

A Taxonomic Revision of *Amphitrichae*, a New Section of *Crotalaria* (Fabaceae)

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Abstract—*Crotalaria* sect. *Amphitrichae* is described as new to give formal recognition to a strongly supported clade revealed by a recent molecular systematic study. The five known species are restricted to the arid western parts of southern Africa (*C. colorata*, *C. excisa*, *C. humilis*, *C. meyeriana*, and *C. pearsonii*). Species of the section are morphologically distinct in having (1) hairs distributed all around the distal part of the style; (2) ridge callosities on the standard petal blade and claw; (3) a rounded keel; (4) a twisted keel beak; and (5) a rounded style. A cladistic analysis of 18 morphological characters resulted in a well-resolved cladogram that recovers relationships within the section. The study revealed that two new species should be recognised, described here as *C. giessii* and *C. kolbergii*. A taxonomic revision of the section is presented, with descriptions, diagnostic characters, distribution maps, and illustrations of all seven recognised species.

Keywords—Amphistylar hairs, *Crotalaria giessii*, *Crotalaria kolbergii*, new species, ridge callosities, southern Africa.

Recent molecular systematic studies of the genus *Crotalaria* L. (Le Roux et al. in prep.) revealed a distinct monophyletic group of five closely related species (*C. colorata* Schinz, *C. excisa* (Thunb.) Baker f., *C. humilis* Eckl. and Zeyh., *C. meyeriana* Steud., and *C. pearsonii* Baker f.), all with amphistylar hairs and ridge callosities on the standard petals (Le Roux and van Wyk 2012). These species were previously part of sect. *Crotalaria* (Bisby and Polhill 1973; Polhill 1982), but some doubt was expressed by the authors regarding their placement because of the anomalous combination of unspecialized and specialized floral characters.

The vegetative and reproductive morphology of some species of the new section is shown in Fig. 1. Of special taxonomic value are the presence of ridge callosities (Fig. 1L) at the base of the standard petal blade that extends slightly onto the claw, combined with a rounded keel (with the curvature more or less in or below the middle; Fig. 1A, E, H), a twisted keel beak (twisted more than 180°; Fig. 1A), and trichomes present all around the distal part of the style (Fig. 1K). The last-mentioned character is particularly useful as diagnostic character and is reflected in the name *Amphitrichae*.

The new section is endemic to the dry western coastal parts of South Africa and southern Namibia (Fig. 2). The species occur mostly in the Succulent Karoo biome, extending northwards into the Namib Desert (as far north as Swakopmund) and southwards into the Fynbos biome, as far south as the Cape Peninsula. This is unlike the typical Grassland or Savanna distribution patterns for the rest of the genus (Polhill 1982; Wardell-Johnson 2000).

Amphitrichae is here described as a new section, along with the revision of seven species, including four subspecies and two new species. A cladistic analysis of relationships within the section based on morphological characters is also presented.

MATERIALS AND METHODS

Herbarium specimens from BOL, GRA, JRAU, NBG (including SAM), PRE, and WIND as well as digital images photographed in K and UPS were studied. Field work was conducted to view some of the plants in their natural habitat. Operational taxonomic units (OTUs) were identified (based on morphological and geographical variation) for each taxon and three measurements per character for three specimens per OTU were taken where possible. Floral dissections were done and individual parts

illustrated using a WILD M3Z stereomicroscope with a *camera lucida* attachment. Distribution maps were drawn using the Quarter Degree Reference System (Leistner and Morris 1976). It is composed of a one-degree square taken from the latitude and longitude of the north-west corner (e.g. 22°17') accompanied by a name of the closest town or place of importance (e.g. Windhoek) and a subdivision of the one-degree square, these being subdivided into half-degree squares labeled A and B above and C and D below. Each of these are consecutively subdivided into quarter-degree units in the same manner as for the half-degree units, giving a total of 16 units for each degree square, which are then appended to the degree numbers to yield an alpha-numeric coordinate reference (e.g. 2217CC Windhoek).

A cladistic analysis was done using 18 morphological characters that were coded as binary or multistate characters and inapplicable data as missing. *Crotalaria monophylla* Germish. (sect. *Geniculatae* Polhill) was chosen as outgroup. The molecular study (Le Roux et al. in prep.) indicated that sect. *Geniculatae* is sister to sect. *Amphitrichae*. Furthermore, *C. monophylla* is the only other species in the entire genus that also has amphistylar hairs. The 18 characters used in the analysis were unordered and evenly weighted (Appendices 1 and 2). The dataset is archived in TreeBASE (study number S12676). Analysis was conducted using maximum parsimony analysis (MP; Fitch 1971) in PAUP* version 4.0b10 (Swofford 2002). A heuristic search was conducted with 1,000 random sequence additions and holding 10 trees per replicate with tree bisection-reconnection (TBR) branch swapping and the MULTREES options in effect. Delayed transformation character optimization (DELTRAN) was used to illustrate branch lengths. Internal support was determined using bootstrap analysis (Felsenstein 1985) with 1,000 replicates and heuristic search settings as described above. Bootstrap values were evaluated according to the following scale: 50–74%, low; 75–84%, moderate; 85–100%, strong.

RESULTS AND DISCUSSION

Morphology—LIFE HISTORY AND GROWTH FORM—Species in sect. *Amphitrichae* have often been confused, but subtle differences in the habit are important to distinguish between them (Fig. 3). All the species are perennial herbs (Figs. 1C, F, I, J, and 3A–D, G–I) except for two species that are annuals; *C. giessii* (closely related to *C. meyeriana*) and *C. humilis* (similar to *C. excisa*) (Fig. 3E, F). The annuals can be easily distinguished by the stems all originating from the same point at ground level, while the perennials have the basal stems branching alternately and thus arising irregularly at different heights, mostly above ground level (e.g. *C. colorata* Schinz subsp. *erecta* (Schinz) Polhill, Fig. 3A) but sometimes below (as in the two subspecies of *C. excisa*, Fig. 3C, D). Most species have a decumbent growth form, but *C. colorata*, *C. kolbergii*, and *C. pearsonii* are virgate to erect (Figs. 1F; 3A, B, H, I).



FIG. 1. Diagnostic characters and habit of some species of *Crotalaria* sect. *Amphitrichae*. Note the flower (A, E, H), and fruit structure (B, D, G), rounded keel petals with twisted keel beaks (A, E, H), amphistylar hairs (K), and ridged callosities (L), as well as the variation in habit (C, F, I, J). A. *Crotalaria humilis*. B, C. *C. excisa* subsp. *excisa*. D, E, F. *C. kolbergii*. G, H, I. *C. meyeriana*. J, *C. colorata* subsp. *erecta*. Photographs: A and B by B.-E. van Wyk, C, K, and L by M. M. le Roux, D–F by H. Kolberg, and G–J by C. Mannheimer.

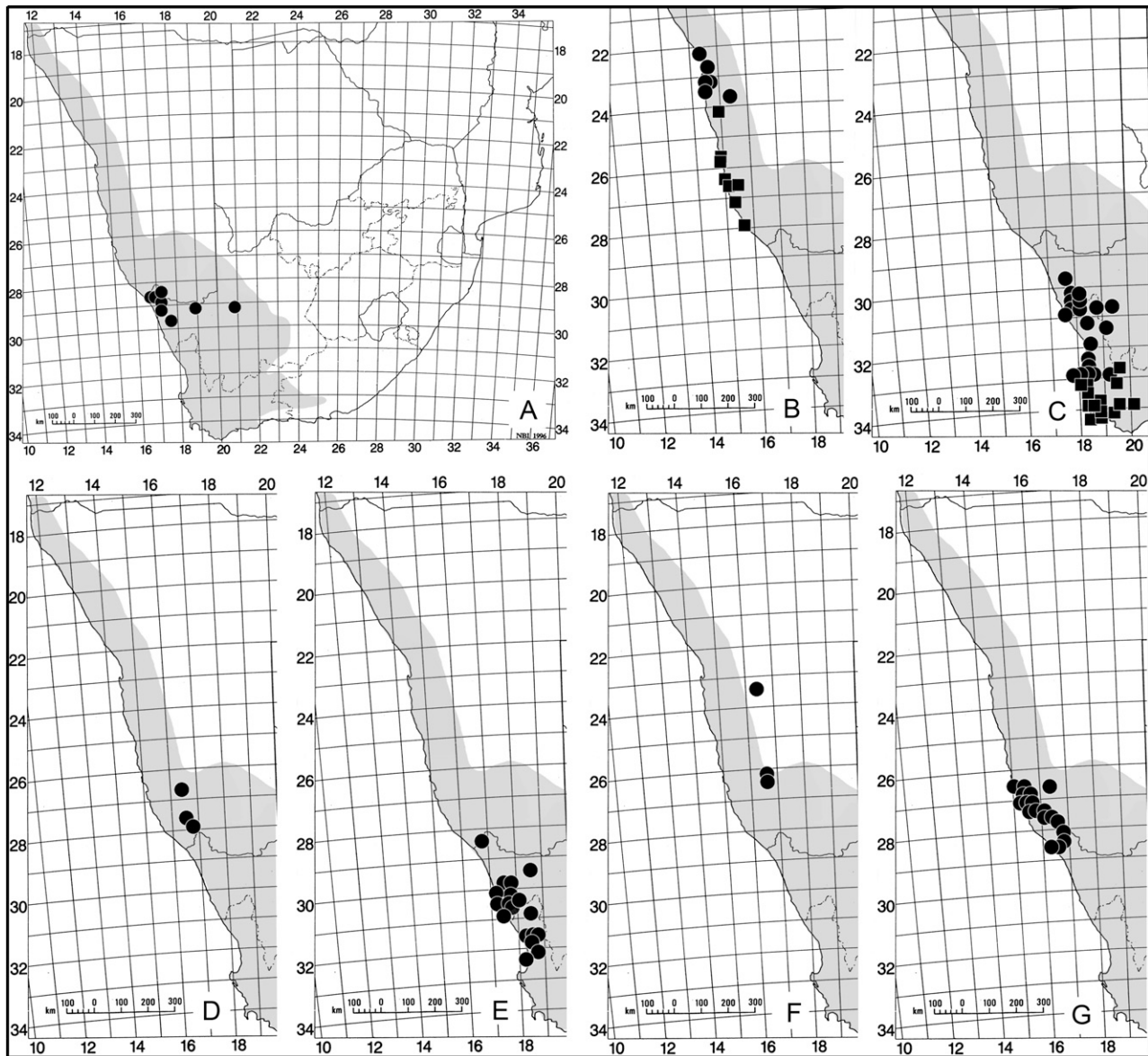


FIG. 2. Distribution maps of the species of *Crotalaria* sect. *Amphitrichae*. The grey zone represents the area of summer aridity (within the 75 mm isohyet of summer rain, i.e. total rainfall for December, January, and February less than 75 mm). Note the almost perfect agreement between summer aridity and the distribution of the species. A. *Crotalaria pearsonii*. B. *C. colorata* subsp. *colorata* (rectangles) and *C. colorata* subsp. *erecta* (circles). C. *C. excisa* subsp. *excisa* (rectangles) and *C. excisa* subsp. *namaquensis* (circles). D. *C. giessii*. E. *C. humilis*. F. *C. kolbergii*. G. *C. meyeriana*.

INDUMENTUM—The density, orientation, and length of hairs on the stems, leaves and floral parts are taxonomically informative. *Crotalaria colorata* has sericeous hairs – appressed in subsp. *colorata* with the hairs up to ± 1 mm in length; spreading in subsp. *erecta* with the hairs ± 1 mm in length or longer. *Crotalaria meyeriana* (Figs. 1G–I; 3G) and *C. giessii* both have pilose hairs, while *C. excisa*, *C. humilis*, *C. pearsonii*, and *C. kolbergii* are all pubescent to strigose (Fig. 1A, B, D, E).

STIPULES—All species except *C. pearsonii* have persistent linear to subulate or lanceolate stipules (Fig. 4), varying from 0.5–3.0 mm in length (up to 8 mm in *C. colorata*). Stipules are rarely present on specimens of *C. pearsonii*.

