Malpighiaceae Juss. in the Upper Paraná River Floodplain, States of Paraná and Mato Grosso do Sul, Brazil

© Ricardo Pacifico1,2 and © Rafael Felipe de Almeida3

Received: 30.11.2019; accepted: 28.05.2020


ABSTRACT – (Malpighiaceae Juss. in the Upper Paraná River Floodplain, States of Paraná and Mato Grosso do Sul, Brazil). We present a taxonomic treatment for Malpighiaceae Juss. from the Upper Paraná River floodplain, Brazil, where 20 species in 12 genera were recognized. An identification key, morphological descriptions, photo plates, and comments on distribution and ecology of the species are provided. Tetrapterys xylosteifolia is recorded for the first time in both Paraná and Mato Grosso do Sul States in Brazil.

Keywords: Atlantic Rainforest, Cerrado, Malpighiales, Taxonomy


Palavras-chave: Cerrado, Floresta Atlântica, Malpighiales, Taxonomia

Introduction

Malpighiaceae is a pantropical flowering plant family with about 1,300 species in 77 genera (Davis & Anderson 2010) and can usually be recognized by its malpighiaceous hairs, flowers with a pair of oil secreting glands at the base of each sepal, and unguiculate petals (Anderson 1981). This family is represented by lianas, shrubs or trees and attains its highest species richness in the Neotropical region (Davis & Anderson 2010).

River basins are long known to encompass a great diversity for some Malpighiaceae genera within forested habitats in the Neotropics (Anderson 1981, Anderson C. 1997, 2014, Almeida & Amarim 2014). One of the largest river basins in the Neotropical region is Paraná River Basin, which includes areas of Argentina, Paraguay, and seven States in Brazil (Stevaux 1994). Since 1998, when the Porto Primavera Dam was closed, the Upper Paraná River Floodplain (here mentioned as PIARP) is the only section of the Paraná river that maintains its natural hydrological processes (Agostinho et al. 2004).

During the last couple of decades, floristic research on PIARP included checklists of vascular plants [PIARP by Souza et al. (2009); Mata do Araldo by Slusarski & Souza (2012); Figueira lake by Kawakita & Souza (2003); epiphytes by Tomazini (2003); aquatic macrophytes by Ferreira et al. (2011)] and taxonomic treatments for Sapindaceae Juss. (Romagnolo & Souza 1994), Myrtaceae Juss. (Romagnolo & Souza 2004, 2006), Rubiaceae Juss. (Souza & Souza 1998), Poaceae Barnhart (Kawakita et al. 2016), Crotalaria L. (Garcia et al. 2013), and Aeschynomene L. (Souza et al. 2012). We present here a floristic treatment of Malpighiaceae from PIARP.

1. Universidade Estadual de Maringá, Departamento de Ciências Biológicas, 87020-900, Maringá, PR, Brasil
2. Corresponding author e-mail: ricardo.b9@hotmail.com
3. Scientifik Consultoria, 25651-090, Petrópolis, RJ, Brasil
Material and Methods

Study area - PIARP comprises an extensive floodplain of about 230 km long and up to 20 km wide, totally included in the Brazilian territory (Agostinho et al. 2004). It is located approximately between 22º38'-22º57' S and 53º05'-53º36' W (Figure 1) and partially overlaps with the municipalities of Porto Rico, São Pedro do Paraná, Marilena and Querência do Norte (in Paraná State), Batayporã, Novo Horizonte do Sul, Jateí and Taquaruçu (in Mato Grosso do Sul State). Many localities in PIARP were subjected to anthropogenic activities, as deforestation and invasion by alien plants (Agostinho et al. 2004, Garcia et al. 2013). Three conservation units overlap totally or partially with PIARP: Ilha Grande National Park, Ivinhema State Park, and Environmental Protection Area (APA) of islands and flooded areas of Paraná River (Agostinho et al. 2004).

The left margin of the Paraná River is not exposed to seasonal floods and consists of colluvial soils deposited upon the Mesozoic sandstone of Caiuá formation (Stevaux 1994). The right margin presents both colluvial deposits formed in situ and terraces originated by fluvial processes associated with its paleodrainage system (Sallun et al. 2007). The region seasonally flooded is a plane lowland located at the right margin (Stevaux 1994), where the Paraná river has an anastomosed system that continuously generates islands by deposition of alluvial sandy sediments (Corradini et al. 2008).

The main vegetation type found in PIARP is the Submontane Semideciduous Seasonal Forest, which occurs at elevations between 100-600 m and is defined by the partial fall of leaves during dry seasons (IBGE 2012). Marshes, grasslands (Souza et al. 2009) and Cerrado remnants are also found surrounding seasonally flooded areas. The most representative plant families in PIARP are Fabaceae Lindl., Poaceae, and Rubiaceae Juss. (Souza et al. 2009). Phytosociologically, Cecropia pachystachya Tréc., Inga vera Wild. and Guazuma ulmifolia Lam. were reported by Campos et al. (2000) as tree species of high importance values in PIARP.

Floristic inventory and taxonomic study - The floristic inventory of PIARP started with annual expeditions between 1987-1999. In 1999 the study area was included in the Long Term Ecologic Research project (PELD/CNPq - site 6). Since then, seven-day floristic expeditions have been performed quarterly to cover both flood and dry seasons. Main sets of collections made in PIARP are housed in the herbaria HNUP and HUEM, both of which are located at the Maringá State University, Paraná, Brazil.

For the taxonomic study, morphological descriptions and phenology of the studied species were based on collections from CEPEC, HUEFS, HNUP, HUEM, MBM, RB, SP.
and UEC herbaria. The indumenta terminology follows Anderson (1981), structure shapes follow Radford et al. (1974), the inflorescence terminology and morphology follows Weberling (1965, 1989), and fruit terminology follows Spjut (1994) and Anderson (1981).

