

## Final Evaluation Report

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Your Details	
Full Name	Elpis J. Chávez Calderón
Project Title	Trophic ecology and habitat selection of the bull shark ( <i>Carcharhinus leucas</i> ) at two Costa Rican estuarine systems
Application ID	27385-2
Grant Amount	£5,000
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Date of this Report	July 2020

**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
Determine the trophic level of juvenile bull sharks at Coyote and Bongo estuaries				A total of 26 juvenile bull sharks were sampled (24 from Coyote and two from Bongo estuary). Samples of muscle, plasma and red blood cells tissue were analysed to determine the trophic position of sharks.
Determine the diet composition of juvenile bull sharks at Coyote and Bongo estuaries				We collected muscle tissues from potential preys of bull sharks at Coyote and Bongo estuaries to analyse their isotopic values and their contribution to the diet of bull sharks.
Determine if there are food-related movements of <i>Carcharhinus leucas</i> between Coyote and Bongo estuary.				Because of bad weather and changes in the Bongo river’s mouth (temporal closure), we could only sample two sharks at the Bongo estuary, and neither of the sharks tagged and sampled in the Coyote estuary were found at Bongo and vice versa. We found that both estuaries have similar isotopic marks, so we cannot tell whether sharks are feeding in a particular estuary system.
Give talks to local communities to increase the awareness of shark conservation				We gave talks to local community members about the project and the importance of sharks. Additionally, throughout the research several volunteers had the opportunity to participate in the fieldwork.

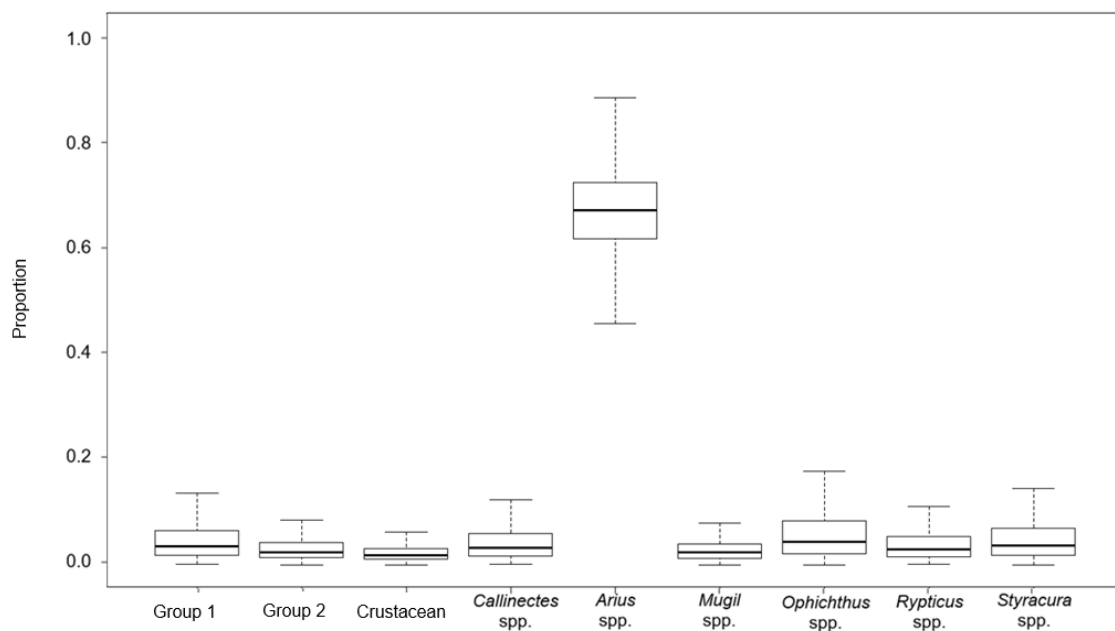
**2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.**

With the onset of the rainy season, a large amount of sediment from inland, together with strong currents, caused the temporal closure of the Bongo’s river mouth. Juvenile bull sharks tend to swim in and out of the estuaries. The closure of the mouth could cause result in low captures of bull sharks inside the Bongo estuary. Additionally, the bad weather conditions, mainly heavy rain and strong winds, forced us to suspend the fieldwork and shark capture for some days. During the fieldwork, the outboard motor of the boat had engine problems, and we had to have it repaired, which caused another delay in the field activities that we had planned. Although we were able to do the fieldwork and collect the species

