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A NEW RUPICOLOUS PALM FROM THE CAMPOS RUPESTRES, MINAS GERAIS, BRAZIL

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The *Syagrus glaucescens* species complex occurs in the Espinhaço Range in Minas Gerais state, Brazil. In addition to *Syagrus duartei* Glassman, *S. glaucescens* Glaz. ex Becc. and *S. evansiana* Noblick, a fourth undescribed species was previously identified by its morphology, leaf anatomy and geographical isolation. Here we formally describe this species as new to science and compare it with *Syagrus evansiana*, its closely related species. We also provide a distribution map, illustrations, photographs, taxonomic notes, and an IUCN conservation status assessment of Endangered.

Keywords. Arecaceae, Palmae, Serra do Cabral State Park, *Syagrus aristeae*, *Syagrus evansiana*, *Syagrus glaucescens* complex.
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Introduction

The monophyletic genus *Syagrus* comprises 70 species, mostly native to Brazil, with 33 being acaulescent (lacking a visible stem or short-stemmed) species (Dransfield *et al.*, 2008; Meerow *et al.*, 2009; Noblick *et al.*, 2014; Noblick & Meerow, 2015; Noblick, 2017a, 2018; Soares & Guimarães, 2019; Firmo *et al.*, 2021; Soares, 2022; Sant'Anna-Santos *et al.*, 2023a, 2023b). More than half of the acaulescent *Syagrus* species bear similar unbranched inflorescences, flowers and fruits (Dransfield *et al.*, 2008; Noblick, 2013b, 2017a). However, due to the great morphological similarity, some acaulescent species still have uncertain circumscriptions, with some probably representing complexes of several closely related species (Noblick, 2017a; Sant'Anna-Santos *et al.*, 2023a). Furthermore, the high rates of speciation coupled with the lack of field collections in several areas in Brazil (Cássia-Silva *et al.*, 2022; Reflora, 2022; SpeciesLink Network, 2022) make it quite plausible that there are many species yet to be described as new to science.

Most acaulescent *Syagrus* species occur in dry and altitudinal environments such as the campos rupestres, where they are commonly found growing on rocky outcrops (Noblick, 2017a; Soares, 2022). In Brazil, campos rupestres are mainly found along the Espinhaço Range in Bahia and Minas Gerais (Giulietti *et al.*, 1997). Although it constitutes a megadiverse environment with high endemism, the campos rupestres have been under severe and diverse socioeconomic exploitation, causing great concern about the extinction of rare or as-yet-unknown species (Giulietti *et al.*, 1988; Alves *et al.*, 2014; Fernandes, 2016; Batista *et al.*, 2018; Costa *et al.*, 2018; Fernandes *et al.*, 2020; Sant'Anna-Santos,

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2021; Sant'Anna-Santos *et al.*, 2023a, 2023b). Among acaulescent *Syagrus* species, the *S. glaucescens* complex, which occurs exclusively in the Minas Gerais portion of the Espinhaço Range, includes *S. glaucescens* Glaz. ex Becc., *S. duartei* Glassman, *S. evansiana* Noblick (Noblick, 2017a) plus a fourth undescribed species (Firmo *et al.*, 2021). This undescribed species is closely related to *Syagrus evansiana* and is geographically isolated in the disjunct Serra do Cabral massif (Firmo *et al.*, 2021). However, the larger size and its occurrence in a region that is very isolated from the other populations in the *Syagrus glaucescens* complex prompted Firmo *et al.* (2021) to reassess the leaf anatomy of the whole complex. They hypothesised that the Serra do Cabral's taxa was a distinct species supported by their morphological and anatomical evidence (Firmo *et al.*, 2021). Thus, here we describe, illustrate and name this new rupicolous species, adding one more endemic palm species to the Serra do Cabral and highlighting this mountain massif as a priority area for the conservation and biological research of rare and endemic species.

Materials and methods

The present study is based on field observations and collections in the Serra do Cabral State Park, Minas Gerais, Brazil, and herbarium material from MCMG, SPF and UPCB (herbarium codes follow Thiers *et al.*, continuously updated). In the literature review, all available publications on the taxonomy of the genus were considered (Glassman, 1965, 1967, 1968a, 1968b, 1987; Henderson *et al.*, 1995; Marcato & Pirani, 2001; Noblick, 2004a, 2004b, 2004c; Marcato & Pirani, 2006; Dransfield *et al.*, 2008; Meerow *et al.*, 2009; Noblick, 2009, 2010; Noblick & Lorenzi, 2010a, 2010b; Noblick, 2012; Martel *et al.*, 2013; Noblick, 2013a; Soares *et al.*, 2013; Noblick, 2014; Noblick *et al.*, 2014; Noblick, 2017a; Silva-Cardoso *et al.*, 2017; Noblick, 2018, 2019; Soares & Guimarães, 2019; Firmo *et al.*, 2021; Soares, 2022; Sant'Anna-Santos *et al.*, 2023a, 2023b). The circumscription adopted here for *Syagrus* is based on Noblick (2017a), and the terminology adopted for the morphological and anatomical descriptions follows Dransfield *et al.* (2008) and Noblick (2017a, 2017b).

Measurements of the vegetative and reproductive parts were taken *in situ* from 30 randomly chosen individuals of the new species. Herbarium material was examined to confirm the presence of some qualitative characters. Specimens were georeferenced and photographed in the field, using a digital camera. The flowers were stored in ethyl alcohol for further stereomicroscope analysis. Photographs of flowers were generated using a digital camera (CMOS 12 mp PLUS; Patrino Co., Colombo, Brazil) coupled to a stereomicroscope (Bioptika L60T; Patrino Co.). For *Syagrus evansiana*, information on vegetative and reproductive parts was retrieved from the literature (Noblick, 2009, 2017a; Firmo *et al.*, 2021).

Distribution data were plotted on a map, using QGIS software version 3.16.2 (QGIS Development Team, 2022) and assembled from the following data sources: states and cities (IBGE, 2020), Serra do Cabral State Park (Brasil, 2020), elevation (Miranda, 2005). The conservation status of the new species was evaluated according to the IUCN categories

and criteria (IUCN Standards and Petitions Committee, 2022) and using the GeoCAT tool (Bachman *et al.*, 2011).

