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Pellaea flavescens Fée in Rio de Janeiro, its Lectotypification, and its New Record for São Paulo State, Brazil

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In Situ Gametophyte Morphology of the Tropical Epiphyte *Oleandra articulata*

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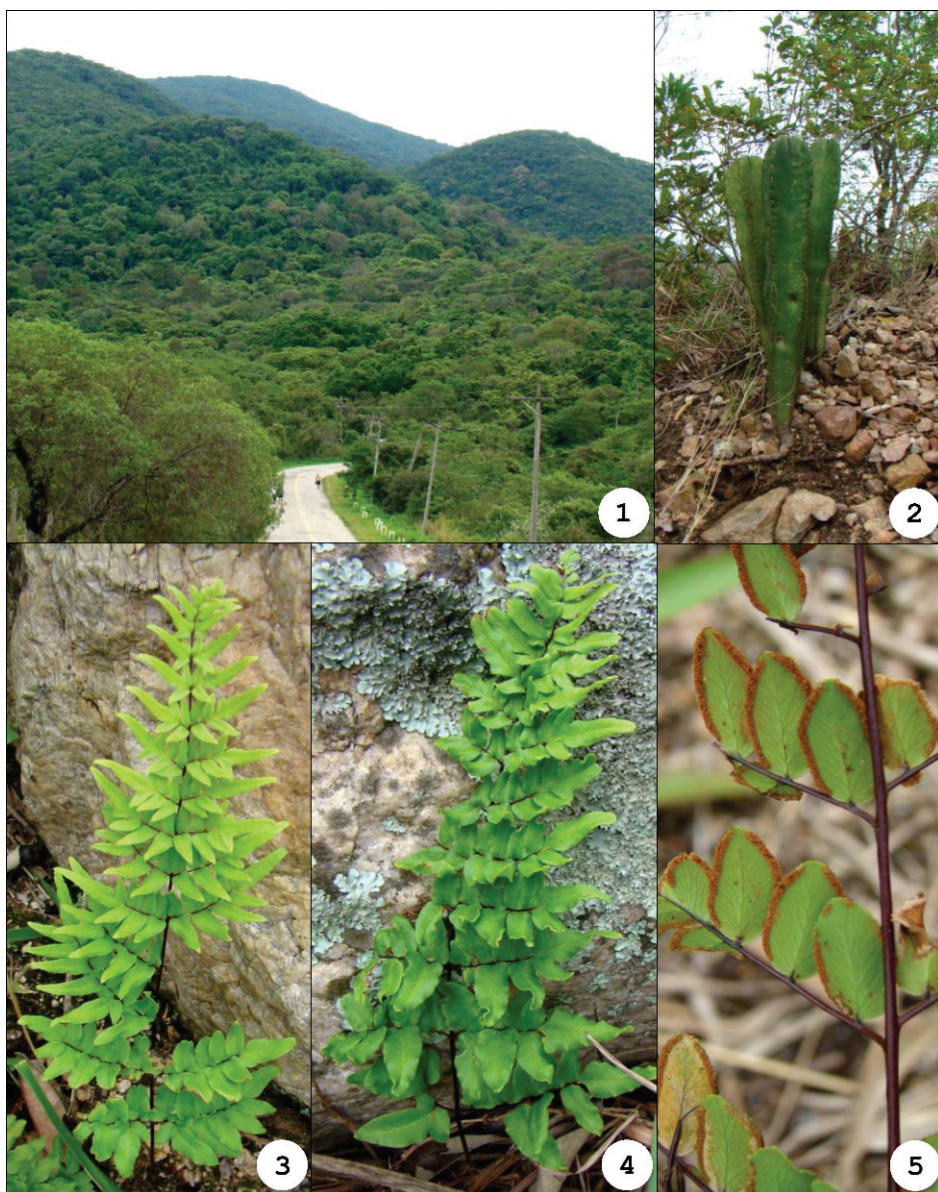
SHORTER NOTES

