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On African violets and Cape primroses—towards a monophyletic *Streptocarpus* (Gesneriaceae)

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Abstract

Recent phylogenetic studies have shown that *Colpogyne*, *Hovanella*, *Linnaeopsis*, *Saintpaulia* and *Schizoboea* (Gesneriaceae) are embedded in *Streptocarpus*. *Saintpaulia* had been expanded to over 20 species, but this narrow species concept was challenged by recent studies that showed that most of these taxa were poorly genetically and morphologically differentiated. The number of species in *Saintpaulia* has been reduced to six, with the majority of former species reduced to subspecies and varieties of *S. ionantha*. A key to the species in *Streptocarpus* subgenus *Streptocarpella* in tropical East Africa, and new combinations in *Streptocarpus* are provided here.

Introduction

The African violet, *Saintpaulia* Wendland (1893: 321), is a genus with six species of herbaceous, subsucculent perennials native to the rain forests in the Eastern Arc Mountain Range and Coastal Forest biodiversity hotspot in southern Kenya and northern Tanzania, an area with exceptionally high species richness and endemism (Myers *et al.* 2000).

The genus *Saintpaulia* has been promoted as a flagship taxon, and has even been called “the giant panda of East African plant conservation”, because of the threatened status of the genus as a whole (Eastwood *et al.* 1998), in combination with familiarity and popularity as a pot plant (Baatvik 1993, Watkins *et al.* 2002). The conservation of habitats with *Saintpaulia* could preserve the entire biodiversity hotspot in the Eastern Arc which houses a high percentage of endemic species. Additionally protecting the genetic resources of African violets in their natural populations could contribute to developing new varieties in horticulture and possibly financially support local communities (Nagoya protocol; CBD 2011a).

African violets are well-known houseplants and are easily cultivated from cuttings. This asexual propagation, which also occurs freely in the wild, has probably contributed to populations looking identical in certain areas that are geographically isolated due to topography (Darbyshire 2006). Because most species were initially described from cultivated material, which was derived from relatively few original accessions, the ‘species’ recognised were discrete in cultivation due to cloning. When further material from the wild became available intermediate strains were found, which some authors treated as new species, but increasingly an appropriate broader concept has been sought. In the floristic treatment of Gesneriaceae for the *Flora of Tropical East Africa*, Darbyshire (2006) recognised only six species, and treated the majority of the remaining taxa as subspecies of *S. ionantha* Wendland (1893), or placed them in synonymy. This was supported by molecular and morphological research (e.g. Möller & Cronk 1997a, 1997b, Lindqvist & Albert 1999, 2001) that showed most of the species to be poorly differentiated, if at all.

Moreover molecular research (Möller & Cronk 1997a) showed that *Saintpaulia* evolved from the caulescent group of *Streptocarpus* Lindley (1828) or Cape primroses, better known as *Streptocarpus*

subgenus *Streptocarpella* Engler (1921). Therefore *Saintpaulia* should be merged with *Streptocarpus* to avoid paraphyly and the species should be placed in *S.* subgenus *Streptocarpella* to make this subgenus monophyletic. The morphological differences in floral and vegetative characters are the cause of a change in pollination syndrome, which has also been found in other genera, such as *Aesculus* L. (e.g. Forest *et al.* 2001) and *Gomesa* R.Br. (Chase *et al.* 2009). The close relationship between *Saintpaulia* and *Streptocarpus* subgenus *Streptocarpella* is supported by many morphological features the two have in common. They both have verrucose seeds, are caulescent (although in some *Saintpaulia* this is reduced, making the plant appear rosulate), share similar embryology and pollen type, and they share the same chromosome number ($2n=30$). Additional molecular studies of Möller & Cronk (1997a,b, 1999, 2001) and Lindquist & Albert (1999) indicate that in addition to *Saintpaulia* also *Colpogyne* B.L.Burt, *Hovanella* A.Weber & B.L.Burt, *Linnaeopsis* Engl. and *Schizoboea* (Fritsch) B.L.Burt have arisen from within *Streptocarpus*. *Colpogyne* and *Linnaeopsis* already have combinations in *Streptocarpus* (Humbert 1967, Darbyshire 2006), but until now combinations in *Streptocarpus* for *Hovanella*, *Schizoboea* and *Saintpaulia* have not been made. The main character that was used to separate *Streptocarpus* from the other genera mentioned above is the spirally twisted fruit. Even though this is generally the case, there are several species of *Streptocarpus* with untwisted fruits.

