

The genus *Bipinnula* (Orchidaceae: Chloraeinae) in Argentina

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A taxonomic synopsis of *Bipinnula* Comm. ex Juss. (Orchidaceae: Chloraeinae) in Argentina is presented. Three species are recognized: *B. biplumata* Rchb.f., *B. penicillata* (Rchb.f.) Cisternas & Salazar and *B. polysyka* Kraenzl. A key to separate these species is presented and their distribution in Argentina is presented. All species are described in detail and photographs of diagnostic vegetative and floral features, as well as distributional, ecological and nomenclatural comments are included. Lectotypes for the basionyms *Arethusa biplumata* L.f., *Chloraea arechavaletae* Kraenzl. and *B. polysyka* Kraenzl. are designated. All studied species are terrestrial orchids that grow in grasslands of the heavily transformed Pampas biome; two of them are restricted to a few counties. Therefore, an assessment on their conservation status is urgently needed.

Orchidaceae Juss., with about 24 000 species, ranks together with Poaceae and Asteraceae among the more species-rich angiosperm families (WCSP 2014). In Argentina, this family is represented by 239 species in 74 genera (Correa 1996). As currently circumscribed, Chloraeinae Pfitzer comprises about 70 species in the three genera *Bipinnula* Comm. ex Juss., *Chloraea* Lindl. and *Gavilea* Poepp. This orchid subtribe dwells principally in the South-American Andes, from Tierra del Fuego and insular territories of the southern Atlantic to Peru (Correa and Sánchez 2003). However, nine species differ from this general distribution pattern and occur outside the Andes, in southern Brazil and nearby parts of Uruguay and Argentina (Buzatto et al. 2014). In this contribution we follow the circumscription of Chloraeinae adopted by Chemisquy and Morrone (2012) and Cisternas et al. (2012a), which is strongly supported by phylogenetic analyses based on molecular characters. The various earlier interpretations of the delimitation of Chloraeinae have been summarized by Buzatto et al. (2014) and Chemisquy and Morrone (2010).

As currently accepted, *Bipinnula* comprises 10 species (Table 1; updated from Schinini et al. 2008). Five of these species (hereafter, the occidental species) are endemic to Chile and the remaining species (hereafter, the oriental species) dwell outside the Andes, at the eastern edge of the continent (Fig. 109.2 of Correa and Sánchez 2003). All occidental species present multi-florous inflorescences. Conversely, the oriental species are uni-florous (exceptionally, bi-florous). The distributional center of the oriental species is Uruguay, where all species occur (Izaguirre 1973, Schinini

et al. 2008). Some species extend north to southern Brazil, reaching Paraná State (Buzatto et al. 2014), while some species extend south, reaching the southern tip of the Buenos Aires Province (this study).

So far, three species have been recorded in Argentina: *B. biplumata* Rchb.f., *B. penicillata* (Rchb.f.) Cisternas & Salazar [formerly, *Geoblasta penicillata* (Rchb.f.) M. N. Correa] and *B. polysyka* Kraenzl. (Correa 1996). Vegetative features in *B. biplumata* and *B. polysyka* are inconspicuous and, in addition, both species present a short flowering period (Results). As a consequence of this, these species are rarely collected. Consequently, information regarding their distribution and habitat in Argentina is scarce and fragmentary (Results). In addition, some floral and vegetative features are poorly known and have never been illustrated in detail. Therefore, the main aim of the present contribution is to present an updated (in nomenclatural and taxonomic terms) synopsis of the *Bipinnula* species occurring in Argentina together with a complete set of illustrations (photos) of vegetative and floral features and updated data regarding their distribution, phenology and ecology.

Methods

The following Argentinean and foreign herbaria were consulted in 2011–2014: AMES, B, BA, BAA, BAF, BBB, BM, CEN, F, G, GH, GOET, HAS, HB, HEPH, IBGE, ICN, K-L, K, LINN, LP, LPS, M, MBM, MVFA, MVM, NY, PACA, PEL, R, RB, S, SI, SP, UB, UEC, VIC and W.

Table 1. Currently accepted *Bipinnula* species, sorted according to their geographical distribution.

Occidental spp. (Andean)	Oriental spp. (non-Andean)
<i>B. apinnula</i> Gosewijn	<i>B. biplumata</i> (L.f.) Rchb.f.
<i>B. fimbriata</i> (Poepp.) I. M. Johnst.	<i>B. gibertii</i> Rchb.f.
<i>B. plumosa</i> Lindl.	<i>B. montana</i> Arechav.
<i>B. taltalensis</i> I. M. Johnst.	<i>B. penicillata</i> (Rchb.f.) Cisternas & Salazar
<i>B. volkmanii</i> Kraenzl.	<i>B. polysyca</i> Kraenzl.

In addition, high-definition photos of specimens deposited at BR, CORD, HBG, MPU, P, SGO, UPS, Z+ ZT were checked online. As a whole, 72 *Bipinnula* exsiccates from Argentina were consulted.

Data concerning distribution, habitat, phenology and complementary information were obtained from the examined exsiccates as well as from personal observations during fieldwork. Fieldwork in Argentina extended from 2011 to late 2013. Vegetative and floral features were recorded from living specimens with the help of a digital camera. Data from pressed specimens and from their respective protologues and relevant literature (Correa 1968a, 1968b, Izaguirre 1973, Correa and Sánchez 2003, Buzatto et al. 2014) was also taken into account. Most of our own collections consist of inflorescences and a few leaves such that collection impact was minimized and orchid individuals were preserved. A minimum of whole specimens were removed in order to illustrate subterranean vegetative characters or vegetative features absent during anthesis. Vouchers were deposited at SI and BA. Only one voucher is cited per administrative unit (county, department, etc.). To ensure their conservation, the precise collection data are not given here. This information is, however, available for bona fide researchers, on request. Specific orchid morphological terms follow Dressler (1993). More specific Chloraceinae terminology follow Sanguinetti et al. (2012).

***Bipinnula* Comm. ex Jussieu (1789, p. 65)**

Type: *Bipinnula commersonii* Lindl. (1827, p. 52). nom. illeg. – *Bipinnula biplumata* (L.f.) Rchb.f. (1883, p. 62); lectotypified by Kraenzlin (1903, p. 18).

Taxonomic synonyms: *Geoblasta* Barb. Rodr. (1891, p. 132). **Type:** *Geoblasta teixeirana* Barb. Rodr. (1891, p. 133). – *Jouyella* Szlach., in Szlachetko and Margonska (2001, p. 124). **Type:** *Jouyella fimbriata* (Poepp.) Szlach. & Marg. (2001, p. 125). – *Chloraea fimbriata* Poepp. (1833, p. 15).