***Pellaea flavescens* Fée in Rio de Janeiro, its Lectotypification, and its New Record for São Paulo State, Brazil.**—The type specimens of *Pellaea flavescens* Fée (*Habitat in Brasilia fluminensi*, *Glaziou* 2473, K-000633009 p.p., K-000633010, P-00252273, P-00252274) came from the Serra dos Órgãos, located in the state of Rio de Janeiro, southeastern Brazil. These mountains have an elevational range of 80–2280 m, and the Atlantic rain forest is the main vegetation. Beyond the specimens cited in the original publication of this species by Fée (*Crypt. Vasc. Brés.* 1:44, t. 22, f. 2. 1869), only a few collections of this taxon were known from Rio de Janeiro, all from the vicinity of the type-locality: Brazil: **Rio de Janeiro**, Tijuca, Pedra José Cineiro, 21 Jan 1871, *Glaziou* 3546 (P); *Ex sylvis montanis Brasiliae prope Petropolis*, 2000–3000 feet, 10 Jul 1882, *Ball s.n.* (K-000633008). The *Glaziou* 3546 collection was mentioned by Fée (*Crypt. Vasc. Brés.* 2: 28. 1873).

Later, the species was collected in the following localities: **Rio de Janeiro**, Santa Maria Magdalena, Alto do Desengano, 2000 m, 3 Mar 1934, *Santos Lima and Brade* 13149 (RB); id, Frade de Macaé, 19 Jun 1937, *Brade* 15803 (RB); id., Base do Pico da Tijuca, 15 Jun 1948, *Duarte and Pereira* 1142 (RB); id., Nova Friburgo, Duas Pedras, 1951, *Capell s.n.* (RB). More recently, on 9 Apr 2006, *P. flavescens* was re-collected (*Moraes* 78, RB), in Petrópolis, Distr. Araras, Área de Proteção Ambiental of Petrópolis, Serra da Maria Comprida. This last locality is also in the Serra dos Órgãos complex. These eight collections represent all records for this taxon to Rio de Janeiro and in spite of its scattered records, *Pellaea flavescens* was not included in a recent list of the Brazilian endangered plants (MMA, Instrução Normativa n. 06, 23 Sep 2008).

In October 2009, the present authors found a small population of *Pellaea flavescens* [*Prado et al.* 2036 (DUKE, MO, SP)] in another range of mountains (Serra do Japi, municipality of Jundiaí), in São Paulo State. This area also has the Atlantic rain forest as the predominant vegetation. The plants were growing at ca. 790 m elevation, among grasses and rocks, in an open area, near some plants of *Cereus peruvianus* (L.) Mill. (Cactaceae) (Figs. 1, 2). This is the first record for this species outside of Rio de Janeiro. It is probable that the distribution of *P. flavescens* will be more extensive than is presently known, but it seems to be very rare in nature, as evidenced by the few specimens that have been collected since the species was first discovered in the 19th century.

Pellaea flavescens can be easily distinguished from other Brazilian cheilantheid ferns by the combination of its short-creeping rhizomes; erect fronds to ca. 50 cm tall; dark brown to blackish petioles and rachises, the rachises not flexuous, bearing hairs and filiform scales, adaxially slightly sulcate and with two narrow wings; the laminae light green, 2-3-pinnate at the base, sometimes the proximal pinnules only lobate, subcoriaceous and glabrous on the laminar tissue; pinnules varying from ovate to lanceolate (Figs. 3–5).



FIGS. 1–5. 1. General view of Serra do Japi, SP. 2. *Cereus peruvianus* (L.) Mill. (Cactaceae). 3, 4. Habit of *Pellaea flavescens* Fée. 5. Abaxial pinnule surface (Photos by J. Prado, Oct 2009).

To fix the application of this epithet, a lectotype for this taxon is chosen here, as follows below:

Pellaea flavescens Fée, Crypt. Vasc. Brés. 1: 44, t. 22, f. 2. 1869. LECTOTYPE (here designated).—BRAZIL: **Rio de Janeiro**, 7 Aug 1869, A. *Glaziou* 2473

(P-00252274; duplicates K-000633009 p.p., K-000633010, MO-1803633 not seen, P-00252273).

Pellaea flavescens Fée var. *macahensis* Brade, Arch. Jard. Bot. Rio de Janeiro 11: 28, t. 8. 1951. TYPE.—BRAZIL, **Rio de Janeiro**, Frade de Macaé, 700 m, 19 Jun 1937, A. C. Brade 15803 (RB).

The variety *macahensis* is merely a bigger plant of *Pellaea flavescens* with the pinnules more widely spaced. In all other features the type of *macahensis* matches with the type of *P. flavescens*.

