A new native family and new endemic species for the flora of New Caledonia: *Patersonia neocaledonica* sp. nov. (Iridaceae, Patersonioideae), from the Mount Humboldt massif

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Goldblatt P., Manning J. C., Munzinger J. & Lowry II P. P. 2011. — A new native family and new endemic species for the flora of New Caledonia: *Patersonia neocaledonica* sp. nov. (Iridaceae, Patersonioideae), from the Mount Humboldt massif. *Adansonia*, sér. 3, 33 (2): 201-208. DOI: 10.5252/a2011n2a4.

RÉSUMÉ
Patersonia neocaledonica sp. nov., a new endemic species from New Caledonia of this predominantly Australian genus, is the first record of Iridaceae as native from this southwestern Pacific island. Eighteen species of *Patersonia* occur in Australia, and one or several more (depending on taxonomy) occur in Malesia, including New Guinea, where they grow in temperate highland areas. *Patersonia neocaledonica* sp. nov. is distinguished by the fan of relatively broad, sword-shaped to subfalcate leaves with woolly margins, large, brown inflorescence spathes 35 mm long, particularly large white flowers and woolly tomentose ovary, bract margins and septa of the capsules. Known from a single population subjected to fire and impacts from human visitors, *P. neocaledonica* sp. nov. is assigned a preliminary threat assessment of Critically Endangered.

KEY WORDS
Iridaceae,
Patersonioideae,
Patersonia,
conservation status,
maquis,
new species.

RÉSUMÉ

Une nouvelle famille native et une nouvelle espèce endémique pour la flore de Nouvelle-Calédonie : Patersonia neocaledonica *sp. nov. (Iridaceae, Patersonioideae), du massif du mont Humboldt.*

Patersonia neocaledonica sp. nov., une nouvelle espèce endémique de Nouvelle-Calédonie de ce genre principalement australien, est le premier signalement d'Iridaceae indigène pour cette île du Pacifique sud-ouest. Dix-huit espèces de *Patersonia* existent en Australie, et une ou plusieurs autres (selon la taxonomie) se trouvent en Malésie (Nouvelle-Guinée comprise), où elles poussent dans des régions montagneuses tempérées. *Patersonia neocaledonica* sp. nov. se distingue par son éventail de feuilles relativement larges, en forme d'épée à sub-falquées avec de larges marges laineuses, les grandes spathes marrons de son inflorescence qui mesurent 35 mm de long, ses fleurs blanches et particulièrement grandes, et la présence d'un indument tomenteux laineux sur son ovaire, les marges de ses bractées et les cloisons de ses capsules. Connue d'une seule population soumise aux feux et aux impacts de visiteurs humains, nous proposons en évaluation préliminaire de menace pour *P. neocaledonica* sp. nov. le statut En Danger Critique d'Extinction.

MOTS CLÉS
Iridaceae,
Patersonioideae,
Patersonia,
statut de conservation,
maquis,
espèce nouvelle.

INTRODUCTION

Until now no native species of Iridaceae Juss., a nearly worldwide family of over 2050 species, has been reported from the southwestern Pacific island of New Caledonia (Goldblatt 1990; Jaffré *et al.* 2004), known for its exceptionally rich and highly endemic vascular plant flora (Lowry *et al.* 2004). The discovery of a robust species with the distinctive features of the Austro-Malesian genus *Patersonia* R.Br. is therefore surprising. Apparently restricted to Mount Humboldt, second highest peak of the island, and known from just a single locality at 1350 m elevation, this new species has white flowers, unusual for the genus, but otherwise accords with *Patersonia* in the unbranched and scape-like flowering stem terminating in a binate rhipidium of two to several, sessile flowers, an elongate-fusiform ovary, a perianth consisting of a slender tube, three large outer tepals, three reduced inner tepals, and broad style lobes (Brown 1807; Cooke 1986; Goldblatt & Manning 2008). A tomentose ovary, conspicuous in the New Caledonian plant, is also a common feature of the genus; the majority of Australasian species have a villous, pubescent or tomentose ovary (Cooke 1986), as does the New Guinean *P. novoguineensis* Gibbs and a second, evidently undescribed species from Papua New Guinea (unpublished data).

