

Inclusion of the endemic New Caledonian genus *Pseudosciadium* in *Delarbrea* (Apiales, Myodocarpaceae)

Porter P. LOWRY II

Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166-0299 (USA)

pete.lowry@mobot.org

and Département Systématique et Évolution (USM 602), Muséum national d'Histoire naturelle,

CP 39, 57 rue Cuvier, F-75231 Paris cedex 05 (France)

lowry@mnhn.fr

Gregory M. PLUNKETT

Virginia Commonwealth University, P.O. Box 482012

Richmond, VA 23284-2012 (USA)

gmplunke@vcu.edu

Virginie RAQUET

Département Systématique et Évolution (USM 602), Muséum national d'Histoire naturelle,

CP 39, 57 rue Cuvier, F-75231 Paris cedex 05 (France)

Raquet.Virginie@caramail.com

Taylor S. SPRENKLE

Virginia Commonwealth University, P.O. Box 482012

Richmond, VA 23284-2012 (USA)

Joël JÉRÉMIE

Départements Milieux et Peuplements aquatiques (USM 403) et Systématique et Évolution (USM 602),

Muséum national d'Histoire naturelle,

CP 39, 57 rue Cuvier, F-75231 Paris cedex 05 (France)

jeremie@mnhn.fr

ABSTRACT

Recent molecular and morphological phylogenetic analyses of the newly-recognized family Myodocarpaceae (Apiales) have shown that the genus *Pseudosciadium* (represented by a single species endemic to New Caledonia) is nested within a well-supported clade that also comprises members of the genus *Delarbrea*, necessitating its inclusion within a more broadly circumscribed *Delarbrea*. An expanded description is provided for *Delarbrea* along with a detailed description of the newly transferred species, *D. balansae*, accompanied by full citation of specimens, an illustration and a preliminary conservation assessment calculated according to IUCN Red List criteria.

KEY WORDS

Apiales,
Myodocarpaceae,
Pseudosciadium,
Delarbrea,
New Caledonia,
conservation.

RÉSUMÉ

Inclusion du genre néocalédonien Pseudosciadium dans Delarbrea (Apiales, Myodocarpaceae).

Des analyses phylogénétiques moléculaires et morphologiques de la famille des Myodocarpaceae (Apiales), reconnue récemment, ont montré que le genre *Pseudosciadium* (représenté par une unique espèce endémique de Nouvelle-Calédonie) est inclus à l'intérieur d'un clade bien soutenu qui renferme aussi des membres du genre *Delarbrea*, ce qui nécessite son placement au sein de ce dernier genre plus largement délimité. Une description élargie est donnée pour *Delarbrea* ainsi qu'une description détaillée de l'espèce *D. balansae*, accompagnée de la liste du matériel étudié, d'une illustration et d'une analyse préliminaire du statut de conservation selon les critères des Listes Rouges de l'UICN.

MOTS CLÉS

Apiales,
Myodocarpaceae,
Pseudosciadium,
Delarbrea,
Nouvelle-Calédonie,
conservation.

The relationships and placement of the monotypic, endemic New Caledonian genus *Pseudosciadium* Baill. have confounded botanists for more than 125 years. BAILLON (1878, 1879) originally described the genus on the basis of a beautifully preserved flowering collection made by BALANSA in 1871 at the mouth of the Dothio River just north of the town of Thio along the eastern coast of New Caledonia. At the time, BAILLON indicated that *Pseudosciadium* was closely related to (and perhaps intermediate between) two other genera then placed in Araliaceae, *Delarbrea* Vieill. and *Myodocarpus* Brongn. & Gris, both of which were regarded as endemic to New Caledonia. BAILLON's initial intention had been to describe this new taxon as a species of *Myodocarpus*, but the presence in some flowers of valvate petals with a narrowed base lacking an evident claw (vs imbricate, distinctly clawed petals in *Myodocarpus*) and of an evident stipe at the base of the ovary (lacking in *Myodocarpus*) prompted him to recognize it as a distinct genus. Subsequent authors (e.g., HARMS 1894-1897; CALESTANI 1905; VIGUIER 1906, 1925; HUTCHINSON 1967), placing substantial emphasis on corolla aestivation for the delimitation of major groups within Araliaceae, separated *Pseudosciadium* from *Delarbrea* and *Myodocarpus* (often regarded as comprising tribe Myodocarpeae), and transferred it to tribe Mackinlayae, defined to include taxa with valvate petals nar-

