Synopsis of Poaceae in the grassland formations of the Parque Estadual do Guartelá, Paraná State, Brazil[1]

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ABSTRACT - (Synopsis of Poaceae in the grassland formations of the Parque Estadual do Guartelá, Paraná State, Brazil). Poaceae is a cosmopolitan family that includes species found in both forest and grassland formations. The objective of this study was to carry out the first floristic survey of Poaceae in the Parque Estadual do Guartelá (PEG), one of the last remnants of native grassland vegetation in the State of Paraná, Brazil, and provide resources to assist the identification of genera and species. The survey was conducted based on field collections and searches in the Species Link online database. In the PEG, Poaceae is represented by 29 genera and 54 species, being *Paspalum* L. (eight spp.), *Andropogon* L. (five spp.) and *Eragrostis* Wolf (four spp.) the richest genera. The number of species in the PEG was incremented by 29 new records. In addition, five species were classified as exotic, five as endemic to Brazil, and two were considered least concern in relation to their conservation. We also present information regarding the distribution, habitat and conservation status for each species.
Keywords: Campos Gerais, floristic, Gramineae, grasses, grassland formations

RESUMO - (Sinopse de Poaceae nas formações campestres do Parque Estadual do Guartelá, Estado do Paraná, Brasil). Poaceae é uma família cosmopolita que inclui espécies encontradas em formações florestais e campestres. O objetivo deste estudo foi realizar o primeiro levantamento florístico de Poaceae no Parque Estadual do Guartelá (PEG), um dos últimos remanescentes de vegetação nativa de formação campestre no Estado do Paraná, Brasil, e fornecer recursos para auxiliar na identificação dos gêneros e espécies. A pesquisa foi realizada com base em coletas a campo e busca na base de dados online Species Link. No PEG, Poaceae é representada por 29 gêneros e 54 espécies, sendo *Paspalum* L. (oito spp.), *Andropogon* L. (cinco spp.) e *Eragrostis* Wolf (quatro spp.) os gêneros mais ricos. O número de espécies de Poaceae no PEG foi incrementado em 29 novos registros. Além disso, cinco espécies foram classificadas como exóticas, cinco como endêmicas para o Brasil e duas foram consideradas menos preocupantes em relação à sua conservação. Também são apresentadas informações sobre distribuição, hábitat e status de conservação de cada espécie.
Palavras-chave: Campos Gerais, florística, Gramineae, gramíneas, formações campestres

Introduction

Poaceae is considered one of the greatest families among Angiosperms (Kawakita *et al.* 2016) and considerably important among the monocots, with approximately 12,074 species included in 771 genera (Soreng *et al*. 2015). In Brazil, there are 1,482 species recorded, distributed among 225 genera (Flora do Brasil 2020), while in Paraná there are 496 species recorded, distributed in 115 genera (Kaehler 2014). Due to their cosmopolitan dispersal, the family has a vast ecological range, with species occurring both in the forest as well as in grassland formations (Kawakita *et al.* 2016, Flora do Brasil 2020), predominating in open areas (Boldrini *et al.* 2008).

In the early Quaternary Period, the grassland formations covered a substantial part of the Paraná State. However, climate change (abundant precipitation) during the recent Quaternary favored the occupation of the land by forests, transforming the state into one of the richest areas of forest in Brazil, leaving the grassland formations restricted to some

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regions, as observed in the Campos Gerais do Paraná (Maack 2012, Labiak 2014).

The Parque Estadual do Guartelá (PEG) was created to ensure the survival of one of the last native and original vegetation with grassland formations of Paraná, in the Campos Gerais region (Federal decree-law nº 2,329 of 24 September 1996). The PEG covers 798.97 ha and presents a high predominance of grassland physiognomy (rocky vegetational refuge, hygrophilous steppe and grassy-woody steppe), which, along with rock outcrops, constitutes 60.55% of the local area, in addition to the Mixed Ombrophilous Forest and Cerrado mosaic (Veloso *et al.* 1991, IAP 2002, Carmo 2006, Vasconcellos & Rocha 2011, Labiak 2014, Maia & Goldenberg 2014).

Even though Campos Gerais has a predominance of grassland physiognomies, which favors the occurrence of Poaceae species, taxonomic and floristic studies aimed at the family in this area and in Paraná are scarce, highlighting the lists of species Poaceae of Renvoize (1988), based on collections of Hatchbach's, and of Kaehler's (2014), based on herbarium collections and online database.

Quite a few of the floristic surveys conducted in Campos Gerais, mention the Poaceae taxa. Among them, it is worthwhile to highlight the works presented by Aguiar & Vieira (2011) performed in the Parque Estadual do Cerrado; Ferreira & Maranho (2011), Oliveira & Maranho (2011), Freitas *et al.* (2011), Oliveira *et al.* (2011) and Silva *et al.* (2016) in the Parque Estadual Vila Velha, and, finally, IAP (2002) and Carmo (2006) in the PEG, where 40 taxa were indicated, of which seven were identified to genera level and one to family.

Considering that the park presents a relictual vegetation of Paraná (Vasconcellos & Rocha 2011), possessing grand biological importance (Michelon & Labiak 2013), this work constitutes the first floristic survey and the first to publish dichotomous keys for the Poaceae family in the grassland formations of PEG and Campos Gerais region.

Material and methods

The Parque Estadual do Guartelá (PEG) is located between the geographical coordinates 24°34'10.11"S and 50°15'56.54"W in the Tibagi municipality, Paraná. It is inserted in the Campos Gerais region of the second plateau of Paraná, being part of the Devonian Scarp Environmental Protection Area (Federal decree-law nº 1,231 of 27 Mach 1992) (IAP 2002, Carmo & Assis 2012) (figure 1). According to Köppen (Alvares *et al.* 2014), the region's climate is Cfa (humid subtropical), with an influence of Cfb (humid temperate) and has average temperatures of 18 ºC (Carmo 2006, Carmo & Assis 2012). The terrain is well-diverse varying from gently undulating to extremely hilly, and its soils are naturally poor and shallow, with high acidity levels and considerable water deficit (IAP 2002, Carmo *et al.* 2012).

For the collection of the Poaceae specimens, expeditions to the PEG were performed in March, June, August and October of 2015, and January and April of 2016, during five days each. All the areas of the grassland formation of PEG and its proximities were sampled, including the trails Básica (5.280 m) and Pinturas Rupestres (7.500 m), both with hygrophilous steppe and grassy-woody steppe (with wet sandy soil and drained sandy soil), and also rocky vegetational refuge (figure 1). Sampling was performed using the wide patrolling method described by Filgueiras *et al.* (1994).

