Population Survey of Organochlorine Contaminants in Steller Sea Lions

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ABSTRACT

Scats (feces) from Steller sea lions (SSL) (*Eumetopias jubatus*) were collected on 21 rookeries over 4 years (1998-2001) to assess exposure of SSL to selected organochlorine (OC) contaminants (e.g., dioxin-like PCBs, DDTs) in the thriving eastern stock in Southeast Alaska/British Columbia (SE) as compared to the depleted western stock in Gulf of Alaska (GOA) and eastern Aleutian Islands (EAI). Concentrations of OCs in scats were used as an indicator of recent exposure reflecting excretion of PCBs congeners in addition to recent dietary intake. The rank order of mean OC concentrations in scats was EAI > SE > GOA. These data suggest that exposure to the OCs is elevated in portions of the range of the declining western stock of Steller sea lions. These findings also show that scat can be used a non-invasive indicator of contaminant exposure.

METHODS

A total of 21 different rookeries were sampled over the study period between the dates of June 26th and July 4th during 1998 - 2001. Samples were collected with spatulas, wrapped in aluminum foil or Teflon® all pre-rinsed with acetone, sealed in whirl-pac® bags and frozen at –20^0 C. Ten to twelve scats per rookery were homogenized into composites prior to extraction for collections from 1998 and 2000. Mean concentrations of 3 individual scats from 4 sites added in 2001 were not included in the statistical analysis. Scats were analyzed for selected OC contaminants using high-performance liquid chromatography (HPLC) with photodiode array detection (Krahn *et al.* 1993). Lipid concentrations of all samples were determined by thin layer chromatography with flame ionization detection (Krahn *et al.* 2001).

Table 1. Mean ± SD concentrations of select PCB congeners in ng/g and TCDD toxic equivalents (TEQ) pg/g lipid weight basis in fecal composites collected on rookeries, 1998 and 2000.

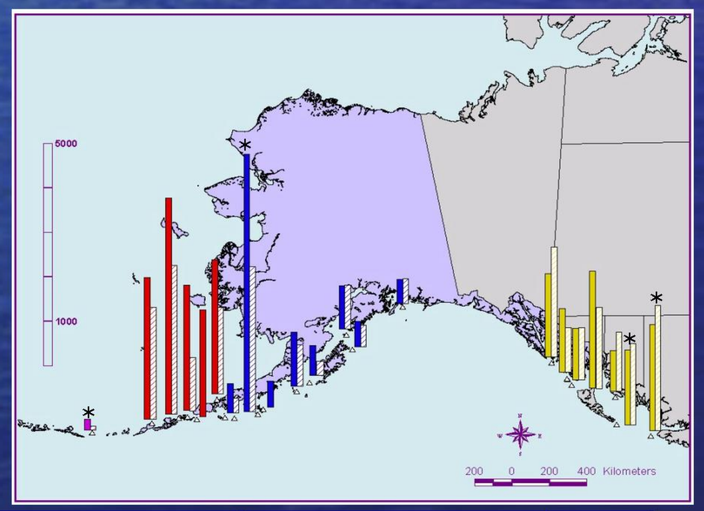
Analyte(s)	EAI *n* = 5	*p*†	GOA *n* = 8	SE *n* = 7	*p*†
PCB101/99/149/196*	860 ± 230§	<0.001	220 ± 120	420 ± 200	0.026
PCB105	100 ± 43	0.024	24 ± 24	52 ± 26	
PCB110	142 ± 78		57 ± 55	46 ± 61	
PCB118	330 ± 54	<0.001	120 ± 52	260 ± 130	0.007
PCB128	150 ± 280		nd	2 ± 26	
PCB138	290 ± 128	<0.001	73 ± 32	190 ± 110	0.003
PCB153/87	860 ± 360§	<0.001	160 ± 74	390 ± 85	<0.001
PCB170/194	38		nd	28	
PCB180	50 ± 51		120 ± 170	60 ± 70	
ΣPCBs	4,600 ± 1,300§	<0.001	1,200 ± 460	2,300 ± 820	0.003
TCDD TEQ	42 ± 10	<0.001	14 ± 6	31 ± 14	0.006
% lipid	0.80 ± 0.30		1.3 ± 0.6	1.7 ± 1.8	

*co-elution; nd all samples below detection limit; *p*† value, significantly > GOA, blank not significant; § significantly > SE, $p < 0.025$

RESULTS

We determined that SSLs from EAI had significantly higher PCB concentrations excreted in feces collected in 1998 & 2000 compared to SSLs in GOA and SE (Table 1). A similar pattern was seen as TCDDs of PCBs and mean concentrations of ΣDDT and p,p′-DDE (Table 1; Figure 1). Individual congener patterns were different between regions. Of particular note; ΣPCBs, CB-101, and CB-153 were significantly lower in SE than in EAI. Hexachlorobenzene was detected in 1 scat each from British Columbia, North Danger Rocks and Sartine Island in the SE in 2000 (17.37 and 42.5 ng/g l.w., respectively) and 1 scat from Cape Morgan in the EAI in 2001 (105.9 ng/g l.w.).

Figure 1. ΣPCB concentrations ng/g l.w. (solid bars) & ΣDDT (striped bars) in scats collected on SSL rookeries. Asterisks mark bars depicting means of 3 scats instead of composite scats, collected in 2001. Colors represent regions: Yellow=SE, Blue=GOA, Red=EAI, Pink=Central Aleutian rookery on Seguam Is.



DISCUSSION

Our findings indicate that PCBs and DDT are present, as far as west as the EAI, in the food web used by SSLs in Alaska and British Columbia, as far west as the EAI. While OC concentrations were higher in SSLs from the EAI portion of the western stock than the levels in sea lions from either the GOA portion of the western stock or the eastern stock, the contaminant levels in SSLs from the eastern stock were higher than those in animals from the GOA. These data suggest that exposure to the OCs measured in this study are most likely not the primary cause of the decline of SSL in certain portions of the western stock (e.g., GOA).

The relatively high OC concentrations we found at the EAI rookeries suggest either a local contaminant source or a strong influence from the Bering Sea. Dutch Harbor on Unalaska Island, located in the EAI, is one possible point source of contamination. The sediments and soils from the Dutch Harbor area contain elevated levels of PCBs and dioxins (currently up to 2,200 μg/kg as Aroclor 1260) due to the military buildup during WWII. Thus, Steller sea lions inhabiting these areas may be at increased risk of adverse effects of exposure to these contaminants.

Fecal OC levels reflect recent dietary intake, as well as excretion of PCB congeners not metabolized or retained in the body. Thus, use of fecal OCs has value as an indicator of recent OC exposure (particularly in the area where the sample was collected) and as an index to compare relative spatial and temporal exposure. It is not necessarily a reflection of the individual OC concentrations in body depot stores. This matrix, as a contaminant exposure-monitoring tool, has great promise because it can be collected without physical capture of animals, which is very expensive and potentially dangerous to both humans and sea lions. Unfortunately, this matrix is not useful in predicting the body burden of a particular individual animal.

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