



Taxonomy of the Genus *Phymaspermum* (Asteraceae, Anthemideae)

Authors: Ruiters, Ashton K., Tilney, Patricia M., Wyk, Ben-Erik Van, and Magee, Anthony R.

Source: Systematic Botany, 41(2) : 430-456

Published By: The American Society of Plant Taxonomists

URL: <https://doi.org/10.1600/036364416X691768>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Taxonomy of the Genus *Phymaspermum* (Asteraceae, Anthemideae)

Ashton K. Ruiters,^{1,2} Patricia M. Tilney,¹ Ben-Erik Van Wyk,¹ and Anthony R. Magee^{1,2,3}

¹Department of Botany and Plant Biotechnology, University of Johannesburg, PO Box 524, Auckland Park, Johannesburg, 2006, South Africa

²Compton Herbarium, South African National Biodiversity Institute, Private Bag X7, Claremont 7735, Cape Town, South Africa

³Author for correspondence (a.magee@sanbi.org.za)

Communicating Editor: Jocelyn Hall

Abstract—*Phymaspermum*, the largest and most complex genus within the subtribe Phymasperminae, is revised and 17 species are recognised, all endemic to southern Africa. Four new species are described (*P. aphyllum*, *P. comptonii*, *P. oppositifolium*, and *P. trifidum*), five species are reduced into synonymy (*P. bolusii*, *P. equisetoides*, *P. montanum*, *P. pubescens*, and *P. villosum*) and *P. thymelaeoides* is recognised as the oldest available epithet for *P. schroeteri*. The species of *Phymaspermum* can be distinguished by a combination of habit, leaf, involucre, and fruit characters. Species relationships are assessed in a cladistic analysis of 12 anatomical and morphological characters. *Phymaspermum* is distinguished from *Eumorphia* and *Gymnopentzia* by the unique stalked myxogenic trichomes on the fruit surface. This character is shown to be a synapomorphy for *Phymaspermum* although subsequently lost in two species and replaced by resin canals in the fruit ribs. A comprehensive taxonomic treatment is presented, including a key to the species, correct nomenclature, typification, descriptions, and geographical distributions.

Keywords—Cladistic analysis, *Eumorphia*, fruit anatomy, *Gymnopentzia*, morphology, myxogenic trichomes, new species.

Phymaspermum Less. is the largest genus within the subtribe Phymasperminae with 18 species previously recognised, all endemic to southern Africa (Germishuizen et al. 2006). The genus was described by Lessing (1832) for a single species (*P. junceum*) and later expanded by Källersjö (1986) to include species which had previously been placed within other genera such as *Athanasia* L., *Brachymeris* DC., and *Pentzia* Thunb. Several of the species are well grazed by livestock (Shearing and Van Heerden 1994; Vlok and Schutte-Vlok 2010; Schutte-Vlok pers. comm.). In particular, the vernacular name of *P. parvifolium*, “good karoo,” alludes to its importance as a pasture plant for Merino sheep (Harvey 1864). *Phymaspermum acerosum* is also used in Zulu culture as a charm to ward off lightning (Hutchings 1996).

Phymaspermum has never been revised and as such was identified as a priority for taxonomic revision in the national strategy for biosystematics research in South Africa (Victor pers. comm.). Several of the species are of conservation concern or data deficient, and preliminary investigations revealed the presence of several new range-restricted species, consistent with the results of various other recent taxonomic studies of southern African Anthemideae genera (Magee and Manning 2010; Magee and Tilney 2012; Powell and Magee 2013; Magoswana and Magee 2014; Magee et al. 2014; Magoswana et al. 2015). Comprehensive taxonomic monographs are vital to species conservation as they directly inform conservation assessments and management as well as policy (Schatz 2002; Mace 2004). Red List assessments completed in the absence of revisions have often been incorrectly categorised, when compared to reassessments done after the taxonomic revision (Kirschner and Kaplan 2002; Powell et al. 2014).

Eumorphia DC. (6 spp.) (Swelankomo 2011), *Gymnopentzia* Benth. (1 sp.), and *Phymaspermum* can be distinguished from all other southern African genera by having papillose cypselas with more than 10 primary ribs (Källersjö 1986), and so these characters were used by Oberprieler et al. (2007) to define the subtribe Phymasperminae. *Phymaspermum* is distinguished by the usual presence of specialized myxogenic, ovoid tri-

chomes on the cypselas. *Gymnopentzia* is distinguished by longer papillate cypselas and *Eumorphia* by paleate capitula (only marginal paleae are present in the capitula of *Phymaspermum* and *Gymnopentzia*). In addition, the leaves of *Phymaspermum* are alternately arranged (except in one of the new species described herein) while those of *Eumorphia* and *Gymnopentzia* are largely opposite (Källersjö 1986; Swelankomo 2011). As pointed out by Källersjö (1986), three species of *Phymaspermum* (viz. *P. acerosum*, *P. pinnatifidum*, and *P. villosum*) lack the diagnostic myxogenic ovoid trichomes on the cypselas, leading her to remark that these species may need to be recognised as a separate genus. A cladistic analysis of morphological characters in the subtribe is explored to assess the monophyly of *Phymaspermum* and possible infrageneric relationships.

A taxonomic revision of *Phymaspermum* is presented, including comprehensive descriptions, a key to the species, nomenclature, typification, diagnostic characters with illustrations and distribution data.

MATERIALS AND METHODS

Most of the species were studied in situ and all were studied from selected specimens from B (digital images), NBG, NU, and PRE, as well as the entire collections of BOL, SAM, and WIND (digital images). Maps of each species were produced according to validated information provided on the associated herbarium labels. Collecting localities and associated grid references were checked in literature (Leistner and Morris 1976). These localities were plotted according to the degree reference system as described by Leistner and Morris (1976). The specimens examined are cited under each species treatment and arranged by country, province and then district, and ordered according to geographical position, from west to east and north to south. The quarter degree and associated district are indicated in bold.

Cypselas material was fixed in formalin-acetic acid-alcohol (FAA) for at least 24 hr. Herbarium material was first rehydrated at 60°C for two days before being fixed. Whole cypselas were embedded in glycol methacrylate (GMA) according to a modification (a five day final infiltration) of the method described in Feder and O’ Brien (1968). They were then stained using the periodic acid-Schiff/toluidine blue (PAS/TB) method of Feder and O’ Brien (1968). All sections were viewed under a

TABLE 1. Taxon by character matrix used for the morphological and anatomical phylogenetic analyses. See Appendix 1 for a description of characters and character states.

Species	1	2	3	4	5	6	7	8	9	10	11	12
<i>A. elsiae</i>	0	0	0	0	0	0	0	0	0	0	?	0
<i>E. corymbosa</i>	0	0	1	0	0	1	0	1	1	0	?	1
<i>E. davyi</i>	0	0	0	0	0	1	0	1	1	0	?	1
<i>E. dregeana</i>	0	0	0	0	0	1	0	1	1	0	?	1
<i>E. prostrata</i>	0	0	0	0	0	1	0	1	1	0	?	1
<i>E. sericea</i>	0	0	0	0	0	1	0	1	1	0	?	1
<i>G. bifurcata</i>	0	0	1	1	0	0	0	1	1	0	?	1
<i>P. acerosum</i>	1	0	1	1	0	0	0	1	1	0	?	0
<i>P. aciculare</i>	1	0	0	1	0	0,1	1	1	1	1	1	1
<i>P. aphyllum</i>	0	0	0	1	0	1	0	1	1	1	0	1
<i>P. appressum</i>	0	1	0	1	1	1	0	1	1	1	0	1
<i>P. argenteum</i>	1	0	1	1	0	0	0	1	1	1	1	1
<i>P. athanasioides</i>	1	0	1	1	0	0	0	1	1	1	1	1
<i>P. comptonii</i>	1	0	1	1	0	0	0	1	1	1	1	0
<i>P. erubescens</i>	1	0	0	1	0	0	1	1	1	1	1	1
<i>P. leptophyllum</i>	0	0	0	1	0	1	0	1	1	1	0	1
<i>P. oppositifolium</i>	0	1	0	1	1	1	0	1	1	1	0	1
<i>P. parvifolium</i>	0	0	0	1	0	1	0	1	1	1	0	1
<i>P. peglerae</i>	1	0	0	1	0	0	1	1	1	1	1	1
<i>P. pinnatifidum</i>	1	0	1	1	0	0	0	1	1	0	?	0
<i>P. thymelaeoides</i>	0	0	0	1	0	1	0	1	1	1	0	1
<i>P. scoparium</i>	0	0	0	1	0	0	0	1	1	1	0	1
<i>P. trifidum</i>	0	0	0	1	0	1	0	1	1	1	0	1
<i>P. woodii</i>	1	0	1	1	0	0	0	1	1	1	1	1

Leitz wetzlar light microscope and photographed with a JVC KY-F1030 digital camera with AcQuis digital imaging software version 4.0.1.7.

Cypselas surface structure was also studied using a scanning electron microscope (SEM). Cypselas were mounted on copper stubs and gold coated using an EmScope gold coater. These were then viewed in a Tescan SEM at 8 kV using the VegaTC software program and photographed with an Oxford instruments X-Max camera.

To construct a phylogeny of *Phymaspermum* and its relationship to the other two genera within Phymasperminae, *Eumorphia* and *Gymnopentzia*, 12 vegetative and reproductive characters for 24 taxa within the tribe were scored (Table 1; Appendix 1) using the outgroup comparison method, with a species of *Athanasia* (*A. elsiae* Källersjö) as outgroup (Källersjö 1991). We selected a member from the subtribe Athanasiinae to root the trees as ITS sequence data (Oberprieler et al. 2007) and available morphological evidence suggest a close relationship to Phymasperminae. *Eumorphia* and *Gymnopentzia* were scored based on literature (Swelankomo 2011, Källersjö 1986). Characters were scored as polymorphic when both states occurred in a single taxon and as unknown (?) if the character was not applicable.

Phylogenetic analyses were conducted using the parsimony algorithm of the software package PAUP* for Windows version 4.0b10 (Swofford 1998) with the PaupUp graphical interface (Calendini and Martin 2005). Characters were equally weighted (Wagner parsimony, Farris 1970) and optimized with both accelerated transformation (ACCTRAN) and delayed transformation (DELTRAN) with no difference between the two. Tree searches were performed using a heuristic search with 1,000 random sequence additions, tree bisection and reconnection (TBR) branch swapping and 10 trees held per replicate. Internal support was assessed with 1,000 bootstrap (BP) replicates under the same search parameters.

The arrangement of the species of *Phymaspermum* in the taxonomic revision reflects the presumed phylogenetic relationships as recovered in the morphological strict consensus tree.

RESULTS AND DISCUSSION

Morphology and Anatomy—**VEGETATIVE CHARACTERS**—All species of *Phymaspermum* are evergreen, perennial shrubs or shrublets and fall into two main growth forms: (1) Multi-stemmed subshrubs with woody rootstocks and virgate unbranched or poorly branched stems (*P. acerosum*, *P. aciculare*, *P. argenteum*, *P. athanasioides*, *P. comptonii*, *P. erubescens*,

P. peglerae, *P. pinnatifidum*, and *P. woodii*, Fig. 1A–E) or (2) single-stemmed, well branched shrubs or shrublets (*P. aphyllum*, *P. appressum*, *P. leptophyllum*, *P. oppositifolium*, *P. parvifolium*, *P. scoparium*, *P. thymelaeoides*, and *P. trifidum*, Fig. 1F–N, where the branch apices of *P. aphyllum* (Fig. 1M) and *P. scoparium* are often spine tipped).

The indumentum ranges from glabrous to densely hairy, although in *P. argenteum*, *P. comptonii*, *P. thymelaeoides* and *P. trifidum* (Fig. 1F–H) it is conspicuously densely sericeous. *Phymaspermum aciculare*, *P. erubescens* and *P. peglerae* are readily distinguished from one another by their indumenta, i.e. glabrous in *P. aciculare*, silvery villous or hispid in *P. erubescens* and bronze villous in *P. peglerae*.