The individuals collected were processed (Bridson & Forman 2004) and deposited in the UNOP and FLOR herbaria (Thiers, continuously updated). The identification of the specimens was performed using specialized literature (Boldrini 1976, Sendulsky 1978, Sendulsky & Soderstrom 1984, Davila 1988, Santos & Boechat 1989, Flores & Valls 1992, Boechat & Longhi-Wagner 1995, Longhi-Wagner 1999, Guglieri & Longhi-Wagner 2000, Boechat & Longhi-Wagner 2001, Longhi-Wagner *et al.* 2001, Boechat 2005, Zuloaga & Morrone 2005, Zanin & Longhi-Wagner 2011, Zuloaga *et al.* 2011, Welker & Longhi-Wagner 2012) and by comparison with specimens in the

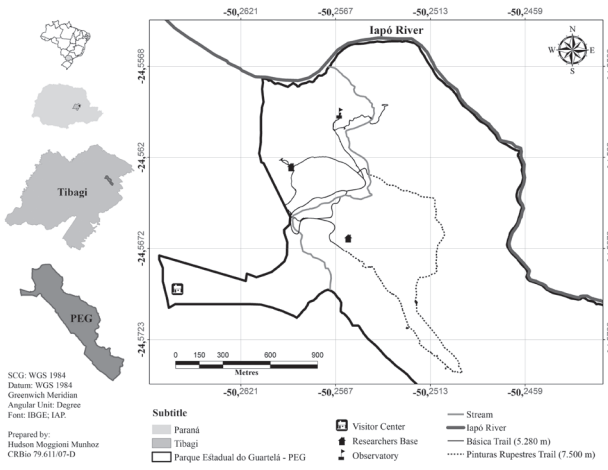

Figure 1. Location map and trails of the Parque Estadual do Guartelá, Tibagi, Paraná State, Brazil.

herbaria MBM (Thiers, continuously updated). The spelling of the names follows the Lista de Espécies da Flora do Brasil (Flora do Brasil 2016) and the World Checklist of Selected Plant Families (WCSP 2016).

In addition to the field expeditions, searches were carried out in the Species Link online database (http://inct.splink.org.br) in order to verify collection records of the family for the PEG, mainly for species not found by the authors in the field. The species indicated were confirmed through visits to the FLOR and ICN herbaria and soon afterward were included in the keys. These are referenced next to the material examined.

The images used in the plates were captured using a video camera SC30 Olympus attached to a stereoscopic microscope trinocular SZX7 Olympus.

The conservation status was added only for the native species, using the IUCN Red List of Threatened Species (IUCN 2016) and the Centro Nacional de Conservação da Flora (CNCFlora 2016) criteria and categories.

Results and Discussion

In the Parque Estadual do Guartelá, 54 species of Poaceae, belonging to 29 genera were found: *Agenium* Nees (one sp.), *Andropogon* L. (five spp.), *Aristida* L. (three spp.), *Axonopus* P. Beauv. (three spp.), *Ctenium* Panz. (one sp.), *Danthonia* DC. (one sp.), *Dichanthelium* (Hitchc. & Chase) Gould (one sp.), *Eragrostis* Wolf (four spp.), *Eriochrysis* P. Beauv. (two spp.), *Homolepis* Chase (one sp.), *Hymenachne* P. Beauv. (one sp.), *Hyparrhenia* Andersson *ex* E. Fourn. (one sp.), *Ichnanthus* P. Beauv. (one sp.), *Melinis* P. Beauv. (one sp.), *Otachyrium* Nees (one sp.), *Panicum* L. (one sp.), *Parodiophyllochloa* Zuloaga & Morrone (one sp.), *Paspalum* L. (eight spp.), *Pharus* P. Browne (one sp.), *Piptochaetium* J. Presl (one sp.), *Pseudechinolaena* Stapf (one sp.), *Rugoloa* Zuloaga (one sp.), *Setaria* P. Beauv. (two spp.), *Sorghastrum* Nash (two spp.), *Sporobolus* R. Br. (one sp.), *Steinchisma* Raf. (two spp.), *Trachypogon* Nees (one sp.), *Trichanthecium* Zuloaga & Morrone (two spp.) and *Urochloa* P. Beauv (three spp.).

Most of Poaceae species studied have been registered in other countries and in almost all Brazilian regions. However, five are considered endemic to Brazil (*Eragrostis leucosticta*, *Eriochrysis villosa*, *Paspalum dasytrichium*, *Sorghastrum scaberrimum* and *Trichanthecium pseudisachne*) (Flora do Brasil 2020) and *Ctenium polystachyum*, *Dichanthelium sabulorum* var. *polycladum*, *Paspalum dasytrichum* and *Piptochaetium montevidense* have restricted distributions to the Southeast and South of and *Eriochrysis villosa* in the South Brazil. In addition, five species are considered exotic (*Melinis repens*, *Setaria sphacelata*, *Urochloa brizantha*, *U. decumbens* and *U. humidicola*) and two are classified as of least concern to conservation (*Agenium leptocladum* and *Hymenachne pernambucensis*) (Flora do Brasil 2020).

Thirteen of the species found are considered ruderal (*Andropogon bicornis*, *A. leucostachyus*, *Eragrostis bahiensis*, *E. neesii* var. *neesii*, *E. polytricha*, *Melinis repens*, *Paspalum polyphyllum*, *P. urvillei*, *Sporobolus indicus*, *Steinchisma laxum*, *Urochloa brizantha*, *U. decumbens* and *U. humidicola*) (Sendulsky 1978, Boechat & Longhi-Wagner 1995, Boechat & Longhi-Wagner 2001, Longhi-Wagner *et al*. 2001, Zuloaga & Morrone 2005, Zanin & Longhi-Wagner 2011, Lorenzi 2014). The presence of these species in the PEG can be explained by the closely location of trails to the visitation and grazing areas.

The majority of Poaceae species in the grassland formations of PEG, mainly those belonging to *Agenium*, *Aristida*, *Axonopus*, *Ctenium*, *Dichanthelium*, *Homolepis*, *Ichnanthus*, *Melinis*, *Panicum*, *Parodiophyllochloa*, *Pharus*, *Piptochaetium*, *Pseudechinolaena*, *Setaria*, *Sporobolus*, *Rugoloa*, *Trachypogon* and *Urochloa* genera, were found in open areas with drained sandy soil and rock outcrops. Others studies with species of these genera highlight their preference for types of environment (Boldrini 1976, Boechat & Longhi-Wagner 1995, Longhi-Wagner 1999, Guglieri & Longhi-Wagner 2000, Longhi-Wagner *et al.* 2001, Boechat 2005). In the same way, the species study here belonging to the genera *Danthonia*, *Eriochrysis*, *Hymenachne*, *Hyparrhenia*, *Otachyrium*, *Steinchisma* and *Trichanthecium* were collected in wet sandy soil, as described by Sendulsky & Soderstrom (1984), Santos & Boechat (1989), Longhi-Wagner *et al*. (2001), Welker (2011) and Zuloaga *et al*. (2011). The species of the genera *Andropogon*, *Eragrostis*, *Paspalum* and *Sorghastrum*, study here and by others authors (Davila 1988, Boechat & Longhi-Wagner 2001, Longhi-Wagner *et al*. 2001, Zuloaga & Morrone 2005, Zanin & Longhi-Wagner 2011), were found in both drained and wet soils.

With the data obtained, it was possible to contribute 11 genera and 29 species of Poaceae to PEG. Hence, the number previously indicated by the IAP (2002) and Carmo (2006) was 21 genera and 40 species, of these

seven were identified only to genus level and one to family level. In addition, the occurrence of *Homolepis glutinosa* (Sw.) Zuloaga & Soderstr., *Paspalum erianthum* Nees *ex* Trin. and *Paspalum plicatulum* Michx, recorded by IAP (2002), could not be confirmed by the absence of data in the herbarium where they were deposited. The same happened with *Chascolytrum calotheca* (Trin.) Essi, Longhi-Wagner & Souza-Chies, *Digitaria insularis* (L.) Fedde, *Anthaenantia lanata* (Kunth) Benth. and *Paspalum ellipticum* Döll, indicated by Carmo (2006) to the PEG, in which, only *C. calotheca* appears in the online database Species Link, but when searching the herbarium there was no success on the confirmation. So, these species were not included in this work.