Since 1997 the Botanic Garden at Helsinki University (now part of the Finnish Museum of Natural History) has cultivated African violets for scientific study (e.g. Kolehmainen & Mutikainen 2006, Kolehmainen 2008) and in collaboration and exchange with Uppsala University Botanic Garden, the Royal Botanic Garden Edinburgh and the National Botanical Garden of Belgium in Meise we have maintained a collection for *ex situ* conservation (Schulman & Kolehmainen 2004, Miranto 2005), in accordance with the Global Strategy for Plant Conservation (CBD 2011b). Since 2010 I have been responsible for curating this collection, and the lack of combinations for these taxa in *Streptocarpus*, where they doubtlessly belong, has come to my attention. Below I follow the most recent monograph (Darbyshire 2006) and provide the necessary combinations.

Recently two additional species were described, which in my opinion are not isolated from species mentioned in Darbyshire (2006): *Saintpaulia ulugurensis* Haston (in Haston *et al.* 2009) matches the description of *Streptocarpus ionanthus* subsp. *grandifolius*, and *Saintpaulia watkinsii* Haston (in Haston *et al.* 2009) appears to be a variety of *Streptocarpus afroviola*.

Key to the tropical East African species of *Streptocarpus* subgenus *Streptocarpella*

1. Plants acaulescent, all leaves sprouting directly from the soil surface, the stems underground with no aboveground branching; leaves solitary or in a rosette, spirally arranged; fruits always conspicuously twisted *S.* subgenus *Streptocarpus*
- Plants caulescent, leaves sprouting from aboveground stems, sometimes the internodes reduced and the plant appearing (sub-)rosulate; leaves opposite or alternate; fruits twisted or not 2. *S.* subgenus *Streptocarpella*
2. Leaves alternate 3
- Leaves opposite (sometimes becoming alternate due to differential growth) 6
3. Leaves subsessile; lateral veins scalariform *S. bullatus*
- Leaves petiolate; lateral veins ascending 4
4. Leaf apices acute to short-acuminate; plants subscandent *S. subscandens*
- Leaf apices rounded to obtuse; plants subrosulate or creeping 5
5. Plants creeping; petiole more than half as long as the length of the blade *S. heckmannianus*
- Plants subrosulate; petiole less than half the length of the blade *S. albus*
6. Corolla tube up to 3 mm long, shorter than the upper lobe; anthers yellow, always exerted 7. (formerly *Saintpaulia*)
- Corolla tube 4–40 mm long, longer than the upper lobe; anthers not yellow, usually included in the tube 12
7. Leaf blades glabrous above *S. inconspicuus*
- Leaf blades pubescent above 8

