

Grassland Vegetation of Pitangui River Valley, Southern Brazil

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Abstract A systematic floristic survey was carried out on native grasslands at Pitangui river valley areas, in the state of Paraná, Southern Brazil. Monthly samples collection covering an area of 9.4 ha over a two year period was conducted. A total of 51 angiosperm, one conifer and 4 fern families from four mesic steppic areas were identified. There were 196 genera and 420 species present in the area surveyed. The family Asteraceae contributed the highest species richness with a total of 119 species, 28% of the total. Herbs were found to dominate the area contributing almost 80% of all the plant forms. There were six non-native species, including African grasses and contaminating exotic pines observed and identified in the grassland area. Twelve native species, belonging to 11 families (contributing a total of 2.8% of all the flora identified) are listed as threatened. The high species richness and the considerably high number of threatened species in such a small area underlined the need for more conservation efforts in these grasslands. It is therefore recommended that additional zoning and better management effort be the primary concerns to conserve the area.

Keywords Floristic, Grasslands, Riparian Area

1. Introduction

Native subtropical grasslands at South Brazil plateaus are located at high altitudes where low temperatures and high annual rainfall usually predominate. Riparian areas in Campos Gerais are combined by moderate to poorly drained soils, covered by hydrophilous steppes or by pioneering formations of fluvial influence, where Haplic Histosols, Melanic Gleysols, or Fluvic Leptosols can be encountered. In addition, hygrophilous to mesic steppes typically encompassing herbs and shrubs species, where Litholic Leptosols and Haplic Inceptisols are also available [1],[2].

The great ecological relevance of the Brazilian Atlantic Rainforest biome, which includes grasslands, has given this area the status as global biodiversity hotspots [3],[4]. The remaining grasslands in the state of Paraná have been suffering severe anthropogenic pressure, especially due to the expansion of agriculture and non-native forestry activities. However, despite the global importance of this grassland ecosystem, their floristic richness is hardly known.

Therefore as one of the first steps of the Biodiversity of grassland-forest ecotones in South Brazil Project team was to provide a species checklist of Pitangui river valley native grasslands. Their adaptive lifeforms were previously discussed by Mioduski & Moro [5].

2. Methods

We carried out this floristic study in the dip slope of 1st cuesta of state of Paraná (Devonian Slope), inserted over Furnas sandstone, with medium altitude of 980 m a.s.l. The area is comprised of the region nationally known as Campos Gerais, specially where Pitangui river flows within a canyon in its medium course crossing the Slope (J 594408 E 7232272), after Alagados dam, between Ponta Grossa and Carambeí municipalities, Paraná State (Figure 1). The climate is Cfb (altitudinal subtropical humid) according to Köppen's classification, with mean annual temperature between 18 and 19°C, and an average rainfall of 1,600mm/yr [6].

Sample collection was carried out monthly over a two year period (August 2009/July 2011) in an 9.4 ha area inserted over Furnas sandstone formation on superficial soils of 1 meter or less. According to the Brazilian Soil classification system, the Abrigo Pitangui site (A) is an 2.1 ha concave slope with Haplic Cambisols, Lithic Neossols and Fluvic

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Neossols in sequence. The Usina São Jorge site (B) is an 0.2 ha flat surface with Haplic Cambissols, The Fazenda Panorama site (C) is an 4.0 ha slightly convex slope with Haplic Cambissols, and the Mirante Pitangui site (D) is an 3.1 ha slightly convex slope with Litolic Neossols.



Figure 1. Location of the sampled areas in Pitangui river valley, Southern Brazil: A- Abrigo Pitangui; B- Usina São Jorge; C- Fazenda Panorama; D - Mirante Pitangui

Botanical material was collected according to the wandering method described in Filgueiras *et al.*[7], that consists of listing the species presented in each delimited

area as the investigator walks slowly on straight lines along it. Vouchers are deposited in the UEPG herbarium (HUPG), and research has been authorized by SISBIO 28694/1. For species' taxonomic classification, Tryon and Tryon[8] and Smith *et al.*[9] for Ferns, and Angiosperm Phylogeny Group III[10] for Angiosperms were followed. The official plant names and their authors followed the electronic databases of Kew Gardens Plant List[11].

Evaluation and enumeration of the presence of extinction threatened species in the study area through comparison and review of Brazilian official threatened species lists [12],[13],[14] was also conducted. In addition, the presence of non-native plant (exotic) species was evaluated through revisions of the local governmental list[15] and Horus Institute[16].

3. Results and Discussion

Among the four areas, we recorded 421 taxa distributed in 51 Angiosperm families, one Conifer and 4 Ferns. There were present 420 species and 196 genera (Table 1). One *Aristida* taxon (Poaceae) was identified only at the generic level at this moment, needing further studies to settle it as a new species.

Table 1. Grassland plants present at Pitangui river valley, Southern Brazil. Habit: He – herbaceous; Sh – forbs; Tr - treelets; Li – prostrated herbs; Hc - Humic Cambissols; Ha - Haplic Cambissols; Ln - Litolic Neossols; Fc - Fluvic Cambissols

