

### Final Evaluation Report

Your Details	
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Project Title	Livestock systems that protect biodiversity, functions, and services: an association to preserve and produce in the forests of the Argentinean dry Chaco
Application ID	32306-1
Date of this Report	06/05/2022



#### 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
Estimate the diversity of dung beetles in two livestock management systems in the Argentine dry Chaco.				A total of 2042 dung beetles were collected, 1392 in native grasslands and 650 in silvopastoral systems. In addition, a total of 28 species/morphospecies were identified.
Evaluate the burial activity performed by dung beetles in two livestock management systems in the dry Argentinean Chaco.				The field experiments were carried out as planned; soil samples were collected and analysed in the National Institute of Agricultural Technology (INTA - Spanish acronym) laboratory.
Analyze the effect of livestock on the ecosystem functions performed by dung beetles in two livestock management systems in the Argentine dry Chaco.				We already have the results of the diversity and functions of dung beetles and temperature and humidity data for each livestock management.
Disseminate the results with local producers				This activity was complicated by the restrictions related to contact with people due to the COVID pandemic. We are reformulating this component to carry out workshops with the producers in conjunction with INTA.

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

a). For the first time, the role of dung beetles in the functioning of livestock systems in the dry Chaco was reported. We describe the abundance and richness of dung beetles in two livestock management systems with native vegetation (trees and grasslands) of the Argentine dry Chaco (see Table 1).

b). Real-time climatic data: We have recorded ground level temperature and humidity in two native environments with integrated cattle ranching for 5 consecutive months (September 2021 to February 2022); this is very relevant for this study as dung beetles are sensitive to microclimatic changes.



c). Influence of dung beetles on some chemical properties of the soil: from our functional experiments and thanks to the collection of soil samples in each of these experimental treatments, we have the possibility of evaluating the role played by dung beetles in the cycling of nutrients, immersed in a livestock matrix, within two of the most important native ecosystems of the Argentine Chaco (see Figure 1).

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

One of the main difficulties we had once we started planning the field trip was to change the study site to the south of the province of Santiago del Estero, mainly due to logistical issues associated with the restrictions of the pandemic situation. Based on the above, we developed our project within the experimental field of INTA (National Institute of Agricultural Technology), which has an extensive area of dry forest and native grasslands. It was interesting because it allowed us to compare two native environments that are part of the Gran Chaco matrix, which are threatened by the advance of the agricultural frontier. Besides, we were able to evaluate the role of dung beetles in two native environments that incorporate livestock activity following the basic principles of sustainability, thanks to the collaboration of INTA's technical and professional staff. Finally, we will have the possibility of interacting with producers in the area in conjunction with INTA.

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

We have not had direct contact with the local communities, partly because we have invested a great deal of time in carrying out the fieldwork and because of COVID-19 restrictions. However, the dissemination of our results will be much completed thanks to the close contact of the technical and professional staff of INTA with the local producers. Besides, it will allow us to articulate the productive and technological work carried out by INTA with the ecological work carried out by us as researchers of the National Council for Scientific and Technical Research (CONICET-Spanish acronym).

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

Yes, we would like to continue monitoring the diversity and functions of dung beetles, as more information is needed to have more conclusive results on the importance of dung beetles and livestock management. Besides, our medium and long-term plans are to articulate results in the dry Chaco (province of Santiago del Estero) with the humid Chaco (province of Chaco) since these ecosystems are highly threatened by the agricultural frontier and because they are geographically connected. The final objective is to transfer the results to producers to promote more sustainable livestock systems in this ecosystem.

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

We will disseminate our results through workshops with INTA technicians and local producers in Santiago del Estero through face-to-face and virtual modalities. In



addition, we will use the social networks of the NGO Centro de Investigaciones del Bosque Atlántico (CEIBA-Spanish acronym) to disseminate our results to the public, as we have done in other opportunities (e.g., <u>Happy Hour Científico</u>).

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

I believe that the next step should be to monitor the diversity and functions over the next 2 years to generate as much information as possible to give more convincing recommendations on the effect of livestock on dung beetles. In addition, over these 2 years, it will be easier to articulate the work with local producers; this is because one of the most common problems in the country's management plans is the lack of follow-up on these projects. We want to generate a baseline of information that will allow us to continue monitoring and following up on biodiversity-friendly livestock management; we will develop it in conjunction with decision-makers and local producers since they have been working on this land for years and are the most interested in making it sustainable.

# 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?

No

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

**Gustavo Zurita:** He was the main responsible for articulating the work with technicians and professionals from INTA and CONICET in Santiago del Estero and Misiones, respectively; thanks to his experience working on livestock systems, dung beetles, and community ecology, we have been able to solve difficult situations during the development of the project.

Ana Munévar: She was one of the main collaborators in the fieldwork (installation of pitfall traps and functional experiments) and subsequent monitoring; besides, thanks to her experience as an ecologist and entomologist of CONICET in Misiones, we were able to address other subtopics from the fieldwork (i.e., diversity and taxonomy of arachnids).

**Victoria Giménez:** She installed pitfall traps to capture the dung beetles; besides, we were able to resolve some doubts about the optimal development of the project thanks to her experience working with dung beetles at CONICET in Misiones.

**Rubén Coria:** He has experience working with livestock management within the INTA experimental field; thanks to his collaboration, we chose the best sites to evaluate the role of dung beetles, and we obtained updated information on the management of the grazing areas, the animals, and the soil in which we developed the project; moreover, he was an important collaborator to articulate the INTA-CONICET work.



**Marcelo Naval:** He is the main responsible for the INTA experimental field; thanks to his collaboration, we obtained the necessary permissions to carry out the project in Santiago del Estero.

**Fernando Foletto, Agustín Solari, and José Paliza:** They are field technicians of the CONICET in Misiones. They participated in different tasks in the final phase of the fieldwork; they were also essential to solving logistical problems, from the maintenance traps and experiments to the maintenance of the field vehicles.

#### 10. Any other comments?

Knowledge of dung beetles and their role in livestock farming in the dry Chaco is very scarce; this is the first study that inventories these insects in two native ecosystems (trees and grasslands) with livestock production (see Table 1). Our functional results showed that this group has a central role in soil fertility, particularly the phosphorus incorporation into the soil (see Figure 1). We believe it is essential to continue this work to obtain more conclusive results on the importance of dung beetles and livestock management in the dry Chaco, where deforestation rates and the advance of the livestock frontier are critical. We have not been able to fully develop the fieldwork we had planned, as usually happens, and we do not work directly with local communities. However, the articulation between INTA and CONICET has been a good achievement because it is essential to generate more complete management plans; besides, the approach with local producers will be much easier, while the divulgation of our results will be much greater.

Table 1. Diversity of dung beetles in two livestock systems with native vegetation (grasslands and trees) of the dry Chaco in Argentina.

Sites	Abundance	Richness
Rangeland 1	398	22
Rangeland 2	233	17
Rangeland 3	225	19
Rangeland 4	250	19
Rangeland 5	286	19
Silvopastoral 1	72	15
Silvopastoral 2	92	13
Silvopastoral 3	102	7
Silvopastoral 4	185	12
Silvopastoral 5	199	16
Total	2042	28





Figure 1. Changes in soil phosphorus (P) content over three treatments associated with livestock systems in the dry Chaco of Argentina. PPM: Parts Per Million. Control: Treatment without dung and beetles. With exclusion: Treatment with dung and without beetles. Without exclusion: Treatment with dung and beetles