

**SOCIETY FOR MARINE MAMMALOGY: SMALL GRANTS IN AID OF  
RESEARCH (2022)**

**PROJECT TITLE:** Persistent organic pollutant levels in Mexican Central Pacific humpback whales (*Megaptera novaeangliae*)

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ANNUAL SUMMARY REPORT

Knowing the toxicological status of humpback whales (*Megaptera novaeangliae*) that are distributed in the MCP, without a doubt has relevance in the management aspects for its conservation. Despite the fact that many of the Persistent organic pollutant (POPs) are prohibited by many countries, the oceans preserve these pollutants and continue to bioaccumulate through the food chain. Therefore, it is necessary to maintain constant monitoring of POPs concentrations in humpback whales to know the health impact on their populations and elucidate the feeding areas that present the greatest contamination risks.

In the Mexican Central Pacific, 249 samples of humpback whale blubber were collected during the 2010-2021 seasons (Figure 1), of which the concentrations of POPs such as polycyclic aromatic hydrocarbons (PAH), dienes, hexachlorocyclohexanes (HCH), endosulfans, chlordanes, heptachlor, polychlorinated biphenyls (PCB) and dichlorinated diphenyl trichloroethanes (DDT) were obtained. The group of contaminants with the highest concentration recorded were dienes with an average value of 736.128 ng/g and a maximum value of 33469.695 ng/g, while the lowest group was HCHs with an average value of 2.390 ng/g and a maximum value of 37.070 ng/g (Table 1).

