

THE OSPREY AND RIVER OTTER AS SENTINEL SPECIES FOR LONG TERM MONITORING OF PCBS ALONG THE LOWER COLUMBIA RIVER

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PCB CONTAMINANTS AND FISH-EATING OSPREY NESTING ALONG THE LOWER COLUMBIA RIVER, 1997/1998 AND 2004

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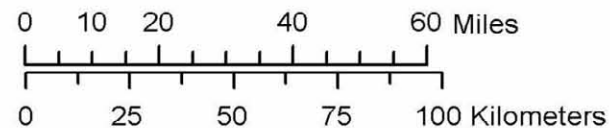
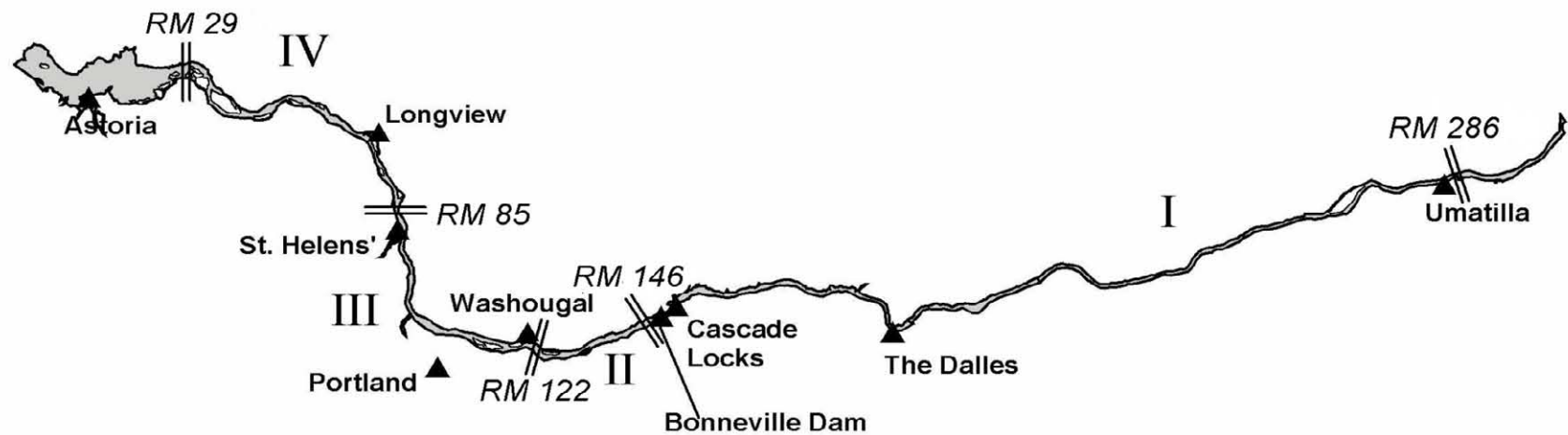
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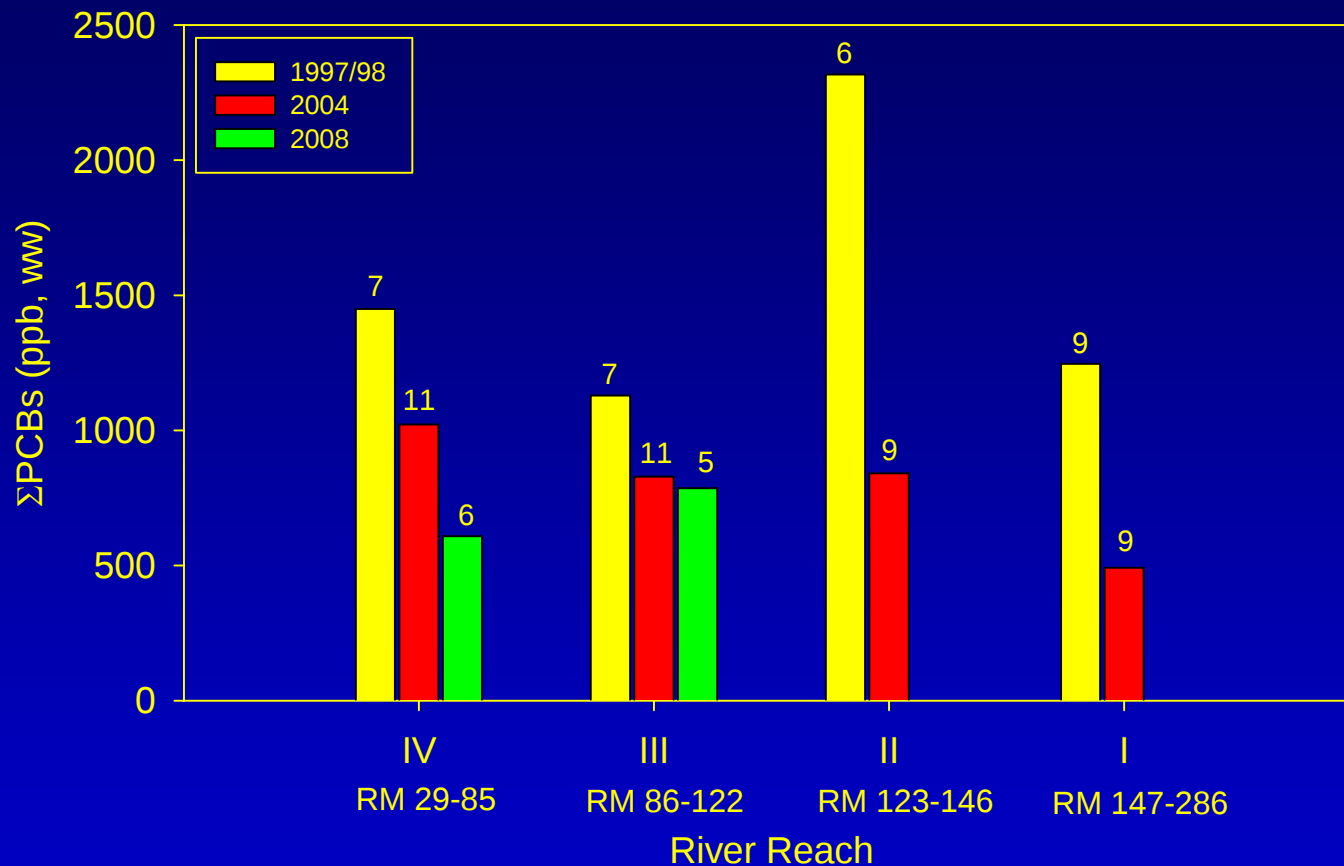


