Final Evaluation Report

Your Details	
Full Name	Juan Francisco Tellarini
Project Title	The invasive axis deer or chital as a potential new threat for the southernmost and most endangered population of the marsh deer.
Application ID	24842-1
Grant Amount	£5,000
Email Address	colojft@gmail.com
Date of this Report	March 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
To obtain the spatial extent of the axis invasion through occupancy models.				It was possible to carry out field work in 2018, even reaching places in the study area where the difficulty of access was very high. Single season occupancy models were developed from this sample. It was not possible to develop occupancy models with previous data because the number of indirect signs of axis presence was insufficient, although these data contributed to understand the process of invasion.
Develop fine-scale habitat suitability models for the axis deer in the Paraná delta.				The data collected on the field sampling and the landscape metrics obtained from land use maps enabled the development of models, which showed interesting results for planning priority zones for marsh deer conservation actions (Figure 4).
Perform a genetic comparison with other axis populations, trying to identify the population source.				We were able to determine the population limits and tracked the source of individuals to the lower delta lower delta of the Paraná River.

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

We had difficulties in the calibration process of the specific microsatellite primers because, of the 10 microsatellite primers designed specifically for axis deer, five had never been used in the Argentinean populations (because they are monomorphic or not replicate). We incorporated 30 microsatellite primers and we found 11 polymorphic loci.

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

The three most relevant outcomes arose from the analysis of the systematic sign survey, the development of occupancy models and the population genetics studies:

- We observed an expansion of the known invasion foci for the species, such as records at new private properties, which would show that it has dispersed to other places where it would be scarce (Figure 1).
- Occupancy models showed that the axis deer occupancy is probably greater at sites with a lower proportion of freshwater marshes (Figure 2), an environment that had naturally dominated the region and has been replaced by productive environments (commercial forestry plantations and pasture lands). The axis occupancy probability would increase at sites with less abundance of the native deer, the marsh deer (*Blastoceros dichotomus*, Figure 3). This could be due to the fact that in the early stage of the invasion, the chital selected places with few to no native deer. It could also be because the marsh deer could act as an indicator (even better than landscapes metrics) of the character and intensity of anthropic disturbance to the delta environment.
- The population genetics studies showed that the axis deer in central-eastern Argentina are divided into two populations with a low (or no) migration rate. The axis deer population of the lower delta of the Paraná River is connected with the Entre Ríos province population. Our results suggest that the Paraná delta axis deer population was originally formed by individuals arriving from the Entre Ríos province population from this would come the individuals that formed the population.

4. What do you consider to be the most significant achievement of this work?

This work enabled important achievements on different levels. The main achievement was elucidating the origin of the axis deer population of the lower delta and providing proof of their connection with the population of Entre Ríos province. Additionally, it enabled a deeper understanding of the environment used by this species, which can have different application: it can be useful to guide the conservation efforts destined to native deer protection and axis deer management. There was also a methodological achievement: honing the occupancy sampling tool, which proved to be very useful for this kind of study, and we will be applying in the future for monitoring axis deer spread in the region.

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

According to our perspective, local communities are key for nature conservation. In this case, the coexistence between local producers and villagers and marsh deer is essential, and it can be achieved if they get to know more about this species and their healthy environment.

Based on this approach, we have participated in forest producers and livestock farmers meetings, with the National Institute of Agricultural Technology (INTA), where we discussed the need to conserve the marsh deer and report the presence of the axis in their farms.

We set up an informative stand in the Islander festival ("Festival del Isleño") where villagers, producers and other actors of the local community meet (Figure 5). We

have also held several environmental education workshops for children and adolescents in rural schools.

During the isolation due to the COVID-19 pandemic, we have continued to be part of activities involving the local communities. I participated in three virtual workshops with producers, policies managers, villagers and park rangers. These meetings which were organised by the National Ministry of Environmental and Sustainable Development (Ministerio de Ambiente y Desarrollo Sostenible) together with other provincial ministries.