8. Upper corolla lobes clearly darker blue to violet, the lower lobes near white; leaf blades usually less than 4 cm long 9
 -. Upper corolla lobes similarly coloured than the lower lobes, colour various, sometimes with a darker eye; leaf blades up to 12.5 cm long 10
9. Corolla lobes with glandular hairs on the margin; leaf blade densely pilose above..... *S. goetzeanus*
 -. Corolla lobes with non-glandular hairs on the margin; leaf blade sparsely long-pilose above*S. afroviola*
10. Filaments slender; leaf blades sparsely long-pilose above, mature ones usually less than 5 cm long*S. shumensis*
 -. Filaments broad, flattened; leaf blades with variable pubescence, but when as above, usually interspersed with dense short hairs and mature blades longer than 5 cm 11
11. Mature leaves subpeltate *S. teitensis*
 -. Mature leaves cordate, obtuse or rounded *S. ionantha*
12. Inflorescences terminal; capsules straight, 15 – 30 mm long..... *S. kamerunensis*
 -. Inflorescences axillary; capsules usually spirally twisted, but if straight, than 5–17 mm long 13
13. Leaf margins entire 14
 -. Leaf margins crenulate or serrulate 24
14. Corolla mouth (almost) closed by the upcurved ridged palate, vertically compressed 15
 -. Corolla mouth open, sometimes somewhat laterally compressed 20
15. Ovary densely pubescent 16
 -. Ovary glabrous (sessile glands may be present) 17
16. Pedicels glandular-hairy; leaves cordate to obtuse at base..... *S. glandulosissimus*
 -. Pedicels hairy, not glandular; leaves acute to attenuate at base..... *S. buchananii*
17. Floor of the corolla tube strongly ventricose; corolla lobes usually striped with purple..... *S. pallidiflorus*
 -. Floor of the corolla tube not ventricose; corolla lobes never striped..... 18
18. Corolla tubes 9 mm or shorter; leaves densely pubescent on both sides*S. caulescens*
 -. Corolla tubes 9 mm or longer; leaves sparsely pubescent 19
19. Corolla tubes longer than 13 mm, inflated at the base *S. inflatus*
 -. Corolla tube shorter than 13 mm, not inflated at the base *S. holstii*
20. Corolla tube shorter than 10 mm 21
 -. Corolla tube longer than 10 mm 24
21. Stems often swollen at base; corolla longer than 12 mm *S. pallidiflorus*
 -. Stems not swollen at base; corolla shorter than 14 mm..... 22
22. Corolla tube narrowed towards the mouth, swollen in the middle..... *S. gonjaensis*
 -. Corolla tube wider at the mouth 23
23. Corolla up to 8.5 mm long, lower lip to 3 mm long, the lobes rounded *S. kimbozanus*
 -. Corolla 9 mm or longer, lower lip longer than 3.5 mm, the lobes oblong..... *S. thysanotus*
24. Leaf margins shallowly crenulate/serrulate; stamens inserted at the upper part of the corolla tube 25
 -. Leaf margins strongly crenate/serrulate; stamens inserted near the base of the corolla tube 26
25. Corolla tube 10 mm or shorter; lobes of lower lip held forwards *S. kirkii*
 -. Corolla tube longer than 10 mm; lobes of lower lip spreading *S. stomandrus*
26. Capsules up to 10 mm long *S. parensis*
 27. Capsules 15 mm or longer *S. schliebenii*

Taxonomy

Streptocarpus Lindley (1828)

Type: *Streptocarpus rexii* Lindley (1828: 1173)

Synonyms: *Colpogyne* B.L.Burt in Burt & Keraudren-Aymonin (1971: 150), *Hovanella* Weber & Burt (1998: 333), *Linnaeopsis* Engler (1900: 483), *Saintpaulia* Wendl (1893: 321), *Schizoboea* (Fritsch) Burt (1974: 266).

Streptocarpus afroviola Christenh., *nom nov.*

Basionym: *Saintpaulia pusilla* Engler (1900: 481), non *Streptocarpus pusillus* Harv. ex C.B. Clarke

Type: TANZANIA. Morogoro Distr.: Uluguru-Berge, Lukwangule-Plateau, Urwald an Felsblöcken zwischen Moos, 1200–1800 m, 22 November 1898, *Goetze 205* (holotype B!).

***Streptocarpus afroviola* var. *watkinsii* (Haston) Christenh., comb. & stat. nov.**

Basionym: *Saintpaulia watkinsii* Haston (in Haston *et al.* 2009: 278).

Type: TANZANIA. Morogoro Distr.: Uluguru Mountains, 13 December 2005, *Haston & Mejissa 99* (holotype NHT, isotype E).

***Streptocarpus goetzeanus* (Engl.) Christenh., comb. nov.**

Basionym: *Saintpaulia goetzeana* Engler (1900: 481).

Type: TANZANIA. Morogoro Distr.: Uluguru-Berge, am Lukwangule-Plateau, Urwald am Felsblock zwischen Moos, 1300–2000 m, 28 November 1898, *Goetze 245* (holotype B!).

***Streptocarpus inconspicuus* (Burt) Christenh., comb. nov.**

Basionym: *Saintpaulia inconspicua* Burt (1958: 557).

Type: TANZANIA. Morogoro Distr.: Uluguru Mountains, Morogoro, Kisasi Road, moist soil in forest, 18 December 1934, *Bruce 328* (holotype K!-000378645).

***Streptocarpus ionanthus* (H.Wendl.) Christenh., comb. nov.**

Basionym: *Saintpaulia ionantha* Wendl. (1893: 321, fig. 66, t. 1391).

Type: TANZANIA. About one hour from Tanga, *Von Saint-Paul-Illaire*, cult. in Herrenhausen, Hannover (colourplate opposite p. 321 in Wendl. 1893).