Why Select Ospreys as Sentinel Species

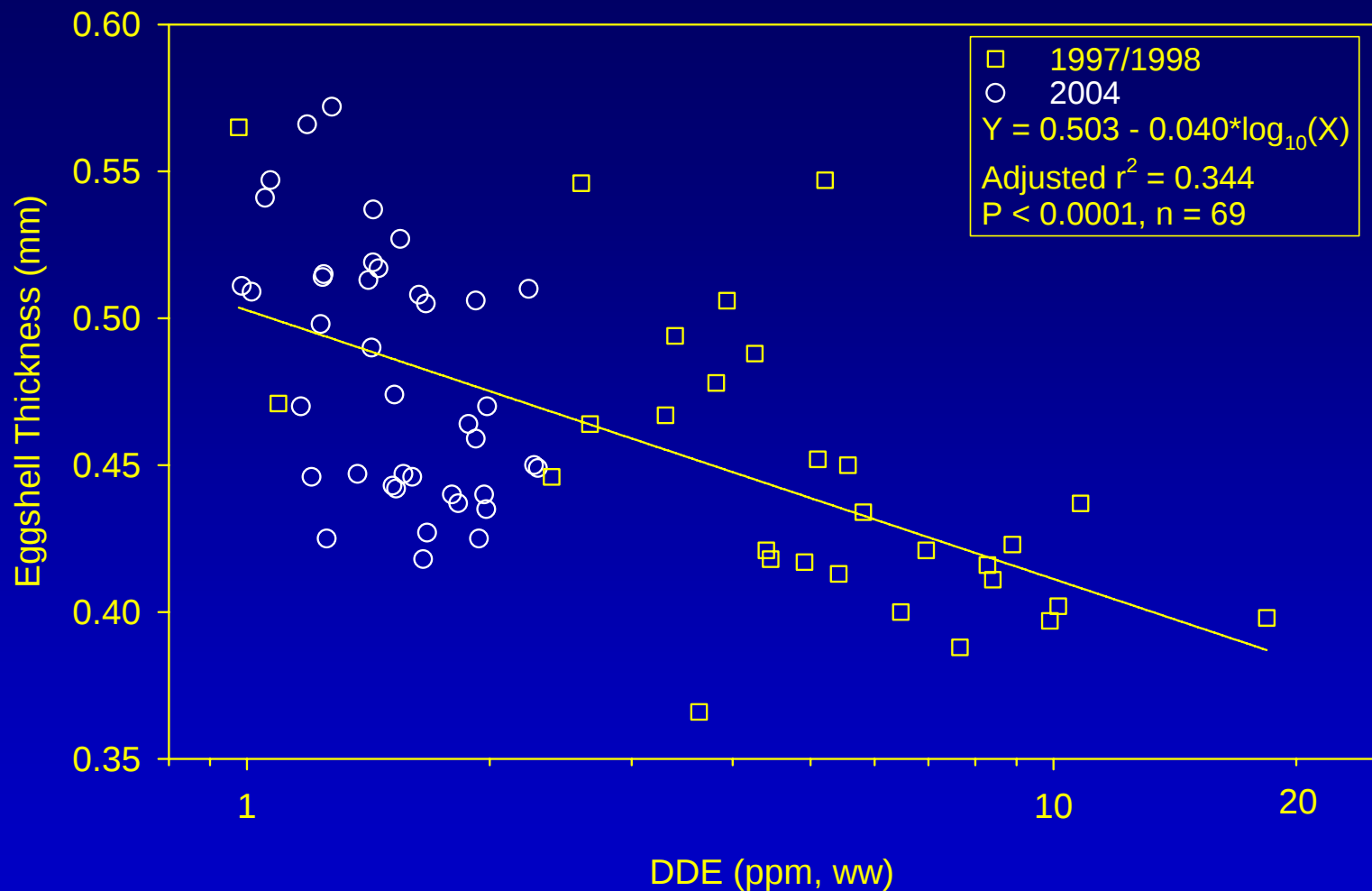


- Worldwide distribution (comparable data many locations)
- Diet almost exclusively live fish captured near the nest
- Long-lived and high nest fidelity.
- Large stick nests easily located and spaced at regular intervals along rivers
- Nests on artificial structures in urban areas with easy nest access
- Tolerates short-term nest disturbance during collection of sample egg
- Sensitive to many contaminants with “effect concentrations” known.
- Lay extra egg which is rarely fledged (sample egg collection has minimal effect)





Comparison of ΣPCB concentrations in Osprey eggs by reach and year. Numbers above bars denotes the number of eggs analyzed. ΣPCBs is the sum of congeners analyzed.



Relationship between DDE concentrations (ppm) and eggshell thickness (mm) of Osprey eggs from the Lower Columbia River, 1997/1998 and 2004.

Osprey nesting success along the Lower Columbia River, 1997/1998 and 2004.

Category	1997/1998 ^a	2004
Young/Occupied Nest ^b		
Reach I	1.47	1.86
Reach II	1.23	1.29
Reach III	1.46	1.74
Reach IV	1.79	1.37
Combined	1.54	1.59
Young/Successful Nest ^b		
Reach I	1.90	2.37
Reach II	2.24	2.27
Reach III	2.17	2.50
Reach IV	2.16	2.23
Combined	2.11	2.35

Note: The generally accepted reproductive rate necessary to maintain a stable Osprey population is 0.80 young/occupied nest.

^a From Henny et al. (2004), Raptors Worldwide.

