



The Carandilla Palm (*Trithrinax schizophylla* Drude, Arecaceae) is not extinct in Brazil: first primary records from the Chaco region of Mato Grosso do Sul

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Abstract: We report the occurrence of several remnant stands of *Trithrinax schizophylla* Drude in Porto Murtinho municipality, southwestern Mato Grosso do Sul state, Brazil. Until recently, the species was considered as probably extinct in the country. *Trithrinax schizophylla* is found only in the Chaco provinces of Argentina, Paraguay, and Bolivia, with a narrow strip in the southwestern region of Mato Grosso do Sul. The region is one of the most modified inside the Pantanal wetland in Brazil, and conservation actions are in need to protect this and other species in the region.

Key words: Pantanal wetland, palm, conservation

The palm *Trithrinax schizophylla* Drude is characteristic from the Chaco phytogeographic province, which ranges from northern Argentina, northwestern Paraguay and southern Bolivia, with a very restricted area in the southwestern Mato Grosso do Sul state, Brazil (Hueck 1972; Cabrera and Willink 1980). The species was first described in 1882 (Martius 1882) based on specimens collected by d'Orbigny in Santa Cruz, Bolivia, and by Weddell in Mato Grosso, Brazil. Barbosa Rodrigues (1899) described *Trithrinax biflabellata* based on specimen collected from the Paraguayan Chaco, near Concepción, a name that was later placed in the synonymy of *T. schizophylla* by Henderson et al. (1995). Cano et al. (2013) treated *T. biflabellata* as a variety of *T. schizophylla*, the typical variety *T. schizophylla* var. *schizophylla* occurring along the foothills of the Andes, in Argentina and Bolivia, ranging from 250 to 1,400 m above the sea level, while *T. schizophylla* var. *biflabellata* occurs in areas ranging from 100 to 150 m above the sea level in northern

Paraguay and southern Bolivia. Although some authors consider this latter variety as a distinct species (e.g., Leitman et al. 2015), in this note we follow the concept of Cano (2013).

Trithrinax schizophylla is widely distributed in Chaco region (Henderson et al. 1995; Olson et al. 2001; Zak et al. 2004; Pintaud et al. 2008; Gauto et al. 2011; Cano et al. 2013) and tolerates seasonal floods (Moraes 2006, 2007; Oliveira-Filho et al. 2006). The species has been considered rare and probably extinct in Brazil (Lorenzi et al. 2010). Previous floristic inventories in the southernmost region of the Pantanal wetlands have failed to find *T. schizophylla* along the Brazilian border with Paraguay and Bolivia (Noguchi et al. 2009; Pott et al. 2011), where the species is still known to occur (Lorenzi et al. 2010; Leitman et al. 2015; Cano et al. 2013). Recently, Cano et al. (2013) conducted a taxonomic revision of the genus *Trithrinax*, but no primary records from the southwestern Mato Grosso do Sul have been reported. Therefore, despite Drude's description of *T. schizophylla* based on specimen from Bolivia and Brazil (Martius 1882), there were no records of the species occurring in the latter country besides the type so far.

In this note we report the first primary records of *T. schizophylla* from Brazil, and document a small population at the southwestern region of Mato Grosso do Sul, indicating that the species is not extinct in Brazil. In November 2011 and October 2012 we found a few stands of *T. schizophylla* in a cattle ranch (Tereré Ranch, 21°24'46.14" S, 057°47'06.74" W) during mammal and ecotope surveys at Porto Murtinho municipality, southwestern Mato Grosso do Sul state, Brazil. Additionally, few individuals were found in another ranch (Verginia Ranch, 22°01'39.79" S, 057°54'16.04" W), close to the

banks of the Apa river, in the border between Brazil and Paraguay (Figure 1).

