doi: 10.17138/TGFT(8)280-288

Short Communication

Terra Ronca State Park: A potential natural *Cratylia argentea* (Desv.) Kuntze conservation area in Goiás, Brazil

Parque Estadual 'Terra Ronca': Un área potencial de conservación natural de Cratylia argentea *(Desv.) Kuntze en Goiás, Brasil*

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Abstract

Cratylia argentea (cratília) is a neo-tropical leguminous plant with high resprouting ability, showing great potential as both an animal feed and to fertilize the soil through its N-fixing ability. During scientific expeditions carried out in 2016 to identify and collect germplasm in different states of Brazil, the Terra Ronca State Park (PETeR) stood out as a potential conservation area for this species. There, cratília is well adapted to the dry season, retaining green leaves even during extended dry periods and was found to develop a shrub or climbing habit, depending on light conditions. In the traditional cattle production systems of the region livestock readily consume cratília, making it an important asset for local inhabitants. Based on several populations identified and collected in PETeR, the value of traditional knowledge and use of cratília is discussed as is the potential role of the Park as an in situ conservation unit.

Keywords: Biodiversity, in situ conservation, livestock, novel forage, tropical legumes.

Resumen

Durante las expediciones realizadas en 2016 para identificar y recolectar germoplasma de *Cratylia argentea* (cratilia) en diferentes estados de Brasil, se identificó el Parque Estadual Terra Ronca (PETeR), situado en el bioma Cerrado en el este del estado Goiás, como un área de conservación potencial para la especie. El clima del parque es subhúmedo seco y los suelos son moderadamente ácidos y de fertilidad mediana a baja. Allí, cratilia está bien adaptada a la estación seca, conservando las hojas verdes incluso durante largos períodos de sequía y presenta un hábito arbustivo o trepador, dependiendo de las condiciones de luz. En los sistemas tradicionales de producción ganadera del área, el ganado muestra buen consumo de esta leguminosa, lo que la convierte en un activo importante para los productores locales. Con base en las diversas poblaciones identificadas y recolectadas en PETeR, se discute el valor del conocimiento tradicional sobre cratilia y su uso, y el papel potencial del Parque como una unidad de conservación in situ.

Palabras clave: Biodiversidad, conservación in situ, forraje nuevo, ganado bovino, leguminosas tropicales.

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Introduction

Cratylia argentea (Desv.) Kuntze (hence-forward cratília, its common name in Brazil) is an important leguminous plant native to tropical South America [Bolivia, Brazil and Peru (Queiroz and Coradin 1995)] and with high phenotypic plasticity. Its potential as a forage plant was recognized some decades ago by Otero (1961), and more recently a number of authors [e.g. Sarria and Martens (2013); Valles-De la Mora et al. (2017); Silva et al. (2017)] indicated it has great potential for feeding cattle and swine, owing to its high nutritive value (especially protein concentration).

This species branches at the base of the stem and can reach up to 3 m in height with good regrowth capacity due to its vigorous root development (Rincón et al. 2002). It forms symbiotic relationships with nitrogen-fixing bacteria, has application in silvopastoral systems and is suggested as being a promising forage source in animal production systems associated with the conservation of tropical soils (Valles-De la Mora et al. 2014; Mattar et al. 2018a). It has potential to be utilized as perennial green manure in alley cropping (Matrangolo et al. 2019) and since it is well adapted to nutrient-deficient and acidic soils, it also has potential for recovery of degraded land. Likewise, cratília has grown successfully in soil contaminated by mining waste from the greatest environmental disaster in Brazil, the rupture of the Mariana dam in Minas Gerais state in 2015 (Costa et al. 2018).

After the first collections by J.M. Sobrinho in 1975/76 in Goiás (Sobrinho and Nunes 1995), Embrapa Recursos Genéticos e Biotecnologia (formerly: CENARGEN) and International Center for Tropical Agriculture (CIAT) initiated in 1980 widespread collecting activities aimed at the formation of the first germplasm banks of *C. argentea* (Queiroz and Coradin 1995; Pizarro et al. 1997). After an extended period, in 2016, further technical-scientific expeditions were mounted to identify and collect germplasm (seeds) of cratília in different states of Brazil, including Acre, Ceará, Goiás, Maranhão and Tocantins, by Federal University of Acre, Federal University of Viçosa, Federal University of Paraná and Embrapa Maize and Sorghum. Thirty-two accessions were collected and now form the first active cratília germplasm bank in the Amazon region, which is currently one of the few collections of this species in the country (Mattar 2018).