Ultimately, the abundance of species found, confirm what was already known, in that the Campos Gerais do Paraná, where PEG is located, has in its composition a dominance of grasses (Labiak 2014), which makes this family one of the most representative herbaceous components of the grassland formation in this region. We must also highlight that the species found on both drained and wet soils, emphasize the importance of the conservation of microenvironments that can be affected by touristic trails in the park.

Key to the Genera of Poaceae occurring in the Parque Estadual do Guartelá - Paraná State

(For the genera represented by a single species, this appears directly in the key)

1. Spikelets unisexual, the females and males different in size and shape (figure 2a); lemma of female spikelet membranous, with uncinate trichomes; leaves with twisting pseudopetiole ..... 19.1. *Pharus lappulaceus*
1. Spikelets bisexual or if unisexual, the females and males are quite similar; lemma of female spikelet never with uncinate trichomes; leaves not twisted.
   2. Articulation between rachilla and pedicel of spikelet located above glumes, in a way that glumes persist in the inflorescence after the fall of mature florets; spikelet basitonic (figure 2b) or rarely mesotonic.
      3. Upper glume awn dorsal; spikelet mesotony, with two basal sterile florets reduced to the lemmas, third floret fertile and the other apical florets sterile or rudimentary ..... 5.1. *Ctenium polystachyum*
      3. Upper glume without awn dorsal; spikelet basitony, with 1-numerous basal florets with bisexual flower, with or without apical florets sterile or rudimentary.
         4. Lemma apex deeply 2-dentate, the two dent prolonged in lateral awns, with one more dorsal awn geniculate, with twisted column differentiated from the subule (figure 2c) ..... 6.1. *Danthonia secundiflora*
         4. Lemma apex entire, muticate or with apical awn
            5. Lemmas awn stiff, with margins convolute or involutes, enclosing the caryopsis in its interior.
               6. Lemma cylindrical with apical awn 3-fid (figure 4b) ..... 3. *Aristida*
               6. Lemma wide-obovoid with a single apical awn often deciduous ... 20.1. *Piptochaetium montevidense*
            5. Lemma membranous muticate, open, not enclosing the caryopsis in its interior
               7. Spikelet with a single floret (figure 2d) ..... 25.1. *Sporobolus indicus*
               7. Spikelet with 2-numerous florets ..... 8. *Eragrostis*
   2. Articulation between rachilla and pedicel of spikelet located below glumes, in a way that glumes are deciduous with the mature florets or branches with fragile rachis, disarticulating into units consisting of a sessile spikelet, one pedicellate spikelet and one articulation of rachis; spikelets acrotonic (figure 2e)
      8. Spikelets arranged in pairs in each rachis node, one sessile and one pedicellate, usually falling into a set with rachis internode (figure 2f); lemma of upper floret hyaline, less consistent than the glumes
         9. Inflorescence composed of a solitary floriferous branch at the apex of culm
            10. Floriferous branches with the lower spikelets pairs homogamous (both with male flowers) and muticate; upper pairs heterogamous, with female sessile spikelet aristate and spikelet pedicellate male and muticate …..... 1.1. *Agenium leptocladum*
            10. Floriferous branches with the spikelets pairs heterogamous throughout its length, with sessile spikelet male and muticate and pedicellate spikelet bisexual and aristate (figure 2g) ..... 27.1. *Trachypogon spicatus*

9. Inflorescence composed of two or more floriferous branches conjugate or subdigitate at the apex of culm (figure 2h), or inflorescence ramose oblong or corymbiform with spatheoles apparent (figure 2i), or inflorescence with long central axis with secondary branches adpressed or ascendent, spatheoles not apparent (figure 3c)
    11. Spikelets pedicellate with bisexual flower and long plumose awn of 75-90 mm, falling solitarily at maturity, sessile spikelets persistent in the inflorescence ….. 27.1. *Trachypogon spicatus*
    11. Spikelets pedicellate absent (ex. *Sorghastrum*), rudimentary or bearing male or female flowers, blunt or aristulate, glabrous awn of 0.5-2.5 mm, falling solitarily or along with the sessile spikelet and internode of the rachis at maturity
        12. Panicle without a central axis well defined, with floriferous branches isolated, conjugate or digitate per spatheole (figure 2h), with spatheole apparent; spikelet pedicellate usually sterile and rudimentary, or developed bearing male flower
            13. One floriferous branch per spatheole (figure 2i) ……..... 2.5. *Andropogon* (*A. virgatus*)
            13. Two or more floriferous branches per spatheole
                14. Floriferous branch with whitish hair, with more than 3 pairs of spikelets; spikelets pedicellate rudimentary (figure 3a) (except in *A. lateralis* with developed pedicellate spikelets, but then sessile spikelets with awn up to 9 mm long) …….....…….....2. *Andropogon*
                14. Floriferous branch with yellow to rufescent hair, with 2-3 pairs of spikelets; spikelets pedicellate developed (sessile spikelets with awn of 18-23 mm long) (figure 3b) ..... 12.1. *Hyparrhenia bracteata*
        12. Panicle with a long and well defined central axis (figure 3c), with floriferous branches alternate along the persistent central axis, without apparent spatheole; spikelets pedicellate absent or developed bearing the female flower
            15. Panicle pilose, with golden-brown dense trichomes (figure 3c); spikelets pedicellate developed bearing a female flower …..... 9. *Eriochrysis*
            15. Panicle glabrous; spikelet pedicellate absent, only the pedicel present .....…….....24. *Sorghastrum*
8. Spikelets isolated, rarely binate or in groups, all pedicellate, falling separately; lemma of upper floret coriaceous to cartilaginous, never hyaline, firmer than the glumes (except in *Melinis*, whose upper floret is membranous, however it presents spikelets with long rose trichomes)
    16. Spikelets surrounded by a set of involucral bristles at the base (figure 3d) ..... 23. *Setaria*
    16. Spikelets without involucral bristles at the base
        17. Spikelets pilose, with long rose trichomes (figure 3e); upper floret membranous ... 14.1. *Melinis repens*
        17. Spikelets glabrous, with short trichomes, not rose; upper floret cartilaginous or coriaceous
            18. Upper lemma with two aliform lateral appendages at the base of the ventral region .... 13.1. *Ichnanthus inconstans*
            18. Upper lemma without aliform lateral appendages at the base of the ventral region
                19. Inflorescence in panicle of unilateral branches spiciform or contracted, conjugate, subconjugate, alternate-distichous, digitate or subverticellate
                    20. Upper glume provided with uncinate trichomes at maturity .... 21.1. *Pseudechinolaena polystachya*
                    20. Upper glume devoid of uncinate trichomes at maturity
                        21. Lower glume present
                            22. Lower palea absent; robust plants higher than 160 cm, marshy ...……..... ..... 11.1. *Hymenachne pernambucensis*
                            22. Lower palea present; plants less than 130 cm high, campos or dry environments partially shaded