rowed at the base, where it joined two other genera, *Apiopetalum* Baill. from New Caledonia and *Mackinlaya* F. Muell. from Australia and New Guinea. The affinities of *Pseudosciadium* remained ambiguous, however, until mature fruits became available demonstrating unmistakable homologies with the fruits of *Delarbrea* and *Myodocarpus*, including the presence of distinctive oil vesicles in the endocarp, a feature known nowhere else in the family. This prompted LOWRY (1986a) to suggest that *Delarbrea*, *Myodocarpus* and *Pseudosciadium* form a monophyletic group within Araliaceae, signaling a return to BAILLON's (1878, 1879) original concept.

Over the years the position of these three genera within Apiaceae has likewise presented difficulties. Because *Delarbrea*, *Myodocarpus* and *Pseudosciadium* are all woody, they have traditionally been placed in Araliaceae, despite the presence of several features generally regarded as more typical of Apiaceae, including a bicarpellate gynoeceum, petals with inflexed tips and, in the case of *Myodocarpus*, a schizocarpic fruit. To clarify the affinities of these and several other taxa often regarded as "intermediates" between the two families, PLUNKETT & LOWRY (2001) used a combination of nuclear (ITS) and plastid (*matK*) sequence data to evaluate the phylogenetic relationships of these problematic taxa. Their results confirmed that *Delarbrea*, *Myodocarpus* and *Pseudosciadium* comprise a strongly supported monophyletic

group segregated from the core members of Araliaceae and from other basally branching lineages in Apiales, a conclusion that led DOWELD (2001) to describe Myodocarpaceae as a distinct family. Within this clade, two well supported subclades were identified, one comprising *Delarbraea* + *Pseudosciadium* (which share terete fleshy fruits and noncalyptrate corollas) and another containing species of *Myodocarpus* (characterized by dorsally flattened, winged schizocarpic fruits and buds with calyptrate corollas) a finding supported by data from wood anatomy (OSKOLSKI *et al.* 1997). The study of PLUNKETT & LOWRY (2001) was not, however, able to resolve the relationship between *Delarbraea* and *Pseudosciadium*, although some of their cladograms suggested that *Pseudosciadium* may be nested within the *Delarbraea* subclade. In a subsequent study, SPRENKLE (2002; see also PLUNKETT *et al.* 2004) carried out a more detailed phylogenetic analysis focusing specifically on relationships within Myodocarpaceae using an expanded set of molecular data from three nuclear markers (ITS, ETS and the 5S non-transcribed spacer) and one chloroplast marker (*trnL-trnF*). The results of that study confirmed the earlier finding of two well-differentiated clades within the family, and clearly showed that *Pseudosciadium* falls within the *Delarbraea* clade. In a complementary phylogenetic study using 35 morphological characters, RAQUET (2004) also confirmed the presence of two distinct lineages within Myodocarpaceae corresponding to *Myodocarpus* and *Delarbraea* + *Pseudosciadium*, as well as the placement of *Pseudosciadium* nested among the members of *Delarbraea*. The morphological analysis also revealed the presence of a stipe at the base of the fruits of several species of *Delarbraea*, further supporting a close relationship with *Pseudosciadium*. Taken together, these findings indicate that *Pseudosciadium* should be included within a more broadly circumscribed *Delarbraea*, necessitating the transfer of *P. balansae*.

DELARBREA Vieill.

Bull. Soc. Linn. Normandie 9: 342 (1865).

LECTOTYPE. — *Delarbraea collina* Vieill., designated by Hutchinson, Gen. Fl. Pl. 2: 63 (1967).

Porospermum F. Muell., Fragm. 7: 94 (1870). —

Type: *Porospermum michieanum* F. Muell.

Pseudosciadium Baill., Adansonia 12: 130 (1878), *syn. nov.* — Type: *Pseudosciadium balansae* Baill.