Patersonia, the only genus of Iridaceae subfamily Patersonioideae Goldblatt, is one of five genera of the family known from the Australasian region, an early center of diversification for Iridaceae (Goldblatt *et al.* 2008). *Patersonia* is sister to the Afro-Madagascan lineage that includes its immediate sister genus, *Geosiris* Baill. (Geosiridoideae Goldblatt & Manning, 1 genus: 2 species), as well as *Aristea* Aiton (Aristeoideae Vines, 1: *c.* 55), and the largely sub-Saharan African subfamilies Nivenioideae Schultz ex Goldblatt (3: 15) and Crocoideae Burnett (29: > 1075), the latter also in Eurasia. Molecular clock estimates of the age of *Patersonia* indicate that it diverged from its immediate sister lineage *c.* 55 mya (Goldblatt *et al.* 2008). The presence of a species on New Caledonia is probably the result of more recent long-distance dispersal, given that the flora of this botanically rich island appears to have been largely or entirely derived from elements that arrived following the Eocene re-emergence of the land areas now comprising the largest island, Grande Terre (Paris 1981; Cluzel *et al.* 2001; Pelletier 2006; Schellart *et al.* 2006).

Species of *Patersonia* are evergreen except *P. babianoides* Benth., a deciduous geophyte; the remaining taxa are either undershrubs with perennial, leaf-bearing flowering stems (*P. glabrata* R.Br., *P. pygmaea* Lindl. and *P. spirafolia* Keighery) or more often with an annual, leafless flowering stem that dies after fruit production. New flowering stems are then produced in subsequent years from the rhizomatous base (Cooke 1986). Flowers of *Patersonia* are usually shades of blue to violet, but *P. umbrosa* Endl. subsp. *xanthina* (F.Muell.) Domin. has yellow flowers and the Western Australian *P. inaequalis* R.Br., otherwise quite unlike the new species described below, has white flowers. *Patersonia novoguineensis* likewise has either white or pale blue-mauve flowers (Gibbs 1917), but is otherwise very different from the New Caledonia species.

Patersonia is largely an Australian genus and comprises some 20 to 22 species, 18 of which occur in Australia, all endemic there (Cooke 1986; Keighery 1990). *Patersonia borneensis* Stapf was described from Temburongo, Mount Kinabalu, in Borneo, while *P. lowii* Stapf occurs on Mount Kinabalu (Stapf 1894) at lower elevations and *P. novoguineensis* was described from New Guinea (Gibbs 1917). The genus also occurs in the Philippines and populations there have been referred to *P. lowii* (Merrill 1907; Amoroso *et al.* 2009), the name under which all three Malesian species were united by Geerinck (1977). *Patersonia borneensis*, a tall plant with leaves overtopping the stems, is rather different from the shorter *P. lowii*, as is *P. novoguineensis*, in which the leaves, about as long or slightly shorter than the stems, have densely tomentose margins. Merrill (1940) and later Geerinck (1977) reported the occurrence of the genus in Sumatra, where it was first collected in 1937.

SYSTEMATICS

1. ***Patersonia neocaledonica*** Goldblatt & J.C.Manning, sp. nov. (Fig. 1)

Plantae ad 60 cm altae ex rhizomate prostrata, caule eramoso ± tereti glabri 4-5 mm diam., foliis 6-12 omnibus basalibus ensiformibus ± 20 cm longis ad 12 mm latis, marginibus laminis peracutis albo-tomentosis, inflorescentia rhipidia binata, spathis siccis rubro-brunneis ± 35 mm longis, floribus actinomorphis fugaceis, perianthio albo, tubo 35-40 mm longo, tepalis unequalibus externis patentibus 25-30 × 18-20 mm late elliptico-ovatis, internis suberectis ± 7 × 4 mm, ovato-cucullatis, filamentis ± 5 mm longis in columnam connatis 4 mm longis, antheris linearibus ± 5 mm longis atrofulvis, ovario fusiformi tomentoso, lobis stigmatosis latis patentibus pallide aurantiacis, capsulis ellipsoideo-fusiformibus ± 25 mm longis lignosis, septis lanatis, seminibus semilunatis ± 3 mm longis.

TYPUS. — **New Caledonia**. Mount Humboldt, near the refuge at 1350 m., XII.2007, fl, *Pillon, Méndez, Chapelle & Munzinger 1156* (holo-, P; iso-, MO, NOU 030665).

