

Final Evaluation Report

| Your Details | |
|----------------------------|---|
| Full Name | Francesca Pancaldi |
| Project Title | Trophic structure, bioaccumulation and trophic transfer of trace elements in three species of cetaceans in the Gulf of California |
| Application ID | 35545-1 |
| Date of this Report | 31 st October 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 |
|---|--------------|--------------------|----------------|--|
| Collection of biopsies from orcas, fin whales and bottlenose dolphins | | | | The collection of orca biopsies was quite complicated due to the high presence of tourist boats that really did not allow us to carry out the research as we would have liked. |
| Collection of tissues from preys: rays (munk's devil ray mainly), zooplankton, sardines, mackerel, dorado, and skipjack | | | | We could not collect deep zooplankton (100 m) as the net got broken. |
| Gender analysis | | | | The number of obtained samples on predators was not enough to separate the results for sex and ages. |
| Analysis of trace elements and stable isotopes | | | | |

2. Describe the three most important outcomes of your project.

a). We found very high concentrations of mercury (the most toxic heavy metal of the planet) in some individuals of orcas. These levels are possibly taken up by the prey (possibly dolphins). We do not know what the consequences on the health of the animal will be (there is no study that provides this information for this species), but we can assume that this element will be transferred from the mother to her offspring with possible consequences for the new-born.

b). We found high levels of arsenic in devil rays (*Mobula munkiana*), a species that, despite its protection status is still consumed here in Mexico. Hence, the consumption of this species can possibly expose consumers to contamination.

c). We obtained the results of some trace elements (called technological metals) that are considered "emerging" in the environment and in organisms. Obtaining these elements was not contemplated at the beginning of the work, but it was possible to obtain them thanks to the implemented laboratory technique. These elements are relatively new and have not yet been reported in any of the species included in this work. We consider these results highly valuable.

This is the first study on concentrations of heavy metals in orcas of the Gulf of California. Obtaining those samples has been a great achievement. Another important aspect of this work is that it successfully includes species that represent

different trophic levels and therefore allows us to compare the concentration of elements depending on the type of diet.

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

1. The collection of biopsies for orcas was quite complicated due to the intense unregulated tourist activities that stressed the animals (resulting in changes in behaviour, movements, etc.). We talked about the study among the community of tourist service providers (organisation of public talks aimed at the community) so that they would know our project and its importance. In some cases, credit was given publicly (on social platforms) to the tour companies that supported the project (they notified us of the presence of orcas, they facilitated the work of collecting biopsies).
2. The machine for the analysis of trace elements got broken and we could not obtain the results on time. We asked an extension to Jane, and this allowed us to get the results. The machine was repaired on time, and we could analyse the samples with no issues.

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

At the beginning of the project, it was very difficult to make the community understand the importance of this study; the tourist service providers only focused on their activities and the fact that the presence of the researchers bothered them. However, two public talks were organised, open to all, where the researchers involved with this project explained the objectives and the possible impact of this work. Providers began to change their minds as they saw that studies like this generate information that they can then use with tourists.

The tourist providers that helped us during the field trips (advertising us on the presence of the orcas and allowed us to take samples) received public thanks on their social network channels, which helped them to increase their prestige and obtain more clients.

5. Are there any plans to continue this work?

I consider that the results we obtained from the trace elements analysis are exhaustive and we do not need to further continue this work. Nevertheless, this study has allowed us to identify uncontrolled tourism as a factor of great stress for orcas, and we think that to promote a public policy and management of the species, information should be generated that proves that the animals are highly stressed. For this reason, I would like to focus my next research on hormone of stress in orcas, possibly correlating this with the results of the contaminants found in this present study.

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

- We are proceeding to analyse all results and I am planning to write three different scientific articles about these results.
- Our results will be shared on our social media channels.
- The Autonomous University of Baja California Sur (UABCS) is organising a Pollution Forum, open to the entire community to discuss the problem of pollution both in the city and in the environment that surrounds us. We are thinking of participating and exposing our results to spread the risk of consuming species that, in addition to being protected, could represent a danger to human health.

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

The important next step would be:

- Analyse all the results.
- To publish the articles.
- Diffusion of the results.
- To develop the stress hormones project for orcas.

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?

Yes, me and my partners posted several posts on social media to give diffusion to the project. The #ruffordgrants was used every time.

The famous underwater photographer Brandon Cole got interested in this study and he has included it in an article that will be published in Scuba Diving Magazine (date to be determined).

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

Dr. Martin Federico Soto Jiménez

He directed the trace elements analytical work. This included: the digestion of the samples, and the trace elements analyses. He directed the preparation of the samples for the stable isotopes analysis.

Dr. Hiram Rosales Nanduca

He took the biopsies of orcas, fin whales, bottlenose dolphins as well as provided the samples of dead common dolphin tissues.

Erick Higuera

He participated in all the field trips, took videos and photos of the different phases of the project.

M.S. Marta Diaz Palacios

She provided the samples of devil's rays (*Mobula munkiana*).

Dr. Juan Carlos Herguera García

He directed the analysis of stable isotopes.

10. Any other comments?

I just would like to thank the foundation for this opportunity as well as the trust they put in me.



Bottlenose dolphins, *Tursiops truncatus*, in the Bay of La Paz. Two ecotypes of bottlenose dolphins are spotted in the bay: the coastal ecotype (in the picture) which mainly visit the south and shallower area of the bay, and the oceanic ecotype, more common of the north side. Both ecotypes use the bay for breeding and feeding purposes. © Erick Higuera.



Individuals of Fin whale, *Balaenoptera physalus*, in the Bay of La Paz. In the Gulf of California, there is a resident population of *Balaenoptera physalus* estimated to be between 400 and 800 animals. This population is one of the most genetically isolated of the species, therefore it is considered at high risk of extinction. Fin whales are seasonally spotted in the bay, feeding on dense aggregation of krill. © Erick Higuera.