LEAVES—All the species have trifoliolate leaves (Fig. 4) but they differ in the relative length of the petiole, the size and shape of the leaflets and the leaf apices. The length of the petiole is as long as or longer than the terminal leaflet in

C. excisa and *C. humilis* (Fig. 4B3, D3, respectively), but shorter than or equal to the terminal leaflet in all the other species. *Crotalaria colorata*, *C. giessii*, *C. meyeriana*, and *C. pearsonii* have obovate-elliptic leaflets, often with somewhat retuse apices (even mucronulate in *C. colorata*) but obtuse in *C. pearsonii* (Fig. 4G3) and linear with acute apices in *C. kolbergii* (Fig. 4F3). Leaf size is generally variable but *C. giessii* has relatively small leaflets of less than 10 mm long (Fig. 4C3). Hairs are confined to the lower surface of the leaflets, except in *C. colorata* where they cover both surfaces (Figs. 3A, 4A3). *Crotalaria meyeriana* also has hairs on the upper surface, but only along the margins (the area in the middle of the leaflet is glabrous).

INFLORESCENCES—Terminal or leaf-opposed racemose inflorescences are present in all the species (Fig. 3) but they differ in the number of flowers – usually more than six flowers per inflorescence, few-flowered in *C. excisa* (one to



FIG. 3. Selected herbarium specimens of the seven species (including four subspecies) of *Crotalaria* sect. *Amphitrichae*, showing differences in the habit and vestiture. A. *Crotalaria colorata* subsp. *erecta* (densely sericeous). B. *Crotalaria colorata* subsp. *colorata* (sericeous). C. *Crotalaria excisa* subsp. *excisa* (perennial with branches at different levels). D. *Crotalaria excisa* subsp. *namaquensis* (perennial with branches at different levels, large flowers). E. *Crotalaria giessii* (small annual). F. *Crotalaria humilis* (annual, branches all at ground level). G. *Crotalaria meyeriana* (perennial, pilose). H. *Crotalaria kolbergii* (perennial, leaflets linear). I. *Crotalaria pearsonii* (perennial, leaflets obovate). A. Giess and Van Vuuren 735 (WIND). B. Giess 9571 (WIND). C. Tölken 6 (PRE). D. Bean and Viviers 1705 (BOL). E. Giess 13765 (WIND). F. Perolt 1645 (BOL). G. Meyer 50 (WIND). H. Kolberg and Tholkes HK 804 (WIND). I. Marloth 12445 (PRE).

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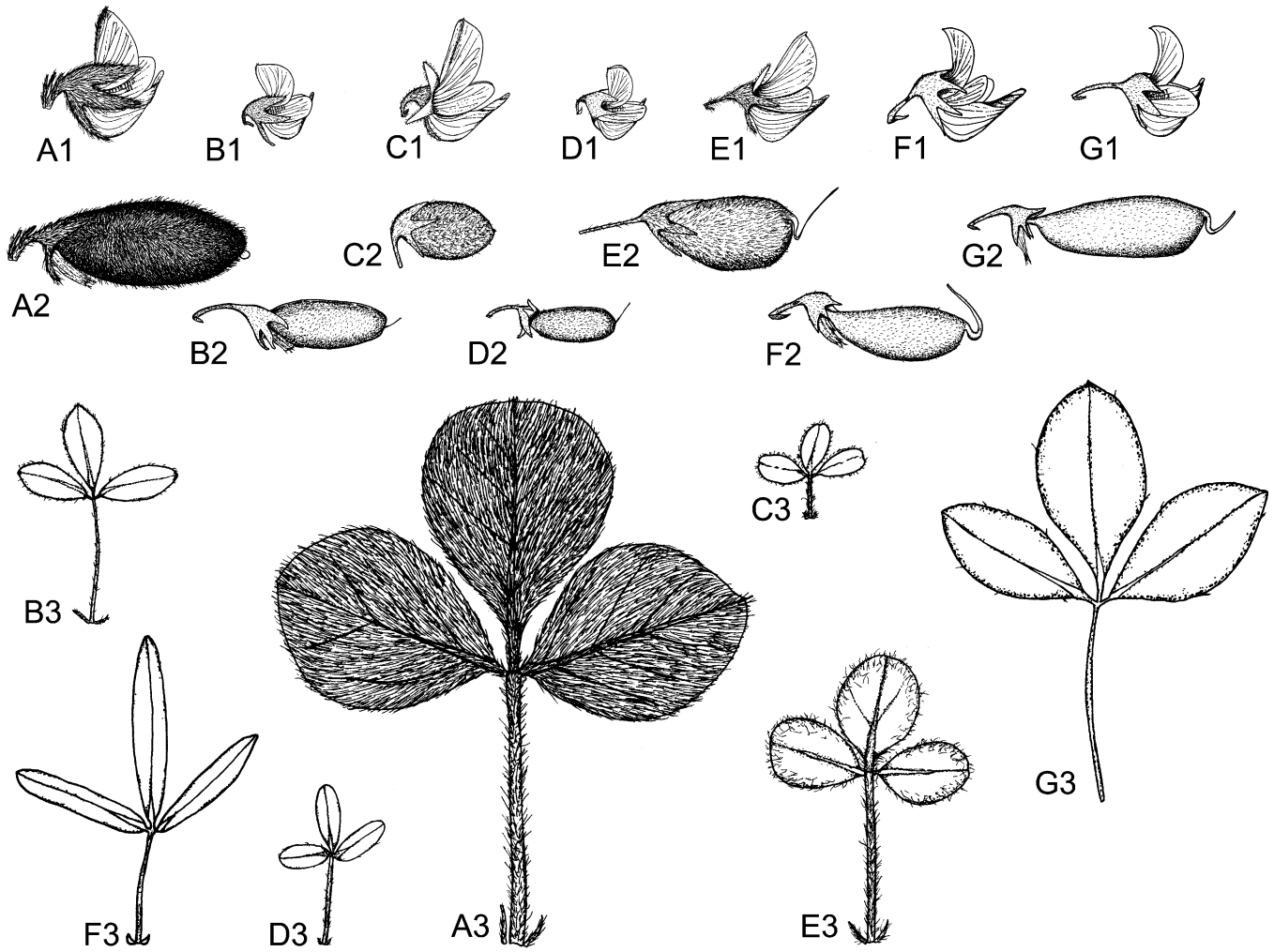


FIG. 4. Flowers, fruits, and leaves of all seven species of *Crotalaria* sect. *Amphitrichae*, showing differences in size, shape, and vestiture. A1–G1. Flowers. A2–G2. Fruits. A3–G3. Leaves and stipules (adaxial view). A. *Crotalaria colorata* subsp. *erecta*. B1, B3. *C. excisa* subsp. *excisa*. B2. *C. excisa* subsp. *namaquensis*. C. *C. giessii*. D. *C. humilis*. E. *C. meyeriana*. F. *C. kolbergii*. G. *C. pearsonii*. A1. Kolberg and Maggs 172 (WIND). A2. Merxmüller and Giess 28371 (PRE). A3. Giess and Van Vuuren 735 (PRE). B1. Tölken 6 (PRE). B2. Rösch and Le Roux 1460 (PRE). B3. Van Wyk 2695 (JRAU). C1–3. Giess 13765 (WIND). D1. Thompson 2845 (PRE). D2. Thorne 52437 (NBG). D3. Koekemoer 2860 (PRE). E1. Müller 832 (PRE). E2. Kolberg and Maggs 174 (WIND). E3. Merxmüller and Giess 3045 (PRE). F1, F3. Kolberg and Tholkes HK 804 (WIND). F2. Germishuizen 8020 (PRE). G1–3. Marloth 12445 (PRE). Scale bar: 10 mm.

three, rarely up to six flowers except in the Kamiesberg Pass population) and *C. humilis* (two to seven flowers). Both *C. excisa* and *C. humilis* often have a slight extension of the rachis (absent in all other species). The flowers are invariably yellow, but purplish-veined only in *C. kolbergii* and *C. pearsonii*.

BRACTS AND BRACTEOLAS—Bracts are usually linear to subulate or lanceolate in shape (Fig. 5A8–G8) and of little diagnostic value except in *C. colorata*, where they are up to 6 mm long in subsp. *colorata* (Fig. 3B) and usually more than 6 mm in subsp. *erecta* (Fig. 3A). Bracteoles are generally inserted near the middle of the pedicel, but near the base of the calyx in *C. kolbergii*. The bracts and bracteoles are invariably persistent in all seven species.

CALYX—The calyx is equally lobed and always longer than the tube (Fig. 5A4–G4) but the indumentum differs, as noted above.

COROLLA—The shape of the standard petal varies from obovate to elliptic to sub-circular (Fig. 5A1–G1), with the apex obtuse or acute but retuse in *C. excisa*, *C. humilis*, and

C. pearsonii. The median area is sericeous or pilose in *C. colorata*, *C. meyeriana*, and *C. giessii* (Fig. 4A1, C1, E1) but strigose in *C. excisa*, *C. humilis*, *C. kolbergii*, and *C. pearsonii* (Fig. 4B1, D1, F1, G1), where the hairs are restricted to the midrib.

The wing petals are usually oblong to obovate (Fig. 5A2–G2) and as long as or slightly shorter than the keel in all the species, except *C. giessii* and *C. kolbergii* (Fig. 4A1–G1) where they are invariably shorter.

All species have a rounded keel with the curvature more or less in or just below the middle and a twisted keel beak (Figs. 4A1–G1 and 5A3–G3), but *C. giessii* (Fig. 5C3) has the curvature invariably below the middle with a straight and projecting beak.

ANDROECIUM—All species have a 5 + 5 anther arrangement (five long basifixed anthers alternating with five short dorsifixed ones). The androecium is of no diagnostic value at specific level (Fig. 5A5–G5).

GYNOCIUM—The presence of hairs all around the style is a unique character for the section, present in all the species