Description

Terrestrial herbs; geophytes. Roots fascicled, cylindrical and tuberose. Leaves basal, fascicled to rosulate, elliptic to linear-lanceolate, with entire margin and obtuse to acute apex; generally withering or absent during anthesis in the oriental species. Inflorescence a multi-florous spike in the occidental species and uni-florous (exceptionally bi-florous) in the oriental ones. Scape erect and covered by some acute, sterile bracts. Floral bracts acuminate and larger

than the sterile ones, partially or totally covering the ovarium. Flowers showy, sessile, with sepals and lateral petals light-green coloured, with a darker green reticulated pattern and labellum differently shaped, coloured and sized than the other perianth parts. Dorsal sepal concave, triangular to lanceolate, with entire margin and acuminate apex, sometimes crenate. Lateral sepals usually longer and narrower than the dorsal one, pectinate-fimbriate in its apical third (although entire in *B. apinnula* and *B. penicillata*), with simple to trifid laciniae. Petals asymmetric, ovate, with entire to crenate margin. Labellum sessile to unguiculate and articulated at the base of the column, ecalcarate, entire to tri-lobed, fleshy and darker than the other perianth parts, usually with dorsal and/or lateral parts ornamented with warts, pubescence and/or projections. Column erect, slightly curved, flat in its adaxial surface, without noticeable column wings; in occidental species two fossae may occur at the column base. Anther dorsal and terminal, bi-ocular, triangular to circular in shape. Pollinarium made up by two oblong, subdivided, granular, yellow pollinia but devoid of viscidium. Ovarium obconic to clavate. Capsule ellipsoid to pyriform, dehiscent through two longitudinal slits along the dorsal carpelar suture.

Historical treatments

The name *Bipinnula* was coined by Commerson and published by Jussieu (1789, p. 65), in order to set apart species formerly placed in *Arethusa* L. (1753, p. 950) whose lateral sepals have pectinated-ciliated apices, among other less important features. Phylogenetic studies based on molecular characters have clearly pointed out that the species currently placed in *Bipinnula* (Table 1) form a well-supported clade which, in turn, is the sister-group of *Gavilea*. Both clades are inserted within the species-groups of *Chloraea*, rendering the latter genus paraphyletic (Chemisquy and Morrone 2012, Cisternas et al. 2012a).

Kraenzlin (1903, p. 18) first recognized two well-differentiated species assemblages within *Bipinnula* by placing the oriental species in the “Uniflorae” group, and the occidental species in the “Spicatae”, accompanying this segregation with the short phrase “*Species spicatae terrae Chilensis, uniflorae regionis Bonariensis et Brasiliae meridionali sincolae*”. Nieuwenhuizen (1993, p. 13) published the most recently described species in the genus and then proposed dividing it into three sections: *B.* sect. *Bipinnula* (containing the type species *B. biplumata* and all oriental species) (Table 1), *B.* sect. *Trilobatae* Gosewijn and *B.* sect. *Multiflorae* Gosewijn. Species in *B.* sect. *Bipinnula* are non-andean and easily diagnosed on the basis of their uni-florous inflorescences, entire to obscurely tri-lobed, sometimes fleshy lip, covered by papillae or pubescence and fimbriate lateral sepals, often with bifid laciniae. Species in *B.* sect. *Trilobatae* and *Multiflorae* (two and three species, respectively) are exclusively Andean (Chilean). Species within *B.* sect. *Trilobatae* have pauciflorous spikes (2–10 flowers), clearly 3-lobed labellum with erect lateral lobes and mid-lobe covered by warty or papillose projections, apices of lateral sepals without laciniae or shortly pectinate and base of the column with two shallow fossae. Species within *B.* sect. *Multiflorae* are diagnosed by their multi-florous

(> 10 flowers), wide entire labellum which often has fleshy projections, fimbriate lateral sepals with long laciniae and column base with two fossae projecting inside the ovary.

Barbosa Rodrigues (1891, p. 133) proposed the genus *Geoblasta*, when publishing *G. teixeirana*, based on specimens collected in Curitiba, Paraná, Brazil. Much later, Hoehne (1940) correctly synonymized *G. teixerana* with *Chloraea penicillata* Rchb.f. (a name with nomenclatural priority). However, Hoehne (1940) was emphatic in that this taxon could be separated from *Chloraea* owing to a distinct set of morphological features, therefore suggesting the revalidation of *Geoblasta* (Hoehne 1940). Considering all these precedents, Correa (1968a, p. 71) proposed the rehabilitation of *Geoblasta*, with *G. penicillata* (Barb. Rodr.) Hoehne ex M. N. Correa as its only species. However, it is important to highlight that Correa (1968a, p. 71) was the first to notice the morphological resemblances between *Geoblasta* and some uni-florous species of *Bipinnula*. Cisternas et al. (2012b, p. 10), on account phylogenetic analyses based on molecular characters (Chemisquy and Morrone 2012, Cisternas et al. 2012a) and morphological features (Correa 1968a) transferred *G. penicillata* to *Bipinnula*, thus creating the new combination *Bipinnula penicillata* (Rchb.f.) Cisternas & Salazar. By making this, they obtained a consistent delimitation of *Bipinnula* (Cisternas et al. 2012b). Keeping *Geoblasta* as an accepted genus would have rendered *Bipinnula* paraphyletic (Cisternas et al. 2012b).

Szlachetko and Margonska (2001), based on observation of morphological features on herbarium specimens, suggested that *Bipinnula* was not monophyletic and proposed a new genus (*Jouyella* Szlach.) for the species in the *B.* sect. *Multiflorae*. However, ongoing phylogenetic analyses (Cisternas et al. 2012a, 2012b) strongly suggest that *Bipinnula* species of the sections *Bipinnula* and *Trilobatae* are nested among the species of *B.* sect. *Multiflorae* (= *Jouyella*). Based on this evidence, Buzatto et al. (2014) synonymized *Jouyella* with *Bipinnula*.

Notes on extra-Argentinean *Bipinnula*

In the following, some issues regarding extra-Argentinean species are commented in order to clarify the generic circumscription (Table 1). This, however, does not pretend to replace a thorough generic revision. *Bipinnula ctenopetala* Schltr. has recently been considered a dubious name and a probable synonym of *B. montana* Arechav. (Buzatto et al. 2014). Based on morphological (mostly floral) characters, Szlachetko transferred *B. apinnula* to the genus *Chloraea* [as *Chloraea apinnula* (Gosewijn) Szlach; Szlachetko 2001] and later to the genus *Ulantha* [as *U. apinnula* (Gosewijn) Szlach; Szlachetko and Tukallo 2008]. Therefore, *Bipinnula apinnula* was placed as a synonym of *Ulantha apinnula* in the ‘Catálogo de Plantas Vasculares del Cono Sur’ (Schinini et al. 2008). Furthermore, in the ‘World checklist of selected plant families’ (WCSP 2014) *Chloraea apinnula* is the currently accepted name, this being reflected in several major sources of taxonomic information such as Tropicos (2014) and ‘The plant list’ (2013). However, phylogenetic studies have unequivocally shown that this taxon is well-nested within *Bipinnula* (Cisternas et al. 2012a), thus supporting the position that Nieuwenhuizen (1993) assigned

to this species based on morphological standards. Using the same criterion that prompted the nomenclatural transfer of *G. penicillata* to *Bipinnula*, the name *B. apinnula* should be kept as the correct one in order to avoid paraphyly of *Bipinnula*. Therefore, the following treatment is proposed:

***Bipinnula apinnula* Gosewijn, in Nieuwenhuizen (1993, p. 11)**

Based on the same type: *Chloraea apinnula* (Gosewijn) Szlach., in Szlachetko and Margonska (2001, p. 20). – *Ulantha apinnula* (Gosewijn) Szlach., in Szlachetko and Tukallo (2008, p. 115).

