Scientific Note

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New and revised records of *Tacinga* from Goiás and Tocantins States, Brazil

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ABSTRACT – (New and revised records of *Tacinga* from Goiás and Tocantins States, Brazil). *Tacinga saxatilis* (Ritter) N.P.Taylor & Stuppy subsp. *saxatilis* belongs to the Cactaceae, a family of succulent plants. We report a new records of the *Tacinga* genus (Cactaceae) from Goiás State, Central-West Region and Tocantins State, North Region of Brazil, within the Cerrado phytogeographic domain, providing new data on the geographic distribution of this species to the flora of Brazil and increasing the number of species of the family for these brazilian States.
Keywords: brazilian flora, Caryophyllales, Cerrado, endemic, Taxonomy

RESUMO – (Novos e revisados registros de *Tacinga* para os Estados de Goiás e Tocantins, Brasil). *Tacinga saxatilis* (Ritter) N.P.Taylor & Stuppy subsp. *saxatilis* pertence às Cactaceae, uma família de plantas suculentas. Relatamos um novo registro do gênero *Tacinga* (Cactaceae) para os Estados de Goiás, Região Centro-Oeste e Tocantins, Região Norte do Brasil, no domínio fitogeográfico do Cerrado, contribuindo com novos dados sobre a distribuição geográfica dessa espécie para a flora do Brasil e aumentando o número de espécies da família para esses Estados brasileiros.
Palavras-chave: Caryophyllales, Cerrado, endêmica, Flora do Brasil, Taxonomia

Introduction

Cactaceae belongs to the order Caryophyllales (APG IV 2016) and comprises about 124-150 genera and 1428-1.851 species (Hunt *et al.* 2006, Korotkova *et al.* 2021). In Brazil, the family is represented by 38 genera, 276 species, and 102 subspecies (Flora e Funga do Brasil 2023). The family is highly threatened, with approximately 31% of its evaluated species endangered with some level of extinction (Vulnerable, Endangered, or Critically Endangered) (Goettsch *et al.* 2015).

Tacinga Britton & Rose, a genus from the subfamily Opuntioideae, was described in 1919, and presents intermediate morphological characters between the genera *Opuntia* Mill. and *Nopalea* Salm-Dyck (Britton & Rose 1919), and according to current molecular studies, *Nopalea* is considered a synonym of *Opuntia* (Hernández-Hernández *et al.* 2011, Majure *et al*. 2012, Majure & Puente 2014). The genus comprises ca. ten species and two subspecies, occurring in the States of Alagoas, Bahia, Ceará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, and Sergipe Northeast Region and in Minas Gerais, Southeast Region of Brazil according to data from Brazilian Flora (Freitas *et al*. 2021,Taylor *et al*. 2023, Zappi & Taylor 2023). The genus is characterized by shrubs, subshrubs, and lianas, cylindrical or flattened branches, areoles with abundant glochids and trichomes, spinescent, with solitary flowers, usually emerge from the apex or margin of the cladodes, with a relatively short floral

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tube, external perianth-segments short, succulents, erect, patent or strongly reflexed, internal perianth-segments colored, delicate, erect, somewhat spreading or strongly reflexed; stamens numerous, with solitary fruit, globose, turbinate or elongate clavate, with a very deep umbilicus, flower remnants deciduous; funicular pulp translucent or opaque and colored, fibrous or almost lacking, and few seeds, globular to reniform (Taylor & Zappi 2004, Zappi & Taylor 2023). Species of the genus are popularly known in Brazil as "*quipás*, *palmas* or *palmatórias*" (Cavalcante *et al.* 2013).

The *Cerrado* is the predominant type of vegetation in the States of Goiás and Tocantins, with about 70% and 87 % of its territory coverage, respectively, characterized by trees and shrubs with crooked branches and thick bark (IBGE 2023). Cactaceae is represented in the state of Goiás by 11 genera, 24 species, and five subspecies (Flora and Funga do Brasil 2023). There are several variations of vegetation whose boundaries are not always well defined, among them are typically grasslands (*campos sujos*, *limpos* and *rupestres*), forested forms (gallery forest, riparian forest, and dry forest), and also the *veredas* and palm groves (Oliveira 2014). According to the BFG (2015), the state of Tocantins has 2,306 species of angiosperms, of which 45 are endemic. Constantly updated data from Flora and Funga do Brasil (2023), show an even more considerable number, about 2,927 species, divided into 156 botanical families, and Cactaceae is represented by six genera, 12 species, and two subspecies.