Taxonomic treatment

Syagrus aristeae B.F.Sant'Anna-Santos, **sp. nov.**

Similar to *Syagrus evansiana* Noblick but differs by its size (100–165 cm vs 60–100 cm tall); abaxial side of petiole and rachis with tomentum and leaf rachis 94–145 cm long (vs glabrous and 21–92 cm long); peduncular bract glabrous (vs with indument); inflorescence axis 18–29.5 cm long (vs 4.5–17 cm long); the rachillae of the apex and base of the inflorescence being almost the same size (vs different sizes); staminate flowers 10–15.9 mm long and stamens 5.9–9 mm long (vs flowers 8–10 mm long and stamens 3.5–4 mm long); pistillate flowers of the apex and base of the inflorescence being almost the same size (vs different sizes); pistil 5.8–7.7 cm long and glabrous (vs 10–11 cm long with lepidote indument from base to nearly the base of the stigmas); stigmas 3 (vs 3–5), epicarp covered with crackled plates (vs with a thick brown indument). – Type: Brazil, Minas Gerais, Buenópolis, Parque Estadual da Serra Cabral, 17°54'21.00"S, 44°14'33.30"W, 1134 m, 14 vii 2022, *B.F. Sant'Anna-Santos* 388 (holotype DIAM; isotypes IBGE, MBM, UFG, UPCB). **Figures 1, 2 and 3.**

Small, solitary palm, 100–165 cm tall. *Stem* 10–15 × 3–9 cm, appearing acaulescent or with a short erect or prostrate stem. *Leaves* 3–6; sheathing leaf base c.13–23 cm long; pseudopetiole 15–34 cm long; petiole 10–32.5 × 0.8–1.4 cm, 0.3–0.6 cm thick, abaxial side of petiole and rachis with white tomentum; rachis 94–145 cm long; pinnae medium to dark green, discolorous, abaxial surface glaucous, linear, rigid-coriaceous with apex more or less asymmetrical and long tapering, pinnae numbering 38–67 pairs, in clusters of 2 or 3(–4), inserted in divergent planes over the rachis, no ramenta scales or tomentum present where the pinnae are inserted on the rachis, and none along the abaxial midvein of the pinnae; basal pinnae 20–32 × 0.5–1.2 cm, middle pinnae 22–33 × 1.3–3 cm, apical pinnae 7–18 × 0.6–1 cm, one lobe of the asymmetrical tip rounded and the other one rounded or long tapering. *Inflorescence* erect, spicate or spirally branched, prophyll 7–23 × 1.3–4.8 cm; peduncular bract c.32–67 cm long, inflated portion 14–31 × 3.3–6.5 cm, including a beak of 1–2 cm, 4–7 cm perimeter, 2.5–3 mm thick, woody, sulcate, exterior glabrous; peduncle 18–42 cm long, 4–9 × 3–6 mm wide, elliptical in cross-section, glabrous; inflorescence axis 18–29.5 cm long; rachis 0–5.5(–10) cm long; rachillae 1–9, 11–21 cm long at the apex, 11–21 cm long at the base, glabrous; staminate flowers 10–12.5 × 3–7.3 mm at apex, 11.2–15.9 × 3–6.6 mm at base, sessile, yellow, sepals 1.3–1.8 × 0.7–1.3 mm at apex, 1.7–3.6 × 1.1–2.6 mm at base, glabrous, no visible nerves, briefly connate at the base, petals 9–11.5 × 2.1–4.4 mm at apex, 9.8–14.8 × 2.8–4.5 mm at base, with acute tips, nerves indistinct, stamens 5.9–9 mm long, anthers 4.4–7.7 mm long; filaments 1.3–3.2 mm