Monocaulous or sparsely branched, glabrous, unarmed treelets or small trees. Stem tips, petioles and base of inflorescence often glaucescent. Leaves imparipinnate, alternate, clustered at ends of branches; leaflets opposite to subopposite (or sometimes alternate, especially the lower ones), entire or remotely dentate, occasionally serrate on the first few leaves borne on new shoots (to deeply serrate or lacerate in juvenile foliage of some species), the base of the lateral leaflets oblique; rachis not articulated; petiole with an expanded, clasping base with membranous or scarious margins. Inflorescence a panicle of umbellules, terminal, erect or pendant, the lateral branches, peduncles and umbellules subtended by membranous, scarious or foliaceous bractlets, the pedicels free or basally united into groups of 2–4, articulated below the ovary. Flowers hermaphrodite and protandrous, often also functionally staminate (in andromonoecious species), actinomorphic. Sepals united below into a short tube, the 5 free lobes obtuse or triangular to rounded or oblate, valvate, sometimes with a scarious margin, not or only slightly expanding in fruit, the margins often somewhat scarious. Petals 5, imbricate or valvate, broadly ovate to obovate or spatulate, keeled within, narrowed to distinctly clawed toward the base. Stamens 5, inflexed before anthesis, the filaments stout, the anthers with 4 thecae, cream-white, dorsifixed. Ovary inferior, 2-carpellate, vestigial in staminate flowers, sometimes prolonged below into a slender stipe, surmounted by a small, rounded to depressed conic nectar disc, styles 2, free, erect and appressed at anthesis, spreading as the \pm clavate stigmas become receptive. Fruit a drupe, ellipsoid-ovoid to ovoid or cylindrical, crowned by the persistent calyx and spreading styles; exocarp fleshy or spongy, the endocarp papery to bony with large oil vesicles; endosperm with shallow longitudinal grooves, not ruminant.

NOTES. — *Delarbraea* was last revised by LOWRY (1986a), who recognized six species, two of which were further divided into two subspecies

each. Here we add a seventh species with the transfer of *Pseudosciadium balansae*. The genus is centered on New Caledonia, where all of the taxa are endemic except two: *D. michieana* (F.Muell.) F. Muell., which is restricted to Queensland, Australia, and *D. paradoxa* Vieill. subsp. *paradoxa*, which extends from New Caledonia south to Norfolk Island (GREEN 1994) and north through Vanuatu and the Solomon Islands to the Moluccas and the Lesser Sunda Islands (LOWRY 1986a,b, 1989; VAN BALGOOY & LOWRY 1993).

For the herbarium material cited below, geographic coordinates indicated in square brackets were assigned *post facto* using 1:50000 scale topographic maps of New Caledonia.

Delarbrea balansae (Baill.) Lowry & Plunkett, **comb. nov.**

Pseudosciadium balansae Baill., Adansonia 12: 130 (1878). — Lectotype (here designated): *Balansa* 3380, New Caledonia, bosquets situés près de l'embouchure du Dorio (= Douthio), [21°35'S, 166°12'E], Dec. 1871, fl. (P!; iso-, MO!, NOU!, P (3 sheets)!).

Trees 2-4 m tall. Leaves 25-40(-50) cm long; leaflets 9-15, membranous, ovate to ovate-elliptic, often narrowly so, 5-12.5 × 2-5 cm, the lowermost somewhat reduced and often broadly ovate, apex narrowly obtuse to acuminate, minutely mucronate, margin entire, to serrate on the first few leaves of new shoots (finely and more deeply serrate in juvenile foliage), base obtuse to truncate; petiolules 7-15 mm long, flattened laterally, with the scarious margins upturned and forming a groove on the top; petiole terete, with an evident thickening *c.* 1 cm from the base, usually glaucescent. Inflorescence light yellow-green throughout, primary axis (55-)65-150 cm long, pendant, glaucescent at the base, secondary axes 10-15, alternate, regularly scattered and borne at 45-90° angle to the primary axis, the lower ones up to 40 cm long, reduced progressively toward the apex, tertiary axes 8-12 per secondary axis (fewer on the upper ones), alternate, 3-9 cm long (the uppermost somewhat smaller), each with a terminal umbellules of 4-10(-12) hermaphrodite flowers and (0-)1-4 small lateral umbellules of 1-8 staminate flowers, involucre minute, of

4-6 triangular, acuminate bractlets each 0.5-1 mm long (smaller in staminate umbellules), pedicels 3-7 mm long (those of the staminate flowers 1.5-4 mm long). Petals yellow-green, *c.* 0.7 mm long (smaller in staminate flowers). Filaments yellow-green, 0.8 mm long, anthers 0.6 mm long (0.4-0.5 mm in staminate flowers). Ovary 0.8-1 mm long at anthesis, styles 0.6-0.8 mm long at anthesis (0.4 mm long and vestigial in staminate flowers), expanding very little in fruit, but becoming somewhat thicker. Fruit ellipsoid-ovoid, olive-green turning deep purple when mature, 10-13 mm long, smooth, shiny, nearly always crushed in pressed specimens. 2n = 24 (LOWRY 1986b; Yi *et al.* 2004). — Fig. 1.

