Final Evaluation Report

We ask all grant recipients to complete a project evaluation that helps us to gauge the success of your project. This must be sent in **MS Word and not PDF 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 – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please DO NOT fill in and submit this form until the project has been completed.

Complete the form in English. Note that the information may be edited before posting on our website.

Please email this report to jane@rufford.org.

Your Details	
Full Name	Rocio E. Álvarez Varas
Project Title	Population genomics and adaptation of the black turtle in the Pacific Ocean: management and conservation implications
Application ID	35621-1
Date of this Report	06-30-2024

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
Examine the genetic structure between *C. mydas* rookeries in the Eastern Pacific region.			X	Genomic libraries of 96 individuals (15-20 individuals per location) were prepared at the University of Massachusetts, which were sequenced at low coverage (2-4x) in Novogene, USA, using the Illumina platform. The nesting areas of *Chelonia mydas* studied included Hawaii (USA), Revillagigedo and Michoacán (Mexico), Guanacaste (Costa Rica) and Galapagos (Ecuador). Population structure analyses between areas were performed using SNPs recovered from the nuclear genome.
Estimate the dispersal patterns and delimitate management units (MUs) for *C. mydas* Eastern Pacific region.			X	We reanalysed SNPs collected during my doctoral research using a reduced representation technique called dartseq, focusing on individuals from foraging areas. This approach allowed us to establish connections between three foraging grounds of *C. mydas* in Chile (Easter Island, Arica, and Atacama) and nesting areas in Galapagos and Mexico. These findings were published in the journal Animals in 2022 (https://doi.org/10.3390/ani12121473).
Estimate the proportion of the genomic regions under selection and their enriched		X		We identified selective regions within the 5 nesting areas using PCAngsd software. Currently, we are conducting further analyses to compile a comprehensive list of

biological function throughout the *C. mydas* genome.				candidate single nucleotide polymorphisms (SNPs) using both PCAngsd and pcadapt programs. We also are calculating pairwise Fst values between localities and generate Manhattan plots. Following SNP selection, we will investigate the biological functions associated with these variants. It should be noted that data analysis process has been time-consuming due to the large file sizes (complete genomes) and the computational requirements of softwares employed. We are currently working with two national servers: NLHPC at the Universidad de Chile, and HPC OCEANO at the Pontificia Universidad Católica de Valparaiso.
Provide management and conservation recommendations based on the project results to the local communities involved.		X		The project progress has already been disseminated to the Rapa Nui community during August 2023. A next outreach campaign is planned for July 2024 in Rapa Nui and October 2024 in Atacama, northern Chile. At both events, the final project results will be disclosed.

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

a) **Regional Management Units:** We have delineated three Management Units (MUs) or metapopulations for green sea turtles in the Eastern Pacific: i. Hawaii, ii. Northeastern Pacific (Revillagigedo and Michoacán in Mexico), and iii. Southeastern & Central Pacific (Guanacaste in Costa Rica and Galapagos in Ecuador). These findings contrast with previous studies suggesting greater genetic differentiation among individual nesting areas. Likewise, this information is crucial for the conservation and management of this endangered species at a regional scale.

b) **Connectivity**: Our results have allowed us to understand the genetic connectivity between three Chilean foraging grounds of *C. mydas* (Easter Island, Arica, and Atacama) and nesting sites in the Eastern Pacific. Specifically, we found that most individuals feeding in Chile come from the Galapagos and Mexico. These results are crucial for establishing cooperation in research and conservation among these countries.

c) **Outreach:** We have disseminated the project results within the Rapa Nui community, reaching approximately 300 people from local schools, NGOs, and governmental and private entities such as the Municipality, National Fisheries Service (Sernapesca), the army, National Tourism Service (Sernatur), among others. A next campaign is scheduled between July 28 and August 08, 2024, to disclose the final results of the project. Additionally, we plan to disseminate results in Atacama in October 2024.

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

One unexpected difficulty that arose during the project was the COVID-19 pandemic. The pandemic restricted travel and field activities, making data collection challenging. To address this challenge, the project team adapted by using remote research methods, such as analysing existing data and collaborating with researchers from other countries. Additionally, the project's lead researcher travelled to Germany for training in computer data analysis. This trip was also delayed due to instability in Europe caused by the Russia-Ukraine war. Furthermore, we experienced delays due to issues with the server used for our data analysis, as we required a significant amount of space and time for analysing the complete genomes of *C. mydas*, which are very large.