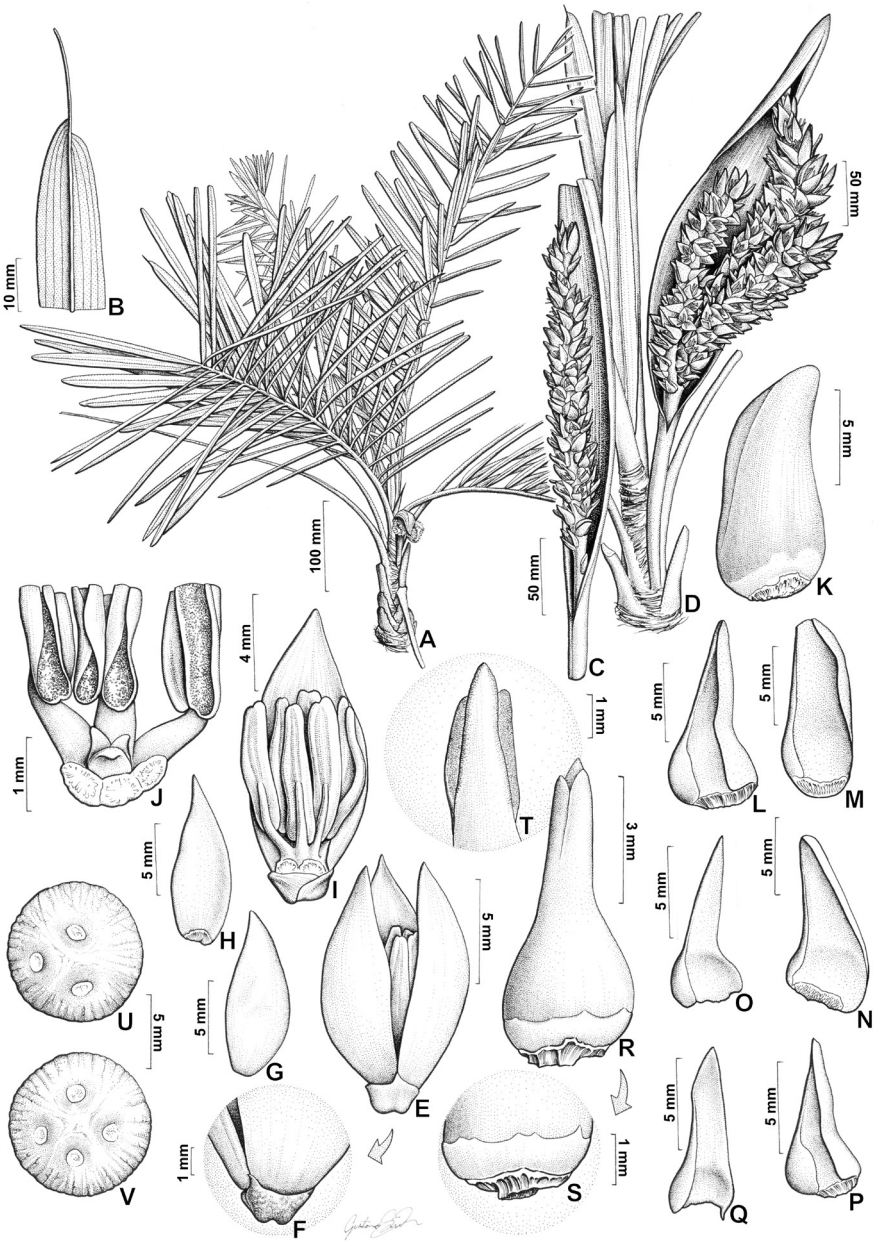

Figure 1. *Syagrus aristeae* B.F.Sant'Anna-Santos, sp. nov. A, Solitary habit; B, asymmetrical tip; C, unbranched inflorescence; D, branched inflorescence. E–J, staminate flower: E, staminate flower, opened; F, detail of calyx; G and H, petals; I, dorsal view of stamens; J, ventral view of stamens and pistillode. K–S, pistillate flower: K, pistillate flower (front view); L–N, sepals; O–Q, petals; R, pistil; S, staminodal ring. T, Stigma; U, three endocarp pores; V, four endocarp pores. Drawn from the holotype, *Sant'Anna-Santos* 388 (DIAM), by G. Surlo.

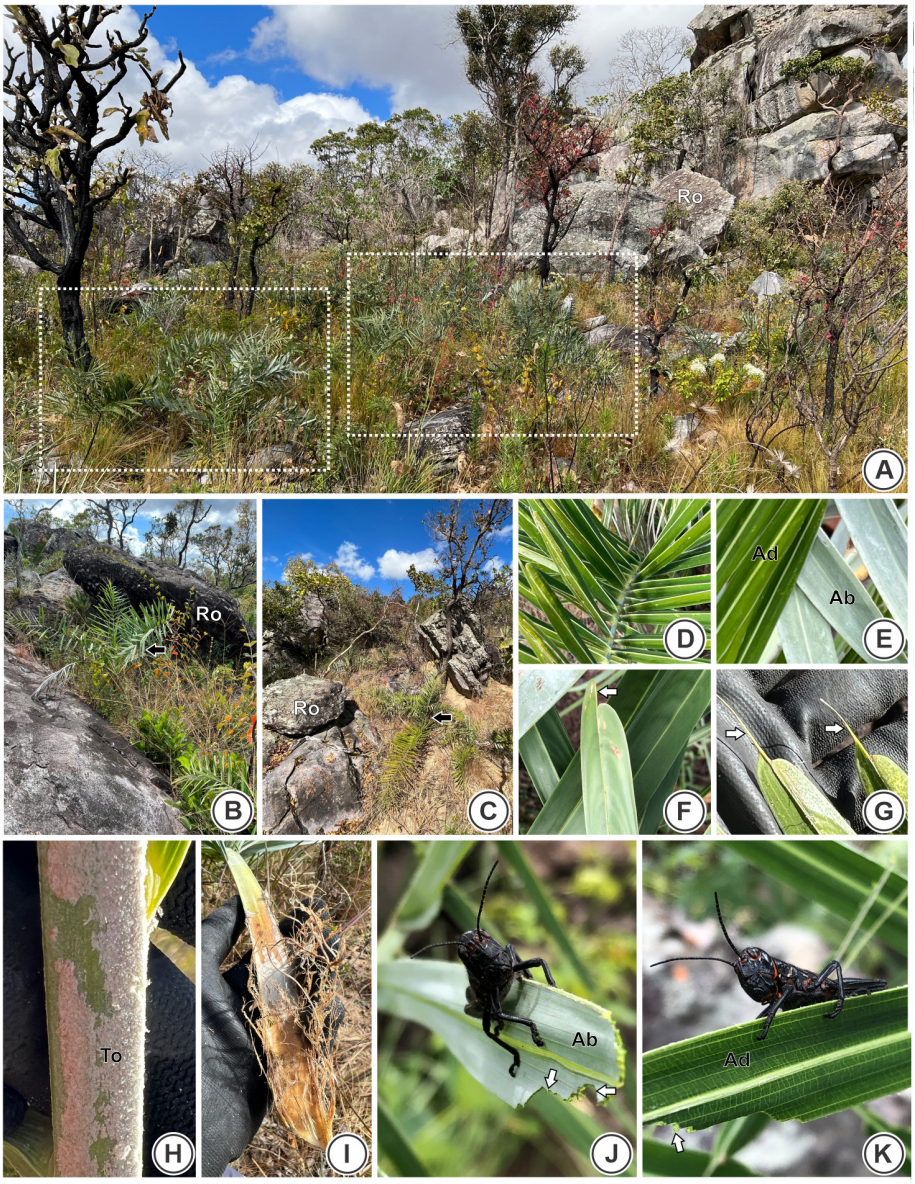

Figure 2. *Syagrus aristeae* B.F.Sant'Anna-Santos, sp. nov. A, Landscape photograph of the type locality in the Serra do Cabral State Park: individuals (white rectangles) growing in the rocky outcrops (Ro); B, specimen (black arrow) growing in the rocky outcrop (Ro); C, specimen (black arrow) growing on the sandy soils near rocky outcrops (Ro); D, pinnae irregularly arranged in the leaf rachis; E, dark-green adaxial (Ad) and glaucous abaxial (Ab) surfaces of the pinnae; F, the asymmetrical tip (white arrow); G, the long tapering tip (white arrow); H, abaxial side of the leaf rachis with white tomentum (To); I, leaf sheath with fibrous margins; J, pinnae consumed (white arrow) by locusts: abaxial surface (Ab); H, pinnae consumed (white arrow) by locusts: adaxial surface (Ad). Photographs: B. F. Sant'Anna-Santos.

