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Chromosome Numbers of South African Acanthaceae

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Original meiotic chromosome counts are presented for 19 species in 14 genera of Acanthaceae from South Africa. These counts represent the initial reports of chromosome numbers from southern African Acanthaceae. Chromosome numbers of 13 species representing 11 genera are reported for the first time. The counts in *Aulojusticia*, *Duvernoia*, and *Metarungia* are the first for these genera. Counts for five species confirm numbers previously reported for them based on plants from other regions. A new chromosome number is reported in *Justicia* (n = 26 in *J. petiolaris*). Systematic implications of these chromosome counts are addressed.

The Acanthaceae are a large (ca. 4000 species in some 230 genera) pantropical family with major concentrations of species in southeastern mainland Asia, insular Malesia, the Indian subcontinent, Madagascar, tropical Africa, Brazil, Andean South America, and Mexico-Central America. Knowledge of chromosome numbers among Acanthaceae has proven useful in resolving generic positions of problematic species, reassessing phylogenetic relationships among subfamilial taxa, and understanding morphological variation (e.g., Ensermu Kelbessa 1990; Daniel and Chuang 1993; McDade et al. in press). A major problem with using chromosome number data in the study of systematic and evolutionary relationships among Acanthaceae is that numbers remain unknown for the vast majority of both genera and species. Daniel (2000) noted that chromosome numbers had been reported for only 29% of the genera and less than 12% of the species of Acanthaceae. Similarly, chromosome numbers remain undetermined for five of the 12 tribes recognized by Bremekamp (1965) in the family: Haselhoffieae, Louteridieae, Rhombochlamydeae, Stenandriopsideae, and Whitfieldieae. Another problem is the lack of, or poor sampling of, species from regions rich in Acanthaceae but underrepresented by chromosome counts of them. One such region, as identified by Daniel (2000), is southern Africa. This region, comprising Namibia, Botswana, South Africa, Lesotho, and Swaziland, has an acanthaceous flora of some 341 species (Welman 1993). Chromosome numbers have been reported previously for 28 of these (see Appendix), but none of these reports was based on collections from southern Africa. This study of chromosome numbers in selected Acanthaceae from South Africa is our first attempt to provide this systematically useful information for taxa from this region.

Methods

In February and March of 1999, floral buds and herbarium vouchers of South African Acanthaceae were collected from their native habitats and from plants cultivated in gardens. Buds were fixed in absolute ethanol:glacial acetic acid (3:1) for 24 hours and subsequently washed and stored in ethanol (70%) until analyzed. Anthers were macerated in ferric acetocarmine (1%) on a microscope slide, squashed under a coverslip by hand, and studied under oil immersion on a phase contrast microscope at a magnification of 1000×. Counts were made from microsporocytes in various stages of meiosis. Preparations from which counts were obtained were recorded with camera lucida drawings. Voucher specimens are deposited at CAS and J. The camera lucida drawings are attached to the vouchers at CAS.

In the following discussion, all previously published chromosome counts are listed as *n* (gametic, haploid, meiotic) numbers irrespective of whether they were originally reported as gametophytic or sporophytic numbers. Voucher specimens, if they exist, documenting previous counts by other workers have not been examined.

Results

Chromosome numbers determined for 19 species representing 14 genera of Acanthaceae from South Africa are summarized in Table 1 and illustrated in Figures 1–3. Chromosome numbers of 13 of these taxa are reported for the first time. The counts for *Aulojusticia*, *Duvernoia*, and *Metarungia* represent the first reports for these genera. Counts for five species (*Asystasia gangetica*, *Hypoestes aristata*, *H. forskaolii*, *Justicia betonica*, and *Rhinacanthus gracilis*) agree with some or all numbers previously reported for them from different sources. The chromosome number reported here for *Justicia odora* is the first non-approximate number reported for the species. The count of $n = 26$ for *J. petiolaris* is the first report of this number in the genus.

Discussion

Asystasia Blume. Fifty or more species are recognized in this genus, which is native to the Old World. Eight species are known from southern Africa (Welman 1993). Daniel (2000) summarized previous reports of chromosome numbers in both *A. gangetica* and in the genus. Although a diversity of meiotic numbers, including 14, 22, 24 and 25, has been reported for *A. gangetica*, counts of $n = 13$ and $n = 26$ are much more common. A meiotic number of 13 is also the most frequently reported chromosome number among other species in the genus.

Asystasia gangetica has a broad distribution, occurring indigenously in southern and tropical Africa and in the Indian subcontinent. It has become naturalized in several other tropical regions (e.g., Hawaii, Java). Previous counts (including those reported for *A. coromandeliana* Nees; see summary of counts in Daniel 2000) have come from plants in cultivation (without provenance data; e.g., Grant 1955), from the Indian subcontinent (e.g., Valsala Devi and Mathew 1982), from tropical west Africa (e.g., Gadella 1977), and from plants naturalized outside of the native range of the species (e.g., Daniel 2000). Our count of $n = 13$ for a southern African representative of the species reveals a continuity of chromosome number with plants from other portions of the species' range. Plants from which our count was determined would appear to be diploid within the species. As indicated by Daniel (2000), a basic number of $x = 13$ appears likely for the genus.

Aulojusticia Lindau. Our count of $n = 40$ for *A. linifolia* is the first chromosome count for this genus. *Aulojusticia* has been variably treated by students of Acanthaceae: Dyer (1975) recognized it as a unispecific genus endemic to northeastern South Africa; Graham (1988) included it within her broad

TABLE 1. Meiotic chromosome counts of South African Acanthaceae. Note: Counts for *Duvernoia aconitiflora*, *Justicia petiolaris*, *Metarungia longistrobus*, *Pseuderanthemum hildebrandtii*, and *Ruspolia hypocrateriformis* were obtained from plants in cultivation; * indicates first counts for taxa.

