



A new species of *Monanthes* from Gabon with a unique inflorescence type for Annonaceae

PAUL H. HOEKSTRA^{1,2}, LARS W. CHATROU² & JAN J. WIERINGA^{1,2}

¹Naturalis Biodiversity Center (Section NHN), Herbarium Vadense, Darwinweg 2, 2333 CR Leiden, The Netherlands

²Biosystematics group, Wageningen University, Droevendaalsesteeg 1, 6708 PB Wageningen, The Netherlands; Email: paul.hoekstra@naturalis.nl

Introduction

Monanthes Baillon (1890: 878) currently consists of 56 species (Rainer & Chatrou 2006) confined to tropical Africa and Madagascar and is the second most species-rich genus of Annonaceae in Africa after *Uvaria* Linnaeus (1753: 536). Both genera belong to the tribe Uvarieae Hooker & Thomson (1855: 91, 92). Circumscription of this tribe has recently been modified to comply with the principle of monophyly, and it now almost exclusively consists of climbing species, all from the Old World tropics (Chatrou *et al.* 2012). Generic circumscription within Uvarieae has been in disarray for considerable time. Delimitation of *Uvaria* and related genera has recently been modified based on phylogenetic relationships (Zhou *et al.* 2010, Zhou *et al.* 2009). *Monanthes* was monophyletic in Wang *et al.* (2012), based on a limited sampling of seven species. Subsequent study with increased sampling (Hoekstra, unpub.) has revealed that the African species of *Friesodielsia* van Steenis (1948: 458) and *Exellia* Boutique (1951b: 117) are nested in *Monanthes*. Whatever the solution and taxonomic consequences, the name *Monanthes* with the type *Monanthes congoensis* Baillon (1890: 879) will be retained as it is the oldest valid generic name.

Along with phylogenetic analysis, we are conducting a taxonomic revision. The last revision of *Monanthes* and allied genera was published over a century ago by Engler & Diels (1901). Since then, only contributions to local floras have been published (e.g. Boutique 1951a, Le Thomas 1969, Robson 1960, Verdcourt 1971a). While studying the material of *Monanthes*, we encountered a remarkable new species, which differs from all other species of Annonaceae in its large and lax panicle-like inflorescence. Panicle-like inflorescences are rare in Annonaceae, and those that have been recorded are either congested, as in e.g. *Unonopsis* and *Gutteria* (Erkens *et al.* 2008, Maas *et al.* 2007), or with only a few flowers, as in *Monanthes le-testui* Pellegrin (1950: 75). This new species is probably closely related to *M. congoensis* since they share several characters. Verdcourt (1971b) divided the genus in three subgenera and five sections. In his classification, this new species would join *M. congoensis* in the typical section *Monanthes*, which is easily distinguished by having flowers with the four to six petals in a single whorl and less than 17 stamens. Because it is so similar to *M. congoensis*, our new species will almost certainly be classified within *Monanthes*, and we decided to publish it before a new generic classification has been completed.

Monanthes paniculata P.H.Hoekstra, spec. nov. (Fig. 1)

Type:—GABON. Ogooué-Ivindo: north of Koumameyong along SHM lumber roads, 0° 25' N, 11° 55' E, 31 January 1993, McPherson 16123 (holotype: WAG!, isotypes: MO!, P!).

Additional specimen examined: GABON, Estuaire: ca 20 km N of Libreville, 29 January 1987, Reitsma 2870 (NY!, WAG!).

Monanthes paniculata resembles *Monanthes congoensis*, but differs in the panicle-like inflorescence, instead of a raceme.

Liana to 20 m long; old branches dark, blackish, glabrescent with lenticels, young branches densely pubescent with appressed, ferruginous-brown hairs 0.5 mm long. Petioles 4–8 mm long, 1.0–1.5 mm wide, grooved adaxially, densely