Figure 3. *Syagrus aristeae* B.F.Sant'Anna-Santos, sp. nov. A, Habitat photograph of the type locality in the Serra do Cabral State Park: individual flowering (white circle); B, branched inflorescence; C, detail of branched inflorescence: floral visitor on the peduncular bract (PB); D, rachillae with pre-anthesis flowers stored in ethyl alcohol: triads (a central pistillate flower flanked by two staminate flowers) on the lower portion of the rachilla (black line) and isolated staminate flower occupying the upper half of the rachilla (blue line); E, deeply grooved peduncular bract (PB); F, prophyll (Pr); G, unbranched inflorescence; H, fruits (Fr): epicarp covered with crackled plates. Photographs: B. F. Sant'Anna-Santos.

long, very briefly connate at the base; pistillode trifid, c.0.5–1.5 mm long; pistillate flowers elongate-pyramidal, 12.1–16 × 4.4–6.7 mm, glabrous, sepals 11.1–14.6 × 3.9–8.2 mm, yellow, no visible venation, imbricate, petals 7–12 × 1.6–4.7 mm, valvate tips 2/5 to 1/2 the length of the petals, pistil 5.8–7.7 × 2.1–3.9 mm, glabrous, stigmas 3, 2.8–3.4 mm long, staminodal ring c.1 mm high, 6-dentate. *Fruit* nearly globose, 1.7–2.5 × 1.1–1.9 cm, yellowish brown when mature, epicarp covered with stiff appressed brownish plates, epicarp less than 1 mm thick, mesocarp 1–2.5 mm thick, succulent and fibrous; endocarp c.1.3–1.8 × 1.1–1.4 cm, c.1 mm thick, with 3–5 pores on the basal end; seed to nearly globose, endosperm homogeneous. Germination remote-tubular.

Distribution. *Syagrus aristeae* is endemic to the Serra do Cabral mountain range, north-central Minas Gerais state, Brazil (Figure 4).

Habitat and ecology. The species occurs in quartzitic campos rupestres, mainly on rocky outcrops at elevations between 867 and 1238 m (see Figures 2A–C, 3A,B). The campos

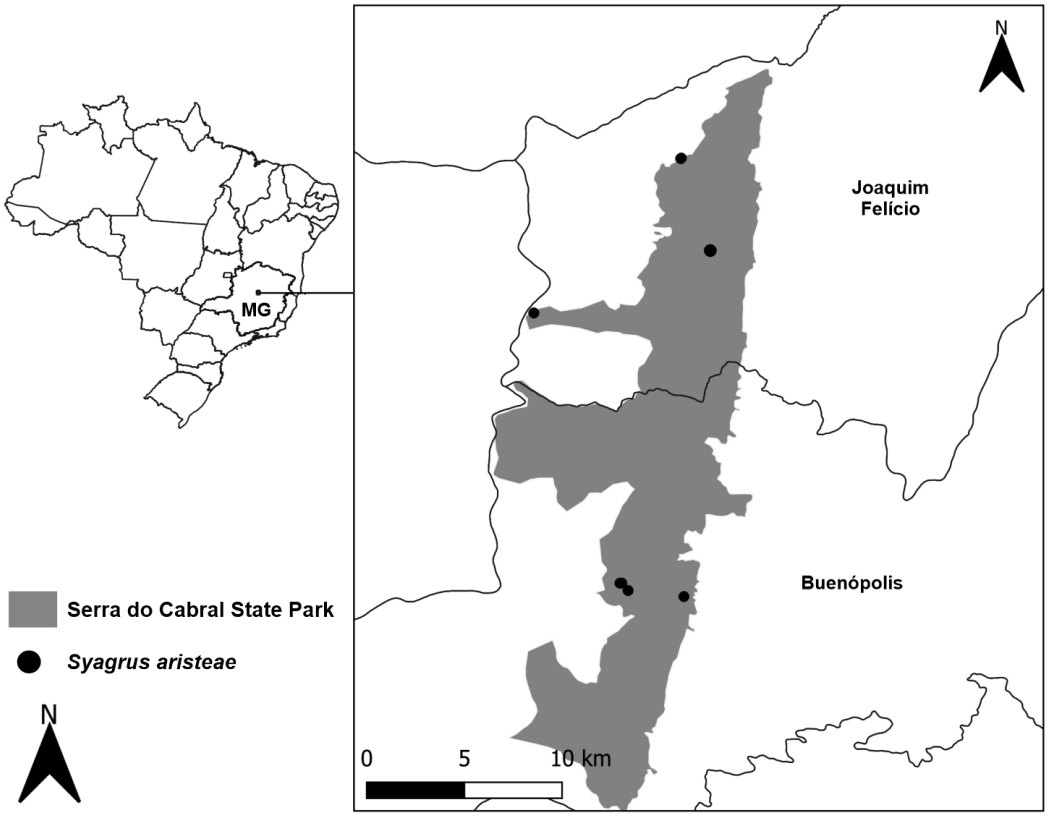

Figure 4. Distribution of *Syagrus aristeae* B.F.Sant'Anna-Santos, sp. nov. in the Serra do Cabral State Park, Minas Gerais (MG).

rupestres are characterised by poor soils and harsh climate conditions (Almada *et al.*, 2016; Fernandes *et al.*, 2020). Recorded with flowers in July and fruits in December, January and July.

Etymology. Named in honor of Professor Aristea Alves Azevedo, one of the most prominent Brazilian botanists and the first woman hired as a professor by the Universidade Federal de Viçosa (UFV) in the 1970s. Recently, she received the Peter Henry Rolfs Medal of Merit in teaching, one of the UFV's highest honours. She mentored many botanists in plant anatomy, an inarguable source for the taxonomy of Arecaceae. Moreover, her former mentees carry out relevant research in plant conservation in Brazil, including for several botanical families of the campos rupestres of Minas Gerais.

Proposed IUCN conservation category. The extent of occurrence and the area of occupancy of *Syagrus aristeae* calculated using the online software GeoCAT (Bachman *et al.*, 2011) were 178.741 km^2 and 32 km^2, respectively. Therefore, following the IUCN criteria (IUCN Standards and Petitions Committee, 2022), this taxon should be classified as Endangered: EN B1b(ii,iii)c(i).

The pinnae of *Syagrus aristeae* are heavily consumed by locusts (see **Figure 2**J,K). However, the intense fires in the area (**Figure 5**A) are of more concern for the conservation of the species. Despite the important conservation role of the Serra do Cabral State Park, the area that the Park protects is relatively small (Costa *et al.*, 2018). To illustrate, the populations of *Syagrus aristeae* are close to the limits of the Park (see **Figure 4**), near the plantations of exotic species such as *Pinus* sp., *Eucalyptus* sp. and *Mangifera indica* (**Figure 5**B–D). Some activities with potential negative impact occur in the vicinity of the Serra do Cabral State Park, as previously shown by Costa *et al.* (2018). Therefore, rare or endemic species from various botanical families are under pressure due to the impact caused by these anthropogenic activities on rocky outcrops (see **Figure 5**B). Recently, electrical poles were installed and there is a noticeable increase in housing construction (**Figure 5**E,F). Some anthropogenic activities also observed near the Park include gravel extraction (**Figure 5**G) and the use of ovens for charcoal production (**Figure 5**H).

