

## Final Evaluation Report

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Your Details	
<b>Full Name</b>	Stephanie Itzel Villagómez Vélez
<b>Project Title</b>	Assessment of microplastic-bound persistent organic pollutants (POPs) in whale Shark aggregations in Bahía de los Angeles.
<b>Application ID</b>	30058-1
<b>Date of this Report</b>	December 2022

**1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.**

Objective	Not achieved	Partially achieved	Fully achieved	Comments
To determine levels of persistent organic pollutants (POPs) including organochlorine pesticides, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) in whale shark subdermal tissue and zooplankton samples from Bahía de los Ángeles, Mexico.				This objective was partially met, since it was not possible to quantify the levels of PCBs in the samples due to the lack of the required analytical standards. However, concentrations of organochlorine pesticides and PAHs were determined in whale shark biopsies and in zooplankton samples collected in whale shark sighting areas. Additionally, the scope of the work was expanded by quantifying the content of PAHs and pesticides in phytoplankton samples, adding information from one more link in the food web for the analysis of the results.
To assess if there is a relationship in the content of POPs (individual compounds and concentrations) between predator-prey (biomagnification) in the study area.				Once the levels of POPs in the three matrices were quantified, statistical analyses were performed to evaluate the behaviour of the two groups of contaminants (organochlorine pesticides and PAHs) in the samples. The biomagnification coefficient was calculated, obtaining a positive result for the phytoplankton-zooplankton link, but no increase in contaminant levels was observed in the upper link, that is, in the whale shark samples; This may be because the subdermal tissue of <i>R. typus</i> is not the ideal matrix for the bioaccumulation of the compounds measured in this study.
To determine the presence of microplastics (MPs) in Bahía de los Ángeles, classifying them by size, colour and type; as well				This objective is marked as partially achieved since the determination of the presence of microplastics in the study area was fulfilled, their classification by size, colour and type was completed, and the number of

<p>as the determination of the polymer of which they are made.</p>			<p>PM pieces per sample was counted. However, the type of polymer that made them up could not be determined, since the money retained by the organisation in charge of managing the monetary resource was underestimated, so that part of the investigation was reduced.</p>
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**2. Describe the three most important outcomes of your project.**

- a). The analytical techniques used were adequate to quantify organochlorine pesticides and PAHs in samples of phytoplankton, zooplankton and subdermal tissue of whale sharks, generating databases of concentrations of these pollutants, both individually and grouping them by molecular weight or similarity in chemical structure.
- b). Biomagnification of POPs was observed in the phytoplankton-zooplankton trophic link, however, contrary to expectations, no increase in concentrations was observed in the next level, that is, in whale shark dermal tissue.
- c). Higher concentrations of high molecular weight PAHs were detected in the three matrices studied (phytoplankton, zooplankton and whale shark subdermal tissue), indicating that the main contributions of these pollutants to Bahía de los Angeles are pyrogenic sources.
- d). Microplastics were observed in all samples generating information for databases on microplastic leakage in coastal habitats. The number of pieces per m<sup>3</sup> increased comparing the results with those of a previous study.

The greatest achievement of this project is to provide information on the current state of pollution in Bahía de los Angeles with respect to the presence of persistent organic pollutants (POPs), specifically polycyclic aromatic hydrocarbons (PAHs) and organochlorine pesticides. The fact of having data on the concentration of these contaminants in the three matrices studied (whale shark, zooplankton and phytoplankton), helps to contemplate a possible transfer of PAHs and pesticides through the food web. This information is important, since these compounds are toxic and remain in the marine environment for long periods, and can be accumulated by other species of fish, seabirds and marine mammals.

**3. Explain any unforeseen difficulties that arose during the project and how these were tackled.**

The greatest difficulty arose in October 2021, as the number of Covid-19 cases in Mexico increased, laboratories were closed and student mobility processes to carry out research in research centres and educational institutions, including the CICIMAR-IPN and the UNAM Sisal Academic Unit, were cancelled. Therefore, the analysis of the samples and the collection of data was considerably delayed. However, once

access was granted (under controlled conditions) to the required facilities, the main objective of the investigation was fulfilled.

The whale shark season in Bahía de los Ángeles had the highest number of sightings during the sampling campaigns; however, the sharks were found on the shores of the beginning of the bay and not in the corner, the most frequent sighting area. Therefore, samples of dermal tissue of the whale shark, as well as the samples of zooplankton and phytoplankton, were collected only where the sharks were observed on the established sampling days.

There was a bit of difficulty in the bureaucratic procedures. Due to the pandemic, the procedures turned out to be slower than normal, especially to access the CICIMAR-IPN facilities and the Bahía de los Angeles Biosphere Reserve, Canales de Ballenas and Salsipuedes.

Despite these difficulties, the established objectives were achieved.

#### **4. Describe the involvement of local communities and how they have benefited from the project.**

The results obtained were presented to the service providers, pointing out the convenience of improving some practices such as fuel management and avoiding the burning of garbage, in order to reduce the levels of PAHs in the bay and thus avoid bioaccumulation and biomagnification. in marine organisms.