Families/Species	habit	threatened status	Predominant Soil type
ACANTHACEAE			
<i>Dyschoriste hygrophiloides</i> (Nees) Kuntze	He		Hc, Ha, Ln
<i>Ruellia multifolia</i> (Nees) Lindau	He	rare	Hc, Ha, Ln
AMARANTHACEAE			
<i>Alternanthera brasiliana</i> (L.) Kuntze	He		Hc, Ha, Fc, Ln
<i>Gomphrena macrocephala</i> A.St.-Hil.	He	rare	Fc
<i>Pfaffia helichrysoides</i> (Mart.) Kuntze	He		Hc, Ha, Ln
<i>Pfaffia jubata</i> Mart.	He	rare	Ha
<i>Pfaffia tuberosa</i> (Spreng.) Hicken	He		Ln
AMARYLLIDACEAE			
<i>Nothoscordum gracile</i> (Aiton) Stearn	He		Ln
<i>Nothoscordum luteomajus</i> Ravenna	He		Hc
APIACEAE			
<i>Eryngium ebracteatum</i> Lam.	He		Ha, Fc
<i>Eryngium elegans</i> Cham. & Schltdl.	He		Ha
<i>Eryngium horridum</i> Malme	He		Hc, Ha
<i>Eryngium junceum</i> Cham. & Schltdl.	He		Hc, Ha, Ln
<i>Eryngium sanguisorba</i> Cham. & Schltdl.	He		Hc
APOCYNACEAE			
<i>Mandevilla atrovioleacea</i> (Stadlm.) Woodson	He		Ln
<i>Mandevilla coccinea</i> (Hook. & Am.) Woodson	He	rare	Ha, Fc, Ln
<i>Mandevilla emarginata</i> (Vell.) C.Ezcurra	He		Hc, Ln
<i>Mandevilla pohliana</i> (Stadlm.) A.H.Gentry	He		Hc, Ha
<i>Oxypetalum sublanatum</i> Malme	Li		Ln
<i>Widgrenia corymbosa</i> Malme	Li		Ha, Ln
ARECACEAE			
<i>Allagoptera campestris</i> (Mart.) Kuntze	He		Ha, Hc, Ln
<i>Butia microspadix</i> Burret	He	rare	Ha, Hc, Ln
ASTERACEAE			
<i>Acanthospermum australe</i> (Loefl.) Kuntze	He		Ha
<i>Achyrocline satureioides</i> (Lam.) DC.	He		Ha, Hc, Ln
<i>Actinoseris radiata</i> (Vell.) Cabrera	He		Fc
<i>Ageratum conyzoides</i> (L.) L.	He		Ha, Ln

<i>Angelphytum grisebachii</i> (Baker) H. Rob.	He	Ha
<i>Aspilia montevidensis</i> (Spreng.) Kuntze	He	Ha, Hc, Ln
<i>Aspilia reflexa</i> (Sch. Bip. ex Baker) Baker	He	Ha, Ln
<i>Austroeupatorium cf inulifolium</i> (Kunth) R.M. King & H. Rob.	He	Hc
<i>Austroeupatorium laetevirens</i> Hook. & Am.	Sh	Ha, Hc
<i>Baccharis articulata</i> (Lam.) Pers.	Sh	Ha, Ln
<i>Baccharis axillaris</i> DC.	Sh	Ha, Hc, Fc
<i>Baccharis brevifolia</i> DC.	Sh	Ha
<i>Baccharis coridifolia</i> DC.	Sh	Ha, Hc
<i>Baccharis dracunculifolia</i> DC.	Sh	Ha, Hc
<i>Baccharis semiserrata</i> var. <i>elaeagnoides</i> (Stend.)	Sh	Ha
<i>Baccharis erioclada</i> DC.	Sh	Ha
<i>Baccharis genistelloides</i> (Lam.) Pers.	Sh	Ha
<i>Baccharis genistelloides</i> subsp. <i>crispa</i> (Spreng.) Joch. Müll.	Sh	Hc, Fc, Ln
<i>Baccharis glutinosa</i> Pers.	Sh	Ha
<i>Baccharis illinita</i> DC.	Sh	Ln
<i>Baccharis linearifolia</i> (Lam.) Pers. subsp. <i>linearifolia</i>	Sh	Ha, Ln
<i>Baccharis myricifolia</i> DC.	Sh	Ha, Ln
<i>Baccharis pentodonta</i> Malme	Sh	Ha
<i>Baccharis spicata</i> (Lam.) Baill.	Sh	Ln
<i>Baccharis uncinella</i> DC.	Sh	Ha
<i>Barrosoa betoniciformis</i> (DC.) R.M. King & H. Rob.	He	Ha, Hc
<i>Bidens alba</i> (L.) DC.	He	Hc, Ln
<i>Calea cuneifolia</i> DC.	He	Ha, Ln
<i>Calea cymosa</i> Less.	He	Ha, Ln
<i>Calea parvifolia</i> (DC.) Baker	He	Ha, Ln
<i>Calea triantha</i> (Vell.) Pruski	He	Ha, Ln
<i>Campuloclinium macrocephalum</i> (Less.) DC.	He	Ha
<i>Chaptalia graminifolia</i> Cabr.	He	Ln
<i>Chaptalia integerrima</i> (Vell.) Burkart	He	Hc, Fc, Ln
<i>Chaptalia nutans</i> (L.) Polák	He	Hc, Fc, Ln
<i>Conyza bonariensis</i> (L.) Cronquist	He	Ha
<i>Coreopsis lanceolata</i> L.	He	Ha, Hc, Fc, Ln
<i>Chromolaena ascendens</i> (Sch. Bip. ex Baker) R.M. King & H. Rob.	He	Hc
<i>Chromolaena laevigata</i> (Lam.) R.M. King & H. Rob.	He	Ha, Ln
<i>Chromolaena stachyophylla</i> (Spreng.) R.M. King & H. Rob.	He	Ha
<i>Chrysolaena flexuosa</i> (Sims) H. Rob.	He	Ha
<i>Chrysolaena nicolackii</i> H. Rob.	He	Ln
<i>Chrysolaena oligophylla</i> (Vell.) H. Rob.	He	Ha
<i>Chrysolaena platensis</i> (Spreng.) H. Rob.	He	Ha
<i>Chrysolaena propinqua</i> (Hieron.) H. Rob.	He	Ha, Ln
<i>Diacranthera crenata</i> (Schltdl. ex Mart.) R.M. King & H. Rob.	He	Ha
<i>Disynaphia filifolia</i> (Hassl.) R.M. King & H. Rob.	He	Hc
<i>Elephantopus mollis</i> Kunth	He	Hc, Fc, Ln
<i>Emilia sonchifolia</i> (L.) DC. ex DC.	He	Ha, Hc
<i>Erechtites hieracifolius</i> (L.) Raf. ex DC.	He	Ln
<i>Erechtites valerianifolius</i> (Link ex Spreng.) DC.	He	Ha, Ln
<i>Eupatorium agrigaudium</i> Cabrera	He	Ha
<i>Eupatorium hirsutum</i> Hook. & Am.	He	Ha
<i>Eupatorium multifidum</i> DC.	He	Ha
<i>Eupatorium orbiculatum</i> DC.	He	Ln
<i>Eupatorium palmare</i> Sch. Bip. ex Baker	He	Ln
<i>Eupatorium serratum</i> Spreng.	He	Ha
<i>Eupatorium squarulosum</i> Hook. & Am.	He	Ha
<i>Eupatorium tanacetifolium</i> Gillies ex Hook. & Am.	He	Ln
<i>Gamochaeta purpurea</i> (L.) Cabrera	He	Ln
<i>Grazelia multifida</i> (DC.) R.M. King & H. Rob.	He	Ln
<i>Heterocondylus alatus</i> (Vell.) R.M. King & H. Rob.	He	Ln
<i>Heterothalamus psiadioides</i> Less.	He	Ln
<i>Hieracium urvillei</i> Sch. Bip.	He	Hc
<i>Hieracium ignatianum</i> Baker	He	Ln
<i>Holochaetus hieracioides</i> (D. Don) Cabr.	He	Hc
<i>Hypochaeris glabra</i> L.	He	Ln
<i>Hypochaeris lutea</i> (Vell.) Britton.	He	Hc
<i>Hypochoeris radicata</i> L.	He	Hc
<i>Inulopsis scaposa</i> O. Hoffm.	He	Ha, Hc, Ln
<i>Isostigma crithmifolium</i> Less.	He	Ln
<i>Lepidaploa psilostachya</i> (DC.) H. Rob.	He	Ha, Ln