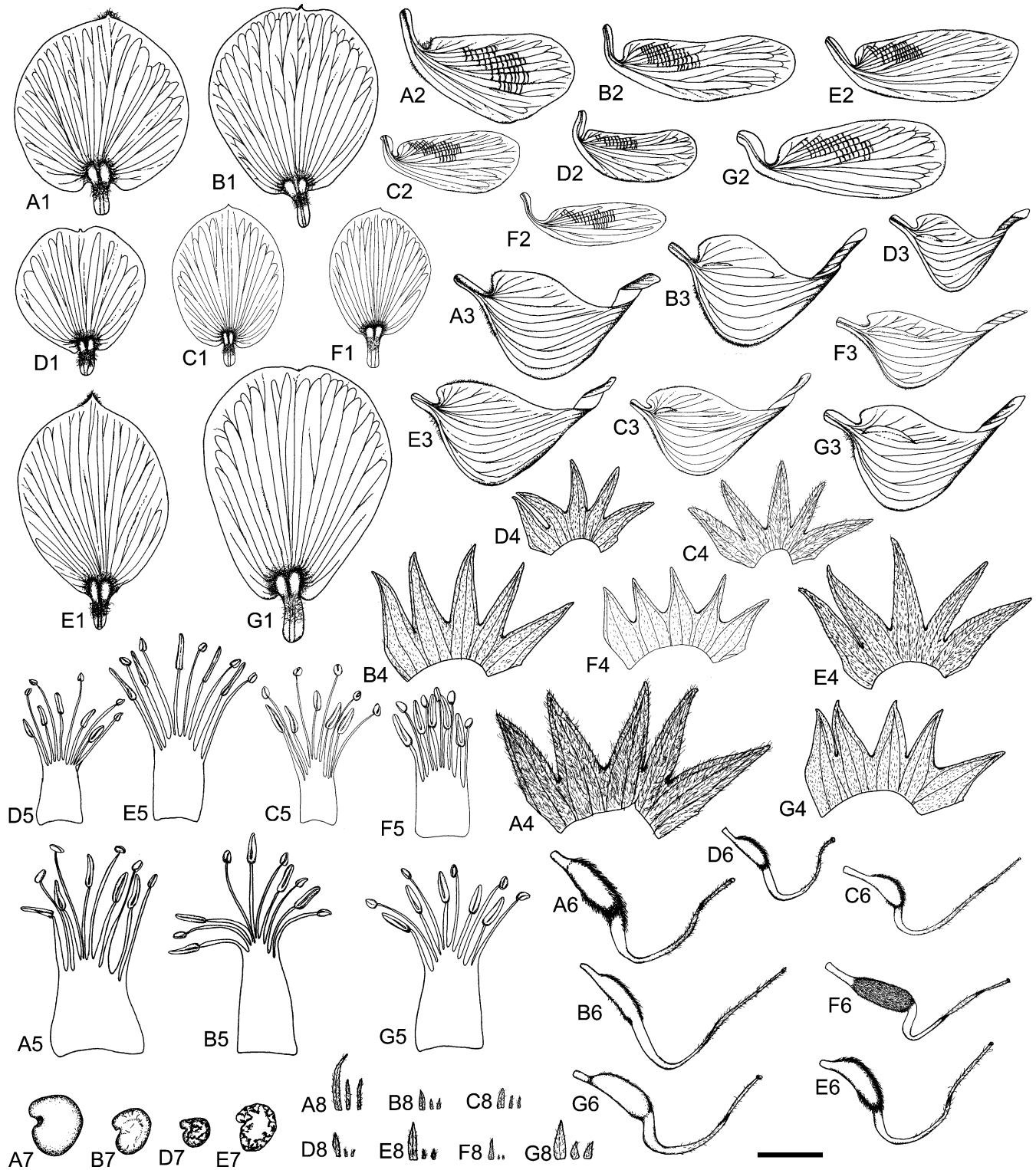


FIG. 5. Floral parts, bracts, bracteoles, and seeds of all seven species of *Crotalaria* sect. *Amphitrichae*, showing differences in size, shape, and vestiture. A1–G1. Standard petals. A2–G2. Wing petals. A3–G3. Keel petals. A4–G4. Calyces (upper lobes to the left). A5–G5. Androecia. A6–G6. Gynoecia. A7, B7, D7, E7. Seeds. A8–G8. Bracts and bracteoles. A. *Crotalaria colorata* subsp. *colorata*. B1–6. *C. excisa* subsp. *namaquensis*, B7, B8. *C. excisa* subsp. *excisa*. C. *C. giessii*. D. *C. humilis*. E. *C. meyeriana*. F. *C. kolbergii*. G. *C. pearsonii*. A1–6, A8. Giess 12426 (WIND). A7. Mannheim and Mannheim CM1683 (WIND). B1–6. Bean and Viviers 1705 (BOL). B7. Le Roux and Van Wyk 108 (JRAU). B8. Koekemoer 805 (PRE). C1–6, C8. Giess 13765 (WIND). D1–6, D8. Le Roux 2658 (BOL). D7. Thorne 52437 (SAM). E1–6, E8. Müller 832 (PRE). E7. Merxmüller and Giess 32051 (WIND). F1–6, F8. Germizhuizen 8020 (PRE). G1–6, G8. Dean 664 (JRAU). Scale bar: 10 mm.

(elsewhere only in *C. monophylla*). Hairs are also invariably present along the upper and lower margins of the terminal part of the ovary (Fig. 5A6–G6) but in *C. kolbergii* (Fig. 5F6) the entire ovary is densely covered with strigose hairs.

FRUITS—The shape of the fruit is oblong-clavate and strigose in *C. excisa*, *C. humilis*, *C. kolbergii*, and *C. pearsonii* (Fig. 4B2, D2, F2, G2). Both *C. colorata* (Fig. 4A2) and *C. meyeriana* (Fig. 4E2) have oblong-ellipsoid fruits, but they are densely sericeous in the former and pilose in the latter. *Crotalaria giessii* has ellipsoid and pilose fruits (Fig. 4C2).

SEEDS—The shape varies from reniform to oblique-cordate (Fig. 5A7, B7, D7, E7) with a rugulose to rugose surface in all species except *C. colorata* (smooth) and *C. excisa* (smooth and strigose). *Crotalaria excisa* and *C. humilis* are superficially very

similar but the distinct differences in the seeds are taxonomically useful.

GEOGRAPHICAL DISTRIBUTION—It is interesting to note the almost perfect agreement between summer aridity and the geographical distribution of sect. *Amphitrichae*. The section is the only one which reflects localised diversification and regional endemism, presumably resulting from adaptations to low winter rainfall and extremely dry summers (Fig. 2). All other sections are widely distributed.

Relationships in the Section—Fourteen of the 18 morphological characters (Appendices 1 and 2) were parsimony informative. The cladistic analysis resulted in a single tree (Fig. 6) with a length of 29 steps, a consistency index (CI) of 0.72 and a retention index (RI) of 0.68.

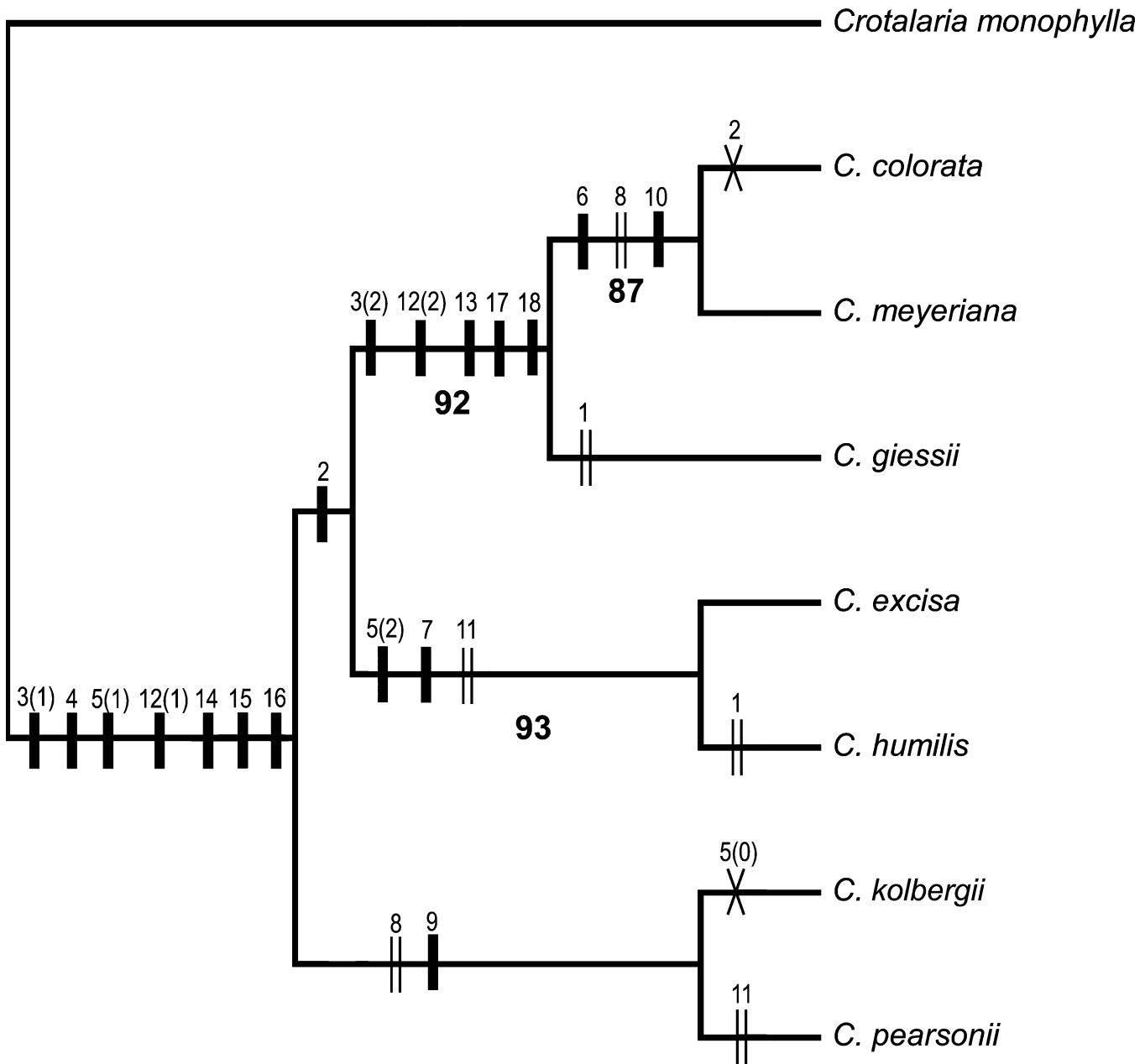


FIG. 6. Phylogenetic relationships of the seven species of *Crotalaria* sect. *Amphitrichae* as suggested by a cladistic analysis of 18 morphological characters (data presented in Appendices 1 and 2). Bootstrap values above 50% are shown below the branches and character state changes are indicated by numbers above the branches, accompanied by symbols (apomorphies shown with solid black bars, reversals shown with crosses and convergences indicated by parallel lines). Number of trees = 1; TL = 29; CI = 0.72; RI = 0.68.

Morphological variation was carefully considered and the tree in Fig. 6 represents a first hypothesis of relationships in the sect. *Amphitrichae*. This study revealed the presence of two undescribed species: *C. kolbergii* (sister to *C. pearsonii*) and *C. giessii* (sister to *C. meyeriana* and *C. colorata*, forming a strongly supported group with 92% BS). *Crotalaria colorata* and *C. meyeriana* are moderately supported as sister species (87% BS). *Crotalaria excisa* and *C. humilis* are closely related (93% BS).

TAXONOMIC TREATMENT

Crotalaria* section *Amphitrichae M. M. le Roux and B.-E. van Wyk sect. nov.—TYPE: *Crotalaria colorata* Schinz, here designated.

Crotalaria [unranked] *Oliganthae* Benth. in Hook., Lond. J. Bot. 2. 573. 1843; Baker in D. Oliver, Fl. Trop. Afr. 2. 8. 1871, non sensu Harv. ≡ *C.* subsect. *Oliganthae* (Benth.) Baker f., J. Linn. Soc. 42. 386. 1914.—LECTOTYPE: *Crotalaria humilis* Eckl. and Zeyh.

Species sect. *Amphitrichae* in morphologia similes sect. *Calycinae* et sect. *Crotalaria* subsect. *Crotalaria* sunt, sed praesentia pilorum distributorum percircum stylum, callorum porcatorum, carinis rotundis curvatura paululum circum vel infra medium et stylorum rotundorum differunt. In sect. *Calycinis* pilis distributis in una vel duabus lineis secus stylum, callis lamelliformibus, carinis plerumque subangulatis vel angulatis curvatura sub medio vel in triente inferiore, et stylis rotundis vel geniculatis. In sect. *Crotalaria* subsect. *Crotalaria* pilis distributis in lineis duobus secus stylum et callos discorum.

Decumbent to erect annual or perennial, up to 0.6 m in height, strigose to sericeous. Stipules usually present, linear, linear-lanceolate or subulate, 0.5–8.0 mm long, strigose to sericeous, persistent, rarely deciduous or absent. Leaves with petioles shorter to longer than the leaflets, 4–37 mm long; leaflets linear, elliptic to obovate or sub-circular, strigose to sericeous or glabrous; terminal leaflet 6–42 × 3–28 mm,

lateral leaflets 5–38 × 3–24 mm, acute to obtuse, often retuse or mucronulate. Inflorescences terminal or leaf-opposed raceme, 20–290 mm long, with 1–30 flowers; pedicels 2–13 mm long; bract linear-lanceolate to subulate, 1–11 mm long, pubescent or pilose to sericeous, persistent; bracteoles linear to subulate, 0.5–4.0 mm long, strigose to sericeous, persistent, inserted in the middle or near the top of the pedicel. Flowers yellow, sometimes with reddish-brown or purple veins. Calyx 5–13 mm long, strigose to sericeous, lobes as long as or longer than the tube; lobes 2–10 mm long, acuminate; tube 2–4 mm long. Standard lamina elliptic or obovate to sub-circular, 9–19 × 9–20 mm, with two ridge-shaped callosities at the bottom of the blade extending onto the claw, acute to obtuse or retuse and mucronulate, strigose to pilose-sericeous or glabrous; claw 2–4 mm long. Wings oblong to obovate, 10–20 × 2–10 mm, shorter to as long as the keel, with 5–12 rows of sculpturing; claw 2–4 mm long. Keel rostrate, 9–20 mm long, rounded in or below the middle with a straight or slightly incurved, twisted beak, pocket often present; claw 2–4 mm long. Pistil stipe 1–3 mm long; ovary 3–6 × 1–5 mm, with 8–20 ovules, strigose to densely sericeous; style rounded, 10–40 mm long, pilose all around, curved upwards. Fruits oblong-ellipsoid to rounded-elliptic or clavate, 13–37 × 4–16 mm, strigose to sericeous; stipe 1–4 mm long, tardily dehiscent. Seeds oblique-cordiform to sub-circular-reniform, 2–4 × 2–4 mm, rugose or smooth (with trichomes), yellow to brown and sometimes maculate.