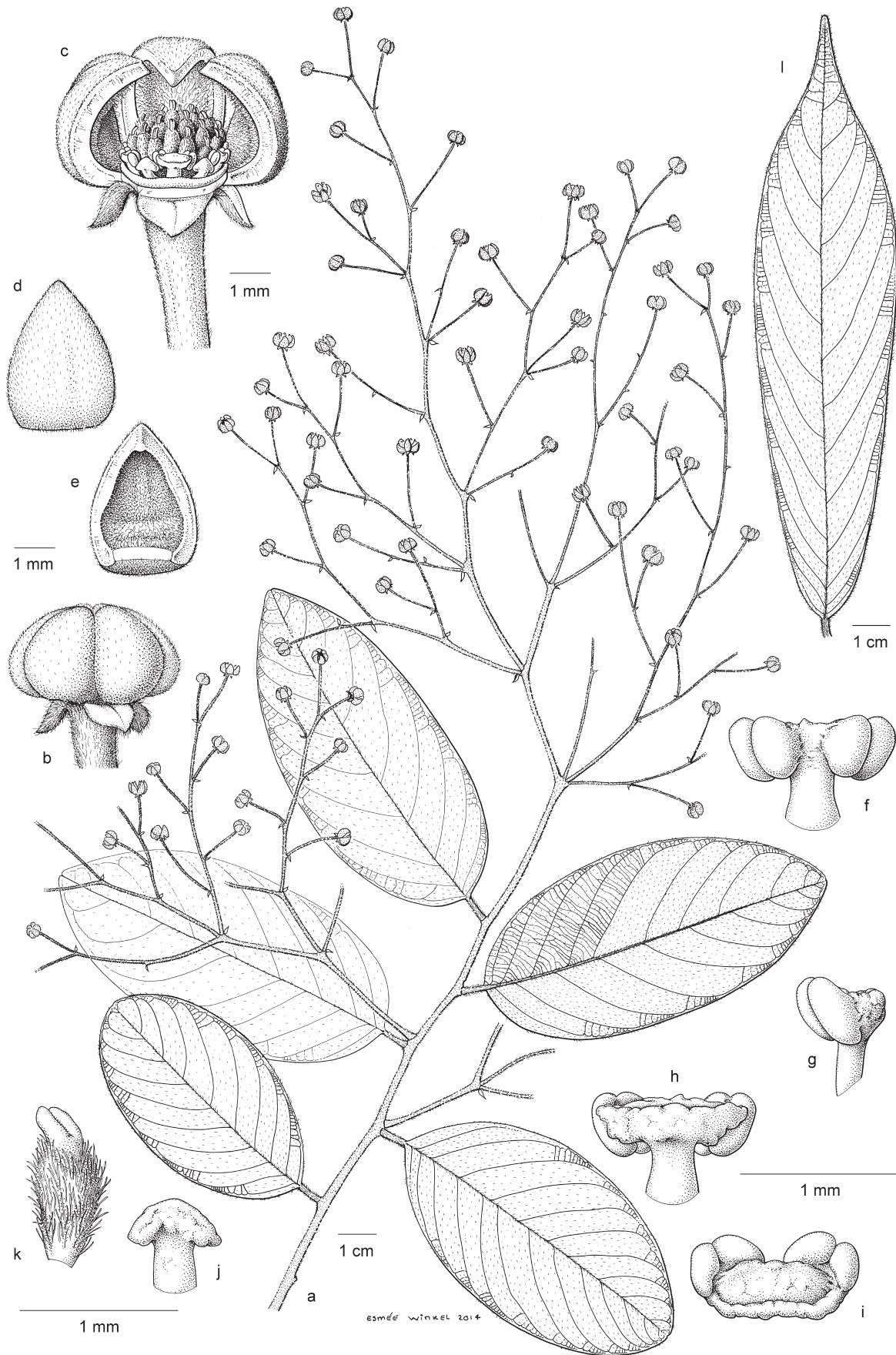


FIGURE 1. *Monanthotaxis paniculata*. A. Flowering branch. B. Flower bud. C. Flower bud with 3 petals removed. D. Petal from outside. E. Petal from inside. F. Stamen from inside. G. Stamen lateral view. H. Stamen from outside. I. Stamen from top. J. Staminode. K. Ovary. L. Leaf upperside. A–K from *McPherson 16123*; L from *Reitsma 2870*. Illustrator: Esmée Winkel.