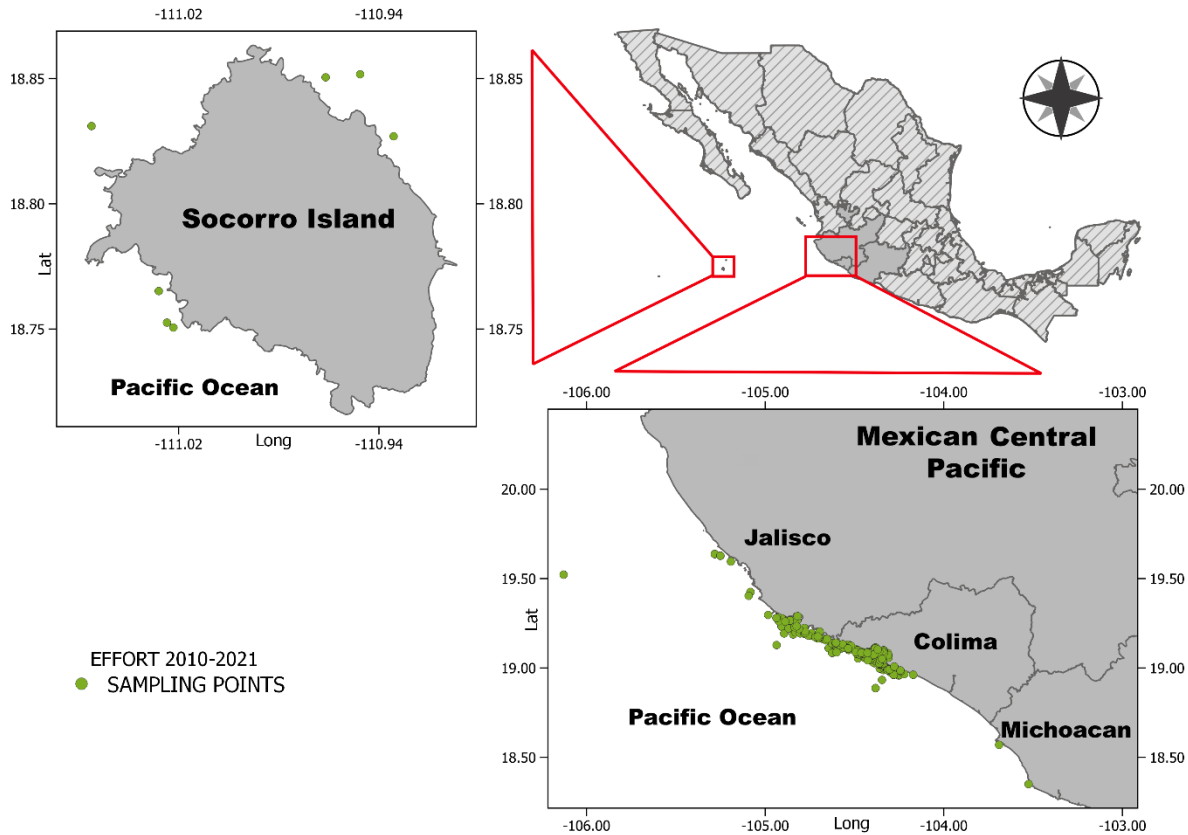


Figure 1. Central Mexican Pacific study area and sites where blubber samples were collected from humpback whales (*Megaptera novaeangliae*) during the 2010-2021 seasons.

Table 1. Descriptive statistics of Persistent Organic Pollutants (ng/g lipid base) present in blubber samples from humpback whales (*Megaptera novaeangliae*) collected in the Mexican Central Pacific during the 2010-2021 seasons. Polycyclic aromatic hydrocarbons (PAH), dichlorinated diphenyl trichloroethanes (DDT), dienes (DIEN), hexachlorocyclohexanes (HCH), polychlorinated biphenyls (PCB), endosulfans (ENDSUL), heptachlor (HEPT), and chlordanes (CHLOR).

	$\Sigma$ PAH	$\Sigma$ DDT	$\Sigma$ Dien	$\Sigma$ HCH	$\Sigma$ PCB	$\Sigma$ Endsul	$\Sigma$ Hept	$\Sigma$ Chlor
<b>Average</b>	76.424	3.097	736.128	2.390	4.774	7.612	2.633	5.563
<b>SD</b>	149.095	8.121	2424.188	5.288	13.126	28.236	5.402	12.798
<b>Min Value</b>	0	0	0	0	0	0	0	0
<b>Max Value</b>	1051.829	103.592	33469.695	37.0702	178.990	378.383	45.679	92.013

Talking about these seasons, over time the concentrations of POPs are variants, where the 2020 season had the higher concentration of POPs recorded, standing out the dienes group with the highest average of 2697.149 ng/g, and the heptachlor group with the lowest average of 1.056 ng/g; while the 2016 season registered the lowest concentration of POPs, with the dienes group presenting the highest average of 100.216 ng/g and the endosulfan group the lowest average of 0.679 ng/g (Figure 2).