Majority species of *Tacinga* are mostly endemic to the Caatinga biome, except *T. saxatilis*, that occur in limestone outcrops, which expands slightly beyond the Caatinga limits within the 'Cerrado' domain (Zappi & Taylor 2023).

Here we present the new and revised records of *Tacinga* from Goiás and Tocantins States, Brazil, for two new regions of Brazil, expanding knowledge of the geographical distribution of this genus and the species *Tacinga saxatilis* subsp. *saxatilis*.

Methods

We revised and analyzed the collections at the RB herbaria and the virtual collections on the Jabot (http://jabot.jbrj.gov.br/), Reflora (http://reflora. jbrj.gov.br/), SpeciesLink (http://www.splink.org. br/) and INaturalist (https://www.inaturalist.org/home) databases to elucidate indeterminate collections, with erroneous or incomplete identifications associated with *Tacinga* and/or *Opuntia* genus. We also requested samples from other herbaria (CEN and HUEFS) that contained material of interest to be analyzed and measured.

Field expeditions were carried out in the different areas of Goiás state starting in 2016 and with more intensity as of 2021. Information about sightings and species photographs occurred at specific locations during this period, and in February 2023 we located and collected the species in the field with fruit. We used the collected material and the literature as a basis for the description. We identified the specimens based on the protologue (Ritter 1979), publications, and specialized bibliography in Cactaceae (Taylor *et al*. 2002, Taylor & Zappi 2004, Hunt *et al.* 2006). The geographic distribution maps (figure 1) were made using QGIS 3.16. We incorporate the collected materials into the collection of the RB herbarium (Thiers 2023) and the living collection of the Cactarium of the Rio de Janeiro Botanical Garden. The figure was made using the open-access program Inkscape 1.2.2 (https://inkscape.org/pt-br/) with samples collected from Goiás, and one sample photographed in Tocantins States.

Results

Four samples were located in Brazilian herbaria, three records from the state of Goiás and one from Tocantins, all lacking more accurate determination, and additionally one record was found on the INaturalist online platform (https://www.inaturalist.org/observations/59161024) in the north of Goiás, municipality of Monte Alegre de Goiás, reported in August 2020. Based in the records of herbaria, for Goiás state, from the two samples deposited in the CEN herbarium of Embrapa Genetic Resources and Biotechnology, one of them was designated as *Opuntia* sp., from the municipality of Alvorada do Norte with yellow flowers, and the other sample had the designation of *Tacinga* sp., from São Domingos, and from this same municipality there is another sample deposited in the herbarium of the Federal University of Rio Grande do Norte (UFRN), registered within a Conservation Unit of Integral Protection, the Parque Estadual de Terra Ronca. In addition to these data, we searched for photographic information from local visitors and located the recent record deposited in the RB herbarium of the Rio de Janeiro Botanical Garden, from the municipality of Formosa, on private property. All collections occupy an area of just over 300 km² in extension, with their records in the East and Northeast faces of the state of Goiás, all in the *Cerrado* area, linked to limestone outcrops. We located the record from the state of Tocantins in the herbarium of the Feira de Santana State University (HUEFS) under the name *Tacinga* sp., this record is 230km distant from the nearest point of registered occurrence in Goiás, on the east side of the state.

Taxonomic treatment – *Tacinga saxatilis* (Ritter) N.P.Taylor & Stuppy subsp. *saxatilis* Studies in Opuntioideae (Cactac.) 115. 2002.

Figure 2

Shrubby, 20-80 cm, without a main stem. Branches erect, green, stem-segments 8.7-16.5 × 4.2-8 cm, 6-7 mm