**Results and Discussion**


Only three species [Banisteriopsis muricata (Cav.) Cuatrec., Hiraea hatchbachii C.E. Anderson and Mascagnia divaricata (Kunth) Nied.] were found in islands of PIARP, where floods are frequent. The reduced richness of Malpighiaceae in islands was probably determined by water level, turbulences, wave current, deposition and erosion processes, which usually affect plant occupation in floodplains (Junk et al. 1989, Junk & Piedade 1997, Ferreira et al. 1999). In Mutum island, Hiraea hatchbachii survives during floods by climbing on the forest canopy (R. Pacifico, personal observation). Banisteriopsis muricata, H. hatchbachii and M. divaricata seem to be flood-resistant because mature individuals of these species were found in localities exposed to annual floods. In turn, Banisteriopsis campestris (A.Juss.) Little, Peixotoa reticulata Griseb. and Tetrapterys ambiguа (A.Juss.) Nied. are restricted to Cerrado remnants with dry soils during all year long.

**Taxonomic treatment**

**Malpighiaceae** Juss., Gen. Pl. 252. 1789. Type: Malpighia L.

Trees, shrubs, subshrubs to lianas; unicellular hairs T-Y-V-shaped, rarely aciculate; stipules epiphyllous, diminute or expanded. Leaves simple, opposite, rarely subopposite; leaf blade glandular, rarely eglandular, margins plane or revolute; petiole glandular, rarely eglandular. Inflorescences of first order of 1-3-flowered cincinni; second order inflorescences thyrsi, corymbs or umbels; third order inflorescences dichasias, thyrsi or panicles, axillary or terminal. Flowers zygomorphic, bisexual, heterocyclic, hypogynous; sepals 5, glands 0-2 per sepal, anterior sepal usually eglandular; petals 5, yellow or white to pink, free, clawed; posterior petal generally markedly different from lateral petals. Stamens (4-6)-10, isomerous or heteromorphic; anthers pubescent or glabrous. Gynoecium 2-3-carpellate, free or connate, 1-ovulate; ovule pendulous, anatropous; styles 1-3, free, rarely connate, apex acute, obtuse, capitate or truncate; stigmas terminal or lateral. Fruit a drupe, nut or schizocarp, the latter splitting into 3 mericarps, smooth, setose or winged.

Key to the species of Malpighiaceae of PIARP

1. Umbels disposed in compound inflorescences or solitary umbels
2. Umbels disposed in dichasia or short thyrsi
3. Apex of styles capitate
4. Stipules minute and free, anthers always releasing pollen grains
5. Mericarps with four lateral wings more developed than the dorsal wing, X-shaped
6. Mericarps with the dorsal wing more developed than the lateral wings
7. Leaf blades tomentose or sericeous, petals yellow
8. Leaves deciduous when flowering, petioles without linear stipules
   1. Thyrsi or corymbs
9. Corymbs, mericarps with two lateral wings fused into a single orbicular wing
10. Leaf blades velutine, petals yellow ................................................................. Mascagnia australis
10. Leaf blades sericeous to glabrous, petals pink ................................................ Mascagnia divaricata
9. Thyrsi, mericarps with lateral wings not fused into a single orbicular wing, or nuts.
11. Bracts and bracteoles cucullate, nuts ................................................................. Dicella nucifera
11. Bracts and bracteoles flat, mericarps
12. Mericarps with two or four lateral wings more developed than the dorsal wing, butterfly-shaped, X-shaped or orbicular
13. Petals white to pink, leaves strongly discolored when dry ........................................ Alycia anisopetala
13. Petals yellow to reddish, leaves concolorous to slightly discolored when dry
14. Subshrubs, leaves abaxially densely tomentose ................................................... Tetrapteryx ambigua
14. Lianas, leaves abaxially sericeous to glabrescent
15. Petioles glabrous, leaf blades with the margins glabrous, mericarps butterfly-shaped ............ Carolus chlorocarpus
15. Petioles glandular, leaf blades with the margins glandular, mericarps X-shaped ............ Niedenzuella multiglandulosa
12. Mericarps with lateral wings less developed than the dorsal wing or absent
16. Leaves abaxially sericeous or velutine becoming glabrescent with age
17. Petioles glandular at the base, floral peduncles absent ............................................ Heteropterys argyrophylla
17. Petioles glandular near the apex, floral peduncles 1.6-2 mm long .................. Heteropterys byronominifolia
16. Leaves always glabrous abaxially
18. Leaf blades linear to lanceolate 0.3-0.5 cm wide .................................................... Heteropterys glabrula
18. Leaf blades narrowly elliptical to ovate 1.6-5.4 cm wide
19. Petioles glandular near the apex, bracteoles elliptical ........................................ Heteropterys cochleosperma
19. Petioles eglandular, bracteoles expanded and foliaceous ..................................... Heteropterys eglandulosa


Figure 2

Lianas; stems sericeous; stipules epipetiolar, triangular. Leaves decussate; petioles 8.8-15.5 mm long, 2-6-glandular; blades 6.7-15.6 × 3.7-8.3 cm, widely ovate, base cuneate, margin entire, 1-10-glandular near base, apex acute or cuspidate, adaxially glabrescent, abaxially tomentose. Thyrsi, solitary or arranged in panicles, axillary or terminal; cincinnati bracts ca. 2.8 mm long, spatulate; peduncles 2.3-2.5 mm long; bracteoles 2.4-3.8 mm long, foliaceous. Flowers with pedicels 3-3.6 mm long; sepals 3.2-3.5 × 1.3-1.8 mm, narrowly triangular, adaxially glabrous, abaxially sericeous; glands 1.5-2 mm long, anterior sepal eglandular; petals white to pink, margin denticulate to shortly-fimbriate, adaxially glabrescent, abaxially densely sericeous; lateral petals limb 1.7-2.2 × 1-1.2 mm, claws 0.7-1 mm long; posterior petal limb ca. 3.6 × 1.8 mm, claw ca. 1.5 mm long. Fertile stamens 10, subsimomorph; filaments 0.7-1.6 mm long; anthers 0.8-1.1 mm long; staminodes absent. Ovaries pilose; styles 3, 0.8-1.2 mm long, subsimomorph, glabrous; stigmas lateral. Mericarps winged, lateral wings 2, well-developed (butterfly-shaped), 1.5-2.4 cm long, free partially fused at base, sericeous; dorsal wing 4-6 mm long, sericeous.