We identified our specimens as *T. schizophylla* var. *biflabellata* based on morphological aspects, as well as on the geographical congruence with the species distribution Cano et al. (2013). The species has solitary or multiple aerial stems (Figure -b), 2–6m tall and 12–20cm

diameter, covered by leaves-sheaths bearing long woody spines (Figure 2d) in its terminal part (Martius 1837), palmate leaves with long petioles, leaf blade divided up to two-thirds or more in deeply bifid segments (more than 20 per leaf blade) (Henderson et al. 1995; Cano et al. 2013). Fruiting individuals were observed in October 2012 bearing globose or subglobose (Figure 2c),

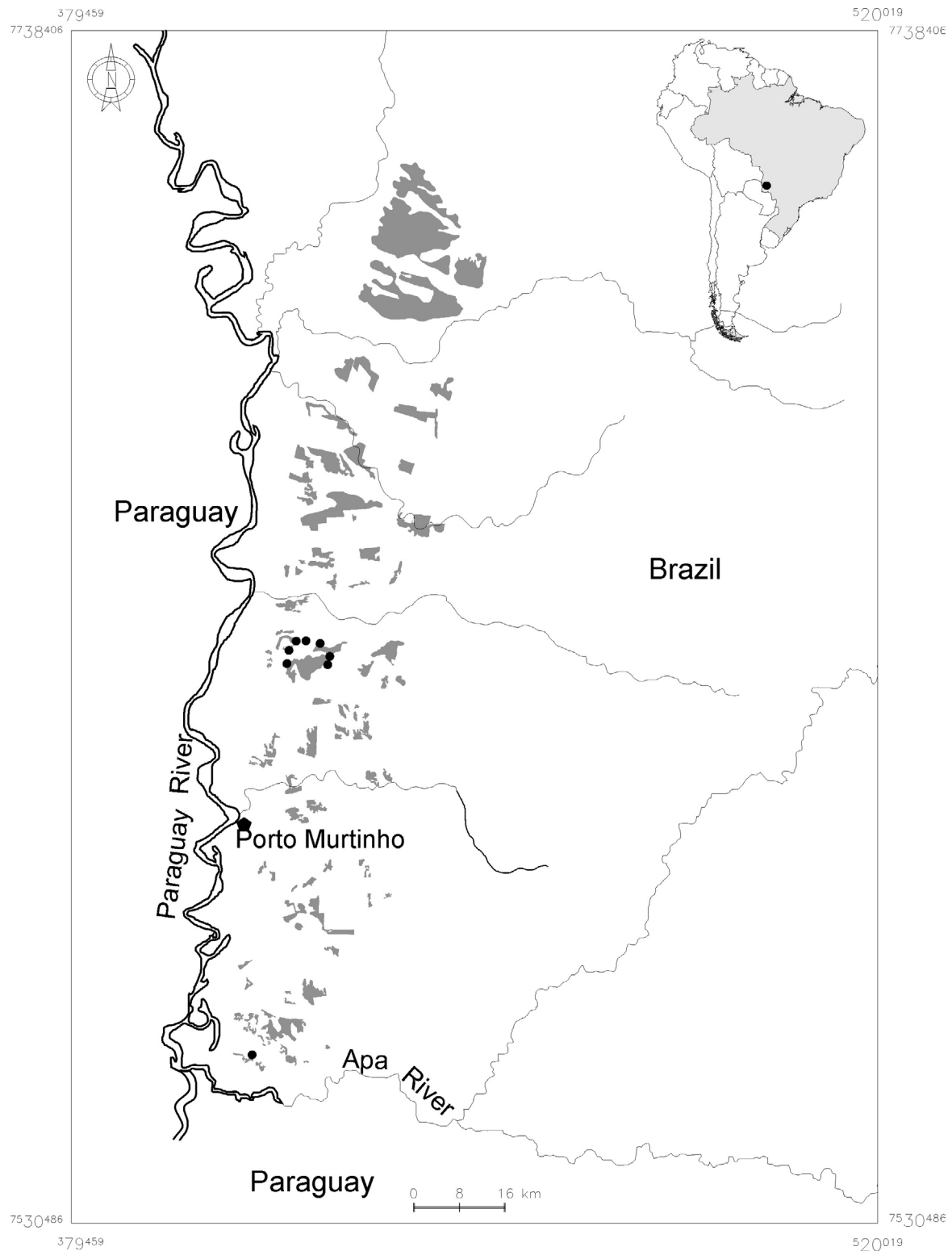


Figure 1. Records of *Trithrinax schizophylla* var. *biflabellata* stands at the wet Chaco region of Porto Murtinho municipality, state of Mato Grosso do Sul, Brazil (black dots).