Type: Chile. Talca, Cerro Peine, 1800 m a.s.l., 6 Dec 1989, Gosewijn s.n. (holotype: SGO-1352 [image!], isotype SGO-1353 [image!]; paratypes CONC-117825, SGO-110620, K).

Key to the Argentinian species of *Bipinnula*

1. Leaves linear, erect; labellum apex velutinous, entire
..... *B. biplumata*
– Leaves circular-ovate, decumbent or prostrate; labellum apex ornamented with non-velutinous warts or projections, not entire 2
2. Apex of lateral sepals entire; labellum sessile, with long, claviform, dark and yellow projections *B. penicillata*
– Apex of lateral sepals fimbriate; labellum articulated, unguiculate, with short, warty, dark projections
..... *B. polysyka*

***Bipinnula biplumata* (L.f.) Rchb.f. (1883, p. 62) (Fig. 1)**

Basionym: *Arethusa biplumata* L.f., in Linnaeus (1782, p. 405).

Based on the same type: *Bipinnula bonariensis* Spreng. (1826, p. 745), nom. illeg. – *Bipinnula commersonii* Lindl. (1827, p. 52), nom. illeg.

Type: ‘in Fretto Magellanico’, 1767, Commerson s.n. (lectotype designated here: LINN-HS-1394.5 [image!], isolectotypes: MPU-017561 [image!], MPU-017562 [image!], UPS-Thunb-21419 [image!], P-372103 [image!], P-372104 [image!], P-372105 [image!], P-372108 [image!]).

Description

Herb, 15–50 cm high (Fig. 1A). Roots numerous, fascicled, tuberous, up to 8 cm long, with conical apex and annular thickenings at the base. Leaves fascicled, with sheathing base, numerous, erect, linear, 14–20 cm long and 1.0–1.5 cm wide, with apiculate apex, persistent or withering during the anthesis (Fig. 1C). Scape erect, uni-florous (exceptionally bi-florous), with short, invaginant bracts slightly longer than the internodes. Flower violaceous–green, held by an invaginant bract with acute apex (Fig. 1B). Dorsal sepal triangular to lanceolate, 25–30 mm long and 8–11 mm wide, concave, with entire margin and acuminate apex. Lateral sepals linear, recurved



Figure 1. *Bipinnula biplumata*. (A) view of whole plant, inset: detail of bi-florous individual, (B) flower, (C) vegetative features, (D) flower in lateral view, lateral petal and lateral sepal removed, (E) pollinarium, (F) adaxial view of labellum, (G) ovary and column, (H) detail of the apex of lateral sepal, (I) fruit. Scales: (A)–(C) and (I) = 1 cm, (D) = 5 mm, (E)–(H) = 1 mm. (A) and (I) from Sanguinetti 63 (BA), (B) and (D)–(H) from Sanguinetti 119 (SI).

and involute, slightly curved, 30–45 mm long and 3–5 mm wide in basal part, narrowing towards the apex and with pectinate apical part, with cylindric, somewhat curved, sometimes bifid, laciniae that are 2–4 mm long (Fig. 1H). Petals ovate, asymmetric, 20–25 mm long and 14–18 mm wide, with entire margin and acute apex. Labellum shortly unguiculated, articulated at the base of the column, obscurely 3-lobed, 14–17 mm long and 10–14 mm wide; lateral lobes involute, white, with transversal, contrasting and regularly-spaced black warts; the median lobe pulvinate, with dark, muricate surface; apex obtuse, recurved and revolute, with velvety surface coloured in dark olive

green (Fig. 1D–F). Column erect, slightly curved, 17 mm long and 4 mm wide. Stigmatic surface ovate, distal, 4 mm long. Rostellum light green, thick and glandular, transversal (Fig. 1G). Anther incumbent, triangular. Pollinarium 7 mm long and 4 mm wide (Fig. 1E). Ovary obconic, 10 mm long (Fig. 1D). Fruit an obovoid capsule, 20 mm long and 13 mm wide (Fig. 1I).

Phenology

This species flowers from November to December and fructifies from December to January after which they become quiescent. Plants sprout again in February–March.

Distribution

Bipinnula biplumata extends to the north, with discontinuities, to the Brazilian State of Paraná (Buzatto et al. 2014), Brazil and Uruguay. To the south, this species reaches the central hills of the Buenos Aires Province. The few known Argentinean specimens come from the sierras of Olavarría and Azul, with a single known specimen from low elevations in Santa Fé Province (Fig. 4).

Habitat and ecology

Bipinnula biplumata is associated with rocky outcrops in hilly landscapes, just like *B. penicillata*. However, *B. biplumata* grows in deeper soils and may be surrounded by denser and taller vegetation than the latter species. In Buenos Aires it is found either in hilly grasslands dominated by *Piptochaetium* spp. and *Nassella* spp., or in shrubby communities with predominance of *Baccharis tandilensis* Speg. and *Eupatorium buniifolium* Hook. ex Arn. During anthesis, *B. biplumata* may or not present fresh leaves, depending on light conditions and water availability.

Notes

Bipinnula biplumata is the type species of the genus. This species was cited for Argentina more than a hundred years ago (Hicken 1910, p. 77). However, *B. biplumata* is represented by very few herbarium specimens in local and foreign herbaria. For instance, the four most important herbaria from Buenos Aires Province (SI, LP, BAA and BA) had – to date – a single collection made by Spegazzini, in 1901, in Buenos Aires Province.

Spegazzini (1916, p. 140) was the first researcher that gave a precise location for this species in Argentina. Unfortunately, he referred to this species as “*B. biplumosa* Reich.”, thus causing confusion with the Chilean, multi-florous, *B. biplumosa* Lindl. This error was later corrected by Hauman and Vanderveken (1917, p. 309). Correa (1968b, p. 589) refers to the Spegazzini specimens in her ‘Flora de Buenos Aires’, defining the habitat of the species as follows: “vive en campos abiertos” (living in open grasslands). After almost a hundred years, Orfila (2000, p. 5) again collected this species at the sierras of Azul (Buenos Aires Province). His publication (Orfila 2000) was scarcely divulged. However, Orfila (2000) provided photographic illustrations and more precise habitat references. The known distribution of this taxon in Argentina is restricted and noteworthy. So far, *B. biplumata* has been collected at the northeastern extreme of the Tandilia mountain system. This species has never been found in other parts of this mountain system that, as a whole, is very well-explored from the floristic point of view since Spegazzini (1916) to the present (Frangi 1975). More remarkable is the only known specimen (dated 1886–1887) from Santa Fé Province. This pressed voucher comes from the northern limit of the Rolling Pampas phytogeographic district (sensu Soriano 1991), with deep loessic soils and devoid of mountains or rocky outcrops. The natural grasslands of this region have mostly become crop lands (especially soybean plantations) (Baldi and Paruelo 2008). Therefore, is quite unlikely that there are relictual populations of *B. biplumata* in that region.