Taxon	Chromosome number (*n*)	Locality (province)	Collection number (Daniel et al.)
Asystasia gangetica (L.) T. Anderson	13	KwaZulu-Natal	9348
Aulojusticia linifolia Lindau	40*	Mpumalanga	9388
Barleria senensis Klotzsch	16*	Mpumalanga	9375
Crabbea angustifolia Nees	21*	Mpumalanga	9370
Dicliptera heterostegia Presl. ex Nees	15*	KwaZulu-Natal	9329
Dicliptera magaliesbergensis K. Balkwill	13*	Gauteng	9357
Duvernoia aconitiflora A. Meeuse	17*	Gauteng	9361
Hypoestes aristata (Vahl) Sol. ex R. & S.	30	KwaZulu-Natal	9351
Hypoestes forskaolii (Vahl) R.Br.	15	Gauteng	9358
Isoglossa hypoestiflora Lindau	17*	KwaZulu-Natal	9341
Isoglossa ovata (Nees) Lindau	17*	KwaZulu-Natal	9336
Justicia betonica L.	17	KwaZulu-Natal	9330
Justicia betonica L.	17	KwaZulu-Natal	9334
Justicia odora (Forssk.) Lam.	14	North-West	9364
Justicia petiolaris (Nees) T. Anderson	26*	Mpumalanga	9387
Metarungia longistrobus (C. B. Cl.) Baden	14*	Gauteng	9355
Pseuderanthemum hildebrandtii Lindau	21*	Mpumalanga	9394
Rhinacanthus gracilis Klotzsch	15	KwaZulu-Natal	9340
Rhinacanthus gracilis Klotzsch	15	KwaZulu-Natal	9328
Ruspolia hypocrateriformis (Vahl) Milne-Redh.	21*	Gauteng	9359
Ruttya ovata Harv.	21*	KwaZulu-Natal	9338

circumscription of *Justicia*; and Immelman (1995a) treated it as *Siphonoglossa linifolia* (Lindau) C. B. Clarke. *Siphonoglossa*, which is based on an American type, is conspecific with *Justicia* (Graham 1988, Daniel 1995). Molecular studies that seek to improve our understanding of *Justicia* and allied genera in Africa are currently underway. *Aulojusticia* undoubtedly falls within the morphological circumscription of *Justicia* as delimited by Graham. If treated in that genus, the chromosome number here reported for *A. linifolia* would be the highest number so far known in *Justicia*; the highest number previously reported is $n = 34$ (Daniel 2000). Also, if treated in *Justicia*, which appears to have a basic number of $x = 7$ (see below), then this species likely would have been derived from a hexaploid ancestor.

Barleria L. *Barleria* is a pantropical genus of perennial herbs and shrubs comprising some 300 species. The majority of species are African and 69 occur in southern Africa (Balkwill and Balkwill 1997). Daniel and Chuang (1989, 1998) summarized previously reported chromosome numbers in *Barleria*. They noted the prevalence of $n = 20$ among species of the genus and the likelihood of $x = 20$ as a basic number in the genus.

Our count of $n = 16$ for *Barleria senensis* is the first count for this species, which is native to southern and tropical Africa. Previously, this number has been reported in the genus once for *B. cristata* L. (Datta and Maiti 1970, as "*B. cristata* var. *dichotoma*"). There are many counts for this species and most of them are $n = 20$ (Daniel and Chuang 1989). Because these two species are treated in different subgenera of *Barleria* (Balkwill and Balkwill 1997), a common chromosome number between them is doubtfully due to common ancestry.

Barleria was treated in tribe Barlerieae by Lindau (1895) and in tribe Ruellieae, subtribe Barleriinae by Bremekamp (1965) and Balkwill and Getliffe Norris (1988). Based on DNA sequence data (Hedrén et al. 1995; Scotland et al. 1995; McDade and Moody 1999), *Crabbea* and *Lepidagathis* would appear to be closely related to *Barleria*. A chromosome number of $n = 21$ has been reported in species from each of these three genera (Chuang et al. 1963; Grant 1964; De 1966; Daniel in press, see below) suggesting a possible symplesiomorphic number among them. Additional counts of species in *Barleria* are needed in order to ascertain whether knowledge of chromosome numbers will help to resolve infrageneric relationships.

Crabbea Harv. Two previous chromosome counts have been reported for this African genus of about 12 species, seven of which occur in southern Africa (Welman 1993). Our count of $n = 21$ for the South African endemic, *C. angustifolia*, is the first report of a chromosome number in the species. It agrees with a previous count for *C. velutina* S. Moore (Grant 1964, as *C. reticulata* C. B. Clarke). Renard et al. (1983) reported $n =$ ca. 14 for *C. velutina*.

Based on the few counts for species of *Crabbea*, a basic number of $x = 21$ is tentatively proposed for the genus. Lindau (1895) included *Crabbea* in his tribe Barlerieae and the genus would be included in Bremekamp's (1965) tribe Ruellieae, subtribe Barleriinae. As noted above under *Barleria*, this number is known in the related genera *Barleria* and *Lepidagathis*. Balkwill and Getliffe Norris (1988) advocated the placement of *Crabbea* in the Ruellieae, Ruelliinae. Among genera of Ruelliinae for which chromosome numbers are known, $n = 21$ has been reported in several species of *Eranthemum* L. (e.g., Kaur 1970; Govindarajan and Subramanian 1985; Mangenot and Mangenot 1958, 1962).