pubescent around. Leaf lamina $8.5\text{--}23.5 \times 3.3\text{--}6.6$ cm, length: width ratio 2.0–4.2, ovate to oblong-lanceolate, base cuneate to almost rounded with small linear black swollen base (see notes), apex acute to acuminate, acumen to 2.7 cm long, chartaceous, discolorous, young leaves adaxially with scattered appressed white hairs 1 mm long, glabrescent, abaxially glaucous or green, densely pubescent with appressed yellowish hairs 2 mm long, less densely in older leaves, secondary veins 9–16 on each side of primary vein, oblique, curving upwards, impressed adaxially, tertiary venation scalariform to somewhat reticulate, finely raised adaxially, abaxially only visible in older leaves. Inflorescence axillary or terminal, a 5.5–27.0 cm long panicle-like rhipidium with many flowers, peduncle 15–40 mm, rachis often multiple times bi- or trifurcate, densely pubescent with short ferruginous hairs, 1–3 flowers in the axil of each bract; bracts lanceolate $1.0\text{--}8.0 \times 0.5\text{--}1.5$ mm, same indumentum as rachis; flower buds depressed-globose. Flowers bisexual; pedicels $5\text{--}29 \times 0.4\text{--}0.8$ mm, indumentum as rachis; sepals 3, $0.6\text{--}1.3 \times 1.0\text{--}1.5$ mm, broadly ovate, outside densely pubescent with ferruginous hairs, inside glabrous, apex acute; petals 6 in one whorl, yellowish or dull yellow, $2.7\text{--}3.0 \times 1.5\text{--}2.0$ mm, ovate, both inside and outside with short, appressed yellowish hairs; receptacle 2.0–3.5 mm in diameter; stamens 12, in one whorl, inserted on a black hexagonal disc, 6 fertile stamens opposite to the petals, free at the base, obconic, 0.6 mm long, filaments 0.2 mm long, theca introrse/latrorse, connective appendage glabrous, truncate, kidney-shaped from above, 1.0 mm wide, not hiding anther cells, 6 sterile stamens alternating with inner stamens, 0.4 mm long, 0.5 mm wide, reduced theca-like structures 2, dorsal; carpels 14–24, 0.9×0.4 mm, ellipsoid, densely ferruginous pubescent with 1 ovule, stigma bifurcate, 0.2 mm long, glabrous. Fruits unknown.

Etymology:—The specific epithet refers to the lax, many-flowered panicle-like inflorescence, which is unique within the family of Annonaceae.

Distribution:—Gabon, provinces Estuaire and Ogooué-Ivindo (Fig. 2).



FIGURE 2. Distribution map of *Monanthataxis paniculata*.

Ecology:—In forest fringe of a marshy savannah and along lumber roads, elev. 0–500 m.

Phenology:—Flowers collected in the last week of January.

IUCN-conservation status:—A first assessment results in “Data Deficient”, since the extent of occurrence cannot be calculated with only two data points. However, in the last decades many collections have been made in Gabon, and for the revision we have seen almost all collections of *Monanthataxis* in Gabon and surrounding countries. No other material has thus far been found. Therefore, the species seems to be genuinely rare (see also the discussion). Furthermore, both collections have been made in unprotected areas, one of which is in danger because of the expanding city of Libreville. The other collection has been made in a logging area, and therefore we suggest the status endangered: B2 ab(iii) for this species.

Notes:—A black swollen leaf margin at the base of the leaf is a common feature in many species of *Monanthataxis*. In most literature, it is referred to as glands (e.g. Le Thomas 1969, Verdcourt 1971a). We are not sure if it is glandular tissue and until this is examined in more detail do not refer to it as such.