Species of sect. *Amphitrichae* are morphologically similar to sect. *Calycinae* and sect. *Crotalaria* subsect. *Crotalaria*, but differ in having hairs distributed all around the style, ridge callosities, rounded keels with the curvature in or below the middle and rounded styles. Sect. *Calycinae* has hairs distributed in one or two lines along the style, lamelliform callosities, mostly sub-angled or angled keels with the curvature below the middle or in the lower third and rounded or geniculate styles. Sect. *Crotalaria* subsect. *Crotalaria* has hairs distributed along two lines on the style and disc callosities.

KEY TO SPECIES

1. Plants pilose or sericeous; back of standard petal pilose or sericeous along the entire apex; fruits oblong-elliptic 2
2. Plants annual; lower leaf surface pilose, upper surface glabrous 3. *C. giessii*
2. Plants perennial; lower and upper leaf surfaces pilose or sericeous 3
3. Habit erect; upper leaf surface sericeous throughout; flowers uniformly yellow; seeds smooth 1. *C. colorata*
3. Habit decumbent; upper leaf surface glabrous along the middle but pilose along the margins; flowers yellow, sometimes with reddish-brown veins; seeds rugose 2. *C. meyeriana*
1. Plants pubescent or strigose; back of standard petal strigose or glabrous along the midvein only; fruits elliptic-clavate 4
4. Habit erect; flowers yellow with purple veins 5
5. Leaves elliptic-obovate, stipules usually absent; standard petal elliptic-obovate, retuse; wing petals ± as long as the keel or slightly shorter 7. *C. pearsonii*
5. Leaves linear, stipules invariably present; standard petal ± elliptic, acute; wing petals usually shorter than the keel 6. *C. kolbergii*
4. Habit decumbent; flowers uniformly yellow 6
6. Plants annual; stems all originate from the same point at ground level with no branching above or below the ground 5. *C. humilis*
6. Plants perennial; stems originate at different heights, with branching above and /or below the ground 4. *C. excisa*

1. *CROTALARIA COLORATA* Schinz, Mem. Herb. Boissier. 1. 127. 1900; Baker f., J. Linn. Soc. 42. 359. 1914; I. Verd., Bothalia 2. 397. 1928; A. Schreib. in Merxm., Prod. Fl. SWA. 60. 22. 1970; Polhill, *Crotalaria* in Africa and Madagascar 263. 1982; Nkonki and Swelankomo in Germishuizen and Meyer, Strelitzia 14. 500. 2003.—TYPE: NAMIBIA. Erongo, Swakop (Tsoaxaub) River mouth (2214AB), *Dinter 1* (lecto-

type: Z, digital image! [*sub Z no. 000022616*], here designated; isolectotype: Z, digital image!).

Erect perennial, up to 0.6 m in height, sericeous. Stipules linear or linear-lanceolate, 1–8 mm long, sericeous, persistent. Leaves with petioles shorter than the leaflets, 9–37 mm long; leaflets obovate or elliptic, sericeous above and below;

terminal leaflet 17–42 × 7–28 mm, lateral leaflets 15–38 × 8–24 mm, obtuse, often retuse or mucronulate. Inflorescences terminal and leaf-opposed raceme, 30–210 mm long, with 4–27 flowers; pedicel 4–13 mm long; bract linear-lanceolate, 2–11 mm long, sericeous, persistent; bracteoles linear, 1–4 mm long, sericeous, persistent, inserted near the middle of the pedicel. Flowers yellow. Calyx 11–13 mm long, sericeous, lobes longer than the tube; lobes 8–10 mm long, acuminate; tube 3–4 mm long. Standard lamina sub-circular, 13–17 × 14–20 mm, obtuse, pubescent-sericeous medially; claw 3–4 mm long. Wings broadly obovate, 14–20 × 6–8 mm, ± as long as the keel, with 7–12 rows of sculpturing; claw 3–4 mm long. Keel 15–19 mm long, rounded ± in or below the middle with a straight or slightly incurved beak, small pocket often present; claw 3–4 mm long. Pistil stipe 1–2 mm long; ovary 5–6 × 2–5 mm, 9–16 ovules, densely sericeous along the upper and lower margins of the ovary; style 14–19 mm long. Fruits oblong-ellipsoid, 23–31 × 9–16 mm, sericeous; stipe 1–2 mm long. Seeds sub-circular-reniform, 3–4 × 3–4 mm, smooth, yellow-brown. Figures 4A, 5A.

Note—*Dinter 1 sub Z no. 000022616* is here selected as lectotype because Schinz was based in Z (Stafleu and Cowan 1985) and because it is the only sheet with flowers.

Diagnostic Characters—*Crotalaria colorata* is closely similar to *C. meyeriana*, but differs in the erect habit, sericeous indumentum (with hairs obscuring both the upper and lower surfaces of the leaflets), and smooth seeds. *Crotalaria meyeriana* has a decumbent habit, pilose indumentum (with the upper surface of the leaflet glabrous for the most part and the lower surface pilose but not obscured by the hairs), and rugose seeds.

Distribution and Habitat—The distribution of *C. colorata* is restricted to the sandy Namibian coastal area at altitudes below 600 m above sea level (with only one locality more inland in the Namib-Naukluft Park). *Crotalaria colorata* subsp. *colorata* occurs from the Swakopmund area southwards to Walvis Bay and Sandwich Harbour; subsp. *erecta* is allopatric and is found from the Spencer Bay area southwards to Lüderitz (Fig. 2B).

Phenology—Flowering specimens have been recorded for most months of the year (all months except February, June, and July). Fruiting specimens have been collected in April, May, and August to September. It seems as though flowering occurs sporadically in response to rain or stream flow along rivers.

Conservation Status—This species is not listed in Loots (2005) but is probably least concern, because both subspecies have a wide distribution area and are known from several localities.

1.1 CROTALARIA COLORATA SCHINZ SUBSP. COLORATA

Stem hairs appressed and short, usually less than 1 mm long. Leaves sericeous. Inflorescences 4–9(16)-flowered; bracts 2–6 mm long.

Representative Specimens Examined—NAMIBIA. Erongo: Swakopmund distr., Swakopmund, in the dunes (2214AB), 19 Jun 1955, *Seydel 598* (K), 7 Oct 1958, *Seydel s.n.* (K); Swakopmund River mouth (2214AB), 20 Jan 1907, *Pearson 7606* (K), 24 Jun 1955, *Seydel 698* (K); at Swakopmund in sand (2214DA), 30 Mar 1964, *Giess 7817* (WIND); in the Swakop River on the road to the Namib-Naukluft Park (2214DA), 12 Nov 1983, *Leuenberger, Raus and Schiers 3352* (PRE); Namib at Richthofen (2214DA), Feb 1935, *Dinter 8413* (BOL, K, WIND); S bank at Swakopmund (2214DA), 15 Nov 1966, *Giess 9571* (K, WIND); Swakop River (2214DA), 19 Apr 1972, *Schmidt 143* (WIND); Swakop River, ± 8 km from sea (2214DA), 8 Nov 1984, *Craven 1927* (WIND), 1 Oct 1968, *Jensen 40* (PRE); Swakopmund (2214DA), 12 Mar 1906, *Dinter*

206 (SAM), 28 Mar 1913, *Dinter 2796* (SAM), Nov 1924, *Rogers 29690* (GRA), 23 Oct 1956, *Seydel 8M* (K); Swakopmund at the railway bridge (2214DA), Jan 1963, *Watt sub Giess 2164* (WIND). Sandwich Harbour distr., on the road to Sandwich Harbour (2314AB), Jan 1960, *Jensen 88* (WIND); Sandwich Bay road, 10 km S of Walvis Bay (2314AB), 13 Apr 1987, *Long and Rae 763* (K); SE of Walvis Bay (2314AB), 15 Nov 1972, *Giess 12426* (WIND); 11 km S of Walvis Bay in dune valley (2314AB), Dec 1962, *Giess 5050* (K, WIND); Sandwich Harbour (2314AD), 31 May 1959, *Jensen 66* (WIND); Namib Desert Park, dunes E of Ronderduin (2314BA), 20 Apr 1981, *Ward 9409* (WIND). Rostock distr., Namib Desert Park: Kuiseb Canyon ca. 2 km above Nareb in dry sand of river bed (2315CB), 6 Jan 1979, *Ward 9210* (WIND).

1.2 CROTALARIA COLORATA SCHINZ SUBSP. ERECTA (Schinz) Polhill, *Crotalaria* in Africa and Madagascar. 263. 1982; Nkonki and Swelankomo in Germishuizen and Meyer, *Strelitzia* 14. 500. 2003. *Crotalaria mollis* var. *erecta* Schinz, *Abhandl. Bot. Verein Branden.* 30. 161. 1888. *Crotalaria erecta* (Schinz) Schinz ex Baker f., *J. Linn. Soc.* 42. 359. 1914. I. Verd., *Bothalia* 2. 397. 1928 non Pilger 1902 nom illegit.—TYPE: NAMIBIA. Hardap, Lüderitzbucht (Angra Pequena) (2615CA), *Schenck 1* (lectotype: BM!, fragment, here selected).

Crotalaria schultzei Harms in L. Schultze, *Aus Namaland und Kalahari.* 701. 1907.—TYPE: NAMIBIA. Namib, Angra Pequena, *Schultze 104* (B, holotypet).

Stem hairs slightly spreading and relatively long, ± 1 mm or more. Leaves velutinous-sericeous. Inflorescences 14–30-flowered; bracts (5)6–11 mm long.

Note—It appears that the fragment in BM is the only remaining type material of this taxon, as nothing could be found in Z or any other herbarium. It is noteworthy that Polhill (1968, 1982) also did not see the type specimens (*Schenck 1* and *Pohle s.n.*) even though several types from Z (of other species) were cited. The densely sericeous calyx of the lectotype clearly belongs to subsp. *erecta* so that there is no need to designate an epitype.

Representative Specimens Examined—NAMIBIA. Hardap: Sossusvlei distr., Diamond area No. 2 (2414BB), 18 May 1984, *Irish s.n.* (WIND). Karas: Spencer Bay distr., Spencer Bay (2514DB), 17 Jan 1973, *Seely-Robinson 419* (WIND); Spencer Bay, 2 km N of Sattelhügel, N Camp (2514DB), 14 Jan 1974, *Giess and Robinson 13201* (WIND); Spencer Bay, 3 km E of the coast (2514DB), 13 Jan 1974, *Giess and Robinson 13199* (WIND); Spencer Bay, 25°46'24"S 14°52'13"E (2514DD), 18 Sept 2001, *Mannheimer and Mannheimer CM1683* (GRA, WIND). Hottentot Bay distr., Aurus, not far from Hottentot Bay at the blue mountain (2614BD), 7 May 1967, *Sydow sub herb. Giess 10180* (WIND). Lüderitz distr., Kolmanskop (2615CA), 5 Oct 1922, *Dinter 4062* (BOL, K, PRE); Lüderitzbucht (2615CA), 16 Oct 1913, *Peter 47181* (K); 4 km from Lüderitzbucht (2615CA), 19 Oct 1913, *Peter 47186* (K); in rocks near Grasplatz (2615CB), 20 Jul 1922, *Dinter 3811* (K); 15 Oct 1950, *Kings 2700* (PRE), May 1981, *Lavranos and Pehlman 19637* (WIND), Sept 1963, *Merxmüller and Giess 3053* (PRE), 12 Sept 1972, *Merxmüller and Giess 28371* (K, PRE, WIND); main road to Lüderitz from Aus, near Lüderitz, 26°42'14"S 15°16'14"E (2615CB), 26 Aug 2002, *Mannheimer CM2019* (WIND); 13 miles (20.92 km) from Lüderitz on road to Aus (2615CB), 10 Aug 1959, *Giess and Van Vuuren 735* (K, PRE, WIND); 14 km from Hohlenberg (Haalenberg) Station to Lüderitz, next to main road, 26°37'30"S 15°22'30"E (2615CB), 21 Oct 1987, *Kolberg and Maggs 172* (WIND). Steinhausen distr., Pomona, Alicetal (2715AB), 15 May 1929, *Dinter 6362* (K); Sperrgebiet, Port Reef, 27°49'40"S 15°39'03"E (2715DC), 23 Aug 1997, *Burke 97173* (WIND).