Epitype (selected by Darbyshire, 2006): TANZANIA. coll. *Von Saint-Paul-Illaire*, cultivated at R.B.G. Kew, 11 July 1894 (K!-000378664).

Homotypic synonyms: *Petrocosmea ionantha* (H.Wendl.) Rodigas, *Saintpaulia kewensis* C.B. Clarke, *nom. superfl.*

Heterotypic synonyms: *Saintpaulia tongwensis* B.L. Burt,

Unpublished horticultural names: *Saintpaulia* “Pangani Falls”, *S.* “Sigi Falls”, *S.* “White Ionantha”.

***Streptocarpus ionanthus* subsp. *grandifolius* (B.L. Burt) Christenh., comb. nov.**

Basionym: *Saintpaulia grandifolia* B.L. Burt (1958: 560).

Type: TANZANIA. Lushoto Distr.: West Usambara Mountains, Lutindi, 1 July 1955, *Punter ref. S*, cultivated at R.B.G. Edinburgh, C1575 (holotype E!, isotype E!).

Homotypic synonym: *Saintpaulia ionantha* subsp. *grandifolia* (B.L. Burt) I. Darbysh.

Heterotypic synonym: *Saintpaulia ulugurensis* Haston

***Streptocarpus ionanthus* subsp. *grotei* (Engl.) Christenh., comb. nov.**

Basionym: *Saintpaulia grotei* Engler (1921: 202).

Type: TANZANIA. Lushoto Distr.: E. Usambara Mts, near Amani, 1912, *Grote 3708* (holotype B!).

Homotypic synonym: *Saintpaulia ionantha* subsp. *grotei* (Engl.) I. Darbysh.

Heterotypic synonym: *Saintpaulia amaniensis* E.P. Roberts, *S. confusa* B.L. Burt, *S. difficilis* B.L. Burt, *S. magungensis* E.P. Roberts, *S. magungensis* var. *minima* B.L. Burt

***Streptocarpus ionanthus* subsp. *ionanthus* var. *diplotrichus* (B.L. Burt) Christenh., comb. nov.**

Basionym: *Saintpaulia diplotricha* Burt (1947: 23).

Type: TANZANIA. Lushoto Distr.: Usambara, 1000 m, 26 November 1895, *Buchwald 149* (holotype K!-000378665, isotypes B!, BM, BR).

Homotypic synonym: *Saintpaulia ionantha* subsp. *ionantha* var. *diplotricha* (B.L. Burt) I. Darbysh.

***Streptocarpus ionanthus* subsp. *mafiensis* (I. Darbysh. & Pócs) Christenh., comb. nov.**

Basionym: *Saintpaulia ionantha* subsp. *mafiensis* I. Darbysh. & Pócs in Darbyshire (2006: 70).

Type: TANZANIA. Lushoto Distr.: SW of West Usambara Mts. Submontane rain forest on the plateau of Mafi

Hill, near the headwaters of Kwakulonge stream, on shady cliff, 1300 m, 27 January 1985, *Mziray & Temu* 85286 (holotype UPS, isotype E!).

Homotypic synonym: *Saintpaulia ionantha* subsp. *mafiensis* I.Darbysh. & Pócs

Unpublished horticultural names: *Saintpaulia* “Mafia Hills”, *S.* “Mafiensis”

***Streptocarpus ionanthus* subsp. *nitidus* (B.L.Burtt) Christenh., comb. nov.**

Basionym: *Saintpaulia nitida* Burtt (1958: 564).

Type: TANZANIA. Morogoro Distr.: Ngura Mountains, near Morogoro, August 1959, *Harvey Cox ref. A*, cultivated at R.B.G. Edinburgh, C1557 (holotype E!, isotypes E!, K! 2 sheets).

Homotypic synonym: *Saintpaulia ionantha* subsp. *nitida* (B.L.Burtt) I.Darbysh.

***Streptocarpus ionanthus* subsp. *occidentalis* (B.L.Burtt) Christenh., comb. nov.**

Basionym: *Saintpaulia magungensis* var. *occidentalis* Burtt (1964: 195).

Type: TANZANIA. Lushoto Distr.: W. Usambara Mts., Mlalo (Bagai), July 1962, *Punter X59 4355*, cultivated at R.B.G. Edinburgh C3854 (holotype E!).

Homotypic synonym: *Saintpaulia ionantha* subsp. *occidentalis* (B.L.Burtt) I.Darbysh.

