CONTAMINANTS AND BIOLOGICAL MEASUREMENTS IN MINK (*Mustela vison*) AND RIVER OTTER (*Lontra canadensis*)

Lee Harding and **John Elliott**
Pacific Wildlife Research Centre, Canadian Wildlife Service, RR#1 5421 Robertson Road, Delta, B.C., Canada V4K 3N2
Craig Stephen
Department of Health Care and epidemiology, University of British Columbia, 5804 Fairview Avenue, Vancouver, British Columbia, Canada V6T 1Z3

1. Introduction

Mink (*Mustela vison*) and river otter (*Lontra canadensis*) indicate contaminant uptake from aquatic food webs because they are resident, largely piscivorous, and at or near the top of the food chain.[1] Mink are particularly sensitive to effects of PCBs and TCDD, especially in effects on reproduction.[2,3,4,5] Collections were made during 1995 to compare contaminant levels and biological measurements in the Fraser and Columbia Rivers.

2. Methods

A total of 32 otters and 26 mink carcasses were obtained from registered trappers. Collection areas were (1) upper Fraser River, (2) lower Fraser, (3) upper Columbia River, (4) Kootenay River (tributary to the Columbia) and (5) lower Columbia above the United States border. The upper Fraser River has five pulp mills, the upper Columbia is below two hydroelectric dams, the Kootenay is a timbering/ mining/ light agricultural area, and the lower Columbia is downstream from three hydroelectric dams, a large bleached kraft pulp mill, a smelter and the confluence with the Kootenay River. Composite otter samples of 6-12 individual otters from each area (except the lower Columbia where only one was obtained) were analyzed for PCDDs, PCDFs, congener-specific PCBs, non-ortho PCBs and heavy metals. Individual liver samples from two mink in each of the upper Columbia, Kootenay and lower Fraser areas were analysed initially/ individual samples of livers from each otter and 20 additional mink were submitted for metals, pesticides and PCBs, and will be reported subsequently, along with any correlations with individual biological measurements.

Each specimen was sexed, measured and weighed, and internal organs examined according to a protocol used by the US National Biological Survey[6] and a canine tooth was removed for ageing by dental cementum annuli. Individual mink and composite otter liver samples were analyzed Zenon Environmental Laboratories Ltd. (Burnaby, B.C.) for PCDD/PCDF (GC/MS), organochlorines and co-planar PCBs. QA/QC consisted of blind field duplicates, multiple standard reference samples and lab replicates.

3. Results

Chlorinated hydrocarbon results by Zenon were blank-corrected (not corrected for surrogate recoveries) and reported as μg/g wet weight except for coplanar PCBs which were reported as ng/g wet weight. In mink, PCDD and PCDF were not detected (low-res MS). Other Chlorinated organics and pesticides were low (generally lower than 0.1 μg/g) or not detected, although somewhat different patterns were seen in lower Fraser vs. Kootenay system mink. PCB 18, 28, 33, 44, 118, 153, 105, 138, 182/187, 180, 170 and 194 were detected in mink livers from both areas. PCB 70/76, 101, 87, 110 and 149 were detected in the Kootenay system, but not the lower Fraser, while PCB 156 was found in Lower Fraser Valley mink, but not in those from the Kootenay system. Within the Kootenay system, PCB 28, 33, 22, 183 and 128 where found in Slocan River mink, while mink from the Kootenay River below the Skookumchuk pulp mill had PCB 52, 70/76, 66/95, 56/60, 101, 87, 110, 149, and 146. Overall levels in total (sum of congener-specific) PCBs between the lower Fraser Valley and the Kootenay system were not different.

Non-ortho PCBs 77 and 126 were found in mink from below the Skookumchuk mill and in the Lower Fraser Valley (were they were slightly higher), but not in Slocan River mink.

OC pesticides found in mink from both the Kootenay system and the lower Fraser Valley were heptachlor epoxide, hexachlorobenzene and oxychlordane. In addition, DDE, dieldrin and endosulfan II were found in the lower Fraser Valley.