2. CROTALARIA MEYERIANA Steud., *Nom. Bot.* 2. 444. 1840; A. Schreib. in Merxm., *Prod. Fl. SWA.* 60. 25. 1970; Polhill, *Crotalaria* in Africa and Madagascar 263. 1982; Nkonki and Swelankomo in Germishuizen and Meyer, *Strelitzia* 14. 501. 2003. *Crotalaria mollis* E. Mey., *Comm.* 1. 23. 1836; Benth. in Hook., *Lond. J. Bot.* 2. 575. 1843; Harv. in Harv. and Sond., *Fl. Cap.* 2. 42. 1862; Baker f., *J. Linn. Soc.* 42. 359. 1914; I. Verd., *Bothalia* 2. 386. 1928, non

Weinm. 1828, nom. illegit.—TYPE: SOUTH AFRICA. Northern Cape, Orange (Gariiep) River at 200 ft (60 m) and islands at the mouth (2816CB), *Drège s.n.* ("III, B") (lectotype: P!, here designated; isolectotypes: BM, digital image!, K, two sheets, digital images!, MO, digital image!, P, digital image!, PRE!, S, digital image!).

Decumbent to virgate perennial, up to 0.4 m in height, densely pilose. Stipules subulate, 1–2 mm long, pilose, deciduous. Leaves with petiole shorter to as long as the leaflets, 11–30 mm long; leaflets elliptic-obovate to subcircular, pilose above (except in the middle of the leaf) and below; terminal leaflet 17–29 × 12–15 mm, lateral leaflets 14–24 × 11–16 mm, obtuse, sometimes slightly retuse. Inflorescences terminal or leaf-opposed raceme, 30–130 mm long, with 5–17 flowers; pedicel 4–9 mm long; bract subulate, 2–6 mm long, pilose, persistent; bracteoles linear-subulate, 1–3 mm long, pilose, persistent, inserted near the middle of the pedicel. Flowers yellow, sometimes with reddish-brown veins. Calyx 9–10 mm long, pilose, lobes longer than the tube; lobes 7–9 mm long, acuminate; tube ± 2 mm long. Standard lamina ± elliptic to sub-circular, 15–16 × 12–15 mm, acute, pilose medially; claw ± 3 mm long. Wings broadly oblong, 11–15 × 5–6 mm, slightly shorter to ± as long as the keel, with 8–10 rows of sculpturing; claw 3–4 mm long. Keel 12–17 mm long, rounded sometimes ± in or mostly below the middle with a straight and projecting beak, pocket often present; claw 2–3 mm long. Pistil stipe 1–2 mm long; ovary 3–4 × 1–2 mm, with 12–19 ovules, densely pilose on the upper and lower margins of the ovary; style 14–40 mm long. Fruits oblong-ellipsoid, 20–26 × 9–14 mm, densely pilose; stipe 1–3 mm long. Seeds oblique-cordiform to reniform, ± 3 × 2–3 mm, rugose, especially along the margins, brown. Figures 4E, 5E.

Note—*Crotalaria mollis* E. Mey. described in 1836 is a later homonym of the name created by Weinmann (1828; a synonym for *C. verrucosa* L.) and can therefore not be used as the correct name.

Since 1840 the name *C. meyerana* has often been used, but '*meyeriana*' is here confirmed as the original spelling of Steudel (1840).

Drège s.n. in P with the original locality numbers ('III, B') is chosen because it matches the protologue of the basionym and was annotated by Meyer.

Diagnostic Characters—*Crotalaria meyeriana* is closely related to *C. colorata*, but differs in having a decumbent habit, pilose indumentum, and rugose seeds (erect habit, sericeous indumentum, and smooth seeds in *C. colorata*). Another close relative of *C. meyeriana* is *C. giessii*. Both species have a decumbent habit and pilose indumentum, but *C. meyeriana* is a perennial (up to 0.4 m in height) with terminal leaflets 17–29 mm long (pilose hairs on the upper and lower surfaces of the leaflets), wing petals that are ± as long as the keel and the curvature of the keel ± in the middle. *Crotalaria giessii* is an annual (up to 0.15 m in height), with terminal leaflets 4–10 mm long (pilose hairs on the lower surface of the leaflets and glabrous above), wing petals invariably shorter than the keel and the curvature of the keel usually below the middle.

Distribution and Habitat—*Crotalaria meyeriana* occurs in sandy soil from Lüderitz southwards to the Orange River at altitudes below 600 m above sea level (Fig. 2G). The

blank area within the circle of known localities is the restricted diamond area (*Sperrgebiet*) where botanists have had limited access.

Phenology—Flowering specimens have been collected in January and May to October and fruiting specimens in January to February, May, June, and August to October. It seems that there is no seasonal pattern and that flowering may occur any time of the year in reaction to rain (as is also the case with *C. colorata*). This has also been reported for other plants growing in similar environments in Namibia (Bruyns 1991).

Conservation Status—*Crotalaria meyeriana* is not listed in Loots (2005) but is here considered to be least concern.

Representative Specimens Examined—NAMIBIA. Karas: Lüderitz distr., Angra Pequena (2615CA), Aug 1885, *Schenck 18* (PRE); Kolmanskop (2615CA), Aug to Sept 1927, *Pillans 6005* (BOL); Lüderitz Bay (2615CA), 10 Aug 1925, *Peter 30087* (K), 15 May 1956, *Volk 12822* (PRE, WIND), 5 Aug 1959, *Giess and Van Vuuren 666* (K), 16 May 1965, *Meyer 57* (WIND), May 1980, *Lavranos and Pehlmann 19642* (WIND), Jul 1912, *Range 1552* (BOL); Lüderitz, between Diaz Point and the turn-off to Groot Bay (2615CA), 24 Jun 1975, *Müller and Jankowitz 293* (WIND); Hohlenberg (Haalenberg), Lüderitz (2615CB), 15 May 1965, *Meyer 50* (WIND), 18 Feb 1963, *Leippert 4098* (WIND); in light red dune sand at base and on plains below Kowis Mountains, 26°39'28"S 15°22'29"E (2615CB), 19 Sept 2001, *Mannheimer and Mannheimer CM1691* (WIND); on the road S from Lüderitz towards Oranjemund in the Diamond Area No. 1 (2615CD), 9 Jun 1990, *Bean and Oliver 2426* (BOL, WIND); road to Grillental from Kaukausib, 26°58'12"S 15°31'20"E (2615DC), 5 Sept 2002, *Mannheimer CM2205* (WIND); 5 miles (8.05 km) E of Rotkop Station (2615DC), 22 Aug 1963, *Merxmüller and Giess 3045* (PRE); 15 km from Rotkop Station on track next to power-line, 26°52'30"S 15°37'30" (2615DC), 22 Oct 1987, *Kolberg and Maggs 174* (PRE, WIND). Aus distr., Lüderitzbucht (2616CB), Sept 1917, *Knobel 12784* (SAM). Steinhausen distr., Prince of Wales Bay (2715AA), Aug 1911, *Schaefer 11* (PRE); Pomona (2715AB), 15 May 1929, *Dinter 6361* (BOL, GRA, K, PRE), Aug 1922, *Dinter 4035* (BOL, K); Pomona area, W-facing slope, ± 15 km from the houses in the E, 27°09'32"S 15°22'00"E (2715AB), 13 Sept 2000, *Mannheimer, Loots and Dauth CM880* (GRA, WIND); Diamond Area No. 1, between Tsabiams and Grillental, rocky outcrop next to road, 27°00'25"S 15°39'18"E (2715BA), 5 Sept 2002, *Bartsch, Loots and Mannheimer SB1025* (WIND); Diamond Area No. 1, towards Klinhardt, 27°18'40"S 15°33'51"E (2715BC), 4 Aug 2001, *Bartsch SB331* (WIND); Klinghardt Mountains, in sandy soil of dunes between koppies (2715BC), 28 Jun 1977, *Müller 832* (PRE, WIND); Klinghardt Mountains, W of Sargdeckel (2715BC), 16 Sept 1977, *Merxmüller and Giess 32051* (WIND); Namitas, S of Klinghardt Basin, 27°26'52"S 15°51'53"E (2715BD), 1 Sept 2002, *Mannheimer CM2120* (WIND). Witpütz distr., Klinghardt Mountains, koppie SW facing, 27°26'02"S 16°04'16"E (2716AC), 6 Aug 2001, *Mannheimer CM1484* (WIND); Diamond Area No. 1, Uguchab River from Aurus towards Heioab, 27°31'20"S 16°12'00"E (2716CA), 17 Sept 2003, *Bartsch, Klaassen and Loots SB1503* (WIND); plain off break in Aurus Mountains (2716CB), 8 Sept 1992, *Kubirske, Strohbach and Swart 154* (WIND); Buchenberg, Sperrgebiet (2716DC), 31 Jul 1977, *Williamson 2581* (BOL). Oranjemund distr., Richtersveld, Chameis (2816BB), 11 Sept 1977, *Williamson 2654* (BOL); Richtersveld, Kortderm, in sand (2816BB), 23 Feb 1985, *Williamson 3378* (BOL, JRAU, K); 15 km N of Sendlingsdrift (2816BB), 13 Aug 1976, *Giess 14609* (WIND); 15 miles (24.14 km) S of Chameis (2816BB), *Williamson 2657* (BOL); Bloeddrif (2816BD), 17 Aug 1982, *Metelerkamp 323* (BOL); NW slope of Numeesberg down to Grasvlakte (2816BD), 6 Oct 1991, *Smook 7974* (PRE); between Witbank and the Orange River mouth (2816CB), Sept 1926, *Pillans 5229* (K); E of Groot Derm (2816DA), Sept-Oct 1926, *Pillans 5335* (BOL); 2 miles (3.22 km) E of Oppenheimer Bridge (2816DA), 19 May 1969, *Leistner 3442* (K, PRE); 40 miles (64.36 km) N of Port Nolloth, on the way to Alexander Bay (2816DA), 19 May 1969, *Wenger 508* (K, PRE).

3. *Crotalaria giessii* M. M. le Roux and B.-E. van Wyk, sp. nov.—TYPE: NAMIBIA. "Farm Witpütz Nord: Lu 22, 16 km westlich Polizeistation" (2716DD), *Giess 13765* (holotype: WIND!; isotypes: K!, PRE!, WIND!).

Crotalaria giessii similis *C. meyerianae* sed habitu omnino minoris. *Crotalaria giessii* annua est 0.15 m altitudine, foliolis 4–10 mm longis, foliolis glabris in summo, alis petalis

brevioribus carina et curvatura carinae plerumque sub medio, sed *C. meyeriana* perennis est altitudine ad 0.40 m, foliolis 17–29 mm longis pilosis in summo, alis petalis carinam circa aequantibus et curvatura carinae circum medium.