Additional material examined

Argentina. Buenos Aires: Olavarría, 20 Nov 1901, Spegazzini s.n. (LPS-1989!). Azul, 22 Nov 2013, A. Sanguinetti 119 (SI!). Santa Fé: Iriondo, 1886/1887, Berndt s.n. apud Kurtz 5156 (CORD [image!]).

Iconography

Lamarck (1797, Pl. 729, Fig. 4); Smith (1789, XXII; based on the lectotype); Cogniaux (1893, Pl. 21, Fig. 1; reproduced by Correa 1968b, p. 590, Correa et al. 2009, p. 351, Herter 1939, p. 250); Kraenzlin (1903, Pl. I, Fig. D); Izaguirre (1973, p. 265, 1984, p. 414); Buzatto et al. (2014, p. 5).

Bipinnula penicillata (Rchb.f.) Cisternas & Salazar in Cisternas et al. (2012a, p. 10). (Fig. 2)

Basionym: *Chloraea penicillata* Rchb.f. (1878, p. 51).

Based on the same type: *Geoblasta penicillata* (Rchb.f.) Hoehne ex M. N. Correa (1968a, p. 71).

Type: “Orange Harbour. Tierra del Fuego”, 1838, Wilkes Expedition s.n. (holotype: AMES-106737!).

Taxonomic synonyms: *Geoblasta teixeirana* Barb. Rodr. (1891, p. 133); based on the same type: *Chloraea teixeirana* (Barb. Rodr.) Cogn. (1893, p. 107). **Type:** Brazil. Paraná: Curitiba, Barbosa Rodrigues s.n. (destroyed, fide Sprunger et al. 1996, Buzatto et al. 2011, 2013). Lectotype designated by Buzatto et al. 2014: Barbosa Rodrigues's original illustration deposited at the Biblioteca de Barbosa Rodrigues, Jardim Botânico de Rio de Janeiro, Iconographie des Orchidées du Brésil. Vol. 1, Pl. 34, holotype cited as Pl. 865 [inedit], Barbosa Rodrigues (1891), reproduced by Sprunger et al. (1996. Vol. 1, p. 87).

– *Chloraea arechavaletae* Kraenzl. (1888, p. 316); based on the same type: *Asarca arechavaletae* (Kraenzl.) Kuntze (1898, p. 298) and *Geoblasta arechavaletae* (Kraenzl.) Szlach. & Marg. (2001, p. 125). **Type:** Uruguay. Montevideo: “entre las piedras de Independencia”, Nov 1874, Arechavaleta 2615 (lectotype designated here: HBG-500263 top left specimen [image!], isolectotypes rest of HBG-500263 specimens, MVFA!, probably HBG-500925 and HBG-500926 [not seen]).

– *Chloraea bergii* Hieron. (1879, p. 380); based on the same type: *Geoblasta bergii* (Hieron.) Szlach. & Marg. (2001, p. 125). **Type:** Argentina. Provincia de Buenos Aires: Carmen de Patagones, 1874, Berg s.n. (holotype: CORD-2208 [image!]).

Description

Herb, 10–20 cm high (Fig. 2A). Roots fascicled and dimorphic; 3–5 tuberoso and thick, 4 to 7 cm long and 2.5 cm wide, with annular thickenings at the base; 3–7 slender and cylindrical, up to 10 cm long and 0.3 cm wide, with conic apex and devoid of basal annular thickenings. Leaves scarce, rosulate, prostrate, elliptic to ovate, 3–7 cm long and 1.5–3.0 cm wide, with obtuse to rounded apex, sometimes mucronulate,

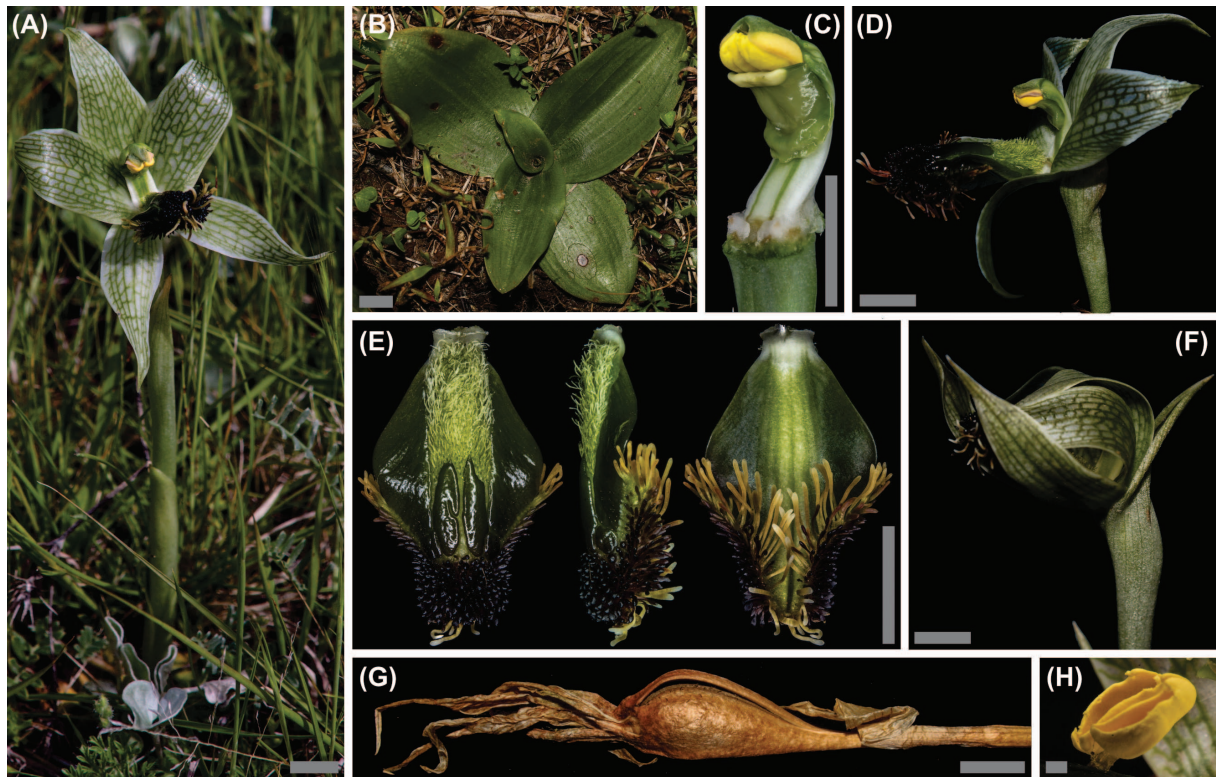


Figure 2. *Bipinnula penicillata*. (A) view of whole plant, (B) vegetative features, (C) column, (D) fully opened flower, (E) from left to right, labellum in adaxial, lateral and abaxial views, respectively, (F) closed flower, (G) fruit, (H) pollinarium glued to a pin by means of rostellar secretion. Scales: (A)–(G) = 1 cm, (H) = 1 mm. (A) from Sanguinetti 103 (SI); (C)–(F) and (H) from Sanguinetti 102 (SI).