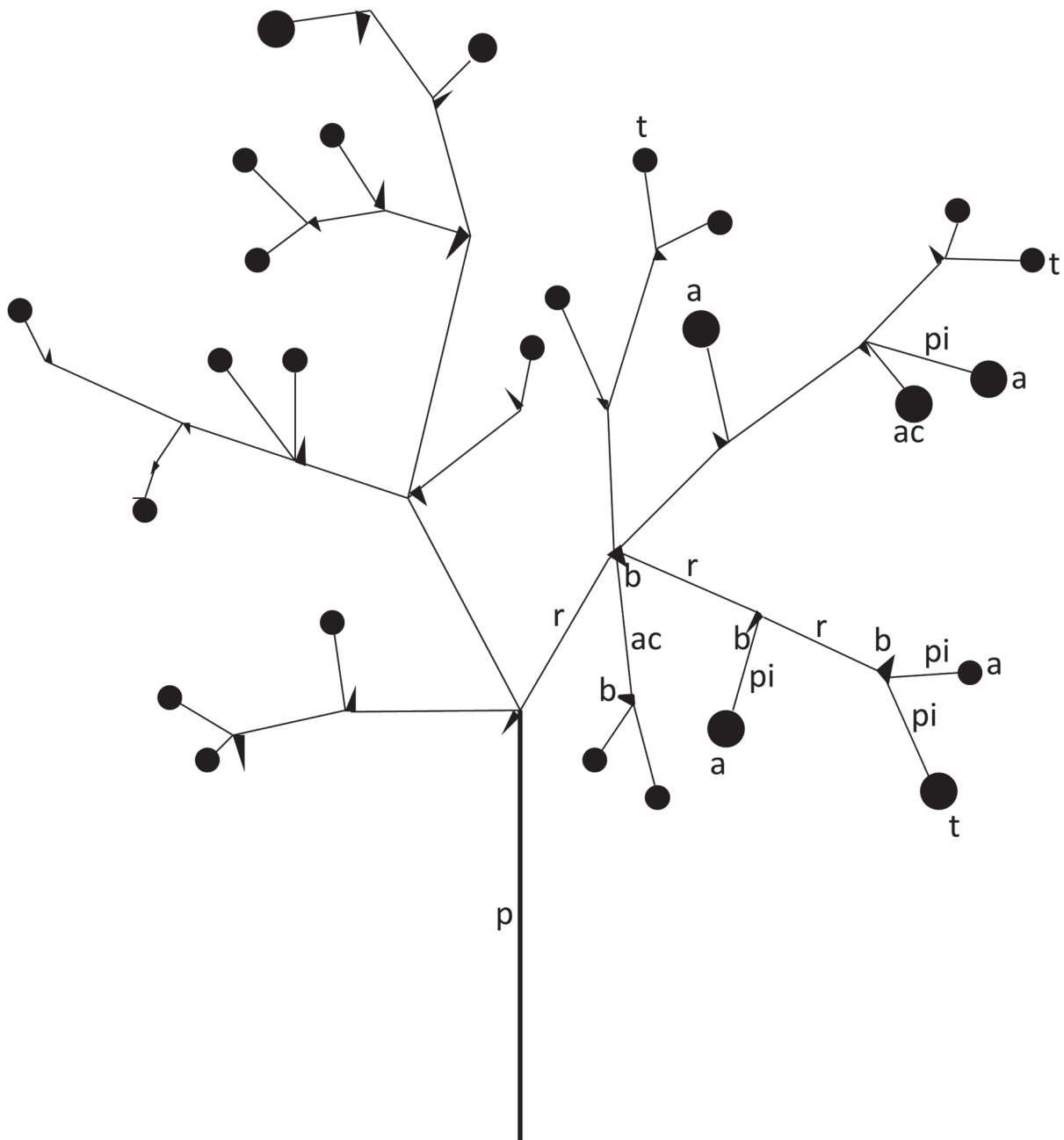


FIGURE 3. Schematic drawing of a part of the inflorescence of *Monanthataxis paniculata*, p peduncle, r rachis, b bract, a axillary flower, t terminal flower, pi pedicel, ac flower or branch developed from accessory bud.

Discussion

Monanthes paniculata is similar to species that Verdcourt (1971b) placed in *M.* section *Monanthes* because it has six petals in a single whorl. The species is similar to *M. congoensis* and *M. poggei* Engler & Diels (1901:53). All three species have a dense pubescence of appressed hairs on the young branches and lower side of the leaves, which is unique within lianescent Annonaceae of Africa. However, *M. paniculata* can easily be distinguished by the inflorescence type, which is raceme-like in *M. congoensis*, single-flowered or a short up to 4-flowered fascicle in *M. poggei* and a panicle-like thyrsoid in *M. paniculata*. Other characteristics differentiating *M. paniculata* from *M. congoensis* and *M. poggei* are the depressed-globose buds (versus ovate-triangular), insertion of the stamens on a black hexagonal disc (versus no black hexagonal disc present) and connective appendage being kidney-shaped in dorsal view (versus rounded or slightly prolonged inwards).

Monanthes paniculata is more difficult to distinguish vegetatively from *M. poggei* and *M. congoensis* because of the high within-species variability of leaf shape and indumentum in those species. *Monanthes paniculata* differs from *M. congoensis* in having yellowish (versus whitish) hairs on the lower side of the leaves, and it differs from *M. poggei* in its cuneate to broadly cuneate leaf base versus rounded to subcordate. The two specimens of *M. paniculata* show some differences vegetatively; the lower side of the leaves of the type specimen are glaucous green, whereas the lower side of the leaves of the other specimen are green as indicated on the collection label. Furthermore, the type specimen has an acute to almost rounded leaf apex, whereas the other specimen has an acuminate leaf apex. Therefore, more collections are needed to assess the variability of leaf characters in *M. paniculata*.