Alicia anisopetala is widely distributed in South America (Anderson 2006). In Brazil, it occurs in all States of the southern and midwest regions, and in Mato Grosso do Sul and Bahia (Almeida 2020). In PIARP, Alycia anisopetala may be recognized by the combination of leaves strongly discolored when dry and butterfly-shaped mericarps. Carolus chlorocarpus shares with Alycia anisopetala the butterfly-shaped mericarps and differs by the leaves concolorous when dry (vs. discolored) and flowers with yellow petals (vs. white to pink). Alycia anisopetala was only found in forest galleries at the left margin of PIARP, flowering and fruiting from April to July and December.


Figure 3

Erect subshrubs; stems sericeous to tomentose; stipules epipetiolar, triangular. Leaves decussate; petioles 3.6-4.7 mm
long, eglandular; blades 4.9-6.8 × 3.8-4.4 cm, elliptical, base subcordate to truncate, margin entire, apex mucronulate-cuspidate, both sides tomentose, 2-glandular at base. Umbels arranged in dichasia, 4-flowered; cincinni bracts 1.9-2.2 mm long, narrowly triangular; peduncles absent; bracteoles ca. 1.5 mm long, triangular. Flowers with pedicels ca. 1.5 cm long; sepals not seen; petals not seen; androecium and gynoeceum not seen. Mericarps winged, dorsal wing well-developed and thickened along the upper margin, 2.1-2.3 cm long, densely sericeous-tomentose; lateral wings absent.

**Banisteriopsis campestris** occurs only in Brazil, where it is widely distributed in Cerrado areas from Paraná to Mato Grosso, Tocantins and Maranhão, and in Caatinga regions of Bahia (Flora do Brasil 2020). In PIARP, it may be distinguished by having tomentose leaves, pink petals, and mericarps with the dorsal wing widely expanded. It differs from *B. muricata* by the leaf blades abaxially tomentose (vs. sericeous) and 2-glandular at the base (vs. eglandular). *Banisteriopsis campestris* was found only in the right margin of PIARP, near the Ivinhema River, in Cerrado remnants that are not exposed to seasonal floods.


Figure 4

Lianas; stems glabrescent; stipules interpetiolar, triangular. Leaves decussate; petioles 0.8-1 cm long, eglandular; blades 7.3-10.8 × 3.1-6.8 cm, ovate or elliptical, base rounded to subcordate, margin entire, apex mucronate to cuspidate, adaxially glabrous, abaxially sericeous, eglandular. Umbels arranged in reduced dichasia, 4-flowered, axilar or terminal; cincinni bracts and bracteoles 0.7-1 mm long, narrowly triangular; peduncle absent. Flowers with pedicels 5.3-14 mm long; sepals ca. 2.3 × 1.4 mm, triangular, abaxially tomentose; glands ca. 1.5 mm long; anterior sepal eglandular; petals white to pink, margin fimbriate, both surfaces glabrous; lateral petals limb 4.3-5.6 × 3.3-4.6 mm, claws 0.7-1.3 mm long, posterior petal limb 5.3-5.7 × 3.7-3.9 mm, claw 1.8 mm long. Fertile stamens 10, heteromorphic;
filaments 1.1-3.5 mm long; anthers 0.6-0.8 mm long; staminodes absent. Ovaries pilose; styles 3, 2.5-4.2 mm long, isomorphic or subisomorphic, glabrescent; stigmas apical. Mericarps winged, dorsal wing well-developed and thickened along the upper margin, 1.6-3.6 cm long, sericeous; lateral wings absent.

*Banisteriopsis muricata* is widely distributed from Mexico to Argentina (Gates 1982). It is a common species in PIARP and occurs in both of its margins, besides its islands and river channels. *Banisteriopsis muricata* can be recognized by a combination of sericeous leaves, pink petals, and mericarps with the dorsal wing widely expanded at the base and constricted at the apex. It is morphologically related to *B. campestris* (see comments on this species). It was collected in gallery forests, islands and river channels, on hydromorphic soils, flowering from January to March, and fruiting from February to May and August.


**Figure 5**

Lianas; stems sericeous to glabrescent; stipules interpetiolar, triangular. Leaves decussate; petioles 3.1-5.6 mm long, eglanular; blades 3.5-9.8 × 0.9-2.8 cm, narrowly elliptical to lanceolate, base cuneate, margin entire, apex attenuate to acuminate, both sides sparsely sericeous to glabrescent, eglanular. Thyrsi, solitary, axillar; cincinnati bracts 1.8-3.2 mm long, narrowly triangular; peduncles 1-1.5 mm long; bracteoles ca. 0.7 mm long, elliptical. Flowers with pedicels 3.5-4 mm long; sepals 1.8-1.9 × 0.8-1.2 mm, triangular to narrowly triangular, abaxially sericeous; glands ca. 1.2 mm long; anterior sepal eglanular; petals yellow, margin glandular-fimbriate, adaxially glabrescent, abaxially sericeous; lateral petals limb 2.6-4.3 × 2.4-3.7 mm, claw 1.4-2 mm long; posterior petal limb 1.9-2.2 × 1.8-2.5 mm, claw 1.8-2.1 mm long. Fertile stamens 10, subisomorphic; filaments 1.7-2.1 mm long; anthers ca. 1 mm long; staminodes absent. Ovaries pilose; styles 3, 1.1-1.4 mm long, isomorphic, glabrescent; stigmas lateral. Mericarps not seen.
Carolus chlorocarpus occurs in Bolivia, Paraguay (Anderson 2006), and from Paraná to Bahia in Brazil (Flora do Brasil 2020). It can be recognized the leaf blades eglandular at the margin, flowers disposed in thyrsi, and butterfly-shaped mericarps. It could be confused with A. anisopetala (see the comments on this species). Carolus chlorocarpus was found only at the left margin of PIARP, in a gallery forest with hydromorphic soils, flowering in May.