normally withering during anthesis (Fig. 2B). Scape erect, uni-florous (exceptionally bi-florous, P-372174), covered by 4–6 apiculate, invaginant bracts up to 4 cm long. Floral bract bigger than the scape bracts and totally covering the ovarium. Flower whitish–green, with darker, fleshy, shiny and insectiform labellum. The remaining perianth parts membranous, semi-transparent and with a contrasting dark–green reticulated pattern (Fig. 2A, 2D). Dorsal sepal lanceolate, 25–50 mm long and 10–15 mm wide, entire, acute to acuminate. Lateral sepals lanceolate, 25–45 mm long and 12 mm wide, entire, acuminate (Fig. 2A, 2F). Petals ovate to lanceolate, slightly asymmetric, 25–45 mm long and 13–15 mm wide, with entire margin, sometimes slightly serrated at the apical part, and acute apex. Labellum sessile, elliptic to slightly rhombic or obtrullate, in its basal and median parts green, fleshy and shiny, 20–22 mm long and 12–14 mm wide. The labellar basal part is covered by villose whitish green pubescence. Two longitudinal, shiny, fleshy and smooth carenae stand out from the rest of the smooth labellar surface. Labellar apex covered by short clavate to capitate brownish projections; margin of basal part entire and margin of distal part revolute and provided with several simple, cylindrical, yellow projections that are ca 3–6 mm long (Fig. 2E). Column incurved, 13 mm long and 4 mm wide. Stigmatic surface roundish, wider than the column, ca 6 mm long. Rostellum glandular, prominent and transverse (Fig. 2C). Anther circular. Pollinarium 5 mm long and 4 mm wide (Fig. 2H). Ovarium obconic, 10 mm long. Fruit an obovoid capsule 20–30 mm long and 14 mm wide (Fig. 2G).

Phenology

Flowers from October to early December. Fructifies from November to December after which they become quiescent. Sprouts again in March.

Distribution

Among the oriental species, this is the one with the widest distribution. The known northern distributional limit is the Brazilian state of Paraná and its southernmost record is that of the holotype of *Chloraea bergii*, which was collected in Carmen de Patagones, Buenos Aires Province, the northern limit of the Patagonia (Buzatto et al. 2014, this study). In Argentina, this species has been collected in the eastern part of the Entre Ríos Province and, in the Buenos Aires Province, from the central Sierras towards the south (Fig. 4). Correa (1968a, p. 71) explains that the Tierra del Fuego citation appearing at the label of the type specimen of *Chloraea penicillata* is an error and that this material may actually have been collected at the estuary of Río Negro (near Carmen de Patagones) where the Wilkes Expedition disembarked. Vervoorst (1967, p. 104) states that *Chloraea bergii* (= *B. penicillata*) is present in the same plant communities as *B. polyzyka* (below), but this may also be an error. Whereas *Chloraea membranacea* Lindl. (Chloraeinae) is indeed quite common in these plant communities, *B. penicillata* has never been collected in these localities.

Habitat and ecology

Usually common in prairies on hills (Spegazzini 1901, p. 47), *B. penicillata* is generally associated with shallow

soils in rocky environments where survival to dry periods is granted by means of its tuberous roots. There, it can be found together with other drought-tolerant plants such as *Wigginsia tephraantha* (Link & Otto) D. M. Porter, *Oxalis articulata* Savigny, *Gomphrena perennis* L., *Vernonia flexuosa* Sims, *Gamochaeta filaginea* (DC.) Cabrera, *Dichondra repens* var. *sericea* (Sw.) Choisy and *Aristida spagazzini* Arechav. (Frangi 1975, pers. obs.). In the Entre Ríos Province this plant has been recorded in grasslands and *Baccharis* spp. maquis as well, in relatively high, well-drained areas (Ciotek pers. comm.). This species is pollinated by males of *Campsomeris bistrimaculata* (Lepelletier) that attempt copulation with the insectiform labellum (Ciotek et al. 2006). During the sunnier and hottest hours, sepals and lateral petals of fresh flowers incurve, totally exposing the column and labellum. Remarkably, the same floral parts have the ability to turn back and hide/protect the column and labellum after late afternoon and/or under adverse weather conditions (Fig. 2F).

Notes

Bipinnula penicillata is the species with the most numerous herbarium records from Argentina. In Buenos Aires Province, most records come from the Partidos (counties) of Tornquist (23%), Tandil (21%), Balcarce (17%) and Saavedra (17%). All these localities are placed within the Tandilia and Ventania mountain systems. When in bloom, this species is quickly and easily found, because it is relatively frequent in some specific localities. When devoid of flowers, however, the plant is remarkably inconspicuous for the non-trained eye. Yet, this species tends to occur in similar microsites at the outcrops, mostly in places with sparse vegetation. These mountain systems are very well explored from the floristic point of view, a fact that may have contributed to the relative richness of records of this species in Argentinian herbaria. Conversely, adjacent regions (such as Coronel Dorrego, General Alvarado, Tres Arroyos) have not been explored so thoroughly and, consequently, few specimens are known from there. The same factors may apply for the Carmen de Patagones region (southern Buenos Aires Province) and for the Entre Ríos Province as well. Because this species is inconspicuous and seems to have a low abundance outside rocky environments, it is possible that its distribution in non-montane environments is actually underrepresented.

This species was originally referred to the genus *Chloraea* (see synonymy). Kraenzlin (1903, p. 44) published an artificial key to set apart four species that are today considered heterotypic synonyms (*C. arechavaletae*, *C. bergii*, *C. penicillata*, *C. teixerana*), based on geographical distribution and labellar characters. Remarkably, each of these different names agrees with different collection localities (Montevideo, Buenos Aires, Tierra del Fuego and Paraná). Hauman (1920, p. 44) was the first to synonymize *Chloraea bergii* under *C. arechavaletae*, recognizing that labellar features are variable, even within the same region. Indeed, Hauman (1920) emphasized the already well-known floristic affinities between Uruguay, Entre Ríos and Buenos Aires argue against Kraenzlin's (1903) geographic arguments. Later, using similar criteria, Hoehne (1940, p. 196) placed *C. arechavaletae*,

C. bergii and *C. teixerana* in the synonymy of *C. penicillata*. The history of the rehabilitation of *Geoblasta* and its further transference to *Bipinnula* is described above (see comments after the generic description).

