

4to Report

The analysis of organochlorine pesticides (POCs) was conducted on skin biopsies of whale sharks, as well as phytoplankton and zooplankton from the refuge area of this species in BLP.

The total POCs concentrations in BLP during the 2020-2021 and 2022 seasons across the three study matrices are shown in Fig.1. The highest concentrations were found in whale shark skin>zooplankton>phytoplankton in both seasons. Upon applying the statistical analysis, we found a significant difference between the POCs concentrations in whale shark skin, zooplankton, and phytoplankton during the 2020-2021 season (Kruskal-Wallis $p=0.041$) and in 2022 (Kruskal-Wallis $p=0.001$).

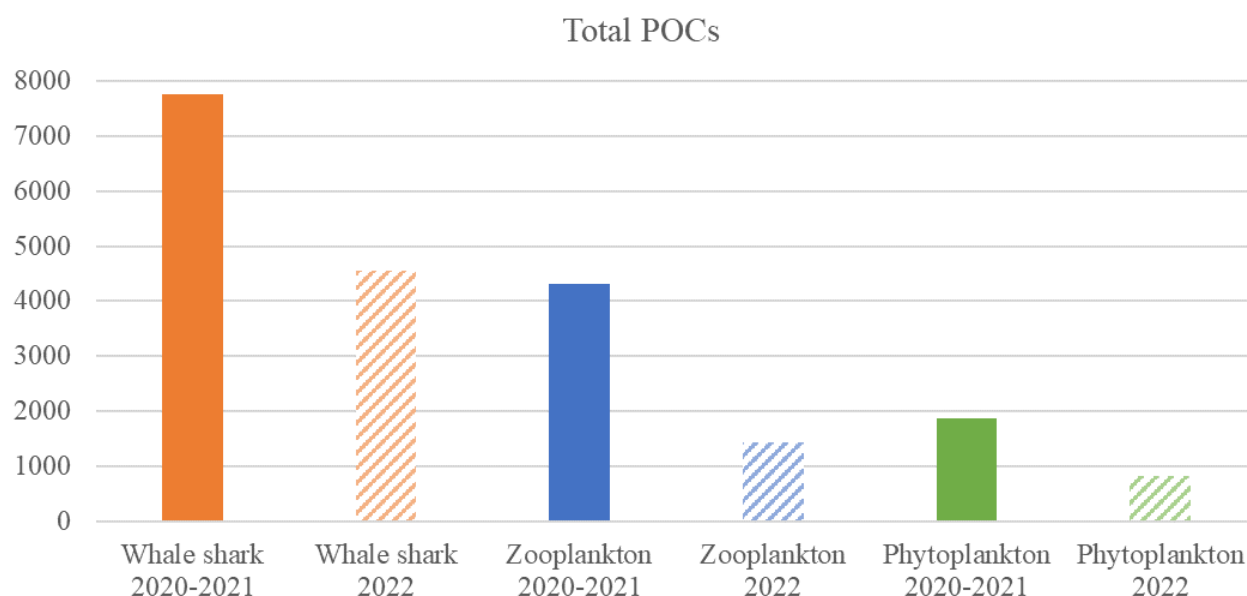


Figure 1. Total POCs in skin whale shark, zooplankton and phytoplankton

The whale sharks were grouped by size into $\leq 5\text{m}$ and $> 5\text{m}$. When applying a median difference test (Mann-Whitney), no significant difference was found between the POCs concentrations in sharks of different sizes during the 2020-2021 season ($p=0.808$) and 2022 ($p=0.277$) in BLP. For phytoplankton, there were significant differences between the seasons (Mann-Whitney $p=0.019$). No significant differences were found for zooplankton between the seasons (Mann-Whitney $p=0.661$).

When calculating the ratio $(p,p'\text{-DDE} + p,p'\text{-DDD})/p,p'\text{-DDT}$ in zooplankton for BLP 2020-2021, values greater than 1 were obtained for zooplankton (4.94) and phytoplankton (4.79), unlike those calculated for BLP 2022, where zooplankton (0.69) and phytoplankton (0.05) showed lower values, suggesting a recent input of DDT only for this area and season (Zhang et al., 2018). This recent DDT input for the 2020-2021 season may be associated with the mooring of cruise ships during the whale shark sighting season.

Organochlorine pesticides have been detected in the Gulf of California. Gutiérrez-Galindo et al. (1992) reported the presence of DDT and its metabolites, heptachlor epoxide, endrin, and α -endosulfan. Agrochemicals used in agricultural development areas such as the Mexicali Valley, Sonora, and Sinaloa are among the main sources (Gutiérrez-Galindo et al., 1992; Fossi et al., 2017). Additionally, the use of dicofol (a pesticide containing DDT as an impurity) has been reported in Sonora (Rauert et al., 2018), and the proximity of this area to BLA and BLP could be a direct source. Values greater than 1 were also found in the skin biopsies of the whale sharks, indicating a recent input of DDT in the organisms during the 2020-2021 season. However, since whale sharks are highly migratory, these values could reflect concentrations from other study areas (Eckert and Stewart, 2001).

When calculating the biomagnification indices, positive values were obtained at all trophic levels, indicating biomagnification of POCs in the small trophic network of this study (whale shark-zooplankton-phytoplankton) (Barwick and Maher, 2003). However, it is important to note that whale shark skin is not a tissue commonly used to determine biomagnification, as it lacks a high concentration of lipids, with COPs being adsorbed in the dermal denticles (Corsolini et al., 2014; Zhou et al., 2018; Boldrocchi et al., 2021, 2022). These contaminants may be adsorbed in the skin without undergoing a metabolic absorption process that reflects biomagnification, thus serving as a passive sampler for external contamination (Boldrocchi et al., 2022).

It is also important to mention that, in marine food webs, which are more open, predators consume a wide range of prey, reducing the likelihood of biomagnification in these networks due to the variability of concentrations in the different species consumed (Isaacs, 1973; Gray, 2002). In addition to lipid content, another factor associated with differences in biomagnification potential is the length of the trophic web (Fisk et al., 2001).

Feeding areas for this species in the Gulf of California, such as BLP, are sources of POCs for whale sharks and other fauna present in these areas. It is important to mention that the mooring activities of boats near the whale shark feeding areas are a major source of contaminants and may, over time, affect the organisms.

One of the project's goals is to engage with and work alongside the community. Among the activities we planned was the delivery of composting workshops. Around 20 workshops were held in different elementary schools with 5th-grade students. We received a great level of participation from the children, and their favorite activities were making compost, playing bingo, and working as a team. The winners were given red California worms and a brochure to create compost and worm compost at home.

Photo collage:







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