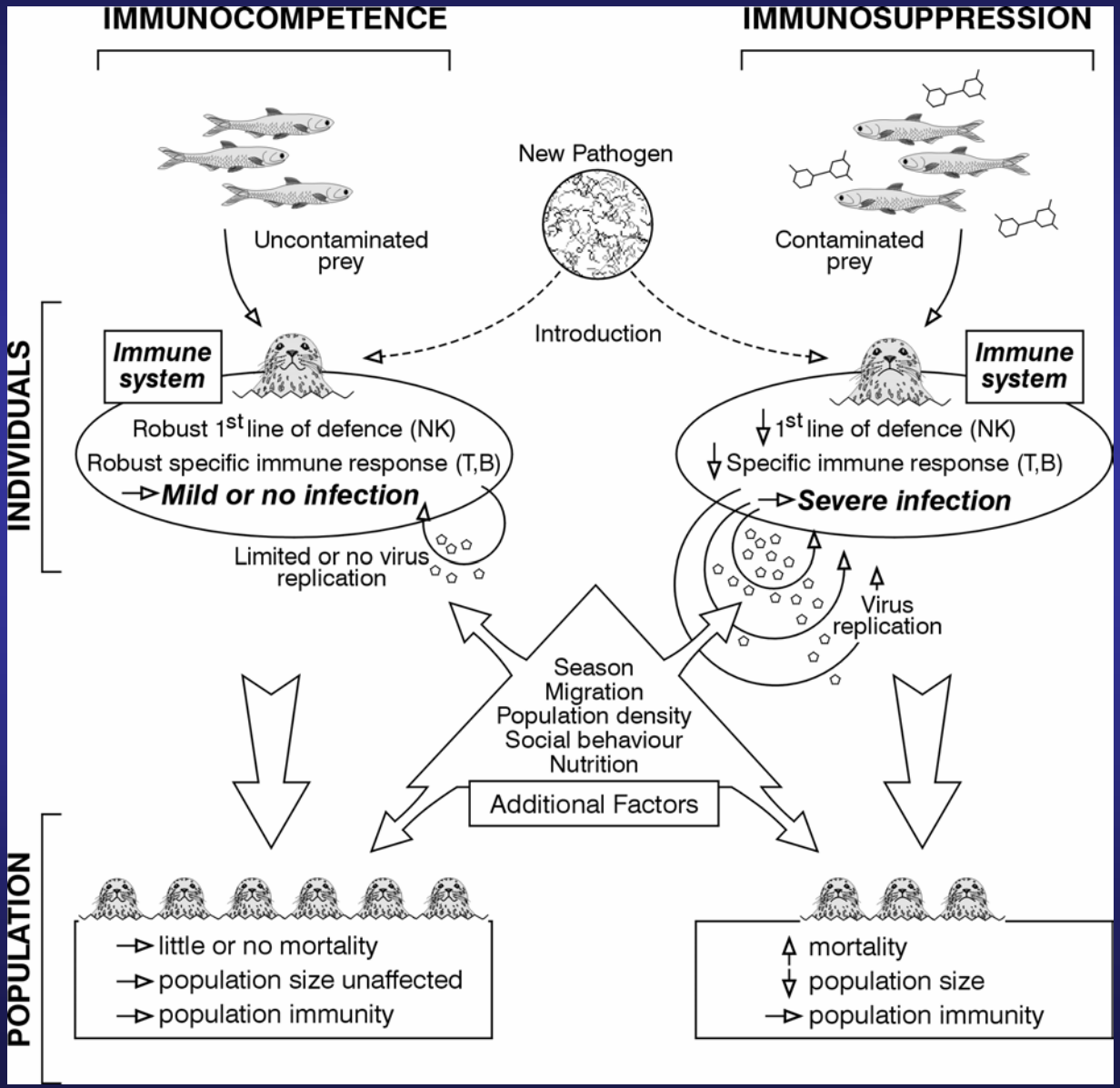
A health threat to contaminated killer whales?