<i>Lessingianthus arachniolepis</i> (Ekman ex Ekman & Dusén) H. Rob.	He	Ln
<i>Lessingianthus asteriflorus</i> (Mart. ex DC.) H. Rob.	He	Ha
<i>Lessingianthus bardanoides</i> (Less.) H. Rob.	He	Ha
<i>Lessingianthus brevifolius</i> (Less.) H. Rob.	He	Ha
<i>Lessingianthus elegans</i> (Gardn.) H. Rob.	He	Ha
<i>Lessingianthus glabratus</i> (Less.) H. Rob.	He	Ha, Ln
<i>Lessingianthus grandiflorus</i> (Less.) H. Rob.	He	Ha, Ln
<i>Lessingianthus plantaginodes</i> (Kuntze) H. Rob.	He	Ha
<i>Lessingianthus polyphyllus</i> (Sch. Bip. ex Baker) H. Rob.	He	Ha
<i>Lessingianthus rubricaulis</i> (Bonpl.) H. Rob.	Sh	Ha
<i>Lessingianthus simplex</i> (Less.) H. Rob.	He	Ha, Ln
<i>Lucilia acutifolia</i> (Poir.) Cass.	He	Ha
<i>Lucilia lycopodioides</i> (Less) S.E. Freire	He	Ha, Hc
<i>Mikania micrantha</i> Kunth	Li	Ln
<i>Mikania oblongifolia</i> DC.	He	Hc
<i>Mikania sessilifolia</i> DC.	Li	Hc
<i>Noticastrum sericeum</i> (Less.) Less. ex Phil.	He	Ha
<i>Orthopappus angustifolius</i> (Sw.) Gleason	He	Ha
<i>Praxelis diffusa</i> (Rich.) Pruski	He	Ha
<i>Praxelis sanctopaulensis</i> (B.L. Rob) R.M. King & H. Rob.	He	Ha, Ln
<i>Pterocaulon alopecuroides</i> (Lam.) DC.	He	Ha, Ln
<i>Pterocaulon angustifolium</i> DC.	He	Ha, Ln
<i>Pterocaulon lanatum</i> O. Kuntze	He	Ha
<i>Senecio brasiliensis</i> (Spreng.) Less.	He	Ha, Hc, Fc, Ln
<i>Senecio conyzaeifolius</i> Bak.	He	Hc
<i>Senecio oleosus</i> Vell.	He	Ha, Ln
<i>Solidago chilensis</i> Meyen	He	Ha, Ln
<i>Sonchus oleraceus</i> (L.) L.	He	Hc
<i>Stenocephalum megapotamicum</i> (Spreng.) Sch. Bip.	He	Hc
<i>Stevia cinerascens</i> Sch. Bip. ex Baker	He	Ha
<i>Stevia clausenii</i> Sch. Bisch. ex Baker	He	Hc
<i>Stevia linearifolia</i> Walp.	He	Ln
<i>Stevia lundiana</i> DC.	He	Ha, Ln
<i>Stevia myriadenia</i> Sch. Bip. ex Baker	He	Ha
<i>Symphyotrichum squamatum</i> (Spreng.) G.L. Nesom	He	Ha
<i>Trichocline speciosa</i> Less.	He	Ha
<i>Verbesina sordescens</i> DC.	He	Ha, Ln
<i>Vernonanthura cuneifolia</i> (Gardner) H. Rob.	Sh	Ha, Ln
<i>Vernonanthura crassa</i> (Vell.) H. Rob.	Sh	Ha, Ln
<i>Vernonanthura nudiflora</i> (Less.) H. Rob.	Sh	Ha
<i>Vernonanthura westiniana</i> (Less.) H. Rob.	Sh	Ha
<i>Vernonanthura rigiophylla</i> (Sch-Bip ex Kuntze) H. Rob.	He	Ln
<i>Vernonia megapotamica</i> Spreng.	He	Ha
<i>Viguiera macrorrhiza</i> Baker	He	Ha, Ln
<i>Viguiera paranensis</i> (Malme) J.U. Santos	He	Ha, Ln
<i>Viguiera trichophylla</i> Dusén	He	Ha, Ln
<i>Willoughbya officinalis</i> (Mart.) Kuntze	Li	Ha
BIGNONIACEAE		
<i>Jacaranda caroba</i> (Vell.) DC.	Sh	Ha
BORAGINACEAE		
<i>Moritzia duseii</i> I.M. Johnst.	He	Ha, Ln
BROMELIACEAE		
<i>Aechmea distichantha</i> Lem.	He	Ln
CACTACEAE		
<i>Parodia ottonis</i> var. <i>villa-velhensis</i> (Brack. & Voll.) N.P. Taylor	He	Ln
CAMPANULACEAE		
<i>Lobelia camponum</i> Pohl	He	Ha, Hc, Ln
<i>Lobelia paranaensis</i> R. Braga	He	Ha
<i>Lobelia hederacea</i> Cham.	He	Ha, Ln
<i>Wahlenbergia brasiliensis</i> Cham.	He	Ha
CARYOPHYLLACEAE		
<i>Cerastium dicotrichum</i> Fenzl ex Rohrb.	He	Ha, Ln
<i>Silene gallica</i> L.	He	Ha
<i>Stellaria media</i> (L.) Vill.	He	Ha
CARYOCARACEAE		
<i>Caryocar brasiliense</i> A.St.-Hil.	Sh	vulnerable Ha, Ln
CELASTRACEAE		
<i>Plenckia populnea</i> Reissek	Tr	Ha