DESCRIPTION

Plants to 60 cm high from a thick creeping rhizome. Flowering stem ± terete, 4-5 mm diam., unbranched, leafless. Leaves 6-12 in a 2-ranked fan, sword-shaped to subfalcate, suberect, ± 20 cm long, thus reaching to just below middle of flowering stem, to 12 mm wide, tightly sheathing one another below, unifacial above, pale grey-green, abaxial margins of sheath and both margins of blade sharply acute, densely white-woolly. Inflorescence a binate rhipidium, each rhipidial unit with 2-6 flowers; outer spathe pair dark red-brown, ± 35 mm long, with broad, ± membranous, translucent margins, glabrous, inner spathes and bracts smaller, dry, with woolly margins. Flowers radially symmetric, fugaceous, white; perianth tube 35-40 mm long, densely wooly-hairy in proximal half; tepals unequal, outer three spreading horizontally, 25-30 × 18-20 mm, broadly elliptic-ovate, inner three suberect, ± 7 × 4 mm, ovate-cucullate, narrowed below into short claws ± 2 mm long. Stamens symmetrically disposed, filaments ± 5 mm long, connate for ± 4 mm into a thick cylindrical column, spreading above; anthers linear, ± 5 mm long, deep yellow. Ovary fusiform, ± 12 mm long, densely woolly-tomentose along septa and less so along locular angles, style exserted ± 2 mm beyond filament column and sharply deflexed, dividing into 3 broad, connate, fleshy stigmatic lobes, pale orange. Capsules ellipsoid-fusiform, ± 25 mm long, ± woody, woolly along septa and locule margins. Seeds semi-lunate, ± 3 mm long.

Remarks

One of the taller species of the genus, the flowering stems of *Patersonia neocaledonica* sp. nov. reach about 60 cm, standing well above the fan of broad leaves less than half that length. A conspicuous feature of the species is the large white flower, unusual for the genus, most members of which have violet or pale blue flowers, and the relatively well developed inner tepals, which are often vestigial or lacking in the genus. The Western Australian *P. inaequalis* R.Br. also has white flowers, but this low-growing species has leaves reaching up to 32 cm and short stems only 6 cm high, covered with leaf bases (Cooke 1986), and thus is quite unlike *P. neocaledonica* sp. nov.

Patersonia neocaledonica sp. nov. shows no particular similarities with any of the Australian or Malesian members of the genus but is broadly allied with those having leaves clustered at the base, a naked unbranched flowering stem, and brown to black (versus green) spathes. The robust habit is matched in only a few Australian species and among these, *P. neocaledonica* sp. nov. is perhaps most closely allied with those species that have smooth rather than silky or tomentose stems and spathes, a hypothesis that will have to be tested using molecular sequence data. These potential relatives include the Western Australian *P. limbata* Endl. and *P. occidentalis* R.Br. The broad leaves of *P. neocaledonica* sp. nov., less than half as long as the stem, are not only unique among these putative relatives but for the genus as a whole. A survey of material of the Malesian species (including their types) at several herbaria shows that they also broadly resemble *P. occidentalis* but are less robust and have relatively narrow leaves, either about as long as the stems (*P. lowii*, *P. novoguineensis*) or substantially exceeding them (*P. borneensis*). All the Malesian species have brown spathes, variously described as brownish purple (*Chew et al. 996* [K, L] for *P. borneensis*), brownish crimson (*Woods 2627* [GH, K, L, NSW] for plants allied to *P. lowii* from Papua New Guinea) or brownish orange (*DeWilde & DeWilde-Duyfjes 16390* [K, L] for plants also allied to *P. lowii* from North Sumatra). Like *P. neocaledonica* sp. nov., *P. novoguineensis* has a tomentose perianth tube whereas *P. borneensis* and *P. lowii* have a sparsely hairy to almost smooth perianth tube. Available evidence suggests that *P. neocaledonica* sp. nov. is probably more closely related to members of the genus in Australia.

Patersonia neocaledonica sp. nov. is known from a single collection made at 1350 m on the western slope of Mount Humboldt (Fig. 2). It grows in montane maquis, a vegetation type found above 1200 m on ultramafic substrates in the southern part of the main island, Grande Terre (Morat *et al.* 1981). Montane maquis is thought to represent a primary vegetation type, which today covers less than 100 km^2 (Jaffré *et al.* 1998) and has several narrow endemic species (Bradford & Jaffré 2004; Munzinger *et al.* 2008; Pillon *et al.* 2008). *Patersonia neocaledonica* sp. nov. is the fourth species restricted to the summit of Mount Humboldt, along with *Dracophyllum alticola* Däniker (Ericaceae), *Megastylis paradoxa* (Kränzlin) N.Hallé (Orchidaceae) and *Scaevola racemigera* Däniker (Goodeniaceae).