PCBs implicated in adverse health effects in seals

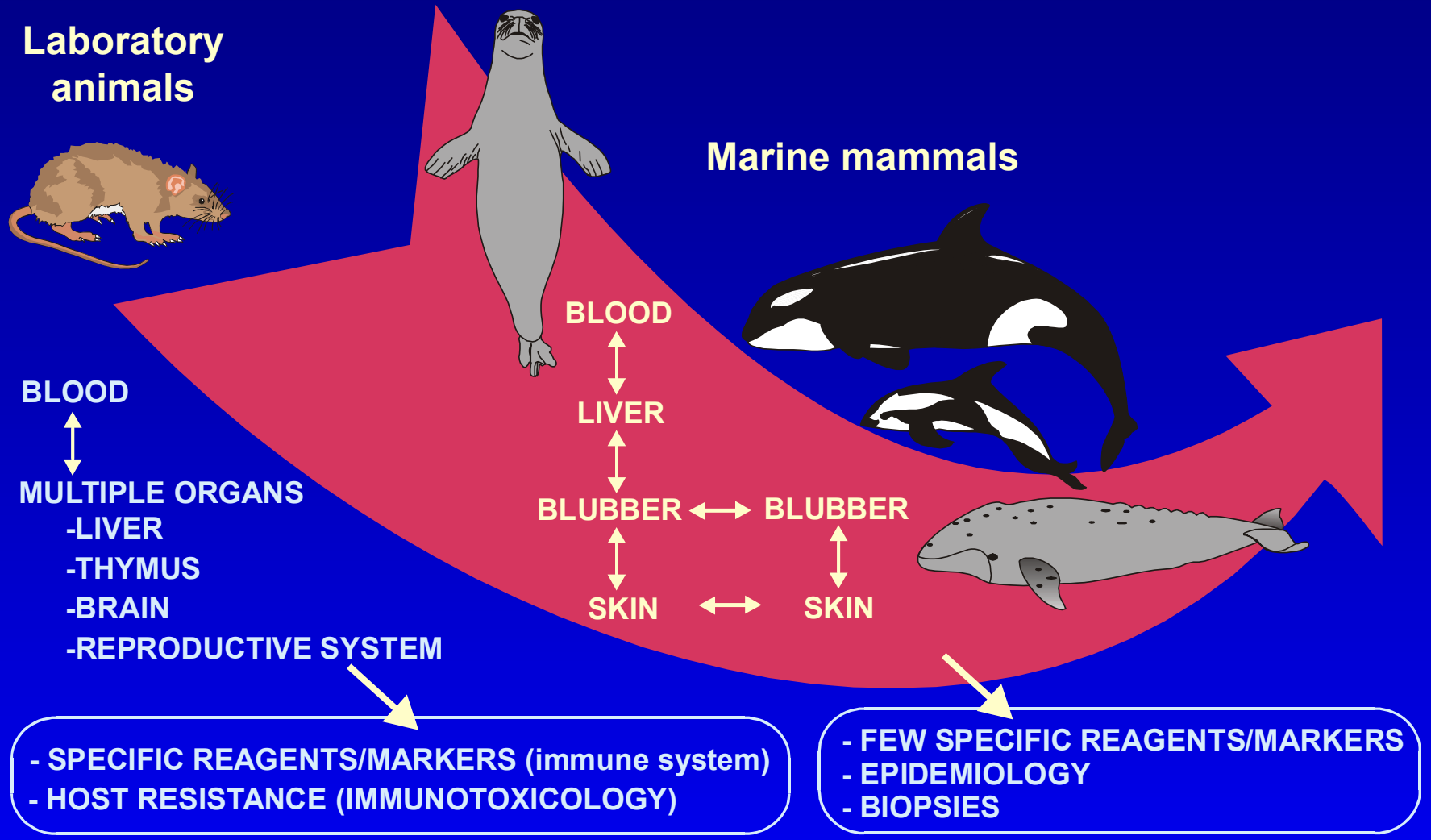
- Field studies have implicated environmental contaminants in *reproductive impairment, skeletal malformations, and disease outbreaks* in harbour, grey and ringed seals, and California sea lions.