CISTACEAE			
<i>Halimium brasiliense</i> (Lam.) Grosser	He	rare	Ha, Hc, Ln
COMMELINACEAE			
<i>Commelina villosa</i> C.B.Clarke ex Chodat & Hassl.	He		Hc, Ln
<i>Commelina virginica</i> L.	He		Ln
<i>Tradescantia cerinthoides</i> Kunth	He		Ln
CONVOLVULACEAE			
<i>Evolvulus sericeus</i> Sw.	Li		Ln
CUCURBITACEAE			
<i>Cayaponia espelina</i> (Silva Manso) Cogn.	Li	rare	Ha
CUSCUTACEAE			
<i>Cuscuta racemosa</i> Mart.	Li		Ha
CYPERACEAE			
<i>Bulbostylis capillaris</i> (L.) Kunth ex C.B.Clarke	He		Hc, Fc
<i>Bulbostylis scabra</i> (J.Presl. & C.Presl.) C.B.Clarke	He		Hc
<i>Bulbostylis vestita</i> (Kunth) C.B.Clarke	He		Hc
<i>Cyperus aggregatus</i> (Willd.) Endl.	He		Hc
<i>Cyperus haspan</i> L.	He		Hc
<i>Cyperus hemaphroditus</i> (Jacq.) Standl.	He		Hc, Ha
<i>Cyperus meyenianus</i> Kunth	He		Hc
<i>Cyperus rigens</i> J.Presl. & C.Presl. subsp. <i>rigens</i>	He		Hc
<i>Fimbristylis autumnalis</i> (L.) Roem. & Schult.	He		Hc
<i>Fimbristylis dichotoma</i> (L.) Vahl	He		Hc
<i>Fimbristylis squarrosa</i> Vahl	He		Hc
<i>Kyllinga brevifolia</i> Rottb.	He		Hc
<i>Kyllinga odorata</i> Vahl. subsp. <i>odorata</i>	He		Hc
<i>Kyllinga pumila</i> Michx.	He		Hc
<i>Lagenocarpus rigidus</i> (Kunth) Nees	He		Hc
<i>Pycnus lanceolatus</i> (Poir.) C.B.Clarke	He		Hc
<i>Rhynchospora albiceps</i> Kunth	He		Hc
<i>Rhynchospora consanguinea</i> (Kunth) Boeck	He		Hc
<i>Rhynchospora corymbosa</i> (L.) Britton	He		Hc
<i>Rhynchospora emaciata</i> (Nees) Boeckeler	He		Hc
<i>Rhynchospora glaziovii</i> Boeckeler	He		Hc
<i>Rhynchospora globosa</i> (Kunth) Roem. & Schult.	He		Hc, Ln
<i>Rhynchospora hieronymi</i> Boeckeler	He		Hc
<i>Rhynchospora junciformis</i> (Kunth) Boeckeler	He		Hc
<i>Rhynchospora pallida</i> M.A. Curtis	He		Hc
<i>Rhynchospora rugosa</i> (Vahl) Gale	He		Hc
<i>Rhynchospora setigera</i> (Kunth) Griseb.	He		Hc, Ln
<i>Scleria hirtella</i> Sw.	He		Hc
DENNSTAEDETIACEAE			
<i>Pteridium arachnoideum</i> (Kaulf.) Maxon	Sh		Ha, Fc, Ln
DROSERACEAE			
<i>Drosera brevifolia</i> Pursh.	He		Ln
<i>Drosera communis</i> A.-St.Hil.	He		Ln
<i>Drosera villosa</i> A.-St. Hil.	He		Ln
ERICACEAE			
<i>Agarista pulchella</i> G.Don	Sh		Ha, Ln
<i>Gaylussacia brasiliensis</i> (Spreng.) Meisn.	Sh		Ha, Ln
<i>Gaylussacia pseudogaultheria</i> Cham. & Schltdl.	Sh		Ha, Ln
ERIOCAULACEAE			
<i>Actinocephalus polyanthus</i> (Bong.) Sano	He		Hc, Ln
<i>Eriocaulon ligulatum</i> (Vell.) L.B.Sm.	He		Hc
<i>Eriocaulon sellowianum</i> Kunth	He		Hc
<i>Leiothrix flavescens</i> (Bong.) Ruhland	He		Hc, Ln
<i>Paepalanthus albogarginatus</i> Silveira	He		Hc, Ln
<i>Paepalanthus planifolius</i> (Bong) Korn.	He		Hc
<i>Syngonanthus caulescens</i> (Poir.) Ruhland	He		Hc
ERYTHROXYLACEAE			
<i>Erythroxylum microphyllum</i> A.St.-Hil.	Sh		Ha
EUPHORBIACEAE			
<i>Croton antisiphiliticus</i> Mart.	He		Ln
<i>Croton heterodoxus</i> Baill.	He		Ha, Hc, Fc, Ln,
<i>Croton lundianus</i> (Didr.) Muell.Arg.	He		
<i>Croton myrianthus</i> Muell.Arg.	Sh		Ha
<i>Croton migrans</i> Casar.	He		Ha, Ln
<i>Euphorbia hyssopifolia</i> L.	He		Ha

