The Rufford Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Debbie López Núñez
Project title	Unravelling the secrets of the batoids paradise in the coasts of Costa Rica
RSG reference	21951-1
Reporting period	
Amount of grant	£5000
Your email address	debblonu@gmail.com
Date of this report	August 1st 2018

1. Please 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
Examine spatial and temporal patterns of abundance, diversity and biomass of the batoids present in El Jobo bay, North Pacific, Costa Rica				Currently, we have a large database since 2017, where we are reported data about abundance, diversity and biomass of the batoids in El Jobo Bay
Examine the residency, habitat use and movement patterns of a common stingray species (Urotrygon chilensis) in el Jobo bay				Due to different inconveniences, such as the arrival of the equipment, permission processing and tests to place the acoustic telemetry equipment in the water, this part of the project has been considerably delayed. However, data is currently being generated to complete this objective. In addition, the species under study is replaced by *Urobatis halleri.*
Implement an environmental education program with the community of El Jobo to raise awareness of the current population status of sharks and rays, current threats affecting their populations, and potential opportunities for their conservation and local economic development through sustainable tourism				Environmental education meetings have been given to children and adults from the El Jobo community, as well as to groups of students who have come to learn about the project thanks to the NGO "Equipo Tora Carey" (ETC) and Veritas University, providing an economic income to members of the local community. In addition, with the help of the NGO, it has begun to implement ecological tourism aimed at observation and active participation within the project of batoids, which has generated an extra income for the person who collaborates permanently in the project.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

One of the main difficulties that we faced during the development of the project was the delay in the placement of the acoustic telemetry equipment, both the receivers in the water and the transmitters in the rays. This is mainly due to the fact that the delivery of the equipment was delayed (11/13/2017) due to natural disasters in the United States, processing of permits to place the equipment and the realisation of the Range Test.

Due to certain discrepancies in logistics and disagreements regarding animal welfare with the work team established up to that date (01/08/2017), it was decided to part ways with the collaboration of two team members (Isaac Chaves and Mario Espinoza) with their self-awareness. Instead, we incorporated the collaboration of a couple of veterinarians with extensive experience in batoids to carry out surgeries, expert biologists in this field to perform the Range Test (Randall Arauz and Elena qué ?) and collaboration of a fisherman to help place the receivers in the most appropriate place, thus reducing the risk of animal mortality and loss of equipment.

It is important to mention that for the objective "Examine the residency, habitat use and movement patterns of a common stingray species (*Urotrygon chilensis*) in the Jobo bay" the species of study was replaced by *Urobatis halleri*. This is due to the fact that at the time when the rays were marked, we found only relatively small individuals of *Urotrygon chilensis*, the size of the transmitter being too big for them, contrary to what happened with the species *Urobatis halleri*, where the greater rays prevailed. It should be noted that both species share similar morphological traits and apparently in their behavior, so it does not have a negative effect on this objective.

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

With this project, it was possible to determine the seasonality of certain species, for example, the presence of two species (*Urobatis halleri* and *Urotrygon chilensis*) is evident throughout the year, contrary to certain guitar fish species, such as *Pseudobatos glaucostigma* and *Pseudobatos leucorhynchus*. Guitar fish, like other species, are only observed during certain months of the year, which coincides with the arrival of a phenomenon known as seasonal upwelling. This phenomenon is generated when the trade winds contribute to the recirculation of the water, the warm waters move towards the sea and the cold water, rich in nutrients from the bottom, moves towards the surface, which causes the temperature of the water to decrease and increase water productivity, promoting an increase in the biomass of fish and invertebrates in the region (Cortés, 2014, Lizano & Alfaro, 2014).

Also, we are proud to mention the active participation of children and adults from the El Jobo community in the project. These people are known as "rayeros", who are responsible for capturing, processing and teaching others about important aspects of batoids, promoting the conservation and protection of these.

4. Briefly describe the involvement of local community and how they have benefitted from the project (if relevant).

Currently, we have the active participation of three children and a local ex-fisherman, who collaborates in the processing and data collection of batoids. In addition, this project has promoted the arrival of volunteers, students and tourists to the community of El Jobo, which generates economic income to the community, both directly and indirectly. The NGO ETC, has managed to coordinate that the majority of people who come to learn about the project, stay in the houses of the communities and also contract the food services, which generates income to local families.