^b Nests without and egg collected.

Osprey nesting pairs (pairs/river mile) by reach along the Lower Columbia River, 1997, 1998 and 2004.

Occupied Nests	1997	1998	2004
Reach I	21 (0.15)	24 (0.17)	57 (0.41)
Reach II	17 (0.81)	19 (0.90)	28 (1.33)
Reach III	29 (0.78)	29 (0.78)	59 (1.59)
Reach IV	27 (0.49)	31 (0.56)	81 (1.47)
Combined	94	103 (9.6%) ^a	225 (13.9%) ^b

Note: Length of Columbia Reaches: I (140 miles), II (21 miles), III (37 miles), IV (55 miles).

^a Annual rate of population increase.

^b Average annual rate of population increase.

ENVIRONMENTAL CONTAMINANTS IN MALE RIVER OTTERS FROM OREGON AND WASHINGTON, USA, 1994-1999

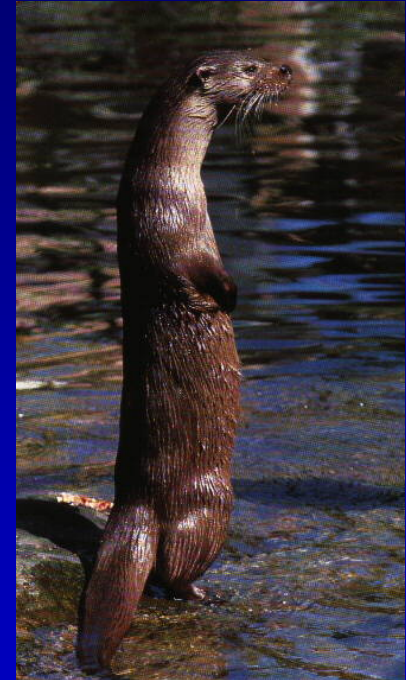
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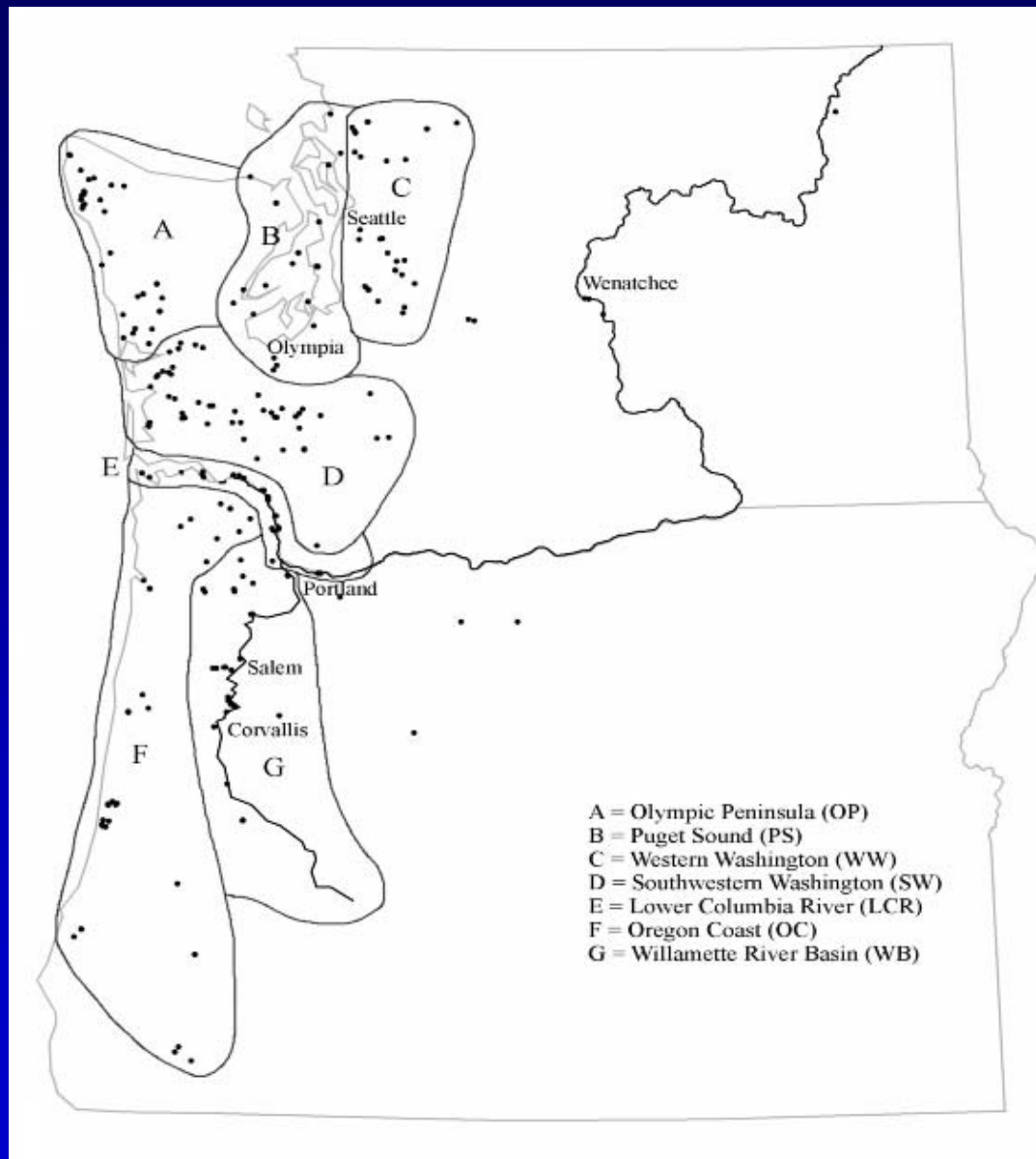
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North American River Otter (*Lontra canadensis*)