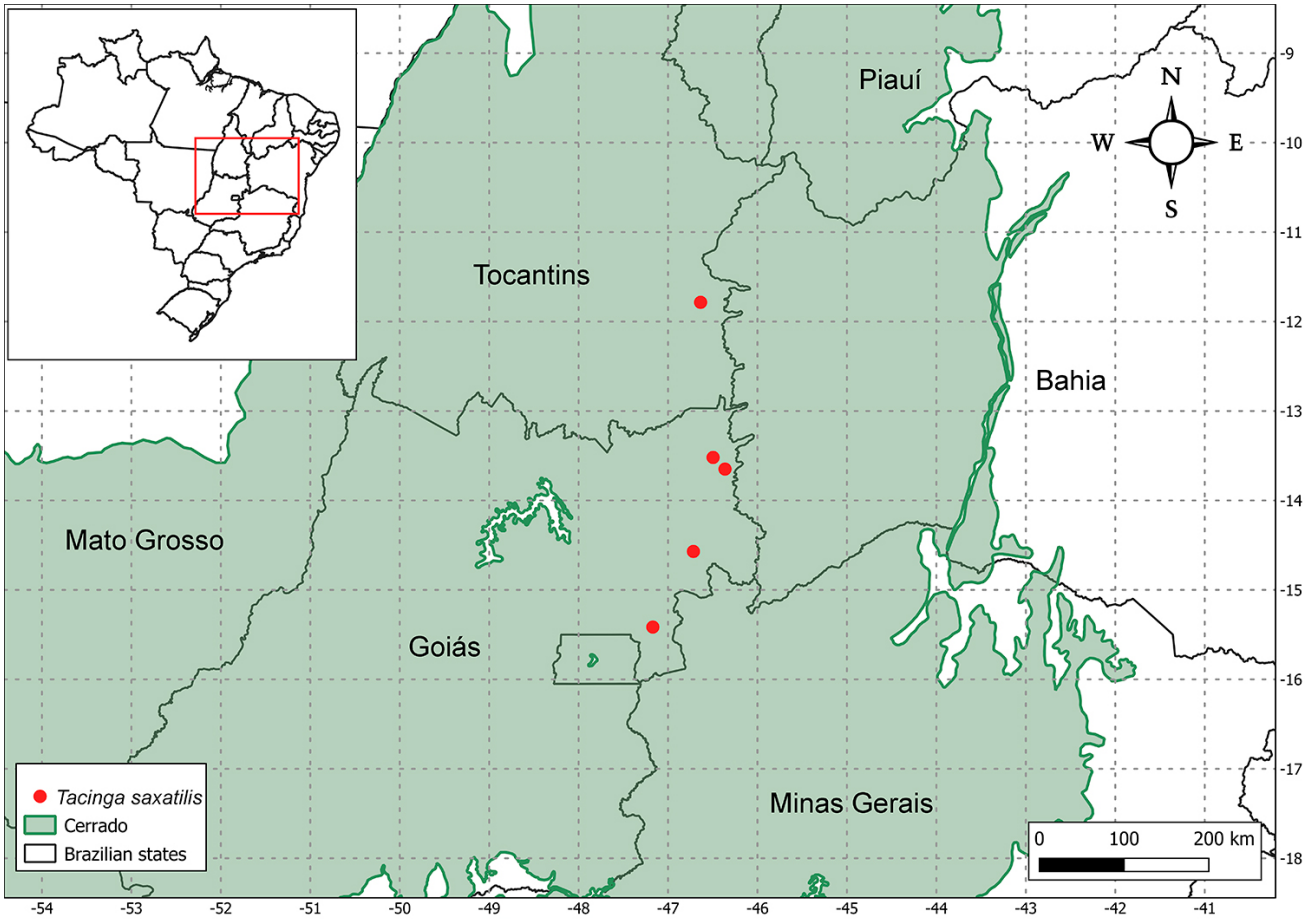

Figure 1. Distribution map of the *Tacinga saxatilis* (F.Ritter) N.P.Taylor & Stuppy subsp. *saxatilis* in Goiás and Tocantins States, Brazil, based in records of brazilian herbaria.

thick, areoles 1-3 mm diam., apart 3-11 mm, 1-5 spines per areole, white to gray, 5-16 mm long., flexible or rigid. Yellow flowers, to ca. 11 mm long., apex of perianth segments acuminate, pericarpel 18-20 × 10 mm, green, clavate, pubescent, with triangular bract-scales, to ca. 1 mm long., glochids, and flexible spines. Fruit 2.2-3.0 × 1.7-2.3 cm diam., solitary, globose to depressed-globose, slightly beaked, the beak 3-5 mm, green when immature and wine-red when mature, pubescent areoles with glochids, yellow-gold, flexible spines, gray, flower remnants deciduous, deciduous bract-scales and funicular pulp translucent. Seeds numerous, cochleariform, 0.3-0.5 × 0.22-0.45 × 0.2-0.3 cm, light brown, covered by fibrous trichomes.