Notes. The morphological recognition of the species within the *Syagrus glaucescens* complex is difficult, even for experienced taxonomists (Marcato & Pirani, 2001). In the past, *Syagrus duartei* and *S. glaucescens* were considered the same taxon by Marcato & Pirani (2001). However, these authors did not consider the differences in leaf anatomy shown by Glassman (1972, 1987). Recently, Noblick (2013b, 2017b) showed that *Syagrus evansiana*, the third species included in the complex, also possess a distinct leaf anatomy pattern (Noblick, 2009, 2017a, 2017b; Firmo *et al.*, 2021).

Plant size is an important feature in distinguishing between species in the *Syagrus glaucescens* complex (Glassman, 1987; Noblick, 2009, 2017a; Firmo *et al.*, 2021). For the differentiation of *Syagrus duartei* and *S. glaucescens*, the larger peduncular bracts, larger

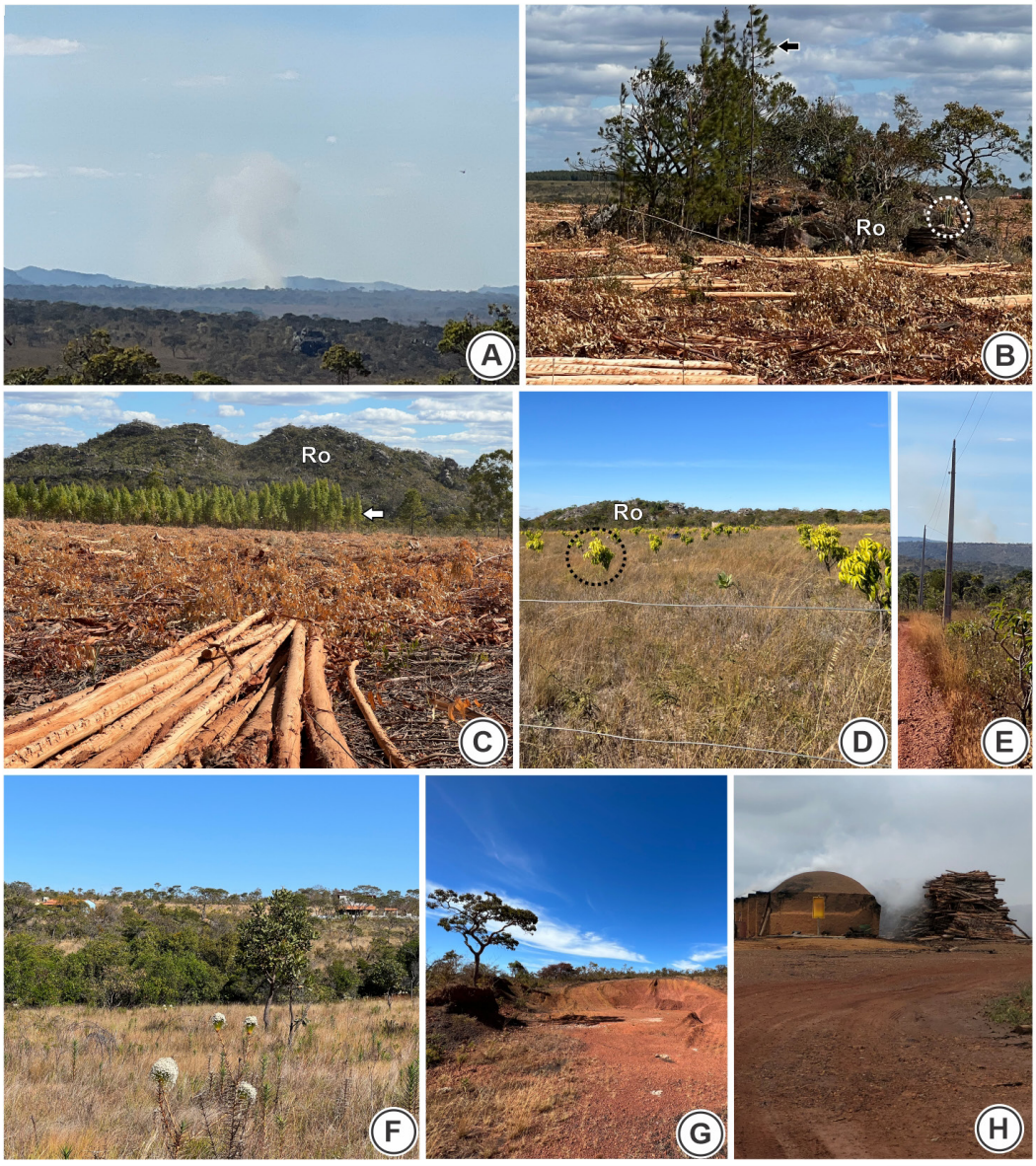

Figure 5. Examples of diverse threats in the vicinity of the Serra do Cabral State Park: A, large-scale fire; B, plantation of *Pinus* sp. (black arrow) – the white circle shows a rare species of Cactaceae on a small rocky outcrop (Ro); C, plantation of *Eucalyptus* sp. (white arrow) near a rocky outcrop (Ro); D, plantation of *Mangifera indica* near a rocky outcrop (Ro); E, electrical poles recently installed; F, houses; G, gravel mining; H, charcoal plant. Photographs: B. F. Sant'Anna-Santos.

inflorescences, and larger globose fruit of *S. duartei* are reliable characters (Noblick, 2017a). On the other hand, *Syagrus evansiana* has unique distinguishing characteristics, such as its smaller size, the two types of inflorescences, and the variable number of endocarp pores (Noblick, 2009, 2017a).

Geographically, the species of the *Syagrus glaucescens* complex possess almost separate distributions (Marcato & Pirani, 2001; Noblick, 2009, 2017a; Firmo *et al.*, 2021). *Syagrus duartei* is endemic to Serra do Cipó, whereas *S. glaucescens* is more abundant in the region of Diamantina, although some latter specimens could be found near the distribution limits of *S. duartei* (Noblick, 2017a). *Syagrus evansiana* occurs further north than *S. duartei* and *S. glaucescens* (Noblick, 2017a), whereas *S. aristeae* is endemic to the Serra do Cabral, a massif that shows a remarkable degree of endemism and holds rare species from several botanical families, including recent newly described species in Arecaceae (Noblick *et al.*, 2014; Costa *et al.*, 2018; Firmo *et al.*, 2021; Sant'Anna-Santos, 2021; Sant'Anna-Santos *et al.*, 2023a, 2023b).