<i>Microstachys hispida</i> (Mart.) Govaerts.	Sh	Ha
FABACEAE		
<i>Aeschynomene falcata</i> (Poir.) DC.	He	Ha
<i>Chamaecrista punctata</i> (Vogel) H.S.Irwin & Bameby	He	Ha, Ln
<i>Chamaecrista desvauxii</i> var. <i>langsdoerffii</i> (Vogel) H.S.Irwin & Bameby	He	Ha, Ln
<i>Chamaecrista rotundifolia</i> (Pers.) Greene	He	Ha, Ln
<i>Clitoria densiflora</i> (Benth.) Benth.	He	Ha
<i>Collaea speciosa</i> (Loisel.) DC.	Sh	Ha
<i>Crotalaria balansae</i> Micheli	He	Ha
<i>Crotalaria hilariana</i> Benth.	Sh	Ha, Ln
<i>Crotalaria micans</i> Link	He	Ha
<i>Crotalaria martiana</i> Benth.	He	Ha
<i>Desmodium adscendens</i> (Sw.) DC.	He	Ha
<i>Desmodium barbatum</i> (L.) Benth.	He	Ha
<i>Desmodium incanum</i> DC.	He	Ha
<i>Eriosema campestre</i> Benth.	He	Ha, Ln
<i>Eriosema crinitum</i> (Kunth) G.Don	Li	Ha
<i>Eriosema longifolium</i> Benth.	He	Ha, Ln
<i>Eriosema heterophyllum</i> Benth.	He	Ha, Fc, Ln
<i>Galactia benthamiana</i> Micheli	He	Ha
<i>Galactia boavista</i> (Vell.) Burkart	He	Ha, Ln
<i>Galactia neesii</i> DC.	He	Ha
<i>Mimosa acerba</i> Benth.	Sh	Ha
<i>Mimosa acerba</i> subsp. <i>acerba</i> var. <i>arudes</i>	Sh	Ha
<i>Mimosa acerba</i> subsp. <i>acerba</i> var. <i>foliolosa</i>	Sh	Ha, Ln
<i>Mimosa brevipes</i> Benth.	Sh	Ha
<i>Mimosa daleoides</i> Benth.	Sh	Ha
<i>Mimosa dolens</i> Vell.	Sh	Ha
<i>Mimosa dolens</i> subsp. <i>acerba</i> (Benth.) Barneby	Sh	Ha, Ln
<i>Mimosa dolens</i> var. <i>rigescens</i> (Benth.) Bameby	Sh	Ha
<i>Mimosa debilis</i> Willd.	Sh	Ha
<i>Mimosa micropteris</i> Benth.	Sh	Ha
<i>Mimosa orthacantha</i> Benth.	Sh	Ha
<i>Mimosa paranapiacabae</i> Bameby	He	Ha
<i>Mimosa ramosissima</i> Benth.	Sh	Ha
<i>Periandra mediterranea</i> (Vell.) Taub.	Sh	Ha, Ln
<i>Rhynchosia corylifolia</i> Benth.	Li	Ha
<i>Stylosanthes guianensis</i> (Aubl.) Sw.	He	Ha
<i>Stylosanthes hippocampoides</i> Mohlenbr.	He	Ha
<i>Vigna peduncularis</i> var. <i>peduncularis</i> (Kunth) Fawc. & Rendle	Li	Ha
<i>Zornia cryptantha</i> Arechav.	Li	Ha, Ln
<i>Zornia diphylla</i> (L.) Pers.	Li	Ha
<i>Zornia latifolia</i> Sm.	Li	Ha
GESNERIACEAE		
<i>Sinningia allagophylla</i> (Mart.) Wiehler	He	
GLEICHENIACEAE		
<i>Dicranopteris flexuosa</i> (Schrad.) Underw.	He	Hc
<i>Gleichenella pectinata</i> (Willd.) Ching	He	Hc, Ln
<i>Sticherus bifidus</i> (Willd.) Ching	He	Ln
HYPERICACEAE		
<i>Hypericum cordatum</i> (Vell.) N.Robson	He	Ha
<i>Hypericum teretiusculum</i> A.St.-Hil.	He	Ha
<i>Hypericum temum</i> A.St.-Hil.	He	Ha, Ln
HYPOXIDACEAE		
<i>Hypoxis decumbens</i> L.	He	Ha, Hc, Fc, Ln
IRIDACEAE		
<i>Sisyrinchium graminifolium</i> Lindl.	He	Hc, Fc
<i>Sisyrinchium laxum</i> Otto ex Sims	He	Hc
<i>Sisyrinchium micranthum</i> Cav.	He	Hc
<i>Sisyrinchium restioides</i> Spreng.	He	Hc
<i>Sisyrinchium vaginatum</i> Spreng.	He	Ln
<i>Sisyrinchium wettsteinii</i> Hand.-Mazz.	He	Ln
LAMIACEAE		
<i>Aegiphila paraguariensis</i> Briq.	He	Ha
<i>Hyptis plectranthoides</i> Benth.	He	Ha, Ln