During these expeditions, collectors visited the northeast of Goiás state, from where a high number of botanical collections (herbarium specimens) were known. Although the Terra Ronca State Park (PETeR, its acronym in Portuguese; Figure 1), located in São Domingos municipality, was initially not defined as one of our collection target areas, due to the reported diversity of the vegetation and the Park´s current status as a conservation unit, we decided to include it for an exploratory visit. Furthermore, the local population indicated that native cratília was used in the traditional livestock production system in that area before the creation of the Park in 1989.

Therefore, the objective of this Research Note is to describe the ecological aspects of the natural habitats of cratília populations in PETeR, the potential of the Park as an in situ cratília conservation area, and the use of the species in the traditional livestock system in Northeastern Goiás.

Materials and Methods

For all our expeditions, the collection sites were chosen by analyzing the records of botanical collections of the species in the National Institute of Science and Technology - INCT/Virtual Herbarium of Flora and Fungi (CRIA 2009). One of those regions is in Northeastern Goiás, where PETeR is located. The collection of the species was authorized by SECIMA-GO (State Office for the Environment, Water Resources, Infrastructure, Cities and Metropolitan Affairs of Goiás, permit 004/2017).

The area of PETeR is about 57,000 ha, most within the municipality of São Domingos (92.4%), with a minor area (7.6%) extending into the municipality of Guarani de Goiás; in the east it borders the state of Bahia (Figure 1) (Instituto Socioambiental 2020). The Park is located in one of the driest areas of Goiás state, with 1,000–2,000 mm annual precipitation and annual average temperature 24–25 °C with an absolute minimum around 15 °C and maximum of around 37 °C. The Köppen-Geiser climatic classification is Aw, i.e. tropical climate with a distinct dry season during winter (Cardoso et al. 2014). PETeR is located in the core region of the Cerrado domain (Brazilian savanna) and its vegetation is characterized by a mosaic of savanna phytophysiognomies, floristically influenced by the adjacent Caatinga, and local edaphic aspects. The predominant physiognomy in the area is the Cerrado (sensu stricto) savanna, followed by seasonally deciduous forests, usually associated with limestone outcrops, and transition vegetation (Felfili et al. 2007; Instituto Socioambiental 2020).

Field activities occurred in October 2016, during the transition from dry season to wet season and we used a catalog with photos of cratília plants (leaves, branches and flowers), which we showed to residents in order to identify sites where the species might occur. In the collection work carried out at PETeR, we were accompanied by a tourist guide (Sr Hilário), who is native to the locality and also indicated probable places where the species could be found.

