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A new species of *Carlephyton* (Araceae) from northern Madagascar with notes on the species of this genus

Abstract

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A new aroid species endemic to northern Madagascar, *Carlephyton darainense*, is described and illustrated. The new species differs from the similar *C. madagascariense* by the male flowers with laxly arranged synandria, each consisting of two stamens with the filaments basally connate but apically free and turned horizontally, and a long cylindric style in the female flowers, whereas in *C. madagascariense* the male flowers have densely arranged synandria, each consisting of two to six completely connate stamens, and a short conical style in female flowers. The distribution and ecology of *C. darainense* are briefly discussed, a comparison with the three other species of the genus and a key to all four species are included.

Résumé

Une nouvelle espèce d'Aracée endémique du nord de Madagascar, *Carlephyton darainense* est décrite et illustrée. Elle diffère principalement de *C. madagascariense* par ses fleurs mâles avec des synandries lâches et composées de deux étamines dont les filets sont soudés à la base mais libres à l'apex et tournés horizontalement et par ses fleurs femelles composées d'un long style cylindrique alors que chez *C. madagascariense*, les synandries sont compactes et composées de deux à six étamines soudées et les fleurs femelles sont composées d'un style conique court. La distribution et l'écologie de la nouvelle espèce sont brièvement analysées. Cette espèce est comparée aux autres espèces du genre et une clé de détermination des espèces est incluse.

Additional key words: aroids, *Arophyteae*, *Carlephyton darainense*, *Carlephyton madagascariense*, taxonomy

Introduction

The tribe *Arophyteae* of family *Araceae* is endemic on Madagascar and consists of three genera: *Carlephyton* Jum. with so far three species, the monotypic *Colletogyne* Buchet and *Arophyton* Jum. with seven species, thus altogether containing eleven species (Bogner 1975; Mayo & al. 1997, 1998). The first known species of this tribe, *Carlephyton madagascariense* Jum., was described by Jumelle (1919) and emended by Buchet (1941). A re-

vision of the tribe, also including new species, was published by Bogner (1972).

The tribe *Arophyteae* is related to the tribe *Peltandreae* (Mayo & al. 1997, 1998), the latter tribe including the monotypic genus *Typhonodorum* Schott, also distributed on Madagascar and moreover on the surrounding islands (Comores, Mauritius, Pemba, Zanzibar), and *Peltandra* Raf. with two extant species in North America. There are fossil records for the *Peltandreae* from North America, Europe and Asia (Bogner 2003).

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Several specimens of *Araceae* were collected during the flora and vegetation study carried out in the Loky-Manambato (Daraina) region through collaboration between the Conservatoire et Jardin botaniques de la Ville de Genève (CJB) and the Universities of Antananarivo and Geneva with the Malagasy NGO Fanamby in charge of conservation planning in the area. This region includes steep environmental gradients and a complex topography, where four of the six Madagascan phytogeographic domains (sensu Humbert 1955) are intermixed, providing a good example of the complex phytogeography of northern Madagascar (Gautier & al. 2006; Nusbaumer & al. 2010).

The main part of the field work took place during three consecutive years from 2003 to 2006 in the rainy season, i.e. between November and April of each year, and representing more than 300 days spent in the field and more than 54 000 records of plant occurrences in the ten main forest blocks of the region. After determinations carried out by the collaborators of the project, and by more than 50 taxonomists working on the flora of Madagascar all over the world, more than 85 new species have been documented among the approximately 5000 fertile plants collected during the study. Several taxa have already been published or are under way (see Nusbaumer 2011; Cribb & al. in press).

The first author of the present paper identified two of the specimens collected as being a species new to science, which is here described. This new species was discovered by the second author and Patrick Ranirison in the Daraina region in northern Madagascar in 2004 and 2006.

Results and Discussion

Carlephyton darainense Bogner & Nusb., sp. nov.

Holotypus: Madagascar, province de Diego-Suarez/Ant-siranana, sous-préfecture de Vohemar, commune rurale de Daraina, forêt d'Antsahabe (13°13'S, 49°33'E), alt. 872 m, forêt dense sempervirente de transition sur gros rochers, herbacée tubereuse, 30 cm de hauteur, spathe vert pâle au bord, plus foncé au centre et translucide, étalé en floraison puis se replie sur les fruits, étamines en croix pourpre à petites anthères jaune aux extrémités, fleurs femelles à la base de l'inflorescence, style et stigmate en trompette jaune, vert pâle, 13.12.2004 [in flower and fruit], L. Nusbaumer & P. Ranirison LN 1347 (G, isotypes: K, MO, P, TAN; field herbarium of Daraina).