We note that a sample of *Patersonia neocaledonica* sp. nov. has been sequenced for several plastid genes and was included in the matrix of Goldblatt *et al.* (2008). It was retrieved as sister to *P. occidentalis*, the only other member of the genus for which DNA sequences are currently available (F. Forest, pers. comm. 2010).

Conservation status

The only known population of *Patersonia neocaledonica* sp. nov. is located within the Mount Humboldt Nature Reserve (Fig. 2), where collecting is allowed only with formal authorization (Anonymous 2009). Fire can be a significant threat in this type of vegetation, especially as visitors sometimes light fires outside designated areas at the Mount Humboldt shelter. We suspect, however, that *P. neocaledonica* sp. nov. is to some extent fire resistant, as are members of the genus in Australia, whose underground rhizomes are adapted to survive wildfires. The sole population of *P. neocaledonica* sp. nov. is, however, situated only *c*. 30 m from the Mount Humboldt shelter, and may thus be impacted by trampling of the vegetation by visitors. Global warming is a pos-

FIG. 1. — *Patersonia neocaledonica* Goldblatt & J.C. Manning sp. nov.: **A**, habit, including separate young inflorescence and infructescence; **B**, inner tepal; **C**, detail of anthers and stigma. *Pillon et al. 1156* (MO). Scale bar: A, 10 mm; B, 2 mm; C, 2.5 mm. Drawing by John Manning.