As previously mentioned, *Monanthes paniculata* is directly distinguishable from all other Annonaceae by its many-flowered, open panicle-like inflorescence. The basic inflorescence type in Annonaceae is a terminal flower with two opposed bracts, a lower bract just below the articulation and an upper bract on the pedicel. Additional flowers normally originate from axils of the lower bracts, and multiple flowers create a cymose determinate inflorescence, called a rhipidia or a thyrsoid (Couvreur 2009, Maas *et al.* 2003, Weberling & Hoppe 1996). Often the inflorescences do not appear terminal, but leaf-opposed, axillary or supra-axillary, due to overtopping by the shoot from the axil of the leaf below the inflorescence (Maas *et al.* 1992, Maas *et al.* 2003, Weberling & Hoppe 1996). There exist many small aberrations of the basic Annonaceae inflorescence type. For example, axes of the inflorescence in *Fusaea* (Baillon 1868: 326) Safford (1914: 64) are not in one plane but have a displacement of 80–90° (Chatrou & He 1999). In most species, aberrations are caused by different degrees of reduction of the thyrsoid (Weberling & Hoppe 1996).

The inflorescence of *Monanthes paniculata* generally follows the basic Annonaceae scheme. The inflorescence terminates with a flower, and there is one bract below each articulation. However, the inflorescence of *M. paniculata* differs from all other Annonaceae by the combination of the following characters: each node has one to multiple accessory buds, most flowers are placed in the axils of bracts, not opposite bracts, there are no upper bracts and each secondary lower bract is on an enlarged rachis (Fig. 3). There are some other species of Annonaceae with inflorescences with many flowers, but most of those species, such as *Hornschurchia obliqua* Maas & Van Setten in Maas *et al.* (1988: 260), have a condensed panicle-like inflorescence. Besides, in those species flowers are placed opposite bracts, not in axils.

Monanthes paniculata so far is known from only two localities, both in Gabon. Gabon is rich in endemics (Sosef *et al.* 2006), and still every year additional endemic plant taxa are described (e.g. Bissiengou *et al.* 2013, Sonké *et al.* 2012, van der Maesen 2010, van Velzen & Wieringa 2014, Wieringa & Mackinder 2012). Many of these, often narrow endemics, have unique distributions. The two known localities of *M. paniculata* do not fit any of these patterns. It is remarkable that they come from different vegetation zones, one from the coastal sedimentary basin and the other from the interior forest zone, two areas that exhibit little floral affinities (Harris *et al.* 2012, Wieringa & Sosef 2011). Most species occurring in such different zones are less restricted in distribution and are not endemic to Gabon. This peculiar distribution might imply that the species actually has a wider distribution, but is so rare within its range that it has only been collected twice. Alternatively, its current distribution is formed by relicts of a previously larger area. A third hypothesis would be that specimens of the two localities belong to two different (sub)species because of differences exhibited in leaf morphology. However, this last hypothesis is unlikely because both inflorescence and flowers are similar in these specimens. Targeted sampling may reveal its local abundance and open up the opportunity to assess the population genetic structure, if more plants can be found.