With the exception of the new species, *P. oppositifolium*, all the species of *Phymaspermum* have sessile, alternate leaves. Most of the species have spreading or erect leaves, except in *P. appressum* (Fig. 1I, J) and *P. oppositifolium* where they are characteristically closely appressed. *Phymaspermum aphyllum* is the only species which has characteristically very few and reduced leaves (Fig. 1M, N). The leaves are usually pinnatisect to trifid. Invariably simple entire leaves are diagnostic for *P. aphyllum*, *P. appressum*, *P. oppositifolium*, and *P. scoparium*. In *P. leptophyllum* and *P. thymelaeoides*, the leaves are usually simple and entire, rarely lobed. The leaves of *P. appressum* and *P. oppositifolium* are characteristically very bony, becoming scarious along the peduncles, while in the rest of the genus they are either fleshy or leathery.

REPRODUCTIVE CHARACTERS—The capitula of *Phymaspermum* are usually terminal and more or less solitary or aggregated into corymbs (Fig. 1A–D). In *P. scoparium*, however, the capitula are axillary and sessile. The multistemmed species are all corymbose, except for *P. aciculare*, *P. erubescens*, and *P. peglerae*. In the latter three discoid species and all the radiate species, the capitula are either solitary on the peduncles or with one to three additional capitula borne from leaf axils below (Fig. 1E, H–N). The capitula of *P. appressum* (Fig. 1I, J) and *P. oppositifolium* appear to be borne on short axillary fascicles due to their indistinct peduncles.

Most *Phymaspermum* species have up to four series of involucre bracts, although there can be up to five series in *P. athanasioides* or six series in *P. woodii*. The bracts are usually tightly arranged in an imbricate manner and have conspicuous longitudinal resin ducts. In *P. acerosum*, *P. comptonii*, and *P. pinnatifidum*, however, the bracts are irregularly arranged and the number of series are more difficult to distinguish. The involucre bracts of *Phymaspermum* species are generally rigid with membranous apices and edges, but in *P. appressum* and *P. oppositifolium*, the bracts become scarious and brittle. All *Phymaspermum* species have membranous apices especially on the innermost bracts. The margins of the involucre bracts are prominently dark brown in *P. argenteum* and sometimes light brown or indistinct in *P. woodii* and *P. leptophyllum*. The involucre bracts of *P. comptonii* have a prominent brown midrib. A brown midrib can also be seen in *P. pinnatifidum* due to the large bulging resin canal. These bulging resin canals also give the outer bracts a distinctive curved appearance. The involucre bracts can also be hairy or glabrous and have scarious apices and margins. *Phymaspermum thymelaeoides* has silvery villous involucre bracts which are bronze in *P. peglerae*. Other species such as *P. comptonii*, *P. scoparium*, and *P. trifidum* have silvery pubescent involucre bracts. The rest of the species generally have glabrous involucre bracts.



FIG. 1. General morphology of *Phymaspermum*. A–B. Multistemmed habit and corymbose synflorescence of *Phymaspermum woodii*. C. *Phymaspermum pinnatifidum*. D. Simple leaves and corymbose synflorescences of *Phymaspermum athanasioides*. E. Simple capitula of *Phymaspermum erubescens*. F–H. Shrubby habit, slightly fleshy, silvery sericeous leaves, and radiate capitula of *Phymaspermum trifidum*. I–J. Appressed leaves and purplish ray florets of *Phymaspermum appressum*. K. Few-rayed capitula of *Phymaspermum parvifolium*. L. *Phymaspermum leptophyllum*. M–N. Sparse, reduced leaves, longitudinally white striped stems and persistent, often spinescent peduncles of *Phymaspermum aphyllum*. Photographs: A & B, D–K. by A. R. Magee; C. by A. Young; M. by M. Maclean; N. by A. Schutte-Vlok.

As also found in *Gymnopentzia*, paleae of *Phymaspermum* species are restricted to the margins and are usually in one series, but sometimes in two series as in *P. woodii*. However, we have sometimes observed rudimentary paleae in the centre of the receptacles in *P. acerosum* and *P. thymelaeoides*. Unlike involucre bracts which usually only have scarios margins and apices, most paleae are scarios and sometimes have ciliate margins (*P. acerosum*) and apices with reduced longitudinal resin canals. The shape and size of these paleae are variable within species.

The capitula are largely either radiate or discoid, although in one species, *P. athanasioides*, they are disciform. This character is constant for all the species except *P. aciculare*, where plants can have either discoid or sometimes radiate capitula. When ray florets are present in this species, however, they are very few and reduced in size.

The ray florets are pistillate and fertile, with a white to cream limb which may sometimes have a purplish tinge near the base or underside; in *P. appressum* and *P. oppositifolium* they are often entirely purplish. The limbs are usually ovate to obovate and apically three-toothed, although in *P. aciculare* they are obelliptic.

The disc florets are bisexual and five-lobed. The tube is usually readily distinguishable from the limb and equal in length, although in *P. athanasioides* and *P. woodii*, the tube can be longer than the limb, and in *P. appressum* and *P. oppositifolium* the distinction between the tube and the limb is not clear. The corollas are always somewhat glandular, but pilose hairs can be found in *P. scoparium* and *P. thymelaeoides*. The lobes are triangular and usually spreading, except in *P. appressum* and *P. oppositifolium* where they are erect. Similarly erect lobes are sometimes also observed in *P. athanasioides*. Resin canals in the lobes of the disc florets are absent in all species except in *P. acerosum*, which rarely has red resin ducts in the tube, limb, and lobes. The anthers of all species have a more or less sagittate base and the appendages were not found to be taxonomically useful.

The cypselas are ellipsoid or obovoid and usually prominently 10–14 ribbed, except in *P. leptophyllum* where ribs are not prominent (Fig. 2D, L). The fruits are usually 1.6–2.5 mm long and 0.5–0.7 mm wide, although in three species, *P. aciculare*, *P. erubescens* (Fig. 2E), and *P. peglerae*, they are prominently larger, being more than 2.5 mm long (up to 3.5 mm) and 1.0 mm wide. The fruits of *P. pinnatifidum* can also be up to 3.5 mm long (Fig. 2F) but they are never as wide as those of *P. aciculare*, *P. erubescens*, and *P. peglerae*. A pappus is lacking in all the species, although there may be a thickened apical rim on the cypselas. *Phymaspermum pinnatifidum* is unique in that it has a conspicuous and extended membranous apical rim (Figs. 2F). The cypselas of *Phymaspermum* are unique in that they have ovoid, stalked myxogenic trichomes (Fig. 2A–E, I, L, M), a synapomorphy for the genus. These shortly stalked myxogenic trichomes are white when dry with an ovoid head consisting of a few cells (Fig. 2L, L, M). *Phymaspermum* is the only genus within Anthemideae with these stalked trichomes on the cypselas rather than the more usual myxogenic epidermal cells. Only those trichomes on the fruits of the radiate species were observed to rupture (Fig. 2L) when in contact with water. In the discoid species no evidence of rupturing was observed (Fig. 2I, M). These stalked trichomes are particularly dense on the cypselas of the radiate species (Fig. 2B–D). The stalked trichomes are more sparse on the discoid species and can sometimes

even be completely lacking in some individuals (Fig. 2E, H, M, N). However, in *P. acerosum* (Fig. 2G, J, K) and *P. pinnatifidum* (Fig. 2F) the stalked trichomes have been consistently lost.

In transverse section the epidermal cells are usually more anticlinally elongated in the radiate species of *Phymaspermum*. In *P. leptophyllum* (Fig. 2L), these cells are much more distinct and uniform and unlike the other species where they are shorter and distinctly papillate. The cypselas ribs of *P. leptophyllum* are therefore not as distinct as those in other species. The stalks of the myxogenic trichomes are embedded between these cells and as a result appear sessile. These distinct epidermal cells of *P. leptophyllum* allow this species to be distinguished from other closely related species such as *P. aphyllum* and *P. thymelaeoides*.

The testa epidermis and endocarpic cells remain parenchymatous but in some species they become sclerified. In the mesocarp, the sclerenchyma of *Phymaspermum* is organised into discrete bundles in which the vascular tissue is found (Fig. 2I–N). The endocarp is seen as a single layer of cells with dark staining contents (Fig. 2I–N).

In three species, resin canals were observed in the cypselas ribs, viz. *P. acerosum* (Fig. 2J, K), *P. comptonii* (Fig. 2I), and *P. pinnatifidum*. The presence of a resin canal in the cypselas of *P. comptonii* is significant, as it is the only species that combines both resin canals and myxogenic trichomes.

Phylogenetic Relationships—Of the 12 scored characters, 10 were parsimony-informative and two parsimony-uninformative. Two equally parsimonious trees were obtained (differing only in the placement of *P. scoparium* — either sister to the radiate clade or unresolved) with a tree length (TL) of 17 steps, a consistency index (CI) value of 0.71 and a retention index (RI) value of 0.9. The strict consensus tree is presented in Fig. 3.

Eumorphia and *Phymaspermum* are recovered to be monophyletic although without bootstrap support and the monotypic *Gymnopentzia* is not embedded within either *Eumorphia* or *Phymaspermum*. Despite the shared presence of opposite leaves, *Eumorphia* and *Gymnopentzia* were not recovered as sister genera. Rather, *Gymnopentzia* was placed sister to *Phymaspermum* based on the synapomorphic loss of receptacular paleae (character 4). This sister relationship between *Gymnopentzia* and *Phymaspermum* was also recognised by Bremer and Humphries (1993) in an alternative equally parsimonious cladogram. *Phymaspermum* is recovered as monophyletic, supported by the presence of myxogenic trichomes on the cypselas (character 10) (secondarily lost in *P. acerosum* and *P. pinnatifidum*). Within *Phymaspermum* three lineages are identified, although their relationships to one another are unresolved. The first comprises the anomalous *P. scoparium*, the second a clade of radiate (character 6), single-stemmed species and the third a clade of multistemmed (character 1), largely discoid species (sometimes sparsely radiate in *P. aciculare*) with sparsely glandular fruits (character 11). Within the discoid clade, *P. aciculare*, *P. erubescens*, and *P. peglerae* form a sister group (BP 67) to the rest of the species based on their larger fruits (character 7) and a subclade comprising *P. acerosum* – *P. woodii* is recovered based on the corymbose synflorescence structure (character 3). Within the latter subclade the presence of resin canals in the fruits (character 12) group *P. acerosum*, *P. comptonii*, and *P. pinnatifidum* together. Resolution within the radiate clade is largely unresolved, except for the obvious sister