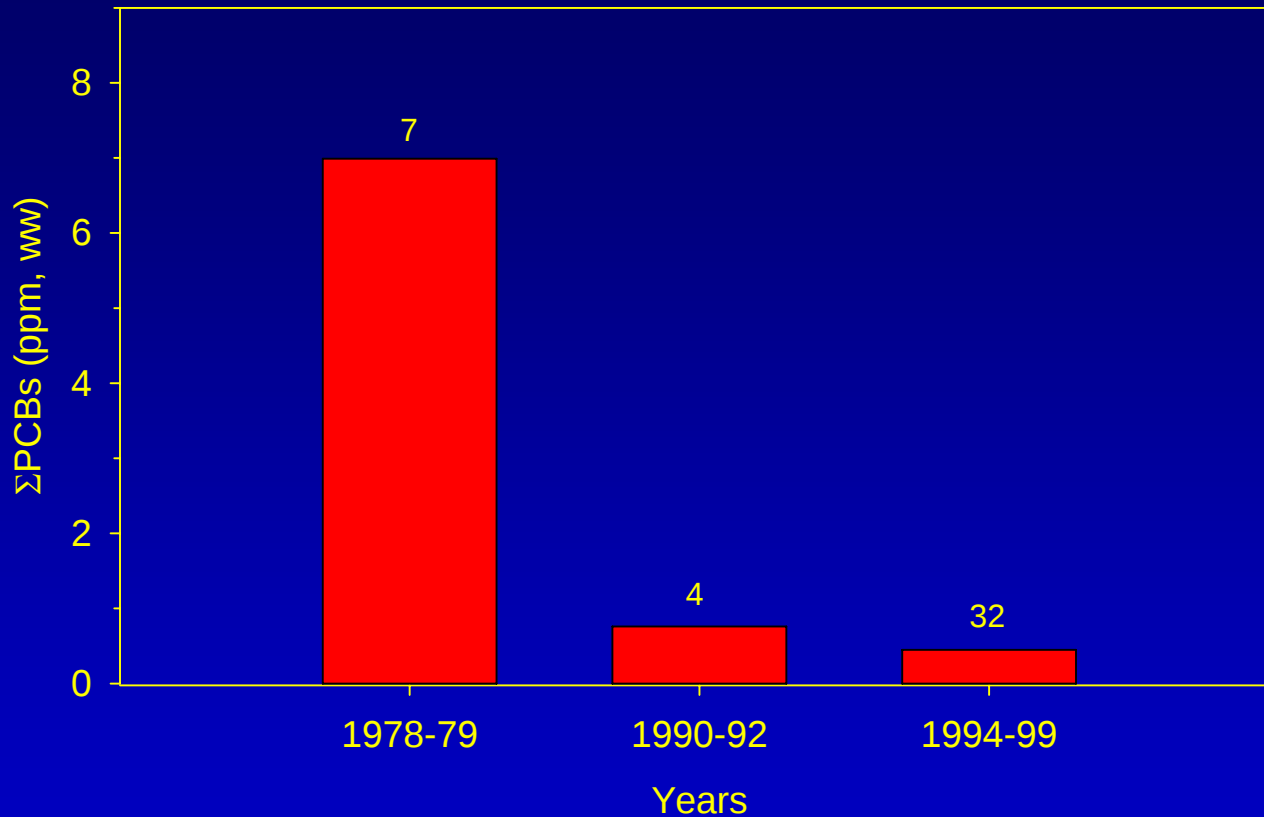
- Order – Carnivora
 - Family – Mustelidae
 - Subfamily – Lutrinae
- Top predator of most aquatic food chains
 - Adapted to a wide variety of aquatic habitats
- Differing degrees of sociality and spacing
 - Based on habitat and shelter availability
 - Food Abundance
- Home range defined by local topography
 - Extensive overlap within and among sexes
- Exhibit degrees of mutual avoidance and tolerance
 - Based on seasonal resource availability
- Diet primarily fish, but also aquatic inverts and amphibians