Dicliptera Juss. Chromosome numbers have been reported for 22 of the more than 100 species of perennial herbs and shrubs in this pantropical genus. Fifteen of these species are from the New World and seven are native to the Old World. Counts for all New World species are $n = 40$ (or $n =$ ca. 40; Daniel 2000, Daniel and Chuang 1993, Piovano and Bernardello 1991) whereas previous counts of species from the Old World comprise $n = 10, 13, 15, 24$, and 26 (with $n = 13$ being most frequently reported; Daniel and Chuang 1993). The species of *Dicliptera* from the Old World that were studied are all indigenous to Asia and comprise: *D. bupleuroides* Nees, *D. cuneata* Nees, *D. elegans* W. W. Smith [Kaur (1970) identified this taxon as "*Dicliptera elegans* Dalz.," and neither the source of the plant nor a voucher was cited; Dalziel did not publish a species with this name and whether the plant studied by Kaur is actually the Chinese species described by Smith or an Indian taxon is not known], *D. leonotis* Dalziel ex C. B. Clarke, *D. parvibracteata* Nees, *D. roxburghiana* Nees, and *D. verticillata* (Forsk.) C. Chr. Although two of these species (i.e., *D. leonotis* and *D. verticillata*) also occur in tropical Africa, chromosome numbers for all of the Old World species of *Dicliptera* were apparently determined from Asian populations. Our counts would therefore appear to be the first from African plants, and the first for species of *Dicliptera* native to southern Africa. Twelve species of *Dicliptera* are known to occur in southern Africa (Balkwill et al. 1996). The count of $n = 13$ for *D. magaliesbergensis* agrees with the majority of previous counts for Old World species. The count of $n = 15$ for *D. heterostegia* agrees with a count by Kaur (1970) for the widespread Paleotropical species *D. verticillata*.

Daniel et al. (1990) noted that the difference in ploidal level between species of *Dicliptera* in the Old and New Worlds suggests a major geographical division in the genus. Recent phylogenetic studies of the Justicieae that included Paleotropical and Neotropical species of *Dicliptera* indicate that the genus is monophyletic and is related to *Hypoestes* and *Peristrophe* in subtribe Diclipterinae (McDade et al. in press).