<i>Hyptis sinuata</i> Pohl ex Benth.	Sh	Ha
<i>Hyptis villosa</i> Pohl ex Benth.	He	Ha
<i>Peltodon longipes</i> A.St.Hill. ex Benth.	He	Ha, Ln
<i>Peltodon rugosus</i> Tolm.	He	Ha, Ln
<i>Rhabdocalyon gracile</i> (Benth.) Epling	He	Ha
<i>Salvia aliciae</i> E.P. Santos	He	Ha, Ln
<i>Salvia borjensis</i> E.P. Santos	He	Ha
<i>Salvia lachnostachys</i> Benth.	He	Ha, Ln
<i>Salvia nervosa</i> Benth.	He	Ha
<i>Salvia rosmarinoides</i> A.-St.Hil.	He	Ha
LYCOPODIACEAE		
<i>Lycopodium clavatum</i> L.	He	Hc
LYTHRACEAE		
<i>Cuphea calophylla</i> subsp. <i>mesostemon</i> (Koehne) Lourteig	Li	Ln
<i>Cuphea carthagenensis</i> (Jacq.) J.F.Macbr.	He	Ha
<i>Cuphea confertiflora</i> A.St.-Hil.	He	Ha
<i>Cuphea fruticosa</i> Spreng.	He	Ha
<i>Cuphea glutinosa</i> Cham. et Schldl.	He	Ha
<i>Cuphea hatschbachii</i> Lourteig	He	endangered Ha
<i>Cuphea lindmaniana</i> Koehne ex Bacig.	He	Ha
<i>Cuphea linifolia</i> Koehne	He	Ha, Ln
<i>Cuphea longiflora</i> Koehne	He	Ha, Ln
<i>Cuphea racemosa</i> (L.f.) Spreng.	He	Ha, Ln
<i>Cuphea thymoides</i> var. <i>satureoides</i> A.St.-Hil.	He	Ha, Ln
MALPIGHIACEAE		
<i>Aspicarpa pulchella</i> (Griseb) O'Donnell & Lourteig	He	Ha, Ln
<i>Byrsonima brachybotrya</i> Nied.	Sh	Ha, Ln
<i>Byrsonima guilleminiana</i> A.Juss.	Sh	Ha
<i>Byrsonima intermedia</i> A.Juss.	Sh	Ha, Ln
MALVACEAE		
<i>Byttneria hatschbachii</i> Cristóbal	He	Ha, Ln
<i>Krapovickasia macrodon</i> (DC.) Fryxell	He	Ha, Ln
<i>Melochia tomentosa</i> L.	He	Ha
<i>Pelteaea speciosa</i> (Kunth) Standl.	He	Ha, Ln
<i>Pavonia schrankii</i> Spreng.	He	Ha
<i>Pavonia sepium</i> A.St.-Hil.	He	Ha, Fc
<i>Sida vianum</i> A.St.-Hil.	Sh	Ha
<i>Waltheria indica</i> L.	He	Ha
MELASTOMATACEAE		
<i>Acisanthera alsinaefolia</i> (DC.) Triana	He	Ha, Ln
<i>Acisanthera variabilis</i> (DC.) Triana	He	Ha, Ln
<i>Leandra australis</i> (Cham.) Cogn.	He	Ha, Ln
<i>Leandra erostrata</i> (DC.) Cogn.	He	Ha, Ln
<i>Leandra lacunosa</i> Cogn.	He	Ha
<i>Leandra pupurascens</i> (DC.) Cogn.	He	Ha
<i>Leandra simplicicaulis</i> Cogn.	He	Ha
<i>Miconia ligustroides</i> (DC.) Naudin	Sh	Ha, Ln
<i>Miconia sellowiana</i> Naudin	Sh	Ha, Fc
<i>Miconia theizans</i> (Bonpl.) Cogn.	Sh	Ha
<i>Rhynchanthera brachyryncha</i> Cham.	He	Ha
<i>Tibouchina cerastifolia</i> Cogn.	He	Ha
<i>Tibouchina debilis</i> (Cham.) Cogn.	He	Ha, Ln
<i>Tibouchina dubia</i> Cogn.	He	Ha, Ln
<i>Tibouchina gracilis</i> (Bonpl.) Cogn.	He	Ha, Ln
<i>Tibouchina martialis</i> (Cham.) Cogn.	He	Ha
MORACEAE		
<i>Dorstenia cayapia</i> Vell.	He	endangered Ha, Ln
MYRTACEAE		
<i>Campomanesia adamantium</i> (Cambess.) O.Berg	Sh	Ha
<i>Campomanesia pubescens</i> (Mart. ex DC.) O.Berg	Sh	rare Ha
<i>Campomanesia xanthocarpa</i> (Mart.) O.Berg	Sh	Ha
<i>Eugenia pitanga</i> (O.Berg) Nied.	Sh	Ha
<i>Eugenia puniceifolia</i> (Kunth) DC.	Sh	Ha
<i>Myrcia multiflora</i> (Lam.) DC.	Tr	Ha
<i>Myrcia pulchra</i> (O.Berg) Kiaersk.	Sh	Ha
<i>Myrciaria cuspidata</i> O.Berg	Sh	Fc
<i>Myrciaria delicatula</i> (DC.) O.Berg	Sh	Fc
<i>Psidium grandifolium</i> Mart. ex DC.	Sh	Ha, Ln