Lianas; stems sericeous; stipules interpetiolar, triangular. Leaves decussate; petioles 0.2-2 cm long, bearing a pair of glands at the base or the apex; blades 2.6-11.4 × 0.6-6.8 cm, elliptical to narrowly elliptical, base rounded, margin entire, apex shortly acuminate, adaxially glabrescent, abaxially sericeous-tomentose, 1-4-glandular on secondary veins. Thyrsi, axillar; cincinni bracts ca. 3.8 mm long, obovate; peduncles 5.2-5.5 mm long; bracteoles ca. 2.9 × 1.5 mm, foliaceous. Flowers with pedicels 1.1-1.7 mm long; sepals ca. 2.3 × 1.2 mm, narrowly triangular, abaxially sericeous; glands ca. 1.2 mm long; anterior sepal eglandular; petals yellow to reddish at age, margin sinuate to serrate, adaxially glabrescent, abaxially sericeous; lateral petals limb 4.5-5 × 1-2 mm, claw 0.8-1.5 mm long; posterior petal limb ca. 0.6 × 0.3-0.4 cm, claw ca. 0.2 cm long. Fertile stamens 10, subisomorphic; filaments 1.7-2.7 mm long; anthers ca. 1 mm long; staminodes absent. Ovaries pilose; styles 2, 1-1.2 mm long, isomorphic, glabrescent; stigmas lateral. Nut, subspherical, 2.5-3.5 cm diam., sericeous.

Dicella nucifera occurs from Argentina to southern Brazil (Chase 1981; Pessoa 2020). PIARP is the northernmost limit of its distribution. It can be readily recognized among Malpighiaceae of this area for being the only species with cucullate bracteoles and nuts. Dicella nucifera was found only at the left margin of PIARP, in gallery forests with hydromorphic soils, flowering from December to March, and fruiting in February and March.

Figure 5. *Carolus chlorocarpus* (A.Juss.) W.R. Anderson. a. Leaf in adaxial view. b. Flower in frontal view. c. Fruit in frontal view (Photos a-b by P.H.B. Dettmann, c by M. Engels).


Figure 7

Lianas; stems glabrescent; stipules not seen. Leaves deciduous. Umbels, 4-flowered, axillary; cincinni bracts and bracteoles ca. 2 mm long, narrowly triangular; peduncle absent. Flowers with pedicels 10.9-20.2 mm long; sepals ca. 2 × 1.4 mm, triangular, abaxially glabrescent; glandular; petals yellow, margin fimbriate, adaxially glabrescent, abaxially sericeous; lateral petals limb 3.6-6.3 × 4.1-5 mm, claw 1.4-2.7 mm long; posterior petal limb ca. 3.5 × 4.3 mm, claw ca. 3.6 mm long. Fertile stamens 10, heteromorphic; filaments 2.4-3.3 mm long; anthers 0.8-1.1 mm long; staminodes absent. Ovaries pilose; styles 3, 3.8-3.9 mm long, isomorphic, lateral styles glabrous, anterior style pilose; stigmas apical. Mericarps not seen.

*Diplopterys lutea* occurs in Argentina, Paraguay, Bolivia, Peru, and in Brazil from Paraná to Maranhão (Gates 1982). It can be easily recognized in PIARP for being the only species of Malpighiaceae with deciduous leaves. *Diplopterys lutea* was found exclusively in the left margin of PIARP, in gallery forests with hydromorphic soils, flowering from August to September.


Figure 8

Lianas; stems glabrescent; stipules interpetiolar, narrowly triangular. Leaves deciduous. Umbels, 4-flowered, axillary; petioles 1.7-3.4 mm long, eglandular; blades 6.1-9.5 × 3.4-4.1 cm long, elliptical, base rounded to cuneate, margin entire, apex acute, cuspidate to subcaudate, both surfaces glabrescent, 2-glandular near margin. Umbels arranged in short thyrsi, axillary or terminal; cincinni bracts 1.5-1.8 mm long, narrowly triangular; peduncle absent; bracteoles 1.5-1.8 mm long, narrowly triangular. Flowers with pedicels 8.9-16 mm long; sepals ca. 2.5 × 1.5 mm, oblong to elliptical, abaxially sericeous, glands ca. 1.4 mm long, anterior sepal eglandular; petals yellow, margin denticulate to shortly fimbriate, adaxially glabrescent, abaxially sericeous, lateral petals limb 4.6-6.2 × 4.6-6.4 mm, claw 1.4-1.7 mm long; posterior petal limb ca. 5.2 × 5 mm, claw 3-3.6 mm long. Fertile stamens 10, heteromorphic; filaments 1.5-4.1 mm long; anthers 1.1-1.6 mm long; staminodes absent. Ovaries pilose; styles 3, 1.3-4 mm long, heteromorphic, glabrous; stigmas apical. Mericarps not seen.

*Diplopterys pubipetala* is widespread in Brazil and extends its distribution to Colombia, Peru, Bolivia, and
Paraguay (Gates 1982). It can be recognized in PIARP by a combination of glabrescent leaves, solitary umbels, and petals abaxially sericeous. *Diplopterys pubipetala* can be easily differentiated from *D. lutea* (the only congener in the area) by its persistent leaves (vs. deciduous). *Diplopterys pubipetala* was found only in the right margin of PIARP, near the Guiraí river, in gallery forests with hydromorphic soils that are not exposed to seasonal floods, flowering in November.


Lianas; stems sericeous or glabrescent, hairs sessile; stipules interpetiolar, triangular. Leaves decussate; petioles 5.6-10.3 mm long, bearing a pair of glands at the base; blades 5.8-12.9 × 3.3-7 cm, elliptical to widely ovate, rarely obovate, base cuneate or rounded, margin entire, apex acute, adaxially glabrous, abaxially sericeous, eglandular. Thyrsi, axillar or terminal; cincinni bracts ca. 3 mm long, lanceolate; peduncles absent; bracteoles ca. 1.1 mm, triangular. Flowers with pedicels 2.6-4.4 mm long; sepals 2.5-2.8 × 1-1.1 mm, narrowly triangular, abaxially sericeous, glands 0.9-1.2 mm long, anterior sepal eglandular; petals yellow, margin sinuate, both surfaces glabrous; lateral petals limb 1.9-2.9 × 1.6-2.1 mm, claw 1.1-2.4 mm long; posterior petal limb 2.8-3.1 × 1.4-1.7 mm, claw 1.3-2 mm long. Fertile stamens 10, heteromorphic; filaments 1.6-2.2 mm long; anthers ca. 1 mm long; staminodes absent. Ovaries pilose; styles 3, 1.4-2.2 mm long, isomorphic, glabrous; stigmas subapical. Mericarps winged, dorsal wing well-developed and thickened along the lower margin, 1.6-1.9 cm long, sericeous to glabrescent, lateral wings absent.