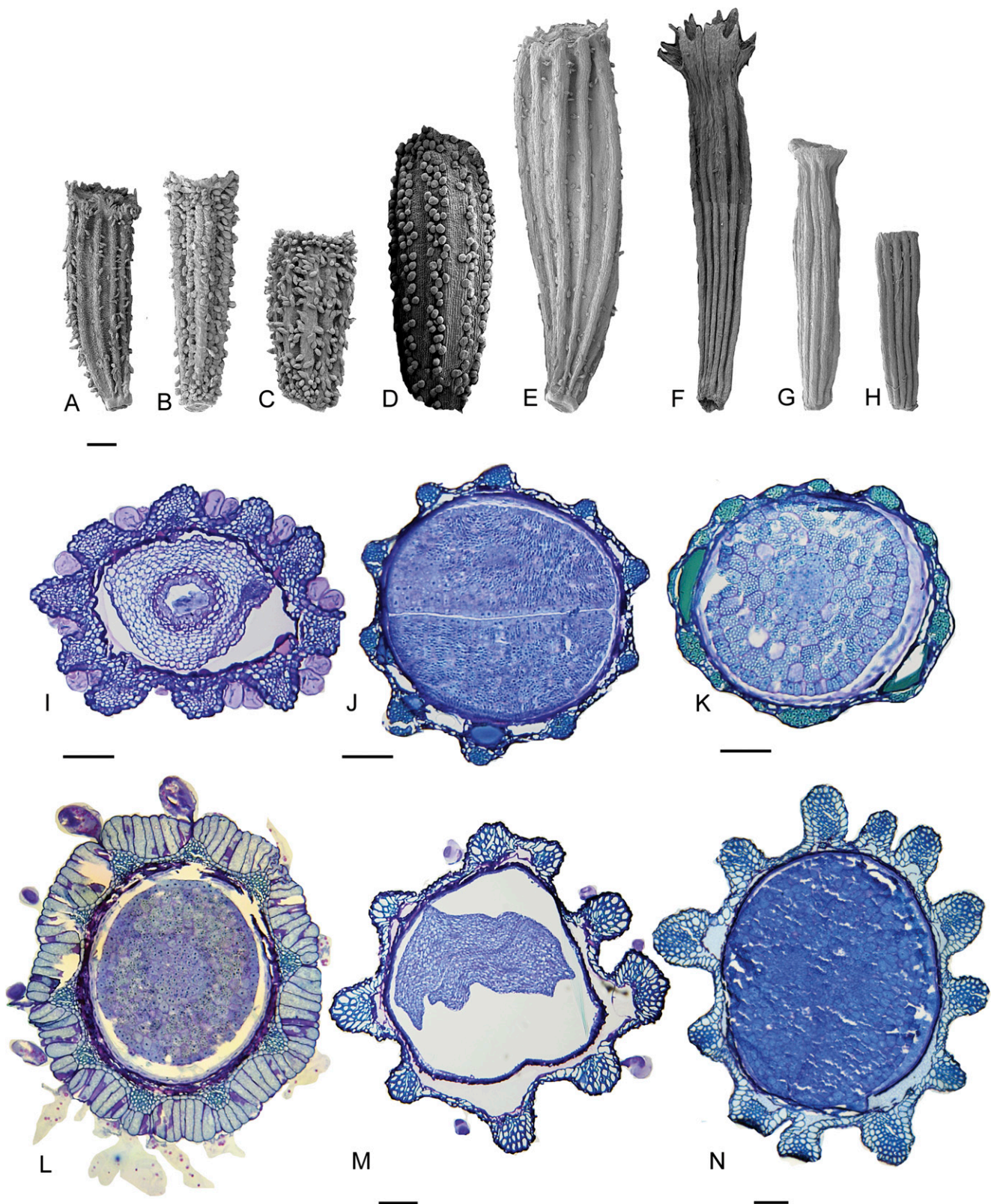


FIG. 2. Scanning electron micrographs (A–H) and transverse sections (I–N) of selected *Phymaspermum* cypselas. A. *P. scoparium*. B. *P. appressum*. C. *P. trifidum*. D. *P. leptophyllum*, note the obscure ribs and apparently sessile trichomes. E. *P. erubescens*, with the sparse stalked trichomes. F. *P. pinnatifidum*, showing the absence of stalked trichomes and the prominent apical crown. G. *P. acerosum*, note the absence of stalked trichomes. H. *P. comptonii*, showing the absence of stalked trichomes. I. *P. comptonii*, illustrating the presence of both stalked trichomes between the ribs and the resin canal. J–K. *P. acerosum*, note the absence of stalked trichomes and the resin canals. L. *P. leptophyllum*, with anticlinally elongated epidermal cells with trichome stalks inbedded between cells (note also the ruptured trichomes on the bottom left). M. *P. erubescens*. N. *P. peglerae*. Vouchers: A. Theron 1055 (PRE); B. Germishuizen 6615 (PRE); C. Magee and Boatwright 512 (NBG); D. Magee and Boatwright 372 (NBG); E. M. Acocks 12161 (PRE); F. Young 1441 (NBG); G. Ward 11272 (PRE); H. Compton 31199 (PRE). I. Burrows 8119 (PRE); J. Dieterlin 822 (PRE); K. Nicholson 2249 (PRE); L. Bohnen 9371 (NBG); N. Pegler 1601 (BOL). Scale: A–H = 500 μ m; I–N = 0.1 mm.

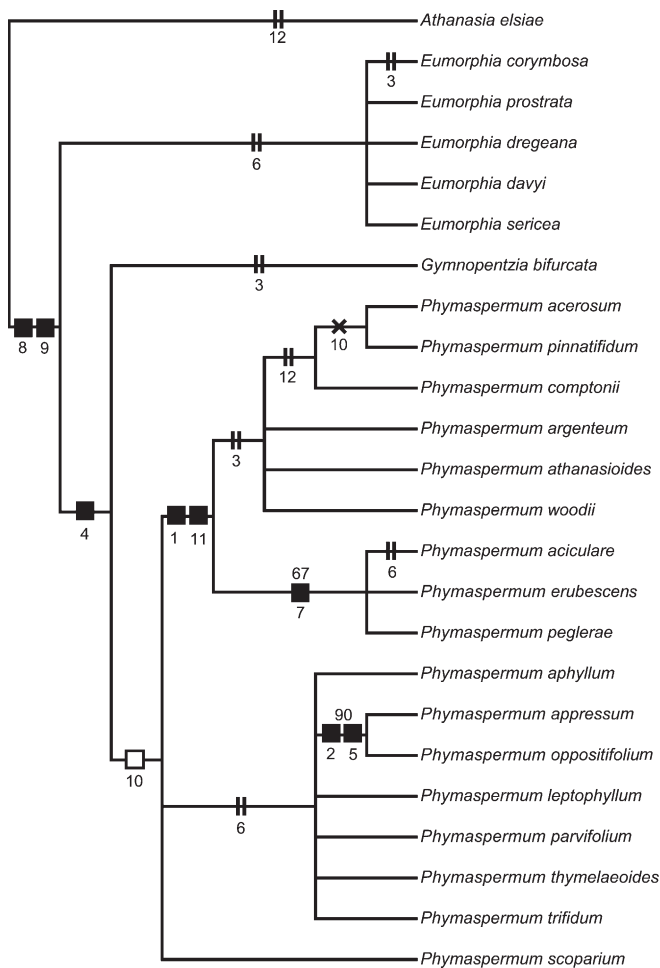


FIG. 3. Strict consensus tree obtained from a cladistic analysis of the morphological data in Appendix 1. Bootstrap values are indicated below the branches. Tree length = 17. Consistency index = 0.7059. Retention index = 0.9020. ■ = synapomorphy without reversal; □ = synapomorphy with reversal; × = reversal; || = convergence.

relationship between *P. appressum* and *P. oppositifolium* (BP 90), based on the closely appressed leaves (character 2) and scarious bracts (character 5).

TAXONOMIC TREATMENT

PHYMASPERMUM Less., Syn. Gen. Compos.: 253 (1832); DC., Prodr. 6: 44 (1838); Harv. in Harv. and Sond., Fl. Cap. 3: 160 (1864); Benth. and Hook. f. ex B.D. Jacks., Gen. pl. 2 (1): 422 (1873); Källersjö in Nord. J. Bot. 5(6): 535 (1986); B.D. Jacks., Index Kew. 1: 37 (1893); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Retief and P.P.J. Herman, Pl. N. Prov. S. Afr.: 329 (1997); Goldblatt and J.C. Manning, Cape Pl.: 352 (2000); Germish. and N.L. Mey., Pl. S. Afr.: 273 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006); Kadereit and C. Jeffrey in Fam. Gen. Vasc. Pl. [Kubitzki] 8: 356 (2007). —TYPE: *Phymaspermum leptophyllum* (DC.) Benth. & Hook. f. ex B.D. Jacks. (Proposed conserved type, Magee et al. 2013)

Adenachaena DC., Prodr. 6: 49 (1838); Harv. in Harv. and Sond., Fl. Cap. 3: 160 (1864); B.D. Jacks., Index Kew. 1: 37

(1893). —TYPE: *Adenachaena leptophylla* DC. ≡ *Phymaspermum leptophyllum* (DC.) Benth. & Hook. f. ex B.D. Jacks.

Brachymeris E. Mey. ex DC., Prodr. 6: 76 (1838); Harv. in Harv. and Sond., Fl. Cap. 3: 163 (1865); Hutch. in Bull. Misc. Inform. Kew 1916: 171 (1917); Källersjö in Nord. J. Bot. 5(6): 535 (1986). —TYPE: *Brachymeris scoparia* E. Mey. ex DC. ≡ *Phymaspermum scoparium* (E. Mey. ex DC.) Källersjö

Oligoglossa DC., Prodr. 6: 76 (1838); B.D. Jacks, Index Kew. 1: 339 (1893) *Iocaste* E. Mey ex Harv. in Harv. and Sond., Fl. Cap. 3: 160 (1865). —TYPE: *Oligoglossa acicularis* E. Mey. ex DC. ≡ *Phymaspermum aciculare* (E. Mey. ex DC.) Benth. and Hook. f. ex B.D. Jacks.

Evergreen, single- to multistemmed, very sparsely to densely leafy, shrubs or shrublets, 0.2–2.0 m high. Stems unbranched to much-branched; branches erect or spreading, rarely spine-tipped, striate, glabrous to densely matted; fascicles usually present in leaf axils, sometimes becoming woolly (in *P. acerosum* and *P. woodii*). Leaves sessile, alternate or rarely opposite (*P. oppositifolium*), very sparsely to closely imbricate, appressed to spreading, 1.0–40.0 × 0.2–3.0 mm, linear to spatulate, entire to pinnatifid, margins involute to revolute, sometimes narrowed into petiole-like base with secondary basal lobes, glabrous to villous, bony, leathery or fleshy; basal swelling continuous with stem ribs present; lobes 0–9, 0.2–24.0 × 0.5–1.5 mm, linear, mucronate to attenuate. Capitula homogamous or heterogamous, radiate, disciform or discoid, terminal or on very short axillary shoots, solitary, with 0–3 additional capitula from leaf axils below or in few- to many-headed (3 to >100), simple or compound corymbs, pedunculate or rarely subsessile; peduncles 1.0–95.0 mm long, glabrous to densely matted. Involucre cylindrical or urceolate to campanulate or hemispherical, sometimes tapering at the base; involucre bracts 3- to 7-seriate, loosely or tightly arranged, 1.0–7.0 mm long, ovate to linear, obtuse to attenuate, margins and apices scarious (bracts entirely scarious in *P. appressum* and *P. oppositifolium*), inner bracts with membranous apices 0.3–2.5 mm long, glabrous to densely villous, green to dark brown, purple, sometimes with brown margins, median resin canals present. Receptacle flat to convex, alveolate, paleate; paleae in marginal series (rarely rudimentary inner paleae present), 2.6–6.3 mm long, linear to obovate, apices obtuse to attenuate, entirely scarious or margins and apices scarious. Ray florets (when present) 3–22, pistillate; tube 1.0–4.2 mm long, sessile glandular trichomes present; limb 3.0–12.0 × 1.8–4.3 mm, ovate to obovate, usually apically 3-dentate, rarely 2-dentate or entire, white to purple. Filiform florets (only in *P. athanasioides*) ± 20, pistillate; corolla 2.3–3.0 mm long, yellow, with sessile glandular trichomes, zygomorphic; adaxial lobes 2, abaxial lamina 3-dentate, without resin canals. Disc florets 3 to > 100, bisexual, without resin canals (except sometimes in *P. acerosum*); corolla 1.6–4.0 mm long, with sessile glandular trichomes, zygomorphic; glabrous or rarely pilose, yellow to purple; tube 0.7–2.6 mm long; limb 0.5–1.8 mm long (excluding lobes), very narrowly to broadly campanulate, 5-lobed; lobes erect to spreading, 0.3–1.0 mm long, narrowly to broadly triangular or triangular ovate. Anthers 2.0–4.3 mm long (including apical appendage), sagittate at base; apical appendages lanceolate to rounded. Style 1.7–4.0 mm long (excluding the two terminally stigmatic branches), terete with thickened base; branches 0.1–1.9 mm long, truncate, with dorsal papillae. Cypselas 1.6–3.5 × 0.5–1.0 mm,

oblong to broadly obovoid, shortly papillate, apical rim absent or thickened to membranous, conspicuously or inconspicuously (in *P. leptophyllum*) 10- to 14-ribbed, stalked glandular trichomes present or rarely absent, usually mucilaginous, discontinuous resin canals in ribs rarely present (in *P. acerosum*, *P. comptonii*, and *P. pinnatifidum*).