ORCHIDACEAE		
<i>Epidendrum secundum</i> Jacq.	He	Ln
<i>Oncidium pontagrossense</i> Campacci	He	Ln
<i>Sacoila lanceolata</i> (Aubl.) Garay	He	Ln
<i>Stenorrhynchus australis</i> Lindl.	He	Ha
OROBANCHACEAE		
<i>Buchnera longifolia</i> Kunth	He	Ha
<i>Buchnera temifolia</i> Kunth	He	Ha
<i>Esterhazyia splendida</i> J.C.Mikan	Sh	Ha, Ln
OxALIDACEAE		
<i>Oxalis nupestris</i> A.St.-Hil.	He	Ha, Ln
PASSIFLORACEAE		
<i>Passiflora lepidota</i> Mast.	Li	Fc, Ha
PINACEAE		
<i>Pinus elliottii</i> Engelm.	Tr	Ha, Hc, Fc, Ln
<i>Pinus taeda</i> L.	Tr	Ha, Hc, Fc, Ln
PLANTAGINACEAE		
<i>Angelonia integerrima</i> Spreng.	He	Hc
<i>Plantago australis</i> Lam.	He	Ha
<i>Plantago guilleminiiana</i> Decne.	He	Ha, Ln
<i>Plantago lanceolata</i> L.	He	Ha
<i>Plantago tomentosa</i> Lam.	He	Ha, Ln
<i>Mecardonia procumbens</i> (Mill.) Small	He	Ha
<i>Scoparia elliptica</i> Cham.	He	Ha
POACEAE		
<i>Andropogon bicornis</i> L.	He	Ha
<i>Andropogon leucostachyus</i> Kunth	He	Ha, Ln
<i>Andropogon microstachys</i> Desv.	He	Ha
<i>Andropogon selloanus</i> (Hack.) Hack.	He	Ha
<i>Andropogon tematus</i> (Spreng.) Nees.	He	Ha
<i>Andropogon virgatus</i> Desv.	He	Ha
<i>Aristida</i> sp	He	Ha
<i>Aristida jubata</i> (Arechav.) Herter	He	Ha
<i>Axonopus siccus</i> (Nees) Kuhlman.	He	Ln
<i>Axonopus affinis</i> Chase	He	Ha
<i>Brachiaria decumbens</i> Stapf	He	Ha, Ln, Fc
<i>Calamagrostis viridiflavescens</i> (Poir.) Steud.	He	Ha, Hc
<i>Eleusine tristachya</i> (Lam.) Lam.	He	Ha
<i>Elionurus muticus</i> (Spreng.) Kuntze	He	Ha
<i>Eragrostis airoides</i> Nees	He	Ha
<i>Eragrostis bahiensis</i> Roem. & Schult.	He	Ha
<i>Eragrostis ciliaris</i> (L.) R.Br.	He	Ha
<i>Eragrostis neesii</i> Trin.	He	Ha
<i>Eragrostis pilosa</i> (L.) P.Beauv.	He	Ha
<i>Eragrostis polytricha</i> Nees	He	Ha
<i>Eustachys distichophylla</i> (Lag.) Nees	He	Ha
<i>Melinis minutiflora</i> P.Beauv.	He	Ha, Ln
<i>Melinis repens</i> (Willd.) Ziska	He	Ha, Ln
<i>Panicum glabripes</i> Döll	He	Hc, Fc
<i>Panicum millegrana</i> Poir.	He	Hc, Fc
<i>Panicum sabulorum</i> Lam.	He	Ha
<i>Paspalum compressifolium</i> Swallen	He	Ha
<i>Paspalum conjugatum</i> P.J.Bergius	He	Ha
<i>Paspalum dilatatum</i> Poir.	He	Ha
<i>Paspalum distichum</i> L.	He	Ha
<i>Paspalum guenoanum</i> Arechav.	He	Ha
<i>Paspalum polyphyllum</i> Nees ex Trin.	He	Ha
<i>Pennisetum purpureum</i> Schumacher.	He	Ha
<i>Schizachyrium condensatum</i> (Kunth) Nees	He	Ha, Ln
<i>Schizachyrium spicatum</i> (Spreng.) Herter	He	Ha
<i>Setaria parviflora</i> (Poir.) M.Kerguelen	He	Ha
<i>Sorghastrum minarum</i> (Nees) Hitchc.	He	Hc
<i>Sporobolus indicus</i> (L.) R. Br.	He	Ha
POLYGALACEAE		
<i>Momina cardiocarpa</i> A.St.-Hil.	He	Ha, Ln
<i>Polygala cyparissias</i> A.St.-Hil. & Moq.	He	Ha
<i>Polygala longicaulis</i> Kunth	He	Hc, Ln
<i>Polygala molluginifolia</i> A.St.-Hil.	He	Hc