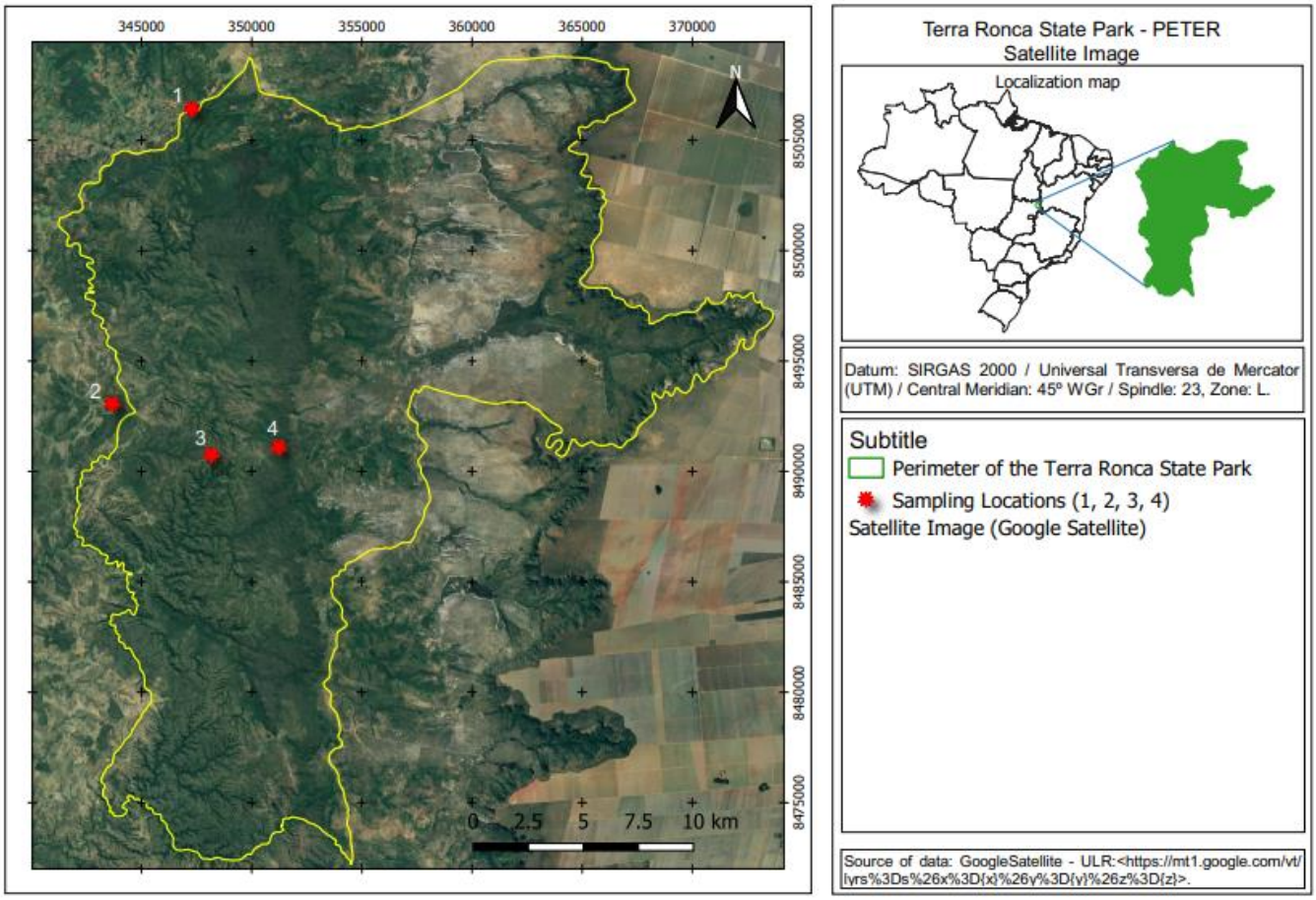

Figure 1. Satellite image (Sirgas 2000; Google Earth 2020) of the Terra Ronca State Park and collection sites of cratília samples.

The team stayed in the São João village, where we interacted with residents to discuss the species and participated in an advisory meeting promoted by the PETeR Advisory Council, attended by residents of the Park and surrounding areas, and officials from SECIMA-GO. At the meeting, we explained the purpose of our work and asked those attending about their knowledge of cratília.

Since our visit to the Park was meant to be of an exploratory nature, our collecting strategy consisted of following the suggestions of local people. Each accession, collected in or near the Park, is made up of seeds collected from the soil surface under the respective cratília populations. The sites were georeferenced with a Garmin Map 78s GPS device. Soil samples (0–20 cm horizon) were taken at each collection site and chemically analyzed using standard methodologies (Raij et al. 2001; Silva 2009).

The thematic maps of soil, vegetation and satellite images were made using the software Qgis 10.1, the base of geographic information from the Brazilian Institute of Geography and Statistics (IBGE 2019), the State System of Geoinformation of Goiás - SIEG (IMB 2020) and Google (Google Earth 2020). The georeferenced collection sites are inserted in the maps.

Results and Discussion

Four populations were found inside the Terra Ronca State Park and slightly beyond its western border (Figure 1 and Table 1). Of these, seed from 3 populations could be collected (Accessions 1–3); of Population 4, seed could not be found at the time of our visit. Accession 3 was identified as one of the largest populations of cratília in all our expeditions conducted in 2016, with more than 30 individuals from the surroundings of the observation tower next to the conservation unit headquarters (Figure 2A).