Diagnostic Characters—*Phymaspermum* shares the papillose, many ribbed (≥ 10) cypselas with *Eumorphia* and *Gymnopentzia* but can be distinguished by the alternate leaves (except in one species, *P. oppositifolium*) and the

presence of unique stalked myxogenic trichomes on the cypselas (subsequently lost in two species, *P. acerosum* and *P. pinnatifidum*). It can be further distinguished from *Eumorphia* by the absence of inner paleae (inner paleae present in *Eumorphia*) and from *Gymnopentzia* by the shortly papillose cypselas (long papillate cypselas in *Gymnopentzia*).

Distribution and Ecology—*Phymaspermum* is largely restricted to southern Africa, with one species extending into Zimbabwe. Six of the species are endemic to the Greater Cape Floristic region.

KEY TO THE SPECIES OF *PHYMASPERMUM*

1. Capitula in prominent corymbs 2
2. Capitula heterogamous with filiform outer florets; primary leaves mostly entire, some 2- or 3-fid 12. *P. athansioides*
2. Capitula homogamous; primary leaves mostly trifid to pinnate 3
3. Involucral bracts closely appressed, deltoid to ovate, dorsal surface flat; fruits without resin canals 4
4. Leaf lobes ≤ 0.5 mm wide, usually sparsely villous; involucre apically constricted, bracts with indistinct to light brown margins; restricted to KwaZulu-Natal and Eastern Cape 13. *P. woodii*
4. Leaf lobes ≥ 1 mm wide, usually silvery sericeous; involucre apically spreading, bracts with prominent dark brown margins; restricted to Limpopo and Mpumalanga 14. *P. argenteum*
3. Involucral bracts loosely appressed, narrowly ovate to lanceolate, dorsal surface ridged; fruits with resin canals 5
5. Ovary and fruit with a prominent membranous crown; plants less than 0.5 m tall, stems thin and herbaceous; spring flowering 16. *P. pinnatifidum*
5. Ovary and fruit at most apically dentate; plants more than 0.5 m tall, stems stout and woody; autumn to winter flowering 6
6. Involucre campanulate, bracts \pm equal, innermost with prominent rounded scarious appendages; fruits with stalked trichomes; leaves usually silvery sericeous 15. *P. comptonii*
6. Involucre cylindrical to narrowly campanulate (rarely campanulate), bracts clearly unequal, innermost without rounded scarious appendages; fruits without stalked trichomes; leaves glabrescent to villous 17. *P. acerosum*
1. Capitula solitary, sometimes with 1–5 additional capitula from leaf axils below 7
7. Capitula discoid (sometimes radiate in *P. aciculare* but then ray florets scanty, up to four, with small limb, less than 5 mm long) 8
8. Capitula sessile, axillary, peduncle becoming spinescent; floret limb hairy 1. *P. scoparium*
8. Capitula prominently pedunculate, terminal, not spinescent; floret limb glabrous 9
9. Stem and leaves glabrous; capitula obconical, < 6 mm wide, with 3–5 additional capitula from leaf axils below 9. *P. aciculare*
9. Stem and leaves pubescent to sericeous; capitula cyathiform (cup-shaped) to hemispherical, > 5 mm wide, solitary or with up to 2 additional capitula from the leaf axils below 10
10. Stem and leaves silvery villous or hispid; leaves 2–10 mm long; fruits ≤ 4 mm long 10. *P. erubescens*
10. Stem and leaves densely bronze villous; leaves 9–18 mm long; fruits > 4 mm long 11. *P. peglerae*
7. Capitula radiate (rays more than four and limb usually more than 5 mm long) 11
11. Leaves strongly appressed; involucral bracts largely scarious, with obscure resin canals 12
12. Leaves alternate; involucral bracts ovate 7. *P. appressum*
12. Leaves opposite; involucral bracts lanceolate to oblong 8. *P. oppositifolium*
11. Leaves erect to spreading; involucral bracts herbaceous to bony with only narrow scarious margins and apices, with prominent resin canals 13
13. Compact, closely branched shrublets, ≤ 0.3 (0.4) m tall, capitula with < 8 ray florets 2. *P. parvifolium*
13. Straggly, openly branched shrubs, ≥ 0.5 m tall, capitula with ≥ 8 ray florets 14
14. Leaves silvery sericeous, spatulate to trifid, flat; involucral bracts ovate to narrowly ovate 15
15. Leaves regularly trifid along the entire stem; innermost involucral bracts with broad scarious appendages; floret tube without hairs 4. *P. trifidum*
15. Leaves entire, spatulate (some becoming trifid towards the peduncle); innermost involucral bracts without broad scarious appendages; floret tube usually prominently hairy 3. *P. thymelaeoides*
14. Leaves glabrous to sparsely pubescent, green, linear, subterete; involucral bracts lanceolate to oblong 16
16. Stems not longitudinally white-striped, hairs scattered along stem; leaves not sparse or caducous, ± 1.0 – 2.0 mm wide; peduncles not becoming spinescent, fruits with indistinct ribs and myxogenic trichomes apparently sessile 5. *P. leptophyllum*
16. Stems longitudinally white-striped, densely white woolly between ribs; leaves sparse, caducous, ± 0.5 mm wide; peduncles often become spinescent; fruits with distinct ribs and obviously stalked myxogenic trichomes 6. *P. aphyllum*

1. *PHYMASPERMUM* SCOPARIUM (E. Mey. ex. DC.) Källersjö in Nordic J. Bot. 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Germish. and N.L. Meyer, Pl. S. Afr.: 274 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). *Brachymeris scoparia* E. Mey. ex. DC., Prodr. 6:76 (1838); Harv. and Sond., Fl. Cap. 3: 163 (1864); Hutch., Bull. Misc. Inform. Kew, 1916: 173

(1917). —TYPE: SOUTH AFRICA. Northern Cape, Hanover (3124): 'Zeekoerivier' [Seekoeirivier] (–BC), March 1835, Drège 801 (lectotype: G–DC–image!, designated here; isolectotype: HBG–image!, P–image!). [Note: de Candolle cited two Drège collections in his protologue. There is a single sheet in G–DC which has both collections. The specimen from Seekoeirivier (Drège locality 1,c,1), on the right, is selected as it is the better of the two specimens and has duplicates in HBG and P.]

Single-stemmed, sparsely leafy shrublet, height unknown. Stem much-branched; branches erect to spreading, spine-tipped, silvery-pubescent; fascicles sometimes present in leaf axils. Leaves alternate, appressed to spreading, 1.0–5.0 × 1.0–2.0 mm, triangular ovate to spatulate, rounded to mucronate, entire, narrowed into petiole-like base, without secondary basal lobes, densely silvery pubescent on both surfaces, fleshy; basal swelling present, continuous with stem ribs. Capitula discoid, homogamous, on short axillary shoots, solitary, subsessile. Involucre 4.0 × 3.0 mm, cyathiform, tapering at the base; involucre bracts 4-seriate, tightly arranged, margins and apices scarious, membranous apices of all bracts 0.1–0.2 mm long, glabrous to villous along edges, brown margins absent, median resin canals present; outer bracts deltoid to lanceolate, ca. 1.5 mm long, acute to obtuse; middle bracts deltoid to lanceolate, ca. 1.8 mm long, acute to obtuse; inner bracts lanceolate to oblong, ca. 1.8 mm long, obtuse; innermost bracts oblong, ca. 2.2 mm long, obtuse. Receptacle convex; paleae in marginal series, linear, ca. 3.0 mm long, obtuse, rigid with scarious margins and apices, scarious apices 0.6 mm long. Disc florets ± 10, without resin canals; corolla ± 1.8 mm long, with glandular trichomes and hairs on tube and limb, yellow; tube ± 1.0 mm long; limb narrowly campanulate, 0.8 mm long (excluding lobes); lobes spreading, 0.7 mm long, triangular-ovate. Anthers 2.1 mm long (including apical appendage); apical appendage oblong. Style 2.2–2.5 mm long (excluding branches); branches 0.8 mm long. Cypselas 2.0 × 0.8 mm, narrowly obovate, 11-ribbed, apical rim thickened, slightly dentate, glandular trichomes present, dense, scattered, not mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 4.

Diagnostic Characters—*Phymaspermum scoparium* is unlikely to be confused with any of the other discoid species. It is easily recognised by the subsessile, axillary heads, apically spinescent stems, and florets with a pilose corolla.

Distribution and Ecology—*Phymaspermum scoparium* is a very poorly collected species from near Graaff-Reinet in the Eastern Cape to Hanover in the Northern Cape (Fig. 4F). The species appears to favor seasonally moist sites. Flowering time is from November to March.

Additional Specimens Examined—SOUTH AFRICA. Northern Cape: 3024 (De Aar): Rhenosterberg (–AC), *Drège s.n.* (P–image); between Colesberg and Hanover (–DD), *Henrici* 3924 (PRE). 3124 (Hanover): Seekoerivier, Klein Tafelberg, Winterveld (–AD), *Ecklon and Zeyher* 127 (SAM); Noupoort (–BB), *Henrici* 4446 (PRE). Eastern Cape: 3125 (Steynsburg): Middelberg (–AC), *Acocks* 15324 (PRE); Middelburg, Leeufontein (–AC), *Theron* 1055 (PRE). 3224 (Graaff-Reinet): Sneeuwberg (–AA), *Drège* 45070 (SAM); Sneeuwberg lowlands (–AA), *Drège* 59179 (PRE), *Drège s.n.* (S– two images).

2. *PHYMASPERMUM PARVIFOLIUM* (DC.) Benth. and Hook. f. ex B.D. Jacks., *Index Kew.* 1: 37 (1893); Källersjö in *Nordic J. Bot.* 5(6): 535 (1986); K. Bremer and Humphries in *Bull. Nat. Hist. Mus. Lond. (Bot.)* 23(2): 94 (1993); Germish. and N.L. Meyer, *Pl. S. Afr.*: 274 (2003); Klopper et al. *Checklist of the flowering plants of Sub-Saharan Africa*: 147 (2006); Germish. et al. *Checklist S. African Pl.*: 243 (2006). *Adenachaena parvifolia* DC., *Prodr.* 6: 50 (1838); Harv. and Sond., *Fl. Cap.* 3: 161 (1864). —TYPE: SOUTH AFRICA. Eastern Cape, Port Elizabeth (3325): 'Uitenhage', 1835, *Ecklon* 1845 (holotype: G–DC–image!; isotype: S–image!). [Note: This is the only specimen of this species in de Candolle's collection at G–DC.]