According to Tryon and Tryon (*Ferns and allied plants, with special reference to tropical America*, Springer-Verlag, New York, pg. 288. 1982), *Pellaea flavescens* belongs to the Section *Ormopteris*. However, in the modern sense of the genus (Gastony and Rollo, Amer. Fern J. 85(4):341–360. 1995[1996]) this taxon is not a *Pellaea*. This taxon also differs from the other members of Section *Ormopteris* by the slightly sulcate axis adaxially. Molecular studies are currently underway to assess its correct position into Brazilian cheilanthoid ferns.

This species is endemic to southeastern Brazil and now it is known from Rio de Janeiro and São Paulo States, from disjunct populations along the Atlantic rain forest.

We are grateful to Dr. João Vasconcellos Neto (UNICAMP) for invitation to participate of the project to collect ferns in the Serra do Japi, São Paulo.—JEFFERSON PRADO and REGINA YOSHIE HIRAI, Instituto de Botânica, Herbário SP, C. P. 3005, 01031-970 São Paulo, SP, Brazil.

***In Situ* Gametophyte Morphology of the Tropical Epiphyte *Oleandra articulata*.**—The genus *Oleandra* is a poorly understood lineage of ferns that is comprised of epiphytic, hemiepiphytic, and terrestrial species (Moran and Riba, Eds, Psilotaceae a Salviniaceae. Flora Mesoamericana. Universidad Nacional Autonoma de Mexico, Mexico City. 1995; Tsutsumi and Kato, Bot. J. Lin. Soc. 151:495–510. 2006). In spite of the fact that the genus has been variably treated as a member of the Polypodiaceae, Dryopteridaceae, and Nephrolepidaceae several early authors recognized the unique nature of the group. Hooker (*Genera Filicum*. H.G. Bohn, London.1840) remarked that *Oleandra* was a “highly beautiful and very natural genus.” Others from Greville (*Trans. Bot. Soc. Edin.* 3:49–50.1848) to Pichi-Sermolli (*Webbia* 20:765–769. 1965) and Tryon (*Rhodora* 99:335–343. 1997; *Rhodora* 102:428–438. 2000) have all commented on the unique morphological nature of this lineage. Indeed, recent molecular analyses have confirmed these observations and *Oleandra* is now placed in the monogeneric Oleandraceae as sister to the clades containing the old world Davalliaceae and cosmopolitan Polypodiaceae (Tsutsumi and Kato, 2006; Schuettpelz and Pryer, Fern Phylogeny. In T. A.

Ranker and C. H. Haufler [eds.], *The Biology and Evolution of Ferns and Lycophytes*, 395–416. Cambridge Univ. Press, Cambridge. 2008). Whereas there has been no detailed monographic revision of this group, it is estimated that 40 (Smith *et al.*, *Taxon* 55:705–731. 2006) to 80 species have been described from the neo- and paleotropics and Polynesia (Moran and Riba, 1995). In Mesoamerica there are four (Tryon, 1997) to five (Moran and Riba, 1995) species recognized. *Oleandra articulata* (Sw.) C. Presl (Figure 1a) is one of the most abundant epiphytes at the La Selva Biological Station in Costa Rica (Watkins Jr. and Cardelús, *Am. Fern J.* 99:162–175. 2010).

The morphology and habit of *Oleandra articulata* are unlike that of most epiphytic ferns: its leaves are paper-thin (Watkins, Rundel, and Cardelus, *Oecologia* 153:225–232. 2007) and produce long and un-branched parallel veins; the species also produces a long-traipsing rhizome that grows over surrounding epiphytes in the canopy habitat. Indeed, it can be difficult to find the origin of many plants as rhizomes can grow 3–5m (J.E. Watkins, Jr. *Pers. Obs.*). The species is often found in great densities in some host trees and represents a significant component of the canopy flora (Watkins Jr. and Cardelús, 2010). Given the unusual nature of this species it is surprising that little is known of its reproductive ecology.

Recently, we had the great fortune to discover a large number of gametophytes and young sporophytes of this species growing in the canopy of a *Hyeronima alchorneoides* (Euphorbiaceae) at La Selva Biological Station in Costa Rica (Fig. 1A–D). To our knowledge, the gametophyte of this species has yet to be described. In addition, none of the descriptions that exist for the genus have used material collected *in situ* (e.g., Atkinson and Stokey, *Phytomorphology* 14:51–70. 1964; Nayar and Kaur, *Bot. Rev.* 37:295–396. 1971), that is the goal of this note.