*Heteropterys argyrophaea* occurs form Argentina to Paraguay (Amorim 2003) and the Brazilian States of Paraná, Mato Grosso do Sul, São Paulo and Minas Gerais (Flora do Brasil 2020). In PIARP, it can be recognized by a combination of leaves discolored when dry, petioles glandular at the base, and mericarps with the dorsal wing well-developed and thickened along the lower margin. It differs from *Heteropterys cochleosperma* by the leaves abaxially sericeous (vs. glabrous) and petioles bearing a pair of glands at the base (vs. glands close to the apex). *Heteropterys argyrophaea* was found on both margins of PIARP, in gallery forests with hydromorphic soils, flowering in November, December, February and March, and fruiting in May.


Figure 9

Erect shrubs; stems glabrescent; stipules interpetiolar, triangular. Leaves decussate; petioles 2.4-3.3 mm long, generally bearing a gland at the apex; blades 8-9.5 × 3.2-4 cm, narrowly-elliptical or oblong, base rounded or cuneate, margin entire, apex acute, adaxially glabrescent, abaxially sparsely velutine or glabrescent, eglandular. Thyrsi, terminal; cincinni bracts ca. 1 cm long, elliptical; peduncles 1.6-2 mm
long; bracteoles ca. 1.8 mm long, elliptical. Flowers with pedicels 2.9-4.1 mm long; sepals 2.5-2.7 × 1.7-1.7 mm, triangular, abaxially sparsely sericeous; glands ca. 1.5 mm long; anterior sepal eglandular; petals yellow (not seen). Fertile stamens 10, heteromorphic; filaments 1.9-2.9 mm long; anthers 0.6-0.8 mm long; staminodes absent. Ovaries pilose; styles 3, 2.2-2.7 mm long, subisomorphic, glabrous; stigmas subapical. Mericarps not seen.

_Heteropterys byrsonimifolia_ occurs only in Brazil, from Mato Grosso south to Paraná and east to Bahia (Flora do Brasil 2020; Pessoa et al. 2014). In PIARP, it may be recognized by a combination of shrubby habit, branches with white lenticels, coriaceous leaves and flowers disposed in thyrsi. It differs from _Heteropterys eglandulosa_ by the shrubby habit (vs. climbing habit) and leaves that are abaxially sericeous becoming glabrescent with age (vs. glabrous). _Heteropterys byrsonimifolia_ was found in the right margin of PIARP, in a disturbed and deforested site with dry soils that are not exposed to seasonal floods, flowering in September.


Figure 10

Lianas; stems glabrous; stipules not seen. Leaves decussate; petioles 5.1-11 mm long, bearing a pair of glands close to the apex; blades 6.5-10.3 × 2.3-5.4 cm, narrowly-elliptical, elliptical or narrowly-ovate, base cuneate or attenuate, margin entire, apex acute, acuminate or cuspidate, both surfaces glabrous, eglandular. Thyrsi, terminal or axillary; cincinni bracts 1.1-2.6 cm long, foliaceous; peduncles 3.8-4.3 mm long; bracteoles ca. 1.9 mm long, elliptical. Flowers with pedicels 3-3.5 mm long; sepals 1.5-1.7 × 1.1-1.2 mm, triangular or ovate, abaxially sericeous, eglandular; petals yellow, margin entire or slightly sinuate, both surfaces glabrous; lateral petals limb 2.8-3 × 1.8-2 mm, claw 1.4-2.1 mm long, posterior petal limb ca. 2.2 × 1.8 mm, claw 2.2-2.3 mm long. Fertile stamens 10, heteromorphic; filaments 1.7-2.3 mm long; anthers 0.8-1 mm long; staminodes absent. Ovaries pilose; styles 3, 1.8-2.5 mm long, subisomorphic, glabrous; stigmas subapical. Mericarps winged, dorsal wing well-developed and thickened along the lower margin, 2.2-3.4 cm long, sericeous to glabrescent; lateral wings absent.

Heteropterys cochleosperma occurs in the Brazilian States of Paraná, Mato Grosso do Sul, São Paulo, Goiás and Bahia, and in Paraguay (Landrum 8597, MBM; Flora do Brasil 2020; Pessoa et al. 2014). In PIARP, it can be recognized by a combination of petioles glandular at the apex and mericarps with the dorsal wing well-developed and thickened along the lower margin. It is morphologically related to H. argyrophaea (see comments on this species). Heteropterys cochleosperma was collected on both margins of PIARP, in gallery forests with hydromorphic soils, flowering in March, and fruiting from May to July.

Figure 10. *Heteropterys cochleosperma* A.Juss. a. Flowering branch. b. Detail of floral buds and flowers. c. Fruit in side view (Photos by R.Pacifico).


Lianas; stems glabrous; stipules not seen. Leaves decussate to subopposite, petioles 4-6 mm long, eglandular; blades 3.5-13.3 × 1.6-5.4 cm, elliptical to narrowly-elliptical, base cuneate or rounded, margin entire, apex acuminate, both surfaces glabrous, eglandular. Thyrsi, axillar or terminal; cincinni bracts 2-4 mm long, foliaceous; peduncles 2.8-3.8 mm long; bracteoles 1.8-2 mm long, foliaceous. Flowers with pedicels 1.8-3.3 mm long; sepals 2.2-2.2 × 1-1.2 mm, narrowly triangular, abaxially sericeous; glands 1-1.3 mm long; anterior sepal eglandular; petals yellow, margin sinuate or shortly denticulate, both surfaces glabrous; lateral petals limb 2.4-3.2 × 1.8-3.3 mm; claw 1.8-3 mm long, posterior petal limb 2.3-2 × 1-1.2 with claw 1.8-2.2 mm long. Fertile stamens 10, heteromorphic; filaments 1.4-3.2 mm long; anthers ca. 0.8 mm long; stamnodes absent. Ovaries pilose; styles 3, 2-2.6 mm long, subisomorphic, glabrous; stigmas subapical. Mericarps winged, dorsal wing well-developed and thickened along the lower margin. It could be confused with *H. byrsonimifolia* (see comments on this species). It was collected on both margins of PIARP, in gallery forests with hydromorphic soils, flowering in April, October and December, and fruiting in October and November.