***Streptocarpus ionanthus* subsp. *orbicularis* (B.L.Burtt) Christenh., comb. nov.**

Basionym: *Saintpaulia orbicularis* Burtt (1947: 23).

Type: TANZANIA. Lushoto Distr.: W. Usambara Mts, Sakarre, Ambangulu, on a wet rock (gneiss) beside a waterfall at 4000ft, 4 August 1938, *Moreau 2* (holotype K!-000378673 and 000378672, 2 sheets).

Homotypic synonym: *Saintpaulia ionantha* subsp. *orbicularis* (B.L.Burtt) I.Darbysh.

Heterotypic synonym: *Saintpaulia orbicularis* var. *purpurea* B.L.Burtt

***Streptocarpus ionanthus* subsp. *pendulus* (B.L.Burtt) Christenh., comb. nov.**

Basionym: *Saintpaulia pendula* Burtt (1958: 561).

Type: TANZANIA. Lushoto Distr.: E. Usambara Mts., Mt Mtai, 2 June 1959, *Punter ref. U*, cultivated in R.B.G. Edinburgh, C1686 (holotype E, isotypes E!, K! 2 sheets).

Homotypic synonym: *Saintpaulia ionantha* subsp. *pendula* (B.L.Burtt) I.Darbysh.

Heterotypic synonyms: *Saintpaulia intermedia* B.L.Burtt, *S. pendula* var. *kizarae* B.L.Burtt.

***Streptocarpus ionanthus* subsp. *rupicola* (B.L.Burtt) Christenh., comb. nov.**

Basionym: *Saintpaulia rupicola* Burtt (1964: 193).

Type: KENYA. Kilifi Distr.: Kaloleni, on the road from Mariakani to Kilifi, approx. 25 miles NW of Mombasa, October 1958, *Punter ref. X58-3591*, cultivated at R.B.G. Edinburgh, C3065 (holotype E!).

Homotypic synonym: *Saintpaulia ionantha* subsp. *rupicola* (B.L.Burtt) I.Darbysh.

Unpublished horticultural names: *Saintpaulia* “Robertson”, *S.* “Kacharoni”, *S.* “Mwachi”, *S.* “Mwache”

***Streptocarpus ionanthus* subsp. *velutinus* (B.L.Burtt) Christenh., comb. nov.**

Basionym: *Saintpaulia velutina* Burtt (1958: 563).

Type: TANZANIA. Lushoto Distr.: W Usambara Mts, Balangai, 8 km from Sakarre, November 1955, *Punter ref. D, comm. Barker s.n.*, cultivated at R.B.G. Edinburgh, C1579 (holotype E!, isotype E!).

Homotypic synonyms: *Saintpaulia ionantha* subsp. *velutina* (B.L.Burtt) I.Darbysh.

Heterotypic synonym: *Saintpaulia brevopilosa* B.L.Burtt

***Streptocarpus kamerunensis* (Engl.) Christenh., comb. nov.**

Basionym: *Didymocarpus kamerunensis* Engler (1894: 79).

Type: CAMEROON. Barombistation, Kumba. s. dat., *Preuss 951* (holotype B, isotypes BM, K!).

Homotypic synonyms: *Roettlera kamerunensis* (Engl.) Fritsch, *Schizoboea kamerunensis* (Engl.) B.L.Burtt

Heterotypic synonyms: *Didymocarpus stolzii* Engl., *D. stolzii* var. *minor* Mansf.

***Streptocarpus madagascariensis* (C.B. Clarke) Christenh., comb. nov.**

Basionym: *Didymocarpus madagascariensis* C.B. Clarke (1833: 108).

Type: MADAGASCAR. Central Madagascar, Andrangolaoka, August 1881, *Parker s.n.* (holotype K).

Homotypic synonym: *Hovanella madagascariensis* (C.B. Clarke) A. Weber & B.L. Burtt

Heterotypic synonym: *Didymocarpus pusillus* Baker

***Streptocarpus shumensis* (B.L. Burtt) Christenh., comb. nov.**

Basionym: *Saintpaulia shumensis* Burtt (1955: 238).

Type: TANZANIA. Lushoto Distr.: W Usambara Mts, Shume, World's View, 5 April 1947, *Greenway 7934*, cultivated at R.B.G. Kew (holotype K!-000378669, isotype E!).