In otter liver composites, organic contaminants in the upper Fraser samples were lowest, with most congeners of PCDDs and PCDFs, as well as OC pesticides barely detectable. These were followed in generally ascending order by upper Columbia, Kootenay, and lower Fraser Valley samples. PCDDs always increased with increasing chlorination of congeners: $T_4CDD < P_5CDD < P_6CDD < P_7CDD <$ OCDD except in the lower Columbia, where T_4CDD was a bit higher than P_5CDD and about the same as P_6CDD. In the lower Fraser OCDD was about 4,500 pg/g lipid wt., and the lower chlorinated congeners proportionately elevated, compared to the Kootenay composite at about 750 pg/g and the other areas less than 500 pg/g. lipid wt. In wet weight terms, the OCDD levels were about 180 pg/g in the lower Fraser, 30 pg/g in the Kootenay and 17 pg/g in the lower Columbia. Non-ortho PCBs were, however, much higher in the Kootenay (over 2,500 pg/g lipid weight for PCB 169, the highest), followed by the lower Columbia, upper Columbia and lower Fraser valley (about 300 pg/g lipid wt.). This pattern suggests widespread contamination from wood preservation and wood protection compounds, which have been more tightly regulated since the late 1980s, particularly in the lower Fraser River, which has been observed in other wildlife samples.[7)] There is also a hint of residual kraft pulp mill contamination in the lower Columbia, following elimination of PCDDs and PCDFs from effluents around 1990.

Congener-specific PCBs were highest in the lower Columbia, followed by Kootenay and lower Fraser; main peaks were 153, 138 and 180 in all three; 170 was also elevated in the lower Fraser and lower Columbia, but absent in the Kootenay. The proliferation of power dams on the Columbia system is a likely source as suggested previously to account for PCBs in osprey eggs.[8)] DDE was surprisingly high in the Kootenay composite (about 0.10 μg/g wet wt.), possibly because of the long history (for B.C.) of fruit orchard farming. The only other pesticides detected, mainly in lower Columbia and Kootenay composites in trace amounts, were endosulfan sulfate, hexachlorobenzene, trans-nonachlor and oxychlordane. The higher levels of higher chlorinated PCDDs and H_7CDF in the lower Fraser is typical of the levels measured in Bald Eagles (*Haliaeetus leucocephalus*) in the same area, and the much higher PCB levels in the Columbia is also supported by our osprey (*Pandion haliaetus*) data for the same areas.[9]

Few gross abnormalities were observed in the otters examined, and most specimens were in good body condition, although some had no fat. One individual had a few parasites (nematodes). One female had an enlarged spleen and no fat. A male had a missing kidney and an undescended testis. Another had no testes and a small, bent baculum. These abnormalities occurred in areas of both high and low contamination. Neither baculum length nor weight in males were significantly correlated with total body length in otters (Figure right), although a non-linear increase in both measurements relative to age is obvious in the data. Total body length was significantly correlated with weight in female otters, but not significantly so in males. Otter baculum length and testis weight were related non-linearly. In mink, there was no relationship between baculum weight and total length, mainly because most male mink were about the same size. No other obvious signs of reproductive impairment were observed in males or females of either species. One female otter had two foetuses. Henny et al.[10] found strong correlations between a number of contaminants, especially PCBs, and reproductivity abnormalities including smaller testes and bacula in juvenile and yearling river otters from the American portion of the Columbia. When chemical analytical results of individual livers and results of ageing by dentition are received, the relationship, if any, between organ measurements and contaminants will be reported.

4. Conclusions

Organic and inorganic ontaminants occurred in mink and otter tissues in all five areas at low to moderately elevated levels, and could be related spatially to potential sources, including pulp mills, agriculture, hydroelectric installations, a smelter and other industry. Mustelids from the upper Fraser valley were cleanest; those from the lower Fraser, Columbia and Kootenay valleys had the highest levels. Mustelids from lower Fraser River had higher PCDDs, while those from the Columbia system had higher PCBs. Although some biological abnormalities were observed, they were not clearly related to the area of capture, and hence to the level of contamination in the regions.

5. References

1) Moul, I.E. and L.M. Nichol, 1994. Assessment of potential sentinel species for monitoring environmental contamination of the Fraser River Drainage Basin, British Columbia. Unpubl. report for Canadian Wildlife Service. 200 p.