6. Are there any plans to continue this work?

Yes! I expect to be finishing my PhD thesis, on the relationship between axis and marsh deer, in the next few months. I have submitted a postdoc proposal to work with the relictual population of marsh deer in Entre Rios province and hope I can begin to do it this year.

The current project of monitoring axis deer invasion will continue to be carried out by me and other members of my research team. At the same time, we will focus our efforts on developing management measures for axis deer populations in priority locations for marsh deer conservation.

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

The results of this work have been presented in two scientific symposiums: the III workshop of Pantano Project (Proyecto Pantano) in the Natural Sciences Argentine Museum (MACN-CONICET); in November 2019 and the XXXII Argentine Meeting of Mammalogists (Jornada Argentina de Mastozoología) in the city of Puerto Madryn (Figure 6).

As I mentioned before, I participated in three virtual Argentine invasive species workshops whit producers, policies managements, villagers and park rangers where our newest results were discussed with the local communities.

This project is part of my PhD thesis, which I will be presenting and defending publicly in a few months.

We are finishing a scientific paper involving these results which we will submit for publication to an international Journal.

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

The grant was used for fieldwork and acquiring laboratory supplies from August 2018 until September 2019, according to what we had foreseen. However, due to the restrictions associated to the pandemic, the laboratory for the genetic work was closed, thus, laboratory work (Figure 9) was postponed until 2021. The laboratory work and the data analysis were finished during 2021.

9. 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.

The local exchange used was the value of £ sterling converted to Argentine pesos in July 2018 (1 GBP = 36.09 ARS)

Item	Budgeted Amount	Actual Amount	Difference	Comments
Fieldwork activities	3000	2377	-623	The amount was used to carry out three field surveys, one in the Paraná delta to monitor the species and carry out the models and the other two to collect samples. This includes food and accommodation (692.71 GBP), vehicle gas and maintenance (1662.51 GBP) and volunteer field insurance x 4 (22.16 GBP).
Laboratory supplies	2000	2626	+626	The amount was used for K proteinase x 2 (831.92 GBP), Taq polymerase x 4 (860.24 GBP), plastic containers and tips (247.54 GBP), latex gloves (260.46 GBP) and microsatellite primers (426.46 GBP).
	5000	5003	+3	

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

We consider state involvement in this issue to be key for its future development. In that sense, we have begun a conversation with state management agencies (national and provincial), so that the necessary measures are taken to stop the invasive species at this early stage of the invasion. This is progressing slowly and with many difficulties due to the economic, social and political problems in which our country is immersed.

On the other hand, we know that accurate and current data are necessary for effective conservation efforts. Therefore, we will continue monitoring the axis deer spread.

Finally, information on the native species affected by the axis spread is also essential to understand the relationship between these two species and evaluate management options. We are reinforcing our work with the relictual sub-population of the marsh deer in the Entre Rios province area of the lower delta of the Parana River.

11. 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, we used the Rufford Logo in the two scientific meetings where this work was presented (detailed in question 7). One of them is pictured in Figure 6.

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

Dr. Javier Pereira: Proyecto Pantano leader.

Lic. Fernagni Dario Martin: Proyecto Pantano member and PhD student. He has been involved throughout the sampling in the Paraná River delta. He works in the study area researching mammal communities in the different productive modalities (Figure 7).

Ms. Natalia Fracassi: Proyecto Pantano member and researcher in INTA Delta. She is one of the most important nexus between the local communities and Proyecto Pantano. She has been working in the study area for 10 years and fully understand the logistic and social dynamics.

Lic. Diego Varela: Proyecto Pantano founding member. He participated in the first marsh deer surveys in the study area and collaborated in the first step of this work (Figure 7).

Lic. Bernardo Lartigau: Proyecto Pantano founding member. He participated in the first marsh deer surveys in the study area and collaborated in the first step of this work (Figure 7).

Lic. Daniela Pereira: CONICET technician, geneticist. She is currently working on microsatellite primers calibration.

Dr. Jimena Gomes Fernandez: CONICET technician, geneticist. She is currently working on microsatellite primers calibration.