The specimen (*Marcato* et al. 313) identified as the new species in this paper was the first (but erroneous) record of *Syagrus glaucescens* from the Serra do Cabral (SpeciesLink Network, 2022). However, at that time, some Brazilian taxonomists considered *Syagrus duartei* and *S. glaucescens* to be conspecific (Marcato & Pirani, 2001) and *S. evansiana* had not yet been described, which explains the mistake. Later, *Syagrus evansiana* was described as a new species from the northern portion of Minas Gerais (Noblick, 2009) and added to the *S. glaucescens* complex as the third taxon. Recently, the northern portion of the Serra do Cabral was included as the occurrence area of *Syagrus evansiana* (Noblick, 2017a), which led us to look for it in that region in our studies on the Arecaceae flora in the Serra do Cabral.

An unusual *Syagrus* population was found on the Serra do Cabral with younger individuals (already in reproductive phase) resembling *S. evansiana*, and mature specimens appearing to be larger (resembling *S. duartei*). This led them to be considered "confusing intermediates" belonging to the *Syagrus glaucescens* complex (Noblick, 2017a). However, the Serra do Cabral is isolated from the area of Espinhaço Range where *Syagrus evansiana*, *S. duartei* and these "confusing intermediates" are commonly found (Noblick, 2017a; Firmo *et al.*, 2021). Thus, in the following years, we focused on searching for more mature specimens in the reproductive stage to confirm this unusual population of the Serra do Cabral as a new endemic species. As a result, we found specimens with two types of inflorescences (unbranched and branched), which resemble those of *Syagrus evansiana* and not *S. duartei* or *S. glaucescens* (Noblick, 2009, 2017a; Firmo *et al.*, 2021). Additionally, as previously discussed by Firmo *et al.* (2021), we observed that the number of endocarp pores varied between three and five, a character found in both the new Serra do Cabral species and *Syagrus evansiana*. A reassessment of the leaf anatomy of the entire complex highlighted that these individuals were anatomically distinct from the other species of the complex (see Firmo *et al.*, 2021).

Both *Syagrus aristeae* and *S. evansiana* occur in campos rupestres of the Espinhaço Range in Minas Gerais, but *S. aristeae* is commonly found growing on quartzitic rocky outcrops whereas *S. evansiana* is not (Noblick, 2009, 2017a). Prostrate stems are common in *Syagrus aristeae* but not in *S. evansiana* (Firmo *et al.*, 2021), and there are six stamens (sometimes eight) in *S. aristeae* whereas *S. evansiana* has only six stamens. Other differences are described in the diagnosis and the identification key. The leaf anatomy differences between *Syagrua aristeae* and *S. evansiana* are given in Firmo *et al.* (2021).

Additional specimens examined. Brazil. **Minas Gerais**: Joaquim Felício, Arredores da zona urbana, Balneario Veredas, 17°45'28.00"S, 44°10'42.00"W, alt. 705 m, 19 v 2001, *A.C. Marcato* et al. 313 (SPF); Joaquim Felício, Pedra Alta, 17°42'2.78"S, 44°12'48.12"W, alt. 1138 m, 8 xii 2015, *B. F. Sant'Anna-Santos & I. F. P. Azevedo* 40, 41, 42, 43 (MCMG, UPCB); Buenópolis, Parque Estadual da Serra do Cabral, 17°54'44.28"S, 44°12'42.06"W, alt. 867 m, 16 xii 2019, *B. F. Sant'Anna-Santos & D. H. T. Firmo* 199 (UPCB); Buenópolis, Parque Estadual da Serra do Cabral, 17°54'33.84"S, 44°14'19.14"W, alt. 1109 m, 16 xii 2019, *B. F. Sant'Anna-Santos & D. H. T. Firmo* 200 (UPCB); Joaquim Felício, Parque Estadual da Serra do Cabral, 17°45'51.72"S, 44°16'31.50"W, alt. 1238 m, 17 xii 2019, *B. F. Sant'Anna-Santos & D. H. T. Firmo* 226 (UPCB); Joaquim Felício, Parque Estadual da Serra do Cabral, 17°42'2.46"S, 44°12'47.64"W, alt. 1141 m, 8 i 2020, *B. F. Sant'Anna-Santos & D. H. T. Firmo* 245 (UPCB); Joaquim Felício, Parque Estadual da Serra do Cabral, 17°42'1.56"S, 44°12'46.56"W, alt. 1138 m, 8 i 2020, *B. F. Sant'Anna-Santos & D. H. T. Firmo* 246 (UPCB); Buenópolis, Parque Estadual da Serra do Cabral, 17°55'13.56"S, 44°15'38.34"W, alt. 1135 m, 9 i 2020, *B. F. Sant'Anna-Santos & D. H. T. Firmo* 253 (UPCB); Buenópolis, Parque Estadual da Serra do Cabral, 17°54'20.88"S, 44°14'30.12"W, alt. 1115 m, 7 i 2021, *B. F. Sant'Anna-Santos* 319 (UPCB).

Key to distinguish *Syagrus aristeae* from *S. evansiana*

The new couplet to place *Syagrus aristeae* should be inserted at couplet 79 in the key to *Syagrus* species in the *Flora e Funga do Brasil* (Soares, 2022).

1a. Leaf rachis 94–145 cm long; middle pinnae tip usually asymmetrical; abaxial side of leaf rachis and petiole with tomentum; inflorescence axis 18–29.5 cm long; basal and apical rachillae of similar length; epicarp covered with crackled plates _____ *S. aristeae*

1b. Leaf rachis 21–92 cm long; middle pinnae tip usually symmetrical; abaxial side of leaf rachis and petiole glabrous; inflorescence axis 4.5–17 cm long; basal and apical rachillae of different length; epicarp covered by a thick brown indument __ *S. evansiana*

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References

Almada ED, Anaya FC, Monteiro FT. 2016. The people of the mountains: the biocultural heritage of the Espinhaço Range in Minas Gerais State, Brazil. In: Fernandes G, editor. Ecology and Conservation of Mountaintop Grasslands in Brazil. Switzerland: Springer. pp. 479–499. https://doi.org/10.1007/978-3-319-29808-5.

Alves RJV, Silva NG, Oliveira JÁ, Medeiros D. 2014. Circumscribing *campo rupestre* – megadiverse Brazilian rocky montane savannas. Brazilian Journal of Biology. 74(2):355–362. https://doi.org/10.1590/1519-6984.23212.