Adenachaena pubescens DC., *Prodr.* 1: 49 (1838), syn. nov.
Phymaspermum pubescens (DC.) Kuntze, *Revis. Gen. pl.*

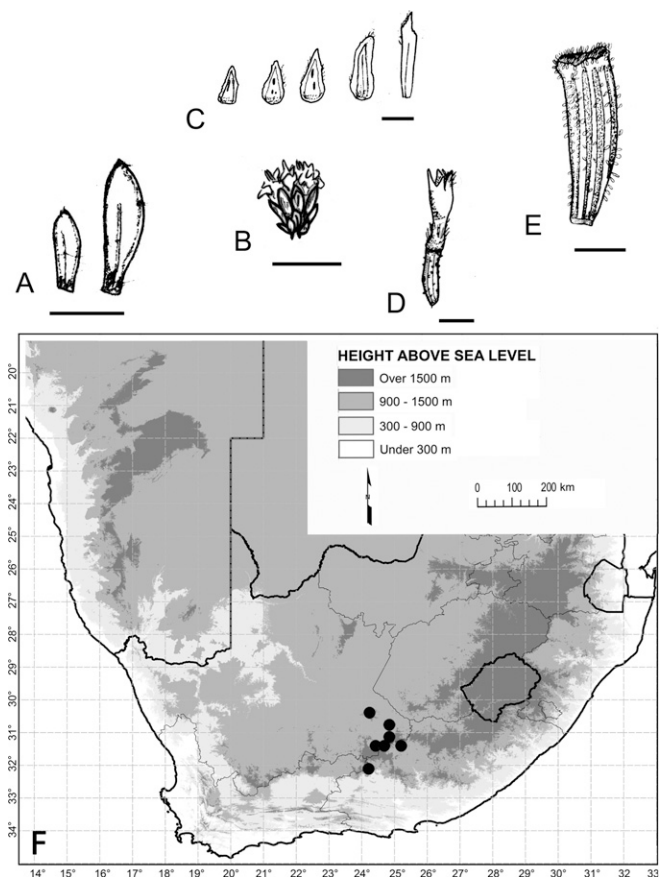


FIG. 4. *Phymaspermum scoparium*. A. Leaves. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Cypselas. F. Known geographical distribution. Vouchers: A, B, E. *Theron* 1055 (PRE); C, D. *Ecklon and Zeyher* 127 (SAM). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

3: 167 (1898); Germish. and N.L. Meyer, *Pl. S. Afr.*: 274 (2003); Klopper et al. *Checklist of the flowering plants of Sub-Saharan Africa*: 147 (2006); Germish. et al. *Checklist S. African Pl.*: 243 (2006). —TYPE: SOUTH AFRICA. Eastern Cape, Aliwal North (3026): 'Nieuwe Hantom' (–CC), February 1835, *Drège* 6135 (lectotype: G–DC sheet G00455508–image!, designated here; isolectotypes: E–image!, G–DC two sheets–image!, HBG–image!). [Note: There are three specimens from the same collection by Drège (Drège locality 1,b,2) in G–DC, only one bears the original collection label with the locality and is designated here.]

Single-stemmed, densely leafy shrublet, 0.15–0.4 m high. Stem strongly-branched; branches erect to spreading, glabrous to densely silvery pubescent; fascicles sometimes present in leaf axils. Leaves alternate, spreading to rarely reflexed, 3.0–15.0 × 0.8 mm, linear to oblong, mucronate, entire to trifid, sometimes narrowed into petiole-like base, sometimes with secondary basal lobes, glabrous to silvery pubescent on both surfaces, fleshy; basal swelling present, continuous with stem ribs; lobes 2 or 3, 0.2–3.0 × 0.8 mm, oblong, mucronate. Capitula radiate, heterogamous, terminal, solitary, with up to 3 additional capitula from leaf axils below, pedunculate; peduncles 5.0–45.0 mm long, glabrous to silvery pubescent. Involucre 2.5–5.0 × 2.5–6.0 mm, narrowly campanulate (rarely hemispherical), tapering at the base;

involucral bracts 4-seriate, tightly arranged, margins and apices scarios, membranous apices of all bracts 0.3–0.6 mm long, usually with fimbriate margins, glabrous to hairy (rarely beyond margins), brown margins absent, median resin canals present; outer bracts deltoid, 1.0–1.6 mm long, acute to attenuate; middle bracts deltoid, 1.5–1.8 mm long, acute to attenuate; inner bracts oblong, 2.2–2.5 mm long, acute to rounded; innermost bracts oblong, 2.8–3.1 mm long, acute to rounded. Receptacle convex; paleae in marginal series, oblong to linear, 2.6–3.0 mm long, rounded, rigid with scarios margins and apices, scarios apices 0.2–0.3 mm long. Ray florets ± 7 ; tube 1.0–1.2 mm long; limb obovate, 4.5–5.3 \times 2.3–3.0 mm, apically 3-dentate, white. Disc florets 10–15, without resin canals; corolla 1.6–2.2 mm long, with only glandular trichomes, yellow to purple; tube 1.0–1.2 mm long; limb campanulate, 0.6–1.0 mm long (excluding lobes); lobes spreading, 0.6–0.7 mm long, triangular. Anthers 2.3–2.8 mm long (including apical appendage); apical appendage ovate. Style 1.7–2.3 mm long (excluding branches); branches 0.5–0.6 mm long. Cypselas 2.0 \times 1.0 mm, narrowly to broadly obovate, 10- to 14-ribbed, apical rim thickened, slightly dentate, glandular trichomes present, dense, scattered, mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 5.

Diagnostic Characters—*Phymaspermum parvifolium* is a compact shrub, less than 0.4 m tall, with a close branching habit and radiate heads. It can sometimes be confused with *P. thymelaoides* but can be distinguished by its compact growth (*P. thymelaoides* is an open branched shrub, usually more than 0.8 m tall), the linear to oblong leaves (spathulate in *P. thymelaoides*), glabrous disc florets (often hairy in *P. thymelaoides*) and glabrous to sparsely hairy (rarely beyond margins) involucral bracts (densely villous in *P. thymelaoides*).

Distribution and Ecology—*Phymaspermum parvifolium* is widely distributed in the largely arid areas of the Western Cape, Eastern Cape and Northern Cape as well as the Free State at an altitude of 300–1,500 m (Fig. 5G). Flowering is throughout the year but peaks from March to May. This species is an important fodder plant for sheep and is commonly known as the “swart karoo,” “vaal karoo,” “wit heuning karoo,” and “good karoo” (Smith 1966; Powrie 2004).

Additional Specimens Examined—SOUTH AFRICA. Free State: **2925 (Jagersfontein)**: Bloemfontein, Hagesdam farm near Hagesdam (–BD), *Zietsman* 4070 (PRE); Fauresmith (–CB), *Macloylhin* 94 (BOL), *Hofman s.n.* (PRE), *Verdoorn* 2093 (PRE); Fauresmith, veld reserve (–CB), *Pappendorf* 700 (PRE); Fauresmith (–CB), *van Breda* SKF521 (PRE); Fauresmith, farm Bakbank, crest of small hill behind homestead (–DC), *Smith* 3997 (PRE); Fauresmith, farm Bakbank, small plateau on hill behind farm house (–DC), *Smith* 4005 (PRE); farm Bakbank, in veld near gate (–DC), *Smith* 5549 (PRE). **2926 (Bloemfontein)**: Bloemfontein (–AA), *Pole-Evans* 1678 (PRE). **3025 (Colesburg)**: 17 km from Bethulie on road to Philippolis (–BC), *Reid* 238 (PRE). **3026 (Aliwal North)**: Low lying area at base of Boesmansberg (–AA), *Reid* 223 (PRE two sheets); Grootfontein along the road to Inhoek (–AC), *Muller* 960 (PRE); Eland’s Hoek (–DC), *Bolus* 267 (BOL). Northern Cape: **2822 (Glen Lyon)**: Hay sandveld at Bermolli (–BD), *Acocks* and *Hafström* H1082 (PRE), *Wilman* 2426 (BOL); Hay, Floradale (–BD), *Esterhuysen* 2303 (BOL). **2823 (Griekwastad)**: 21 miles ESE of Postmasburg (–CA), *Leistner* 1653 (NBG). **2922 (Prieska)**: Niekerk’s Hoop, Griqualand West (–BD), *Wilman* 17105 (BOL); Boesmanland, farm Doonies-Pan 106, 13.3 km NNW of Coppertown (–CC), *Le Roux* and *Lloyd* 137 (PRE); Prieska (–DA), *Bryant* J254 (PRE). **2923 (Douglas)**: Swarthaakveld at Lanyon vale (–AA), *Acocks* 1949 (PRE). **3023 (Britstown)**: De Aar, Quaggafontein (–DB), *Acocks* 12609 (PRE). **3121 (Fraserburg)**: Grootfontein farm, about 42 km N of Williston, 6 km W from farmhouse (–AA), *Germishuizen* 6364 (BOL); Spioenberg, on road from Droëpuit to Fraserburg (–BC), *Germishuizen* 6498 (PRE). **3123 (Victoria West)**: 36 km from Victoria West on main road to Britstown, farm Rietpoort (–AA), *Herman* 1157 (PRE); Groot Bosmanspoortberg, NE of Victoria West (–AC),

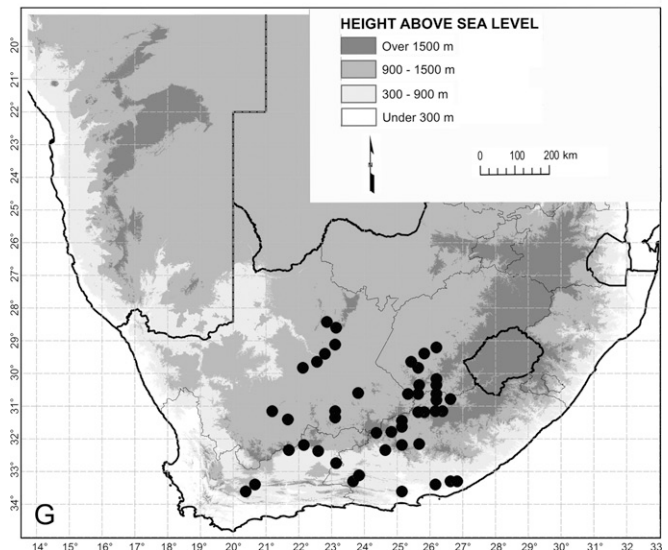
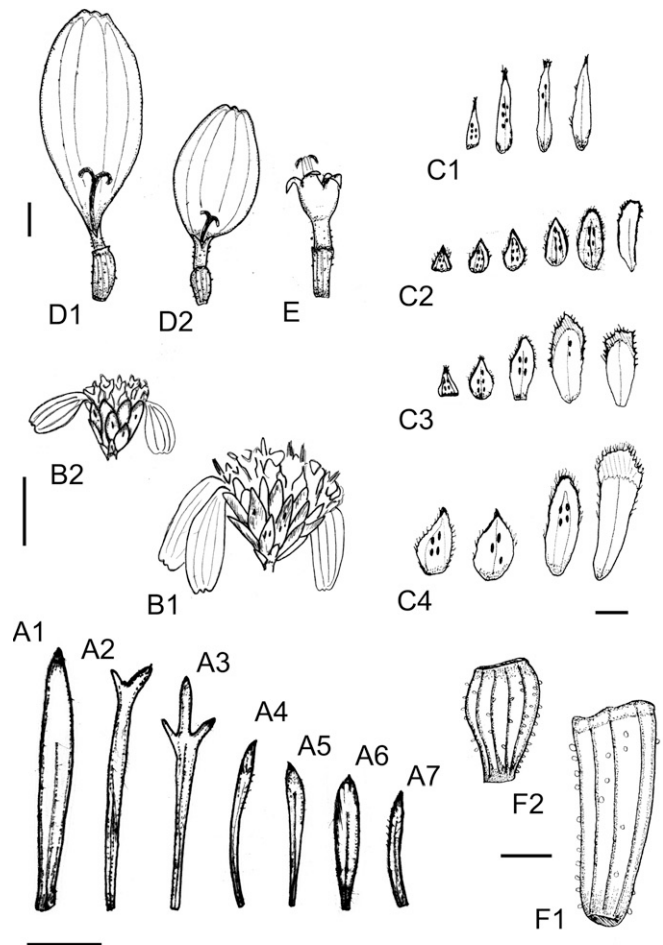


FIG. 5. *Phymaspermum parvifolium*. A. Leaves. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single palea (far right). D. Ray florets. E. Disc floret. F. Cypselas. G. Known geographical distribution. Vouchers: A1, A6, B1, C4. *Bester* 6152 (NBG); A2–A3, A5, C1, D1, E, F1. *Koekemoer* 2322 (PRE); A4, A7. *Reid* 223 (PRE); B2. *Compton* 2031 (NBG); C2, D2, F2. *Viviers and Vlok* 410 (PRE); C3. *Leistner* 1653 (NBG). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