When Correa (1968a) transferred *Chloraea penicillata* Rchb.f., creating the new combination *Geoblasta penicillata*, the spelling of the basionym was changed to "*pennicillata*" without further justifications. Ever since this spelling was kept in numerous important taxonomic works (Correa 1968b, 1996, Correa and Sánchez 2003, Schinini et al. 2008, Correa et al. 2009, Cisternas et al. 2012b). In one of the latest works where Correa participated (Correa et al. 2009) the etymology of "*pennicillata*" is explained as derived from "*penna*" (feather) and the suffixes "*-cillus*" and "*-atus*" (indicating diminutness and likeness, respectively). This may be a hint that the change was made on purpose believing there was an orthographic error, thus attending the Art. 73/Note 4 of the Edinburgh Code (Lanjouw et al. 1966), which corresponds to Art. 60.3 in the present Code (McNeill et al. 2012). In any case, whether this change was intentional or was lapsus calami is irrelevant and *B. penicillata* should be retained. Reichenbach filius published the name in that manner in its protologue and in subsequent works (Reichenbach 1878–1883: 28, 61, pl. 229), not describing the etymology though; where *penicillata* is a feminine and singular compound adjective formed by the noun "*penicillus*" (brush) and the adjectival suffix "*-atus*" (above). Moreover, this author published a drawing (Reichenbach 1878–1883: pl. 229) based on the holotype where a resemblance to a paintbrush is clearly noticed.

Additional material examined

Argentina. Buenos Aires: Azul, 7 Nov 2012, A. Sanguinetti 62 (BA). Balcarce, 31 Oct 1959, E. Grondona 7056 (BAA). Coronel Dorrego, 4 Nov 2008, F. Biganzoli and C. Larsen 1987 (SI). Coronel Pringles, 28 Nov 1932, Stegmann s.n. (SI-25685). General Alvarado, 3 Dec 1946, A. L. Cabrera 10378 (SI). General Pueyrredon, 11 Nov 1962, O. Boelcke et al. 9340 (BAA). Olavarria, 1909, C. Spagazzini s.n. (LPS-2085). Patagones, 1874, C. Berg s.n. (CORD [image]). Saavedra, 10 Nov 1932, L. R. Parodi 10310 (BAA). Tandil, 3 Nov 1928, A. Burkart 2773 (BAA). Tornquist, Oct 1907, C. M. Hicken s.n. (SI-40232).

References of non-examined material

Argentina. Buenos Aires: Bahía Blanca, 1884, M. G. Mansel s.n. (BM-95739, cited in Correa 1968a). Tres Arroyos, 15 Nov 1987, C. B. Villamil and M. G. Canizzaga 5424 (BBB, C.B. Villamil, pers. comm.). Entre Ríos: Colón, cited in Ciotek et al. (2006, p. 366). San Salvador, R. Báez s.n. in Hauman (1920, p. 99).

Iconography

Reichenbach (1883, p. 229, Fig. 1; based on the holotype of *C. penicillata*); Cogniaux (1893, Table 20, Fig. 2 reproduced in Correa et al. 2009, p. 14); Kraenzlin (1903, Table IV, Fig. A–C); Herter (1939, p. 250); Correa [1968a, p. 72, 1968b, p. 592, reproduced in Cabrera and Zardini (1993, p. 216)]; Izaguirre (1984, p. 411); Buzatto et al. (2014, p. 13).

***Bipinnula polysyka* Kraenzl. (1888, p. 317) (Fig. 3)**

Type: Uruguay. Montevideo: Cerro de Montevideo, ladera oeste, Nov 1875. Arechavaleta 2627 (lectotype designated here: ZT-14858 third specimen from left to right [image!], isolectotypes rest of ZT-14858 specimens, MVFA!).

Description

Herb 12–25 cm high (Fig. 3A). Roots fascicled and dimorphic; 2–5 tuberose-globose 2–4 cm long and 1.0–1.5 cm wide, with annular thickenings at the base; 2–5 cylindrical to 5 cm long and 2 mm wide, with conical apex and devoid of annular thickenings. Leaves rosulate, numerous, decumbent, ovate, 2–5 cm long and 1.0–2.5 cm wide, obtuse to acute at apex, withering during anthesis (Fig. 3B). Scape erect, uni-florous (exceptionally bi-florous), covered by apiculate invaginant bracts about 3–5 cm long. Floral bract slightly bigger than the scape bracts, sometimes covering the ovary, sometimes not. Flower terminal, with black, shiny labellum contrasting with the other, mostly greenish floral parts (Fig. 3C). Dorsal sepal ovate 19–22 mm long and 9–12 mm wide, concave and recurved, with entire margin and acute and crenate to condilomatose apex. Lateral sepals linear, recurved and involute, 23–30 mm long and 5–7 mm wide in the basal part, narrowing towards the apex, with margins of apical part fimbriate, bearing irregular, tortuous, simple to trifid laciniae that are 2–4 mm long (Fig. 3E). Petals ovate, slightly asymmetric 16–20 mm long and 9–12 mm wide, margin entire and apex obtuse, crenate to condilomatose, with marginal protuberances extending towards the medial region. Labellum shortly unguiculated, articulated at the base of the column, 16 mm long and 7 mm wide. Labellar disc arched, somewhat panduriform, at base yellowish–green, umbonate and puberulent, darkening towards the apex and acquiring a foveolate surface and a shiny black colour; lateral margins reduced to a short condilomatose wing bearing clavate, flat to geniculate projections. The labellar apex crowned by a dense fascicle of short black projections (Fig. 3D). Column arched, 8 mm long and 4 mm wide (Fig. 3D, 3F). Stigmatic surface elliptic, ca 4 mm long. Rostellum glandular and transversal (Fig. 3F). Anther ovate. Pollinarium ca 4 mm long and 3 mm wide (Fig. 3G). Ovary obconic, 6–8 mm long. Fruit as an obovoid capsule, 13 mm long and 5 mm wide (Fig. 3H).

Phenology

Flowers from late October to late November and fructifies in November and early December after which it becomes quiescent. Plants sprout again in March.

Distribution

This species has been collected in Uruguay, from the county of Soriano to the margins of the Río de la Plata (Izaguirre 1973, SNAP 2014). In Argentina, this species has a narrow distribution in the Buenos Aires Province, from Ezeiza to Pipinas, and from Río Samborombón to Río de la Plata (Voorst 1967; this study) (Fig. 4).

Habitat and ecology

In Uruguay this species has been found growing in exposed, dry places such as mountain summits as well as in locations

at low altitudes, near water sources (Izaguirre 1973, p. 262). In Argentina, this species has been found in plain grasslands and in low altitudes, in association with *Nassella charruana* (Arechav.) M. E. Barkworth and other grasses such as *Aristida murina* Cav., *Briza brizoides* (Lam.) Kuntze, *Briza subaristata* Lam., *Bothriochloa laguroides* (DC.) Herter, *Danthonia montevidensis* Hack. & Arechav., *Lolium multiflorum* Lam. and *Piptochaetium montevidense* (Spreng.) Parodi (Voorst 1967; pers. obs.). These areas are normally used to graze livestock and the soil is very argilose, hard (when dry) and poorly drained.