Erect subshrubs; stems glabrescent; stipules absent. Leaves decussate or subopposite, petioles 1.6-4.9 mm long, generally bearing a pair of glands at the apex; blades 4.2-7.3 × 0.3-0.5 cm, linear to lanceolate, base attenuate, margin entire, apex acute, adaxially sericeous, abaxially glabrous, eventually bearing glands close to the margin or...
the midrib. Thyrsi, axillar or terminal; cincinni bracts not seen; peduncles 5-6.1 mm long; bracteoles 1.3-1.6 mm long, triangular. Flowers with pedicels 1.7-2.1 mm long; sepal 1.8-2 × 0.8-1 mm, narrowly triangular, abaxially sericeous; glands 1-1.2 mm long; anterior sepal eglandular; petals yellow, margin sinuate, both surfaces glabrous; lateral petals limb 3.2-3.6 × 2.5-3.8 mm; claw 1.5-2.1 mm long, posterior petal limb 3.3-3.6 × 2.6 mm, claw 1.6-1.8 mm long. Fertile stamens 10, subisomorphic; filaments 2-2.5 mm long; anthers ca. 1.3 mm long; staminodes absent. Ovaries pilose; styles 3, 1.5-1.9 mm long, subisomorphic, glabrous; stigmas subapical. Mericarps not seen.

_Heteropterys glabra_ occurs in Argentina, Paraguay, and in Brazil from Rio Grande do Sul north to Mato Grosso (Flora do Brasil 2020). It can be easily recognized among Malpighiaceae of PIARP by having leaf blades linear to lanceolate. _Heteropterys glabra_ was found in the right margin of PIARP, on grasslands with hydromorphic soils, flowering from July to August, and fruiting in July.


Figure 12

Lianas; stems glabrescent; stipules linear, epipetiolar. Leaves decussate; petioles 6-11.1 mm long, bearing a pair of glands at the apex to eglandular; blades 6.4-15.2(-19.5) × 2.7-8.8 cm, elliptical to narrowly elliptical, base cuneate or rounded, margin entire, apex acute or mucronate, concolor, both surfaces sericeous or glabrescent, abaxial surface bearing 2-6 glands between the midrib and the margin, or eglandular. Umbels, solitary, 4-flowered, axillary; cincinni bracts not evident; peduncles absent; bracteoles ca. 1.8 mm long, ovate. Flowers with pedicels 11-14 mm long; sepal 1.9-2.1 × 1.6-1.9 mm, triangular, abaxially sericeous; eglandular with glands 1.8-2 mm; petals yellow, margin denticulate, both surfaces glabrous; lateral petals limb 4.6-6.8 × 4.8-6.6 mm, claw 2.2-3.6 mm long, posterior petal limb 3.6-4.7 × 4.4.5 mm, claw 4.1-4.3 mm long. Fertile stamens 10, heteromorphic; filaments 1.6-2 mm long; anthers 0.6-1.2 mm long; staminodes absent. Ovaries pilose; styles 3, 3.8-4.8 mm long, subisomorphic, glabrous; stigmas subapical. Mericarps winged, lateral wings 2, more developed than the dorsal wing (butterfly-shaped), 1.3-2.2 cm long, free at the base, sericeous; dorsal wing 3-6 mm long, sericeous.

_Hiraea hatschbachii_ occurs only in the States of Paraná and Mato Grosso do Sul (Anderson 2014; Flora do Brasil 2020; Francener et al. 2018). _Hiraea hatschbachii_ can be readily recognized by the linear epipetiolar stipules, a feature that is absent in all the remaining Malpighiaceae of PIARP. It was collected on both margins of PIARP, in its islands, river channels and affluent streams, on hydromorphic soils.

Figure 11. _Heteropterys eglandulosa_ A.Juss. a. Flowering branch in side view. b. Flower in frontal view. c. Fruit in side view (Photos by R.F.Almeida).
where floods are frequent, flowering from October to April (except in January), and fruiting from December to July.


Figure 13.

Lianas; stems sericeous or glabrescent, hairs sessile or shortly peduncled; stipules linear, interpetiolar. Leaves decussate to subopposite, petioles 7.5-12.2 mm long, eglandular; blades 7-9.1 × 2.9-5.1 cm, elliptical, base cuneate or rounded, margin entire, apex acuminate or cuspidate, rarely obcordate, subconcolored, both surfaces sparsely sericeous or glabrescent, abaxially bearing 1-4 glands between a midrib e a margin, or eglandular. Corymb, axillary; cincinnati bracts ca. 4.4 mm long, narrowly triangular; narrowly triangular; peduncles ca. 6 mm long, bracteoles 1.2-1.3 mm long, linear to narrowly triangular. Flowers with pedicels ca. 6 mm long; sepals ca. 2 × 1 mm, triangular, abaxially sericeous; glands ca. 2 mm long; anterior sepal eglandular; petals yellow, margin entire, both surfaces glabrous; lateral petals limb ca. 3.9-4 × 2.4-2.9 mm; claw ca. 0.5 mm long, posterior petal limb ca. 4 × 1.8 mm, claw ca. 0.8 mm long. Fertile stamens 10, subisomorphic; filaments 1.2-1.6 mm long; anthers 1-1.3 mm long; staminodes absent. Ovaries pilose; styles 3, 3.4-3.6 mm long, subisomorphic, glabrous; stigmas subapical. Mericarps winged, lateral wings 2, more developed than the dorsal wing, ca. 10 mm long, fused at the base, sericeous; dorsal wing ca. 3.4 mm long, sericeous.

Mascagnia australis occurs only in Brazil, from Rio Grande do Sul to Mato Grosso do Sul (Flora do Brasil 2020). It can be identified in PIARP by its flowers disposed in corymb, yellow petals, and mericarps with two lateral wings more developed than the dorsal wing and fused at the base. It differs from Mascagnia divaricata by the leaves with eglandular petioles (vs. 3-6 glandular) and flowers with yellow petals (vs. purple). Mascagnia australis was collected in the left margin of PIARP, in gallery forests with hydromorphic soils, flowering and fruiting in August.