23. Ligule absent ..... 22.1. *Rugoloa pilosa*
23. Ligule present
24. Spikelets 4-5 × 1.8-2.5 mm; upper floret transversely rugulose to finely striate (figure 3f) …..... 29. *Urochloa*
24. Spikelets 1.1-1.7 × 0.5-0.8 mm; upper floret smooth (figure 3g) ..... 26.2. *Steinchisma* (*S. laxum*)

21. Lower glume absent
25. Glume's back and upper lemma abaxial to the rachis …..... 4. *Axonopus*
25. Glume's back and upper lemma adaxial to the rachis ..... 18. *Paspalum*

19. Inflorescence in typical panicle, lax, open, subcontracted to contracted
26. Upper and lower glume of subequal length between each other
27. Glumes reaching up to half of spikelet length; lower palea with keels expanding at maturity, forming whitish wings; upper floret black at maturity ……..... 15.1. *Otachyrium versicolor*
27. Glumes subequal to spikelets in length; lower palea not expanded at maturity, without wings; upper floret stramineous at maturity .... 10.1. *Homolepis villaricensis*

26. Lower glume always shorter than the superior
28. Panicle contracted to subcontracted, with primary branches adpressed to the main axis; lower palea expanded at maturity ... 26.1. *Steinchisma* (*S. decipiens*)
28. Panicle lax; lower palea absent or not expanded at maturity
29. Lower palea absent ..... 17.1. *Parodiophyllochloa pantricha*
29. Lower palea present
30. Spikelets 5.5-6.3 mm long; upper lemma with tufts of long trichomes laterally and at the base (figure 3h) .... 16.1. *Panicum olyroides* var. *hirsutum*
30. Spikelets 1.3-2.5 mm long; upper lemma without tufts of long trichomes
31. Ligule membranous ciliate, shortly membranous at base, and lengthy ciliate above (figure 3i); upper glume and lower lemma 7-9 veined ..... 7.1. *Dichanthelium sabulorum* var. *polycladum*
31. Ligule membranous, shortly lacinate at apex; upper glume and lower glume 3-5 veined ..... 28. *Trichanthecium*

1. ***Agenium*** Nees *in* J. Lindley, Intr. Nat. Syst. Bot., ed. 2: 447. 1836.

1.1. ***Agenium leptocladum*** (Hack.) Clayton Kew Bull. 27(3): 447. 1972.

For figures, see Longhi-Wagner *et al.* (2001)

Distribution: South America. In Brazil, it occurs in the Central-West, Southeast and South regions (Clayton 1972, Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: LC. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 05-III-2004, *M.R.B. do Carmo 814* (ICN - additional material).

2. ***Andropogon*** L., Sp. Pl. 2: 1045. 1753.

Key to the *Andropogon* species of Parque Estadual do Guartelá

1. Only a single branch per spatheole (figure 2i) ..... 2.5. *A. virgatus*
1. Two or more branches per spatheole
2. Spikelets pedicellate all sterile, usually reduced or rudimentary (figure 4a)
3. Spikelets sessile 4-5 mm long, with awns 17-23 mm long. Callus of sessile spikelet with longer trichomes reaching 1.2-4 mm long (figure 3a) ..... 2.4. *A. macrothrix*
3. Spikelets sessile 2.2-3.1 mm long, with awns 1-3.2 mm long, ocasionally spikelets awnless in the same inflorescence;. Callus of sessile spikelet with longer trichomes reaching 4.2-9 mm long (figure 4a) ..... 2.3. *A. leucostachyus*

2. Spikelets pedicellate, all of them or at least in part of the inflorescence, developed and staminate
4. Inflorescence lax, long; units of terminal inflorescence or terminal and axillary with 3-5 simple floriferous branches or secondary branches, subequal or unequal in length (figure 2h) ..... 2.2. *A. lateralis*
4. Inflorescence corymbiform, clustered at the floriferous culms apex; inflorescence units with 2(3) simple floriferous branches and equal or subequal in length ..... 2.1. *A. bicornis*

2.1. ***Andropogon bicornis*** L., Sp. Pl. 2: 1046. 1753.

For figures, see Longhi-Wagner *et al.* (2001) or Zanin & Longhi-Wagner (2011).

Distribution: Neotropics. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Zanin & Longhi-Wagner 2011, Flora do Brasil 2020).

Habitat: Grassland with drained and wet sandy soil. Ruderal.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 3, 4* (UNOP).

2.2. ***Andropogon lateralis*** Nees *in* Mart., Fl. Bras. Enum. Pl. 2(1): 329. 1829.
Figures 2f, h

Distribution: South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Zanin & Longhi-Wagner 2011, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-X-2015, *T. Souza et al. 5* (UNOP).

2.3. ***Andropogon leucostachyus*** Kunth *in* Humboldt, Bonpland &Kunth, Nov. Gen. Sp. 1: 187. 1816.
Figure 4a

Distribution: Mexico and Antilles to Argentina. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Zanin & Longhi-Wagner 2011, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil. Ruderal.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-VIII-2015, *T. Souza et al. 8, 9* (UNOP), 26-X-2015, *T. Souza et al. 10, 11* (UNOP).

2.4. ***Andropogon macrothrix*** Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 2: 270. 1832.
Figure 3a

Distribution: South America. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Longhi-Wagner *et al.* 2001, Zanin & Longhi-Wagner 2011, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 7* (UNOP), 26-X-2015, *T. Souza et al. 6* (UNOP).

2.5. ***Andropogon virgatus*** Desv. *in* Ham., Prodr. Pl. Ind. Occid.: 9. 1825.
Figure 2i

Distribution: South and Central America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Zanin & Longhi-Wagner 2011, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 12* (UNOP), 26-VIII-2015, *T. Souza et al. 13* (UNOP), 21-I-2016, *T. Souza et al. 14* (UNOP).

3. ***Aristida*** L., Sp. Pl.: 82. 1753.

Key to the *Aristida* species of Parque Estadual do Guartelá

1. Lemma apex without a twisted column; awns 16-20 cm long, starting directly from the lemma apex (figure 4b) ..... 3.1. *A. jubata*
1. Lemma apex with a twisted column (figure 4c); awns 0.8-4.2 cm long, starting directly from the column apex

2. Column 30-42 mm long; awns straight or flexuous at base; acute callus 1-1.4 mm long ……..... 3.2. *A. megapotamica*
2. Column 1.8-2 mm long; awns twisted and coiled at base; obtuse callus 0.2-0.5 mm long (figure 4c) ..... 3.3. *A. recurvata*

3.1. ***Aristida jubata*** (Arechav.) Herter, Revista Sudamer. Bot. 9(4): 98. 1953.
Figure 4b

Distribution: South America. In Brazil, it occurs in the Central-West, Southeast and South regions (Longhi-Wagner 1999, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil and rock outcrops.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-VIII-2015, *T. Souza et al. 15* (UNOP).

3.2. ***Aristida megapotamica*** Spreng., Syst. Veg. 4(2): 31. 1827.

For figures, see Longhi-Wagner (1999) or Longhi-Wagner *et al.* (2001).

Distribution: South America. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner 1999, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 2-VI-2015, *T. Souza et al. 16* (UNOP).

3.3. ***Aristida recurvata*** Kunth *in* Humboldt, Bonpland & Kunth, Nov. Gen. Sp. 1: 123. 1816.
Figure 4c

Distribution: South and Central America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner 1999, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil and rock outcrops.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-VIII-2016, *T. Souza et al. 84* (UNOP).