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References

- Baillon, H. (1868) Mémoires sur la famille des Anonacées. *Adansonia*, 8: 295–344.
- Baillon, H. (1890) Observations sur quelques nouveaux types du Congo. *Bulletin mensuel de la Société Linnéenne de Paris*, 1: 876–879.
- Bissiengou, P., Chatrou, L.W., Wieringa, J.J. & Sosef, M.S.M. (2013) Taxonomic novelties in the genus *Campylospermum* (Ochnaceae). *Blumea - Biodiversity, Evolution and Biogeography of Plants* 58: 1–7.
<http://dx.doi.org/10.3767/000651913X667817>
- Boutique, R. (1951a) Annonaceae. In: Robyns, W., Staner, P., Demaret, F., Germain, R., Gilbert, G., Hauman, L., Homès, M., Jurion, F., Lebrun, J., Vanden Abeele, M. & Boutique, R. (Eds.) *Flore du Congo belge et du Ruanda-Urundi. Spermatophytes*. Bruxelles, pp. 256–389.
- Boutique, R. (1951b) Annonacées nouvelles de la flore du Congo Belge et du Ruanda-Urundi. *Bulletin du Jardin botanique de l'Etat, Bruxelles/Bulletin van den Rijksplantentuin, Brussel* 21: 95–126.
<http://dx.doi.org/10.2307/3666813>
- Chatrou, L.W. & He, P. (1999) Studies in Annonaceae XXXIII. A revision of *Fusaea* (Baill.) Saff. *Brittonia* 51: 181–203.
<http://dx.doi.org/10.2307/2666627>
- Chatrou, L.W., Pirie, M.D., Erkens, R.H.J., Couvreur, T.L.P., Neubig, K.M., Abbott, J.R., Mols, J.B., Maas, J.W., Saunders, R.M.K. & Chase, M.W. (2012) A new subfamilial and tribal classification of the pantropical flowering plant family Annonaceae informed by molecular phylogenetics. *Botanical Journal of the Linnean Society* 169: 5–40.
<http://dx.doi.org/10.1111/j.1095-8339.2012.01235.x>
- Couvreur, T.L.P. (2009) Monograph of the syncarpous African genera *Isolona* and *Monodora* (Annonaceae). *Systematic Botany Monographs* 87: 1–150.
- Engler, A. & Diels, L. (1901) *Monographien Afrikanischer Pflanzen-Familien und -Gattungen. VI. Anonaceae*. Engelmann, Leipzig, 96 pp.
<http://dx.doi.org/10.5962/bhl.title.53505>
- Erkens, R.H.J., Westra, L.Y.T. & Maas, P.J.M. (2008) Increasing diversity in the species-rich genus *Guatteria* (Annonaceae). *Blumea - Biodiversity, Evolution and Biogeography of Plants* 53: 467–514.
<http://dx.doi.org/10.3767/000651908X607459>
- Harris, D.J., Armstrong, K.E., Walters, G.M., Wilks, C., Mouandza Mbembo, J.-C., Niangadouma, R., Wieringa, J.J. & Breteler, F.J. (2012) Phytogeographical analysis and checklist of the vascular plants of Loango National Park, Gabon. *Plant Ecology and Evolution* 145: 242–257.
<http://dx.doi.org/10.5091/plecevo.2012.641>
- Hooker, J.D. & Thomson, T. (1855) *Flora Indica, Vol. 1*. Pamplin, London, 285 pp.
<http://dx.doi.org/10.5962/bhl.title.50109>
- Le Thomas, A. (1969) Annonacées. In: A. Aubréville (Ed.) *Flore du Gabon Vol. 16*. Muséum National d'Histoire Naturelle, Paris, pp. 1–371.
- Linnaeus, C. (1753) *Species plantarum, Vol. 1*. Salvius, Sweden, 1200 pp.
<http://dx.doi.org/10.5962/bhl.title.669>
- Maas, P.J.M., van Heusden, E.C.H., Koek-Noorman, J., van Setten, A.K. & Westra, L.Y.T. (1988) Studies in Annonaceae. IX. New species from the Neotropics and miscellaneous notes. *Proceedings, Koninklijke Nederlandse Akademie van Wetenschappen, series C* 91: 243–282.
- Maas, P.J.M., Westra, L.Y.T. & Collaborators (1992) *Rollinia*. *Flora Neotropica* 57: 1–188.
- Maas, P.J.M., Westra, L.Y.T. & Chatrou, L.W. (2003) *Duguetia* (Annonaceae). *Flora Neotropica* 88: 1–274.
- Maas, P.J.M., Westra, L.Y.T. & Vermeer, M. (2007) Revision of the Neotropical genera *Bocageopsis*, *Onychopetalum*, and *Unonopsis* (Annonaceae). *Blumea - Biodiversity, Evolution and Biogeography of Plants* 52: 413–554.
<http://dx.doi.org/10.3767/000651907x608909>
- Pellegrin, F. (1950) Annonacées nouvelles africaines. *Notulae Systematicae* 14: 75–76.