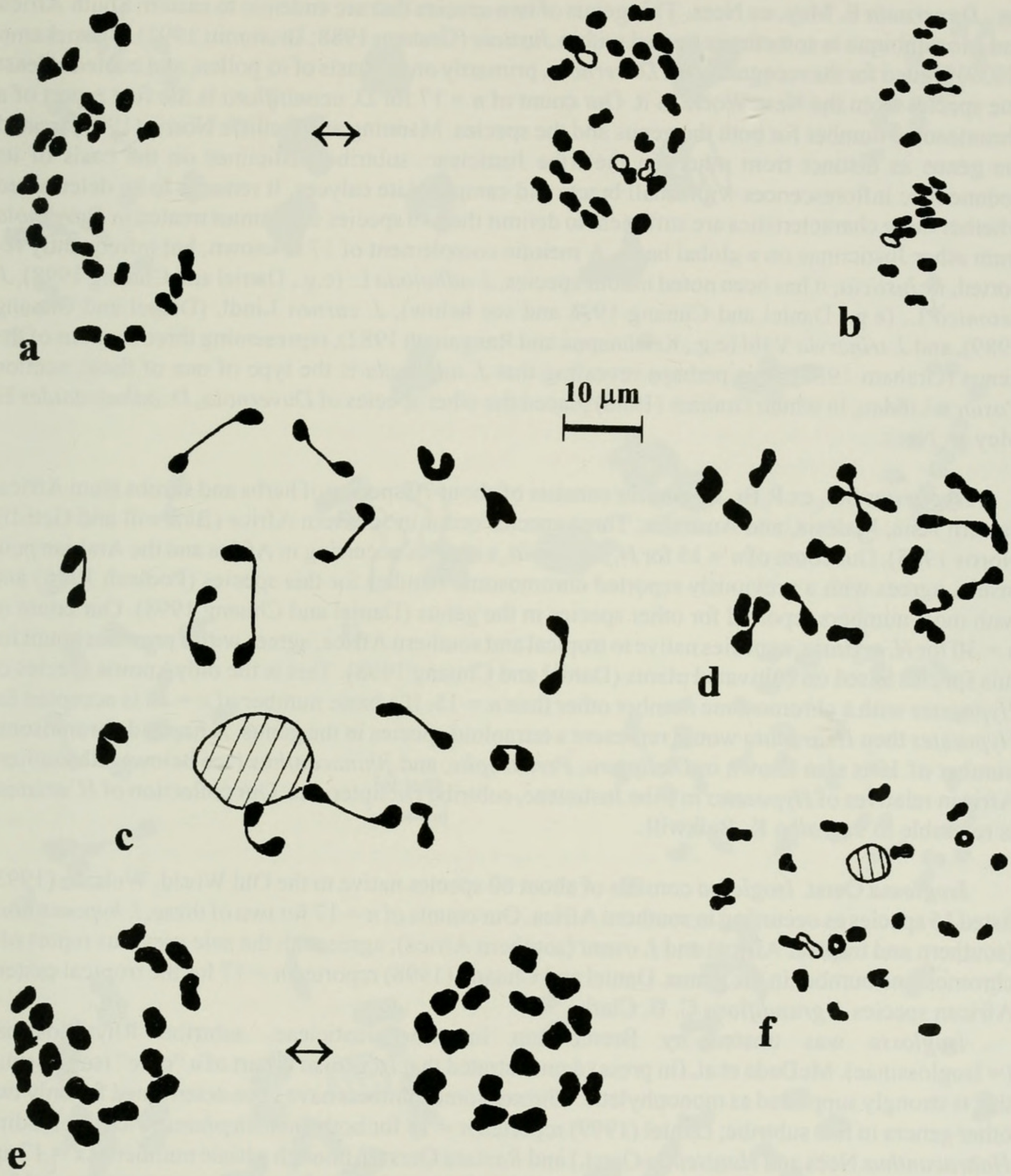

FIGURE 1. Camera-lucida drawings of meiotic chromosome preparations. a. *Justicia petiolaris* (*Daniel et al. 9387*), $n = 26$ (telophase I). b. *Ruttya ovata* (*Daniel et al. 9338*), $n = 21$ (metaphase I). c. *Dicliptera heterostegia* (*Daniel et al. 9329*), $n = 15$ (diakinesis I). d. *Duvernoia aconitiflora* (*Daniel et al. 9361*), $n = 17$ (metaphase I). e. *Isoglossa ovata* (*Daniel et al. 9336*), $n = 17$ (telophase I). f. *Pseuderanthemum hildebrandtii* (*Daniel et al. 9394*), $n = 21$ (diakenesis I).

Piovano and Bernardello (1991) noted that, based on chromosome numbers so far reported in *Dicliptera*, $x = 10$ is likely the basic number of the genus. The occurrence of $n = 15$ in species of all genera of Diclipterinae, however, suggests that $x = 15$ is symplesiomorphic for both the subtribe and *Dicliptera* (Daniel and Chuang 1993, McDade et al. in press).

Duvernoia E. Mey. ex Nees. This genus of two species that are endemic to eastern South Africa and Mozambique is sometimes treated within *Justicia* (Graham 1988; Brummitt 1992). Bremekamp (1939) argued for the recognition of *Duvernoia*, primarily on the basis of its pollen, and treated at least one species from the New World in it. Our count of $n = 17$ for *D. aconitiflora* is the first report of a chromosome number for both the genus and the species. Manning and Getliffe Norris (1995) treated the genus as distinct from others in the tribe Justicieae, subtribe Justiciinae on the basis of its pedunculate inflorescences with small bracts and campanulate calyces. It remains to be determined whether these characteristics are sufficient to delimit the two species sometimes treated in *Duvernoia* from other Justiciinae on a global basis. A meiotic complement of 17 is known, but infrequently reported, in *Justicia*; it has been noted in four species, *J. adhatoda* L. (e.g., Daniel and Chuang 1998), *J. betonica* L. (e.g., Daniel and Chuang 1998 and see below), *J. carnea* Lindl. (Daniel and Chuang 1989), and *J. trinervia* Vahl (e.g., Krishnappa and Ranganath 1982), representing three sections of the genus (Graham 1988). It is perhaps revealing that *J. adhatoda* is the type of one of these, section *Vasiaca* Lindau, in which Graham (1988) placed the other species of *Duvernoia*, *D. adhatodoides* E. Mey ex Nees.

Hypoestes Sol. ex R.Br. *Hypoestes* consists of about 70 species of herbs and shrubs from Africa, eastern Asia, Malesia, and Australia. Three species occur in southern Africa (Balkwill and Getliffe Norris 1985). Our count of $n = 15$ for *H. forskaolii*, a species occurring in Africa and the Arabian peninsula, agrees with a previously reported chromosome number for this species (Podlech 1986) and with most numbers reported for other species in the genus (Daniel and Chuang 1998). Our count of $n = 30$ for *H. aristata*, a species native to tropical and southern Africa, agrees with a previous count for this species based on cultivated plants (Daniel and Chuang 1998). This is the only known species of *Hypoestes* with a chromosome number other than $n = 15$. If a basic number of $x = 15$ is accepted for *Hypoestes* then *H. aristata* would represent a tetraploid species in the genus. A haploid chromosome number of 15 is also known in *Dicliptera*, *Peristrophe*, and *Rhinacanthus* (see below), all southern African relatives of *Hypoestes* in tribe Justicieae, subtribe Diclipterinae. Our collection of *H. aristata* is referable to var. *alba* K. Balkwill.

Isoglossa Oerst. *Isoglossa* consists of about 60 species native to the Old World. Welman (1993) listed 15 species as occurring in southern Africa. Our counts of $n = 17$ for two of these, *I. hypoestiflora* (southern and tropical Africa) and *I. ovata* (southern Africa), agree with the sole previous report of a chromosome number in the genus. Daniel and Chuang (1998) reported $n = 17$ for the tropical eastern African species *I. grandiflora* C. B. Clarke.

Isoglossa was treated by Bremekamp in tribe Justicieae, subtribe Rhytiglossinae (= Isoglossinae). McDade et al. (in press) demonstrated that *Isoglossa* is part of a "core" Isoglossinae that is strongly supported as monophyletic. Chromosome numbers have been determined for only two other genera in this subtribe; Daniel (1999) reported $n = 18$ for both *Stenostephanus* Nees (including *Habracanthus* Nees and *Hansteinia* Oerst.) and *Razisea* Oerst. Although a basic number of $x = 17$ appears likely for *Isoglossa*, and may represent dysploid evolution from an ancestor with $x = 18$, a well-substantiated basic number for the subtribe remains to be determined.