Records – BRAZIL. Goiás: Alvorada do Norte/ Fazenda Irmãos Gravia, 14°34’14”S, 46°43’01”W, 06-XII-2003; Pereira-Silva G. 8261 (CEN). Formosa/ Comunidade do Bezerra; 15°24’57”S, 47°10’14”W. 04-II-2023; Gonzaga D.R. *et al.* 1213 (RB). São Domingos/ Fazenda São Vicente; 13°31’11”S, 46°29’48”W, 11-XI-2004; Sevilha A.C. *et al.* 4170 (CEN). São Domingos/ Parque Estadual de Terra Ronca; 13°38’59”S, 46°21’49”W. 05-X-2015; Pontes R.A. 1083 (UFRN). Tocantins: Novo Jardim/ área da Sharp Mineradora; 11°47’08”S, 46°38’11”W, 13-VII-2017; Pezzini F.F. 277 & Cota M.M.T. (HUEFS).

Geographic distribution – Brazil, previously reported for the Bahia and Minas Gerais States, now including the States of Goiás and Tocantins. Its expanded distribution now reaches the North, Northeast, Southeast, and Central-West regions of Brazil. Its distribution in Goiás and Tocantins States occurs in the altitudinal gradient between 430 and 850 m.s.l., in limestone outcrop environments, where it was possible to observe other species of cacti occurring together: *Cereus jamacaru* subsp. *calcirupicola* (F.Ritter) N.P.Taylor & Zappi, *Micranthocereus estevesii* (Buining & Brederoo) F.Ritter, *Selenicereus setaceus* (Salm-Dyck) Berg and *Pilosocereus* sp. in Goiás only.

Conservation Status – The species is categorized as Least Concern [LC], however, some threats on the occurrence of this species has a strong association with limestone outcrops environments (Taylor & Zappi 2004, Goettsch *et al.* 2015), and main factors for the decline of the populations involves mining, livestock, and agriculture in the short, medium and long term.