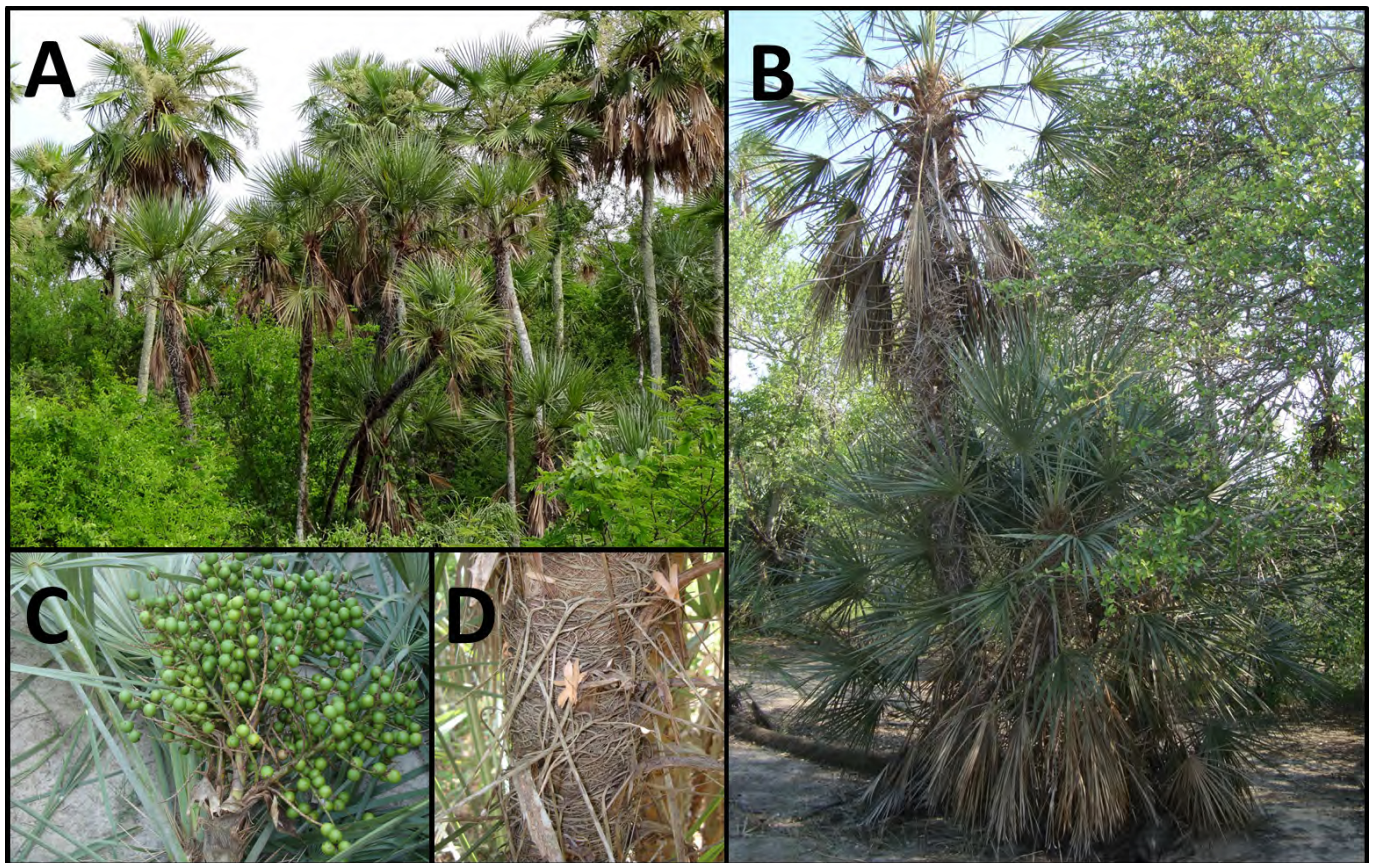


Figure 2. From left to right, (a). Stand of Carandilla Palm amongst Carandá Palm *Copernicia alba*; (b). The Carandilla Palm *Trithrinax schizophylla* var. *biflabellata* in the ranch Tereré, Porto Murtinho, Mato Grosso do Sul state; (c). Immature fruits; (d). Spiny trunk.

yellowish white fruits when mature. Voucher specimens were pressed and dried following conventional methods and deposited at the COR Herbarium, Universidade Federal de Mato Grosso do Sul, Campus Pantanal (IHI-780 registered as COR 15379), with duplicates deposited at the CPAP, Embrapa Pantanal Herbarium (acronyms according to Thiers 2015).