Notes

Bipinnula polysyka was the last species in the genus to be found in Argentina (Correa 1959, p. 180). Remarkably, the first Argentinian voucher (LP 54527) was collected in 1944 at a very urban, accessible place, as it was Barrio Elizalde, in the outskirts of La Plata City. This fact highlights the inconspicuousness of this species. Voorst (1967), as part of his phytogeographic studies of the Rio Salado basin, gave the first accurate information regarding the habitat of this orchid. In fact, the association of *B. polysyka* with communities of *N. charruana* pointed out by Voorst (1967) made it possible to find the plants recorded and illustrated here. In the early 1990's, a remnant population was found at the locality of Esteban Echeverría (Alejandro Taborda, pers. comm.; voucher BAA-24936). This population was lost as a consequence of urban development and no further records are known from this locality. Yet, it is possible that *B. polysyka* also grows in *Nassella charruana* grasslands at the Entre Rios Province (e.g. Gualaguaychú), considering the proximity with localities in Uruguay where this species has already been collected (Izaguirre 1973, SNAP 2014).

Kraenzlin comments in the protologue as well as on the lectotype label that *B. polysyka* is very close to *B. giberti*, a species that – to date – has only been collected in Uruguay and southernmost Brazil (Izaguirre 1973, Buzatto et al. 2014). Yet, Kraenzlin emphasizes that these species can be separated on the basis of the crenate apex of the dorsal sepal in *B. polysyka*, vs the non-crenate condition in *B. giberti*. These characters are well illustrated by Cogniaux (1893, Pl. 21) which, in turn, based his illustrations in the specimens cited in the respective protologues. Williams (1938, p. 138) studied pressed specimens from Uruguay and reaffirms that these species can be separated on the basis of the dorsal sepal features, but establishes that some specimens of *B. polysyka* present a non-crenate dorsal sepal. Finally, Williams (1938) suggests that the study of more specimens may ultimately lead to the conclusion that *B. polysyka* is just a variety of *B. giberti*. After having studied living specimens of both species (Buzatto et al. 2014, this study) we can affirm that *B. polysyka* can be separated from *B. giberti* on the basis of its larger perianth parts, its whitish base of petals and sepals and its shiny black labellum (vs the opaque, greenish–grey labellum of *B. giberti*).

Bipinnula polysyka is easily recognizable among Argentinian *Bipinnula* species because of its massive, shiny black labellum and remaining whitish floral parts. The leaves of *B. polysyka* are easily confused with those of *B. penicillata*. However, the leaves of *B. polysyka* can be

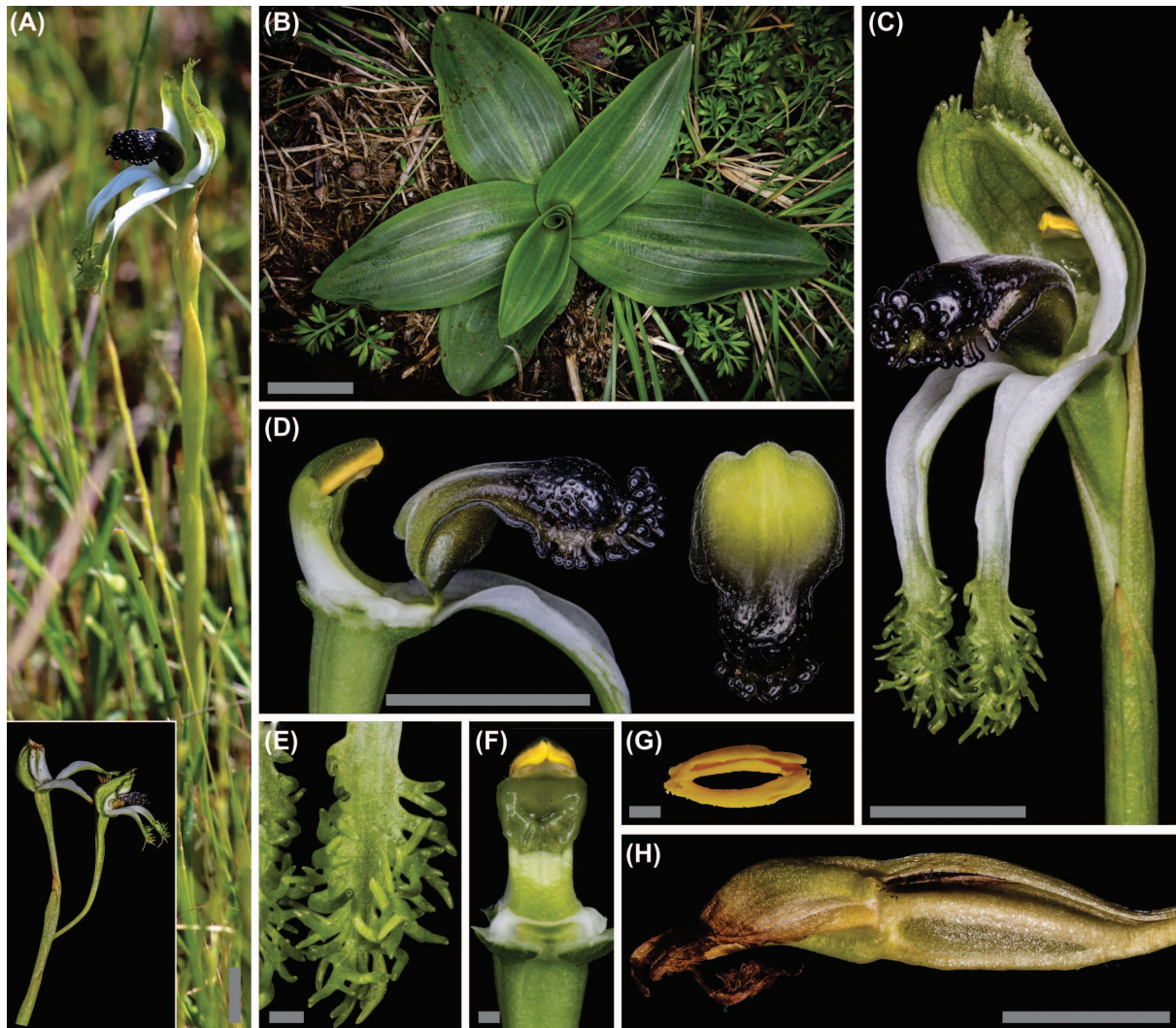


Figure 3. *Bipinnula polysyka*. (A) view of whole plant, inset: detail of bi-florous individual, (B) vegetative features, (C) flower, (D) lateral view of flower with lateral petal and sepals (dorsal and lateral) removed and adaxial view of labellum, (E) detail of the apex of lateral sepal, (F) frontal view of column, (G) pollinarium, (H) fruit. Scales: (A)–(D) and (H) = 1 cm, (E)–(G) = 1 mm. (A) from Sanguinetti 60/64 (SI); (C)–(G) from Sanguinetti 60 (SI).

longer (Description) and slightly less fleshy. Just like *B. penicillata*, this species may lose its leaves when flowering.