<i>Polygala tinoutoides</i> Chodat	He	Hc
RUBIACEAE		
<i>Galianthe verbenoides</i> (Cham. & Schltdl.) Griseb.	He	Ha, Ln
<i>Galium megapoticum</i> Spreng.	He	Ha
<i>Palicourea australis</i> C.M.Taylor	He	Ha
<i>Richardia brasiliensis</i> Gomes	He	Ha
<i>Spemacoce paranaensis</i> (E.L.Cabral & Bacigalupo) Delprete	He	Ha, Ln
<i>Spemacoce poaya</i> A.St.-Hil.	He	Ha, Ln
<i>Spemacoce verticillata</i> L.	He	Ha, Ln
SCHIZAEACEAE		
<i>Anemia tomentosa</i> (Savigny) Sw.	He	Ln
SOLANACEAE		
<i>Calibrachoa ericifolia</i> (R.E.Fr.) Wijsman	He	Ha, Ln
<i>Calibrachoa linoidea</i> (Sendtn.) Wijsman	He	Ha
<i>Calibrachoa nupensis</i> (Dusén) Wijsman	He	Ha, Ln
<i>Solanum americanum</i> Mill.	He	Ha, Hc, Ln
VERBENACEAE		
<i>Lantana camara</i> L.	Sh	Ha
<i>Lippia hirta</i> (Cham.) Meisn. ex Walp.	He	Ha, Ln
<i>Lippia lupulina</i> Cham.	He	Ha, Ln
<i>Lippia tumerifolia</i> Cham.	He	Ha
<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	He	Ha
<i>Stachytarpheta cf. polyura</i> Schauer	He	Ha
<i>Verbena hirta</i> Spreng.	He	Ha, Ln
<i>Verbena rigida</i> Spreng.	He	Ha, Ln
VIOLACEAE		
<i>Hybanthus parviflorus</i> (L.f.) Baill.	He	Ha
XYRIDACEAE		
<i>Xyris jupicai</i> L.C. Rich.	He	Hc, Ln
<i>Xyris neglecta</i> L.A.Nilsson	He	Hc, Ln
<i>Xyris tortula</i> Mart.	He	Hc, Ln

Families with the highest taxa number were Asteraceae (119) followed by Fabaceae (41), Poaceae (38) and Cyperaceae (28), summing up 54% of the total species richness, *i.e.*, the number of taxa in the area.

Previously, in Campos Gerais region, including both mesic and hygrophilous species, in the Vila Velha State Park grassland, Cervi *et al.*[17] have found around 47% of the species richness consisted of 182 taxa of the Asteraceae family, 130 Poaceae, 89 Fabaceae, and 47 Cyperaceae. In the same environment, in the Guartelá State Park, Carmo[18] has found 28% of the species richness composed of 79 Asteraceae, 42 Fabaceae, 35 Poaceae, and 22 Cyperaceae. Outside the conservation zone, those surveys restricted to hygrophilous species, in the Tibagi river valley, only 27 species from Asteraceae family were found, together with 24 species of Poaceae, and 18 Cyperaceae[19]. All these contributed 47% of the total species richness in the surveyed area. Kozera *et al.*[20], in the Iguaçu river floodplain, have identified lesser, consisting of 15 species from Asteraceae family, 45 Poaceae 28, Cyperaceae and one Fabaceae, comprising 50% of the total species richness. The Asteraceae and Fabaceae species diversity increases the biological diversity due to the higher elevation of river banks, allowing the existence of non-hydromorphic soils.

Generally, the grassland of Pitangui river valley areas were dominated by herb species consisting of 79.8% of the total plant types. Shrubs which comprised the 15.4% consisted of the families, Asteraceae, Fabaceae, Malpighiaceae, Ericaceae, and Myrtaceae. In addition,

treelets (1.0%) were observed consisted of the species *Myrcia multiflora* (Lam.) DC. and *Plenckia populnea* Reissek, both configuring rare plant forms in grasslands. The occurrence of these species is probably related to remnants of savannahs present in the vicinity of the study area. Prostrated herbs combine 3.8% of the phytocoenosis.

Twelve species are quoted on the list of threatened species of the state of Paraná[12] as rare: *Ruellia multifolia* (Nees) Lindau (Acanthaceae), *Gomphrena macrocephala* A.St.-Hil. (Amaranthaceae), *Pfaffia jubata* Mart. (Amaranthaceae), *Mandevilla coccinea* (Hook. & Arn.) Woodson (Apocynaceae), *Butia microspadix* Burret (as *B. hatschbachii* Glas mann) (Arecaceae), *Halimium brasiliense* (Lam.) Gross. (Cistaceae), *Cayaponia espelina* (Silva Manso) Cogn. (Cucurbitaceae), and *Campomanesia pubescens* (Mart. ex DC.) O.Berg (Myrtaceae); as endangered: *Chrysolaena nicolackii* H.Rob. (Asteraceae), *Cuphea hatschbachii* Lourteig (Lythraceae), and *Dorstenia cayapia* Vell. (Moraceae); as vulnerable: *Caryocar brasiliense* A.St.-Hil. (Caryocaraceae). In addition, there were six non-native grass species: *Brachiaria decumbens* Stapf.[15], *Melinis minutiflora* P.Beauv., *Melinis repens* (Willd.) Ziska, and *Pennisetum purpureum* Schumacher.[16], all belonging to African genera of the Poaceae family. The high levels of biological contamination with the pines *Pinus taeda* L. and *Pinus elliottii* Engelm. (Pinaceae) and its implications for the Campos Gerais grassland conservation have already been discussed by Ziller & Galvão[21]. They have found 76% of grassland with pine contamination and even pointing their

high potential for environmental degradation, public policies could not be effective yet for its control.

4. Conclusions

The species richness of Pitangui river valley grassland was higher (420 species on 8.3 ha) compared to available data from Campos Gerais region, as listed from the Vila Velha and Guartelá State Parks which were made upon larger protected areas. Asteraceae, Fabaceae, Poaceae, and Cyperaceae are the main families in this ecosystem. The presence of non-native species (4 species), and invasive *Pinus* species (2 species), and the increasing number of threatened species is alarming considering the location and the size of the area. Therefore, it is only high time to suggest that additional zoning and better management effort be the concern of the authorities to conserve the Campos Gerais National Park and its vicinities

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