Georgia Basin-Puget Sound Ecosystem Indicators Report

Technical Backgrounders

Contaminants in Harbour Seals

Spring 2002

Transboundary Georgia Basin-Puget Sound Working Group on Environmental Indicators

Georgia Basin Ecosystem Initiative, Environment Canada
BC Ministry of Water, Land and Air Protection
Puget Sound Water Quality Action Team
Washington State Department of Ecology
US Environmental Protection Agency

Persistent Organic Pollutants in Harbour Seals

Data Used in Persistent Organic Pollutants (POPs) Maps In Indicator Report

Contaminants in Harbour Seals - Georgia Basin and Puget Sound, 1996

Sample name or ID	X-location /coordinate	y-location /coordinate	Dioxins	Furans	PCBs	sample size
			ng/kg lipid	ng/kg lipid	mg/kg lipid	
Hornby Island	49.29'	124.39'	280	16	2.5	8
Crofton	49.3'	123.43'	407	82	1.9	10
Vancouver	49.11'	123.12'	259	16	2.9	13
Victoria	48.23'	123.29'	132	24	2.4	7
Puget Sound	47.13'	122.40'	119	10	18.1	17

Notes:

- *at all sites, blubber biopsy samples were taken from 4-6 week old free-ranging harbour seals pups in good condition.*
- *sample sites pooled for Vancouver owing to sample size. As a result, location reflects site where most samples were obtained, while extra samples were collected in adjacent areas (nearby).*
- *HRGC/HRMS used for congener-specific determination of PCBs, PCDDs and PCDFs. Data here represent sum of all PCDD and PCDF congeners; and the sum of all PCB congeners that were detected in at least 70% of samples.*

Annotated Reference List for Material Provided in Indicator Report

1. Calambokidis,J., Jeffries,S.J., Ross,P.S., and Ikonomou,M.G. 1999. Final Report: Temporal trends in contaminants in Puget Sound harbor seals. USEPA and Puget Sound Water Quality Action Team, Olympia.

   This is a summary of temporal trend information on contaminant levels in Puget Sound harbour seals from 1972 to 1996. This report summarizes congener specific data for PCBs, PCDDs and PCDFs for samples analyzed in 1984, 1990, 1994 and 1996/97, and integrates these with less comprehensive data from the 1970s.

2. Calambokidis, J., Peard, J., Steiger, G. H., Cubbage, J. C., and Delong, R. L. Chemical contaminants in marine mammals from Washington State. NOAA Technical Memorandum NOS OMS 6. 1984.

This report provides a summary of contaminant data generated from the early analysis of harbour seal samples (primarily the 1970s), and highlights the very high levels found in the early years.

3. Ross,P.S. 2000. Marine mammals as sentinels in ecological risk assessment. HERA **6**: 29-46.

   This scientific article highlights the "sentinel" role that marine mammals play in integrating contaminant information from the environment. The various factors that affect contaminant levels in marine mammals, and the links between contaminants and adverse health effects, are described.

4. Ross,P.S., De Swart,R.L., Addison,R.F., Van Loveren,H., Vos,J.G., and Osterhaus,A.D.M.E. 1996. Contaminant-induced immunotoxicity in harbour seals: wildlife at risk? Toxicology **112**: 157-169.

   This article reviews the health effects (toxicities) of Persistent Organic Pollutants (POPs) in marine mammals, and describes the role that such chemicals may have played in facilitating outbreaks of disease and mass mortalities among marine mammal populations around the world.

5. Ross,P.S., Ellis,G.M., Ikonomou,M.G., Barrett-Lennard,L.G., and Addison,R.F. 2000a. High PCB concentrations in free-ranging Pacific killer whales, *Orcinus orca*: effects of age, sex and dietary preference. Mar.Pollut.Bull. **40**: 504-515.

   This article describes the discovery that killer whales off the coast of BC and Washington are the most contaminated marine mammals in the world, surpassing the endangered Beluga whales of the St Lawrence estuary by two to three times. This study combined the unique knowledge of individuals (photo identification catalogue) in this population with minimally-invasive sampling techniques (small biopsy darts) and comprehensive, congener-specific chemical analysis for maximal power of interpretation.

6. Ross,P.S., Jeffries,S., Yunker,M., Ikonomou,M., and Calambokidis,J. 2001. Levels and patterns of congener-specific PCBs, PCDDs and PCDFs in young, healthy harbour seals (*Phoca vitulina*) from coastal British Columbia, Canada, and Washington State, USA. in preparation.

   This article is being submitted to a journal for publication, and details the levels of three important POP classes in harbour seals of BC and Washington. This largely spatial overview provides congener-specific contaminant information generated from biopsy samples collected from young, healthy and free-ranging seals from several sites. PCBs were found to be a continued problem in Puget Sound, while PCDDs and PCDFs were evident in seals from the Strait of Georgia.

7. Ross, P. S., Jeffries, S. J., Ikonomou, M. G., and Addison, R. F. Elevated PCB levels in Puget Sound harbor seals (*Phoca vitulina*). Puget Sound Research '98. 1998.

   This paper (available online) describes the initial findings on spatial and temporal trends in POP levels in Puget Sound harbour seals, based on collaborations with Steve Jeffries (WDFW) and John Calambokidis (Cascadia Research).

8. Ross,P.S., Vos,J.G., Birnbaum,L.S., and Osterhaus,A.D.M.E. 2000b. PCBs are a health risk for humans and wildlife. Science **289**: 1878-1879.

