



A revised delimitation of the rattan genus *Calamus* (Arecaceae)

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Abstract

All available phylogenetic evidence indicates that the rattan genus *Calamus*, the largest of all palm (Arecaceae) genera, is non-monophyletic and that the four remaining genera of subtribe Calaminae (Calameae: Calamoideae), *Ceratolobus*, *Daemonorops*, *Pogonotium* and *Retispatha*, are nested within it. This issue has not yet been adequately addressed in palm classifications, with recent authors preferring to wait for further phylogenetic evidence before revising the limits of the genera. Here, an alternative solution is proposed that is both pragmatic and phylogenetically robust. An expanded *Calamus* is recognised into which *Ceratolobus*, *Daemonorops*, *Pogonotium* and *Retispatha* are subsumed. This broad generic concept, which includes ca. 520 species, has practical advantages as it is more clearly defined by morphological and anatomical characters, and resolves potential biases introduced to recent eco-evolutionary research on palms by the non-monophyly of critical genera. Future phylogenetic research may yet provide an alternative means of delimiting these genera, but the broad sense *Calamus* proposed here is a justifiable alternative that can be adopted immediately. Nomenclatural synopses transferring currently accepted species of *Ceratolobus*, *Daemonorops* and *Pogonotium* to *Calamus* are provided, including 70 new combinations and 12 replacement names.

Key words: lianas, nomenclature, Palmae, palms, rattans, South-East Asia, taxonomy

Introduction

The rattan genus *Calamus* Linnaeus (1753: 325) is the largest of all palm genera, including over 400 species distributed in the Asia-Pacific region, with one species in Africa. In the current classification of palms (Dransfield *et al.* 2008), *Calamus* is placed in subtribe Calaminae (Calameae: Calamoideae) along with four other rattan genera, *Ceratolobus* Blume (in Schultes & Schultes 1830: lxxx), *Daemonorops* Blume (in Schultes & Schultes 1830: 1333), *Pogonotium* Dransfield (1980a: 763) and *Retispatha* Dransfield (1980b: 529). Subtribe Calaminae is a strongly supported monophyletic group, whereas all available molecular and morphological phylogenetic evidence indicates that *Calamus* is not, and that the four other genera in the subtribe are variously nested within it (Baker *et al.* 2000a, Baker *et al.* 2000b, c, Baker *et al.* 2009). These studies also indicate that *Daemonorops*, the second largest genus of Calaminae with ca. 110 species, may not be monophyletic. In the current classification of palms, Dransfield *et al.* (2008) highlighted these systematic issues, but followed Baker *et al.* (2000b) in maintaining the prevailing generic limits, while acknowledging that further phylogenetic research would lead to changes in the future.

While published phylogenetic studies lack sufficient sampling, resolution and support within Calaminae to permit the delimitation of multiple, monophyletic genera within the subtribe, an alternative taxonomic solution is available that is both phylogenetically robust and pragmatic for users of palm taxonomy. An expanded genus *Calamus*, within which *Ceratolobus*, *Daemonorops*, *Pogonotium* and *Retispatha* are subsumed, can be recognised and justified by strong support for its monophyly in all published studies (Baker *et al.* 1999, Baker *et al.* 2000a, Baker *et al.* 2000b, c, Baker *et al.* 2009). In fact, steps along this path have already been taken. In preparation for the publication of the current palm classification (Dransfield *et al.* 2005, 2008), Baker and Dransfield (2008) reduced the genus *Calospatha* (1911: 232), which was accepted in the previous classification of palms (Uhl & Dransfield 1987), into *Calamus*. More recently, Henderson and Floda (2015) placed *Retispatha* in synonymy with *Calamus*, based on published research (Baker *et al.* 1999, Baker *et al.* 2000a, Baker *et al.* 2000b, c) and their own unpublished molecular and morphological phylogenetic studies, which they report to be consistent with the works of Baker *et al.* They chose not to make further changes in the Calaminae, preferring to wait until future analyses are completed. However, the phylogenetic topologies published by Baker *et al.* (1999, 2000a, b, c) dictate that if *Retispatha* is reduced into *Calamus*, then the remaining

Synopsis of *Pogonotium* species transferred to *Calamus*

Calamus moorei (J.Dransf.) W.J.Baker, *comb. nov.*

Pogonotium moorei J.Dransf., *Principes* 26: 174 (1982).