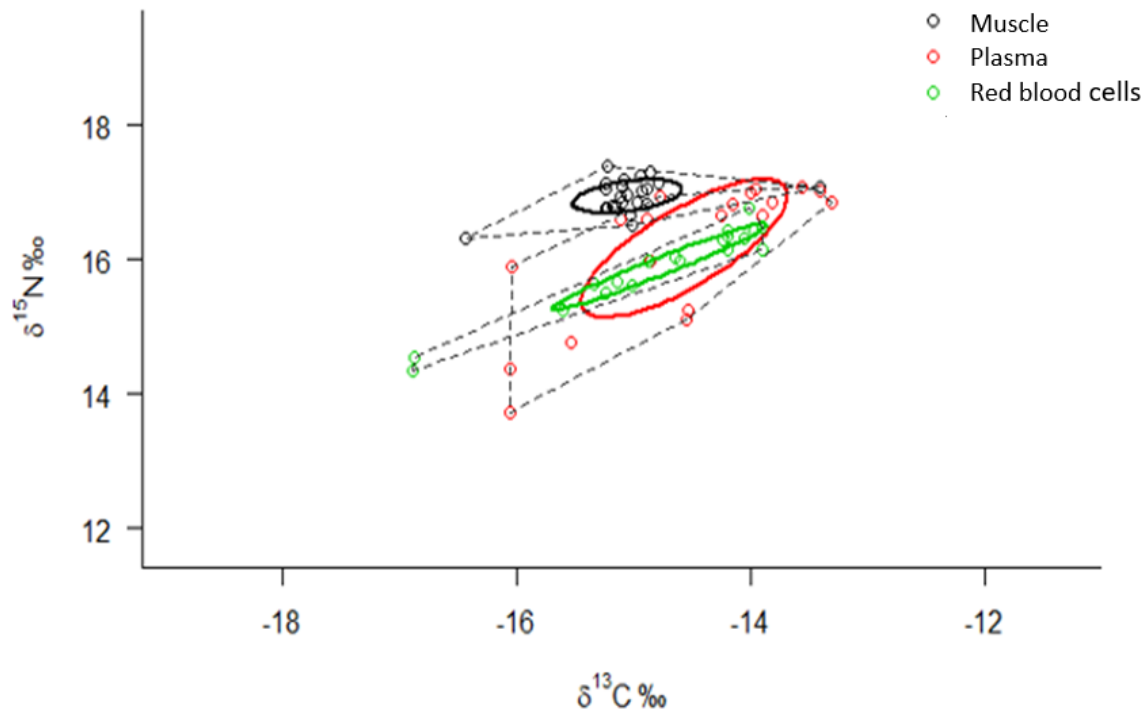
needed, the difficulties mentioned above caused that we could not collect as many samples of bull sharks inside the Bongo estuary as we expected.

### 3. Briefly describe the three most important outcomes of your project.

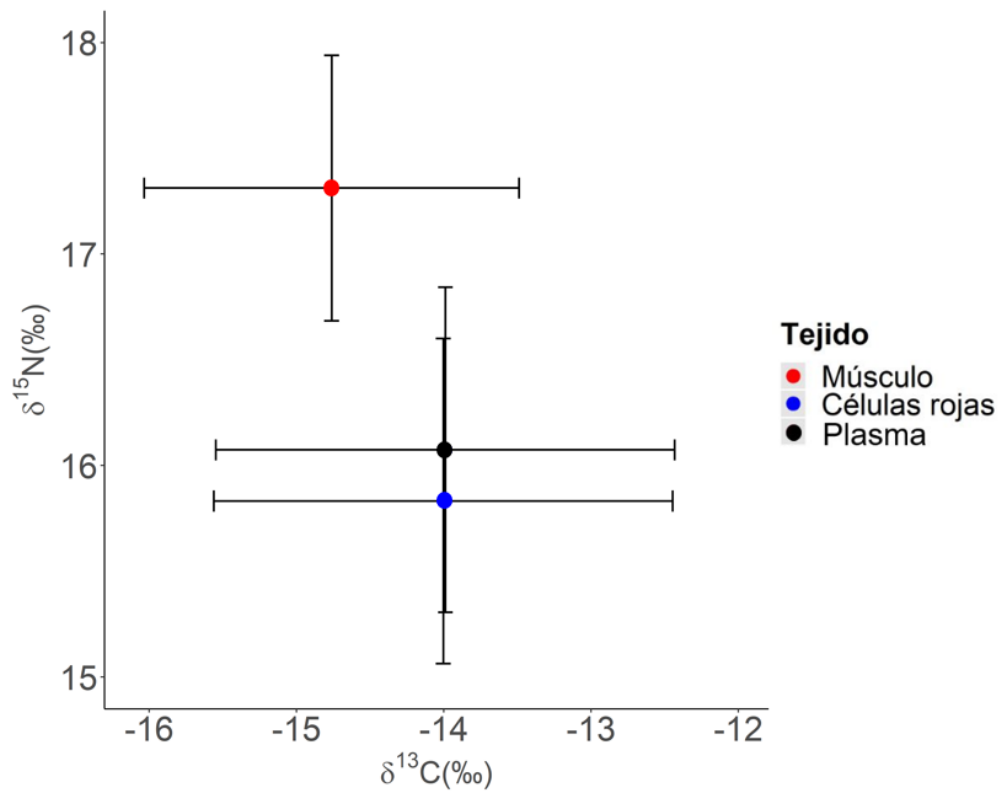
1. We determined that juvenile bull sharks are top predators inside the estuarine systems with trophic positions of 4,2 for the Coyote estuary and 4,4 for the Bongo estuary. Juvenile bull sharks of Coyote and Bongo estuaries are tertiary consumers, occupying high positions in the food chain.
2. The main prey of the bull sharks at Coyote estuary is the catfish (*Arius* spp). The catfish is the most abundant species in both estuaries, so bull sharks are helping to regulate its populations through direct predation (Fig. 1).
3. There were differences between the isotopic niche of the bull shark tissues. Plasma and blood cells are metabolically more active than the muscle. In juvenile sharks, muscle reflects the isotopic mark of the mother (Fig. 2 and 3).