2) Leonards, P.E.G., M.D. Smit, A.W.J.J. de Jongh and B. v. Hattum, 1994. Evaluation of dose-response relationships for the effects of PCBs on the reproduction of mink (*Mustela vison*). Institute for Environmental Studies and Dutch Otterstation Foundation, Netherlands.

3) Smit, M.D., P.E.G. Leonards, B.v. Hattum and A.W.J.J. de Jongh, 1994. PCBs in European otter (*Lutra lutra*). Institute for Environmental Studies and Dutch Otterstation Foundation, Netherlands.

4) Wilson, L.K., J.E. Elliott and P.E. Whitehead (1996, in press.): Chlorinated compounds in wildlife from the Fraser River Basin. Canadian Wildlife Service Tech. Report. Ser. No. 199.

5) Elliott, J.E., P.E. Whitehead, P.A. Martin, G.D. Bellward and R.J Norstrom, 1996. Persistent pulp mill pollutants in wildlife. In M.R. Servos, K.R. Munkittrick, J.H. Carey and G.J. Van der Kraak (eds.), Environmental fate and effects of pulp and paper mill effluents. St. Lucie Press, Delray Florida. p. 297-314.

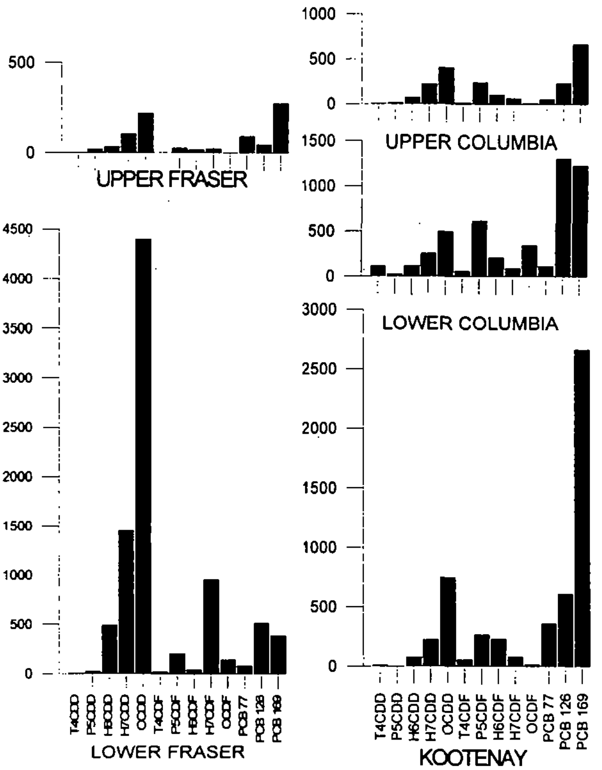
6) Henny, C.J., R.A. Grove and Olaf R. Hedstrom (1996): A field evaluation of mink and river otter on the lower Columbia River and the influence of environmental contaminants. National Biological Service, Corvalis, OR. 64 p. + Appendices.

7) Elliott, J.E., P.E. Whitehead, P.A. Martin, G.D. Bellward and R.J Norstrom, 1996. Persistent pulp mill pollutants in wildlife. In M.R. Servos, K.R. Munkittrick, J.H. Carey and G.J. Van der Kraak (eds.), Environmental fate and effects of pulp and paper mill effluents. St. Lucie Press, Delray Florida. p. 297-314.

8) Whitehead, P.E., J.E. Elliott, R.J. Norstrom, C. Steeger, J. Van Ootsdam and G.E.J. Smith, 1993. Chlorinated hydrocarbon levels in eggs of osprey nesting near pulp mills in British Columbia, Canada (extended abstract). Presented at Dioxin '93, 13th International Symposium on Chlorinated Dioxins and Related Compounds, Vienna. Vol. 12 p. 231-234.