Decumbent annual (stems all arising from the same point at ground level), up to 0.15 m in height, pilose. Stipules subulate, ± 1 mm long, pilose, persistent. Leaves with petiole shorter than the leaflets, 4–10 mm long; leaflets elliptic-obovate, glabrous above, pilose below; terminal leaflet 6–12 \times 4–6 mm, lateral leaflets 5–10 \times 3–6 mm, acute or slightly retuse. Inflorescences terminal raceme, 20–45 mm long, with 2–6 flowers; pedicel 2–4 mm long; bract subulate, 1–3 mm long, pilose, persistent; bracteoles subulate-linear, ± 1 mm long, pilose, persistent, usually inserted near the middle, but also towards the top of the pedicel. Flowers yellow. Calyx 7–10 mm long, pilose, lobes \pm as long as the tube; lobes 2–5 mm long, acuminate; tube 2.0–2.5 mm long. Standard lamina elliptic to obovate, 12–14 \times ± 10 mm, obtuse, pubescent along the midvein; claw ± 2 mm long. Wings obovate, 11.5–12.5 \times ± 10 mm, shorter than the keel, with 9–10 rows of sculpturing; claw 2–3 mm long. Keel ± 16 mm long, rounded below the middle with a straight and projecting beak, pocket invariably present; claw ± 2 mm long. Pistil stipe ± 2.5 mm long; ovary $\pm 3.0 \times 1.5$ mm, ± 13 ovules, pubescent along the upper and lower margins of the ovary; style 14–15 mm long. Fruits rounded-elliptic, 14–17 \times 7–9 mm, pilose; stipe 1–3 mm long. Seeds (immature) rugulose? Figs. 4C, 5C.

Diagnostic Characters—*Crotalaria giessii* (an annual) is similar to *C. meyeriana* (a perennial) but only grows up to 0.15 m in height (up to 0.40 m in *C. meyeriana*). The latter is larger in all parts compared to *C. giessii*. The leaflets are 4–10 mm long and glabrous above (leaflets 17–29 mm long and pilose above in *C. meyeriana*). The wing petals are shorter than the keel and the keel curvature is below the middle (wings \pm as long as the keel and the keel curvature \pm in the middle in *C. meyeriana*).

Distribution and Habitat—This new species is endemic to the Aus-Rosh Pinah area and grows in sandy soil. Plants occur at higher altitudes (± 600 –1,300 m above sea level) than its close relative, *C. meyeriana* (Fig. 2D).

Etymology—The new species is named for Johann Wilhelm Heinrich Giess (1911–2000), who made an important contribution to the botanical exploration of Namibia.

Phenology—Flowering and fruiting specimens have both been collected during February and September.

Representative Specimens Examined—NAMIBIA. Karas: Aus distr., 12 miles (19.31 km) W of Aus on the way to Lüderitzbucht (2616CB), 24 Feb 1963, Giess, Volk and Bleissner 5464 (WIND). Witpütz distr., 4 km W of Rosh Pinah on road to Diamond Area No. 1 (2716DD), 1 Sept 1989, Van Wyk 8965 (WIND).

Conservation Status—The new species appears to be uncommon and we propose that more information is required (data deficient).

4. *CROTALARIA EXCISA* (Thunb.) Baker f., J. Linn. Soc. 42. 394. 1914, excl. syn. *C. humilis*; I. Verd., Bothalia 2. 388. 1928; Adamson and Salter, Fl. Cape Penins. 466. 1950; Polhill, *Crotalaria* in African and Madagascar. 263. 1982; Schutte in Goldblatt and Manning, Strelitzia 9. 483. 2000; Nkonki and Swelankomo in Germishuizen and Meyer, Strelitzia 14. 501. 2003. *Ononis excisa* Thunb., Prodr. Pl. Cap. 129. 1800, Fl. Cap. 586. 1823. *Crotalaria thunbergiana* Vogel ex Walp., Linnaea 13. 475.

1839.—TYPE: SOUTH AFRICA. Cape of Good Hope (3318CD), *Thunberg s.n.* (holotype: UPS! [sub UPS. no. 16608]; isotype: LD, digital image!).

Crotalaria diffusa E. Mey., Linnaea 7. 151. 1832, non Link 1822, nom illegit. *Lotononis diffusa* Eckl. and Zeyh., Enum. Pl. Afric. Austral. 2. 177. 1836.—TYPE: SOUTH AFRICA. Western Cape, Cape Table Mountain (3318CD), *Ecklon un. it. no. 225* (isotypes: K, digital image!, MO, digital image!).

Crotalaria effusa sensu E. Mey., Comm. 1. 25. 1836, p. p.; Baker f., J. Linn. Soc. 42. 395. 1914, p. p. min., non E. Mey. s. s.

Crotalaria humilis sensu Benth. in Hook., Lond. J. Bot. 574. 1843, p. p.; Harv. in Harv. and Sond., Fl. Cap. 2. 41. 1862, p. p.; Bolus and Wolley-Dod, Trans. S. African Philos. Soc. 14. 255. 1903, non Eckl. and Zeyh.

Crotalaria eckloniana Presl., Abh. Königl. Böhm. Ges. Wiss. 476 [46 in reprint] 1845, nom. nud.

Decumbent perennial (stems branching at different heights above and/or below the ground), up to 0.25 m in height, strigulose to pubescent. Stipules linear-subulate, 0.5–2.0 mm long, strigose, persistent. Leaves with petiole shorter to longer than leaflets, 6–27 mm long; leaflets obovate to oblanceolate or elliptic with the upper leaflets sometimes linear, glabrous above, strigulose below; terminal leaflet 9–18 \times 3–8 mm, lateral leaflets 7–16 \times 3–6 mm, acute or retuse. Inflorescences terminal or leaf-opposed raceme, 20–80(120) mm long, with 1–3(6) flowers; pedicel 2–5 mm long; bract lanceolate-subulate, 1–3 mm long, strigose, persistent; bracteoles subulate, 0.5–2.0 mm long, strigose, persistent, inserted near the middle of the pedicel. Flowers yellow. Calyx 7–9 mm long, strigulose, lobes longer than the tube; lobes 4–6 mm long, acuminate; tube 2–3 mm long. Standard lamina obovate to oblate, 11–17 \times 11–17 mm, retuse and mucronulate, glabrous outside, but puberulous along the midvein; claw 2–4 mm long. Wings oblong, 10–15 \times 5–7 mm, slightly shorter to \pm as long as the keel, with 6–9 rows of sculpturing; claw 2–4 mm long. Keel 9–20 mm long, rounded \pm in the middle, usually with a straight and projecting beak or sometimes incurved beak, pocket often present; claw 2–3 mm long. Pistil stipe 1–2 mm long; ovary 3–6 \times 1–2 mm, 10–20 ovules, strigose to pubescent along the upper and lower margins of the ovary; style 11–18 mm long. Fruits oblong-clavate, 14–25 \times 4–7 mm, strigose; stipe 1–2 mm long. Seeds oblique-cordiform to reniform, $\pm 3 \times 2$ mm, smooth with small trichomes, brown, and sometimes maculate. Figures 4B, 5B.

Diagnostic Characters—*Crotalaria excisa* is often confused with *C. humilis*, but can be easily distinguished by the perennial habit, with the stems branching at various heights (Fig. 3C, D) and not from one point at ground level (Fig. 3F). The number of flowers per inflorescence in *C. excisa* varies from one to three (rarely six, usually only in the Kamiesberg Pass population). The seeds are smooth, often with a few trichomes. *Crotalaria humilis* usually has 2–7 flowers per inflorescence and rugose, glabrous seeds.

Distribution and Habitat—*Crotalaria excisa* grows in deep sandy soil at altitudes below 700 m above sea level. The subsp. *excisa* occurs in the southern parts of South Africa from Langebaan to Cape Town and eastwards to Montagu and Bonnievale. The subsp. *namaquensis* is distributed from the Langebaan area northwards to the Kamiesberg (here

often six flowers per raceme) and Springbok (here often large flowers of 16–20 mm long) (Fig. 2C).

Phenology—Flowering occurs from June to November and fruiting from August to November.

Conservation Status—*Crotalaria excisa* has been listed as least concern (Raimondo et al. 2009).

4.1 *CROTALARIA EXCISA* (Thunb.) Baker f. SUBSP. *EXCISA*

Keel 9–10(11) mm long. Fruits 14–20 mm long.

Representative Specimens Examined—SOUTH AFRICA. Western Cape: Clanwilliam distr., Kagga Kama Nature Reserve (3219DA), 24 Sept 1991, *Koekemoer 805* (JRAU, PRE). Cape Town distr., ca. 40 km from Velddrif near koppie on road between Saldanha Bay and Cape Town (3318AA), 3 Jul 1987, *Van Wyk 2695* (JRAU), 1 Nov 2009, *Le Roux and Van Wyk 108* (JRAU); 5 miles (8.05 km) NE of Langebaan (3318AA), 13 Sept 1934, *Salter 4766* (BOL, K); Hopefield (3318AB), 13 Sept 1894, *Schlechter 5330* (GRA), Sept 1905, *Bolus 12664* (GRA, K); along the road, ca. 10 km from Darling on the road to Cape Town (3318AD), 17 Oct 1986, *Van Wyk 2458* (JRAU); 24 km from Malmesbury to Darling (3318AD), 28 Aug 1975, *Stirton 5039* (K); near Hopefield (3318BA), Sept 1905, *Bolus 12664* (PRE); Camp Ground, Rosebank, Cape Peninsula (3318CD), 25 Sept 1918, *Pillans 3475* (BOL, PRE); Cape Flats (3318CD), Oct 1838, *Zeyher s.n.* (SAM); Cape Flats, Claremont (3318CD), Aug 1892, *Schlechter 1534* (GRA); Cape Peninsula, Camp Ground (3318CD), 18 Nov 1935, *Salter 5672* (K); Cape, Table Mountain (3318CD), 1844, *Ecklon 225* (K); Green Point, Cape Town (3318CD), Sept 1898, *MacOwan 1832* (K, UPS); Lion's Head (3318CD), Apr 1903, *Prior s.n.* (K); Lion's Mountain (3318CD), *Ecklon and Zeyher 4* (SAM), date unknown, *Pappe s.n.* (K); Lion's Mountain, Cape Town (3318CD), Aug 1894, *Bolus 2998* (BOL, PRE); Lion's Mountain, Table Mountain and Devil's Mountain (3318CD), Aug, *Ecklon and Zeyher 1275* (SAM); northern part of Paarden Island on a small dune S of Jakkals River mouth (3318CD), Aug 1969, *Tölken 6* (PRE); Rondebosch Common (3318CD), 5 Sept 2011, *Le Roux, Boatwright and Magee 111* (JRAU); Sea Point (3318CD), Oct 1893, *Bolus 2753* (BOL), Sept 1898, *MacOwan 1831* (SAM); university grounds, Rondebosch, between the tennis courts and Stanley Road (3318CD), 2 Oct 1972, *Esterhuysen 32948* (BOL); Paarl (3318DB), 1836, *Drège "d", Drège "d" a* (K); Langebaan, Saldanha Bay (3318DC), 9 Sept 1932, *Salter 3012* (K); Stellenbosch (3318DD), Sept 1919, *collector unknown 990* (GRA, NBG). Worcester distr., turn-off to Eilandia, between factory and winery, ca. 32 km from Worcester on the road to Robertson (3319DC), 18 Oct 1986, *Van Wyk 2469* (JRAU). Montagu distr., Kogmans' Kloof, between Ashton and Bonnievale (3320CC), 31 Jul 1952, *Van Niekerk 25067* (BOL); Montagu Baths (3320CC), Oct 1921, *Page 49* (PRE). Simon's Town distr., Cape of Good Hope Nature Reserve (3418AD), 3 Oct 1963, *Taylor 5278* (BOL); Cape Peninsula (3418AD), date unknown, *Tyson 15352* (SAM), 8 Aug 1896, *Wolley Dod 1545* (K); Springholgat (3418AD), 6 Oct 1967, *Taylor 7162* (BOL); Gordon's Bay, False Bay (3418BB), Oct 1898, *Bolus 8078* (BOL); Kommetjie (3418BD), Sept 1945, *Bolus 23244* (BOL), Oct 1936, *Salter 6383* (SAM). Caledon distr., Swartberg, Caledon (3419AB), Sept, *Ecklon and Zeyher 1274* (GRA). Without precise locality: *Zeyher 4696* (GRA); *Zeyher s.n.* (GRA).