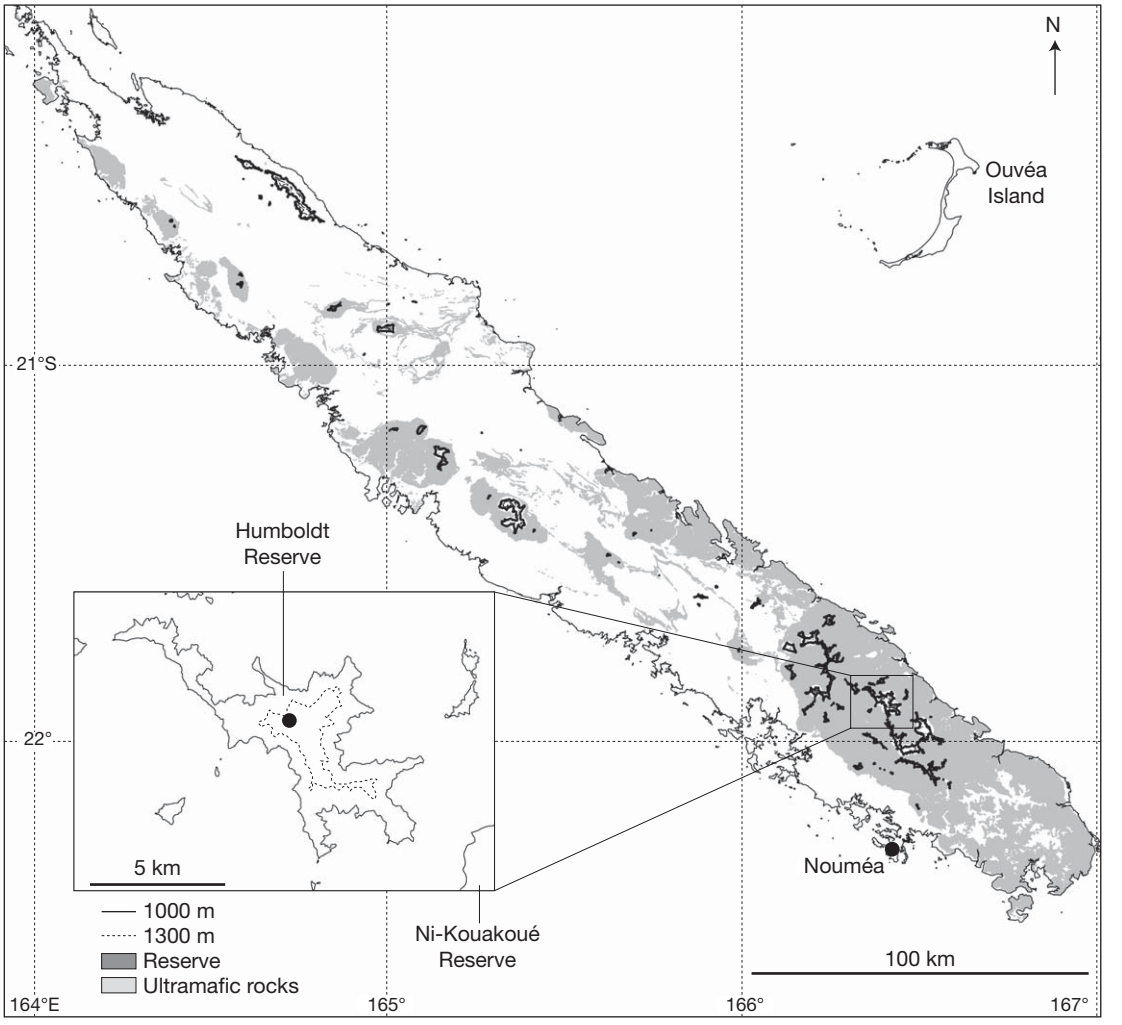

FIG. 2. — Geographic distribution of *Patersonia neocaledonica* Goldblatt & J.C.Manning, sp. nov.

sible future threat for *P. neocaledonica* sp. nov. and the montane maquis on Mount Humboldt as upward shifts in vegetation zones with rising temperature could result in loss of habitat (Thomas *et al.* 2006; Kelly & Goulden 2008). In light of the small population size (estimated at under 75 individuals) and the very restricted area of occupancy, we assign a preliminarily status of Critically Endangered (CR D(1+2)) by application of the IUCN Red List threat criteria (IUCN 2001).

Acknowledgements

We are grateful to Sharon Bodine and Mary Stiffler for cheerfully searching for herbarium material and literature references, respectively. We also thank the curators of the following herbaria for loan of and/or access to their collections (BISH, BRIT, CANB, K, GH, L, MO, NOU, NSW). Thanks to the Environmental Service of South Province (DENV) for permission to collect, to Marcos Méndez and Odile Chapelle for enthusiastic company in the field, and to Stephanus Venter, who noticed this plant for the

first time in 2005. Lastly, we thank Yohan Pillon, Department of Biology, University of Hawai'i, who first brought *Patersonia neocaledonica* sp. nov. to our attention and for his helpful contributions to the manuscript.

REFERENCES

AMOROSO V. B., OSSIOMA L. D., ARLALOJO J. B., ASPIRES R. A., CAPIL D. P., POLIZON J. J. A. & SUMILE E. B. 2009. — Inventory and conservation of endangered, endemic and economically important flora of Hamuguitan Range, southern Philippines. *Blumea* 54: 71-76.

ANONYMOUS 2009. — *Code de l'Environnement de la Province Sud*. Province Sud, 266 p. (accessible at: http://www.province-sud.nc/environnement/guide-de-la-reglementation-environnementale).

BRADFORD J. & JAFFRÉ T. 2004. — Plant species microendemism and conservation of montane maquis in New Caledonia: two new species of *Pancheria* (Cunoniaceae) from Roche Ouaième. *Biodiversity and Conservation* 13: 2253-2273.

BROWN R. 1807. — *Patersonia sericea*, *in* KER GAWLER & SILKY J. (eds), *Patersonia*. *Curtis's Botanical Magazine* 26: t. 1041.

CLUZEL D., AITCHISON J. C. & PICARD C. 2001. — Tectonic accretion and underplating of mafic terranes in the Late Eocene intraoceanic fore-arc of New Caledonia (Southwest Pacific): geodynamic implications. *Tectonophysics* 340: 23-59.

COOKE D. 1986. — Iridaceae, *in Flora of Australia* 46. Australian Government Publishing Service, Canberra: 1-66.

GEERINCK D. J. L. 1977. — Iridaceae, *in* C. STEENIS, (ed.), *Flora Malesiana* I, 8(2). Noordhoff-Kolff, Djakarta: 77-84.

GIBBS L. S. 1917. — *A Contribution to the Phytogeography and Flora of the Arfak Mountains*. Taylor & Francis, London, 226 p.

GOLDBLATT P. 1990. — Iridaceae, *in* MORAT P. & MACKEE H. S. (eds), *Flore de la Nouvelle-Calédonie et Dépendances*. Muséum national d'Histoire naturelle, Paris: 119-124.