HABITAT. — *Delarbrea balansae* appears to be restricted to ultramafic substrates in southern New Caledonia, and occurs primarily in humid forests, although one collection has been made in maquis vegetation (see LOWRY 1986b). The species has only been recorded at five sites, four at low elevation (0-50 m) along or near the east coast (one on the Baie de Ouinné and three in the region of Thio) and one at about 450 m on Mt. Mou, NW of Nouméa.

CONSERVATION STATUS. — Using the IUCN (2001) threat criteria, *Delarbrea balansae* is assigned a preliminary status of Endangered (EN B1ab2abD) based on the fact that it has an Extent of Occurrence of *c.* 1000 km², an Area of Occupancy <100 km² (known from just five locations), and an estimated total population of less than 250 mature individuals.

MATERIAL EXAMINED. — NEW CALEDONIA: Prov. Sud: *Achille* 845, Port Bouquet, rivière Neuméni, près du pont, forêt galerie, terrain ultramafique, [21°39'S, 166°19'E], 20 m, 21 Mar. 2000, fr. (P); *Lowry* 3548, Mt. Mou, NNW of Païta, *c.* 25 km NW of Nouméa, trail to summit above road to Sanatorium, dense forest along trail, peridotite, 22°04'33"S, 166°20'05"E, 450 m, 25 Oct. 1984, fr. (MO, NOU, P); *Lowry* 3549, same locality and date, juv. (MO, NOU, P); *Lowry* 3635, same locality, 20 Dec. 1984, bud, fl. (MO, NOU, P); *Lowry* 3663, same locality, 6 Jan. 1985, fl. (MO, NOU, P); *Lowry* 3799, same locality, 24. Feb. 1985, y. fr. (MO, NOU, P); *Lowry* 3865, same locality, 28 Nov. 1985, bud, fl. (MO, NOU, P); *Lowry, Plunkett & Oskolski* 4714, same locality, 8 Dec.