***Streptocarpus teitensis* (B.L. Burtt) Christenh., comb. nov.**

Basionym: *Saintpaulia teitensis* Burtt (1958: 559).

Lectotype (selected by Darbyshire 2006): KENYA. Teita: Mbololo Hill, in forest near water, October 1938, *Boy Joanna*, *Coryndon Museum no. 8982* (K! sheet 2, duplicates EA, K! sheet 3).

***Streptocarpus vestitus* (Baker) Christenh., comb. nov.**

Basionym: *Didymocarpus vestitus* Baker (1886: 427).

Type: MADAGASCAR. Central Madagascar, recd. December 1883, *Baron 2655* (holotype K!, isotype P).

Homotypic synonym: *Hovanella vestita* (Baker) A. Weber & B.L. Burtt

References

- Baatvik, S.T. (1993) The genus *Saintpaulia* (Gesneriaceae) 100 years: history, taxonomy, ecology, distribution and conservation. *Fragmenta Floristica et Geobotanica, Supplement 2*: 97–112.
- Baker, J.G. (1886) Further contributions to the Flora of Madagascar—Second and final part. *Journal of the Linnean Society, Botany* 21: 407–455.
- Burtt, B.L. (1947) Plants new or noteworthy. Species of *Saintpaulia*. *The Gardeners' Chronicle, ser. 3*, 122: 22–23.
- Burtt, B.L. (1955) Studies in the Gesneriaceae of the Old World IX.—Two new species from Africa. *Notes from the Royal Botanic Garden, Edinburgh* 21: 238–240.
- Burtt, B.L. (1958) Studies in the Gesneriaceae of the Old World XV: The genus *Saintpaulia*. *Notes from the Royal Botanic Garden, Edinburgh* 22: 547–568.
- Burtt, B.L. (1964) Studies in the Gesneriaceae of the Old World XXV: Additional notes on *Saintpaulia*. *Notes from the Royal Botanic Gardens, Edinburgh* 25: 191–195.
- Burtt, B.L. & Keraudren-Aymonin, M. (1971) 180e Famille, Gesnériacées, pp. 47–163 in Humbert, H. & Leroy, J.-F. (ed.) *Flore de Madagascar et des Comores (plantes vasculaires)*. Muséum national d'histoire naturelle, Paris.
- Burtt (1974) Studies in the Gesneriaceae of the Old World XXXVIII: *Schizoboea*, the erstwhile African *Didymocarpus*. *Notes from the Royal Botanic Garden, Edinburgh* 33: 265–267.
- CBD (2011a) *Nagoya protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilization*. Secretariat of the Convention on Biological Diversity, Montreal.
- CBD (2011b) *Life in harmony, into the future Decisions Adopted by the Conference of the Parties to the Convention of Biological Diversity at its Tenth Meeting: Nagoya, Japan, 18–29 October 2010*. Secretariat of the Convention on Biological Diversity, Montreal. Accessed online 9 January 2012: <http://www.cbd.int/decisions/cop/?m=cop-10>.
- Chase, M.W., Williams, N.H., Doniset de Faria, A., Neubig, K.M., Amaral, M.C.E. & Whitten, W.M. (2009) Floral convergence in Oncidiinae (Cymbidieae; Orchidaceae): an expanded concept of *Gomesa* and a new genus *Nohawilliamsia*. *Annals of Botany* 104: 387–402.
- Clarke, C.B. (1833) Cyrtandreae (Gesneracearum tribus), pars prima. *Monographiae phanerogamarum* 5: 1–303.
- Darbyshire, I. (2006). Gesneriaceae. In: Beentje, H.J. & Ghazanfar, S.A. (eds.), *Flora of Tropical East Africa*. Royal Botanic Gardens, Kew, Richmond.
- Eastwood, A., Bytebier, B., Tye, H., Robertson, A. & Maunder, M. (1998) The conservation status of *Saintpaulia*.