Carlephyton darainense a *C. madagascariense* simile, sed florum masculinorum synandriis laxae dispositis, filamentis eorum basi tantum connatis, partibus apicalibus liberis horizontaliter positae et flores feminei stylo longo cylindrico, differt.

Plant tuberous, with 2 to 5 leaves in a rosette and 2–3 inflorescences. *Tuber* depressed-globular, 1.5–2 × 1–



Fig. 2. *Carlephyton darainense* – two leaves, inflorescence in lateral view (on the right) and in front view (on the left). – All from PR 1088; drawing by Cyrille Chatelain; scale bars = 2 cm.

1.8 cm, outside brown, inside white; *roots* arising on the upper side of the tuber, 1–1.2 mm in diameter. *Petiole* (8–)14–22(–30) cm long and 1.5–2 mm in diameter, rounded below and flat on its upper side, green, sheath 6–7 cm long. *Leaf blade* (Fig. 1A, 2) ovate, 9–12 cm long and 6–7(–9.5) cm wide, variable in shape (11 × 9.5, 9 × 6.5, 12 × 6 cm), green, apex acute to cuspidate and ending in a 1–2 mm long mucro, base cordate to sometimes subhastate (with basal lobes slightly turned outward), basal lobes (2–)3–4.5 cm long; *venation* reticulate, *midrib* well developed; *primary lateral veins* 5–6(–7) on each side, ascending upward and forming a collective vein in a distance of 3–4 mm from the margin, with a second finer collective vein very near the margin; *secondary lateral veins* finer and situated between the primaries; *third order veins* much more slender, also with very slender veins between the inner and outer collective veins. *Cataphylls* up to 11 cm long. *Peduncle* 9–14 cm long and 1–1.5 mm in diameter, terete, light green. *Spathe* (Fig. 1B, 2) boat-shaped, opened at anthesis, (3–)3.5–4.5 cm long and 0.8–1.5 cm wide at the middle, slightly translucent (after collector's note), externally and internally green along the longitudinal central part and light green



Fig. 1A–E. *Carlephyton darainense* – A: plant in its natural habitat of the Ambohitsitondroina forest; arrow: inflorescence viewed from back (below right *Selaginella pervillei* Spring); B–C: inflorescence; D: synandria of the male flowers; E: female flowers, note the long and cylindric style, the discoid stigma and the purplish synandrodium surrounding the white ovary. – A–B from PR 1088; C–E: from LN 1347. – Photographs A–B by P. Ranirison, C–E by L. Nusbaumer.

on the margins, ending in a 1–1.5 mm long apex convolute like a mucro. *Spadix* (Fig. 1B–C, 2) 2–3 cm long and 3–4 mm in diameter, where visible whitish in female zone and whitish and purple in male zone; *female zone* 0.5–0.8 cm long and adnate to the base of the spathe, with 5–14 female flowers; *male zone* 1.5–2 cm long, male flowers purple, ending in a very short sterile, $\pm$ purplish apex. *Male flowers* (Fig. 1D) with synandria laxly arranged, 2–2.2 mm long (viewed from above) and c. 0.8 mm tall, consisting of only 2 stamens, these connate only at the base, connate filaments 0.7–0.9 mm in diameter and c. 0.5 mm tall, upper free portion of filaments turned horizontally, 0.8–0.9 mm long, purple, each with 2 light yellow, globular apical thecae 0.3–0.35 mm in diameter, opening by a slit; *pollen grains* (Fig. 5D–E) globular, 30–33 μ m in diameter, inaperturate, exine echinate, spines c. 2 μ m long, surface microverrucate. *Female flowers* (Fig. 1E) 2.5–3 mm tall; ovary surrounded by a synandrodium with an entire, purple and papillose margin, 1–1.1 mm in diameter, synandrodium 0.6–0.8 mm high, laterally whitish to pinkish; *style* long, cylindric, $\pm$ curved and white, exceeding the synandrodium; *stigma* relatively broad, discoid, 0.3–0.4 mm in diameter, papillose, white to light yellowish; *ovary* $\pm$ globular, white, unilocular, with 1 orthotropous ovule on a basal placenta. *Fruits* when young ellipsoid, green apically, with a persistent brown stigma remnant; mature unknown.