Calamus pogonotium W.J.Baker, *nom. nov.*

Pogonotium divaricatum J.Dransf., *Kew Bull.* 34: 766 (1980), non *Calamus divaricatus* Becc., *Ann. Roy. Bot. Gard. (Calcutta)* 11(App.): 10 (1913).

Note:—A replacement name is required as the name *Calamus divaricatus* Becc. has already been used.

Calamus ursinus (Becc.) W.J.Baker, *comb. nov.*

Daemonorops ursina Becc., *Rec. Bot. Surv. India* 2: 222 (1902). *Pogonotium ursinum* (Becc.) J.Dransf., *Kew Bull.* 34: 763 (1980).

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References

- Baker, W.J. & Dransfield, J. (2008) *Calospatha* subsumed in *Calamus* (Arecaceae: Calamoideae). *Kew Bulletin* 63: 161–162.
<http://dx.doi.org/10.1007/s12225-007-9007-5>
- Baker, W.J. & Couvreur, T.L.P. (2013a) Global biogeography and diversification of palms sheds light on the evolution of tropical lineages. I. Historical biogeography. *Journal of Biogeography* 40: 274–285.
<http://dx.doi.org/10.1111/j.1365-2699.2012.02795.x>
- Baker, W.J. & Couvreur, T.L.P. (2013b) Global biogeography and diversification of palms sheds light on the evolution of tropical lineages. II. Diversification history and origin of regional assemblages. *Journal of Biogeography* 40: 286–298.
<http://dx.doi.org/10.1111/j.1365-2699.2012.02794.x>
- Baker, W.J. & Dransfield, J. (2014) New rattans from New Guinea (*Calamus*, Arecaceae). *Phytotaxa* 163: 181–215.
<http://dx.doi.org/10.11646/phytotaxa.163.4.1>
- Baker, W.J., Dransfield, J. & Hedderson, T.A. (2000a) Phylogeny, character evolution, and a new classification of the calamoid palms. *Systematic Botany* 25: 297–322.
<http://dx.doi.org/10.2307/2666644>
- Baker, W.J., Hedderson, T.A. & Dransfield, J. (2000b) Molecular phylogenetics of *Calamus* (Palmae) and related rattan genera based on 5S nrDNA spacer sequence data. *Molecular Phylogenetics and Evolution* 14: 218–231.
<http://dx.doi.org/10.1006/mpev.1999.0697>
- Baker, W.J., Hedderson, T.A. & Dransfield, J. (2000c) Molecular phylogenetics of subfamily Calamoideae (Palmae) based on nrDNA ITS and cpDNA rps16 intron sequence data. *Molecular Phylogenetics and Evolution* 14: 195–217.
<http://dx.doi.org/10.1006/mpev.1999.0696>
- Baker, W.J., Dransfield, J., Harley, M.M. & Bruneau, A. (1999) Morphology and cladistic analysis of subfamily Calamoideae (Palmae). In: Henderson, A. & Borchsenius, F. (Eds.) *Evolution and classification of palms. Memoirs of the New York Botanical Garden* 83, pp. 307–324.
- Baker, W.J., Savolainen, V., Asmussen-Lange, C.B., Chase, M.W., Dransfield, J., Forest, F., Harley, M.M., Uhl, N.W. & Wilkinson, M. (2009) Complete generic-level phylogenetic analyses of palms (Arecaceae) with comparisons of supertree and supermatrix approaches. *Systematic Biology* 58: 240–256.
<http://dx.doi.org/10.1093/sysbio/syp021>
- Beccari, O. (1911) Asiatic palms – Lepidocaryeae. Part 2. The species of *Daemonorops*. *Annals of the Royal Botanic Garden, Calcutta* 12: 1–237.
- Couvreur, T.L.P., Forest, F. & Baker, W.J. (2011) Origin and global diversification patterns of tropical rain forests: inferences from a complete genus-level phylogeny of palms. *BMC Biology* 9: 44.