Lianas; stems sericeous or glabrescent, hairs sessile; stipules oblong-linear, interpetiolar. Leaves decussate; petioles (8.3-)12-22.4 mm long, bearing 3-6 glands irregularly distributed; blades 10.6-13.5 × 5.4-7.6 cm,
ovate or elliptical, base subcordate or rounded, margin entire, apex cuspidate, concolored, adaxially glabrous, abaxially sparsely sericeous or glabrous, bearing 1-5 glands between the midrib and the margin. Corymbbs, axillar or terminal; cincinni bracts 0.6-2.8 cm long, foliaceous; peduncles ca 1.3 mm long, bracteoles ca. 1 mm long, triangular. Flowers with pedicels 5.5-9 mm long; sepals 1.6-2 × 0.9-1.1 mm, triangular, abaxially sericeous; glands 0.7-1.3 mm long; anterior sepal eglandular; petals purple, margin denticulate, both surfaces glabrous; lateral petals limb 2.1-3.1 × 1.7-2.6; claw 0.6-0.8 mm long; posterior petal limb ca. 2.7 × 2.4 mm, claw 0.9-1.6 mm long. Fertile stamens 10, heteromorphic; filaments 0.8-1.3 mm long; anthers 1-1.3 mm long; staminodes absent. Ovaries pilose; styles 3, 1.2-1.3 mm long, isomorphic, glabrescent; stigmas subapical.

Mericarps winged, lateral wings 2, more developed than the dorsal wing, 8.2-9.3 mm long, fused at the base, sparsely sericeous; dorsal wing 2.7-3.5 mm long, sparsely sericeous. Mascagnia divaricata is widespread in western Brazil, from Rio Grande do Sul to Amapá (Flora do Brasil 2020), and extends its distribution south to Paraguay and Argentina.


M. australis (see comments on this species). Mascagnia divaricata was found in the left margin of PIARP and on its islands, in gallery forests with hydromorphic soils, flowering in March, and fruiting in March and December.

10, subisomorphic; filaments 1.5-1.8 mm long anthers not seen; staminodes absent. Gynoecium not seen. Mericarps winged, lateral wings 4, more developed than the dorsal wing (X-shaped), 7.1-14.9 mm long, free at the base, sericeous; dorsal wing ca. 2.5 mm long, sericeous.

*Niedenzuella multiglandulosa* is widespread in Brazil (Flora do Brasil 2020; Anderson 2006). In PIARP, it can be recognized by the leaf blades glandular at the margin, flowers disposed in thyrsi and X-shaped mericarps. It shares the combination of climbing habit and X-shaped mericarps only with *T. xylosteifolia*, and may be differentiated from this species by the glandular petioles (vs. eglandular) and flowers disposed in thyrsi (vs. umbels). *Niedenzuella multiglandulosa* was collected only around affluent streams of the left margin of PIARP, in gallery forests that are not exposed to seasonal floods, flowering and fruiting in May.


17. *Peixotoa reticulata* Griseb., Linnaea 13: 213. 1839. Figure 15
Erect shrubs; stems velutine, hairs long peduncled; stipules foliaceous, interpetiolar. Leaves decussate; petioles 4.6-11.5 mm long, bearing a pair of sessile glands close to the apex; blades 9.7-11.8 × 7.9-11.9 cm, broadly ovate, base truncate, subcordate or rounded, margin entire, apex acute, adaxially sparsely velutine, abaxially variably tomentose-velutine, bearing glands close to the margin, or eglandular. Umbels arranged in dichasia, 4-flowered, terminal; cincinni bracts 4.4-7(-12) mm long, foliaceous; peduncles absent; bracteoles not seen. Flowers with pedicels 8-17 mm long; sepals (3.9-)4.9-7.2 × 3.2-4.5 mm, narrowly triangular, abaxially velutine; glands ca. 1.6 mm long; anterior sepal eglandular; petals yellow, margin denticulate or fimbriate, both surfaces glabrescent; lateral petals limb 6-6.8 × 4.6-6.9 mm, claw 0.7-1.1 mm long; posterior petal limb ca. 4.9 × 4.8 mm, claw ca. 1.3 mm long. Fertile stamens 5, subisomorphic; filaments 1-1.3 mm long; anthers 1.5-1.8 mm long; staminodes 5, 1.7-2 mm long. Ovaries pilose; styles 3, 1.7-2.2 mm long, subisomorphic, glabrescent; stigmas capitate. Mericarps winged, dorsal wing more developed than the lateral wings and thickened along the upper margin, 1.9-2.6 cm long, velutine; lateral wings 2, 2.6-3.2 mm long, velutine.

Peixotoa reticulata is widespread in Brazil, from Bahia to Paraná (Flora do Brasil 2020), extending to Paraguay and Bolivia (Anderson 1982). It can be easily identified among other Malpighiaceae of PIARP for having stipules that are expanded and fused, leaving a concave scar on the nodes after falling away. Peixotoa reticulata was found only in the right margin of PIARP, around the Ivinhema River, in a Cerrado remnant with dry soils that are not exposed to seasonal floods.


Lianas; stems sericeous or tomentose, hairs shortly peduncled; stipules not seen. Leaves subopposite, petioles 1.9-4.2 cm comp., bearing a pair of glands at the apex; blades 4.9-11.6 × 5.2-11.4 cm, ovate to cordiform, base cordate, subcordate or rounded, margin entire, apex mucronate, adaxially tomentose, sericeous or glabrescent, abaxially tomentose, eglandular. Umbels arranged in dichasia, 8-16(-27)-flowered, axilar or terminal; cincinni bracts 2.9-6.6 mm long, triangular to narrowly triangular; peduncles 7.1-18 mm long; bracteoles 1.6-1.8 mm long, narrowly triangular. Flowers with pedicels 7.3-15.5 mm long; sepals ca. 2.3 × 2.3 mm, triangular, abaxially tomentose; glands 1.7-2 mm; anterior sepal eglandular; petals yellow, margin denticulate, both surfaces glabrous; lateral petals limb 6.4-9.4 × 5.2-8.9 mm; claw 2.3-8 mm long; posterior petal limb 6.6-7 × 4.9-5.2 mm, claw 3.5-3.6 mm long. Fertile stamens 10, heteromorphic; filaments 2.2-3.7 mm long; anthers
0.7-1.2 mm long; staminodes absent. Ovaries pilose; styles 3, 3.2-3.7 mm long, subsisomorphic, glabrescent; stigmas foliaceous 2.6-1.9 mm. Mericarps not seen.