The remnants of the original vegetation in the study area are a mosaic of xeric and wet habitats, including dense forest stands containing *Aspidosperma quebracho-blanco* Schltld., *Schinopsis balansae* Engl., *Caesalpinia paraguariensis* (Parodi) Burkart., *Handroanthus heptaphyllus* (Vell.) Mattos, *Phyllostylon rhamnoides* (Pois.) Taub., *Ruprechtia triflora* Griseb., *Prosopis* spp., *Pseudobombax* spp., and *Parkinsonia aculeata* L. In the understory and edges of these forest remnants we found the bromeliads *Bromelia balansae* Mez, *Aechmea distichantha* Lem., and *Bromelia hieronymii* Mez, as well as the cactus *Stetsonia coryne* (Salm-Dyck) Britton & Rose. The spiny, shrubby vegetation outside the forest habitats are dominated by *Vachellia caven* (Molina) Seigler & Ebinger and *Celtis* spp., with patches of *S. coryne*, *Cleistocactus baumannii* (Lem.) Lem., *Gymnocalycium mihanovichii* (Fric ex Gürke) Britton & Rose, *Frailea cataphracta* (Dams) Britton & Rose, *Cereus spegazzinii* F.A.C. Weber and *Copernicia alba* Morong ex Morong & Britton. This palm often forms dense stands

in most of the floodable areas, along with *Handroanthus albus* (Cham.) Mattos, *Prosopis* spp. and *A. quebracho-blanco*, characterizing the wet Chaco.

The stands of *T. schizophylla* found at the Tereré ranch were located inside and at the edges of dry Chacoan forests. Most stands were found in areas of slightly higher ground, and a small portion of them was found in floodable areas among *Copernicia alba* (Figure 2a). The habitat where *T. schizophylla* was found are remnants of the natural vegetation, as most of the region have been submitted to a widespread replacement of the native vegetation by cultivated pastures. The original forest cover in the region (12,144.9 km²) has been reduced to 13% of its original extension, based on our recent mapping using satellite image (Figure 1). Thus, the Chaco may be considered one of the most endangered ecoregions in Brazil, threatening several species of plants and animals with very restrict distribution in Brazil, such as *T. schizophylla*. The population of *T. schizophylla* in Brazil may have been reduced to a few hundred individuals in the region where our records come from, and thus we suggest that the species should integrate the Red List of endangered species in Brazil. In fact, Cano et al. (2013) consider *T. schizophylla* as Vulnerable by the IUCN (International Union for the Conservation of the Nature) criteria, due to low densities found in the field, increasing habitat loss, and exploitation to which

the species has been submitted. However, the status of *T. schizophylla* has not been assessed by the IUCN yet (consulted in February 2015), and the species has not been included in the last updated list of endangered species in Brazil (Ministério do Meio Ambiente 2014).

We performed an assessment of the species status using the GeoCAT tool (Bachman et al. 2011) based on the records from Cano et al (2013) and the current localities in Brazil. The result of this assessment indicates that *T. schizophylla* (both varieties) has an area of occupancy of 228 km² (cell size = 2 km, IUCN standard); separately, *T. schizophylla* var. *biflabellata* should occur in an area of 156 km² (cell size = 2 km, IUCN standard); and finally, the remnant population of *T. schizophylla* var. *biflabellata* in Brazil presents a very small area of occupancy (16 km², cell size = 2 km, IUCN standard). Besides that, the Chaco ecoregion in Argentina, Paraguay and Bolivia has been rapidly replaced by croplands and pastures at alarming rates (Volante et al. 2012; Hansen et al. 2013; Vallejos et al. 2014) reaching over 4% of substitution per year (Vallejos et al. 2014). For instance, Paraguay has the highest rate of deforestation in the world nowadays, and may be completely removed in the next 30 years at the present rates (World Land Trust 2013; Survival International 2014). In this country, Mereles and Rodas (2014) found out that 54% of the Chaco region lost its original forest cover by 2013, resulting in highly fragmented landscape. In the narrow Brazilian stretch of the Chaco region, deforestation has been intensive in the past decades, and only 13% has been left from the original vegetation, as reported in this note. Combining the assessment made using the GeoCAT tool and the IUCN criteria (IUCN 2001), we suggest that *Trithrinax schizophylla* should be classified as Endangered worldwide (EN, B2biii), as well as *T. schizophylla* var. *biflabellata*. For the Brazilian List of Endangered Species we concluded that the species should be considered as Critically Endangered (CR, B2a). The small population left occurs in a reduced area, the distribution is highly fragmented, the habitat modification has been intensive in the entire region, and the area of occupancy is estimated to be smaller than 100 km² even if we double the cell size of IUCN standard (AOO = 64 km²). Classifying this species at global and country levels is fundamental to ensure some degree of protection.