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

The project has engaged local communities of Rapa Nui in various activities, including:

- Community open talks to present project results.
- School talks to educate children about the importance of sea turtles.
- Meetings with key local stakeholders to discuss project implications for sea turtle conservation and management.
- Training local divers and fishermen for the capture and monitoring of sea turtles in the water.

Local communities have benefited from the project in several ways:

- Increased knowledge about sea turtles: Local communities now have greater understanding of sea turtle biology, ecology, and conservation status.
- Enhanced participation in conservation: Local communities are more actively involved in sea turtle conservation efforts. In particular, the information generated here constitutes a scientific basis for the zoning of the marine coastal protected area in Rapa Nui (AMCP-MU). This information has been delivered in writing to the entities involved in the management of this protected area (Council of the Sea "Koro Nui", Municipality of Rapa Nui, Sernapesca, and Fishermen's Union).

5. Are there any plans to continue this work?

The project team has plans to continue work in the following areas:

Research:

- Continue functional analysis of genome regions under selection associated with regional management units delineated in this project.
- Research on the ecological and health status of green turtle aggregations in Rapa Nui and Atacama (natal origin, diet, heavy metal loads, clinical health parameters, etc.).

Local Training and Environmental Education:

- Increase the number of locally trained individuals in the capture and monitoring of sea turtles.
- Form a local support group for monitoring and education on sea turtles in Rapa Nui and Atacama.
- Continue environmental education and awareness activities in local communities and among visitors.

Evidence-Based Conservation:

- Continue generating scientific information for sea turtle conservation and management in Chile (Atacama and Rapa Nui).
- Advise governmental entities on management plans for already established protected areas in Atacama and Rapa Nui.

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

The results of the project will be shared with the scientific community and the public through the following channels:

- Publications in peer-reviewed scientific journals.
- Presentations at scientific conferences.
- Talks and workshops for the community.
- Articles in social media.
- My lab website (https://sites.google.com/view/evolutionarydynamicspucv)

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

- To continue the research to strengthen the scientific foundation used in management and conservation plans for green sea turtles at regional (Eastern Pacific) and local levels (Chile).
- To form a local group that supports turtle monitoring and environmental education activities in Atacama and Rapa Nui, with the aim that in the future it will autonomously manage a conservation program.

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 logo of The Rufford Foundation was included in all presentations held with the Rapa Nui community during our 2023 campaign. Similarly, it will be included in all materials used in the August 2024 outreach campaign. Additionally, The Rufford Foundation was acknowledged in the paper published in 2022 in the journal Animal, as well as in those currently under review in the journals Marine Policy and Archives of Environmental Contamination and Toxicology.

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

- Dr. Carlos Gaymer: Sponsoring Researcher (postdoctoral funding)
- Dr. Lisa Komoroske: Associated Researcher (USA)
- Dr. Peter Dutton:Associated Researcher (USA)
- Dr. Camila Mazzoni: Associated Researcher (Germany)
- Prof. Carlos Delgado: Research Collaborator (Mexico)
- MSc. Maike Heidemeyer: Research Collaborator (Costa Rica)
- Dr. Macarena Parra: Collaborator Researcher (Ecuador)
- Dr. Alejandro Iduya: Field Veterinarian (Rapa Nui)
- Nayade Campos: Field Research Assistant (Rapa Nui)
- Nels Hereveri: Field Support (capture and monitoring, Rapa Nui)
- Gary Palma: Field Support (capture and monitoring, Rapa Nui)
- Kevin Robles: Field Support (capture and monitoring, Rapa Nui)
- Hugo Gutiérrez: Field Support (capture and monitoring, Rapa Nui)

10. Any other comments?

I am tremendously grateful to have received this funding, as it allowed us to conduct high-quality research that is extremely valuable for establishing management and conservation plans for green sea turtles in Chile. Furthermore, it was an international collaborative effort that contributed information across several countries in the Eastern Pacific region. I appreciate your flexibility and understanding regarding the project's delayed completion due to reasons beyond my control. I hope to have met your expectations and look forward to continuing our work with your support in the future.