CONANP has already established a plastic collection programme and they were provided with the results obtained about the microplastics found in zooplankton, in order to offer suggestions to improve the actions carried out within this programme.

In addition, knowledge of the regulations established by the authorities for the conservation of the whale shark was promoted, distributing printed copies among members of CONANP and tourism service providers, so that they could place it on their boats and at the entrance of the ramp where tourist boats leave. With these actions, it is expected to reduce the number of injured whale sharks, a serious problem observed during the sampling campaigns for the realisation of this project.

#### **5. Are there any plans to continue this work?**

It is planned to continue with this project due to the results obtained, verifying the presence of persistent organic pollutants in the aggregation areas of whale sharks; however, it will take place in another whale shark sighting area in Mexico, specifically in the Bahía de La Paz.

#### **6. How do you plan to share the results of your work with others?**

The results obtained with this project will be presented in a scientific article, whose manuscript is in preparation and will soon be submitted for publication.

Also, every year scientific outreach events are held, so the results will be presented at conferences and meetings related to the subject of study.

In addition, there was participation in the workshop: Strengthening the collaboration between scholars and actors of the Rufford Foundation, Cancun, April 3 and 4, 2022.

### **7. Looking ahead, what do you feel are the important next steps?**

The next steps are to show the community the results obtained, additionally, strategies for managing plastics and waste should be proposed by government institutions, since a large amount of plastic and garbage was found in the beach area.

Distributing the support material to show the regulations for swimming and/or whale shark sighting, is for the purpose that both service providers and tourists know and respect it and, if someone does not respect the guidelines, to be able to report it. This was done due to the large number of injured organisms observed during the sampling season. Therefore, as a next step, it is expected to continue with the support of government authorities to deal with complaints or non-compliance with regulations.

The results obtained in this project will be published in a scientific journal, to share the data on levels and types of pollutants that are present in the study area, with a great influence of anthropogenic activities that can have a negative effect on the environment and on the resources available in the area. It is important to disclose this information, since the highest levels were found in the zooplankton samples, organisms that are the baseline in the food chain.

### **8. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?**

The Rufford Foundation logo was placed in all the presentations (power point) where the results obtained were exposed and in the swimming rules with the whale shark that were placed at the entrance of the Bahía de los Ángeles boardwalk. Likewise, the logo is on the stickers of the same rules provided to service providers. During the execution of the project, the activities carried out and the results obtained were disseminated through social networks.

### **9. Provide a full list of all the members of your team and their role in the project.**

**Dr. Felipe Galván Magaña** participated in the drafting of the project, provided some materials to comply with the established methodology and followed up on the results, as well as the writing of the article. He provided the permits for obtaining whale shark samples, as well as the freeze-dryer for freeze-drying all samples. He also participated in the writing of the thesis chapter of which this Project is part, as well as the writing of a scientific article that is about to be submitted to a scientific journal for the dissemination of the results.

**Dr. Rogelio González Armas** organized, participated and provided some materials for the outings to obtain samples to Bahía de los Ángeles; he also participated in the drafting of the project, the chapter of the thesis and the scientific article already mentioned above.

**Dr. Elsa Noreña Barroso** participated in the drafting of the project, the identification and quantification of contaminants in the phytoplankton, zooplankton and whale shark samples, as well as in the analysis of results. She provided the laboratory, materials and reagents, as well as the methodology to be followed for the determination of persistent organic pollutants. She also participated in the writing of the thesis chapter and the scientific article to be submitted.

**M.C. Stephanie Itzel Villagómez Vélez** participated in the drafting and direction of the project, contributing and carrying out the field methodology, obtaining samples, obtaining photo ID and determining the sex of the sharks, as well as videos and photos of the development of the project. She performed the laboratory procedure for the extraction, identification and quantification of persistent organic pollutants from the samples. As well as the digestion and filtering of the samples for the separation of microplastics, in addition to their counting and classification. She was responsible for writing the chapter of the thesis, as well as the scientific article.

**Dr. Lorena Ríos** contributed to the methodology on microplastics.

**Dr. Eduardo Méndez Da Silveira** participated in obtaining samples in the field, taking photos and videos of the development of the project, as well as photo ID and determination of the sex of the sharks.

**M. en C. Romina Cruz** participated in the field trip to take photos and videos of the development of the project, as well as photo ID.

## 10. Any other comments?

We want to thank The Rufford Foundation for its important contribution to this project, the funding received made it possible to carry it out and complete it successfully. We look forward to working with The Rufford Foundation again in the future.

Our thanks and appreciation to the PEJESAPO group, especially Dr. Abraham Vázquez and MVZ Vanessa Vázquez, for their contribution to the field methodology for marking whale sharks with a wax crayon to be able to identify them more easily in the field and avoid repeat individuals.

It is important to emphasise that despite the fact that some objectives were partially met due to changes in the methodology, a reliable final work was obtained.

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