Volunteers (Figure 8): **Tomás Tourn** and **Camila Pardo Argerich** (Park Ranger students), **Hector Omar Lopardo** (Park Ranger) and **Julia Lagleyze** (Biology student).

13. Any other comments?

We would like to extend our most sincere thanks to The Rufford Foundation because without their help it would not have been possible to carry out this study.

The economical support allowed us to respond to the urgent need of scientific knowledge of the axis deer population development. We hope it will allow us to act in time to prevent it from irreversibly settling in the Paraná River delta, and to reduce its consequences on the native marsh deer conservation.

Supplementary material

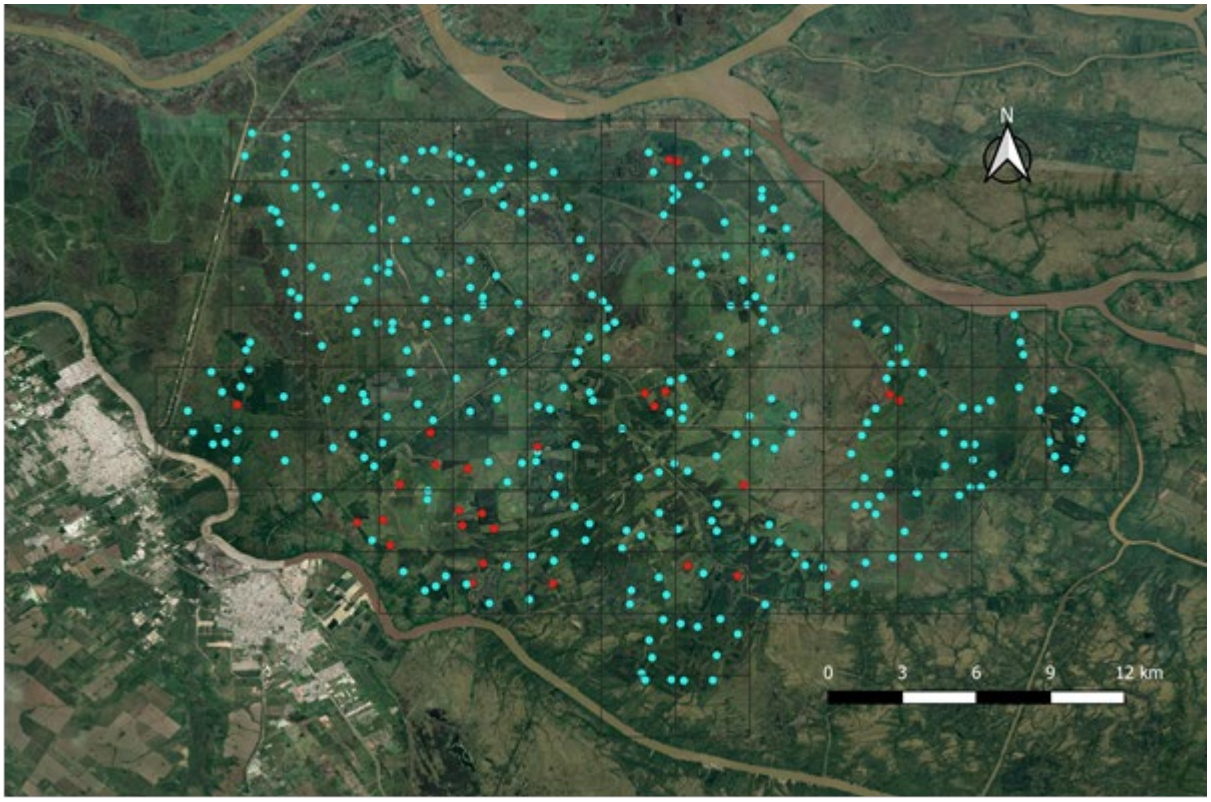

Figure 1. Study area. Grid with 81 sites and their spatial replicates (visits). The red dots indicate the visits in which the presence of axis deer is detected, the blue dots show those where they were not detected.