4.2 *CROTALARIA EXCISA* (Thunb.) Baker f. SUBSP. *NAMAQUENSIS* Polhill, *Crotalaria* in Africa and Madagascar. 264. 1982; Nkonki and Swelankomo in Germishuizen and Meyer, *Strelitzia* 14. 500. 2003.—TYPE: SOUTH AFRICA. Northern Cape, Little Namaqualand, near Klipfontein (3017DB), *Bolus 6552* (holotype: BOL!; isotype: K, digital image!).

Ononis racemosa Thunb., *Prodr. Pl. Cap.* 129. 1800, *Fl. Cap.* 587. 1823.—TYPE: SOUTH AFRICA. Cape, *Thunberg s.n.* (holotype: UPS! [sub UPS. no. 16637]).

Keel (10)11–20 mm long. Fruits 21–25 mm long.

Representative Specimens Examined—SOUTH AFRICA. Northern Cape: Springbok distr., ± 3 km from Bulletrap to Nigramoep (2917DA), 24 Aug 1983, *Van Wyk 6330* (PRE). Hondeklip Bay distr., Kamiesberg Pass (3017BB), 19 Sept 1990, *Van Wyk 3108* (JRAU); Kamiesberg, Skilpad Wild Flower Reserve (3017BB), 19 Aug 1996, *Cruz 186* (NBG); Kamieskroon to Kamiesberg Road, ca. 1 km from turnoff to Springbok (3017BB), 16 Oct 1986, *Van Wyk 2355* (JRAU); Springbok-Kamiesberg Pass, ca. 1 km from turn-off to Leliefontein side (3017BB), 16 Oct 1986, *Van Wyk 2390, 2391, 2392* (JRAU); 15 km from Kamieskroon on the road to Springbok

(3017BB), 25 Aug 1976, *Rösch and Le Roux 1460* (PRE); 16 km from Kamieskroon to Springbok (3017BB), 1 Sept 1976, *Stirton 6000* (K, PRE); between Garies and Brak Dam (3017BD), 4 Sept 1945, *Leighton 1148* (BOL, PRE); 10 km from Kamieskroon to Garies (3017BD), 31 Aug 1976, *Stirton 5987* (K); Klipfontein, 2.5 miles (4.02 km) SW of Rietpoort (3017DB), 19 Sept 1963, *Acoccks 23303* (K, PRE); 2 km from Garies to Kamieskroon (3017DB), 31 Aug 1976, *Stirton 5979* (K); Green River Mouth in deep sand in Strandveld, roadside (3017DC), 19 Sept 1986, *Bean and Viviers 1705* (BOL, PRE). Kamiesberg distr., on road to Leliefontein from Kamieskroon (3018AA), 16 Sept 2006, *Boatwright 156* (JRAU), 9 Nov 2007, *Boatwright 224* (JRAU); Leliefontein, western side of Kamiesberg (3018AC), 2 Oct 1995, *Gess, Gess and Gess 95/96/211* (GRA); near Garies (3018CA), Sept 1941, *Leipoldt 3780* (BOL); 2 km from Garies to Kamieskroon, roadside (3018CA), 31 Aug 1976, *Stirton 5979* (PRE); Kamiesberg Pass (3018DB), 20 Jan 1987, *Van Wyk 2542* (JRAU); Olifants River Valley near Warm Bath (3018DB), 26 Sept 1911, *Stephens 7105* (BOL, K). Western Cape: Loeriesfontein distr., Two Rivers, Kamiesberg (3019CB), 13 Sept 1911, *Pearson 6768* (K). Vanrhynsdorp distr., Kareeberg (3118AB), 19 Jul 1896, *Schlechter 8226* (BOL, GRA, K); Heerenlogement (3118DC), 21 Jul 1941, *Esterhuysen 5592* (BOL). Calvinia distr., Nieuwoudtville (3119AC), date unknown, *Leipoldt s.n.* (BOL). Vredenburg distr., slopes S of Vredenburg (3217DD), 5 Sept 1928, *Hutchinson 243* (BOL, K). Clanwilliam distr., Piquetberg (3218AD), Oct 1892, *Bolus 13539* (BOL); Rietvlei (3218CB), Sept, *Zeyher 15351* (SAM); 9 miles (14.48 km) from Velddrif to St. Helena Bay (3218CC), 14 Aug 1969, *Thompson 809* (K); Berg River Station (3218CD), 13 Oct 1968, *Acoccks 24155* (K); Kapteinskloof (3218DC), 25 Sept 1941, *Stokoe 8446* (BOL). Wuppertal distr., Keerom (3219CC), 3 Dec 1980, *Esterhuysen 17888* (BOL). Saldanha distr., Oostenwal, Saldanha Bay (3318DC), 4 Aug 1968, *Acoccks 24055* (PRE).

5. *CROTALARIA HUMILIS* Eckl. and Zeyh., *Enum. Pl. Afric. Austral.* 2. 174. 1836; Benth. in Hook., *Lond. J. Bot.* 574. 1843, p. p.; Harv. in Harv. and Sond., *Fl. Cap.* 2. 41. 1862, p. p.; Polhill, *Crotalaria* in Africa and Madagascar. 264. 1982; Schutte in Goldblatt and Manning, *Strelitzia* 9. 483. 2000; Nkonki and Swelankomo in Germishuizen and Meyer, *Strelitzia* 14. 501. 2003.—TYPE: SOUTH AFRICA. Western Cape, Olifants River (3018DB), *Ecklon and Zeyher 1263* (lectotype: K! [sub K. no. 000225773], here designated; isolectotypes: MO, digital image!, P, digital image!, S, digital image!, SAM!).

Crotalaria effusa E. Mey., *Comm.* 1. 25. 1836, p. p.; Benth. in Hook., *Lond. J. Bot.* 2. 574. 1843; Harv. in Harv. and Sond., *Fl. Cap.* 2. 41. 1862, excl. syn. *Ononis racemosa*; Baker f., *J. Linn. Soc.* 42. 395. 1914, p. p.; I. Verd., *Bothalia* 2. 388. 1928, p. p. min.—TYPES: SOUTH AFRICA. Western Cape, Krakkeelskraal [between Pedroskloof (3018AA) and Leliefontein (3018AC)], *Drège 'a'* (lectotype: B!; isolectotype: P) and *Drège 'III.A.a'* (isolectotype: NYBG, digital image!) - see Polhill, 1982.

Decumbent, virgate annual (stems all arising from the same point at ground level), up to 0.35 m in height, strigulose. Stipules linear-subulate, ± 1 mm long, strigose, persistent. Leaves with petiole ± as long as or longer than leaflets, 8–32 mm long; leaflets obovate to oblanceolate with the upper leaves often linear, glabrous above, strigulose below; terminal leaflet 8–26 × 4–9 mm, lateral leaflets 7–21 × 3–7 mm, obtuse, sometimes mucronulate. Inflorescences terminal or leaf-opposed raceme, 40–220 mm long, with 2–7 flowers; pedicel 3–7 mm long; bract lanceolate to subulate, 1–2 mm long, strigulose, persistent; bracteoles minutely subulate, ± 0.5 mm long, strigulose, persistent, inserted near the middle of the pedicel. Flowers yellow. Calyx 5–6 mm long, strigulose, lobes longer than the tube; lobes ± 4 mm long, acuminate; tube ± 2 mm long. Standard lamina obovate to oblate, 9–11 × 10–11 mm, retuse, and mucronulate, glabrous outside, but puberulous along the midvein; claw 2–3 mm long. Wings oblong, ± 10 × 2–4 mm,

± as long as the keel, with 5–6 rows of sculpturing; claw 2–4 mm long. Keel ± 10 mm long, rounded ± in the middle, usually with a slightly incurved beak, pocket often present; claw ± 2 mm long. Pistil stipe ± 1 mm long; ovary 3–6 × ± 1 mm, 8–16 ovules, densely strigose to pubescent on the upper and lower margins of the ovary; style 10–11 mm long. Fruits elliptic-oblong to oblong-clavate, 13–21 × 4–6 mm, strigose to strigulose; stipe 1–3 mm long. Seeds oblique-cordiform to sub-circular, ± 2 × 2 mm, rugose, brown Figs. 4D, 5D.

Note—The *Ecklon and Zeyher 1263* collection in K is here selected as the lectotype because it has a hand-written note by Ecklon at the bottom of the sheet. This specimen clearly shows the diagnostic characters of the species (habit, flowers, and young fruit).

Diagnostic Characters—*Crotalaria humilis* is closely related to *C. excisa*, but differs in having an annual habit with all the stems originating from the same central point at ground level, 2–7 flowers per inflorescence, and rugose seeds (perennial habit with branching of stems in different positions, 1–3(6) flowers per inflorescence, and smooth seeds with some trichomes in *C. excisa*).

Distribution and Habitat—*Crotalaria humilis* has a sympatric distribution with *C. excisa* subsp. *namaquensis*. It occurs from Doornpoort in the Springbok district southwards to the Clanwilliam-Verlore Vlei area in sandy soil at altitudes below 1,000 m above sea level (Fig. 2E).

Phenology—Flowering occurs from August to November and fruiting from September to November.

Conservation Status—This species has been listed as least concern (Raimondo et al. 2009).

Representative Specimens Examined—SOUTH AFRICA. Northern Cape: Oranjemund distr., sandy slopes between Kuboos and Doornpoort (2816BD), Sept to Oct 1926, *Pillans 5384* (BOL). Springbok distr., farm Wildepaarde Hoek in flats (2917DC), 17 Aug 1980, *Le Roux 2658* (BOL); 6 km S by E of Komaggas (2917DC), 24 Jul 1957, *Acocks 19376* (BOL, K); between Springbok and Kamieskroon (2917DD), Nov 1936, *Thorne 52437* (NBG, SAM). Gamoeep distr., Ougrabies (2918BC), Aug 1883, *Bolus 9488* (BOL). Hondeklip Bay distr., Namakwa National Park, along the road to Soebatsfontein on red Kalahari sand (3017AB), 1 Sept 2004, *Koekemoer 2860* (PRE); Spoeg River near Wallekraal (3017AD), Oct 1924, *Pillans 17974* (BOL); Arkoep, ± 12 miles (19.31 km) N of Kamieskroon (3017BB), 2 Aug 1972, *Van der Westhuizen 273* (K); 20 km from Kamieskroon to Springbok (3017BB), 24 Aug 1976, *Grobbeelaar 1985* (PRE); Wallekraal, near Hondeklip Bay (3017BC), 2 Sept 1976, *Stirton 6035* (K, PRE); Klipfontein (3017DB), Sept 1883, *Bolus 432* (BOL, K, NBG); 5 km from Kotzesrus turnoff on Wallekraal to Garies Road (3017DB), 3 Sept 1976, *Stirton 6054b* (K); 9 km W of Nariep, farm Roodeheuwel (3017DC), 28 Sept 1987, *Perold 1645* (BOL, PRE). Kamiesberg distr., Kamiesberg, between Garies and Leliefontein (3018AC), Nov 1939, *Esterhuysen 1381* (BOL); Warmvool, NE of Lelike Bankieskoppies (3018DC), 9 Sept 1976, *Thompson 2845* (PRE). Western Cape: Vanrhynsdorp distr., a few miles W of Vredendal (3118CB), 8 Sept 1949, *Wilman 697* (BOL); Vredendal Road, Vanrhynsdorp (3118DA), 8 Sept 1949, *Morris 461* (BOL); 8.8 km from Vredendal to Vanrhynsdorp (3118DA), 26 Sept 1986, *Perry 3530* (NBG); farm Sandkraal near Matzikama Mountains (3118DB), *Stirton 5948* (K); Urionskraal near Vanrhynsdorp (3118DB), 4 Sept 1955, *Barker 8552* (NBG); 15 miles (24.14 km) E of Vanrhynsdorp near the foot of Tierberg (3118DB), 4 Sept 1955, *Lewis 4710* (NBG); Gifberg Pass (3118DC), 21 Sept 1948, *Acocks 14907* (K, PRE); Windhoek (3118DC), 30 Jun 1896, *Drège s.n.* (K); 1.5 km from beginning of the Gifberg Pass (3118DC), 7 Oct 1988, *Van Wyk 2882* (JRAU). Clanwilliam distr., Verlore Vlei (3218AD), 5 Sept 1976, *Stirton 6111* (K); Clanwilliam (3218BB), 30 Jul 1896, *Schlechter 8334* (BOL, GRA). Locality not found: Andaus Poort, 21 Aug 1925, *Marloth 12249* (BOL); Karakuis, 1836, *Drège "b"* (K). Without precise locality: *Bolus 9325* (BOL); *Drège s.n.* (BOL).

