

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

**Indicators of oxidative stress in tissues of California sea lions in select colonies of the  
Southern Gulf of California (Mexico) in relation to mercury concentrations**

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**Project summary:**

California sea lions (CSL; *Zalophus californianus*) are sentinel species. Mercury (Hg) accumulation can result in conditions of oxidative stress, while selenium (Se) exhibits a protective role. Only two studies have explored the concentrations of total Hg ([THg]) and Se ([TSe]) in CSL tissues within the Gulf of California (GC), Mexico. Lanugo and internal tissues will be collected from CSL from the GC between 2021 to 2024 and [THg], [TSe], stable isotopes, and oxidative stress indicators will be evaluated and statistically compared. This study will provide the first long-term analysis of [THg] and [TSe] in the last two decades.

**Project Progress:**

Using the funding generously granted by the *Small Grants in Aid of Research*, field trips were conducted from late May to late July of 2023, in order to collect samples from CSL that reside at Los Islotes, Mexico. Samples, including lanugo (n = 48; 24 male pups; 24 female pups) and internal tissues (heart (n = 2), brain (n = 2), liver (n = 3), kidney (n = 2), muscle (n = 5)) were collected from live (lanugo) and deceased (lanugo and internal tissues) CSL pups during the 2023 reproductive season. Morphometric (weight and total length) values and sample sizes from pups collected during the 2023 field season can be found in **Table 1**. Currently, all samples have been processed and stored pending analysis. An international laboratory exchange will take place in February 2024. During this time, the [THg] and [TSe] will be assessed in all tissues and lanugo and muscle samples will be encapsulated for the analysis of the nitrogen and carbon stable isotopes. Although these analyses are still pending, we expect preliminary results by mid-2024. The indicators of oxidative stress will be analyzed in all internal tissues in mid-2024 following the

conclusion of our final season of fieldwork. This will allow us to analyze all samples (from 2021-2024) together as a means to maximize resources. Therefore, results are expected by mid-2024.

The grant from SMM was used to cover some of the field work expenses during the 2023 field season, where all field trips were successful. As stated in the project (original grant proposal), this is a multi-year (2021-2024) investigation. Further fieldwork will take place during the 2024 field season, while results from the [THg] and [TSe] analysis using samples obtained from 2021-2022 were recently published in the journal *Marine Pollution Bulletin* (doi: [10.1016/j.marpolbul.2023.115712](https://doi.org/10.1016/j.marpolbul.2023.115712)). Results for the [TSe], [THg], stable isotopes of carbon and nitrogen, and oxidative stress indicators will be used in at least one additional manuscript. All data obtained from this investigation will be used in a doctoral dissertation (T.E. Symon) due to conclude in September 2025.

Field Code Changed

**Table 1.** Morphometric variables (average  $\pm$  standard deviation and range) and sample sizes of California sea lion pups captured at Los Islotes, Gulf of California, Mexico, during the 2023 field season.

Cohort	Sample size	Weight (kg)		Total length (cm)	
		Range	Average	Range	Average
Female pups	n = 24	4.60-13.40	10.23 $\pm$ 2.40	67.90-88.50	79.88 $\pm$ 4.74
Male pups	n = 24	8.20-15.30	12.23 $\pm$ 1.80	79.00-94.50	84.00 $\pm$ 3.93
Total pups	n = 48	4.60-15.30	11.23 $\pm$ 2.33	67.90-94.50	81.94 $\pm$ 4.79