First River Otter and Mink Contaminant Study on the Lower Columbia River occurred in 1978-79 (Henny et al. 1981)

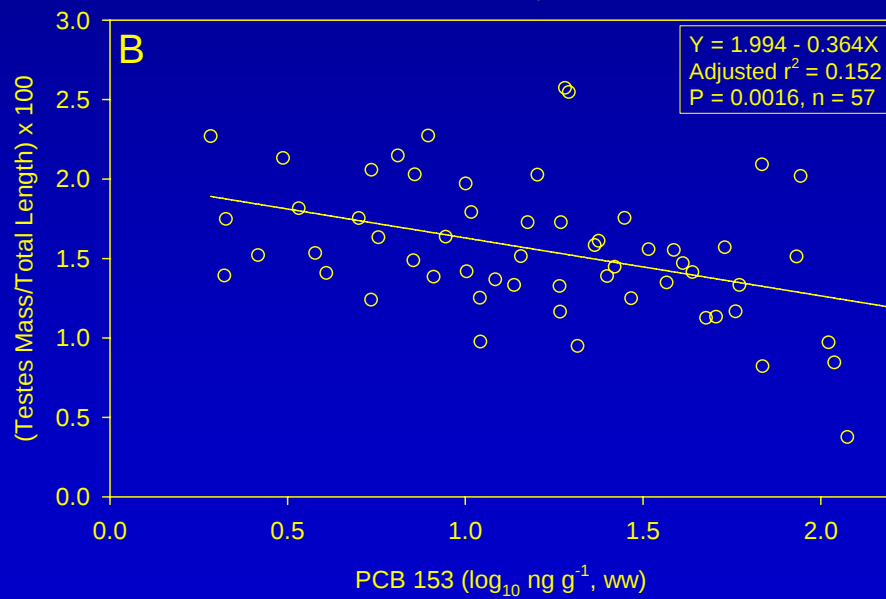
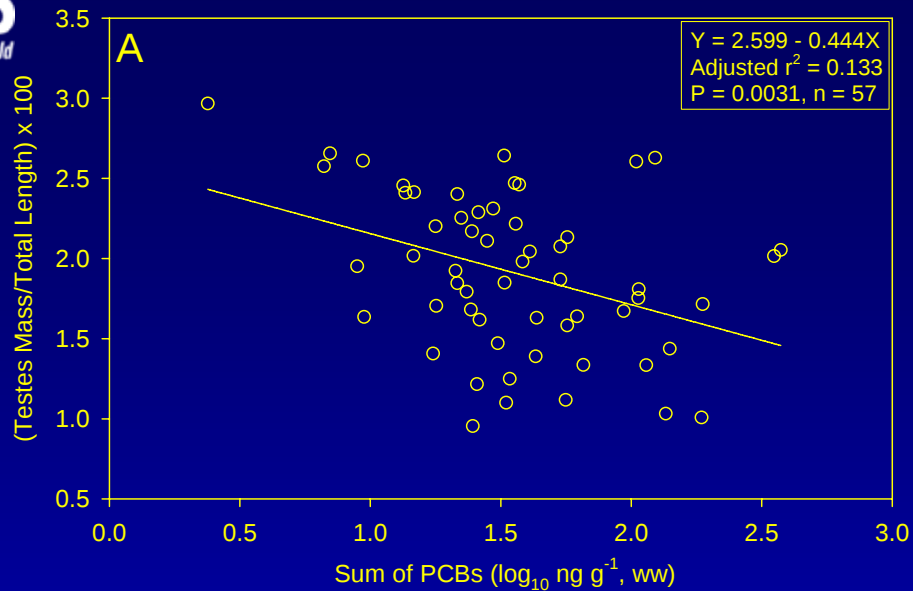
- Concerns over reported mink and river otter population declines in region
 - Declines may have been contaminant based
 - Mink are very sensitive to PCBs (possibly river otters)
- 9 mink and 7 river otters collected for contaminant analyses
- Mink liver polychlorinated biphenyls (PCBs) ranged from 0.55 to 2.1 $\mu\text{g g}^{-1}$, ww
 - Liver DDE from nd to 0.45 $\mu\text{g g}^{-1}$, ww
- River otter liver PCBs ranged from 1.7 to 23.0 $\mu\text{g g}^{-1}$, wet weight (ww)
 - Liver DDE from 0.43 to 4.8 $\mu\text{g g}^{-1}$, ww
- PCB concentrations were based on 1254:1260 Aroclor standards
- Mink reproductive failure reported in laboratory studies were at the higher concentrations found in mink from the Lower Columbia River (Aulerich and Ringer 1977)



Comparison of Σ PCB concentrations by year in livers of river otters collected from the lower Columbia River. Numbers above bars denotes the number of otters livers analyzed. Σ PCBs is the sum of PCBs analyzed.

Summer Population Survey on River Otter and Mink Along the Lower Columbia River, 1994.

- Found a relatively dense river otter population throughout the study area
 - Well distributed, including the heavily polluted portion of the river within the Portland-Vancouver area
- Few mink were found to adequately estimate the population
 - Mink population appeared extirpated, with few animals pioneering into the area
 - Mink habitat was excellent for many portions of the river sampled
 - Based on mink habitat suitability index model (USFWS)