Chaco is not officially recognized by the Brazilian government as an ecoregion occurring in Brazil, as the IBGE maps classify the region as Cerrado, or Savana Estépica (IBGE 2012), or simply as “Pantanal Biome”. However, Cabrera and Willink (1980), Prado et al. (1992), Prado (1993), and Morrone (2001) consider Chaco province as occurring in a restrict area of Mato Grosso do Sul state, Brazil. Additionally, several authors defend the existence of the Chaco in Brazil based on floristic inventories (e.g., Noguchi et al. 2009; Alves and Sartori 2009; Pott et al. 2011), bird community composition

(Straube et al. 2006), and herpetofauna (Souza et al. 2010). As it is a unique ecosystem, sheltering several species not found elsewhere in the country, and given that the region has not a single protected area (Noguchi et al. 2009), it would be strategic to elect the Brazilian Chaco as a conservation priority at federal and state levels. It is important to point out that most stands of *T. schizophylla* were found inside legal reserves, and this fact clearly illustrates the importance of such a management unit in maintaining the biodiversity. Under the Brazilian Forest Code, landowners are required to keep at least 20% of the land as a protected area with native vegetation in the Pantanal region, allowing some level of management, to help biodiversity conservation and to provide other ecosystem services. However, it must be taken into consideration that legal reserves may be managed by the landowners, and thus may not be sufficient to ensure the conservation of biodiversity in the same manner as other types of strict protected areas, such as national parks, ecological stations, or biological reserves. We strongly defend incentives to the establishment of private reserves (Reserva Particular do Patrimônio Natural – RPPN) as well as the implementation of official protected areas in the Porto Murtinho region to ensure total protection for the last Chaco remnants in Brazil. Also, it is fundamental to implement suitable policies to stop additional replacement of the remaining native vegetation by cultivated pastures, as the unique biodiversity present in the region is jeopardized by cattle ranching.

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LITERATURE CITED

- Alves, F. M. and A. L. B. Sartori. 2009. Caesalpinioideae (Leguminosae) de um remanescente de Chaco em Porto Murtinho, Mato Grosso do Sul, Brasil. *Rodriguésia* 60(3): 531-550. http://rodriguesia.jbrj.gov.br/FASCICULOS/rodrig60_3/067-08.pdf.
- Bachman, S., J. Moat, A. W. Hill, J. de la Torre and B. Scott. 2011. Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool *ZooKeys* 150: 117–126. doi: 10.3897/zookeys.150.2109 [Application (Beta version) available at <http://geocat.kew.org>].
- Barbosa Rodrigues, J. 1899. *Palmae novae Paraguayenses*. Rio de Janeiro: Typographia Leuzinger. 66 pp.
- Cabrera, A. L. and A. Willink 1980. *Biogeografía de América Latina*. Washington: Organización de Estados Americanos. 122 pp.
- Cano, A., M. Perret and F. W. Stauffer. 2013. A revision of the genus *Trithrinax* (Cryosophileae, Coryphoideae, Arecaceae). *Phytotaxa*