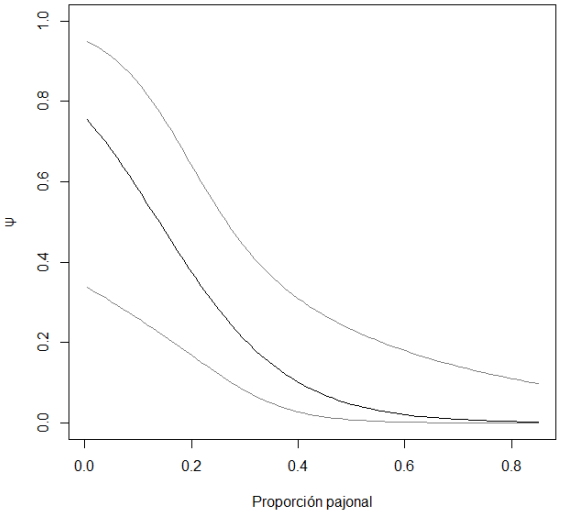

Figure 2. Left: response of the occupancy probability of axis deer (ψ) to the proportion of freshwater marshes at a site in the Occupancy model with maximum likelihood. Right: typical Paraná delta freshwater marshes.

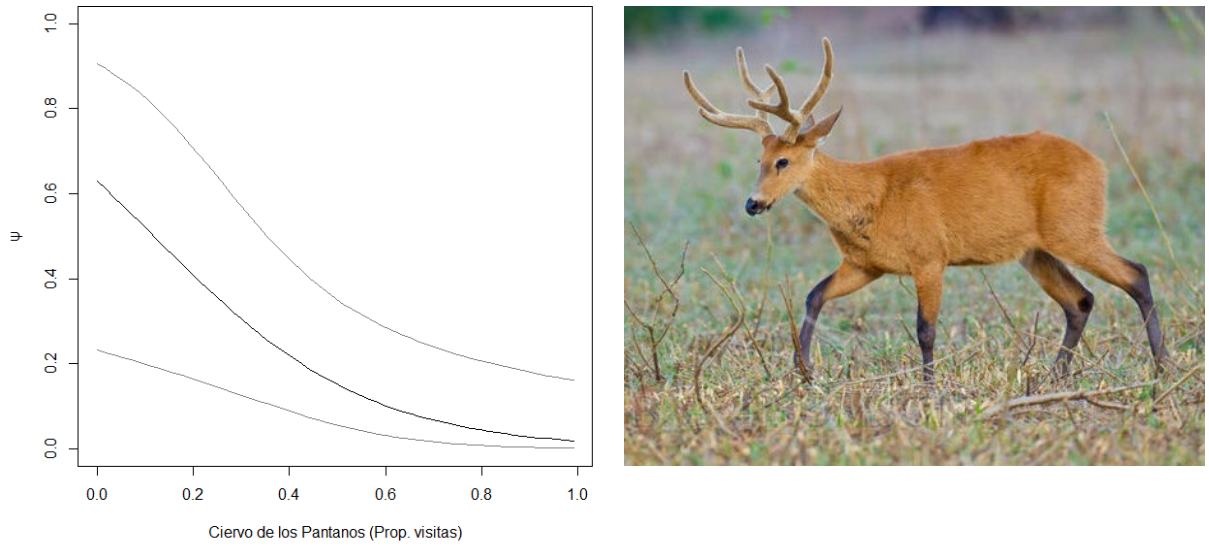

Figure 3. Left: response of the occupancy probability of axis deer (ψ) to the proportion of replicates with marsh deer presence at a given site in the Occupancy model with maximum likelihood. Right: male marsh deer.