- Rainer, H. & Chatrou, L.W. (2006) *AnnonBase: world species list of Annonaceae*, version 1.1, 12 Oct 2006. Available from: <http://www.sp2000.org> (accessed 5 June 2014).
- Robson, N. (1960) Annonaceae. In: Exell, A.W. & Wild, H. (Eds.) *Flora zambesiaca*. Crown agents for oversea governments and administrations, London, pp. 104–149.
- Safford, W.E. (1914) Classification of the genus *Annona*, with descriptions of new and imperfectly known species. *Contributions from the United States National Herbarium* 18: 1–68.
- Sonké, B., Taedoung, H. & Robbrecht, E. (2012) A reconsideration of the Lower Guinean species of *Sericanthe* (Rubiaceae, Coffeae), with four new species from Cameroon and Gabon. *Botanical Journal of the Linnean Society* 169: 530–554. <http://dx.doi.org/10.1111/j.1095-8339.2012.01254.x>
- Sosef, M.S.M., Wieringa, J.J., Jongkind, C.C.H., Achoundong, G., Azizet Issembé, Y., Bedigian, D., van den Berg, R.G., Breteler, F.J., Cheek, M., Degreef, J., Faden, R.B., Goldblatt, P., van der Maesen, L.J.G., Ngok Banak, L., Niangadouma, R., Nzabi, T., Nziengui, B., Rogers, Z.S., Stévant, T., van Valkenburg, J.L.C.H., Walters, G. & de Wilde, J.J.F.E. (2006) *Checklist of Gabonese vascular plants*. (Vol. 35). Jardin Botanique National de Belgique, 438 pp.
- van der Maesen, L.J.G. (2010) Novitates Gabonenses 75: note on *Platysepalum* (Leguminosae-Papilionoideae) in Gabon. *Webbia* 65: 165–171. <http://dx.doi.org/10.1080/00837792.2010.10670871>
- van Steenis, C.G.G.J. (1948) Remarks on some generic names used for Malaysian phanerogams I. *Bulletin du Jardin Botanique de Buitenzorg, Buitenzorg, séries* 3: 457.
- van Velzen, R. & Wieringa, J.J. (2014) *Rinorea calcicola* (Violaceae), an endangered new species from southeastern Gabon. *Phytotaxa* 167: 267–275. <http://dx.doi.org/10.11646/phytotaxa.167.3.5>
- Verdcourt, B. (1971a) Annonaceae. In: Milne-Redhead, E. & Polhill, R.M. (Eds.) *Flora of tropical East Africa*. East African Community by the Crown Agents for Oversea Governments and Administrations, London.
- Verdcourt, B. (1971b) Notes on east African Annonaceae. *Kew Bulletin* 25: 1–34. <http://dx.doi.org/10.2307/4103132>
- Wang, J., Thomas, D.C., Su, Y.C.F., Meinke, S., Chatrou, L.W. & Saunders, R.M.K. (2012) A plastid DNA phylogeny of *Dasymaschalon* (Annonaceae) and allied genera: Evidence for generic non-monophyly and the parallel evolutionary loss of inner petals. *Taxon* 61: 545–558.
- Weberling, F. & Hoppe, J.R. (1996) Comparative morphological evaluation of inflorescence characters in Annonaceae. *Biosystematics and Ecology Series* 10: 29–53.
- Wieringa, J.J. & Mackinder, B.A. (2012) Novitates Gabonensis 79: *Hymenostegia elegans* and *H. robusta* spp. nov. (Leguminosae–Caesalpinioideae) from Gabon. *Nordic Journal of Botany* 30: 144–152. <http://dx.doi.org/10.1111/j.1756-1051.2011.01260.x>
- Wieringa, J.J. & Sosef, M.S.M. (2011) The applicability of Relative Floristic Resemblance to evaluate the conservation value of protected areas. *Plant Ecology and Evolution* 144: 242–248. <http://dx.doi.org/10.5091/plecevo.2011.588>
- Zhou, L., Su, Y.C., Chalermglin, P. & Saunders, R.M. (2010) Molecular phylogenetics of *Uvaria* (Annonaceae): relationships with *Balonga*, *Dasoclema* and Australian species of *Melodorum*. *Botanical Journal of the Linnean Society* 163: 33–43. <http://dx.doi.org/10.1111/j.1095-8339.2010.01045.x>
- Zhou, L., Su, Y.C. & Saunders, R.M. (2009) Molecular phylogenetic support for a broader delimitation of *Uvaria* (Annonaceae), inclusive of *Anomianthus*, *Cyathostemma*, *Ellipeia*, *Ellipeiopsis* and *Rauwenhoffia*. *Systematics and Biodiversity* 7: 249–258. <http://dx.doi.org/10.1017/S147200009003028>