- 136(1): 1–53. doi: [10.11646/phytotaxa.136.1.1](https://doi.org/10.11646/phytotaxa.136.1.1)
- Gauto, I., R.E. Spichiger and F.W. Stauffer. 2011. Diversity, distribution and conservation status assessment of Paraguayan palms (Arecaceae). *Biodiversity and Conservation* 20(12): 2705–2728. doi: [10.1007/s10531-011-0100-6](https://doi.org/10.1007/s10531-011-0100-6)
- Hansen, M. C., P.V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau; S.V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, J. and G. R. Townshend. 2013. High-resolution global maps of 21st-century forest cover change. *Science* 342: 850–853. doi: [10.1126/science.1244693](https://doi.org/10.1126/science.1244693)
- Henderson, A., G. Galeano and R. Bernal. 1995. *Field guide to the palms of the Americas*. Princeton: Princeton University Press. 352 pp.
- Hueck, K. 1972. As regiões de matas do Chaco e áreas marginais; pp. 240–275, in: J.C.A. Azevedo, C.V. Anjos, L.C. Gomes, R. Lyra Filho, R.B. Moraes, W.L. Paraense, and E.N. Fonseca (eds.). *As florestas da América do Sul: ecologia, composição e importância econômica*. Brasília: Editora Polígono.
- IBGE. 2012. *Manual técnico da vegetação Brasileira*. 2ª. Edição. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística. 271 pp.
- IUCN. 2001. *IUCN Red List categories and criteria: version 3.1*. Gland, Switzerland and Cambridge, UK: IUCN Species Survival Commission. Accessed at <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria#critical>, 27 May 2015.
- Leitman, P., K. Soares, A. Henderson, L. Noblick and R.C. Martins. 2015. Arecaceae; in: *Lista de espécies da flora do Brasil*. Rio de Janeiro: Jardim Botânico do Rio de Janeiro. Accessed at <http://floradobrasil.jbrj.gov.br/2012/FB034089>, 27 May 2015.
- Lorenzi, H., L.R. Noblick, F. Kahn and E. Ferreira. 2010. *Flora Brasileira: Arecaceae (Palmeiras)*. Nova Odessa: Instituto Plantarum. 384 pp.
- Martius, C.F.P. 1837. *Historia Naturalis Palmarum*. Vol. 2. Lipsiae: T.O. Weigel. 198 pp.
- Mereles, M.F. and O. Rodas. 2014. Assessment of rates of deforestation classes in the Paraguayan Chaco (Great South American Chaco) with comments on the vulnerability of forests fragments to climate change. *Climatic Change* 127(1): 55–71. doi: [10.1007/s10584-014-1256-3](https://doi.org/10.1007/s10584-014-1256-3)
- Ministério de Meio Ambiente. 2014. *Lista Nacional Oficial de Espécies da Flora Ameaçadas de Extinção*. Diário Oficial da União, Seção I, Número 245, P. 110. Accessed at <http://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?data=18/12/2014&journal=1&pagina=110&totalArquivos=144>, 27 May 2015.
- Moraes, M. 2006. La flora de palmeras de Bolivia en un contexto neotropical. *Flora of Bolivian palms in a Neotropical context*. *Arnaldia* 13(2): 348–359. <http://revistas.concytec.gob.pe/pdf/arnal/v13n2/a10v13n2.pdf>
- Moraes, M. 2007. Phytogeographical patterns of Bolivian palms. *Palms* 51(4): 177–186. <http://www.palms.org/palmsjournal/2007/v51n4p177-186.pdf>
- Morrone, J. J. 2001. *Biogeografía de América Latina y el Caribe*. Zaragoza: M&T-Manuales & Tesis SEA. 148 pp.
- Noguchi, D.K., G.P. Nunes and A.L.B. Sartori 2009. Florística e síndromes de dispersão de espécies arbóreas em remanescentes de chaco de Porto Murtinho, Mato Grosso do Sul, Brasil. *Rodriguesia* 60(2): 353–365. http://rodriguesia.jbrj.gov.br/FASCICULOS/rodrig60_2/08-021-08.pdf
- Oliveira Filho, A. T., J. A. Jarenkow and M.J.N. Rodal. 2006. Floristic relationships of seasonally dry forests of Eastern South America based on tree species distribution patterns; pp. 159–192, in: R.T. Pennington, G. Lewis and J.A. Ratter. 2006. *Neotropical savannas and seasonally dry forests: plant diversity, biogeography and conservation*. Boca Raton, Florida: CRC Press. 484 pp.