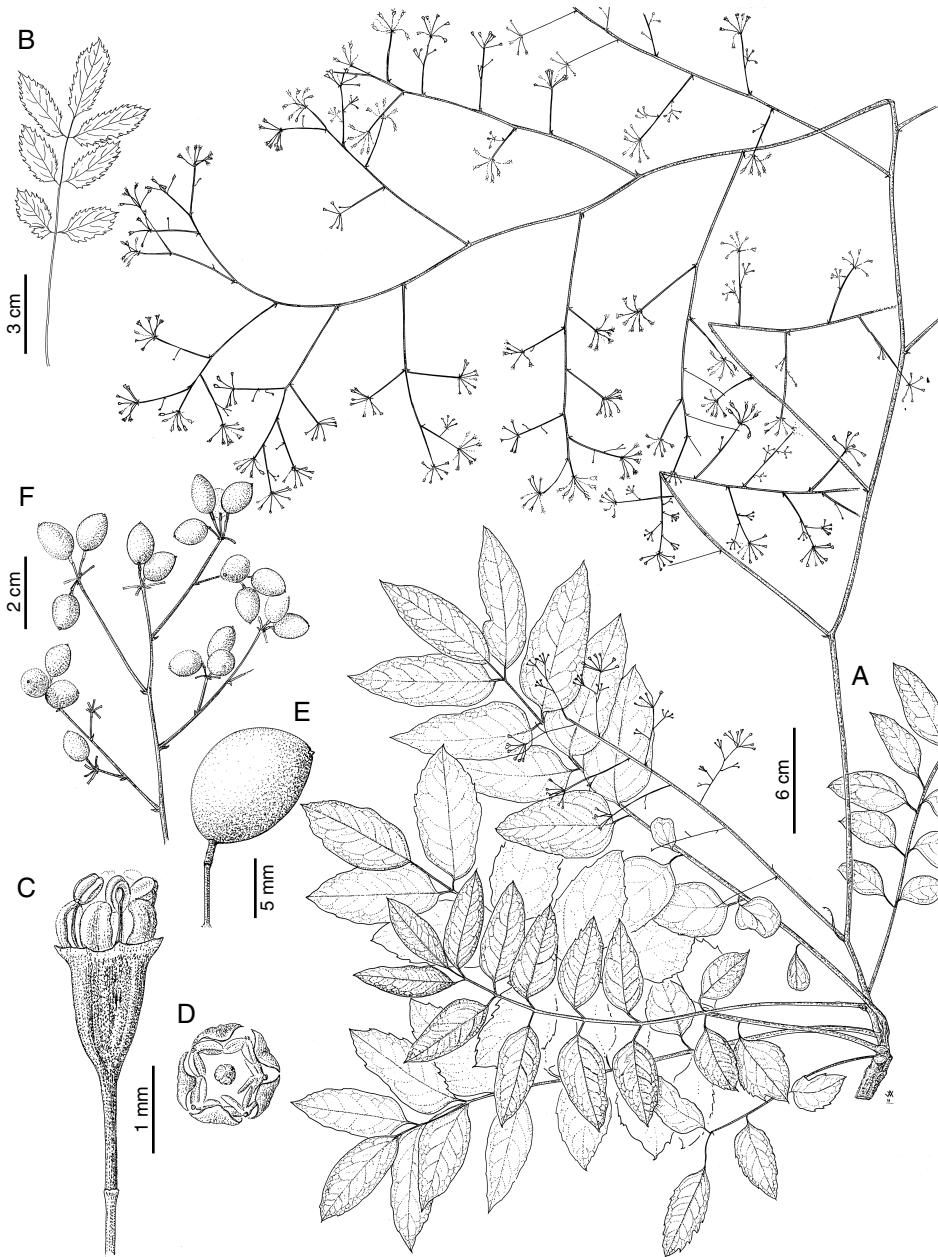


FIG. 1. — *Delarbrea balansae* (Baill.) Lowry & Plunkett: **A**, flowering branch; **B**, juvenile leaf; **C**, flower at anthesis (side view); **D**, flower at anthesis (top view); **E**, fruit; **F**, portion of an infructescence. A, C-D, *Lowry 3663*; B, *Lowry 3549*; E, F, *Lowry 3548*.

1996, bud (MO, NOU, P); *Lowry, Plunkett & Sprengle 5522*, same locality, 6 Mar. 2002, fr. (MO, NOU, P); *MacKee 28732*, Baie de Ouinné, Ué, forêt galerie sur alluvions serpentineuses, [21°59'S, 166°40'E], 2 m, 26 May 1974, fr. (G, MO, P); *MacKee 28733*, same locality and date, juv. (MO, NOU, P); *MacKee 28873*, base ouest du Mt. Mou, ravin boisé en terrain serpentineux, [22°04'S, 166°20'E], 400 m, 4 July 1974, fr. (G, MO, P); *Morat 6363*, piste de la forêt de Saille, bord de rivière, [21°40'S, 166°11'E], Mar. 1979, fr. (NOU, P); *Schmid 2766*, route de Thio à Port-Bouquet (au passage de la rivière Neuméni), maquis sur pente péridotitique au voisinage de la rivière, [21°39'S, 166°19'E], 50 m, 1 Apr. 1969, fr. (P); *Schmid 4927*, Mt. Mou, versant Sanatorium, [21°59'S, 166°40'E], 450 m, 12 Jan. 1974, fl. (NOU, P); *Veillon 2680*, haute vallée de la Nimbrou, fourré hallier à la base de la montagne en bordure de la rivière, [21°40'S, 166°11'E], 50 m, 24 July 1972, fr. (NOU); *Veillon 4720*, creek Neuméni, [21°39'S, 166°19'E], 16 Dec. 1981, fl. (NOU).

Acknowledgements

The authors are grateful to the Direction des Ressources naturelles, Province Sud, for logistical support and permission to conduct field work in New Caledonia, IRD-Nouméa for assistance and access to the NOU herbarium, and John MYERS for the fine illustration. Support for field work was provided by grants from the U.S. National Science Foundation (BSR83-14691 to PPL), the National Geographic Society (5793-96 to GMP), and the John D. and Catherine T. MACARTHUR Foundation (to PPL); laboratory work was supported by grants from the National Science Foundation (DEB-9981641 to GMP and PPL) and the Thomas F. JEFFRESS and Kate MILLER JEFFRESS Memorial Trust (J-506 to GMP).