Etymology — *Carlephyton darainense* is named after the region of Daraina between the Loky and Manambato rivers, where this species is restricted, after current knowledge.

Distribution — *Carlephyton darainense* is only known from the forests of the Loky-Manambato area in the northern Madagascar province of Antsiranana, Vohemar district. Eleven individuals were observed among more than 54 000 plant occurrences identified during a vegetation study of the region. It was found more than once in the forest subareas of Solianampilana (Sol), Antsahabe (Atb) and Bekaraoka (Bek), and once each in Ampondrabe (Apb) and Ambohositondroina (Atd) (Fig. 3).

Further collection seen — Madagascar, province de Diego-Suarez/Antsiranana, sous-préfecture de Vohemar, commune rurale de Daraina, forêt d'Ambohositondroina (13°08'S, 49°28'E), 240 m, forêt sèche, herbacée 15 cm, 15.1.2006 (en fleur), P. Ranirison & L. Nusbaumer PR 1088 (G, K, MO, P, TAN; field herbarium of Daraina).

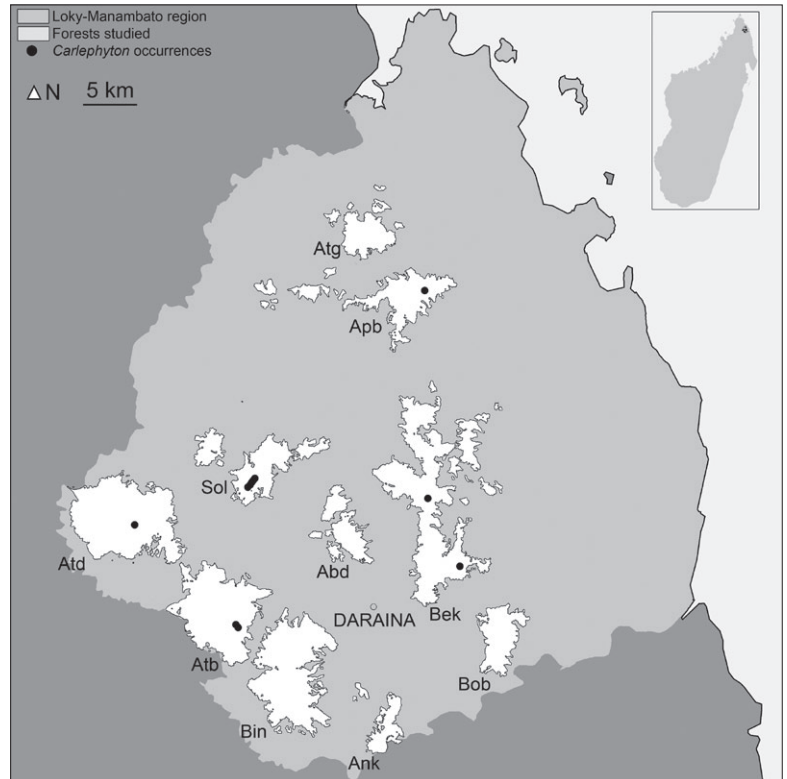


Fig. 3. Distribution of *Carlephyton darainense* in the Daraina region. — Map by L. Nusbaumer; for the full names of the forest subareas see text.

Ecology — *Carlephyton darainense* was mainly observed in dry and ombrophilous forests with canopies reaching 11 to 14 m in dry forests and 16 to 18 m in ombrophilous forests, with emergent trees reaching 16 and 21 m, respectively, sparse arbustive strata 2 to 3.5 m high and sparse suffrutescence strata reaching 0.5 to 1 m high. *C. darainense* occurs on thin substrates, generally among intermediate to large granitic rocky outcrops, from the lowland to the higher elevations of the area, between 200 and 930 m. The most frequent species recorded in the vegetation surveys together with *C. darainense* are, in decreasing abundance, *Mallotus oppositifolius* (Geiseler) Müll. Arg. (in 7 of 11 localities), *Ambilobea madagascariensis* (Capuron) Thulin & al. (5 of 11 localities), *Bussia sakalava* Du Puy & R. Rabev. (in 4 of 11 localities), *Wielandia fadenii* (Radcl.-Sm.) Petra Hoffm. & McPherson (in 4 of 11 localities), *Grossera perrieri* Leandri (in 3 of 11 localities) and *Barleria* sp. (in 3 of 11 localities). *Selaginella pervillei* Spring was also observed in one locality (Fig. 1A).