- Olson, D.M., Dinerstein, E., Wikramanayake, E., Burgess, N., Powell, G., Underwood, E., D'Amico, J.A., Itoua, I., Strand, H.E., Morrison, H.C., Loucks, C.J., Allnutt, T.F., Ricketts, T.H., Kura, Y., Lamoreux, J.F., Wettengel, W.W., Hedao, P. and Kassem, K.R. 2001. Terrestrial ecoregions of the world: a new map of life on earth. *Bioscience* 43(11): 933–938. doi: [10.1641/0006-3568\(2001\)051\[0933:TEOTWA\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2)
- Pintaud, J.-C., G. Galeano, H. Balslev, R. Bernal, F. Borchsenius, E. Ferreira, J.-J. Granville, K. Mejía, B. Millán, M. Moraes, L. Noblick, F.W. Stauffer and F. Kahn. 2008. Las palmeras de América del Sur: diversidad, distribución e historia Evolutiva. *Revista Peruana de Biología* 15(suppl1): 7–29. http://www.scielo.org.pe/scielo.php?script=sci_arttext&pid=S1727-99332008000000003
- Pott, A., A.K.M. Oliveira, G.A. Damasceno-Junior and J.S.V. Silva. 2011. Plant diversity of the Pantanal wetland. *Brazilian Journal of Biology* 71(1): 265–273. <http://www.scielo.br/pdf/bjb/v71n1s1/05.pdf>
- Prado, D.E. 1993. What is the Gran Chaco vegetation in South America? I. A review. *Contribution to the study of flora and vegetation of the Chaco—V. Candollea* 48(2): 145–172.
- Prado, D.E., P.E. Gibbs, A. Pott and V.J. Pott. 1992. The chaco-transition in southern Mato-Grosso, Brazil; pp. 451–470, in: P.A. Furley, J. Proctor and J.A. Ratter (eds.). *Nature and dynamics of forest-savanna boundaries*. London: Chapman & Hall.
- Souza, F. L., M. Uetanabaro, P. Ladgref-Filho, L. Piatti and C. P. A. Prado. 2010. *Herpetofauna, municipality of Porto Murtinho, Chaco region, state of Mato Grosso do Sul, Brazil*. *Check List* 6(3): 470–475. <http://www.checklist.org.br/getpdf?SL013-10>
- Straube, F. C., A. Urben-Filho, M. A. C. Pivatto, A. P. Nunes and W. M. Tomas. 2006. Nova contribuição à ornitologia do Chaco brasileiro (Mato Grosso do Sul, Brasil). *Atualidades Ornitológicas* 135: 1–27. <http://www.ao.com.br/download/chaco.pdf>
- Survival International. 2014. Study reveals world's highest deforestation rate on uncontacted tribe's land. Accessed at <http://www.survivalinternational.org/news/9911>, 27 May 2015.
- Thiers, B. [2015]. *Index Herbariorum: a global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. Accessed at <http://sciweb.nybg.org/science2/IndexHerbariorum.asp>, 27 May 2015.
- Vallejos, M., J. N. Volante, M. J. Mosciaro, L. M. Vale, M. L. Bustamante and J. M. Paruelo. 2013. Transformation dynamics of the natural cover in the Dry Chaco ecoregion: A plot level geodatabase from 1976 to 2012. *Journal of Arid Environments* 2014: 1–9. doi: [10.1016/j.jaridenv.2014.11.009](https://doi.org/10.1016/j.jaridenv.2014.11.009)
- Veloso, H.P., L.C. Oliveira Filho, A.M.S.F. Vaz, M.P.M. Lima, R. Marquete and J.E.M. Brazão (org.). 1992. *Manual técnico da vegetação brasileira*. Manuais técnicos em Geociências. Rio de Janeiro: IBGE. 89 pp.
- Volante, J.N., D. Alcaraz-Segura, J.M. Mosciaro, E.F. Viglizzo and J.M. Paruelo. 2012. Ecosystem functional changes associated with land clearing in NW Argentina. *Agriculture, Ecosystem and Environment* 154: 12–22. doi: [10.1016/j.agee.2011.08.012](https://doi.org/10.1016/j.agee.2011.08.012)
- World Land Trust. 2013. 5,000 acres of Gran Chaco forest felled every day in October 2013. Halesworth, UK: World Land Trust. Accessed at <http://www.worldlandtrust.org/news/2013/11/gran-chaco-deforestation>, 27 May 2015.
- Zak, M.R., M.E. Cabido and J.G. Hodgson. 2004. Do subtropical seasonal forests in the Gran Chaco, Argentina, have a future? *Biological Conservation* 120(4): 589–598. doi: [10.1016/j.biocon.2004.03.034](https://doi.org/10.1016/j.biocon.2004.03.034)

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