Cratília populations were observed in 4 different conditions: (i) plants with both shrub and climbing habit, in a sunny area along a dirt road (Accession 1) (Figure 2B); (ii) plants with climbing habit (climbing on deciduous trees) in a drier environment (where cratília was one of the few species that still had green leaves) (Accession 2) (Figures 2C and 2D); (iii) plants with both shrub and climbing habit (climbing over trees or shrubs) in a sunny area, where most of the cratília branches were browsed (Accession 3) (Figures 2A and 2E); and (iv) plants with climbing habit (climbing on trees and shrubs) in a humid rocky shaded area (Population 4) (Figure 2F).

Table 1. Geographic coordinates, elevation, vegetation and soil characteristics at the collection sites of 4 cratília populations in the Terra Ronca State Park.

	Accession 1	Accession 2	Accession 3	Population 4
Geographic coordinates	13º30'21" S, 46º24'39" W	13º37'37" S, 46º26'42" W	13º38'52" S, 46º24'14" W	13º38'42"S, 46º22'31"W
Elevation (masl)	696	699	734	681
Vegetation[1] (IBGE 2019)	Arboreal Open Savanna (Sa)/Submontane Seasonally Deciduous Forest (Cs) ecotone	Savanna-Seasonal Forest with ecological disturbance due to agricultural activities (SN)	Arboreal Open Savanna (Sa)	Arboreal Open Savanna (Sa)
Soil type (IMB 2020)	CXbd - Inceptisol	PVe - Ultisol (red argisol), in the field appearance of Inceptisol	PVe - Ultisol	RLd - Lithic Entisol
Soil analysis				-
pH H_2O	6.0	5.8	5.8	-
P Mehlich (mg/dm³)	8.4	3.1	4.4	-
K (mg/dm³)	170	218	206	-
Ca (cmolc/dm³)	3.1	8.3	3.3	-
Mg (cmolc/dm³)	2.7	1.3	1.2	-
Al (cmolc/dm³)	0.1	0.1	0.2	-
Potential acidity (H+Al - cmolc/dm³)	2.3	4.1	3.3	-
Organic matter (g/dm³)	28.2	44.6	21.5	-
Sum of bases (cmolc/dm³)	6.2	10.2	5.0	-
CEC (cmolc/dm³)	8.5	14.3	8.3	-
Base saturation (%)	72.9	71.3	60.2	-
Al saturation (%)	1.59	0.97	3.85	-
No. of collected seeds	75	17	64	No seeds
Field observations	Plants in sunny area near adjacent dirt road (PETeR to São Domingos)	Plants climbing on deciduous trees, in drier environment	Largest populations of cratília situated near the observation tower	Plants climbing on trees and shrubs in a humid rocky shaded area

[1]See Figure 3.

Considering vegetation, Accession 1 is located inside the transition area between Arboreal Open Savanna (Sa) and Submontane Seasonally Deciduous Forest (Cs), Accession 2 is located in Savanna-Seasonal Forest with ecological disturbance (areas of anthropogenic interference) due to agricultural activities (SN) and Accession 3 is inside Arboreal Open Savanna (Sa) (Table 1; Figure 3). Population 4 (no seeds collected) is also located in Arboreal Open Savanna (Sa).

Based on information from the Brazil soils map (IMB 2020), cratília was found growing on different soil classes: Inceptisol (Accession 1) and Ultisol (Accessions 2 and 3) (Figure 4). The topography where Accession 1 was found was flat with no limestone rocky outcrops, and the chemical analysis showed intermediate natural fertility. According to the map, Accessions 2 and 3 were growing on an Ultisol, but Accession 2 was on a flat area with limestone rocky outcrops, and described by local farmers as very dry, characteristic of the litholic soils in the semi-arid region (Rocha et al. 2017). Population 4 grew on a Lithic Entisol, in an environment with high presence of large rocks. Considering those characteristics, and also that Accession 2 was located in a transition area from Ultisol to Inceptisol, it is possible that the soil supporting Accession 2 was actually Inceptisol. Accession 3 was growing in a slightly undulating landscape, without rocks, characteristic of an Ultisol. Chemical analysis of the soil showed medium to high levels for the majority of soil nutrients and low acidity (Table 1), which is not common for cratília and other savanna areas. This discrepancy could be explained by the location of the Park between 2 different watersheds (São Francisco river basin and Tocantins river basin); caves are present in the Park and are formed by water percolating through the limestone rocks in Bambuí group (Rocha et al. 2017).