5. Are there any plans to continue this work?

We intend to continue with this project, in order to cover new sampling areas and extend the study of acoustic telemetry to species that we consider are not residents, in order to provide relevant information on the population structure and spatial ecology of the different species of batoids that inhabit the coasts of Costa Rica and in this way, reduce the existing information gaps. At the same time, continuing with this type of studies allows us to actively involve local people, which can generate an economic alternative for them.

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

A detailed report of the results obtained will be made to the Guanacaste Conservation Area, which will also be available to the public, with the purpose of serving as a baseline of research for future projects in the area. Similarly, it is expected to make a publication so that the scientific community can have the results obtained. Inform other teams that are conducting acoustic studies in the Pacific region of Costa Rica to establish working networks, with the purpose of establishing a collaboration between projects.

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

The grant awarded by Rufford Foundation was used during the first months of the project. During the first month, most of the funds were used for the purchase of acoustic telemetry equipment (two receivers and four transmitters) and taxes. The rest of the money was used to cover expenses generated during the range test, taking into account the rental cost of diving equipment, rent and fuel for boats during the first 3 months of the project.

8. Budget: Please 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.

Item	Budgeted Amount	Actual Amount	Difference	Comments
2 VR2W acoustic receivers (£1212 each)	2424	2424		
1 VEMCO BLUETOOTH COMM KIT	0	185	185	The purchase of this equipment in the budget is not contemplated
6 V9 acoustic transmitters (£267 each)	1610	1068		The number of transmitters is reduced to 4 to cover expenses generated by customs taxes
Customs tax payment, storage and contracting of customs agency for the removal of acoustic telemetry equipment	0	416	416	The purchase of this equipment in the budget is not contemplated
Diving gear	0	282	282	Rufford funds must be allocated to cover the rental of two diving equipment on three occasions, as the CIMAR-UCR does not provide the equipment.
Boat rental (£80/day)	955	320		Boat rental is required on 4 occasions to complete the range test.
Fuel for field vehicle	0	305	305	We did not receive support from the CIMAR-UCR to cover the cost of moving to the sampling site, so the remaining funds are used to cover gasoline during the first 6 field trips, that is, the first three months of sampling.

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

It is expected to apply to more funds to increase the number of batoids marked with acoustic telemetry. Likewise, place transmitters to species that are considered as seasonal and at the same time, place acoustic receivers on beaches next to El Jobo Bay, to increase the study area and determine the spatial ecology of different species. In the same way, we intend to implant satellite tags to species considered as highly migratory (*Mobula munkiana*), since these individuals can only be

observed at a specific time of the year and during the first stages of life. This information will help determine if Costa Rica's North Pacific coasts are used as breeding grounds for various batoids species. For this, it requires donations from renowned organizations such as the Rufford Foundation.

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

The Rufford Foundation logo was used to make stickers that help identify the owner of the acoustic receivers that are placed in the water. In addition, every time our project is exposed to the public, mention is made of the collaboration we have received from the Rufford Foundation.

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

Sebastián Hernández is a professor and coordinator of the Molecular Biology Laboratory in Veritas University (Costa Rica). His area of research focuses on population aspects of Elasmobranch species, including the reproductive biology, genetic diversity and connectivity of sharks and rays. He also focuses on the morphological and genetic identification of shark species, especially those involved in the shark fin trade to Asian markets. He becomes a fundamental piece in this pilot project since for several years, he has carried out field work with batoids from Chile, Peru and now Costa Rican, the reason why his experience in the field is important for the surveys and collection of ray samples.

Sebastián Guardia, is the veterinarian who has been in charge of carrying out a physical examination of the batoids caught, as well as actively collaborating in the field to obtain the necessary data to carry out our study and assist during surgeries to implant the transmitters to each batoid. Additionally, he is investigating pathologies of batoids associated with the eye, since organisms with certain conditions in the eye have been observed, resulting in batoids with absent, degenerated, bloody and normal eyes.

Ricardo Obando is a former fisherman from the community of El Jobo, who has become a fundamental part of our team, as it has helped us substantially to collect data on diversity, abundance and biomass of batoids. In addition, due to the empirical knowledge that he has about the sea to be a former fisherman, Ricardo helps us provide the necessary information to place the acoustic telemetry equipment in the most indicated place, where the team will not be affected by currents or other environmental phenomena.