Justicia L. *Justicia* is the largest genus of Acanthaceae with estimates of about 700 species occurring worldwide (McDade et al. in press). Twenty-two species were recognized by Immelman (1995b) in the treatment of Acanthaceae: Justicieae for the *Flora of Southern Africa*. Several other genera from the region that are recognized in the *Flora of Southern Africa* (i.e., *Adhatoda* Mill., *Aulojusticia*, *Duvernoia*, *Siphonoglossa* Oerst.) are sometimes included in *Justicia* (Graham 1988, Brummitt 1992) as well. Daniel (2000) noted the presence, frequency, and distribution of 21 chromosome numbers reported for 93 species in the genus. He noted the prevalence of $n = 14$ throughout *Justicia* and a

FIGURE 2. Camera-lucida drawings of meiotic chromosome preparations. a. *Justicia betonica* (*Daniel et al. 9334*), $n = 17$ (metaphase I). b. *Isoglossa hypoestiflora* (*Daniel et al. 9341*), $n = 17$ (diakenesis I). c. *Barleria senensis* (*Daniel et al. 9375*), $n = 16$ (telophase I). d. *Asystasia gangetica* (*Daniel et al. 9348*), $n = 13$ (metaphase I). e. *Aulojusticia linifolia* (*Daniel et al. 9388*), $n = 40$ (metaphase I). f. *Justicia odora* (*Daniel et al. 9364*), $n = 14$ (diakenesis I). g. *Crabbea angustifolia* (*Daniel et al. 9370*), $n = 21$ (early metaphase I).

probable basic number of $x = 7$ for the genus. Within *Justicia* several sections are characterized by a diversity of chromosome numbers whereas others are homogeneous in the counts reported (Daniel 2000).

Our counts for three species of southern African *Justicia* illustrate the diversity of numbers reported in the genus. The counts of $n = 17$ for two collections of *J. betonica* agree with the majority of previous counts for this native of Africa and the Indian subcontinent (Daniel 2000, Daniel and Chuang 1998). Hedrén (1989) reported n = ca. 13 from a Tanzanian collection of the African and Arabian species, *J. odora*. Our count for this species, based on a collection from South Africa, is $n = 14$. This number has been reported previously in 10 of the 13 sections of *Justicia* recognized by Graham (1988) in which at least one chromosome number has been reported. This is the first report of $n = 14$ in section *Harnieria* (Solms) Benth., however. Our count of $n = 26$ in *J. petiolaris*, a species occurring in eastern South Africa and Swaziland, represents the first report of a chromosome number for the species. It is also the first report of this chromosome number in the genus. Graham (1988) treated *J. petiolaris* in sect. *Tyloglossa* (Hochst.) Lindau. The only other chromosome number known among the species included in this section by Graham is $n = 13$, which has been reported several times (e.g., Mangenot and Mangenot 1962, Podlech 1986) in *J. flava* (Vahl) Vahl. Our collection of *J. petiolaris* pertains to subspecies *petiolaris*. Chromosome numbers reported here for South African species of *Justicia* reflect the putative polyploid and dysploid evolution seen for the genus in other regions (Daniel 2000). Given the large number of species of *Justicia*, its worldwide distribution, and the diversity of chromosome numbers already reported within it, additional cytological studies of the genus are highly desirable.

Metarungia Baden. This genus comprises three species occurring in eastern and southern Africa (Baden 1981, 1984). Our count of $n = 14$ for *M. longistrobus*, a species native to South Africa, Swaziland, and Mozambique, is the first report of a chromosome number in the genus. *Metarungia* is closely related to *Rungia* Nees in the tribe Justicieae and these genera are sister to a clade that includes *Justicia* (McDade et al. in press). Numerous counts have been reported for each of four species of *Rungia*. Counts for three of these (i.e., *R. laeta* C. B. Clarke, *R. parviflora* Nees, and *R. pectinata* (L.) Nees) are mostly $n = 13$ or $n = 26$. Most counts for *Rungia repens* Nees are $n = 10$. Although $n = 14$ is not known in *Rungia*, this is the most commonly reported number in *Justicia* (Daniel 2000).

Pseuderanthemum Radlk. *Pseuderanthemum* consists of about 60 species of perennial herbs and shrubs occurring in both the Old and New Worlds. Two species are known from southern Africa, *P. subviscosum* (C. B. Clarke) Stapf and *P. hildebrandtii* (Welman 1993; Edwards and Harrison 1998). Our count of $n = 21$ for *P. hildebrandtii*, which is native to southern Africa and tropical east Africa, is the first report of a chromosome number for this species and for an African species of the genus. Chromosome numbers have been reported for seven other species of *Pseuderanthemum* native to America, southern Asia, and the Pacific Islands (Daniel and Chuang 1989, 1998; Daniel 2000). Six of these have meiotic complements of 21. Kaur (1969) reported $n = 30$ for the Fijian species, *P. laxiflorum* (A. Gray) F. T. Hubb. As noted by Daniel and Chuang (1998), a basic number of $x = 21$ appears likely for this genus as well as for several of its relatives in the Justicieae. McDade et al. (in press) identified a lineage of Justicieae, including *Pseuderanthemum*, characterized by an androecium of two stamens and two staminodes and by $x = 21$. New World relatives include *Chileranthemum* Oerst., *Odontonema* Nees, and *Oplonia* Raf. Old World relatives include *Ruspolia* and *Ruttya*.