4. ***Axonopus*** P.Beauv., Ess. Agrostogr.: 12. 1812.

Key to the *Axonopus* species of Parque Estadual do Guartelá

1. Branches of the inflorescence hispid to setose in all extesion, with tuberculate trichomes (figure 4d) …….. 4.1. *A. brasiliensis*
1. Branches of the inflorescence glabrous or sparsely scabrous, or with trichomes not tuberculate at the apex of pedicels, usually at the spikelets base
   2. Leaf blades filiform involute; upper floret 1.6-2.2 mm long; upper glume and lower lemma 5-7-veined, veins evident and glabrous or with short trichomes between veins, the central vein always present ..... 4.3. *A. siccus*
   2. Leaf blades flat; upper floret 2.4-3.2 mm long; upper glume and lower lemma 2-4 veined, veins less evident and densely pilose, central vein usually inconspicous (figure 4e) ..... 4.2. *A. marginatus*

4.1. ***Axonopus brasiliensis*** (Spreng.) Kuhlm., Commiss. Linhas Telegr. Estratég. Matto Grosso Amazonas 5(11): 47. 1922.
Figure 4d

Distribution: Paraguay and in Brazil it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 2-VI-2015, *T. Souza et al. 17, 18, 19* (UNOP), 26-VIII-2015, *T. Souza et al. 20, 21* (UNOP), 26-X-2015, *T. Souza et al. 22* (UNOP).

4.2. ***Axonopus marginatus*** (Trin.) Chase *ex* Hitchc., Contr. U. S. Natl. Herb. 17(3): 226. 1913.
Figure 4e

Distribution: Bolivia, Paraguay and in Brazil it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Figure 2. a. *Pharus lappulaceus*, inflorescence branch. b. *Eragrostis polytricha,* spikelet. c. *Danthonia secundiflora*, lemma, dorsal view. d. *Sporobolus indicus*, spikelet. e. *Panicum olyroides* var. *hirsutum*, spikelet. f. *Andropogon lateralis*, detail of a fragment of the inflorescence branch. g. *Trachypogon spicatus*, detail of a fragment of the inflorescence branch. h. *Andropogon lateralis*, inflorescence unit. i. *A. virgatus*, detail of a fragment of the inflorescence branch, showing one floriferous branch per spatheole (arrows).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 2-VI-2015, *T. Souza et al. 23, 24* (UNOP).

4.3. ***Axonopus siccus*** (Nees) Kuhlm., Commiss. Linhas Telegr. Estratég. Matto Grosso Amazonas 67(11): 87. 1922.

For figures, see Longhi-Wagner *et al.* (2001).

Distribution: South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 25, 26* (UNOP).

5. ***Ctenium*** Panz., Ideen Revis. Gräser: 38. 1813.

5.1. ***Ctenium polystachyum*** Balansa, Bull. Soc. Bot. France 32: 244. 1885.

For figures, see Longhi-Wagner *et al.* (2001).

Distribution: South America. In Brazil, it occurs in the Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 24-III-2004, *M.R.B. do Carmo 840* (ICN - additional material).

6. ***Danthonia*** DC., Fl. Franç., 3: 32. 1805.

6.1. ***Danthonia secundiflora*** J.Presl, Reliq. Haenk. 1: 255. 1830.
Figure 2c

Distribution: South America. In Brazil, it occurs in the Northeast, Southeast and South regions (Renvoize 1988, Santos & Boechat 1989, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 2-VI-2015, *T. Souza et al. 27* (UNOP).

7. ***Dichanthelium*** (Hitchc. & Chase) Gould, Brittonia 26: 59. 1974.

7.1. ***Dichanthelium sabulorum*** (Lam.) Gould & C.A. Clark var. ***polycladum*** (Ekman) Zuloaga, Amer. J. Bot. 90: 817. 2003.
Figure 3i

Distribution: South America. In Brazil, it occurs in the Southeast and South regions (Guglieri & Longhi-Wagner 2000, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-X-2015, *T. Souza et al. 77* (UNOP).

8. ***Eragrostis*** Wolf, Gen. Pl.: 23. 1776.

Key to the *Eragrostis* species of Parque Estadual do Guartelá

1. Plants glandulous, glands present in pedicels usually with ring-shaped (figure 4f)
   2. Leaf blade dimorphic, mostly recurved, brown-reddish and other ascendent greenish; caryopsis largely oblong, grooved .... 8.2. *E. leucosticta*
   2. Leaf blade isomorphic, flat to involute; caryopsis largely elliptical, not grooved .... 8.3. *E. neesii* var. *neesii*
1. Plants eglandulous, glands absent in the pedicels
   3. Leaf blade dimorphic ..... 8.2. *E. leucosticta*
   3. Leaf blade isomorphic
      4. Sheath densely pilose on the surface; pedicels with pilose axils (figure 4g); stamens 3 ..... 8.4. *E. polytricha*
      4. Sheath glabrous or with trichomes subdense to sparse on the surface; pedicels with glabrous axils (figure 4h); stamens 2 ..... 8.1. *E. bahiensis*

8.1. ***Eragrostis bahiensis*** Schrad. *ex* Schult., Mant. 2: 318. 1824.
Figure 4h

Figure 3. a. *Andropogon macrothrix*, sessile and pedicellate (rudimentary) spikelets. b. *Hyparrhenia bracteata*, inflorescence branch. c. *Eriochrysis cayennensis*, inflorescence. d. *Setaria scabrifolia*, spikelet with involucral bristles. e. *Melinis repens*, spikelet. f. *Urochloa decumbens*, upper floret, palea view. g. *Steinchisma laxum*, upper floret, palea view. h. *Panicum olyroides* var. *hirsutum*, upper floret, palea view. i. *Dichanthelium sabulorum* var. *polycladum*, leaf highlighting the ligular region.

Figure 4. a. *Andropogon leucostachyus*, sessile and pedicellate (rudimentary) spikelets. b. *Aristida jubata*, lemma. c. *A. recurvata*, lemma, showing detail of the column (arrow). d. *Axonopus brasiliensis*, detail of a fragment of the inflorescence branch. e. *A. marginatus*, spikelet. f. *Eragrostis leucosticte*, pedicel, showing detail of the ring (arrow). g. *E. polytricha*, pilose pedicelar base. h. *E. bahiensis*, glabrous pedicelar base. i. *Eriochrysis cayennensis*, sessile spikelet, lower glume view.

Distribution: North, Central and South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Boechat & Longhi-Wagner 2001, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil. Ruderal.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-XIII-2015, *T. Souza et al. 29, 30* (UNOP), 21-I-2016, *T. Souza et al. 31* (UNOP).

8.2. ***Eragrostis leucosticta*** Nees *ex* Döll *in* Mart., Fl. Bras. 2(3): 144. 1878.
Figure 4f

Distribution: endemic to Brazil, occurring in the Northeast, Central-West, Southeast and South regions (Boechat & Longhi-Wagner 2001, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 32, 33* (UNOP), 26-X-2015, *T. Souza et al. 34* (UNOP).

8.3. ***Eragrostis neesii*** Trin. var. ***neesii*** Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1: 405. 1830.

For figures, see Boechat & Longhi-Wagner (2001) or Longhi-Wagner *et al.* (2001).