Hugo 310 (PRE). Western Cape: **3221 (Merweville)**: Grootfontein, Fraserburg, Layton, Spitskop (–BC), *Shearing* 74 (PRE); Fraserburg district, Layton, kloof bottom, Spitskop, (–BC), *Shearing* 161 (PRE). **3222 (Beaufort West)**: Karoo National Park, NE border of the farm

Brandewynsgat, rivercourse with steep cliffs (–AA), *Bester 6152* (NBG); Karoo National Park, koppie next to road (–BC), *Bohnen 6552* (NBG). **3320 (Montagu):** Anysberg Nature Reserve, just past Vrede homestead on way to man made dam (–BC), *Germishuizen 6746* (PRE); Kruisrivier farm, 4 km S of Bloutoring, near old Ladismith railway (–CB), *Hilton-Taylor 2054* (NBG); Ladismith, about 2 km N of entrance to farm Hoek-Van-Den-Berg (–CB), *Viviers and Vlok 410* (PRE). Eastern Cape: **3025 (Colesburg):** Verwoerd Dam Nature Reserve (–CB), *Muller 1785* (PRE); Oviston Nature Reserve (–DA), *Fourie 455* (PRE). **3026 (Aliwal North):** Excelsior farm (closely adjacent to Cliftonvale farm) 20 km SE of Bethulie (–CA), *Burrows 2407* (PRE); Farm “Die Hoek” 20 km W of Burgersdorp (–CC), *Schieber 22* (PRE); Winnaars baken, Burgersdorp (–CC), *Thorne 51899* (SAM). **3124 (Hanover):** Doornberg hoek near windmill (–CD), *Acocks 8651* (PRE); farm Blue Gum house, stream bank in front of farmhouse (–DD), *Retief and Reid 545* (PRE). **3125 (Steynsburg):** Middelburg (–AC), *Hutchinson 3106* (BOL), *Leistner 631* (NBG); Grootfontein, Middelburg (–AC), *Gill 230* (BOL), *Verdoorn 1481* (PRE), *Theron 552* (PRE); 4 miles from Middelburg on Rietpoort road (–AC), *Commins 724* (PRE); Middelburg Road railway station (–AC), *Flanagan 1384* (PRE, BOL, SAM), *Tyson 45065* (SAM); near Springfontein (–BA), *Rogers 1000* (BOL); farm Palmkop (–BB), *Retief and Germishuizen 294* (PRE); Middelburg district, Erin (–CA), *Acocks 24565* (PRE). **3126 (Queenstown):** Albert (–AA), *Cooper 1360* (BOL), *Drège s.n.* (K–image); SE of Burgersdorp, off Stormberg plateau (–AB), *Victor 1415* (PRE). **3223 (Rietbron):** Concordia (–CC), *Dean 894* (BOL). **3224 (Graaff-Reinet):** Graaff-Reinet (–BC), *Galpin 10587* (PRE two sheets); 30 miles S of Graaff-Reinet (–BC), *Bolus 1864* (BOL). **3225 (Mahlobyanini East):** E slopes of Rietpoort Mountain (–AA), *Acocks 11952* (PRE); Cradock (–BA), *Zeyher and Burke 981* (SAM); 33 miles from Cradock (–BA), *Maguire 706* (NBG). **3323 (Willowmore):** Lower north facing slopes of Witteberg near Rietfontein (–BB), *Viviers and Vlok 161* (PRE); 25 miles E of Willowmore (–BC), *Compton 19640* (NBG). **3325 (Port Elizabeth):** Winterhoeksberg (–CA), *Ecklon and Zeyher s.n.* (S–image). **3326 (Grahamstown):** Albany (–AC), *Acock 15733* (BOL); Albany, Plutos Vale (–BC), *Compton 13104* (NBG); Hunt Hoek (–BC), *Forward A1750* (PRE); Ecra Pass, 26 km from Grahamstown on R67 to Fort Beaufort (–BC), *Koekemoer 2322* (PRE); Albany, Trumpeters Drift (–BD), *Story 2182* (PRE).

PRECISE LOCALITY UNKNOWN: Bonga farm, Middelberg, *Bolus 14076* (BOL).

3. *PHYMASPERMUM THYMELAEOIDES* (DC.) Magee & Ruiters comb. nov. *Osteospermum thymelaeoides* DC., Prodr. 6: 462 (1838). —TYPE: SOUTH AFRICA. Western Cape, Beaufort West (3222): ‘Nieuwewelbergen’ [Nieuwveld mountains] (–AB), Oct 1826, *Drège 6177* (holotype: G–DC–image!; isotypes: P–image!, two sheets). [Note: de Candolle was uncertain about the placement of this taxon in *Osteospermum*. Norlindh (1943) in his revision of *Osteospermum*, recognised that *O. thymelaeoides* was rather a species of *Phymaspermum* but incorrectly considered it to be synonymous with *Phymaspermum parvifolium*. On closer examination the specimen clearly matches *P. schroeteri* with the openly branched habit and sericeous leaves and involucre bracts. As *O. thymelaeoides* is the older name it has priority and *P. schroeteri* is therefore reduced into synonymy. This is the only specimen of this species in de Candolle’s herbarium at G–DC.]

Phymaspermum schroeteri Compton in Trans. Roy. Soc. South Africa 19: 320 (1931); Källersjö in Nordic J. Bot. 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Germish. and N.L. Meyer, Pl. S. Afr.: 274 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). syn. nov. —TYPE: SOUTH AFRICA. Western Cape, Montagu (3320): Ngaap Kop (–BA), 27 Sept. 1926, *Compton 3065* (holotype: BOL!).

Single-stemmed, densely leafy shrub, (0.5)0.8–1.2 m high. Stem much-branched; branches erect to spreading, silvery

pubescent; fascicles sometimes present in leaf axils. Leaves alternate, erect to spreading, 5.0–30.0 × 0.8–3.0 mm, linear to spatulate, mucronate, entire to trifid, narrowed into petiole-like base, sometimes with secondary basal lobes, silvery sericeous on both surfaces, fleshy; basal swelling present, continuous with stem ribs; lobes 3, 2.0–3.0 × 1.0 mm, linear, mucronate. Capitula radiate, heterogamous, terminal, solitary, with 0–2 additional capitula from leaf axils below, pedunculate; peduncles 5.0–35.0 mm long, silvery pubescent. Involucre 4.0–7.0 × 4.0–5.0 mm, hemispherical to cyathiform, sometimes tapering at the base; involucre bracts 3- or 4-seriate, loosely to tightly arranged, margins and apices scarious, membranous apices of all bracts 0.1–1.0 mm long, silvery villous, brown margins absent, median resin canals present; outer bracts lanceolate, 1.5–2.1 mm long, attenuate; middle bracts lanceolate, 2.0–2.3 mm long, rounded; inner bracts oblong, 2.7–3.8 mm long, rounded; innermost bracts oblong, 3.4–4.0 mm long, rounded. Receptacle convex; paleae in marginal series (rarely rudimentary inner paleae present); oblong, 3.5–4.0 mm long, rounded, scarious. Ray florets 8–12; tube 1.2–1.6 mm long; limb obovate, 5.4–7.2 × 2.2–3.0 mm, apically 3-dentate, white to purple. Disc florets 20–30, without resin canals; corolla 1.7–2.7 mm long, with glandular trichomes and sometimes hairs on tube, yellow to purple; tube 0.7–1.8 mm long; limb campanulate, 0.5–1.0 mm long (excluding lobes); lobes spreading, 0.5–1.0 mm long, triangular. Anthers 1.7–3.8 mm long (including apical appendage); apical appendage ovate. Style 1.2–3.2 mm long (excluding branches); branches 0.4–0.5 mm long. Cypselas 2.5 × 0.7 mm, obovate, 11-ribbed, apical rim thickened, slightly dentate, glandular trichomes present, dense, mostly between ribs, mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 6.

Diagnostic Characters—*Phymaspermum thymelaeoides* is an openly branched shrub, more than 0.8 m tall, with radiate heads, usually hairy disc floret tubes, and entire, spatulate leaves. It can be distinguished from *P. leptophyllum* by the spatulate, silvery sericeous leaves and the ribbed cypselas with prominently stalked myxogenic trichomes. Similarly silvery leaves are found in *P. trifidum* but in *P. thymelaeoides* the leaves are largely entire and the innermost involucre bracts have a much shorter membranous appendage.

Distribution and Ecology—*Phymaspermum thymelaeoides* occurs on upper south facing slopes, at altitudes of 1,000–1,700 m, from Ghaapkop near Laingsburg along the Roggeveld and Nuwveld mountains to Molteno Pass (Fig. 6G). Flowering appears to be throughout the year. The species is well grazed (*Shearing 1159*, PRE; *Shearing 1181*, PRE; *Acocks 17199*, PRE) and the flowers have a prominent honey scent.

Additional Specimens Examined—SOUTH AFRICA. Northern Cape: **3221 (Merweville):** Oudekloof Bo, Oukloof (–BB), *Shearing 941* (PRE), *Shearing 1159* (PRE); Fraserburg, Layton Vergenoegd (–BB), *Acocks 23538* (PRE); Layton flats, Vlak Camp (–BB), *Acocks 23538* (PRE). Western Cape: **3221 (Merweville):** Nuwveld mountains, Uitspannings River Pass, 40 km NW of Merweville (–CA), *Brusse 3409* (BOL); Sutherland, Besemgoedberg on Komsberg escarpment (–CA), *Acocks 17199* (PRE). **3222 (Beaufort West):** Nieuwveld mountains (–AB), *Esterhuysen 2746* (BOL); Nieuwveld mountains, next to Molteno Pass, between entrance gates to farms Highlands and Rhénosterveld (–BA), *Vlok 2527* (PRE); Theekloof (–BA), *Acocks 14151* (PRE). **3320 (Montagu):** Boerhoeue farm, between Matjiesfontein and Sutherland (–BA), *Magee and Boatwright 381* (NBG); Ghaap Kop, Laingsburg (–BA), *Compton 14421* (NBG), *Schroeter 18591* (BOL); Ghaap Kop, Laingsburg, Whitehill (–BA), *Compton 4427* (BOL, NBG), *Esterhuysen 3270* (BOL).

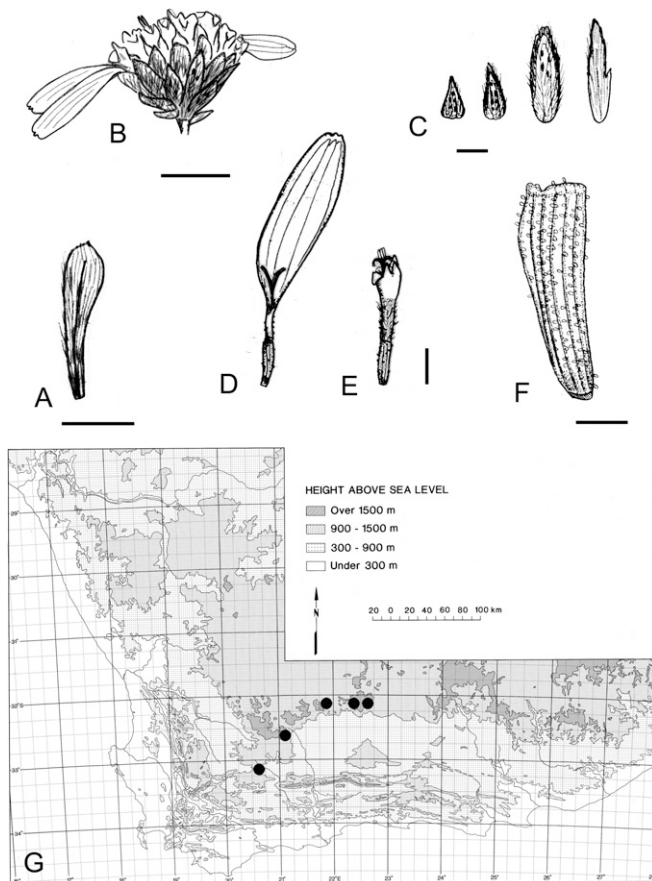


FIG. 6. *Phymaspermum thymelaeoides*. A. Leaf. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single palea (far right). D. Ray floret. E. Disc floret. F. Cypsel. G. Known geographical distribution. Vouchers: A, F. *Shearing 941* (PRE); B-E. *Magee and Boatwright 381* (NBG). Scale: A-B = 4 mm; C-D = 1 mm; E = 500 μ m.