- Captive feeding studies have established a link between the consumption of contaminated fish and *i) reproductive impairment; ii) immunotoxicity; and iii) endocrine disruption*.

Many POPs are immunotoxic, and may lead to population-level consequences in highly exposed marine mammals



Toxicology: a question of rats vs seals vs killer whales



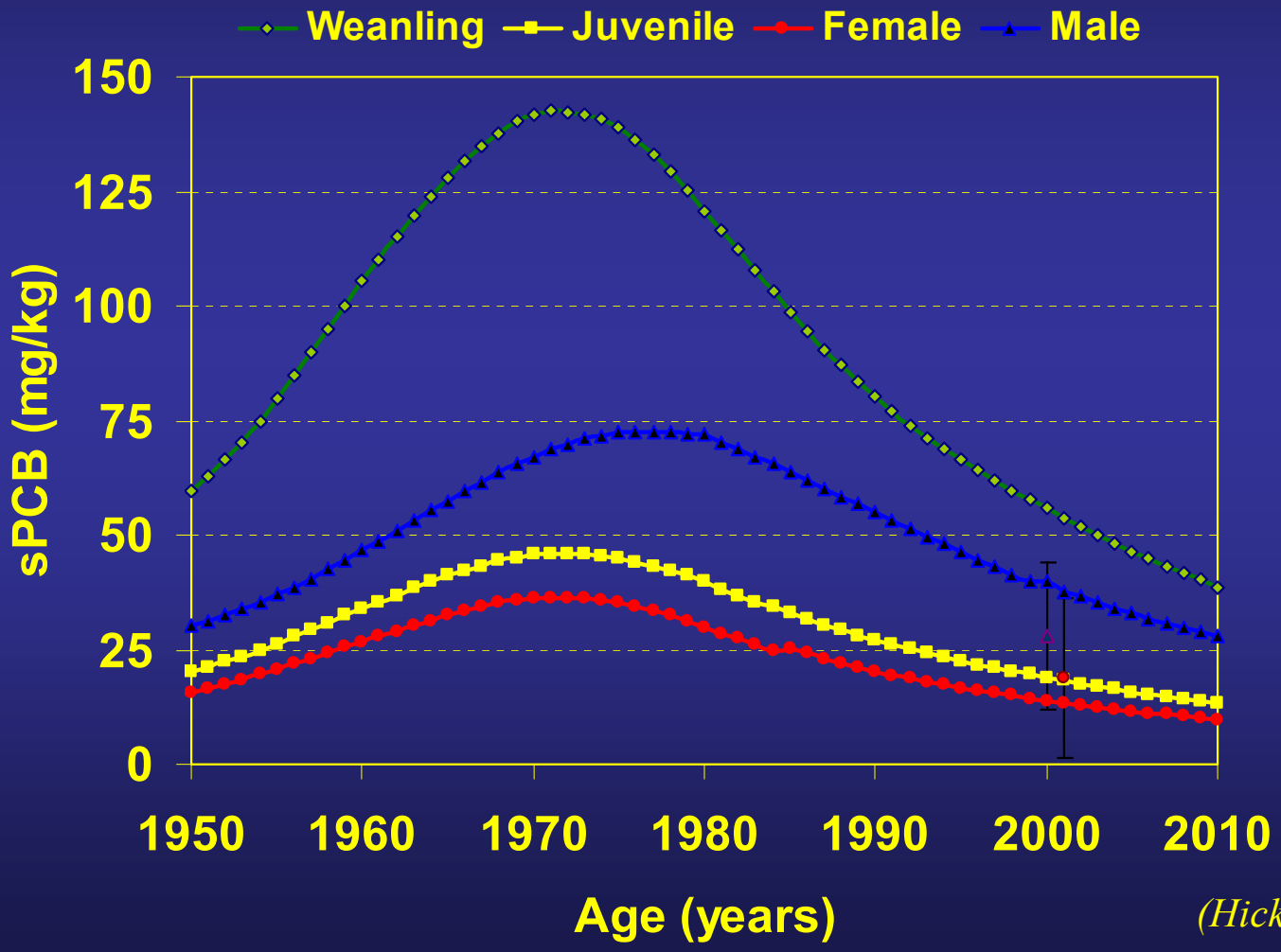
Killer whales are vulnerable to accumulating high levels of POPs from a variety of sources.