12. Any other comments?

During 2017, a total of 163 batoids were processed, of which 121 (74.23%) were marked with an external tag type T-Bar, while 42 batoids (25.76%) were not placed any type of tag due to which were neonates (disk width <17 cm) or were relatively

large to capture (disk width> 1m). On the other hand, until July 16, 2018, a total of 440 batoids were processed, of which 335 (76.14%) were marked, while 117 batoids (26.59%) were not marked. It is important to mention that, to mark long batoids, you must capture the batoids by means of fishing gear or implement a modification in the tip of the spear gun to be able to mark the batoids without needing to capture them, thus reducing the risks generated when catching batoids by means of fishing gear.

In 2017, a total of 60 (36.82%) males, 97 (59.51%) females and 6 bat (3.68%) were classified as undefined, due to the fact that they were only sightings (Figure 1a). While in 2018 146 males and 294 females were processed (Figure 1b), the sex ratio for males and females is 0.62: 1 in 2017 and 0.50: 1 in 2018.

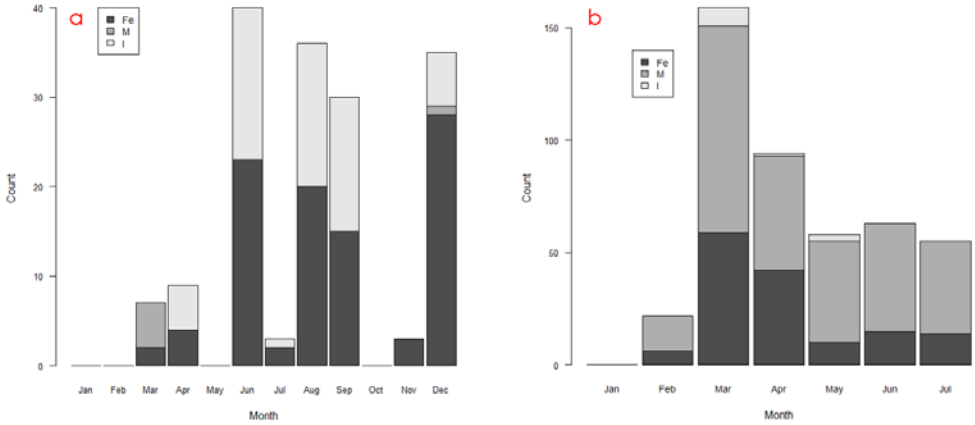

Figure 1. Monthly sex distribution of batoids found at El Jobo Bay during 2017 (a) and 2018 (b). Males (M), Females (Fe) and Indefinite (I).

We report the presence of families Rhinobatidae (*Pseudobatos leucochrynchos, Pseudobatos glaucostigma* and *Pseudobatos sp*), Trygonorrhinidae (*Zapteryx xyster*), Narcinidae (*Diplobatis ommata* and *Narcine entemedor*), Gymnuridae (*Gymnura crebripunctata*), Urotrygonidae (*Urobatis halleri, Urotrygon chilensis, Urotrygon munda, Urotrygon rogersi* and *Urotrygon sp*) and Mobulidae (*Mobula munkiana*), the Urotrygonidae family being the most represented, both in diversity and abundance of species (Figure 2). In addition, it is evident that species such as *U. halleri* and *U. chilensis* are present throughout the year, contrary to what happens with other species, which can only be observed during certain times of the year. The increase in species diversity at certain times of the year (December to April-May) coincides with the arrival of a phenomenon known as seasonal upwelling in the North Pacific of Costa Rica.

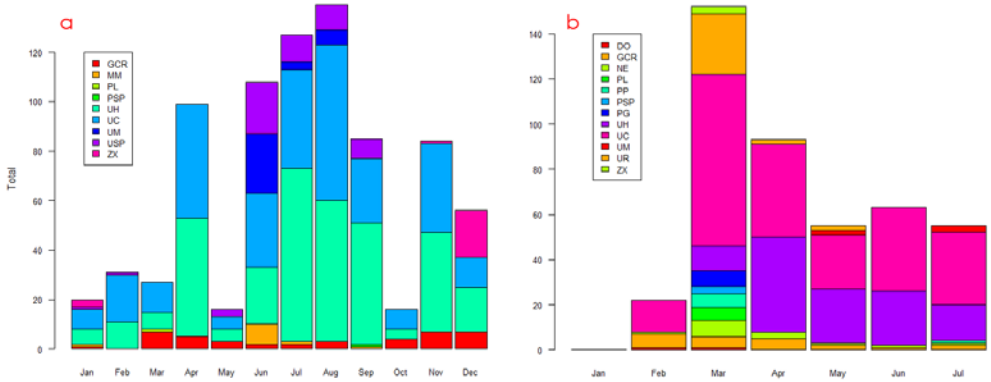

Figure 2. Monthly distribution of abundance of batoids reported in El Jobo Bay during 2017 (a) and 2018 (b). *G. crebripunctata* (GCR), *M. munkiana* (MM), *P. leucorhynchos* (PL), *Pseudobatos sp* (PSP), *U. halleri* (UH), *U. chilensis* (UC), *U. munda* (UM), *Urotrygon sp* (USP) and Z. xyster (ZX).