Additional material examined

Argentina. Buenos Aires: Ezeiza, 21 Nov 1993, A. Castillo et al. s.n. (BAA-24936). La Plata, 9 Nov 1944, A. L. Cabrera 8424 (LP). Magdalena, 15 Nov 2013, A. Sanguinetti 110 (SI). Punta Indio, 17 Nov 2013, A. Sanguinetti 112 (SI).

Iconography

Cogniaux (1893, Pl. 21, Fig. 3; based on original material, modified in Herter 1939, p. 251, Fig. 1001, and Correa 1968b, p. 590, Fig. 124A–C); Kraenzlin (1903, Pl. I, Fig. E); Correa (1959, p. 181); Izaguirre (1973, p. 273, 1984, p. 414); Szlachetko and Margonska (2001, p. 124, Fig. 1B, 2).

Typifications

Linnaeus filius described *Arethusa biplumata* based on material collected in 1767 on the Rio de la Plata basin by

Philibert Commerson and Jeanne Baret. The main collection of Commerson is held at P where many duplicates were distributed by Jussieu to different European herbaria – particularly P, G, LINN, UPS – (Stafleau and Cowan 1976). According to Art. 9.3 (McNeill et al. 2012) all these Commerson's duplicates of *Arethusa biplumata* are treated as original material. We designate the specimen at LINN-HS as the lectotype because this belonged to the collection which Linnaeus filius mostly worked with (Stafleau and Cowan 1976).

Kraenzlin described both *Bipinnula polysyka* and *Chloraea arechavaletae* (= *B. penicillata*) based on specimens sent by the Uruguayan botanist Arechavaleta (Kraenzlin 1888), without mentioning the herbarium of reposition (Christenson 1994). The primary set of Kraenzlin's types was sold to Berlin (B) in 1907 and most likely lost during Allied air raids in World War II (Stafleau and Cowan 1976, Poppendieck 2001). In agreement with this scenario, two of the authors (CRB and RBS) thoroughly revised the orchid collection at B in late 2012, without finding any of these types. For-

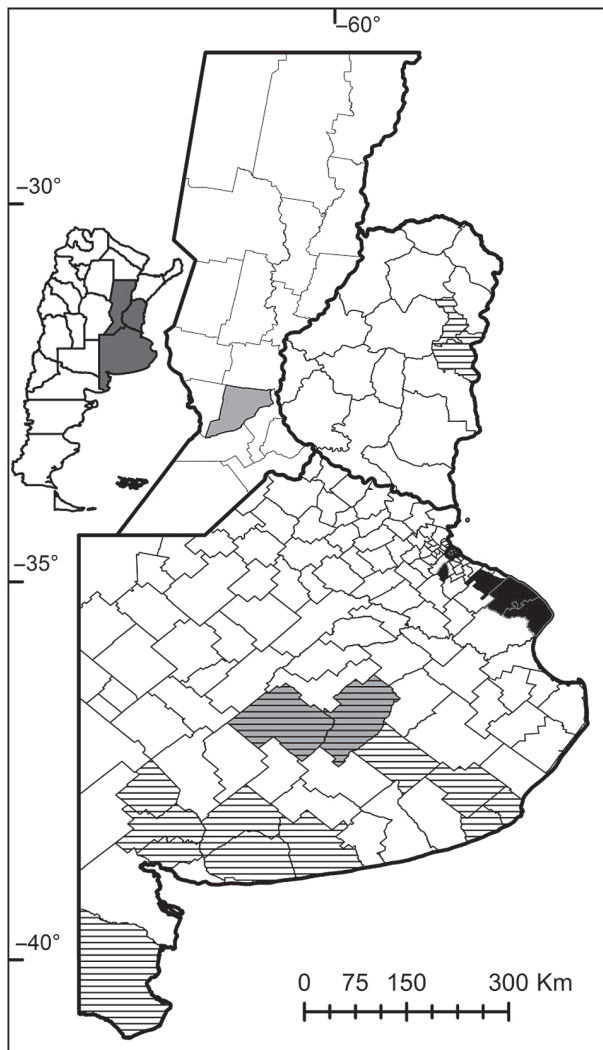


Figure 4. Map of the distribution of *Bipinnula* species recorded from Argentina. Gray: *B. biplumata*. Black: *B. polysyka*. Horizontal lines: *B. penicillata*.

Unfortunately, Kraenzlin kept fragments for his study and this private collection was acquired by HBG in 1935 and thus escaped Allied bombing (Poppendieck 2001, Schultz 2013). Recently, Schultz (2013) published a catalogue of types of Orchidaceae available at HBG with all the critical material from Kraenzlin held there.

The lectotype designated in this work for *Chloraea arechavaleta* (HBG-500263) is a specimen on a sheet with a label from the personal herbarium of Arechavaleta with Kraenzlin's handwriting on it, thus indicating this material was studied by this author. The rest of the specimens on the sheet are isolecotypes. Another set of isolecotypes are held at MVFA, which corresponds to duplicates of the original material kept by Arechavaleta in Uruguay. There is some other material of this species from Kraenzlin's herbarium catalogued at HBG (HBG-500925 and HBG-500926) which was unfortunately on loan and undigitalized, but which may also be isolecotypes.

On the other hand, the lectotype designated here for *Bipinnula polysyka* (ZT-14858) was found by Steudel et al. (2012) while updating the inventory of exsiccates of non-European orchids deposited at Z + ZT. These authors suc-

cessfully located type specimens of Kraenzlin, Schlechter and Mansfeld which were also thought to be lost at B during the WWII. They speculate that these specimens reached Z + ZT due to the active collaboration between these botanists and Hans Shinz, based in Zürich. As for *C. arechavaleta*, parts of the original material of *B. polysyka* corresponding to isolecotypes were kept by Arechavaleta in MVFA.

Conclusions

The vast majority of the extra-Argentinean examined herbarium exsiccates not collected by the present authors belong to *B. penicillata* (87%), followed by *B. polysyka* (8%) and *B. biplumata* (5%). This numerical predominance of *B. penicillata* over the other two species may be – to a great extent – explained by its wider distribution (Fig. 4). Other factors that may have contributed to the rareness of herbarium collections of *B. biplumata* and *B. polysyka* may be their vegetative inconspicuousness and their short flowering period. In Argentina, all these species dwell in Pampean grasslands (*B. penicillata* has also been collected in northeastern Patagonia) and therefore suffer from the pressure of land conversion to agriculture, urban sprawl, mining and extractivism by hobbyists. In the case of *B. biplumata* and *B. polysyka* all these factors are worsened by their restricted distribution. It is urgent to evaluate the conservation status of these species (preferably, under the IUCN criteria) as well as to detect the eventual risks they are exposed to. Additional studies addressing these issues are on the way.

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