REFERENCES

BAILLON H. 1878. — Recherches nouvelles sur les Araliées et sur la famille des Ombellifères en général. *Adansonia* 12: 125-178.
 BAILLON H. 1879. — Ombellifères. *Histoire des Plantes* 7: 66-256.
 CALESTANI V. 1905. — Contributo alla sistematica delle Ombrellifere d'Europa. *Webbia* 1: 89-280.
 DOWELD A. 2001. — *Prosyllabus trachaeophytorum, tentamen systematis plantarum vascularium (Trachaeophyta) (An attempted system of the vascular plants)*. Pensoft, Moscow.

GREEN P. 1994. — *Flora of Australia*. Vol. 49. Oceanic Islands 1. Austr. Biol. Resources Study/CSIRO, Canberra.
 HARMS H. 1894-97. — Araliaceae: 1-62, in ENGLER A. & PRANTL K. (eds), *Die Natürlichen Pflanzenfamilien* III, Vol. 8. W. Engelmann, Leipzig.
 HUTCHINSON J. 1967. — Araliaceae: 52-81. *The Genera of Flowering Plants*, Vol. 2. Oxford Univ. Press, London.
 IUCN. 2001. — *IUCN Red List Categories and Criteria Version 3.1*. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland.
 LOWRY II P.P. 1986a. — A systematic study of *Delarbrea* Vieill. (Araliaceae). *Allertonia* 4: 169-201.
 LOWRY II P.P. 1986b. — A systematic study of three genera of Araliaceae endemic to or centered in New Caledonia: *Delarbrea*, *Myodocarpus* and *Pseudosciadium*. Ph.D. thesis, Washington Univ., St. Louis, Missouri.
 LOWRY II P.P. 1989. — A Revision of Araliaceae from Vanuatu. *Bull. Mus. Natl. Hist. Nat., B, Adansonia* 11: 117-155.
 OSKOLSKI A.A., LOWRY II P.P. & RICHTER H.G. 1997. — Systematic wood anatomy of *Myodocarpus*, *Delarbrea* and *Pseudosciadium* (Araliaceae). *Adansonia*, sér. 3, 19: 61-75.
 PLUNKETT G.M. & LOWRY II P.P. 2001. — Relationships among "ancient araliads" and their significance for the systematics of Apiales. *Mol. Phylogen. Evol.* 19: 259-276.
 PLUNKETT G.M., CHANDLER G.T., LOWRY II P.P., PINNEY S. & SPRENGLE T. 2004. — Recent advances in understanding Apiales, with a revised classification. *S. Afr. J. Bot.* 70: 371-381.
 RAQUET V. 2004. — *Phylogénie morphologique des Myodocarpaceae : famille sub-endémique de Nouvelle-Calédonie*. Mémoire DEA, Muséum national d'Histoire naturelle, Paris.
 SPRENGLE T.S. 2002. — *Molecular systematics of tribe Myodocarpeae (Araliaceae s.l.)*. M.S. Thesis, Virginia Commonwealth Univ., Richmond, Virginia.
 VAN BALGOOY M.M.J. & LOWRY II P.P. 1993. — *Delarbrea*: 95-96, in VAN BALGOOY M.M.J. (ed.), *Pacific Plant Areas*, vol. 5. Rijksherbarium/Hortus Botanicus, Leiden University, The Netherlands.
 VIGUIER R. 1906. — Recherches anatomiques sur la classification des Araliacées. *Ann. Sci. Nat. Bot.*, sér. IX, 4: 1-210.
 VIGUIER R. 1925. — Contribution à l'étude de la flore de la Nouvelle-Calédonie: Araliacées. *J. Bot. (Morot)* II, 3: 38-101 (dated 1910-1913, but not distributed until 1925; see M.L. GREEN in *Bull. Misc. Inform.* 1928: 155-156, 1928).
 YI T., LOWRY II P.P., PLUNKETT G.M. & WEN J. (in press). — Chromosomal evolution in Araliaceae s. lat. *Taxon* 53.

Submitted on 28 June 2004;
 accepted on 7 September 2004.