

## The Rufford Foundation Final Report

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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](mailto:jane@rufford.org).

Thank you for your help.

**Josh Cole, Grants Director**

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Grant Recipient Details	
<b>Your name</b>	Laia Juliana Muñoz Abril
<b>Project title</b>	Genetic diversity and population structure of yellowfin tuna ( <i>Thunnus albacares</i> ) between Ecuador and México
<b>RSG reference</b>	21191-2
<b>Reporting period</b>	One year. December
<b>Amount of grant</b>	£5000
<b>Your email address</b>	laiajulianamu@gmail.com
<b>Date of this report</b>	13/01/2018

**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
Collect samples of red muscle of yellowfin tuna from artisanal ports of mainland Ecuador, Galápagos and Cabo San Lucas, Baja California Sur.				We had excellent field trips and collect the expected number of samples for the analyses from all the locations involved in the study.
Perform a genetic analysis of the samples to compare individuals from both countries and determine if they belong to the same population.				We completed all the analyses and obtained results that helped us establish a new collaboration further the study including genomic analyses.
Publish our results.				We have established a new collaboration with Dr Peter Grewe at CSIRO, Australia, for genomic analyses.

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

- Natural disasters (a series of hurricanes and a 7.1  $M_w$  magnitude earthquake in Mexico) changed our schedule delaying the arrival of the samples from Mexico, but managed to compensate this delay by working particularly harder preparing PCR and genotyping the samples to complete this phase of the project.
- Our biggest concern is the reduction of fishing at the different fishing ports. Our field trips required more days and more effort, and it is important to note that since we started with the project, a constant reduction in the catches is evident each year. This could be a consequence of continuous overfishing, but illegal fishing, which is a severe problem, could also play an important role in this tendency. I participated as a co-author in a paper (Alava et al. 2017) where we exposed the illegal fishing of tuna, shark and other species as a threat for Ecuadorian marine ecosystems.

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

1. We found a large number of alleles in our matrix (47 was our highest), a big number of alleles is normal in a population with a high number of individuals. This large variability makes us think that microsatellites can pose a problem in

the analyses of populations of big fishes. To evaluate our hypothesis, we put together our data from Galapagos and mainland Ecuador and we analysed our results for different stets: for locality and for year. In our robust statistical analyses, we could observe how the number of alleles increases when the number of individuals increases. We could observe how the heterozygosity and Hardy Weinberg equilibrium changed.

2. We did not find a significant structure difference between the populations of Mexico and Ecuador, but there was a little difference in populations each year. We observed how the populations changed between years (Figure 1) and these results are congruent with the aforementioned statement. It is possible that the high number of alleles won't allow us to observe the real behaviour of the populations.

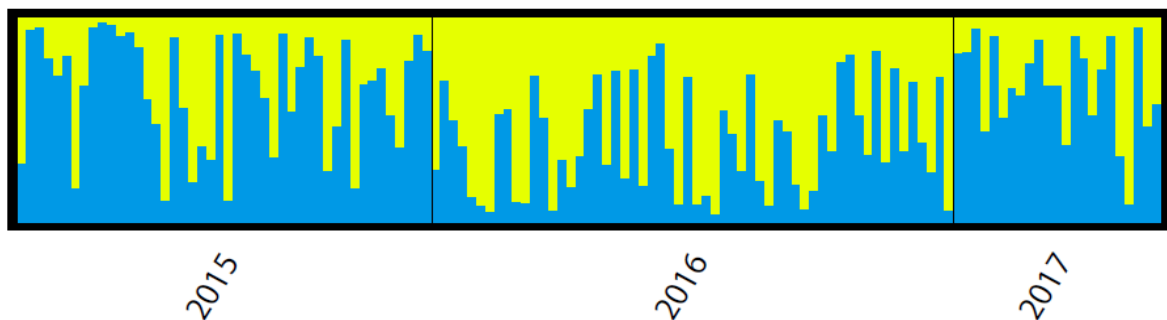


Figure. STRUCTURE cluster of individuals catch at Santa Rosa (mainland Ecuador).

3. After we obtained our results, we talked with authors working on similar studies elsewhere to comment our outcomes. We managed to stablish contact with the corresponding author of: Barth et al. 2017 and with Peter Grewe at CSIRO, Australia. We found similar results with microsatellites and the expert's suggestion was to perform genomics analyses on my samples, which is becoming a more useful tool in fishes' population studies. Thanks to the Rufford foundation we started working with Peter Grewe in order to analyse our samples with SNPs, the latest and most accurate tool in this area which will give us a better understanding of the yellowfin tuna population in the eastern Pacific. We plan to publish our results with microsatellite and SNPs analyses in 7 months. Our ultimate and most important objective with this project is the conservation of tuna in the eastern Pacific, and these analyses are crucial in the pursuit of it.