Distribution: South America. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Renvoize 1988, Boechat & Longhi-Wagner 2001, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil. Ruderal.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-VIII-2015, *T. Souza et al. 35* (UNOP).

8.4. ***Eragrostis polytricha*** Nees, Agrost. Bras. *in* Mart., Fl. Bras. Enum. Pl. 2: 507. 1829.
Figures 2b; 4g

Distribution: North, Central and South America. In Brazil, it occurs in all (Renvoize 1988, Boechat & Longhi-Wagner 2001, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil and rock outcrops. Ruderal.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 37* (UNOP), 26-VIII-2015, *T. Souza et al. 36* (UNOP).

9. ***Eriochrysis*** P. Beauv., Ess. Agrostogr.: 8. 1812.

Key to the *Eriochrysis* species of the Parque Estadual do Guartelá.

1. Lower glume of sessile spikelet with truncate apex, trilobed (figure 4i) ... 9.1. *E. cayennensis*
1. Lower glume of sessile spikelet with acute to subacute apex, non-lobed or with inconspicuous lobes ..... 9.2. *E. villosa*

9.1. ***Eriochrysis cayennensis*** P. Beauv., Ess. Agrostogr.: 8. 1812.
Figures 3c; 4i

Distribution: North, Central and South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Filgueiras 2003, Welker 2011, Welker & Longhi-Wagner 2012, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 38* (UNOP).

9.2. ***Eriochrysis villosa*** Swallen, Phytologia 14(2): 90. 1966.

For figures, see Welker (2011) or Welker & Longhi-Wagner (2012).

Distribution: endemic to Brazil, occurring in the South region (Welker 2011, Welker & Longhi-Wagner 2012, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 4-XII-2003, *M.R.B. do Carmo 450* (ICN - additional material).

10. ***Homolepis*** Chase, Proc. Biol. Soc. Washington 24: 146. 1911.

10.1. ***Homolepis villaricensis*** (Mez) Zuloaga & Soderstr., Smiths. Contr. Bot. 59: 29. 1985.

For figures, see Longhi-Wagner *et al.* (2001).

Distribution: South America. In Brazil, it occurs in the Central-West, Southeast and South regions (Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil and rock outcrops.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-I-2016, *T. Souza et al. 39* (UNOP), 10-II-2004, *M.R.B. do Carmo 684* (ICN - additional material).

11. ***Hymenachne*** P.Beauv., Ess. Agrostogr.: 48. 1812.

11.1. ***Hymenachne pernambucensis*** (Spreng.) Zuloaga, Amer. J. Bot. 90(5): 817. 2003.

For figures, see Guglieri & Longhi-Wagner (2000) or Longhi-Wagner *et al.* (2001).

Distribution: South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Guglieri & Longhi-Wagner 2000, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 2-VI-2015, *T. Souza et al. 40* (UNOP).

12. ***Hyparrhenia*** Andersson *ex* E.Fourn., Mexic. Pl. 2: 51, 67. 1886.

12.1. ***Hyparrhenia bracteata*** (Humb. & Bonpl. *ex* Willd.) Stapf *in* Oliv., Fl. Trop. Afr. 9: 360. 1919.
Figure 3b

Distribution: In the tropical regions of America and Africa. In Brazil, it occurs in the Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 44* (UNOP).

13. ***Ichnanthus*** P.Beauv., Ess. Agrostogr.: 56, Pl. 12, f. 1. 1812.

13.1. ***Ichnanthus inconstans*** (Trin. *ex* Nees) Döll *in* Mart., Fl. Bras. 2(2): 284. 1877.

For figures, see Longhi-Wagner *et al.* (2001) or Boechat (2005).

Distribution: South America. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Boechat 2005, Flora do Brasil 2020).

Habitat: Edge of Mixed Ombrophilous Forest with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-I-2016, *T. Souza et al. 41* (UNOP).

14. ***Melinis*** P.Beauv., Ess. Agrostogr.: 54. 1812.

14.1. ***Melinis repens*** (Willd.) Zizka, Biblioth. Bot. 138: 55. 1988.
Figure 3e

Distribution: Netropics. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil. Ruderal.

Conservation: Exotic.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-VI-2015, *T. Souza et al. 42* (UNOP), 26-X-2015, *T. Souza et al. 43* (UNOP).

15. ***Otachyrium*** Nees, Fl. Bras. Enum. Pl. 2(1): 271. 1829.

15.1. ***Otachyrium versicolor*** (Döll) Henrard, Blumea 4(3): 511. 1941.

For figures, see Sendulsky & Soderstrom (1984) or Longhi-Wagner *et al.* (2001).

Distribution: Central and South America. In Brazil, it occurs in the North, Northeast, Central-West,

Southeast and South regions (Sendulsky & Soderstrom 1984, Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 45, 46* (UNOP), 26-VIII-2015, *T. Souza et al. 48* (UNOP), 21-I-2016, *T. Souza et al. 47* (UNOP).

16. ***Panicum*** L., Sp. Pl.: 55 (1753).

16.1. ***Panicum olyroides*** var. ***hirsutum*** Henrard, Meded. Rijks-Herb. 40: 52. 1921.
Figures 2e; 3h

Distribution: South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Guglieri & Longhi-Wagner 2000, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-I-2016, *T. Souza et al. 49* (UNOP).

17. ***Parodiophyllochloa*** Zuloaga & Morrone, Syst. Bot. 33(1): 69. 2008.

17.1. ***Parodiophyllochloa pantricha*** (Hack.) Zuloaga & Morrone, Syst. Bot. 33: 73. 2008.

For figures, see Guglieri & Longhi-Wagner (2000) or Longhi-Wagner *et al.* (2001).

Distribution: Central and South America. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Renvoize 1988, Guglieri & Longhi-Wagner 2000, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Edge of Mixed Ombrophilous Forest with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-I-2016, *T. Souza et al. 79* (UNOP).

18. ***Paspalum*** L., Syst. Nat. ed. 10, 2: 855. 1759.

Key to the *Paspalum* species of the Parque Estadual do Guartelá.

1. Spikelets with upper glume winged, with cordate base (figure 5a) ..... 18.2. *P. cordatum*
1. Spikelets with upper glume not winged, without cordate base
   2. Inflorescence with 2 branches conjugate or slightly subconjugate (figure 5b), rarely a third below; plants with horizontal supraterraneous rhizomes, entirely covered by old sheath …..... 18.5. *P. notatum*
   2. Inflorescence with 1 to many alternate branches; plants without rhizomes or if with rhizomes, then not supraterraneous
      3. Upper glume and lower lemma with long tuberculate trichomes (longer than 2 mm) on margins (figure 5c) ..... 18.6. *P. polyphyllum*
      3. Upper glume and lower lemma glabrous or with trichomes not tuberculate, silky, delicate and short (shorter than 2 mm) on margins.
         4. Upper floret dark brown to black; lower lemma with transversal undulations between the central and lateral veins (= lemma plicate)
            5. Prefoliation conduplicate; base of plant with leaf sheaths keeled and strongly flattened .... 18.1. *P. compressifolium*
            5. Prefoliation convolute; base of plant with leaf sheaths not keeled and neither strongly flattened .... 18.7. *P. rojasii*
         4. Upper floret white, stramineous or light brown; lower lemma without transversal undulations (= lemma smooth)
            6. Upper glume and lower lemma with silky trichomes, whitish and delicate on margins; base of plant with hispid trichomes (figure 5d) ..... 18.8. *P. urvillei*
            6. Upper glume and lower lemma glabrous or with short and discreet trichomes; base of plant glabrous, pubescent or with soft sparse trichomes

7. Nodes glabrous; lower lemma with a hyaline portion at the center; sheath glabrous or with sparse trichomes or only on margins; spikelets 1.1-1.4 mm long, solitary, arranged in 2 series in the racemes ……..……. 18.4. *P. hyalinum*
7. Nodes hirsute; lower lemma uniform, without a hyaline portion at the center; sheath pubescent; spikelets 1.8-2 mm long in pairs, arranged in 4 series in the racemes (figure 5e) ..... 18.3. *P. dasytrichum*

18.1. ***Paspalum compressifolium*** Swallen, Phytologia 14(6): 381. 1967.