**Figure 1.** Proportion of different prey of the juvenile bull sharks' diet at Coyote estuary.



**Figure 2.** Isotopic niche and trophic overlap between different tissues of juvenile *Carcharhinus leucas* at Coyote estuary.



**Figure 3.** Isotopic values of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of different tissues of juvenile bull sharks at Bongo estuary. Mean and standard error.

**4. Briefly describe the involvement of local communities and how they have benefitted from the project.**

Members of the local community, especially fishermen, helped us during the fieldwork. Local fishermen provided us with bait for the project and volunteers from CREMA, a local NGO, participated in the research and gained experience about capturing and sampling sharks.



**Figure 4.** Amado (local fisherman), and Edna (master student) collecting samples of crustaceans inside the Coyote estuary.

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

The local NGO CREMA is planning to continue with the tagging and acoustic monitoring of juvenile bull sharks in the study area. Also, we would like to collect more samples of juvenile bull sharks from the Bongo estuary and from coastal waters.

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

We will present this research at National University, Costa Rica (UNA) and at the local community. Final reports will be presented to the government authorities and a thesis dissertation will be available for public access. We also expected to submit a scientific paper of this work.

Two informative posters about the importance of sharks, and about this research project were presented to the local people of San Francisco de Coyote (Fig. 5).

An additional product of this project was the publication of a home range expansion of the mangrove cat-eye snake (*Leptodeira rubricata*) (Fig. 6). The encounter with *L. rubricata* took place during the fieldwork activities inside de Coyote estuary. The publication contributes directly to improve our knowledge about the estuarine systems of Costa Rica.