#### **4. Briefly describe the involvement of local communities and how they have benefited from the project (if relevant).**

We have established a great working relationship with the fishing communities, and this is reflected in the number of samples we can collect. Most fishermen are eager to help us and offer us vital information about their labour. In the past season, the general feeling is that fishermen are severely worried for reduction of the catches:

they must spend longer out in the ocean, exposed to the regular risks of their labour for longer periods and return to port with less catches. It is important to mention that fishing is the activity that generates the most jobs in Ecuador. We plan to develop workshops about responsible fishing and consumption with the rest of the community and they are very interested in continuing collaborating with the project.

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

Definitely. Thanks to the Rufford Foundation, we obtained very interesting outcomes that motivate us to further our project, widening the current front of study and opening a new one. In the genetics and genomics front, we want to include more individuals and new sites in the eastern Pacific, and now we would like to analyse mercury and other heavy metal pollution along the trophic chain.

In July 2017 I participated in the 13th International Conference on Mercury as a Global Pollutant (ICMGP) and I could establish contact with Elsie Sunderland at Harvard University. Elsie collaborated with us in the methyl-mercury analyses of my samples and the results are extremely interesting and concerning, because they made it clear that there are two populations (Galapagos and mainland Ecuador) in relation with the mercury levels in tissue of the individuals. Hence our objective to start a larger project to evaluate the levels of mercury and other heavy metals.

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

Publication in different journals is one objective but also, we consider that conservation is effective only if it includes working with local communities. For this reason, we will start workshops in the local communities in the next months with help of Galapagos National Park Directorate and the Environment Ministry of Ecuador. These workshops will aim to offer a clear idea of our results and what they suggest regarding the current state of the fisheries and suggest better and more responsible practices both for fishing and consumption.

#### **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 was used during these past 12 months, in different stages. It helped us fund the two field trips, the shipping of the samples and the lab analyses.

#### **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
Field work	1900	2200	-300	Both in Galapagos and mainland Ecuador there was a reduction in fish catches and we needed more days for getting the samples. Prices of goods in Galapagos were significantly higher due to the wreckage of the ship that transports supplies (e.g. food) to the islands and that affected our budget a little.
Laboratory instrument	1500	1500		
Sequencing	800	800		
Microsatellite primers	300	300		
Laboratory analyses	500	200	300	

Calculated on a rate of exchange of 1.22 US dollars for each British Sterling Pound. US dollar is the current currency in Ecuador

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

This project was initiated with one objective: understand how the yellowfin tuna populations are. This is the starting point of a more complete project that aims to help in the conservation of tuna in the eastern Pacific. As we mentioned before this larger project will have two lines of research: widening the genetics and genomics analyses with more individuals and new fishing sites, and including mercury and other metal pollution along the trophic chain, including both the prey and predators of the tunas (i.e. smaller fishes, marine birds, sea mammals and humans).

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

Yes, in all the conferences I participated, in every poster and presentation, as well as in every workshop, I used the Rufford Foundation logo as stated in the contract prior to receiving the funds:

**12<sup>th</sup> Latin America Biennial Meeting.** Poster presentation. High concentrations of Mercury in yellowfin tuna (*Thunnus albacares*) from the Galápagos Marine Reserve and continental Waters, Ecuador. Providence, Rhode Island. September, 2017.

**13<sup>th</sup> International Conference on Mercury as a Global Pollutant.** Poster presentation. High concentrations of Mercury in yellowfin tuna (*Thunnus albacares*) from the Galápagos Marine Reserve and continental Waters, Ecuador. Providence, Rhode Island. July 6-21, 2017.



**III Congreso Internacional de Biotecnología y Biodiversidad.** Speaker: Diversidad y estructura genética de atún aleta amarilla (*Thunnus albacares*) en la Reserva Marina de Galápagos y Ecuador continental. Guayaquil, Ecuador. October 10-13, 2016.

### 11. Any other comments?

This project has come a long way since it first started, offering very interesting results and opening new questions that require urgent answers. The funding offered by the Rufford Foundation proved to be vital to the success of this phase of the project and we look forward to continuing working in this matter. This will simply be impossible without the funding of the sponsors and we will be definitely applying for the next Rufford Grant with the hopes of continuing working with the support of the foundation.