It should be noted that as of March 2018, with the arrival of a volunteer attracted by the Rufford Foundation website, the methodology of segregating El Jobo Bay was implemented in four different zones (Figure 3). It was observed that, in the areas closest to the coast, there is the greatest diversity of species, contrary to what happened mainly in zone C, in which it has only been possible to observe the presence of *U. halleri* and *U. chilensis* throughout the year, which again confirms the residence of these two species throughout the year (Figure 4).

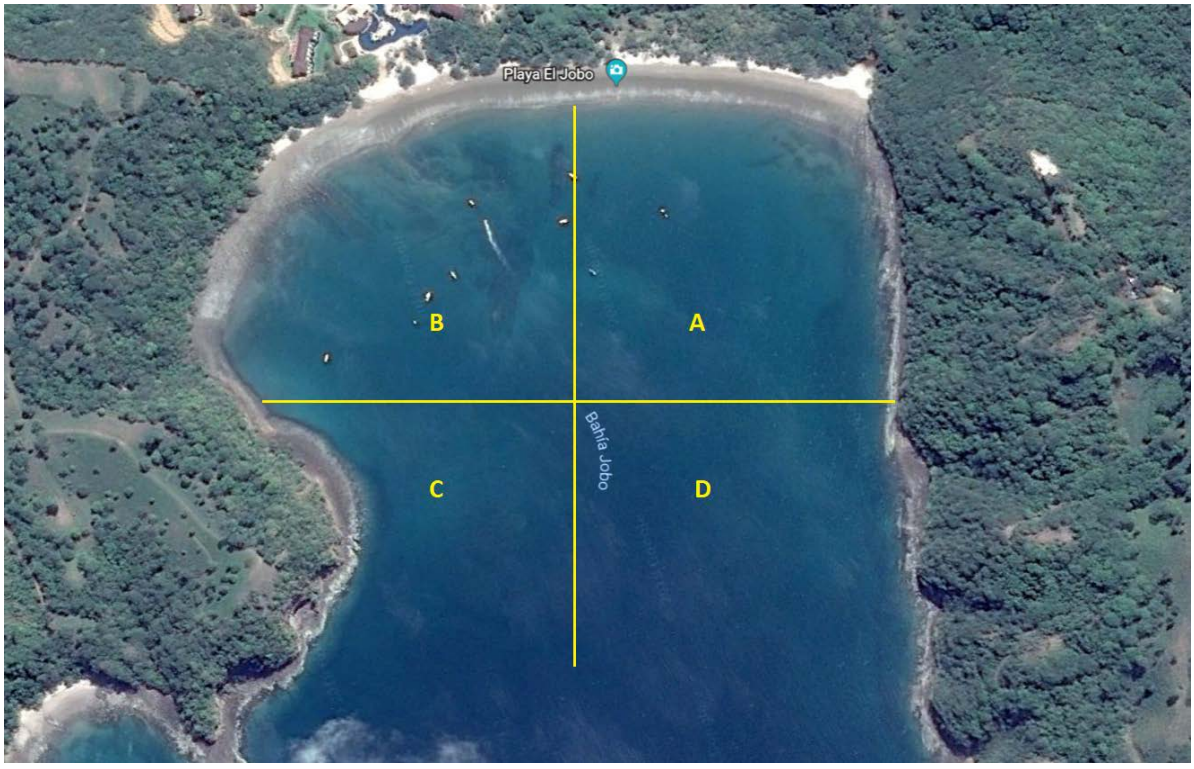

Figure 3. Segregation of El Jobo Bay in four sampling zones

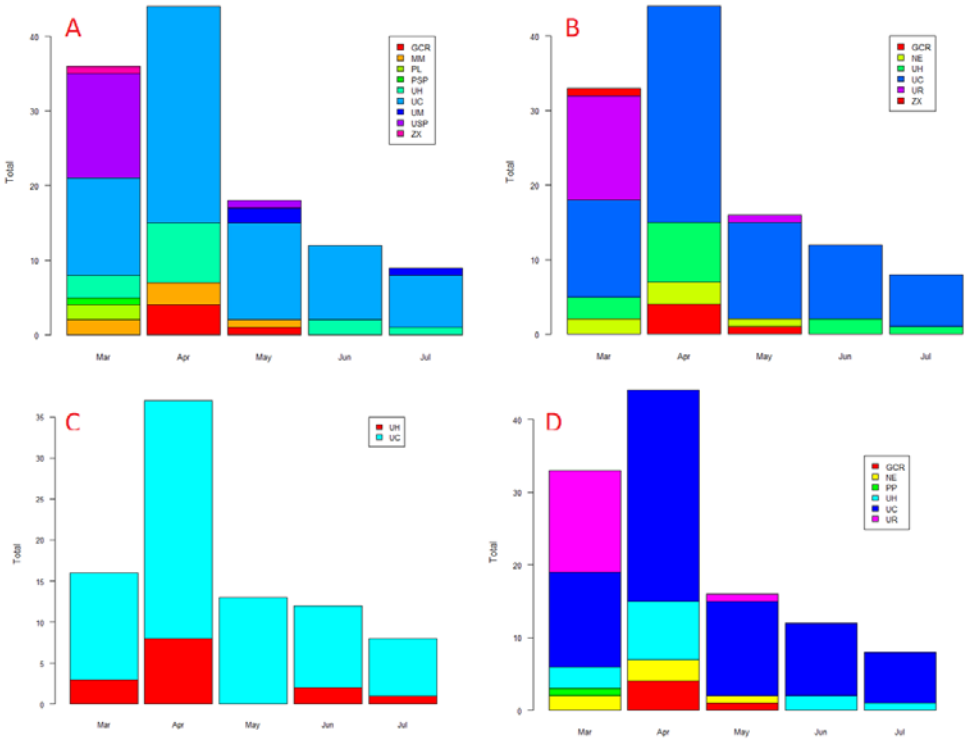

Figure 4. Monthly distribution and segregated by zones of the abundance of rays reported in El Jobo Bay during 2018. *G. crebripunctata* (GCR), *M. munkiana* (MM), *P. leucorhynchos* (PL), *Pseudobatos sp* (PSP), *U. halleri* (UH), *U. chilensis* (UC), *U. munda* (UM), *U. rogersi* (UR), *Urotrygon sp* (USP) and *Z. xyster* (ZX).