Rhinacanthus Nees. *Rhinacanthus* comprises about 20 species occurring in Africa, Madagascar, and Asia. Three species are known in southern Africa (Balkwill 1995). One of these, *R. gracilis*, is sometimes cultivated. Daniel and Chuang (1998) reported a count of $n = 15$ from cultivated materials of this species. Our count of $n = 15$ from two wild-collected plants of the same species confirms the previous count. All other counts reported for species of *Rhinacanthus* are likewise $n = 15$ (Daniel and

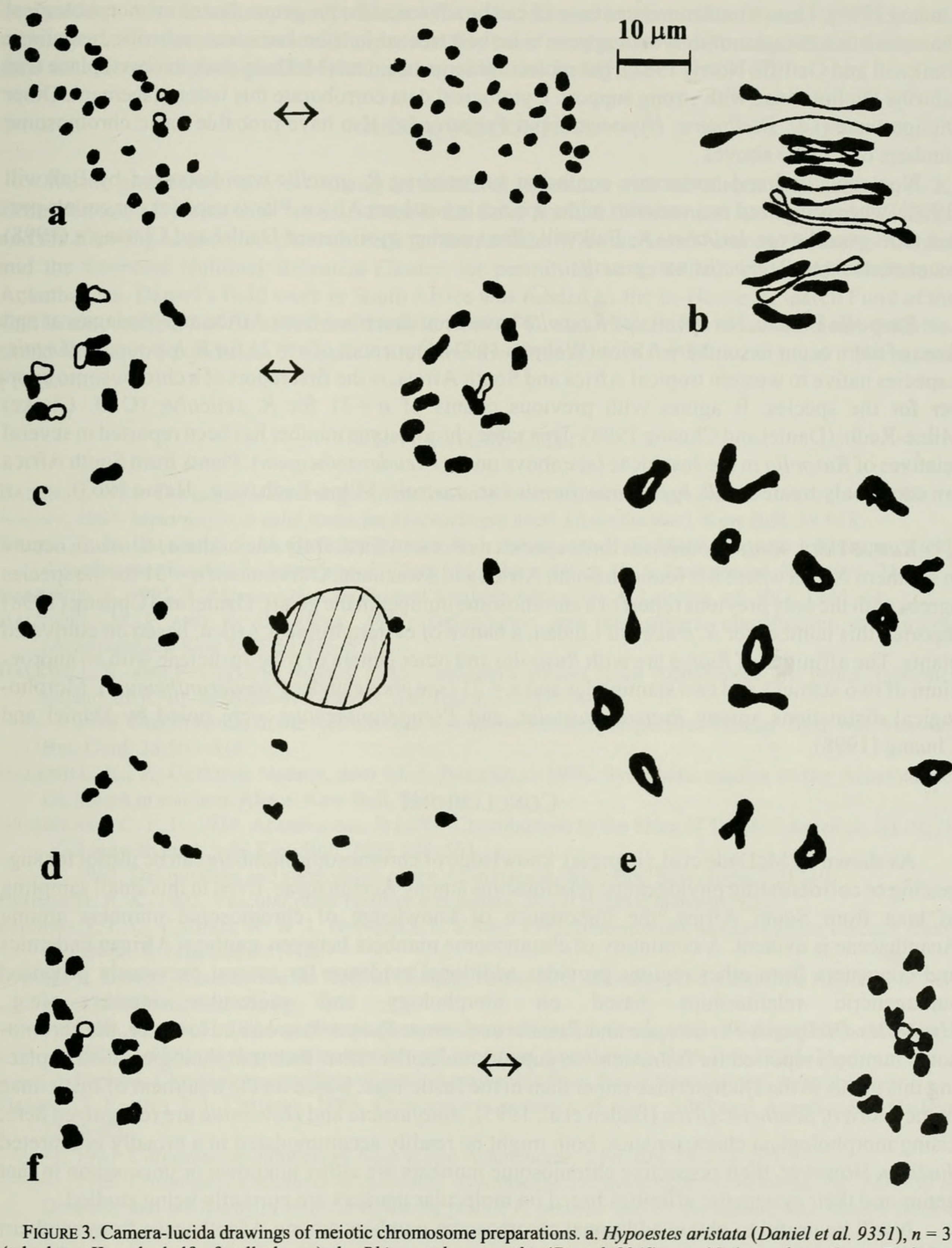

FIGURE 3. Camera-lucida drawings of meiotic chromosome preparations. a. *Hypoestes aristata* (*Daniel et al. 9351*), $n = 30$ (telophase II, only half of cell shown). b. *Rhinacanthus gracilis* (*Daniel 9340*), $n = 15$ (metaphase I). c. *Dicliptera magaliesbergensis* (*Daniel et al. 9357*), $n = 13$ (telophase I). d. *Ruspolia hypocrateriformis* (*Daniel et al. 9359*), $n = 21$ (diakenesis I). e. *Hypoestes forskaolii* (*Daniel et al. 9358*), $n = 15$ (diakenesis I). f. *Metarungia longistrobus* (*Daniel et al. 9355*), $n = 14$ (telophase I).

Chuang 1998). Thus, a basic number of $x = 15$ can be advanced for the genus. Based on morphological characteristics *Rhinacanthus* would appear to be best treated in tribe Justicieae, subtribe Justiciinae (Balkwill and Getliffe Norris 1988), but molecular sequence data (McDade et al. in press) place it in subtribe Diclipterinae with strong support. Cytological data corroborate this latter placement. Other Diclipterinae (i.e., *Dicliptera*, *Hypoestes*, and *Peristrophe*) also have probable basic chromosome numbers of 15 (see above).

Nomenclatural and taxonomic confusion surrounding *R. gracilis* was discussed by Balkwill (1995), who recognized two varieties of the species in southern Africa. Plants used for our counts pertain to *R. gracilis* var. *latilabris* K. Balkwill. The voucher specimen of Daniel and Chuang's (1998) count pertains to *R. gracilis* var. *gracilis*.