Resident killer whales:

- are long-lived;
- occupy a high position in marine food chains;
- are unable to metabolize some contaminants;
- have large habitat requirements for themselves and their prey;
- are exposed to both ‘local’ and ‘global’ sources of contaminants.

Models predict that PCB levels have dropped in killer whales

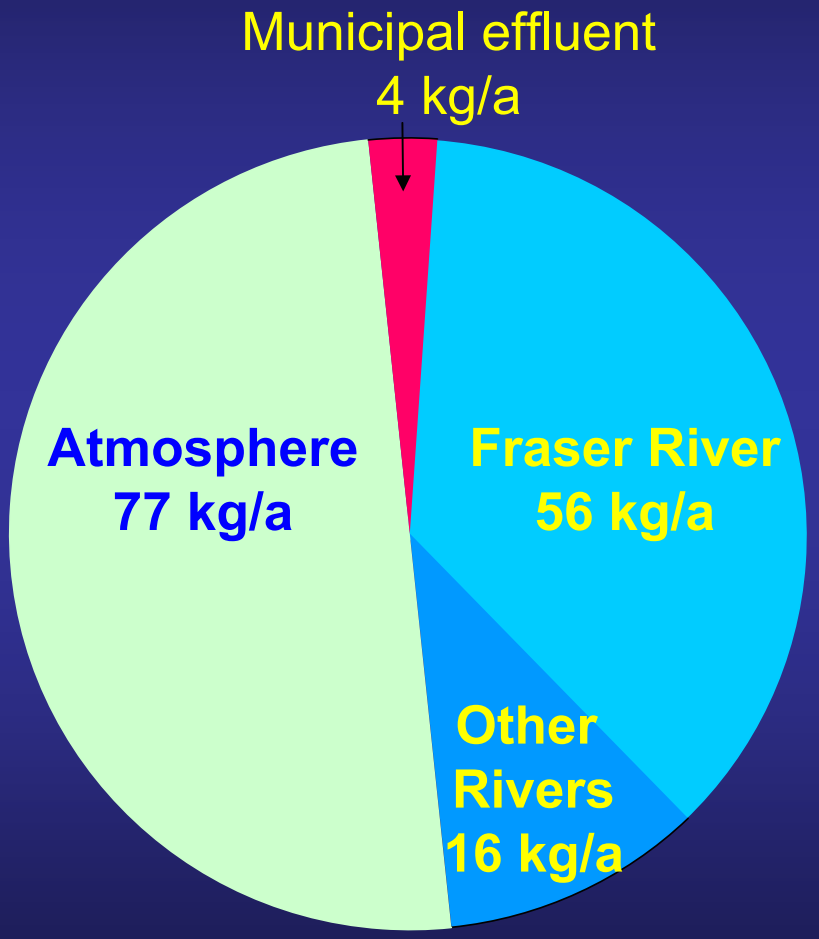
Killer whale life history, Chinook salmon and sediment cores



(Hickie al. 2003)

Point sources: PCB inputs to the Strait of Georgia

Estimated total: 153 kg/a



Sediment sink: 150 kg/a

(BotE model by Johannessen, Macdonald and Ross, 2002)

Marine mammal inventory:

-SR killer whales 4.7 kg
-NR killer whales 2.8 kg
-SoG seals 6.0 kg

(partly from Ross et al 2002)

Acknowledgments

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