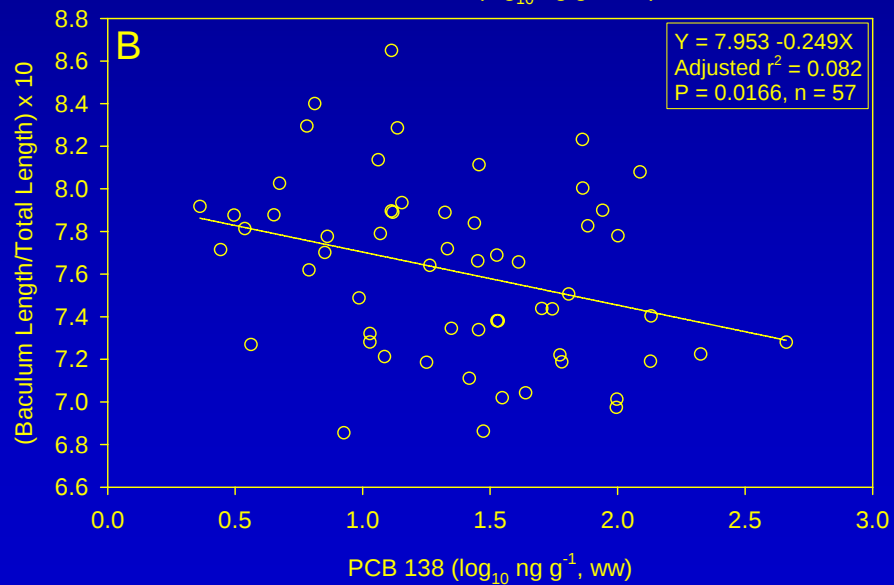
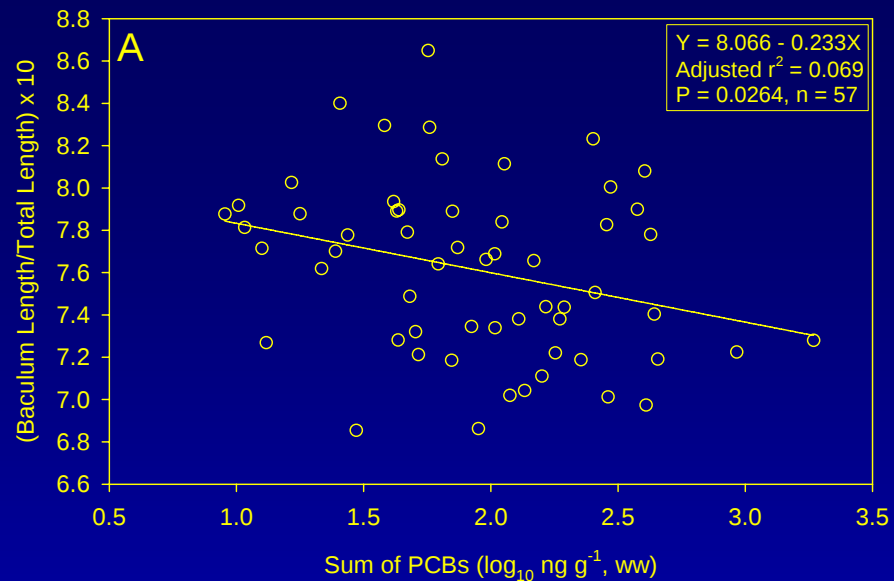


Relationship between (testes mass (g)/total body length (cm)) $\times 100$ and sum of PCBs (A) and PCB 153 (B) analyzed in livers of juvenile river otter males collected from Oregon and Washington, 1994-99.



Sertoli cell #s dictates
final testes size





Relationships between (baculum length (cm)/total body length (cm)) $\times 10$ and sum of PCBs (A) and PCB 138 (B) analyzed in livers of juvenile river otter males collected from Oregon and Washington, 1994-99.

- Few river otter male reproductive tract deformities were noted
 - Incidence of reproductive abnormalities in normal population?
- Virilization of the indifferent urogenital tract progressed normally during embryonic development.
 - No observed hypospadias, indifferent gonadal tissue, hermaphroditism or cryptorchidism
 - Initial production and action of gonadal androgens unaffected by *in utero* contaminant exposure.

- Incidence of fractured baculums (9.9%)
 - Occurred as juveniles and possibly yearlings
 - Michigan otters 1940s 4.7% fracture incidence
 - Incidence higher than found for otters in mid-1940s
 - Possible contaminant connection
 - Juveniles with fractured baculums had higher DDE and PCB concentrations, though not significant
- Mild to moderate lympho-plasmacytic interstitial epididymitis may also be contaminant related
- Impaired immune function (PCB related thymic atrophy also noted in study)

- Significant inverse relationships between hepatic concentrations of PCBs and DDE
 - With juvenile male testes mass, prostate mass and baculum length and mass
- The inverse relationships found with the adult male baculum length and mass implies
 - Reproductive organ hypoplasia observed in juvenile males is carried into adulthood as a permanent effect.
- The effects were not overly conspicuous, but subtle, except at the highest concentrations