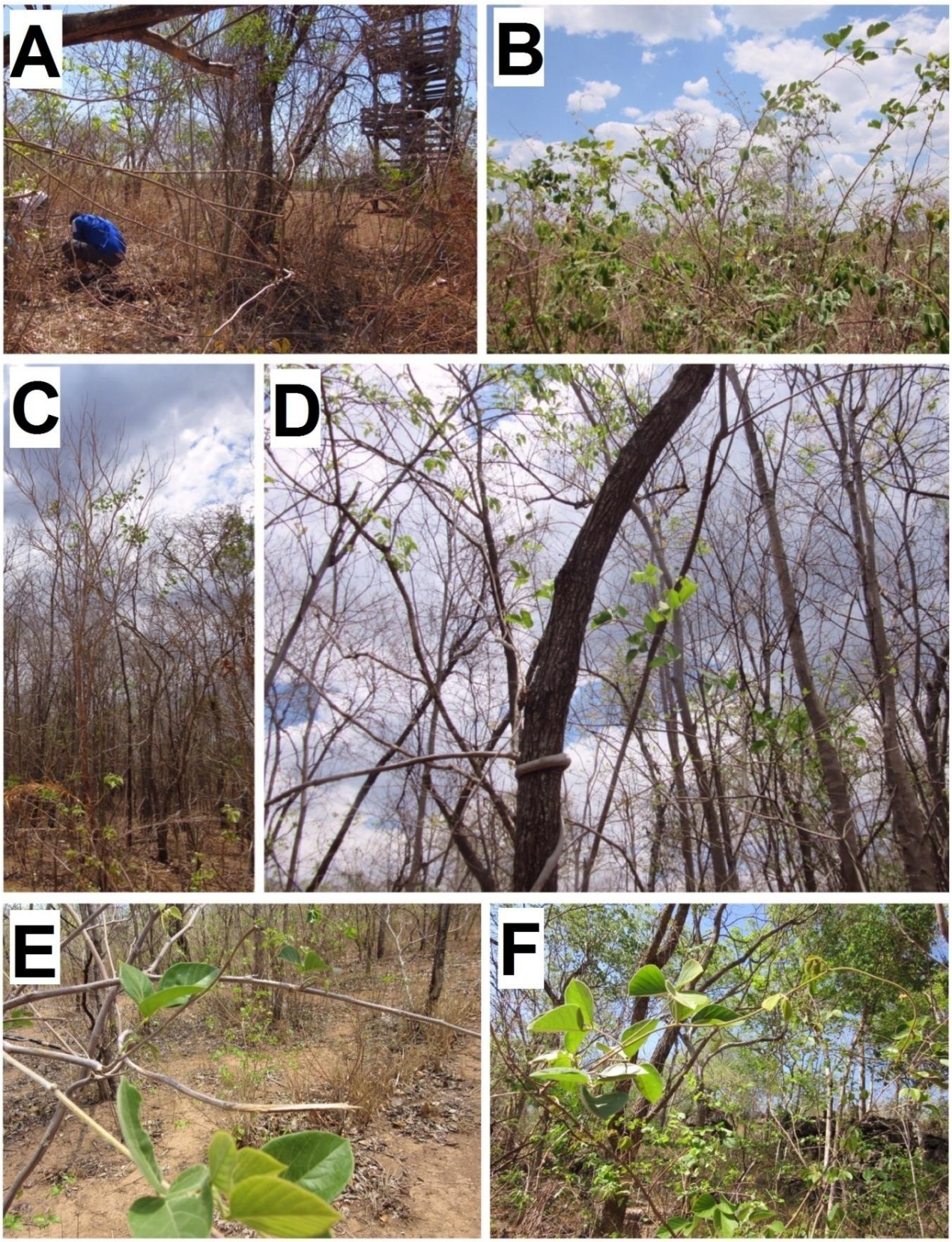

Figure 2. (A) Cratília high population density area (Accession 3); (B) Cratília at roadside (Accession 1); (C and D) Deciduous tree supporting cratília (Accession 2); (E) Foraged cratília plant (Accession 3); and (F) Cratília in a humid rocky shaded area (Population 4).