For figures, see Longhi-Wagner *et al.* (2001) or Zuloaga & Morrone (2005).

Distribution: South America. In Brazil, it occurs in the Central-West, Southeast and South regions (Longhi-Wagner *et al.* 2001, Zuloaga & Morrone 2005, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 22-X-1999, *I.J.M. Takeda et al.* (ICN122952 - additional material).

18.2. ***Paspalum cordatum*** Hack., Ark. Bot. 9(15): 5. 1910.
Figure 5a

Distribution: South America. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Zuloaga & Morrone 2005, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 50* (UNOP), 02-VI-2015, *T. Souza et al. 52* (UNOP), 21-I-2016, *T. Souza et al. 51* (UNOP).

18.3. ***Paspalum dasytrichum*** Dusén *ex* Swallen, Phytologia 14(6): 363. 1967.
Figure 5e

Distribution: endemic to Brazil, occurring in the Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Zuloaga & Morrone 2005, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 04-XI-1994, *M.E. Buim* (ICN191100 - additional material). BRASIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-X-2015, *T. Souza et al. 53* (UNOP), 26-VIII-2016, *T. Souza et al. 83* (UNOP).

18.4. ***Paspalum hyalinum*** Nees *ex* Trin., Gram. Panic.: 103. 1826.

For figures, see Longhi-Wagner *et al.* (2001) or Zuloaga & Morrone (2005).

Distribution: South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Zuloaga & Morrone 2005, Flora do Brasil 2020).
Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 54* (UNOP).

18.5. ***Paspalum notatum*** Flüggé, Gram. Monogr., Paspalum: 106. 1810.
Figure 5b

Distribution: North, Central and South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Zuloaga & Morrone 2005, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-X-2015, *T. Souza et al. 55, 56* (UNOP).

18.6. ***Paspalum polyphyllum*** Nees *ex* Trin., Gram. Panic.: 114. 1826.
Figure 5c

Distribution: South America. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Zuloaga & Morrone 2005, Flora do Brasil 2020).

Figure 5. a. *Paspalum cordatum*, spikelet. b. *P. notatum*, inflorescence. c. *P. polyphyllum*, spikelet. d. *P. urvillei*, base of the plant. e. *P. dasytrichum*, detail of a fragment of the inflorescence branch. f. *Steinchisma decipiens*, inflorescence. g. *Trichanthecium pseudisachne*, spikelet. h. *Urochloa humidicola*, spikelet. i. *U. brizantha*, spikelet.

Habitat: Grassland with wet and drained sandy soil and rock outcrops. Ruderal.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 57, 58, 59* (UNOP), 02-VI-2015, *T. Souza et al. 60, 61* (UNOP).

18.7. ***Paspalum rojasii*** Hack., Repert. Spec. Nov. Regni Veg. 7: 369. 1909.

For figures, see Longhi-Wagner *et al.* (2001).

Distribution: South America. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 05-III-2004, *M.R.B. do Carmo 793* (ICN - additional material).

18.8. ***Paspalum urvillei*** Steud., Syn. Pl. Glumac. 1: 24. 1853.
Figure 5d

Distribution: North and South America. In Brazil, it occurs in the Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Zuloaga & Morrone 2005, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil. Ruderal.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-X-2015, *T. Souza et al. 62* (UNOP).

19. ***Pharus*** P.Browne, Civ. Nat. Hist. Jamaica: 344. 1756.

19.1. ***Pharus lappulaceus*** Aubl., Hist. Pl. Guiane 2: 859. 1775.
Figure 2a

Distribution: North and South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Edge of Mixed Ombrophilous Forest with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-I-2016, *T. Souza et al. 63* (UNOP).

20. ***Piptochaetium*** J.Presl, Reliq. Haenk. 1: 222. 1830.

20.1. ***Piptochaetium montevidense*** (Spreng.) Parodi, Revista Fac. Agron. Veterin. 7: 163. 1930.

For figures, see Zanin *et al.* (1992) or Longhi-Wagner *et al.* (2001).

Distribution: South America. In Brazil, it occurs in the Southeast and South regions (Renvoize 1988, Zanin *et al.* 1992, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-VIII-2015, *T. Souza et al. 64* (UNOP).

21. ***Pseudechinolaena*** Stapf, Fl. Trop. Afr. 9: 494. 1919.

21.1. ***Pseudechinolaena polystachya*** (Kunth) Stapf, Fl. Trop. Afr. 9: 495. 1919.

For figures, see Longhi-Wagner *et al.* (2001).

Distribution: Pantropical. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Edge of Mixed Ombrophilous Forest with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-I-2016, *T. Souza et al. 65* (UNOP).

22. ***Rugoloa*** Zuloaga, Pl. Syst. Evol. 300(10): 2164. 2014.

22.1. ***Rugoloa pilosa*** (Sw.) Zuloaga, Pl. Syst. Evol. 300(10): 2164. 2014.

For figures, see Guglieri & Longhi-Wagner (2000) or Longhi-Wagner *et al.* (2001).

Distribution: North, Central and South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Guglieri & Longhi-Wagner 2000, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Edge of Mixed Ombrophilous Forest with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-I-2016, *T. Souza et al. 74* (UNOP).

23. ***Setaria*** P.Beauv., Ess. Agrostogr.: 51. 1812.

Key to the *Setaria* species of Parque Estadual do Guartelá

1. Basal sheaths laterally compressed, keeled; inflorescence speciform pendant or erect, with basal secondary branches inconspicuous; spikelets accompanied by 4-9 involucral bristles. ……..... 23.2. *S. sphacelata*
1. Basal sheaths not laterally compressed, cylindrical; inflorescence sub-speciform erect, with basal secondary branches conspicuous 5-18 mm long; spikelets accompanied by 1-3 involucral bristles (figure 3d) ... 23.1. *S. scabrifolia*

23.1. ***Setaria scabrifolia*** (Nees) Kunth, Révis. Gramin. 1: 40. 1833.
Figure 3d

Distribution: South America. In Brazil, it occurs in the Northeast, Southeast and South regions (Boldrini 1976, Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-III-2015, *T. Souza et al. 66, 67* (UNOP), 2-VI-2015, *T. Souza et al. 68, 69* (UNOP), 21-I-2016, *T. Souza et al. 70* (UNOP).

23.2. ***Setaria sphacelata*** (Schumach.) Stapf & C.E. Hubb. *ex* M.B. Moss, Kew Bull. 1929(6): 195. 1929.

For figures, see Longhi-Wagner *et al.* (2001).