Characteristics of the genus *Carlephyton*

All four species of *Carlephyton* are tuberous and have a dormant period. *C. darainense* (Fig. 1, 2, 5D–E) differs from the other species of the genus mainly by the following characteristics: (1) laxly arranged synandria of the male flowers, with the filaments of the two stamens only connate basally and the upper free parts are turned



Fig. 4. *Carlephyton diegoense* – A: flowering plant with the tuber (here flowering without leaves); B: inflorescence; C: flowering plant with leaves. – All from Bogner 234; all photographs by J. Bogner.

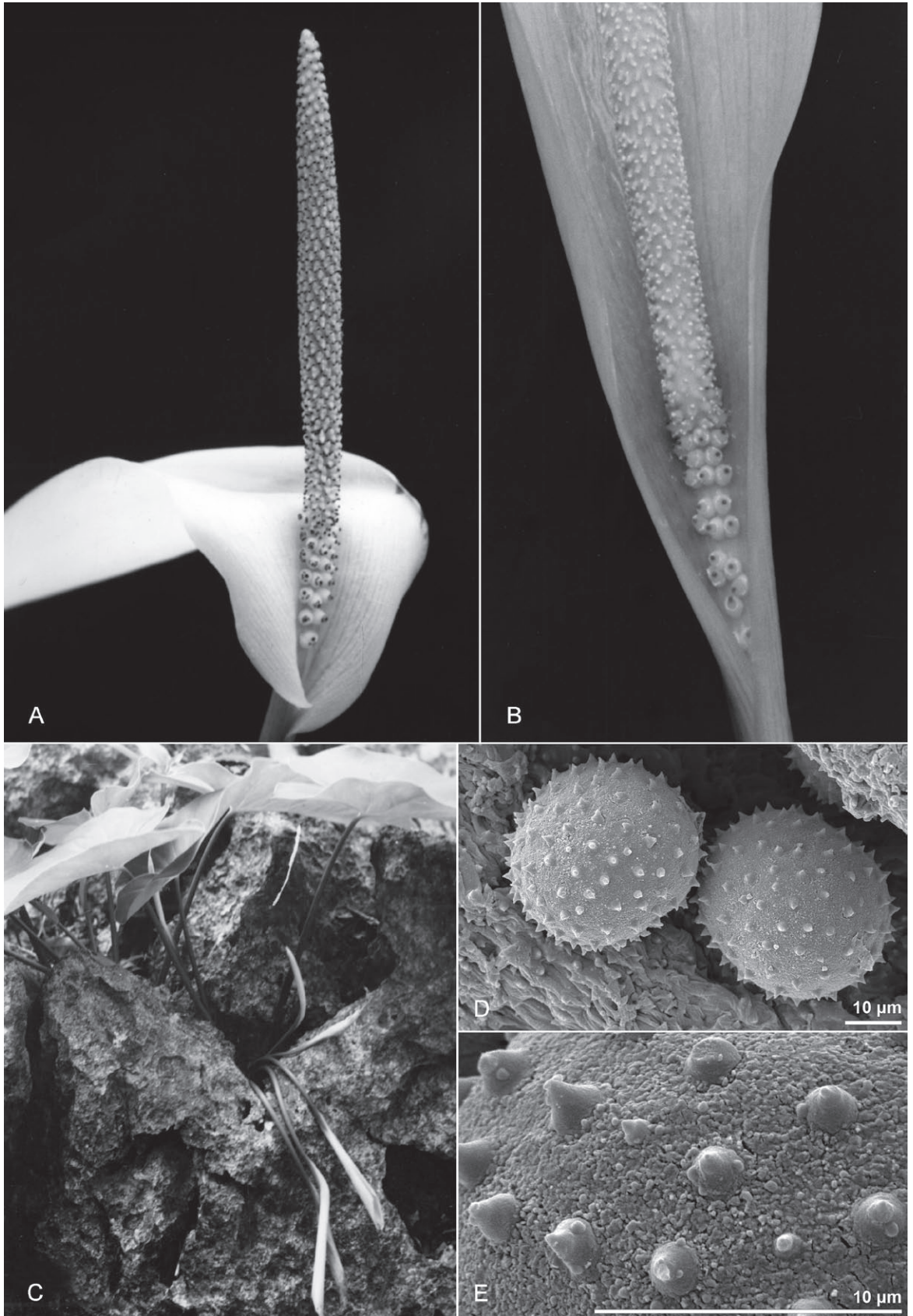


Fig. 5A–C: *Carlephyton glaucophyllum*, A: inflorescence; B: part of the spadix, below female and bisexual flowers, above synandria of the male flowers; C: plant in the natural habitat in the limestone formation of the Massif de l'Ankarana near the Grotte des Fanny. – D–E: *C. darainense*, D: pollen grains, E: microverrucate surface of exine with spines. – A–C from Bogner 167, D–E from P. Ranirison & L. Nusbaumer PR 1088; photographs A–C by J. Bogner, SEM micrographs D–E by M. Hesse.



Fig. 6. *Carlephyton madagascariense* – A: flowering plant; B: leaf blade; C: inflorescence. – All from *Bogner 169*; all photographs by J. Bogner.

horizontally with the two thecae at their tips; (2) synandria light to deep purple, and only the thecae yellow; (3) female flowers with a long, protruding, cylindrical white style and a relatively large, discoid white to light yellowish stigma; (4) synandrodium surrounding the ovary in the female flowers with entire and purple upper margin; (5) leaves $\pm$ ovate/cordate and mid-green.

The other species of *Carlephyton* have also $\pm$ cordate leaves and they are also green in *C. diegoense* Bogner (Fig. 4) and *C. madagascariense* Jum. (Fig. 6), but glaucous in *C. glaucophyllum* Bogner (Fig. 5A–C).

In *Carlephyton madagascariense* the synandria are completely connate and densely arranged (Fig. 6C), consisting of 2–4(–6) stamens with 4–8(–12) thecae. *C. diegoense*, *C. glaucophyllum* and the new species are characterised by synandria with only basally connate but distally free filaments; *C. diegoense* has synandria of 2 to 3 stamens where the free parts are directed more upright, whereas *C. glaucophyllum* has synandria of 2 stamens, reduced to one stamen in the upper part of the spadix, their free parts usually turned horizontally.