   This article highlights some of the evidence and some of the controversies associated with the population-level effects of POPs on wildlife and humans.

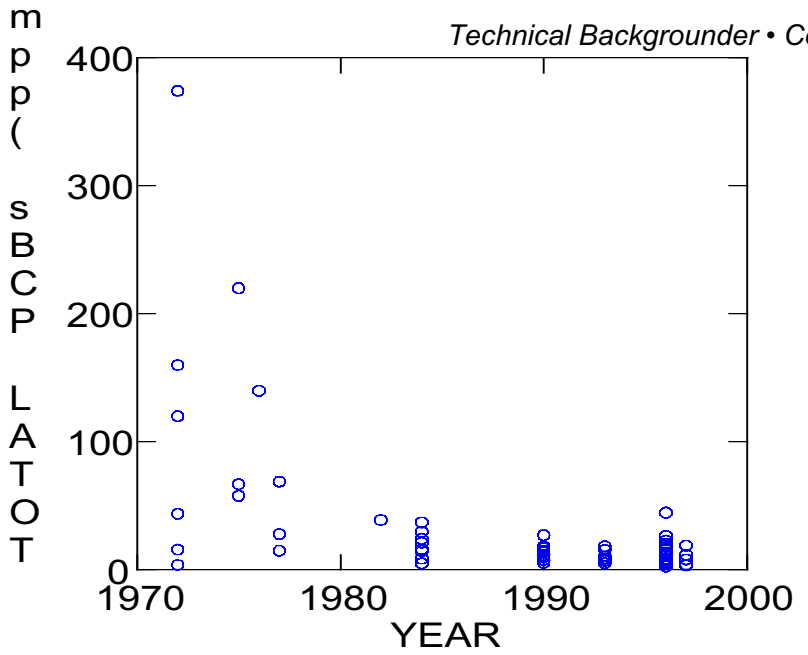
9. Simms,W., Jeffries,S.J., Ikonomou,M.G., and Ross,P.S. 2000. Contaminant-related disruption of vitamin A dynamics in free-ranging harbor seal (*Phoca vitulina*) pups from British Columbia, Canada and Washington State, USA. Environ.Toxicol.Chem. **19(11)**: 2844-2849.

   This article provides the first direct evidence that current levels of POPs (probably PCBs) are affecting harbour seals in BC and Washington. The authors document the disruption of vitamin A levels in free-ranging harbour seals as a consequence of contaminant exposure. This “dietary hormone”, shown in other studies to be sensitive to the effects of PCBs, is essential to the health of animals. Vitamin A is vital to numerous processes, including growth and development, reproduction, immune function and vision.

Further information: Peter S. Ross at [rosspe@pac.dfo-mpo.gc.ca]

Supplemental Data on Total PCBs in Puget Sound Harbour Seals

Temporal trend data exist for polychlorinated biphenyl (PCB), -dibenzo-*p*-dioxins (PCDDs) and –dibenzofurans (PCDFs), as well as the organochlorine pesticides for harbour seal blubber samples collected at approximately five year intervals from Gertrude Island in south Puget Sound between 1972 and 1997 (Calambokidis *et al.* 1999). Spatial trend data exist for PCBs, PCDDs and PCDFs for sites ranging from south Puget Sound (Gertrude Island and Smith Island) through the Strait of Georgia (Victoria, Vancouver, Crofton, Nanaimo, Hornby Island) and into Queen Charlotte Sound (Ross *et al.* 2001;Simms *et al.* 2000), largely reflecting the recent interest in marine mammal-contaminant research of Fisheries and Oceans Canada. There are no data for organochlorine pesticides in British Columbia harbour seals. Temporal trend information reflects the studies in Washington State, while a spatial context has been generated from work in both Washington and British Columbia.



Plot of total PCBs in blubber of Puget Sound pups from 1972 to 1997. Includes both the samples analyzed in the current study and additional data points from past studies (Calambokidis et al. 1978, 1984, 1991 and Arndt 1973).

Calambokidis et al. (1999) present the figure above (their Figure 2) and explain (on p. 11) that by incorporating data from past analyses they are able to "allow evaluation of a longer time series (back to the 1970s)." They justify the incorporation of the earlier data because the duplicate sample analysis by DFO's Institute of Ocean Sciences (used in the current study) and by Cascadia Research at The Evergreen State College (used in earlier studies) "showed good agreement," which suggests that "pooling these results would not strongly bias the trend analysis."

References:

Calambokidis J., S. Jeffries, P.S. Ross and M. Ikonomou. 1999. Temporal Trends in Contaminants in Puget Sound Harbor Seals. Final Report from Cascadia Research Collective (Olympia, Washington) to the U.S. Environmental Protection Agency and the Puget Sound Water Quality Action Team. December 1999.

Ross, P.S., M. Ikonomou, R. Addison. 1998. Elevated PCB Levels in Puget Sound Harbor Seals (Phoca vitulina). Pages 723 to 729 in: Proceedings of 1998 Puget Sound Research Conference. Puget Sound Water Quality Action Team. Olympia, Washington. http://www.wa.gov/puget_sound/Publications/98_proceedings/sessions/toxic_effects.html

Puget Sound Water Quality Action Team. 2000. 2000 Puget Sound Update. http://www.wa.gov/puget_sound/Publications/update_pdf/Intro_PG.html (click on toxic contaminants, see discussion of results on p. 66)