- Curtis's Botanical Magazine* 15: 49–62.
- Engler, A. (1894) Gesneriaceae africanae. Beiträge zur Flora von Africa VII. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 18: 76–80.
- Engler, A. (1900) Berichte über die botanischen Ergebnisse der Nyasa-See- und Kinga-Gebirgs-Expedition der Hermann- und Elise- geb. Heckmann-Wentzel-Stiftung. III. Die von W. Goetze und Dr. Stuhlmann im Ulugurugebirge, sowie die von W. Goetze in der Kisaki- und Khutu-Steppe und in Uhehe gesammelten Pflanzen. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 28: 385–510.
- Engler, A. (1921) Gesneriaceae africanae. IV. Neue Arten und das Auftreten von Kleistogamie sowie Reduktion der Assimilationstätigkeit auf einen laubblattartigen Kotyledon bei kauleszenten Arten von *Streptocarpus*. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 57: 202–219.
- Forest, F., Drouin, J.N., Charest, R., Brouillet, L. & Bruneau, A. (2001) A morphological phylogenetic analysis of *Aesculus* L. and *Billia* Peyr. (Sapindaceae). *Canadian Journal of Botany* 79: 154–169.
- Haston, E.M., Mejissa, J. & Watkins, C. (2009) Two new species of *Saintpaulia* from the Uluguru Mountains, Tanzania. *Curtis's Botanical Magazine* 26: 270–280.
- Humbert, H. (1967) Espèces nouvelles de *Streptocarpus* (Gesneriaceae) a Madagascar. *Adansonia, ser. 2, 7*: 275–294.
- Kolehmainen, J. & Mutikainen, P. (2006) Reproductive ecology of three endangered African violet (*Saintpaulia* H.Wendl.) species in the East Usambara Mountains, Tanzania. *African Journal of Ecology* 44: 219–227.
- Kolehmainen, J. (2008) *Ecology, population genetics and conservation of the African violet (Saintpaulia, Gesneriaceae)*. Academic Dissertation, University of Helsinki. <http://urn.fi/URN:ISBN:978-952-10-4473-1>
- Lindley, J. (1828) *Streptocarpus rexii*. Cape Streptocarpus. *Botanical Register* 14: pl. 1173.
- Lindqvist, C. & Albert, V.A. (1999) Phylogeny and conservation of African violets (*Saintpaulia*: Gesneriaceae): new findings based on nuclear ribosomal 5S nontranscribed spacer sequences. *Kew Bulletin* 54: 363–377.
- Lindqvist, C. & Albert, V.A. (2001) A high elevation ancestry for the Usambara Mountains and lowland populations of African violets (*Saintpaulia*, Gesneriaceae). *Systematics and Geography of Plants* 71: 37–44.
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., Da Fonseca, G.A.B. & Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.
- Miranto, M. (2005) *Living collections of botanic gardens as a means of ex situ conservation – A case study of African violets (Saintpaulia) in Europe*. Master's Thesis, University of Helsinki.
- Möller, M. & Cronk, Q.C.B. (1997a) Origin and relationships of *Saintpaulia* (Gesneriaceae) based on ribosomal DNA internal transcribed spacer (ITS) sequences. *American Journal of Botany* 84: 956–965.
- Möller, M. & Cronk, Q.C.B. (1997b) Phylogeny and disjunct distribution: evolution of *Saintpaulia* (Gesneriaceae). *Proceedings of the Royal Society of London B*, 264: 1827–1836.
- Möller, M. & Cronk, Q.C.B. (1999) New approaches to the systematics of *Saintpaulia* and *Streptocarpus*. Pp. 253–264. In: Andrews, S., Leslie, A. & Alexander, C. (eds.), *Taxonomy of Cultivated Plants*. Third International Symposium. Kew, Royal Botanic Gardens, Kew.
- Möller, M. & Cronk, Q.C.B. (2001). Evolution of morphological novelty: a phylogenetic analysis of growth patterns in *Streptocarpus* (Gesneriaceae). *Evolution* 55: 918–929.
- Schulman, L. & Kolehmainen, J. (2004) Saving wild African violets (*Saintpaulia*, Gesneriaceae): a review of ongoing activities and a plan for ex situ conservation. *Scripta Botanica Belgica* 29: 165–170.
- Watkins, C., Kolehmainen, J. & Schulman, L. (2002) *The wild African violet Saintpaulia (Gesneriaceae) – an interim guide*. Worldstage, Cambridge.
- Weber, A. & Burt, B.L. (1998) Remodeling of *Didymocarpus* and associated genera (Gesneriaceae). *Beiträge zur Biologie der Pflanzen* 70: 293–363.
- Wendland, H. (1893) *Saintpaulia ionantha*. *Gartenflora* 42: 321–324, pl. 1391, fig. 66.