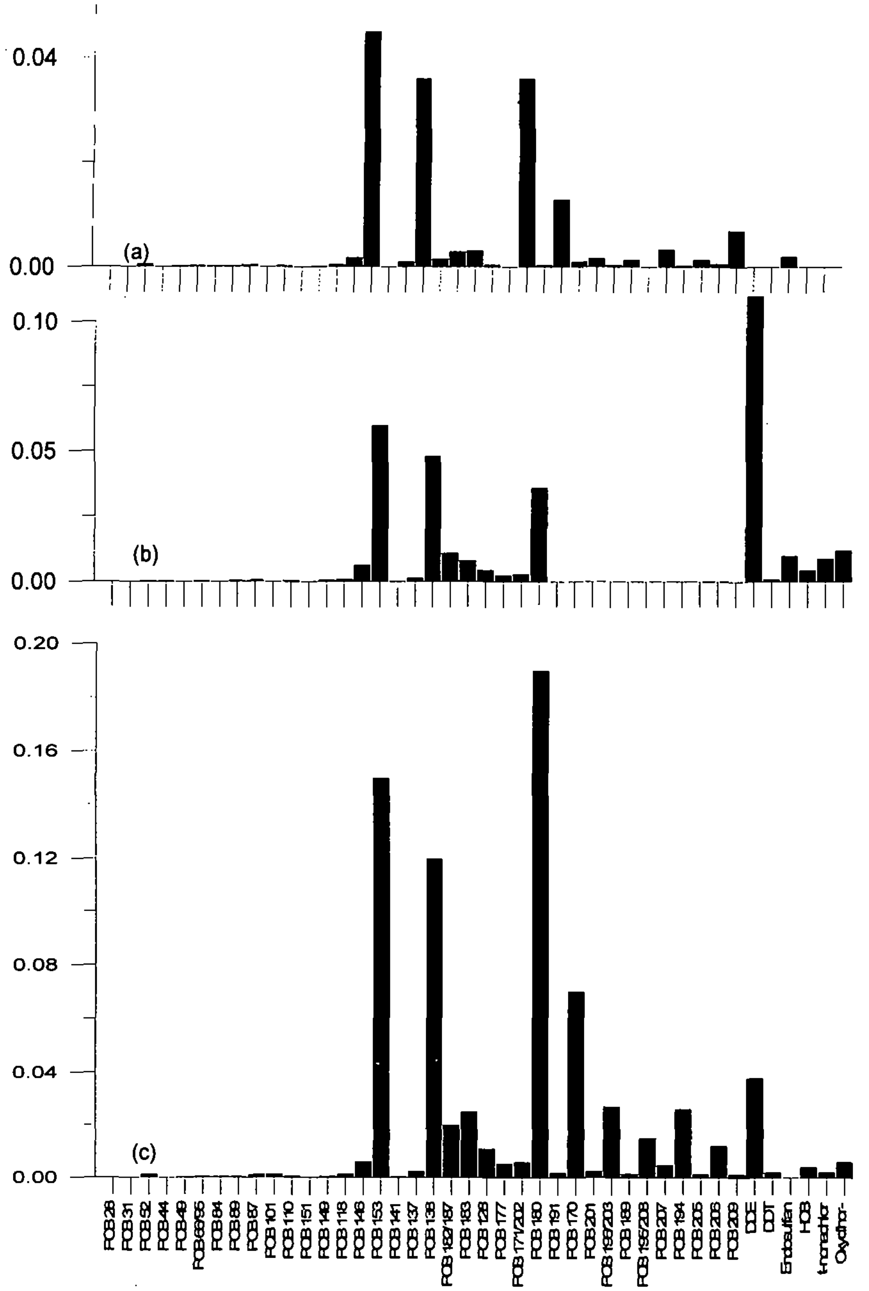
9) Elliott, J.E., P.E. Whitehead, P.A. Martin, G.D. Bellward and R.J. Norstrom, 1996. Persistent pulp mill pollutants in wildlife. M.R. Servos, K.R. Munkittrick, J. Carey and G.J. Van der Kraak (eds.), Environmental fate and effects of pulp and paper mill effluents. St. Sucie Press, Florida. p. 297-314.

10) Henny, C.J., R.A. Grove and Olaf R. Hedstrom (1996): A field evaluation of mink and river otter on the lower Columbia River and the influence of environmental contaminants. National Biological Service, Corvalis, OR. 64 p. + Appendices.