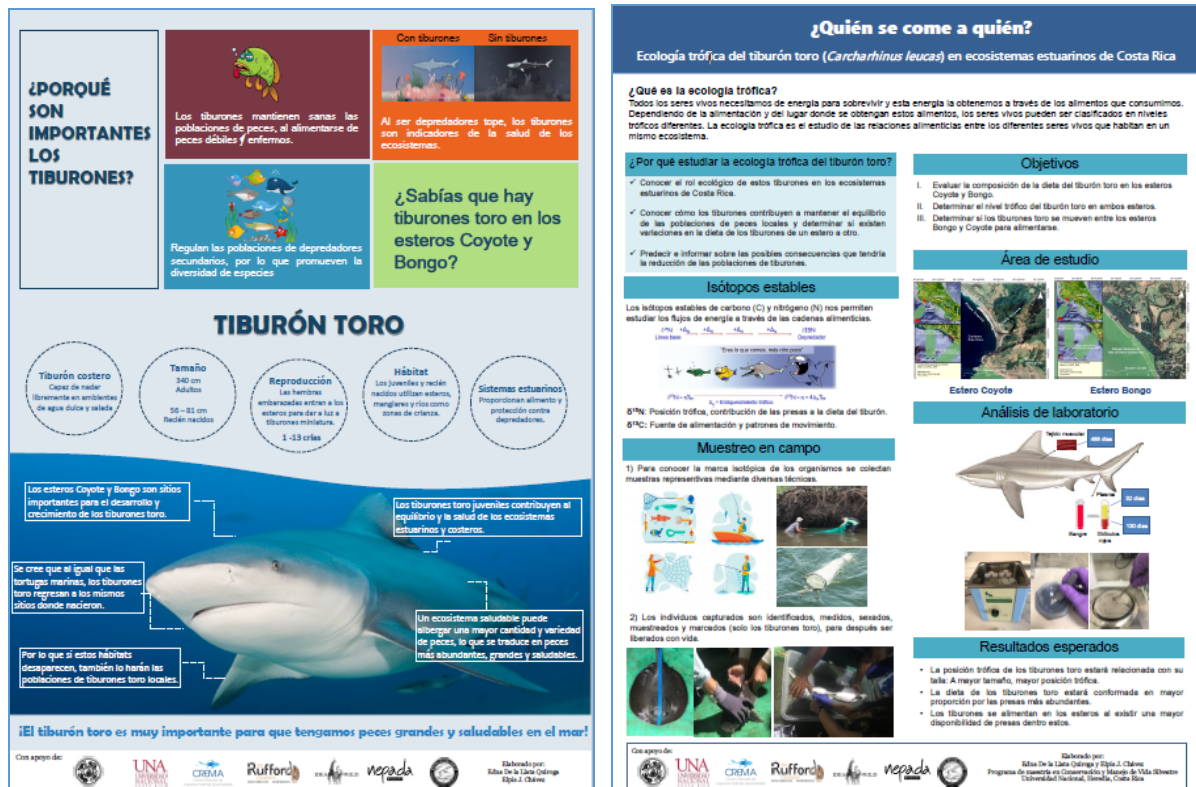


Figure 5. Posters in Spanish presented to the community of San Francisco de Coyote.

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## A new geographic distribution record for *Leptodeira rubricata* Cope, 1893 (Squamata: Dipsadidae): Nicoya Península, Guanacaste, Costa Rica

Edna De la Llata Quiroga<sup>1,\*</sup>, Elpis J. Chávez<sup>2</sup>, Randall Arauz<sup>3</sup>, and Juan G. Abarca<sup>4</sup>

Figure 6. Screenshot of the scientific note of a new distribution record for the mangrove snake observed during this research (De la Llata et al. 2020). The full publication can be found at: <https://www.biotaxa.org/hn/article/view/58254>.

**7. Timescale: Over what period was the grant used? How does this compare to the anticipated or actual length of the project?**

The Second Rufford Small Grant was used during all of the study period.

**8. Budget: Provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.**

Item	Budgeted Amount	Actual Amount	Difference	Comments
Data loggers	122		-122	We used the multiparameter instead of dataloggers to measure the temperature
Multiparameter	1100		-1100	We got a multiparameter from the NGO
Consumables (Bait and combustible)		500	+500	We used more bait and gasoline, we had to make a new long line.
Local assistant (fisherman)		62	+62	Due to the difficulty in collecting some samples, we had to hire a local fisherman to help us.
Plankton nets	780	264	-516	The University of Costa Rica lent us one of the plankton nets
Isotope analysis	2000	3186	+1186	The number of potential preys of the bull sharks were higher than expected
Laboratory materials and equipment	998	991	-7	National University, Costa Rica supported us with the laboratory equipment
<b>TOTAL</b>	<b>5000</b>	<b>5003</b>	<b>+3</b>	Exchange rates used: 1 CRC= 0.0013 GBP; 1 USD = 0.8 GBP

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

The next step should be to collect more samples from sharks at Bongo estuary in order to have more accurate information about juvenile sharks at that site. Also, we think that is very important to enhance the environmental education plans about the estuaries and shark conservation in the area.

**10. 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 RF logo has been used in presentations with the local community. We are planning to use the logo or the name of the foundation in any scientific publications. We will continue to mention the RF as one of the main sponsors of this project and will incorporate the logo in future presentations related with this research.

**11. Please provide a full list of all the members of your team and briefly what was their role in the project.**

**Elpis J. Chávez Calderón** (CREMA NGO, Costa Rica) - Principal investigator, shark researcher and thesis advisor, data analyst.

**Edna de la Llata** (ICOMVIS-UNA, Costa Rica) – Master’s student, laboratory technician and data analyst.

**Amado Quiroz** - Local fisherman, captain and research assistant. His empirical knowledge was invaluable for this research.

**Marcus Vinicius** (CREMA, Costa Rica) – Volunteer from Brasil, field assistant.

**Randall Arauz** (PRETOMA, Costa Rica) – Technical advisor and logistics provider.

**Isabel Naranjo** (CREMA) – Local coordinator and administrator of CREMA.

**Manuel Spinola** (ICOMVIS, Costa Rica) - Specialist in statistical methods applied for wildlife, researcher and data analyst.

**Arturo Tripp** (CICIMAR, Mexico) – Specialist in stable isotope techniques in marine environments, data analyst and researcher.

**Jeffry Madrigal** (CREMA, Costa Rica) - Field assistant.

**Hernaldo Vargas** – Local fisherman. He helped us to collect samples of small fishes and to capture some bull sharks.

**12. Any other comments?**

We are really grateful to the Rufford Foundation for funding this research. Thanks to your support, we were able to continue this project that began in 2015. Up to now, we have completed two master’s dissertations about the bull shark’s ecology in estuarine environments and we are preparing the manuscripts that will be submitted to a scientific journal in the next months.