Bachman S, Moat J, Hill AW, de laTorre J, Scott B. 2011. Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. ZooKeys. 150:117–126. https://doi.org/10.3897/zookeys.150.2109.

Batista EKL, Russell-Smith J, França H, Figueira JEC. 2018. An evaluation of contemporary savanna fire regimes in the Canastra National Park, Brazil: outcomes of fire suppression policies. Journal of Environmental Management. 205:40–49. https://doi.org/10.1016/j.jenvman.2017.09.053.

Brasil. 2020. Ministério do Meio Ambiente. http://mapas.mma.gov.br/i3geo/datadownload.htm.

Cássia-Silva C, Oliveira RS, Sales LP, Freitas CG, Jardim L, Emilio T, Bacon CD, Collevatti RG. 2022. Acaulescence promotes speciation and shapes the distribution patterns of palms in Neotropical seasonally dry habitats. Ecography. 3:e06072. https://doi.org/10.1111/ecog.06072.

Costa FN, Andrino CO, Sano PT, Trovó M, Echternacht L. 2018. *Paepalanthus* (Eriocaulaceae) in the central espinhaço range in Minas Gerais, Brazil: checklist, endemism, and nomenclatural changes. Phytotaxa. 367(2):133–144. https://doi.org/10.11646/phytotaxa.367.2.3.

Dransfield J, Uhl N, Asmussen C, Baker W, Harley M, Lewis C. 2008. Genera *Palmarum*: the Evolution and Classification of Palms. Richmond: Royal Botanic Gardens, Kew. pp. 424–428.

Fernandes GW. 2016. The megadiverse rupestrian grassland. In: Fernandes GW, editor. Ecology and Conservation of Mountaintop Grasslands in Brazil. Switzerland: Springer. pp. 3–14. https://doi.org/10.1007/978-3-319-29808-5_1.

Fernandes GW, Arantes-Garcia L, Barbosa M, Barbosa NPU, Batista EKL, Beiroz W, Resende FM, Abrahão A, Almada ED, Alves E, Alves NJ, Angrisano P, Arista M, Arroyo J, Arruda AJ, Bahia TO, Braga L, Brito L, Callisto M, Caminha-Paiva D, Carvalho M, Conceição AA, Costa LN, Cruz A, Cunha-Blum J, Dagevos J, Dias BFS, Pinto VD, Dirzo R, Domingos DQ, Echternacht L, Fernandes S, Figueira JEC, Fiorini CF, Giulietti AM, Gomes A, Gomes VM, Gontijo B, Goulart F, Guerra TJ, Junqueira PA, Lima-Santos D, Marques J, Meira-Neto J, Miola DTB, Morellato LPC, Negreiros D, Neire E, Neves AC, Neves FS, Novais S, Oki Y, Oliveira E, Oliveira RS, Pivari MO, Junior EP, Ranieri BD, Ribas RP, Scariot A, Schaefer CE, Sena L, Silva PG, Siqueira PR, Soares NC, Soares-Filho B, Solar R, Tabarelli M, Vasconcellos R, Vilela E, Silveira FAO. 2020. Biodiversity and ecosystem services in the Campo

Rupestre: a road map for the sustainability of the hottest Brazilian biodiversity hotspot. Perspectives in Ecology and Conservation. 18(4):213–222. https://doi.org/10.1016/j.pecon.2020.10.004.

Firmo DHT, Santos SA, Perez MEMP, Soffiatti P, Sant'Anna-Santos BF. 2021. Reassessing species boundaries in the *Syagrus glaucescens* complex (Arecaceae) using leaf anatomy. Botany. 99(7):379–387. https://doi.org/10.1139/cjb-2020-0165.

Giulietti N, Giulietti AM, Pirani JR, Menezes NL. 1988. Estudos em sempre-vivas: importância econômica do extrativismo em Minas Gerais, Brasil. Acta Botanica Brasilica. 1(2 Suppl. 1):179–193. https://doi.org/10.1590/S0102-33061987000300018.

Giulietti AM, Pirani JR, Harley R. 1997. Espinhaço Range region, eastern Brazil. In: Davis SD, Heywood VH, Herrera-MacBryde O, Villa-Lobos J, Hamilton AC, editors. Centres of Plant Diversity: A Guide and Strategy to Their Conservation. Cambridge: Worldwide Fund for Nature/World Conservation Unit. pp. 397–404. http://repositorio.usp.br/item/0009811665.

Glassman SF. 1965. Preliminary studies in the palm genus *Syagrus* Mart. and its allies. Fieldiana: Botany. 31(5):147–164. https://doi.org/10.5962/bhl.title.2392.

Glassman SF. 1967. New species in the palm genus *Syagrus* Mart. Fieldiana: Botany. 31(9):235–245. https://doi.org/10.5962/bhl.title.2418.

Glassman SF. 1968a. New species in the palm genus *Syagrus* Mart., II. Fieldiana: Botany. 31(13):285–299. https://doi.org/10.5962/bhl.title.2405.

Glassman SF. 1968b. Studies in the palm genus *Syagrus* Mart. Fieldiana: Botany. 31(17):363–397. https://doi.org/10.5962/bhl.title.2415.

Glassman SF. 1972. Systematic studies in the leaf anatomy of palm genus *Syagrus*. American Journal of Botany. 59(8):775–788. https://doi.org/10.1002/j.1537-2197.1972.tb10152.x.

Glassman SF. 1987. Revisions of the palm genus *Syagrus* Mart. and other selected genera in the *Cocos* alliance. Illinois Biological Monographs. 56:1–230.

Henderson H, Galeano G, Bernal R. 1995. Field Guide to the Palms of the Americas. Princeton, New Jersey: Princeton University Press.

IBGE [Instituto Brasileiro de Geografia e Estatística]. 2020. Portal de mapas. https://portaldemapas.ibge.gov.br/portal.php#homepage. [Accessed 12 April 2020.]

IUCN Standards and Petitions Committee. 2022. Guidelines for Using the IUCN Red List Categories and Criteria, version 15.1. Prepared by the Standards and Petitions Committee. Downloadable from https://www.iucnredlist.org/documents/RedListGuidelines.pdf. [Accessed 11 November 2022].

Marcato AC, Pirani JR. 2001. Flora da Serra do Cipó, Minas Gerais, Palmae (Arecaceae). Boletim de Botânica. 19:45–54. https://doi.org/10.11606/issn.2316-9052.v19i0p45-54.

Marcato AC, Pirani JR. 2006. Flora de Grão-Mogol, Minas Gerais: Palmae (Arecaceae). Boletim de Botânica. 24(1):1–8. https://doi.org/10.11606/issn.2316-9052.v24i1p1-8.