Finally, an analysis of the disc width (DW) size distribution of the species that had more than 30 individuals was carried out. In 2017, *U. chilensis* show no significant differences in disc width throughout the year. However, during the month of June, *U. chilensis* shows the smaller batoids, which may reflect that during this month the females arrive to spawn within the Bay (Figure 5a). This pattern is also observed *in U. halleri,* since at certain times of the year the organisms with the smallest sizes are found, evidencing the presence of neonates in certain months (Figure 5b).

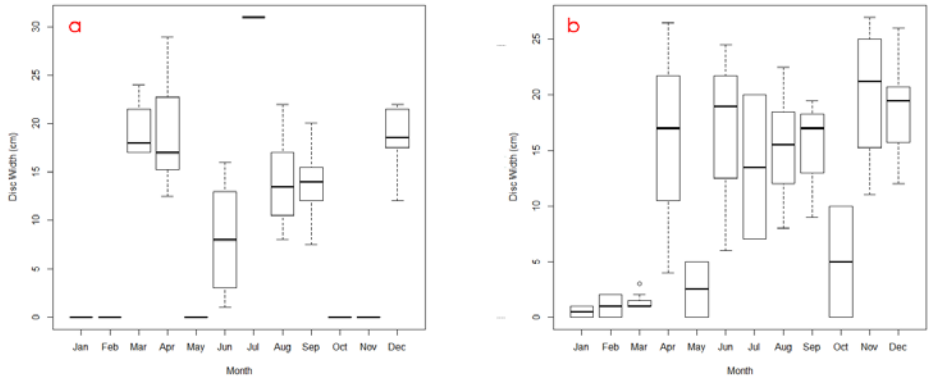

Figure 4. Monthly distribution of disk width (DW) in en *U. chilensis* (a) and *U. halleri* (b) in El Jobo Bay

On the other hand, respect to the size distribution for 2018, a significant difference is shown in *N. entemedor* (Figure 5a), contrary to what happened in *G. crebripunctata* (Figure 5b), *U. halleri* (Figure 5c), *U. chilensis* (Figure 5d) and *U. rogersi* (Figure 5d). In addition, it is possible to differentiate the months in which there is a greater presence of organisms of smaller size, which may coincide with the spawning seasons of some species, showing that El Jobo Bay can be used as a breeding area for several species.