Distribution: Tropical, Subtropical and temperate regions. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: Exotic.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 31-I-2005, *M.R.B. do Carmo 1116* (ICN - additional material).

24. ***Sorghastrum*** Nash *in* Britton, Man. Fl. N. States: 71. 1901.

Key to the *Sorghastrum* specis of Parque Estadual do Guartelá

1. Panicle spiciform; spikelets sessile 7-10 mm long, stramineous to pale yellow, awn (45-)50-75 mm long, callus acute and pungent 2.5-3.5 mm long ..... 24.1. *S. minarum*
1. Panicle sub-open or open; spikelets sessile 4-6.0 mm long, dark brown, awn 10-26 mm long, callus obtuse and not pungent 0.2-0.6 mm long ……..... 24.2. *S. scaberrimum*

24.1. ***Sorghastrum minarum*** (Nees) Hitchc., Contr. U.S. Natl. Herb. 24: 501. 1927.

For figures, see Davila (1988), Flores & Valls (1992) or Longhi-Wagner *et al.* (2001).

Distribution: South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Davila 1988, Renvoize 1988, Flores & Valls 1992, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 11-II-2004, *M.R.B. do Carmo 755* (ICN - additional material).

24.2. ***Sorghastrum scaberrimum*** (Nees) Herter, Revista Sudamer. Bot. 6: 136. 1940.

For figures, see Davila (1988) or Longhi-Wagner *et al.* (2001).

Distribution: endemic to Brazil, occurring in the Southeast and South regions (Davila 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil and rock outcrops.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 4-III-2004, *M.R.B. do Carmo 780* (ICN - additional material).

25. ***Sporobolus*** R.Br., Prodr. Fl. Nov. Holland.: 169. 1810.

25.1. ***Sporobolus indicus*** (L.) R.Br., Prodr. Fl. Nov. Holland.: 170. 1810.
Figure 2d

Distribution: North and South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Boechat & Longhi-Wagner 1995, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil. Ruderal.
Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-VIII-2015, *T. Souza et al. 71* (UNOP).

26. ***Steinchisma*** Raf. *in* Ser. Bull. Bot. (Geneva) 1: 220. 1830.

Key to the *Steinchisma* species of Parque Estadual do Guartelá

1. Plants erect; inflorescence in panicle contracted; primary branches adpressed to the main axis (figure 5f); adaxial face of leaf blade with tuberculate trichomes, deciduous; spikelets 1.7-2.3 mm long arranged in all rachis directions ..... 26.1. *S. decipiens*
1. Plants decumbent, less frequently erects; inflorescence in panicle lax to sub-contracted; primary branches diverging from main axis; abaxial and adaxial face of leaf blade glabrous; spikelets 1-1.4 mm long facing the same side of rachis ..... 26.2. *S. laxum*

26.1. ***Steinchisma decipiens*** (Nees *ex* Trin.) W.V. Br., Mem. Torrey Bot. Club 23(3): 20. 1977. Figure 5f

Distribution: South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.
Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-X-2015, *T. Souza et al. 72* (UNOP).

26.2. ***Steinchisma laxum*** (Sw.) Zuloaga, Amer. J. Bot. 90(5): 817. 2003.
Figure 3g

Distribution: North, Central and South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Guglieri & Longhi-Wagner 2000, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil. Ruderal.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-I-2016, *T. Souza et al. 73* (UNOP).

27. ***Trachypogon*** Nees, Fl. Bras. Enum. Pl. 2: 341. 1829.

27.1. ***Trachypogon spicatus*** (L.f.) Kuntze, Revis. Gen. Pl. 2: 794. 1891.
Figure 2g

Distribution: Tropical Africa, North, Central and South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Renvoize 1988, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 02-VI-2015, *T. Souza et al. 75* (UNOP), 21-I-2016, *T. Souza et al. 76* (UNOP).

28. ***Trichanthecium*** Zuloaga & Morrone, Syst. Bot. Monogr. 94: 13. 2011.

Key to the *Trichanthecium* species of Parque Estadual do Guartelá

1. Blades oval-lanceolate to lanceolate expanded at the base, subcordate to cordate; spikelets glabrous ..... 28.1. *T. cyanenscens*
1. Blades linear to linear-lanceolate becoming narrower toward the base, not subcordate; spikelets pilose, rarely glabrous (Figure 5g) .... 28.2. *T. pseudisachne*

28.1. ***Trichanthecium cyanescens*** (Nees *ex* Trin.) Zuloaga & Morrone, Syst. Bot. Monogr. 94: 25. 2011.

For figures, see Zuloaga *et al.* (2011).

Distribution: Central and South America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Zuloaga *et al.* 2011, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-X-2015, *T. Souza et al. 28* (UNOP).

28.2. ***Trichanthecium pseudisachne*** (Mez) Zuloaga & Morrone, Syst. Bot. Monogr. 94: 69. 2011.
Figure 5g

Distribution: endemic to Brazil, occurring in the Northeast, Central-West, Southeast and South regions (Longhi-Wagner *et al.* 2001, Zuloaga *et al.* 2011, Flora do Brasil 2020).

Habitat: Grassland with wet sandy soil.

Conservation: DD. Native.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 21-I-2016, *T. Souza et al. 78* (UNOP).

29. ***Urochloa*** P.Beauv., Ess. Agrostogr.: 52. 1812.

Key to the *Urochloa* species of Parque Estadual do Guartelá

1. Sheaths and blades glabrous; lower glume 3/4 or equal the spikelet length (figure 5h) .... 29.3. *U. humidicola*
1. Sheaths and blades pilose or ciliate; lower glume reaching up to half the spikelet length (figure 5i)
   2. Rachis 0.5-0.8 mm width; spikelets 1-rowed on the rachis, rare 2-rowed at the base of raceme ..... 29.1. *U. brizantha*
   2. Rachis 1-1.8 mm width; spikelets 2-rowed on the rachis ..... 29.2. *U. decumbens*

29.1. ***Urochloa brizantha*** (Hochst. *ex* A. Rich.) R.D. Webster, Austral. Paniceae: 233. 1987.
Figure 5i

Distribution: Native to Tropical Africa and cultivated in most continents. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Sendulsky 1978, Renvoize 1988, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil. Ruderal. Conservation: Exotic.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-VIII-2015, *T. Souza et al. 80* (UNOP).

29.2. ***Urochloa decumbens*** (Stapf) R.D.Webster, Austral. Paniceae: 234. 1987.
Figure 3f

Distribution: Tropical Africa, introduced as forage in Tropical America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Sendulsky 1978, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil. Ruderal. Conservation: Exotic.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-VIII-2015, *T. Souza et al. 81* (UNOP).

29.3. ***Urochloa humidicola*** (Rendle) Morrone & Zuloaga, Darwiniana 31: 80. 1992.
Figure 5h

Distribution: Tropical Africa, introduced as forage in Tropical America. In Brazil, it occurs in the North, Northeast, Central-West, Southeast and South regions (Sendulsky 1978, Longhi-Wagner *et al.* 2001, Flora do Brasil 2020).

Habitat: Grassland with drained sandy soil. Ruderal. Conservation: Exotic.

Specimens examined: BRAZIL. Paraná: Tibagi, Parque Estadual do Guartelá, 26-VIII-2016, *T. Souza et al. 82* (UNOP).

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