GOLDBLATT P. & MANNING J. C. 2008. — *The Iris Family: Natural History and Classification*. Timber Press, Portland, 336 p.

GOLDBLATT P., RODRIGUEZ A., DAVIES T. J., MANNING J. C., POWELL M. P., VAN DER BANK M. & SAVOLAINEN V. 2008. — Iridaceae "Out of Australasia"? Phylogeny, biogeography, and divergence time based on plastid DNA sequences. *Systematic Botany* 33: 495-508.

IUCN 2001. — *IUCN Red List Categories and Criteria*. Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, 33 p.

JAFFRÉ T., MORAT P., VEILLON J.-M., RIGAULT F. & DAGOSTINI G. 2004. — *Composition et caractérisation de la flore indigène de Nouvelle-Calédonie*. Documents scientifiques et techniques, II4, 2nd ed. IRD, Nouméa, 121 p.

JAFFRÉ, T., BOUCHET P. & VEILLON J.-M. 1998. — Threatened plants of New Caledonia: Is the system of protected areas adequate? *Biodiversity and Conservation* 7: 107-135.

KEIGHERY G. J. 1990. — *Patersonia spirafolia* (Iridaceae), a new species from south-western Australia. *Nuytsia* 7: 137-139.

KELLY A. E. & GOULDEN M. L. 2008. — Rapid shifts in plant distribution with recent climate change. *Proceedings of the National Academy of Science of the USA* 105: 11823-11826.

LOWRY II P. P., MUNZINGER J., BOUCHET P., GÉRAUX H., BAUER A., LANGRAND O. & MITTERMEIER R. A. 2004. — New Caledonia, *in* MITTERMEIER R. A., ROBLES GIL P., HOFFMANN M., PILGRIM J., BROOKS T., MITTERMEIER C. G., LAMOREUX J. L. & DA FONSECA G. A. B. (eds), *Hotspots Revisited: Earth' Biologically Richest and Most Threatened Terrestrial Ecoregions*. CEMEX, Mexico: 193-197.

MERRILL E. D. 1907. — The flora of Mt. Halcon, Mindoro. *Philippine Journal of Science*, C. Botany 2: 251-309.

MERRILL E. D. 1940. — Botanical results of the George Vanderbilt Sumatran Expedition 1939. Plants. *Notulae of the National Academy of Natural Sciences of Philadelphia* 47: 1-9.

MORAT, P., JAFFRÉ T., VEILLON J.-M. & MACKEE H. S. 1981. — Végétation : carte et notice (planche 15), *in* *Atlas de la Nouvelle-Calédonie et Dépendances*. ORSTOM, Paris: t. 1-15.

MUNZINGER J., MCPHERSON G. D. & LOWRY II P. P. 2008. — A second species in the endemic New Caledonian genus *Gastrolepis* (Stemonuraceae) and its implications for the conservation status of high altitude maquis vegetation: coherent application of the IUCN Red List criteria is urgently needed in New Caledonia. *Botanical Journal of the Linnean Society* 157: 775-783.

PARIS J.-P. 1981. — *Géologie de la Nouvelle-Calédonie, un essai de synthèse*. B.R.G.M., Orléans, Mémoires du BRGM no 13, 278 p.

PELLETIER B. 2006. — Geology of the New Caledonia region and its implications for the study of the New Caledonian biodiversity, *in* PAYRI C. & RICHER DE FORGES B. (eds), *Compendium of Marine Species from New Caledonia*. Documents scientifiques et techniques IRD, II 7, Nouméa: 17-30.

PILLON Y., HOPKINS H. C. & BRADFORD J. C. 2008. — Two new species of *Cunonia* (Cunoniaceae) from New

Caledonia. *Kew Bulletin* 63: 419-431.
SCHELLART W. P., LISTER G. S. & TOY V. G. 2006. — A Late Cretaceous and Cenozoic reconstruction of the Southwest Pacific region: Tectonics controlled by subduction and slab rollback processes. *Earth-Science Reviews* 76: 191-233.
STAPF O. 1894. — Irideae, *in* STAPF O., On the flora of Mount Kinabalu in North Borneo. *Transactions of the Linnean Society of London*, Botany, series 2, 4: 241-242.
THOMAS C. D., FRANCO A. M. A. & HILL J. K. 2006. — Range retractions and extinction in the face of climate warming. *Trends in Ecology and Evolution* 21: 415-416.

Submitted on 2 September 2010;
accepted on 17 March 2011.