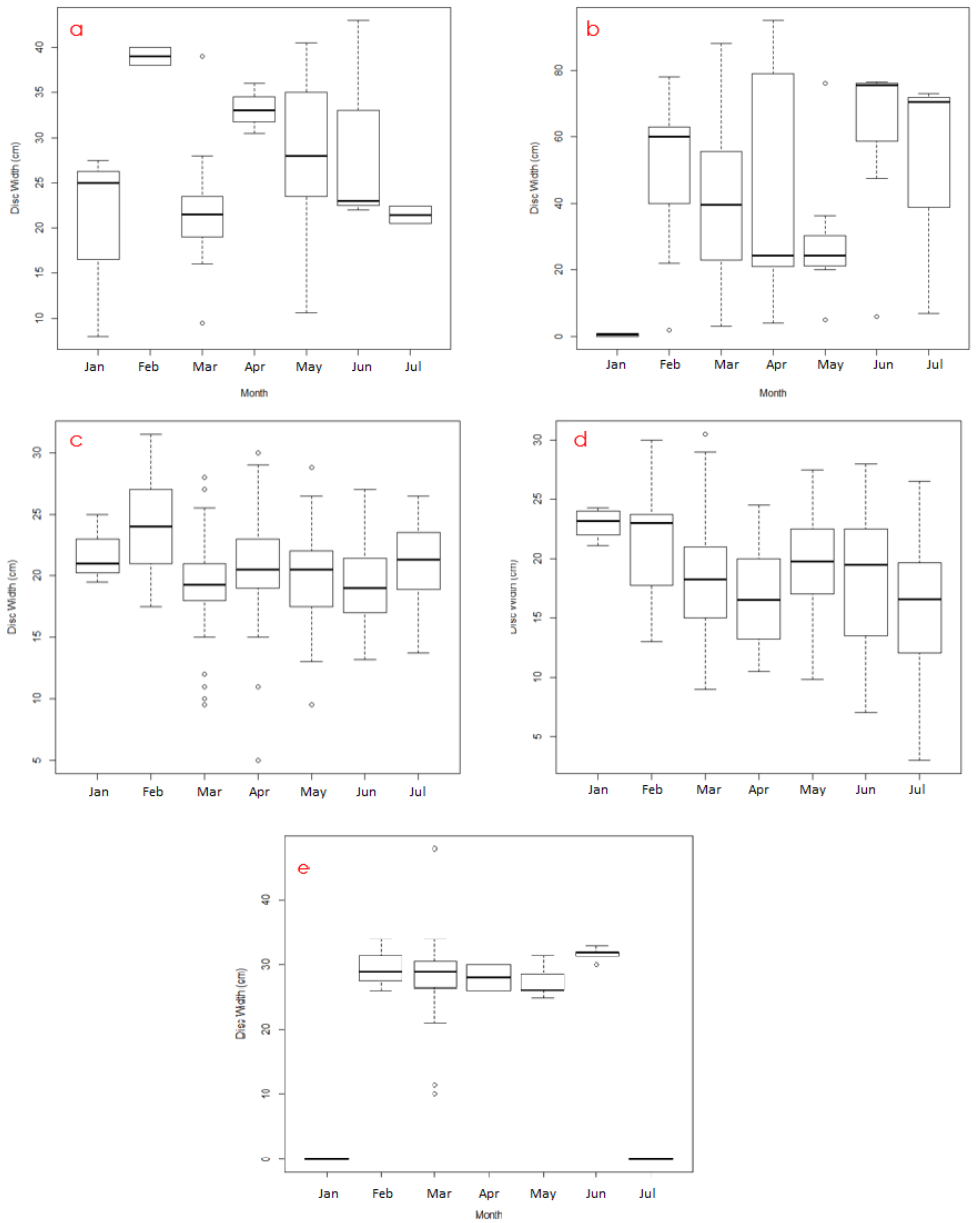

Figure 4. Monthly distribution of disc width (DW) in *N. entemedor* (a), *G. crebripunctata* (b), *U. halleri* (c), *U. chilensis* (d) and *U.* rogersi (e) in El Jobo Bay