Martel C, Noblick L, Stauffer F. 2013. An anatomical character to support the cohesive unit of *Butia* species. Palms. 57(1):30–35. https://palms.org/wp-content/uploads/2016/05/vol57n1p30_37.pdf.

Meerow AW, Noblick L, Borrone JW, Couvreur TLP, Mauro-Herrera M, Hahn WJ, Kuhn DN, Nakamura K, Oleas NH, Schnell RJ. 2009. Phylogenetic analysis of seven WRKY genes across the palm subtribe

Attaleinae (Arecaceae) identifies *Syagrus* as sister group of the Coconut. PLOS One. 4(10):e7353. https://doi.org/10.1371/journal.pone.0007353.

Miranda EE. 2005. Brasil em Relevo. Campinas: Embrapa Monitoramento por Satélite. http://www.relevobr.cnpm.embrapa.br. [Accessed 12 April 2020.]

Noblick LR. 2004a. *Syagrus cearensis*, a twin-stemmed new palm from Brazil. Palms. 48(2):70–76.

Noblick LR. 2004b. *Syagrus vermicularis*, a fascinating new palm from northern Brazil. Palms. 48(3):109–116.

Noblick LR. 2004c. Transfer of *Syagrus campicola* to *Butia*. Palms. 48(1):42.

Noblick LR. 2009. *Syagrus evansiana*, a new palm from Minas Gerais, Brazil. Palms. 53(3):113–118.

Noblick LR. 2010. *Syagrus*. In: Lorenzi H, Noblick L, Kahn F, Ferreira E, editors. Brazilian Flora Lorenzi: Arecaceae (Palms). Nova Odessa: Instituto Plantarum. pp. 304–360.

Noblick LR. 2012. *Syagrus* × *mirandana*, a naturally occurring hybrid of *S. coronata* and *S. microphylla*. Palms. 56(2):57–60.

Noblick LR. 2013a. *Syagrus stenopelata*: a good species. Palms. 57(3):147–149.

Noblick LR. 2013b. Leaflet anatomy verifies relationships within *Syagrus* (Arecaceae) and aids in identification. PhytoKeys. 26:75–99. https://doi.org/10.3897/phytokeys.26.5436.

Noblick LR. 2014. *Syagrus*: an overview. The Palm Journal: Magazine of the Southern California Chapter of the International Palm Society. 205:3–31.

Noblick LR. 2017a. A revision of the genus *Syagrus* (Arecaceae). Phytotaxa. 294(1):1–262. https://doi.org/10.11646/phytotaxa.294.1.1.

Noblick LR. 2017b. Key to *Syagrus* identification using leaflet margin anatomy: supplement to “A revision of *Syagrus* (Arecaceae)”. PhytoKeys. 81:19–46. https://doi.org/10.3897/phytokeys.81.12909.

Noblick LR. 2018. *Syagrus guaratingensis*: a new species from Bahia, Brazil. Palms. 62(2):77–86.

Noblick LR. 2019. Guide to the Palms of Northeastern Brazil. Feira de Santana: UEFS Editora.

Noblick LR, Lorenzi H. 2010a. *Lytocaryum*, including a new species from Bahia, Brazil. Palms. 54(1):5–17.

Noblick LR, Lorenzi H. 2010b. New *Syagrus* species from Brazil. Palms. 54(1):18–42.

Noblick LR, Meerow AW. 2015. The transfer of the genus *Lytocaryum* to *Syagrus*. Palms. 59(2):57–62.

Noblick LR, Lorenzi H, Souza VC. 2014. Four new taxa of acaulescent *Syagrus* (Arecaceae) from Brazil. Phytotaxa. 188(1):1–13. https://doi.org/10.11646/phytotaxa.188.1.1.

QGIS Development Team. 2022. QGIS Geographic Information System. Open Source Geospatial Foundation Project. https://qgis.osgeo.org. [Accessed 12 November 2020.]

Reflora. 2022. Reflora. Herbário Virtual. https://reflora.jbrj.gov.br/reflora/herbarioVirtual/. [Accessed 12 November 2020.]

Sant’Anna-Santos BF. 2021. A new endemic and critically endangered species of *Butia* (Arecaceae) with comments on morpho-anatomical novelties in the genus. Plant Systematics and Evolution. 307(1):4. https://doi.org/10.1007/s00606-020-01729-w.

Sant'Anna-Santos BF, Azevedo IFP, Micheli R, Soffiatti P. 2023a. Morpho-anatomical novelties of a dwarf *Syagrus* (Arecaceae) of *canga*: implications for ecology, conservation, and taxonomy. Plant Systematics and Evolution. 309(2):8. https://doi.org/10.1007/s00606-023-01843-5.

Sant'Anna-Santos BF, Micheli R, Carvalho, LFM, Soffiatti P. 2023b. A new bluish-leaved *Syagrus* (Arecaceae) from an overlooked OCBIL in the Espinhaço Range (Brazil). Plant Ecology and Evolution. 156(2):129–145. https://doi.org/10.5091/plecevo.101027.

Silva-Cardoso IMA, Souza AM, Scherwinski-Pereira JE. 2017. The palm tree *Syagrus oleracea* Mart. (Becc.): a review. Scientia Horticulturae. 225:65–73. https://doi.org/10.1016/j.scienta.2017.06.054.

Soares KP. 2022. *Syagrus* in Flora e Funga do Brasil. Jardim Botânico do Rio de Janeiro. http://reflora.jbrj.gov.br/reflora/floradobrasil/FB15732. [Accessed 12 November 2020.]

Soares KP, Guimarães C. 2019. *Syagrus amicorum*, a new Arecaceae from Bahia, Brazil. Phytotaxa. 387(2):158–164. https://doi.org/10.11646/phytotaxa.387.2.8.

Soares KP, Pimenta RS, Guimarães CA. 2013. Duas novas espécies de *Syagrus* Mart. (Arecaceae) para o Brasil. Ciência Florestal. 23(3):417–426. https://doi.org/10.5902/1980509810553.

SpeciesLink Network. 2022. Sistema de informação distribuído para coleções biológicas: a integração do Species Analyst e do SinBiota (FAPESP). http://specieslink.net/search. [Accessed 12 November 2020.]

Thiers B. Continuously updated. Index Herbariorum: A Global Directory of Public Herbaria and Associated Staff. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/science/ih/ [Accessed 10 May 2021]