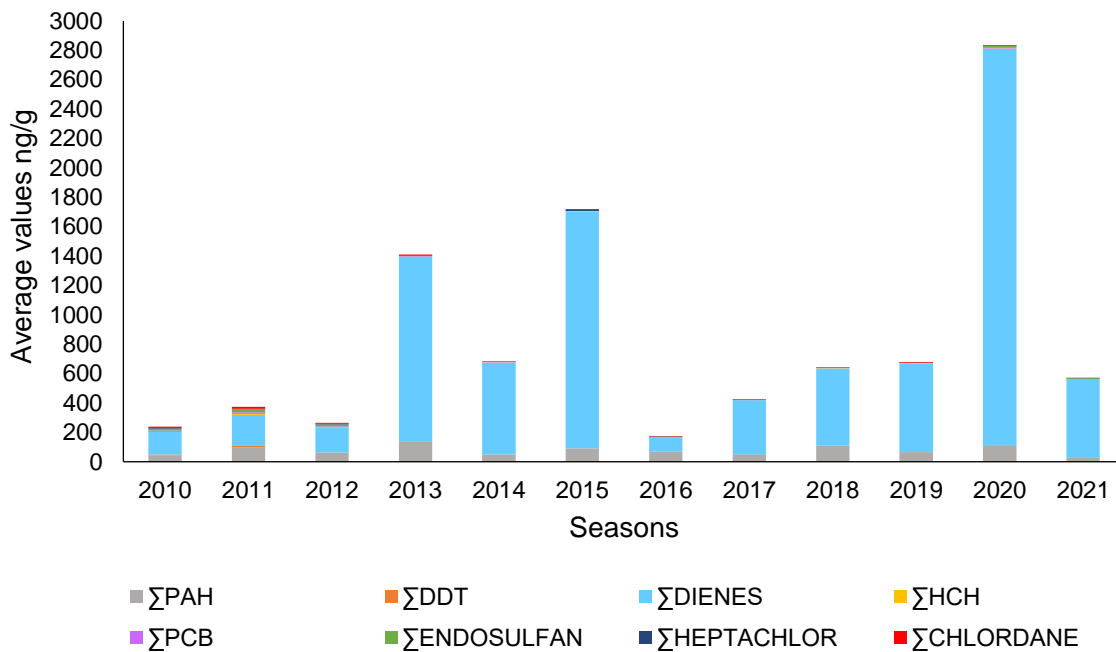


Figure 2. Concentrations of persistent organic pollutants in humpback whales (*Megaptera novaeangliae*) classified by season in the Mexican Central Pacific.

Regarding the differences by sex, it was observed that males presented higher concentrations of POPs compared to females, with the exception of the heptachlor pollutants group, where there is a slight difference, since males present an average of 2.207 ng/g while the average for females is 2.980 ng/g (Figure 3).

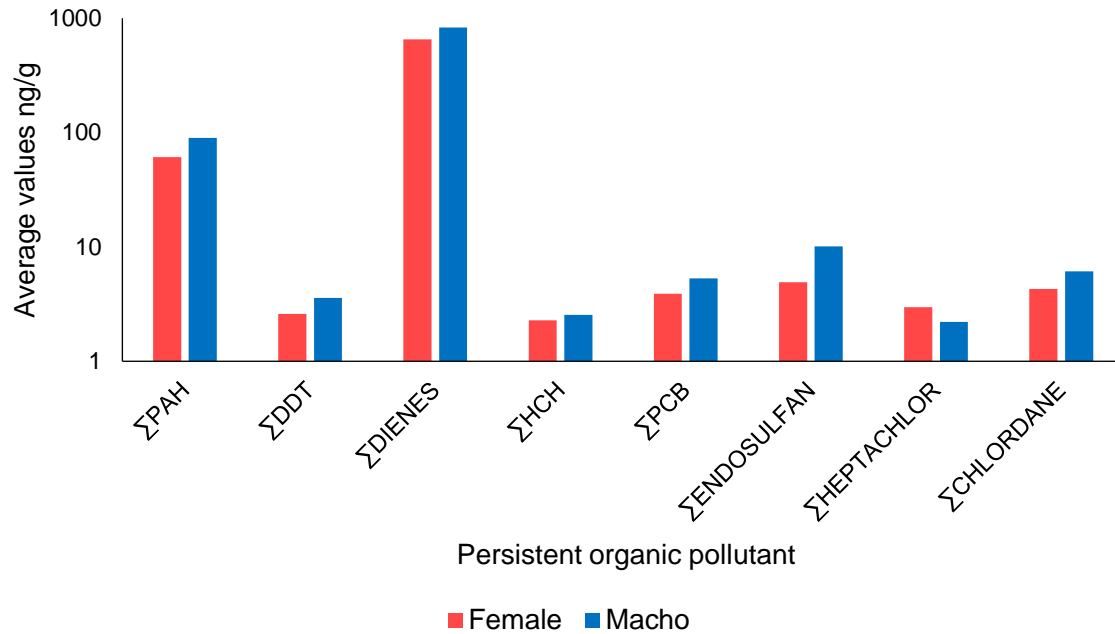


Figure 3. Humpback whale (*Megaptera novaeangliae*) persistent organic pollutant concentrations classified by sex in the Mexican Central Pacific.