Ruspolia Lindau. Six species of *Ruspolia* have been described from Africa and Madagascar and three of them occur in southern Africa (Welman 1993). Our count of $n = 21$ for *R. hypocrateriformis*, a species native to western tropical Africa and South Africa, is the first report of a chromosome number for the species. It agrees with previous counts of $n = 21$ for *R. seticalyx* (C. B. Clarke) Milne-Redh. (Daniel and Chuang 1998). This same chromosome number has been reported in several relatives of *Ruspolia* in the Justicieae (see above under *Pseuderanthemum*). Plants from South Africa are commonly treated as *R. hypocrateriformis* var. *australis* Milne-Redh. (e.g., Heine 1963).

Ruttya Harv. *Ruttya* comprises three species native to Africa. Only one of these, *R. ovata*, occurs in southern Africa where it is found in South Africa and Swaziland. Our count of $n = 21$ for the species agrees with the only previous report of a chromosome number in the genus. Daniel and Chuang (1998) reported this number for *R. fruticosa* Lindau, a native of eastern tropical Africa, based on cultivated plants. The affinities of *Ruttya* are with *Ruspolia* and other genera of tribe Justicieae with an androecium of two stamens and two staminodes and $x = 21$ (see above under *Pseuderanthemum*). Morphological distinctions among *Ruttya*, *Ruspolia*, and *Pseuderanthemum* were noted by Daniel and Chuang (1998).

CONCLUSIONS

As shown by McDade et al. (in press), knowledge of chromosome numbers can be useful for suggesting or corroborating phylogenetic relationships among Acanthaceae. Even in this small sampling of taxa from South Africa, the importance of knowledge of chromosome numbers among Acanthaceae is evident. A continuity of chromosome numbers between southern African endemics and congeners from other regions provides additional evidence for several previously proposed suprageneric relationships based on morphology and molecular markers (e.g., *Hypoestes-Dicliptera-Peristrophe* and *Pseuderanthemum-Ruttya-Ruspolia*). However, the chromosome numbers reported for *Rhinacanthus* support molecular rather than morphological data in placing this genus in the Diclipterinae rather than in the Justiciinae. Based on the treatment of Justiciinae in the *Flora of Southern Africa* (Baden et al. 1995), *Aulojusticia* and *Duvernoia* are recognized here. Using morphological characteristics, both might be readily accommodated in a broadly interpreted *Justicia*. However, their respective chromosome numbers are either unknown or uncommon in that genus and their systematic affinities based on molecular markers are currently being studied.

It will be useful to obtain additional chromosome numbers among Acanthaceae from southern Africa by sampling more taxa from South Africa as well as from other countries in the region. For example, chromosome numbers remain unknown for the following acanthaceous genera that occur in southern Africa: *Acanthopsis* Harv., *Anisotes* Nees, *Chaetacanthus* Nees, *Chorisochora* Vollesen, *Duosperma* Dayton, *Glossochilus* Nees, *Megalochlamys* Lindau, *Neuracanthus* Nees, and *Ruelliopsis* C. B. Clarke. Also, no chromosome counts have been determined for Acanthaceae from any southern African country except South Africa. An increase in the number of taxa for which chromosome numbers are known would help to identify basic numbers for additional genera and assist efforts to understand phylogenetic relationships within the family.

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APPENDIX

Species occurring in southern Africa for which chromosome numbers have been published previously. The taxon name is followed by the author of the name, the chromosome number(s) reported (listed as *n* numbers), literature citation(s), and the country from which the plants studied came. The provenance of the plants is based on information provided in the original publications. Two references with chromosome numbers (both Ph.D. theses) have not been seen and the probable provenance is indicated with a question mark and "not seen" follows. In other publications, where the source of materials studied is unclear or not provided, a question mark is indicated. The provenance of cultivated plants noted below is unknown.

Acanthus pubescens (Oliv.) Engl., *n* = 28, Renard et al. 1983 (Burundi).

Asystasia gangetica (L.) T. Anderson (including *A. coromandeliana* Nees), *n* = 13: Mangenot and Mangenot 1957 (western Africa), Mangenot and Mangenot 1962 (western Africa), Gadella 1977 (Cameroun), Ugborogho and Adetula 1988 (Nigeria); 14: Subramanian and Govindarajan 1980 (India), Govindarajan and Subramanian 1983 (India); 22: Narayanan 1951a (India?); 24: Narayanan 1951a (India?); 25: De 1966 (India?), Sarkar et al. 1978 (India, cultivated); 26: Narayanan 1951b (India), Grant 1955 (U.S. A., cultivated), Ellis 1962 (India), Kaur 1965 (India, cultivated), Valsala Devi and Mathew 1982 (India), Saggoo and Bir 1983 (India), Saggoo and Bir 1986 (India), Daniel 2000 (U.S. A., naturalized).

Barleria repens Nees, *n* = 20: Daniel and Chuang 1998 (cultivated).

Blepharis integrifolia (L.f.) E. Mey. (including *B. molluginifolia* Pers. and *B. repens* (Vahl) Roth), *n* = 17: Kaur 1966 (India, probably cultivated), Sareen and Sanjogta 1976 (India), Ranganath 1981 (India? not seen), Krishnappa and Ranganath 1982 (India), Ranganath and Krishnappa 1982 (India); *n* = 18: Govindarajan and Subramanian 1983 (India), Subramanian and Govindarajan 1980 (India).

B. maderaspatensis (L.f.) Heyne ex Roth (including *B. boerhaaviaefolia* Pers.), *n* = 8: Valsala Devi and Mathew 1982 (India), Saggoo 1983 (India?, not seen), Saggoo and Bir 1982a (India), 1983 (India), 1986 (India), Govindarajan and Subramanian 1983 (India); *n* = 11: Ranganath 1981 (India? not seen), Krishnappa and Ranganath 1982 (India), Ranganath and Krishnappa 1982 (India); *n* = 12: Ranganath and Krishnappa 1982 (India); *n* = 13: Kaur 1966 (India), Sareen and Sanjogta 1976 (India); *n* = 14: Vasudevan 1976 (India), Subramanian and Govindarajan 1980 (India); *n* = 15: Miège 1962 (Senegal), Bir and Saggoo 1979 (India), Saggoo 1983 (India? not seen), Bir and Saggoo 1981 (India), Saggoo and Bir 1982b (India), 1983 (India); 2n = 23: Ranganath and Krishnappa 1982 (India).