4. *Phymaspermum trifidum* Magee and Ruiters sp. nov. —
 TYPE: SOUTH AFRICA. Western Cape, Worcester (3319):
 Farm Goedemoed, between Robertson and McGregor
 (-DD), 28 November 2012, *Magee and Boatwright 512*
 (holotype: NBG!; isotypes: BOL!, K!, PRE!, S!)

Single-stemmed, densely leafy shrub, 0.7 m high. Stem much-branched; branches erect to spreading, silvery pubescent; fascicles sometimes present in leaf axils. Leaves alternate, spreading, 5.0–17.0 \times 0.8–1.0 mm, linear, mucronate, rarely entire (entire on peduncles), trifid, narrowed into petiole-like base, without secondary basal lobes, silvery sericeous on both surfaces, fleshy; basal swelling present, continuous with stem ribs; lobes 3, 1.0–8.0 \times 0.8–1.0 mm, linear, mucronate. Capitula radiate, heterogamous, terminal, solitary, pedunculate; peduncles 20.0–40.0 mm long, silvery pubescent. Involucre 5.0–6.0 \times 6.0–7.0 mm, hemispherical to cyathiform, not tapering at the base; involucral bracts 3- or 4-seriate, tightly arranged, margins and apices scarious, membranous apices of all bracts 0.3–1.3 mm long, pubescent, brown margins present, median resin canals present; outer bracts lanceolate to ovate, 2.1–2.4 mm long, acute to rounded; middle bracts lanceolate to ovate, 2.2–2.6 mm long, rounded; inner bracts ovate, 3.0–4.0 mm long, rounded; innermost bracts linear to oblong, 4.5–4.8 mm long, rounded. Receptacle convex; paleae in marginal series, linear to oblong, 4.3–5.9 mm long, rounded, rigid with scarious mar-

gins and apices, scarious apices 1.0–2.0 mm long. Ray florets 12 to 16; tube 1.4–1.7 mm long; limb obovate, 7.2–7.7 \times 3.1–3.5 mm, apically 3-dentate, white. Disc florets 30–40, without resin canals; corolla 1.7–2.0 mm long, with only glandular trichomes, yellow; tube 1.0–1.1 mm long; limb campanulate, 0.7–1.0 mm long (excluding lobes); lobes spreading, \pm 0.6 mm long, triangular. Anthers 2.0–2.7 mm long (including apical appendage); apical appendage obovate. Style 2.0–2.1 mm long (excluding branches); branches 0.4–0.6 mm long. Cypselas 1.7 \times 0.7 mm, oblong to obovate, 11-ribbed, apical rim absent, glandular trichomes present, dense, scattered, mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 7.

Diagnostic Characters—*Phymaspermum trifidum* is closely related to *P. thymelaeoides* with which it shares the radiate heads, slightly fleshy, silvery sericeous leaves and hairy involucre bracts. *Phymaspermum trifidum* can however be distinguished by the consistently trifid leaves, the broad membranous appendages on the innermost involucre bracts and the glabrous disc floret tubes.

Distribution and Ecology—*Phymaspermum trifidum* appears to be highly restricted and is known from only three localities between McGregor and Bonnievale. It grows in alluvial sand at an altitude of around 150–200 m (Fig. 7G). Flowering

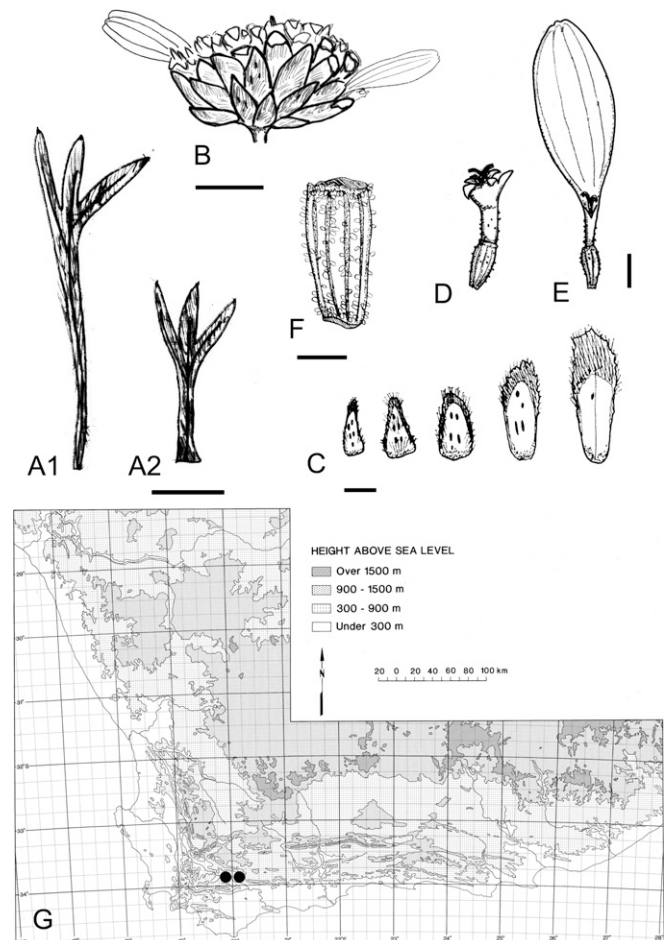


FIG. 7. *Phymaspermum trifidum*. A. Leaves. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Ray floret. F. Cypsel. G. Known geographical distribution. Vouchers: A1, B-E. *Van Breda 4130* (PRE); A2, F. *Magee and Boatwright 512* (NBG). Scale: A-B = 4 mm; C-D = 1 mm; E = 500 μ m.

appears to be from August to November. This species is reported to be well grazed (*Van Breda 4130*, PRE).

Additional Specimens Examined—SOUTH AFRICA. Western Cape: 3319 (**Worcester**): Farm Goedemoed, between Robertson and McGregor (–DD), *Helme 7480* (NBG). 3320 (**Montagu**): Bonnievale, Kapteinsdrift (–CC), *Van Breda 4130* (PRE); Robertson, along road to Stormsvlei (–CC), *Van Breda 805* (PRE two sheets).

5. *PHYMASPERMUM LEPTOPHYLLUM* (DC.) Benth. & Hook. f. ex B.D. Jacks. in *Index Kew.* 1: 37 (1893); Källersjö in *Nord. J. Bot.* 5 (6): 535 (1986); K. Bremer and Humphries in *Bull. Nat. Hist. Mus. Lond. (Bot.)* 23(2): 94 (1993); Goldblatt and J.C. Manning, *Cape Pl.*: 352 (2000); Germish. and N.L. Meyer, *Pl. S. Afr.*: 274 (2003); Klopper et al. *Checklist of the flowering plants of Sub-Saharan Africa*: 147 (2006); Germish. et al. *Checklist S. African Pl.*: 243 (2006). *Adenachaena leptophylla* DC. *Prodr.*, 6:49 (1838); Harv. and Sond., *Fl. Cap.* 3: (1864). —TYPE: SOUTH AFRICA. Western Cape, Montagu (3320): 'Trado' [Tradouw], July 1835, (–DD) *Drège 5954* (lectotype: G–DC sheet G00455504–image!, designated here; isolectotypes: P three sheets–image!). [Note: de Candolle cites both a *Drège* as well as an Ecklon collection. Both are present in G–DC but the *Drège* specimen (locality IV, B,c,1) is selected here as it bears the locality Zwelenddam as cited by de Candolle in the protologue.]

Phymaspermum junceum sensu Less. (1832) non *Osteospermum junceum* Berg. [See Magee et al. 2013]

Single-stemmed, leafy shrub, 0.5–1.6 m high. Stem much-branched; branches erect to spreading, silvery pubescent; fascicles sometimes present in leaf axils. Leaves alternate, spreading to erect, 6.0–25.0 × 1.1–2.0 mm, linear, mucronate, revolute, entire to trifid, without petiole-like base, sometimes with secondary basal lobes, silver hairs on both surfaces, fleshy to leathery; basal swelling present, continuous with stem ribs; lobes 2–3, 2.0–7.0 × 1.0 mm, linear, mucronate. Capitula radiate, heterogamous, terminal, solitary, with 0–3 additional capitula from leaf axils below, pedunculate; peduncles 15–95 mm long, silvery pubescent. Involucre 5.0–6.0 × 6.0–9.0 mm, hemispherical, rarely tapering at the base; involucre bracts 4-seriate, tightly arranged, margins and apices scarios, membranous apices of all bracts 0.5–1.8 mm long, villous silvery hairs, brown margins sometimes present, median resin canals present; outer bracts triangular to lanceolate, 3.3–3.4 mm long, acute; middle bracts lanceolate to oblong, 4.3–4.5 mm long, acute; inner bracts oblong, 5.7–6.2 mm long, acute to obtuse; innermost bracts oblong, 6.5–7.0 mm long, rounded. Receptacle convex; paleae in marginal series, narrowly oblong, 5.2–6.0 mm long, rounded, scarios, tube 1.1–4.2 mm long; limb obovate, 10.0–12.0 × 3.0–4.3 mm, apically 3-dentate, rarely entire or 2-dentate, white to mauve. Disc florets up to 100, without resin canals; corolla 3.5–4.0 mm long, with only glandular trichomes, yellow; tube 1.6–1.7 mm long; limb campanulate, 1.7 mm long (excluding lobes); lobes spreading, 0.7–0.8 mm long, triangular. Anthers 4.3–6.5 mm long (including apical appendage); apical appendage ovate. Style 2.8–3.6 mm long (excluding branches); branches 1.0–1.3 mm long. Cypselas 2.5 × 0.8 mm, oblong to obovate, 10-ribbed, apical rim absent, inconspicuous glandular trichomes present, dense, appearing sessile on ribs, mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 8.

