

**SOCIETY FOR MARINE MAMMALOGY: SMALL GRANTS IN AID OF RESEARCH  
GRANT REPORT**

**Chemical Feeding Ecology in the California sea lion *Zalophus californianus* of the Gulf of California (Mexico), (Report: extension granted)**

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**Project summary:**

Mercury is of concern due to toxicity and biomagnification. The California sea lion (CSL) is an abundant species in the Gulf of California (GOC) and an effective sentinel of contaminant exposure. To date, only two studies have analyzed mercury concentration in the CSL from GOC, and one assessed the influence of the feeding ecology on tissue concentrations. Given the limited information available, the ecological drivers responsible for Hg exposure in CSL are not well understood, which is fundamental for conservation and management strategies. We propose to evaluate the chemical feeding ecology of mercury in the CSL of the GOC.

**Project Progress:**

Thanks to the *Small Grants in Aid of Research*, field trips were conducted to Los Islotes, where a breeding colony of the CSL resides. Samples (hair and soft tissues) from CSL pups were collected in the summer (reproductive season) of 2021 from live (hair) and deceased (hair and internal organ tissues) individuals. Total mercury concentrations ([THg]) and total selenium concentrations ([TSe]) were analyzed in the Trace Elements Research Laboratory of Texas A&M University. [THg] ranged from 1.08 to 23.24 mg kg<sup>-1</sup> dry weight (dw) (Table 1). [THg] was compared with the threshold of concern selected from the literature to assess the prevalence of exceedance (10 and 20 mg kg<sup>-1</sup> established for clinical effects in terrestrial mammals). For this, point estimates and 95% confidence intervals (CIs) for prevalence were calculated. Of the sampled pups, 20% (95% CI 8.44 – 37%) had [THg] above 10 mg kg<sup>-1</sup> dw, while only 2.86% (95% CI 0.07 – 15%) had concentrations above 20 mg kg<sup>-1</sup> dw. There were no significant differences in [THg] by sex ( $p>0.05$ ); however, females had higher concentrations than males (Fig. 1).

For selenium, concentrations ranged from 4.41 to 10.50 mg kg<sup>-1</sup> dw. Significantly higher [TSe] were observed in females than in males (Fig. 2).

To assess protection against Hg toxicosis, Se:Hg molar ratios were evaluated and found to range from 0.65-21.39. One pup had a Se:Hg molar ratio < 1, indicating inadequate protection of Se against Hg. There were no significant differences by sex, although females had a slightly higher Se:Hg molar ratio than males.

Analyses of stable isotopes of carbon and nitrogen ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) are in process. Thus, the chemical feeding ecology of CSL is still pending and expected to be completed in the first months of 2023. This information will be used to explore the influence of the trophic ecology on the tissue THg and TSe concentrations and assess the biomagnification of these elements in the CSL.

The grant from SMM was used to cover some of the field trips (boat transportation to Los Islotes breeding colony) to collect samples from CSL pups. All field trips were successful. At the present time, data analyses and a manuscript are under process. This project is part of a doctoral dissertation, which is expected to be concluded in July 2025. Thus, more samples will be collected in the following years aiming for temporal analysis.

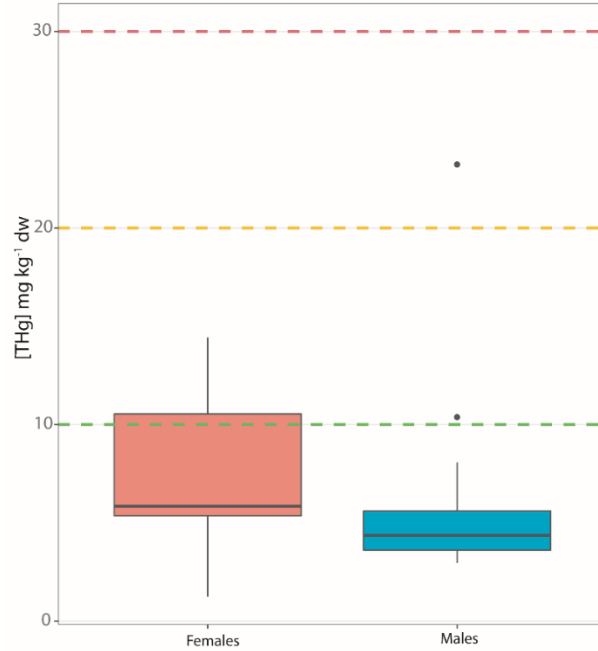


Figure 1. Total mercury concentrations ([THg]) in hair of California sea lion pups from Los Islotes, Southern Gulf of California, by sex. The dashed lines indicate the toxicological thresholds of concern for sublethal and clinical health responses from Hg in fish-eating terrestrial mammals (WHO, 1990; Basu et al., 2007; Evers et al., 2007; Dietz et al., 2011).

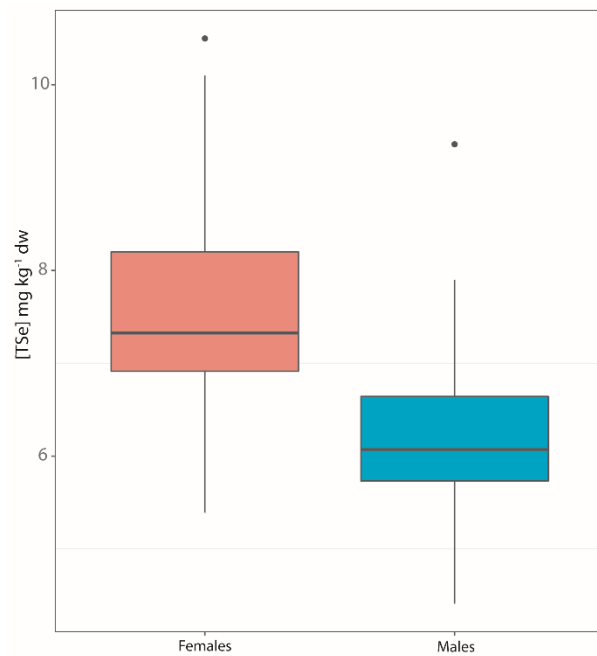


Figure 2. Total selenium concentrations ([TSe]) in hair of California sea lion pups from Los Islotes, Southern Gulf of California, by sex.

Table 2. Biometric data, median, and range of total mercury concentrations ([THg], mg kg<sup>-1</sup> dry weight) in hair of the California sea lion pups from Los Islotes, Southern Gulf of California.

	n	Total length (cm) ± SD	Weight (kg) ± SD	[THg] (mg kg <sup>-1</sup> dry weight)			[TSe] (mg kg <sup>-1</sup> dry weight)			
				Mean ± SD	Median	Range	n	Mean ± SD	Median	Range
Female pups	18	78.31 ± 7.66	12.08 ± 3.05	7.23 ± 3.77	5.85	1.08 - 14.43	18	7.65 ± 1.33	7.33	5.39-10.50
Male pups	17	82.09 ± 9.88	13.70 ± 2.70	5.99 ± 4.84	4.37	2.97 -23.24	16	6.28 ± 1.23	6.07	4.41-9.36
Total pups	35	80.15 ± 8.89	12.86 ± 2.96	6.63 ± 4.26	5.43	1.08 - 23.24	34	7.01 ± 1.44	6.75	4.41-10.50
Pup-juvenile	1	123	-	-	2.22	-	0	-	-	-

SD: standard deviation, n: Sample size.