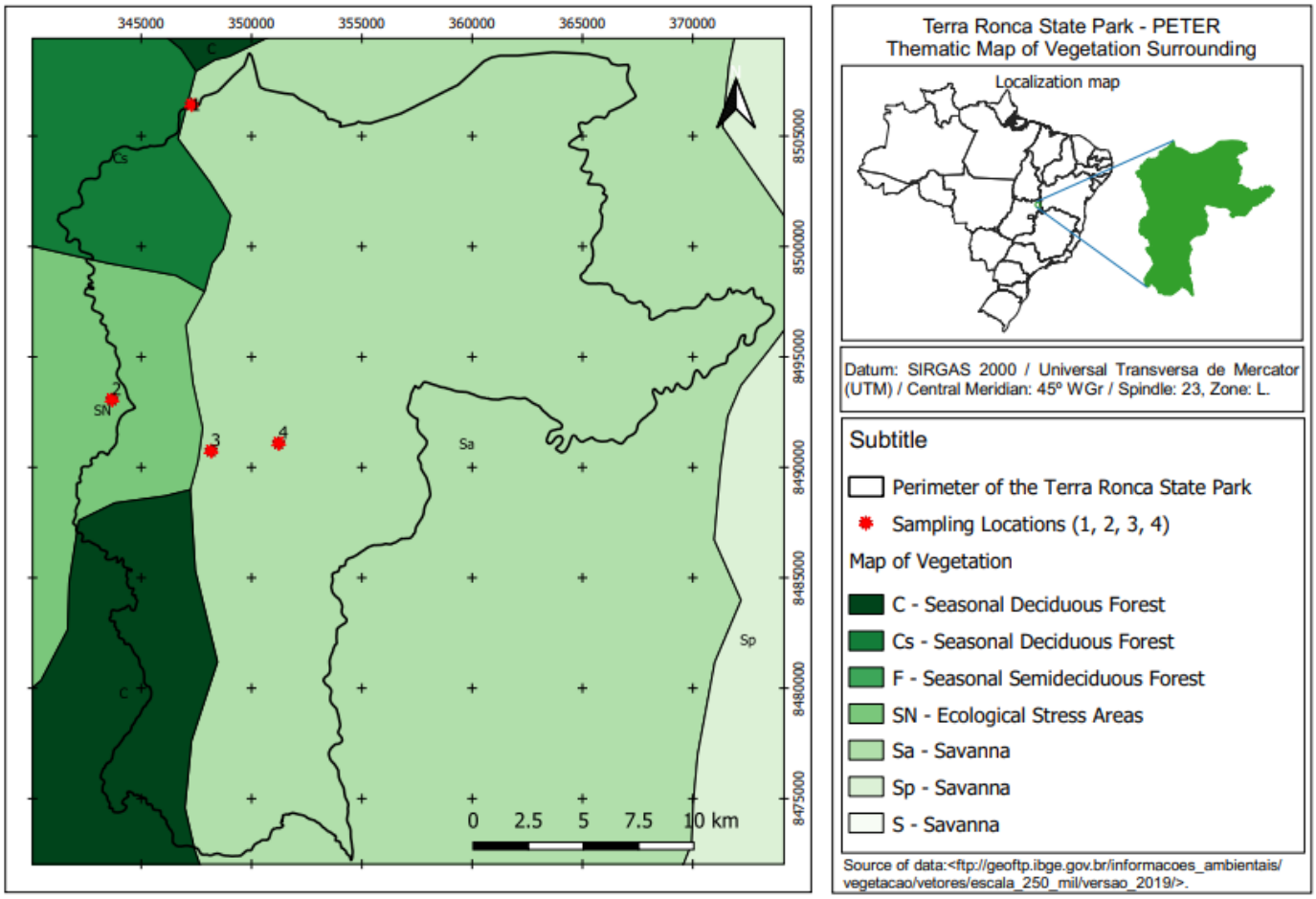

Figure 3. Vegetation map (Sirgas 2000) of the Terra Ronca State Park and collection sites of cratília samples. Source of data: bit.ly/3357lor