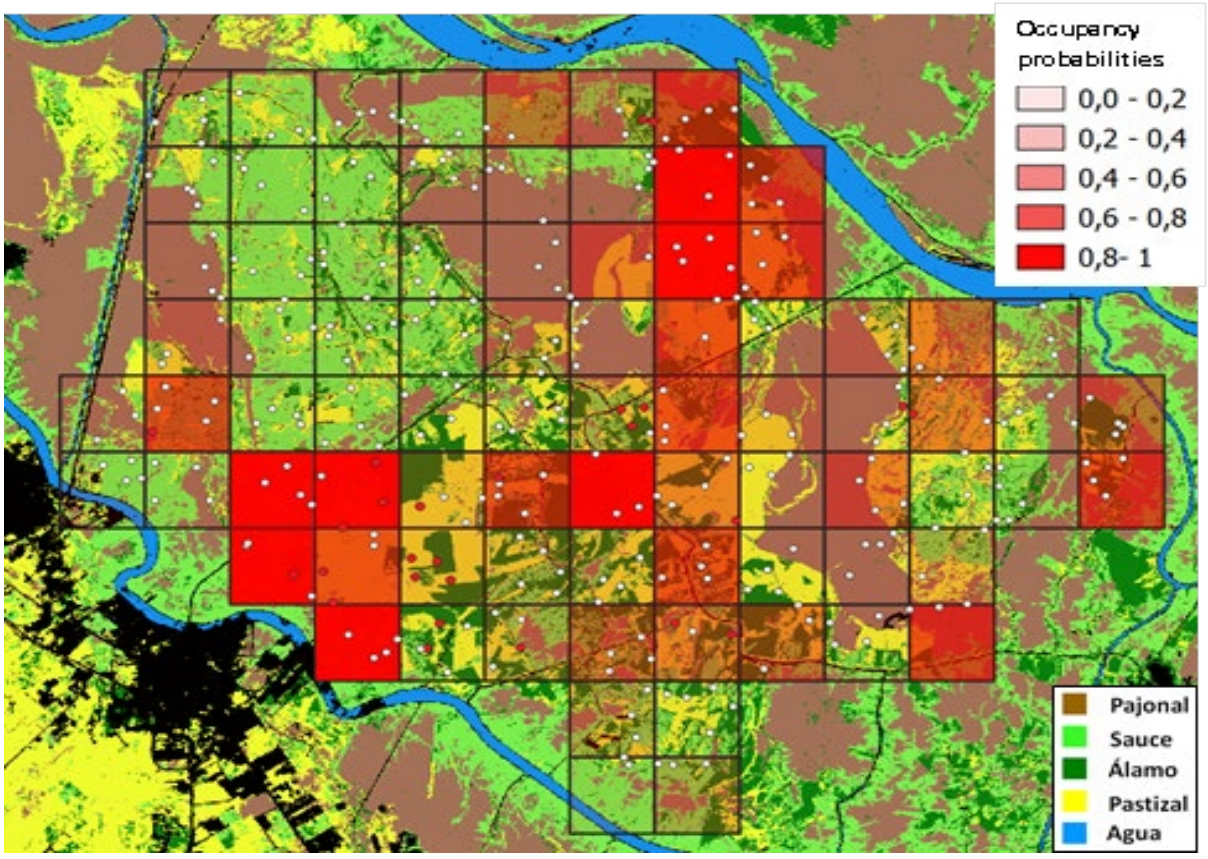

Figure 4. Land use map with the predictive occupancy probabilities for each site.

Figure 5. Stand in the "Festival del Isleño". Left: Javier Pereira (Proyecto Pantano leader) discussing the differences between axis and marsh deer to an islander. Right: Juan Tellarini sharing the investigation advances with two park rangers who work in the region.

Figure 6. Oral presentation at the XXXII Jornadas Argentinas de Mastozoología.

Figure 7. Proyecto Pantano members Diego Varela, Bernardo Lartigau, Darío Fergnani and Juan Tellarini in a poplar plantation.

Figure 8. Volunteers Tomás Tourn, Camila Pardo Argerich and Darío Fergnani crossing a water canal to go to a sampling point. Volunteer Julia Lagleyze collecting a tissue sample from the axis deer remains for the genetic analysis and observing an axis deer herd at a long distance.

Figure 9. Juan Tellarini performing DNA extraction from tissues of axis deer.