Approximately 50 gametophytes were collected and observed under compound and stereoscopic microscopes. In general, the gametophytes are cordiform-thalloid with broad wings (Fig. 2I). Most strikingly, the thallus surface and margins were covered with copious unicellular papillate secretory hairs (Fig. 2A–F, J). The occurrence of such hairs on the gametophyte has been reported for the genus in the past; however, here we describe a novel secretory pattern previously undescribed. From many hairs, the secretions form unusual finger-like projections that extend out in several dimensions (Fig. 2A–F). Even more notable is that these secretory projections often connect several hairs together in a manner resembling electrical lines (Fig. 2A & B). Some of these strands can obtain lengths of nearly 1 cm. The exact chemical nature of the secretion is unknown as we did not have adequate tools for such analyses in the field setting. However, one concern was that these strands could be fungal in origin. We were unable to locate septa in any of the strands and the physical appearance is similar to that produced on the hairs without such outgrowths. Several studies have shown such secretions to be lipidic in nature (Nayar and Kaur, 2007, and references therein). Future work on these secretions would benefit from the simple Sudan test for lipid presence. Speculation as to the function of such hairs is premature; however, they are remarkably reminiscent

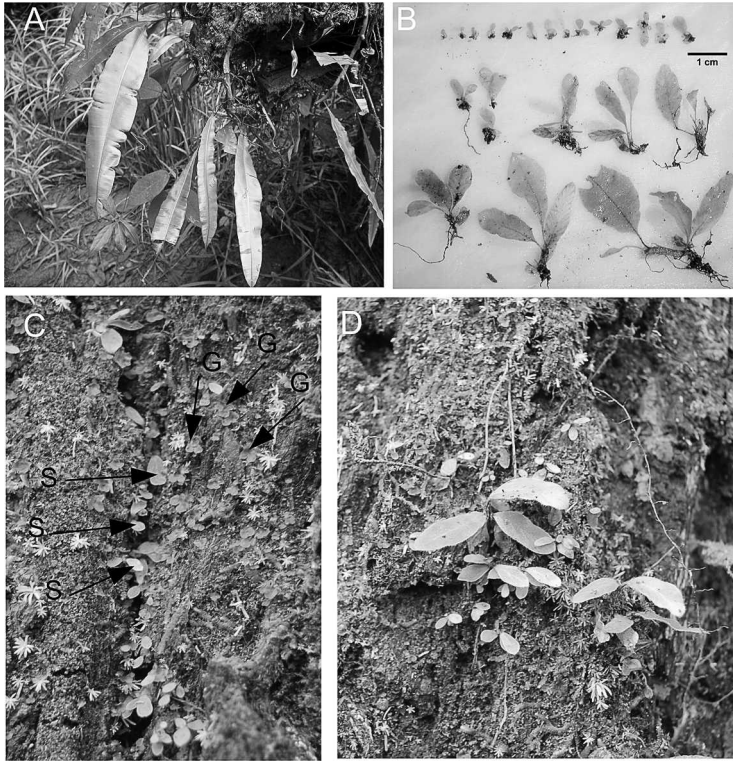


FIG. 1. **A.** Sporophytes of *Oleanandra articulata* growing on a branch *Hyeronima alchorneoides* (Euphorbiaceae) at La Selva Biological Station in Costa Rica. **B.** Developmental series from gametophytes (upper left of image) to young sporophyte with elongated rhizome. **C–D.** Collection of *in situ* gametophytes and young sporophytes growing in the canopy of *Hyeronima alchorneoides* (Euphorbiaceae), G = gametophytes, S = sporophytes.

of the branched hair network on the surface of *Salvinia* sporophytes that render those leaves “unwetttable.” Nevertheless, these hairs serve as an important species specific character allowing for identification of the gametophytes.