Stigmaphyllon bonariense occurs in Uruguay, Paraguay, Argentina (Anderson 1997), and from Rio Grande do Sul to São Paulo in Brazil (Flora do Brasil 2020). It can be readily recognized among Malpighiaceae of PIARP by its styles apically expanded into a leaflike structure. Stigmaphyllon bonariense was collected on both margins of PIARP, in gallery forests with hydromorphic soils, flowering from September to October and from January to March.


Erect subshrubs; stems variably tomentose; hairs long peduncled; stipules narrowly interpetiolar, triangular. Leaves decussate; petioles up to 1.5 mm long, bearing a pair of glands at the apex; blades 2.2-3.7 × 1.3-1.9 cm, elliptical, base cuneate to rounded, margin entire, apex acute, adaxially sparsely tomentose, abaxially densely tomentose, bearing a pair of glands at the base (usually hidden by the indumentum). Thyrsi, axillary or terminal; cincinni bracts not seen; peduncles 2.9 mm long; bracteoles 2.3-2.6 mm long, triangular. Flowers with pedicels 4.9-5.5 mm long; sepals 2.4-3 × 1.2-1.5 mm, narrowly triangular, abaxially tomentose; glands 1.6-1.9 mm long; anterior sepals eglandular; petals yellow to reddish, margin entire or denticulate, both surfaces glabrous; lateral petals limb 4.6-5.7 × 3.6-4.8 mm, claw 0.7-0.9 mm long; posterior petal limb ca. 4.5 × 4.2 mm, claw ca. 1.6 mm long. Fertile stamens 10, heteromorphic; filaments 1-2.2 mm long; anthers 0.8 mm long; staminodes absent. Ovaries pilose; styles 3, 1.7-2 mm long, subsisomorphic, stigmas subapical. Mericarps not seen.

Tetrapterys ambigu occurs in Bolivia and midwest Brazil (Francener et al. 2015), extending its distribution to the States of Tocantins and Minas Gerais (Flora do Brasil 2020). It can be recognized by a combination of subshreppy habit, leaves abaxially densely tomentose, thyrsi, and petals yellow to reddish. It differs from T. xyloseifolia by the subshreppy habit (vs. climbing habit), petioles glandular...
at the apex (vs. eglandular), and flowers disposed in thyrsi
(vs. umbels). *Tetrapterys ambigu*a was found only in the
right margin of PIARP, in a Cerrado remnant with on dry
soils that are not exposed to seasonal floods.

Material examined: BRAZIL. MATO GROSSO DO SUL: Nova
Andradina. Rio Ivinhema, 1998, I. Tanaka s.n. (HNUP
13820, HUEM 27706).

20. *Tetrapterys xylosteifolia* A.Juss., Fl. Bras. Merid. 3:
7. 1833.

Figure 18

Lianas; stems sericeous or tomentose, hairs sessile or
shortly peduncled; stipules narrowly interpetiolar, triangular.
Leaves decussate; petioles 4.7-10 mm long, eglandular; blades
2.1-6.2 × 1.3-3.4 cm, elliptical, base subcordate, margin

---

Figure 17. *Tetrapterys ambigu*a (A. Juss.) Nied. a. Habit showing underground xylopodium. b. Inflorescence in side view. c. Floral bud in side view. d. Flower in frontal view (Photos by C. F. Hall).
entire, apex rounded, concolorous, adaxially glabrescent, abaxially velutine, bearing 1–4 pairs of glands in the margin in its basal portion. Umbels arranged in compound dichasia, 4-flowered, axilar or terminal; cincinni bracts 0.6–1.6 cm long, foliaceous; peduncles 4.5–6.2 mm long; bracteoles 1.1–1.5 mm long, ovate. Flowers with pedicels 5.6–6.6 mm long; sepals 1.5–2 × 1–2.1 mm, triangular or ovate, abaxially glabrescent; glands 1.6–2 mm long; anterior sepal eglandular; petals yellow to reddish, margin entire or slightly sinuate, both surfaces glabrescent; lateral petals limb 4.2–5.1 × 3.4–4.5 mm; claw 1.7–2.6 mm long; posterior petal limb 3.3–3.7 × 3.3–3.5 mm, claw 3–3.2 mm long. Fertile stamens 10, subisosmoric; filaments 1.6–1.9 mm long; anthers 1–1.5 mm long; staminodes absent. Ovaries pilose; styles 3, 1.5–2 mm long, subisosmoric, glabrescent; stigmas apical. Mericarps winged, lateral wings 4, well-developed (X-shaped), 6.8–13.2 mm long, free at the base, sparsely sericeous; dorsal wing absent.

_Tetrapterys xylosteifolia_ occurs only in Brazil and was previously cited for the States of Rio Grande do Sul, Santa Catarina, São Paulo and Bahia (Flora do Brasil 2020). It is here recorded for the first time for both Mato Grosso do Sul (see Francener et al. 2015, 2018) and Paraná States (see Flora do Brasil 2020). _Tetrapterys xylosteifolia_ can be recognized by a combination of leaves abaxially velutine, 4-flowered umbels that are disposed in dichasia, and X-shaped mericarps. For comparisons with _N. multiglandulosa_ and _T. ambigua_ see comments on these species. It was collected on both margins of PIARP, in gallery forests with hydromorphic soils, flowering in June, July and September, and fruiting from July to August.


**Acknowledgements**

We thank the curators of all herbaria, for their assistance; C.E.B. Fernandes and K. Kawakita, for the logistical support; J.L.L. Pereira, for preparing the map; A. Junior, A. Medeiros, A. Popovkin, C.F. Hall, C. Takeuchi, E.F. Rosssetto, L. Funex, M. Engels, M.O.O. Pellegrini, M.R. Pace, M.R.M. Scoarize, and P.H.B. Dettmann, for giving us permission to use their photographs in this study; two anonymous reviewers for their comments on an earlier version of this manuscript. RP was sponsored by a CAPES doctoral fellowship.

**Literature cited**