Specifically in this area, traditional beef cattle production, using a rustic cattle breed known locally as 'Curraleiro', is on natural pasture under extensive production conditions. During the rainy season cattle feed on the seasonally dry vegetation (either Savanna or Semi-Deciduous Forests), and during the dry season are transferred to humid fields associated with 'Veredas' (a grassy or scrubby Cerrado formation on hydromorphic soils associated with gallery forests, usually evidenced by the presence of buriti palm, *Mauritia flexuosa* L.f.). According to the PETeR community, flowers, branches, seed pods ('cachopas') and fallen leaves of cratília are consumed by cattle during the dry season. Besides that, we observed several plants which had evidently been browsed, probably by cattle (Figures 2A and 2E). Consequently, there is a need to determine the forage potential of all local species.

The community related the story of the 'Mineiros' farm. This property was situated where the headquarters of Terra Ronca State Park is today, including the high density area of cratília, near the observation tower (Accession 3). Cratília was managed in a specific manner on this property: The owner prevented livestock from accessing the area with high density of cratília during the rainy season and removed other plant species that appeared spontaneously. During the dry season, when grasses dried off and lost nutritional value, the animals were introduced to the protected cratília area, which supported them during the dry season. Unlike most species in the region, *C. argentea* keeps its leaves during the dry season.

The current livestock system remains unchanged in farms around PETeR. No silage or hay is fed because the native vegetation, including cratília, is capable of providing an adequate diet for maintenance of cattle during the dry season, under the prevailing extensive production conditions. While PETeR is a conservation unit, we observed cattle foraging within the park limits. Despite the high density of cratília (Accession 3), the number of seeds collected at the site was relatively small, indicating that cattle might have eaten the pods. Since cratília is browsed during this reproductive period, seed production is limited. Seeds collected in this area were produced on branches that were supported by nearby trees, out of reach of livestock. Thus, the climbing habit of the plant proved to be advantageous for its persistence/survival in the area under such conditions.