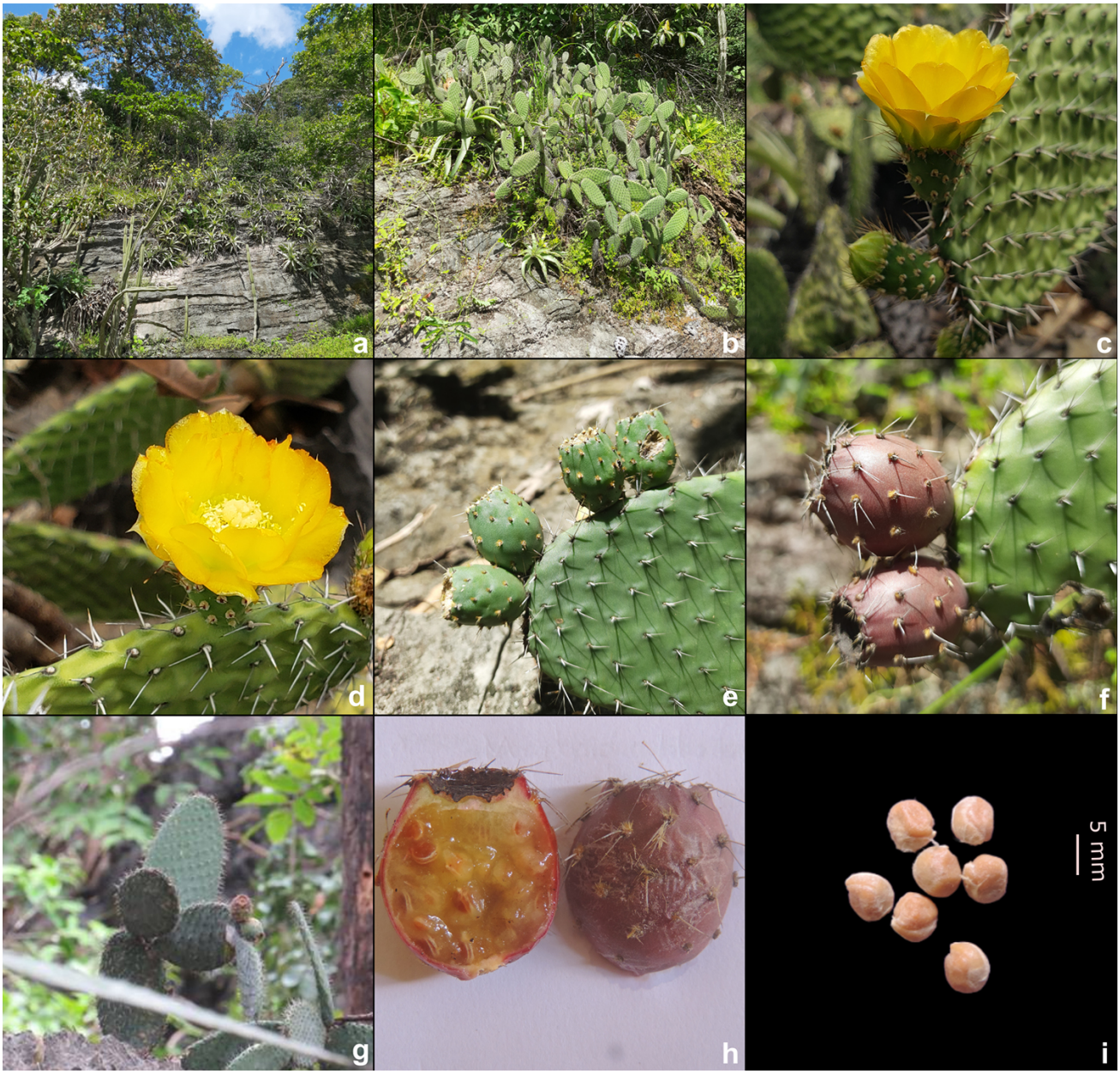

Figure 2. *Tacinga saxatilis* (F.Ritter) N.P.Taylor & Stuppy subsp. *saxatilis*. a. habitat. b. shrub in limestone outcrop. c. floral buds and flower lateral view. d. flower in frontal view. e. immature fruits. f. mature fruits. g. branch and fruit. h. pulp funicular detail. i. seeds. Photo (g) represents the species in the field in Tocantins State, Brazil by photographic record only, without voucher, and the others in Goiás State by voucher Gonzaga *et al*. 1213. (Photos a, b, c, e, f, h, i: Diego R. Gonzaga. d: Gustavo A. Rosa. g: Fernando Franco).

Discussion

We recorded *Tacinga saxatilis* subsp. *saxatilis* in the rainy season with fruits and flowers in the spring. It has narrow distribution and is locally rare, occurring in limestone areas, at the base or median height areas of the outcrop. The occurrence and expansion of the distribution of this species reinforce the need to carry out more floristic studies in areas of rapid habitat loss, demonstrating the need to preserve an endemic species of Brazil. Both records in Goiás and Tocantins are located in the East region of these States, demonstrating a flora shared with the States of Bahia and Minas Gerais. The IUCN Red List classified the species as Least Concern (Goettsch *et al.* 2015), even though Brazilian *Cerrado* is considered highly threatened by human activities, such as urbanization and agriculture (Scarano *et al.* 2014). These States do not have other reports for species of *Tacinga* in their area, and no specific studies

documenting their flora of Cactaceae. In these cases, the Flora do Brasil website (Flora e Funga do Brasil 2023) serves the great purpose of providing information on the occurrence of the species by States. Therefore, this study is of great importance for filling gaps in knowledge and distribution of Brazilian species and helping to outline future public policy strategies for the conservation of threatened environments and endemic species.

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Author Contributions

Diego Rafael Gonzaga: Research and interpretation of data, collect, identification of studied taxa, manuscript and figure preparation.

Fabricio de Oliveira Pereira: Collect, identification of studied taxa, planning of field expeditions, writing collaboration.

Thais Moreira Hidalgo de Almeida: Planning of field expeditions, critical revision of the text, and revision of the English language.

Ana Carolina Mezzonato Pires: Collect, collaboration in writing and revision.

Luiz Menini Neto: Substantial contribution to the concept and development of the study, aggregation of intellectual content, map preparation, critical revision of the text, and supervision.

Conflicts of interest

There is no conflict of interest.

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