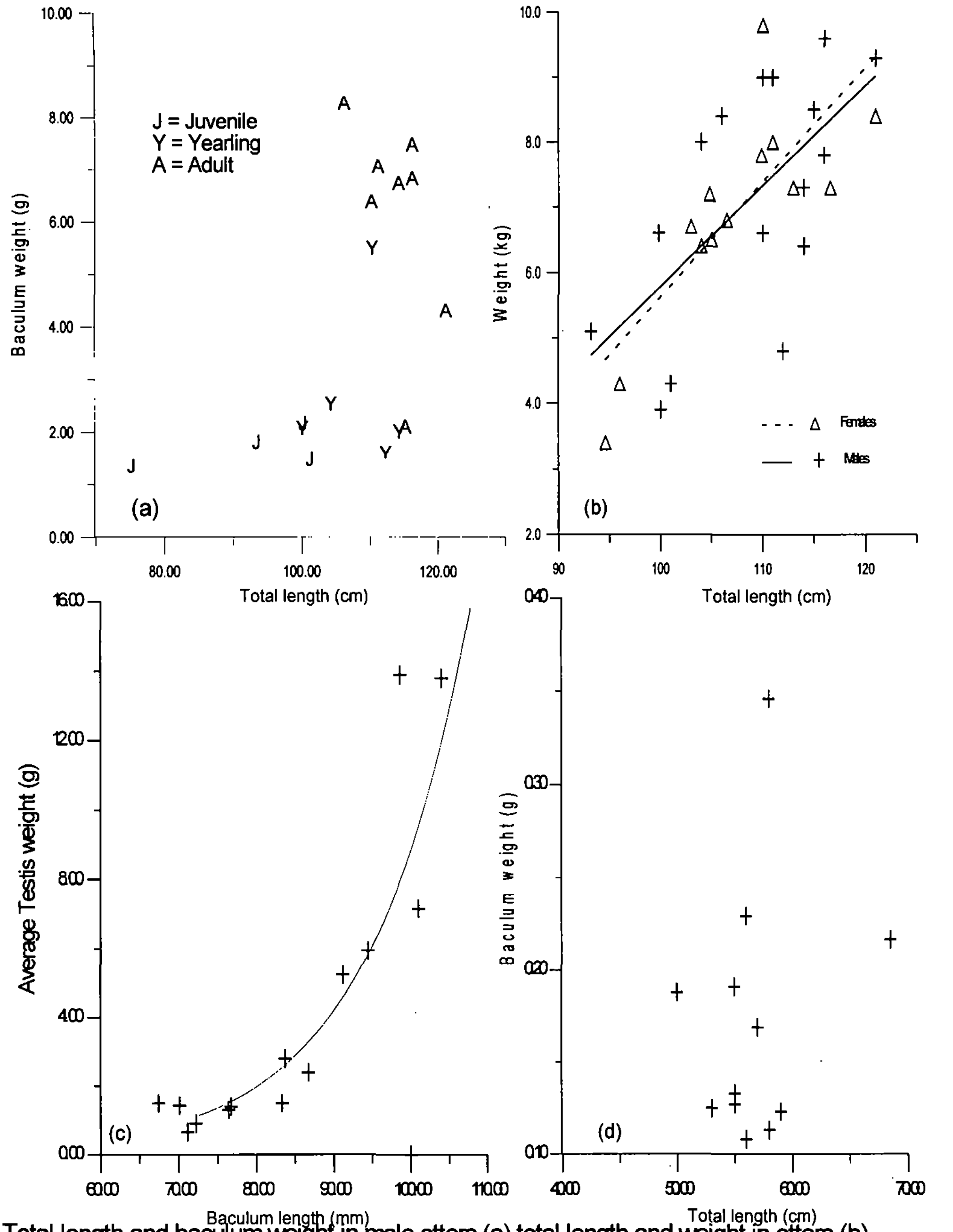


Dioxins, furans and co-planar PCB concentrations (pg/g) in river otter livers, lipid-normalized composite samples.

ECOTOX (po)



PCB and pesticide concentrations (µg/g) in river otter:
(a) Lower Fraser, (b) Kootenay and (c) Lower Columbia Rivers



Total length and baculum weight in male otters (a) total length and weight in otters (b) baculum length and testis weight in male otters (c) total length and baculum length in mink (d).