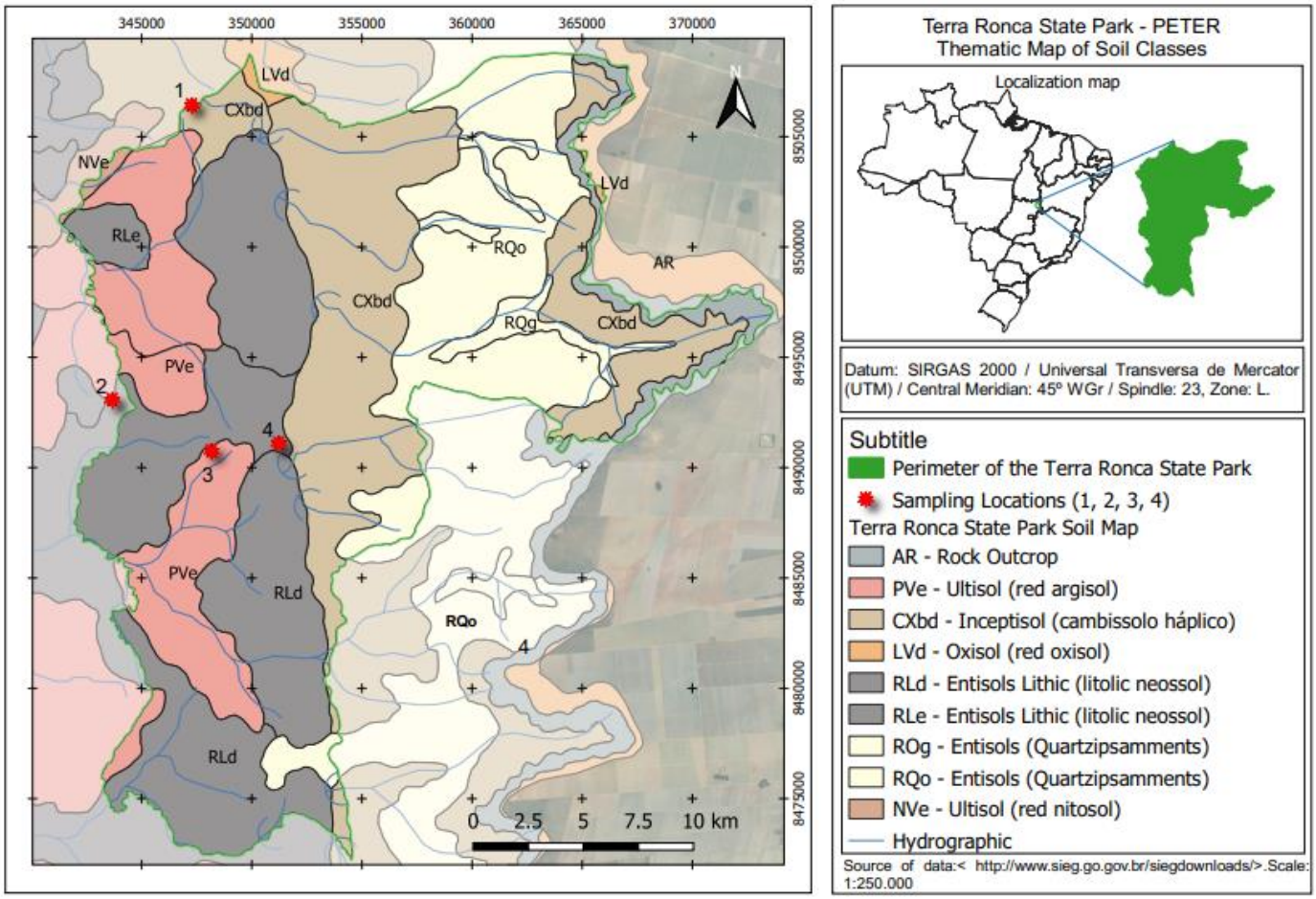

Figure 4. Soil map (Sirgas 2000; IMB 2020) of the Terra Ronca State Park and collection sites of cratília samples.

Our time in PETeR and the São João community has led us to the following reflections and conclusions:

1) Interacting with local people regarding their knowledge about the vegetation, preferred niches of species and local use of species is most valuable and beneficial for science. In the particular case of cratília, it is suggested that the convergence of traditional knowledge with that of academia be sought, resulting in strategies that incorporate both the knowledge and practices of the communities and the ecology and biology of the species.
2) In view of the evident soil and vegetation diversity at the few Park sites where cratília was found in this exploratory mission, systematic collecting of the species in the Park and its surroundings seems to be warranted in order to further increase genetic variability in the germplasm pool that is ex situ (= in a genebank) available for tropical forage legume research and development.
3) In view of PETeR´s status as conservation unit, monitoring of key populations of cratília for in situ conservation (= in the species´ natural environment) could be considered, not only for the 2 conservation strategies to complement each other but also to identify differences, with time, regarding genetic shifts. In situ conservation has the advantage that plant populations continue to evolve in their natural environment (but their existence is at risk due to possible vegetation-destroying events), whereas ex situ conservation ensures continuing seed availability (but requires costly germplasm maintenance and no natural evolution occurs).
4) It is suggested that PETeR could play a particularly important role as a plant germplasm conservation unit as less than 3% of the Brazilian savanna area is included in federal conservation units (Mattar et al. 2018b).

Acknowledgments

We thank the residents of the São João community, especially Sr Ramiro Hilário dos Santos and his family and Mr Virgílio Vieira de Melo Junior, for accompanying us at work and providing important testimonies. We are also grateful to the managers of PETeR, the State Office for Environment, Water Resources, Infrastructure, Cities and

Metropolitan Affairs (SECIMA), who authorized the work in the protected area and provided important information. The Ministry of Agriculture, Livestock and Food Supply (MAPA), the National Council for Scientific and Technological Development (CNPq) and the Ministry of Science, Technology and Innovation (MCTI) financed the work.

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(Note of the editors: All hyperlinks were verified 2 September 2020.)

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(Received for publication 23 January 2020; accepted 18 July 2020; published 30 September 2020)