<http://dx.doi.org/10.1186/1741-7007-9-44>

- Couvreur, T.L.P., Kissling, W.D., Condamine, F.L., Svenning, J.-C., Rowe, N.P. & Baker, W.J. (2014) Global diversification of a tropical plant growth form: environmental correlates and historical contingencies in climbing palms. *Frontiers in Genetics* 5: 452.
<http://dx.doi.org/10.3389/fgene.2014.00452>
- Dransfield, J. (1980a) *Pogonotium* (Palmae: Lepidocaryoideae), a new genus related to *Daemonorops*. *Kew Bulletin* 34: 761–768.
<http://dx.doi.org/10.2307/4119069>
- Dransfield, J. (1980b) *Retispatha*, a new Bornean rattan genus (Palmae: Lepidocaryoideae). *Kew Bulletin* 34: 529–536.
- Dransfield, J., Uhl, N.W., Asmussen, C.B., Baker, W.J., Harley, M.M. & Lewis, C.E. (2005) A new phylogenetic classification of the palm family, Arecaceae. *Kew Bulletin* 60: 559–569.
- Dransfield, J., Uhl, N.W., Asmussen, C.B., Baker, W.J., Harley, M.M. & Lewis, C.E. (2008) *Genera Palmarum - the evolution and classification of palms*. Royal Botanic Gardens, Kew, Richmond, 732 pp.
- Fisher, J.B., Tan, H.T.W. & Toh, L.P.L. (2002) Xylem of rattans: Vessel dimensions in climbing palms. *American Journal of Botany* 89: 196–202.
<http://dx.doi.org/10.3732/ajb.89.2.196>
- Gardiner, L.M. (2012) New combinations in the genus *Vanda* (Orchidaceae). *Phytotaxa* 61: 47–54.
- Gardiner, L.M., Kocyan, A., Motes, M., Roberts, D.L. & Emerson, B.C. (2013) Molecular phylogenetics of *Vanda* and related genera (Orchidaceae). *Botanical Journal of the Linnean Society* 173: 549–572.
<http://dx.doi.org/10.1111/boj.12102>
- Govaerts, R., Dransfield, J., Zona, S., Hodel, D.R. & Henderson, A. (2014) World Checklist of Arecaceae. Facilitated by the Royal Botanic Gardens, Kew. Available from: <http://apps.kew.org/wcsp/>.
- Henderson, A. & Floda, D. (2015) *Retispatha* subsumed in *Calamus* (Arecaceae). *Phytotaxa* 192: 58–60.
<http://dx.doi.org/10.11646/phytotaxa.192.1.8>
- Kissling, W.D., Eiserhardt, W.L., Baker, W.J., Borchsenius, F., Couvreur, T.L.P., Balslev, H. & Svenning, J.C. (2012) Cenozoic imprints on the phylogenetic structure of palm species assemblages worldwide. *Proceedings of the National Academy of Sciences of the United States of America* 109: 7379–7384.
<http://dx.doi.org/10.1073/pnas.1120467109>
- Linnaeus, C. (1753) *Species plantarum*. vol. 1–2. Salvius, Holmiae, 1200 pp.
- Schultes, J.A. & Schultes, J.H. (1830) *Systema Vegetabilium*. Vol.7. J.G. Cottae, Stuttgart, 1816 pp.
- Seubert, E. (1996) Root anatomy of palms. II. Calamoideae. *Feddes Repertorium* 1–2: 43–59.
- Tomlinson, P.B. & Spangler, R. (2002) Developmental features of the discontinuous stem vascular system in the rattan palm *Calamus* (Arecaceae-Calamoideae-Calamineae). *American Journal of Botany* 89: 1128–1141.
<http://dx.doi.org/10.3732/ajb.89.7.1128>
- Tomlinson, P.B., Horn, J.W. & Fisher, J.B. (2011) *The Anatomy of Palms*. Oxford University Press, Oxford, 251 pp.
- Tomlinson, P.B., Fisher, J.B., Spangler, R.E. & Richer, R.A. (2001) Stem vascular architecture in the rattan palm *Calamus* (Arecaceae-Calamoideae-Calamineae). *American Journal of Botany* 88: 797–809.
<http://dx.doi.org/10.2307/2657032>
- Uhl, N.W. & Dransfield, J. (1987) *Genera Palmarum, a classification of palms based on the work of Harold E. Moore Jr.* L. H. Bailey Hortorium and the International Palm Society, Lawrence, Kansas, 610 pp.