Feeding areas were designated with the stable isotope values of these whales, using as reference the  $\delta^{15}\text{N}$  and  $\delta^{13}\text{C}$  values of feeding sites reported by Witteveen et al., (2009). Likewise, the technique of photo-identification of flows through the Happy Whale platform was used to observe migratory movements. In this way, three feeding zones were designated, 1) the southern zone, which includes California, Oregon, Washington, and northern British Columbia areas; 2) the northern zone, comprising the areas of southeastern and northeastern Gulf of Alaska; and 3) the western zone, with the areas of northeastern Gulf of Alaska, Aleutian Islands, Bering Sea, and Russia. With respect to pollutants, the southern and northern zones had the highest concentrations of pollutants. In the case of the southern zone, it presented the highest averages of DDT (3.587), dienes (1020.178 ng/g) and endosulfan (9.557 ng/g); while the northern zone presented the highest averages for the PAH (91.468 ng/g), HCH (3.068 ng/g), PCB (5.452 ng/g), heptachlordane (4.523 ng/g) and chlordane (6.843 ng/g) groups (Figure 4).

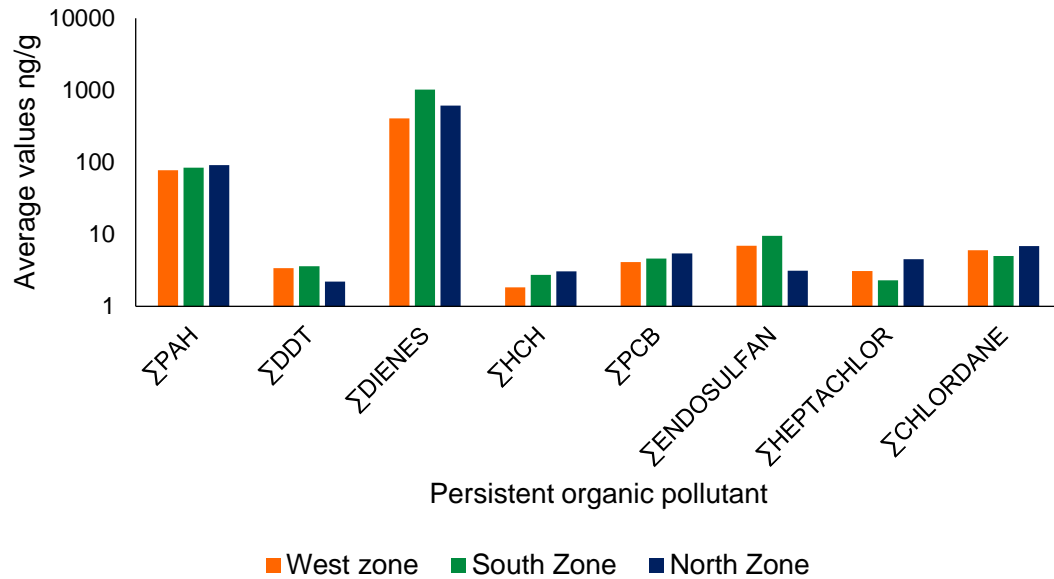


Figure 4. Concentrations of persistent organic pollutants in humpback whales (*Megaptera novaeangliae*) from the Mexican Central Pacific, classified by feeding areas.

This project has been crucial to know the toxicological status of humpback whales that visit Mexican Central Pacific waters. Likewise, these results will be part of my doctoral thesis and will be part of a scientific article, given that this information provides ecological knowledge and will help to contribute with regulations, reports and/or national or international laws for the management and conservation of these populations.

I would like to thank The Society for Marine Mammalogy for their support on the completion of this project.

### Literature cited

Witteveen, B. H., Worthy, G. A., & Roth, J. D. (2009). Tracing migratory movements of breeding North Pacific humpback whales using stable isotope analysis. *Marine Ecology Progress Series*, 393, 173-183.