Crabbea velutina S. Moore (including *C. reticulata* C. B. Clarke), *n* = ca. 14: Renard et al. 1983 (Rwanda); *n* = 21, Grant 1964 (cultivated).

Dyschoriste depressa Nees, *n* = 15: Govindarajan and Subramanian 1985 (India); *n* = 30: Bir and Saggoo 1979 (India), 1981 (India), Saggoo 1983 (India? not seen), Saggoo and Bir 1982b (India).

Elytraria acaulis (L.f.) Lindau, *n* = 17: Kaur 1969 (India?); *n* = 22: Govindarajan and Subramanian 1983 (India); *n* = 23: Subramanian and Govindarajan 1980 (India).

Hygrophila auriculata (Schum.) Heine (including *Asteracantha longifolia*), *n* = 16, De 1966 (India?), Trivedi and Trivedi 1992 (India), Subramanyam and Kamble 1971 (India), Saggoo 1983 (India? not seen), Bir and Saggoo 1981 (India), Saggoo and Bir 1982b (India), 1986 (India).

Hypoestes aristata R.Br., *n* = 30, Daniel and Chuang 1998 (cultivated).

H. forskaollii Vahl, *n* = 15, Podlech 1986 (Yemen).

H. triflora Roem. and Schult., *n* = 15: Saggoo 1983 (India? not seen), Sagoo and Bir 1982a (India), 1983 (India).

Justicia anagalloides (Nees) T. Anderson, *n* = 9: Ensermu Kelbessa 1990 (Ethiopia); *n* = 18: Ensermu Kelbessa 1990 (Ethiopia).

J. betonica L., *n* = 14: Subramanian and Govindarajan 1980 (India), Narayanan 1951b (India?); *n* = 17: Ellis 1962 (India), Ranganath 1981 (India?, not seen), Bir and Saggoo 1979 (India), Krishnappa and Ranganath 1982 (India), Saggoo 1983 (India?, not seen), Valsala Devi and Mathew 1982 (India), Govindarajan and Subramanian 1983 (India), Bir and Saggoo 1981 (India), Saggoo and Bir 1982b (India), 1986 (India), Daniel and Chuang 1998 (cultivated), Daniel 2000 (U.S. A., naturalized).

J. exigua S. Moore, *n* = 7: Renard et al. 1983 (Rwanda), Ensermu Kelbessa 1990 (Ethiopia, Tanzania).

J. flava (Forssk.) Vahl, *n* = 13: Mangenot and Mangenot 1957 (western Africa), 1962 (western Africa), Podlech 1986 (Yemen).

J. glabra Koenig ex Roxb., *n* = 27: Ranganath 1981 (India? not seen), Krishnappa and Ranganath 1982 (India).

J. matammensis (Schweinf.) Oliv., *n* = 7: Ensermu Kelbessa 1990 (Ethiopia).

J. odora (Forssk.) Lam., *n* = ca. 13: Hedrén 1989 (Tanzania).

Mackaya bella Harv., *n* = 42: Daniel and Chuang 1989 (cultivated).

Nelsonia canescens (Lam.) Spreng., *n* = 17: Saggoo 1983 (India? not seen), Saggoo and Bir 1983 (India); *n* = 18: Daniel and Chuang 1993 (Panama).

Peristrophe paniculata (Forssk.) Brummitt (including *P. bicalyculata* (Retz.) Nees), *n* = 10: Narayanan 1951b (India); *n* = 15: Ahuja 1955 (India), Miège and Josserand 1972 (Senegal), Vasudevan 1976 (India), Saggoo and Bir 1983 (India), 1986 (India), Verma and Dhillon 1967 (India).

Phaulopsis imbricata (Forssk.) Sweet, *n* = 16: Manktelow 1996 (Ethiopia, Tanzania, Madagascar); *n* = 17: Daniel and Chuang 1998 (cultivated); *n* = ca. 32: Manktelow 1996 (Madagascar); 2n = 65: Manktelow 1996 (Malawi).

Rhinacanthus gracilis Klotz., *n* = 15: Daniel and Chuang 1998 (cultivated).

Ruellia cordata Thunb., *n* = 16, Rao and Mwasumbi 1981 (Tanzania, probably cultivated).

R. patula Jacq., *n* = 16: Baquar et al. 1966 (Pakistan), Rao and Mwasumbi 1981 (Tanzania, probably cultivated), Govindarajan and Subramanian 1983 (India), Subramanian and Govindarajan 1980 (India).

Ruspolia seticalyx (C. B. Clarke) Milne-Redh., *n* = 21: Daniel and Chuang 1998 (cultivated).

Thunbergia alata Boj., *n* = 9: Grant 1955 (cultivated), Takizawa 1957 (cultivated), Shibata 1962 (Colombia, naturalized), Saggoo 1983 (India?, not seen), Bir and Saggoo 1981 (India), Saggoo and Bir 1982b (India), 1986 (India), Daniel and Chuang 1989 (cultivated), Sugiura 1931 (cultivated?), Tijo 1948 (Indonesia), Narayanan 1951b (India), Kaur 1970 (India?); *n* = 16: Snoad 1952 (cultivated).

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