Unlike many epiphytic gametophytes, the thallus exhibited no tendency to become elongate or three dimensional (Farrar *et al.*, Gametophyte Ecology. *In* T. A. Ranker and C. Haufler [eds.], *Biology and Evolution of Ferns and Lycophtyes*, 222–251. Cambridge University Press, Cambridge. 2008). This discovery is quite exciting given the phylogenetic placement of the genus. As discussed in detail, Farrar *et al.* (2008) have pointed out that many epiphytes rely on gametophytes that produce elongate/strap-shaped growth forms that can persist in the complex and highly competitive matrix that makes up moss mats in epiphytic habitats. It has been suggested that as ferns radiated into the canopy this morphology could have been useful in spreading within moss mats and potentially in increasing thallus water holding capacity (Watkins *et*

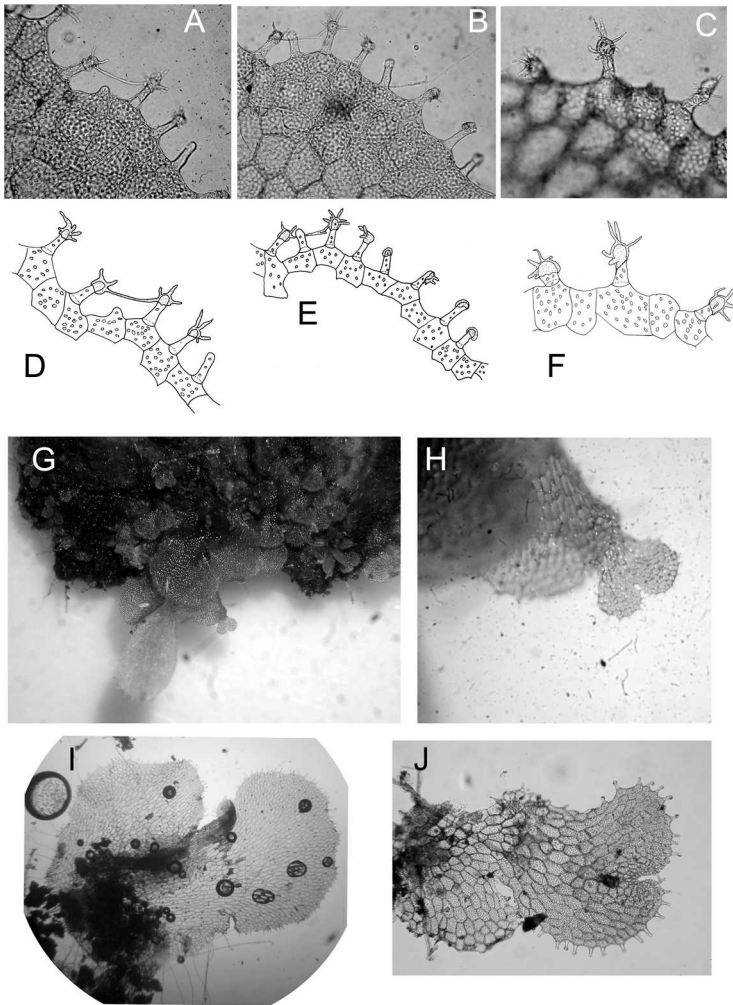


FIG. 2. Details of the gametophytes of *Oleandra articulata* gametophytes collected on a branch of *Hyeronima alchorneoides* (Euphorbiaceae) at La Selva Biological Station in Costa Rica. **A–F.** Hair morphology in this species is unusual via production of secretions that yield finger-like projections. In some cases, these secretions link several hairs together. (**A, B, D, E**, 10 \times ; **C, F** 20 \times). **G–H.** The species produces what appears to be asexual buds from the thallus margins. Buds resemble small versions of mature gametophytes. **I.** Example of mature gametophyte with emerging sporophyte (sp) and surface hairs (sh). **J.** Detail of young gametophyte demonstrating production of marginal hairs (4 \times).

al., *New Phytologist* 176:708–717. 2007). *Oleandra* occurs at the phylogenetic base of a major radiation event into the canopy (Tsutsumi and Kato, 2006; Schuettpelz and Pryer, 2008). Thus, the gametophytes of this species may resemble the archetypal form found in early pre-epiphyte progenitors.

Another aspect of gametophyte morphology that is common in epiphytic taxa is asexual reproduction (Chiou and Farrar, *Am. Fern J.* 87:77–88. 1997).

We did observe this phenomenon in *O. articulata* though it appeared to be less frequent than in other taxa such as the Vittariaceae and Hymenophyllaceae at this site (J.E. Watkins, Jr. Pers. Obs.). While difficult to quantify, we recorded asexual proliferations on approximately 8% of the thalli observed. The formation of these proliferations was not unusual, and resembled cordiform outgrowths of the parent thallus (Fig. 2G & H). Such proliferations are unlikely to act in dispersal, but may result in a long lived perennial gametophyte as has been described in some members of the Polypodiaceae (Chiou and Farrar, 1997).

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