6. *Crotalaria kolbergii* M. M. le Roux and B.-E. van Wyk, sp. nov.—TYPE: NAMIBIA. Hardap, 24.5 km S on road C1283, of turn-off of road, on riverbank of Kubitsaus

River, 23°22'30"S 16°22'30"E (2316AD), *Kolberg and Tholkes HK804* (holotype: WIND!; isotype: PRE!).

Crotalaria kolbergii similis *C. pearsonii* sed differt praesentia constante stipularum, foliolis linearibus, vexillo elliptico obtuso et alis petalis saepe brevioribus carina (in *C. pearsonii* raro praesentia stipularum, foliolis ellipticis-obovatis, vexillo elliptico-obovato retuso et alis petalis carina circa aequantibus vel parum brevioribus).

Erect perennial, up to 0.3 m in height, strigose. Stipules linear-subulate, 1–3 mm long, strigose, persistent. Leaves with petioles shorter than leaflets, 11–19 mm long; leaflets linear, glabrous above, strigulose below; terminal leaflet 23–40 × 3–5 mm, lateral leaflets 18–30 × 3–4 mm, acute. Inflorescences terminal or leaf-opposed raceme, 90–290 mm long, with 6–14 flowers; pedicel 2–5 mm long; bract linear-subulate, 1–3 mm long, pubescent, persistent; bracteoles minutely subulate, 0.5–1.0 mm long, strigulose, persistent, inserted at the top of the pedicel. Flowers yellow with purple veins, petals becoming purple with age. Calyx 6–9 mm long, strigulose, lobes longer than the tube; lobes 4–5 mm long, acuminate; tube 2.5–3.5 mm long. Standard lamina ± elliptic, 11–14 × 9–10 mm, obtuse, glabrous outside, but slightly strigose along the midvein; claw 2.5–3.5 mm long. Wings oblong, 12–15 × ± 4 mm, often shorter than the keel, with 5–7 rows of sculpturing; claw ± 3 mm long. Keel 14–18 mm long, rounded ± in the middle with a straight and projecting beak, pocket invariably present; claw ± 3 mm long. Pistil stipe ± 2 mm long; ovary ± 6 × 2 mm, 8–9 ovules, densely strigose on the upper and lower margins of the ovary; style 13–17 mm long. Fruits elliptic-clavate, 21–34 × 7–12 mm, strigose; stipe 2–4 mm long. Seeds (immature) smooth to somewhat rugulose? Figs. 4F, 5F.

Note—The new species is named for Herta Kolberg of Windhoek, Namibia, in recognition of her contributions to the knowledge of Namibian legumes.

Diagnostic Characters—*Crotalaria kolbergii* is similar to *C. pearsonii*, but differs in consistently having stipules present, linear leaflets, an elliptic, obtuse standard petal, and wing petals often shorter than the keel (stipules rarely present in *C. pearsonii*, with elliptic-obovate leaflets, an elliptic-obovate and retuse standard petal, and wing petals that are ± as long as or slightly shorter than the keel).

Distribution and Habitat—This species grows in loam soils from the Kubitsaus River southwards to the Bethanie area at altitudes of ± 1,600 m above sea level (Fig. 2F). It is the only species of the section that occurs outside the summer arid area (at one locality only).

Phenology—Flowering and fruiting specimens recorded from February to April.

Conservation Status—The new species appears to be uncommon but more detailed information is required (data deficient).

Representative Specimens Examined—NAMIBIA. Karas: Aus distr., Frisgewaagd Farm: BET 124, at the top of the isolated mountain (2616BA), 3 Apr 1968, *Giess 10292* (WIND); 28 km S of Helmeringhausen on road C13 to Aus, where road crosses over Tiras Mountain, 26°04'944"S 16°39'0.468"E (2616BA), 7 Apr 2008, *Kolberg and Tholkes HK2516* (WIND); 28 km S of Helmeringhausen towards Aus, 26°04'42.5274"S 16°39'2.9874"E (2616BA), 17 Mar 2012, *Kolberg and Tholkes HK3107* (WIND). Carolinahof Farm: W of Bethanie on road to Aus, 26°22'35"S 16°44'65"E, (2616BC), 15 Mar 1995, *Germishuizen 8020* (PRE).

7. *CROTALARIA* PEARSONII Baker f., J. Linn. Soc. 42. 342. 1914. I. Verd., *Bothalia* 2. 391. 1928. Polhill, *Crotalaria* in Africa and Madagascar 262. 1982; Nkonki and Swelankomo in *Germishuizen and Meyer, Strelitzia* 14. 502. 2003.—TYPE: SOUTH AFRICA. Northern Cape, S of Orange River, Doornpoort Ravine (2917DA), *Pearson 6131* (holotype: K, digital image!; isotypes: BM, digital image!, BOL!).

Erect perennial, up to 0.4 m in height, strigose (densely strigose on young shoots). Stipules linear, ± 1 mm long, strigose, usually absent. Leaves with petiole shorter than leaflets, 11–26 mm long; leaflets elliptic-obovate, glabrous above, strigose below; terminal leaflet 13–36 \times 5–18 mm, lateral leaflets 10–34 \times 4–14 mm, obtuse. Inflorescences terminal or leaf-opposed raceme, 90–180 mm long, with 5–16 flowers; pedicel 2–11 mm long; bract linear-lanceolate, 1–3 mm long, strigose, persistent; bracteoles subulate, 1.0–2.5 mm long, strigose, persistent, inserted near the middle of the pedicel. Flowers yellow with purple veins, petals becoming purple with age. Calyx 7–9 mm long, strigose, lobes longer than the tube; lobes 4–6 mm long, acuminate; tube 3–4 mm long. Standard lamina \pm elliptic-obovate, 13–19 \times 13–15 mm, retuse, glabrous outside, but slightly strigose along the midvein; claw 3–4 mm long. Wings obovate-oblong, 12–17 \times 5–7 mm, as long as to slightly shorter than the keel, with 7–9 rows of sculpturing; claw 3–4 mm long. Keel 15–17 mm long, rounded \pm in or just below the middle, with a straight and projecting beak, pocket invariably present; claw \pm 3 mm long. Pistil stipe 2–4 mm long; ovary 4–6 \times \pm 2 mm, 11–19 ovules, strigose along the upper and lower margins of the ovary; style 14–15 mm long. Fruits elliptic-clavate, 22–37 \times 6–12 mm, strigose; stipe 2–4 mm long. Seeds (immature) rugulose? Figs. 4G, 5G.

Diagnostic Characters—*Crotalaria pearsonii* is closely related to *C. kolbergii*, but differs in the absence (rarely present) of stipules, the elliptic-obovate leaflets, elliptic-obovate standard petal with a retuse apex, and the wings that are as long as or slightly shorter than the keel (stipules invariably present in *C. kolbergii*, which has linear leaflets, an elliptic standard petal with an obtuse apex, and the wings mostly shorter than the keel). Another species with which *C. pearsonii* has been confused is *C. excisa*, but the former differs in the erect habit and yellow flowers with purple-veins (decumbent habit with uniformly yellow flowers in *C. excisa*).

Distribution and Habitat—*Crotalaria pearsonii* occurs on loam and quartzite soils below 1,000 m above sea level. It is distributed south of the Orange River in South Africa, from Witbank close to Oranjemund and eastwards to Brusselsput in the Kenhardt district (Fig. 2A).

Phenology—Flowering specimens recorded for May and August to September and fruiting specimens from September to November.

Conservation Status—*Crotalaria pearsonii* has been listed as rare (Raimondo et al. 2009).

Representative Specimens Examined—SOUTH AFRICA. Northern Cape: Oranjemund distr., Witbank, Little Namaqualand (2816DA), Sept to Oct 1926, *Pillans 5557* (BOL); cliffs along Karachab River (2816DB), 5 Sept 1925, *Marloth 12445* (BOL, PRE). Vioolsdrif distr., Arragaab, Richtersveld (2817AC), 14 Sept 1929, *Herre s.n. sub STEU 11892* (NBG); Kalkfontein (2817CC), Aug to Sept 1925, *Marloth 12369* (BOL); Kalkfonteinberg, Richtersveld (2817CC), 14 Sept 1929, *Herre s.n. sub STEU 11893* (NBG). Springbok distr., Karachab Arch (2917AA), 22 Apr 1986, *Van Jaarsveld, Forrester and Jacobs 8590* (NBG); Karachab Arch, Lekkersing (2917AA), 26 Aug 1977, *Oliver, Tölken and Venter 143* (K, PRE); Doornpoort, Namaqualand

(2917DA), 20 Sept 1953, *Hall 809* (NBG). Gamoep distr., Aggeneys (2918BB), 23 May 1989, *Dean 659* (JRAU); Aggeneys, Black Mountain area, 29°14'00"S 18°43'00"E (2918BB), 1 Feb 2000, *Nkoana 600* (PRE); Dabbiespoort, Aggeneys (2918BB), 24 May 1989, *Dean 664* (JRAU). Kenhardt distr., Brusselsput (2920BB), 25 May 1989, *Dean 666* (JRAU).

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APPENDIX 1. Characters and character states used in the cladistic analysis of *Crotalaria* sect. *Amphitrichae*. See Appendix 2 for coded character states.

- 1. Life history:** (0) perennial (1) annual. **2. Growth form:** (0) virgate (1) decumbent. **3. Stem indumentum:** (0) glabrous (1) strigose to pubescent (2) pilose to tomentose. **4. Leaves:** (0) simple (1) trifoliate. **5. Leaf shape:** (0) linear (1) obovate-elliptic (2) obovate-oblongate. **6. Upper leaf surface indumentum:** (0) glabrous (1) hairy. **7. Rachis extension:** (0) absent (1) present. **8. Number of flowers:** (0) few-flowered (up to six flowers) (1) many-flowered (more than six flowers). **9. Flower colour:** (0) yellow with darker yellow or maroon to brown veins (1) yellow with purple veins. **10. Standard petal shape:** (0) elliptic to obovate-elliptic (1) subcircular. **11. Standard petal apex:** (0) acute (1) retuse. **12. Standard petal indumentum:** (0) glabrous (1) hairy along midvein only (2) hairy medially (beyond the midvein). **13. Standard petal indumentum:** (?) glabrous inapplicable (0) strigose (1) pilose to tomentose. **14. Callosities:** (0) columnar (1) disc. **15. Keel shape:** (0) angled (1) rounded. **16. Style shape:** (0) geniculate (1) rounded. **17. Fruit indumentum:** (0) glabrous to strigose (1) pilose to tomentose. **18. Fruit shape:** (0) oblong-ellipsoid (1) oblong-clavate.

APPENDIX 2. Coded character states used in the cladistic analysis of *Crotalaria* sect. *Amphitrichae*. See Appendix 1 for characters and character states.

Taxa	Character states																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>C. monophylla</i>	0	0	0	0	0	0	0	0	0	0	0	0	?	0	0	0	0	0
<i>C. colorata</i>	0	0	2	1	1	1	0	1	0	1	0	2	1	1	1	1	1	1
<i>C. excisa</i>	0	1	1	1	2	0	1	0	0	0	1	1	0	1	1	1	0	0
<i>C. humilis</i>	1	1	1	1	2	0	1	0	0	0	1	1	0	1	1	1	0	0
<i>C. giessii</i>	1	1	2	1	1	0	0	0	0	0	0	2	1	1	1	1	1	1
<i>C. meyeriana</i>	0	1	2	1	1	1	0	1	0	1	0	2	1	1	1	1	1	1
<i>C. kolbergii</i>	0	0	1	1	0	0	0	1	1	0	0	1	0	1	1	1	0	0
<i>C. pearsonii</i>	0	0	1	1	1	0	0	1	1	0	1	1	0	1	1	1	0	0