What seems to be a perigone (perianth) around the ovary, is actually a synandrodium (a synandrium lacking anthers) and in a few species there are bisexual flowers with thecae on the margins of these “synandrodes”, clearly showing that this structure is not a true perigone or perianth. The margins of the synandrodia around the ovaries are entire in *Carlephyton madagascariense*, *C. glaucophyllum* and in our new species, but lobed in *C. diegoense*. The female flowers of *C. darainense* have a long, cylindric style, whereas a conic and short style in *C. madagascariense* and *C. diegoense* and a somewhat longer style in *C. glaucophyllum*. The stigmas of all four species are $\pm$ discoid. All *Carlephyton* species have a unilocular ovary with a single orthotropous ovule on a basal placenta and the pollen grains (Fig. 5D–E) are inaperturate with a spiny exine (Grayum 1992).

The female and male zones are contiguous in *Carlephyton darainense*, *C. diegoense* and usually in *C. madagascariense* but in the latter sometimes a few bisexual flowers are present between them. The upper part of the female zone on the spadix of *C. glaucophyllum* usually has a larger number of bisexual flowers.

The fruits of the genus *Carlephyton* are one-seeded berries. The seed has a large embryo with a well developed plumule and lacks endosperm; the testa is thin and smooth.

Key to the species of the genus *Carlephyton*

1. Synandria completely connate and densely arranged, thecae on the margin of the synandria; style short and narrowing towards the stigma; leaf blade green. Widespread in N Madagascar *C. madagascariense*
- Synandria connate only basally with upper part free, $\pm$ laxly arranged, style short or long, leaf blades green or glaucous 2

2. Female and male flower zones contiguous; free part of synandria $\pm$ upright; margin of the synandrodium around the ovary lobed, leaf blade green. Montagne des Français *C. diegoense*
- Female and male flowers zones contiguous or with bisexual flowers separating them; free part of the synandria turned horizontally, margin of the synandrodium around the ovary always entire 3
3. Female and male flower zones contiguous; synandria consisting always of 2 stamens; style long and cylindric, leaf blade green. Daraina region *C. darainense*
- Bisexual flowers between the female and male flower zones; synandria consisting of 2 stamens or on the upper part of the spadix reduced to only one; style conic; leaf blade glaucous. Massif de l'Ankarana *C. glaucophyllum*

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