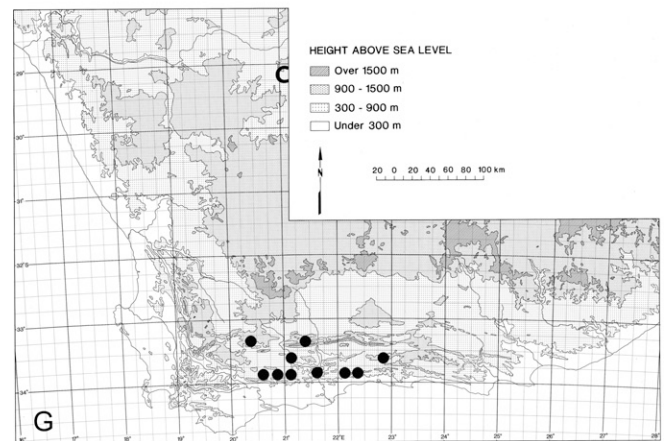
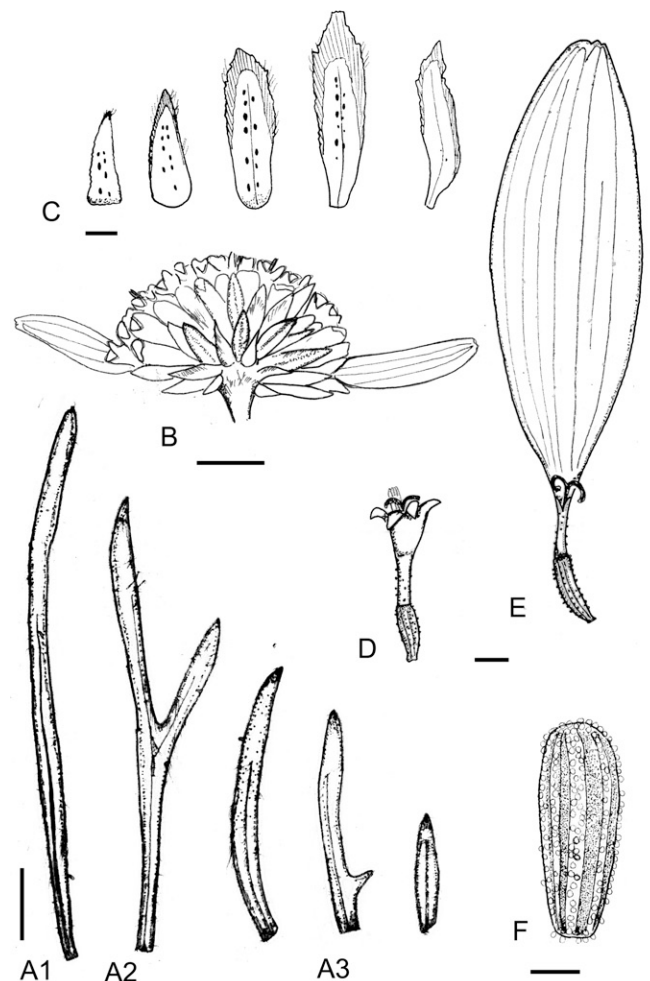


FIG. 8. *Phymaspermum leptophyllum*. A. Leaves. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Ray floret. F. Cypselas. G. Known geographical distribution. Vouchers: A1. *Morris 168* (BOL); A2. *Tyson 3078* (BOL); A3. *Bohnen 9371* (NBG); B. *Vlok 2402* (PRE); C–F. *Magee and Boatwright 372* (NBG). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

Diagnostic Characters—*Phymaspermum leptophyllum* is unique in that the epidermal cells of the cypselas are anticlinally elongated so that they obscure the ribs and hide much of the stalk on the trichomes, making them appear sessile. It can be confused with the sympatric and closely related *P. aphyllum* both of which have linear leaves and

lanceolate to oblong involucre bracts (outer bracts of *P. leptophyllum* are sometimes triangular). However, in addition to the anticlinally elongated epidermal cells of the cypselas *P. leptophyllum* differs from *P. aphyllum* in that it is more densely leafy, with persistent leaves, ± 1.0 – 2.0 mm wide, the branches are not longitudinally white striped and the peduncles do not become spinescent (Fig. 1L).

Distribution and Ecology—*Phymaspermum leptophyllum* is endemic to the Little Karoo where it occurs on quartz outcrops (Vlok and Schutte-Vlok 2010), at an altitude of 400–650 m, from Montagu to Oudtshoorn (Fig. 8G). Flowering is from May to November.

Additional Specimens Examined—SOUTH AFRICA. Western Cape: 3320 (Montagu): Wildehondekloof Pass, 44 km E of Montagu (–AD), Nordenstam and Lundgren 1194 (PRE); Near Barrydale (–DC), Morris 168 (BOL, PRE); 12 miles SW of Barrydale (–DC), Theron 2032 (BOL). 3321 (Ladismith): Ladismith (–AD), Bayliss 2814 (NBG); Levyns 7488 (BOL), Levyns 7487 a (BOL); Ladismith, koppie behind the town (–AD), Levyns 11145 (BOL). Little Karoo, Noukloof Nature Reserve, level spur N of road, 2.8 km from north gate where road reaches its highest point (–CA), Laidler 465 (PRE); Klein Karoo, Kliphooft by Springfontein (–CC), Bohnen 9371 (NBG, PRE); Little Karoo, Gouritsrivier (–DC), Ecklon 622 (MO–image, P–image, S–image). 3322 (Oudtshoorn): lower northern slopes of Outeniqua Mountains, near Saffraanrivier Farm (–CC), Vlok 2402 (PRE); road from Oudtshoorn to Robinson Pass (–CC), Ueckert and Oberprieler 10274 (B–image); 23 km along R328 from Oudtshoorn to Mossel Bay (–CC), Magee and Boatwright 372 (NBG); Perdepoort (–CD), Tyson 3078 (BOL, SAM); Uniondale, Laudina (–DB), Esterhuysen 6502 (PRE, BOL– three sheets); Laudina store (–DB), Acocks 14642 (PRE).

PRECISE LOCALITY UNKNOWN: Karoo, Ecklon s.n. (G–DC–image).

6. *Phymaspermum aphyllum* Magee and Ruiters sp. nov.—
TYPE: SOUTH AFRICA. Western Cape, Montagu (3320):
Along road between Ladismith and Laingsburg, in road
reserve (–BD), 2 June 2007, Vlok & Schutte 596 (holotype:
NBG!; isotype: K!)

Single-stemmed, very sparsely leafy shrub, 0.5–1.0 m high. Stem much-branched; branches erect to spreading, spine-tipped, densely white wooly between ribs; fascicles rarely present in leaf axils. Leaves alternate, very sparse, caducous, appressed to erect, 2.0–20.0 \times 0.5 mm, linear, mucronate, revolute, entire, without petiole-like base, without secondary basal lobes, glabrous on both surfaces, fleshy to leathery; basal swelling present, continuous with stem ribs. Capitula radiate, heterogamous, terminal, solitary, with 0–1 additional capitula from leaf axils below, pedunculate; peduncles 25.0–38.0 mm long, silvery pubescent. Involucre 5.0–6.0 \times 6.0–9.0 mm, hemispherical, rarely tapering at the base; involucre bracts 4-seriate, tightly arranged, margins and apices scarious, membranous apices of all bracts 0.3–0.5 mm long, silvery villous, brown margins absent, median resin canals present; outer bracts lanceolate, 1.5–1.6 mm long, acute; middle bracts lanceolate, 2.0–2.2 mm long, acute; inner bracts lanceolate to oblong, 2.5–3.5 mm long, acute to obtuse; innermost bracts oblong, 3.5 mm long, rounded. Receptacle convex; paleae in marginal series, narrowly oblong, 3.0–4.5 mm long, rounded, scarious. Ray florets 9–10; tube 2.0–2.8 mm long; limb obovate, 5.7–11.4 \times 3.2–4.0 mm, apically 3-dentate, white. Disc florets ± 50 , without resin canals; corolla 1.6–2.0 mm long, with only glandular trichomes, yellow; tube 0.7–1.0 mm long; limb campanulate, 0.7–1.8 mm long (excluding lobes); lobes spreading, 0.5–0.7 mm long, triangular. Anthers 2.0–2.4 mm long (including apical appendage); apical appendage oblong. Style 2.0–2.2 mm long (excluding branches); branches 0.4 mm long. Cypselas 2.0–2.5 \times 0.5–0.8 mm, obovate, 10- to 11-ribbed, api-

cal rim absent, glandular trichomes present, dense, scattered, mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 9.

Diagnostic Characters—*Phymaspermum aphyllum* has in the past been incorrectly identified as *P. junceum* (Berg.) Less. (the latter now a synonym of *Osteospermum junceum*, Magee et al. 2013). It is a sparsely leafy shrub with caducous leaves, ± 0.5 mm wide, longitudinally white striped stems which are densely white wooly between the ribs and persistent peduncles which often become spinescent. It differs further from the closely related *P. leptophyllum* by the obviously ribbed cypselas with prominently stalked myxogenic trichomes. In *P. leptophyllum* the cypselas appear unribbed and the myxogenic trichomes appear sessile due to the prominently elongated epidermal cells.

Distribution and Ecology—*Phymaspermum aphyllum* is known from only a handful of localities between Barrydale and the Witteberg in the Little Karoo at an altitude of around 700 m (Fig. 9G). The leaves of this species are apparently highly palatable for livestock (Vlok and Schutte-Vlok pers. comm.). Flowering is from June to December.

Additional Specimens Examined—SOUTH AFRICA. Western Cape: 3320 (Montagu): 14 miles SSE of Laingsburg (–BB), Acocks 20509 (PRE); Ladismith, Farm Comae, near Plathuis Station (–DB), Van Breda 4407 (PRE); Swellendam, “Poortfontein”, along Barrydale/ Ladismith road (–DD), Van Breda 4545 (PRE).

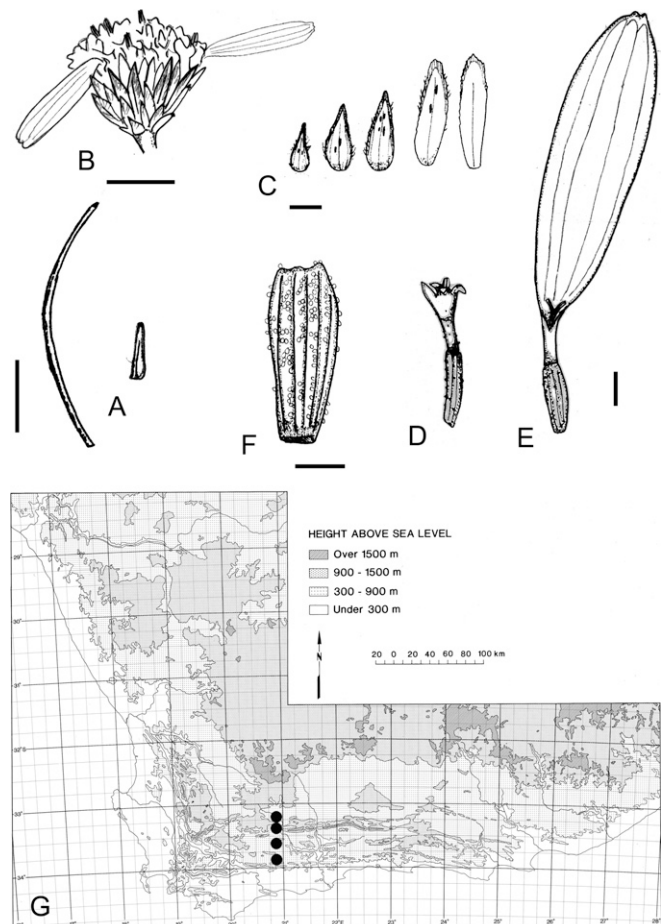


FIG. 9. *Phymaspermum aphyllum*. A. Leaves. B. Capitula. C. Involucre bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Ray floret. F. Cypselus. G. Known geographical distribution. Vouchers: A, C–E. Van Breda 4407 (PRE); B, F. Van Breda 4545 (PRE). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

7. *PHYMASPERMUM APPRESSUM* Bolus in Trans. S. African Philos. Soc. 16: 139 (1906); Källersjö in Nord. J. Bot 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Goldblatt and J.C. Manning, Cape Pl.: 352 (2000); Germish. and N.L. Meyer, Pl. S. Afr.: 273 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006).—TYPE: SOUTH AFRICA. Western Cape, Oudtshoorn (3322): Swartberg Pass (–AC), December 1904, *Bolus 11551* (lectotype: BOL sheet 139059!, designated here; isolectotypes: BOL!, BR–image!, E–image!, GRA–image! two sheets, K–image! two sheets, M–image! two sheets, MO–image!, PRE two sheets, SAM!). [Note: This specimen in BOL is designated here as it is from the author’s own herbarium and is annotated by Bolus as “*Typus auctoris!*”.]

Single-stemmed, densely leafy shrublet, 0.3–1.2 m high. Stem much-branched; branches erect to spreading, glabrous to silvery tomentose; fascicles present in leaf axils. Leaves alternate, closely imbricate, appressed, 1.0–3.0 × 0.5–2.0 mm, ovate to lanceolate, acute to mucronate, entire, without petiole-like base, without secondary basal lobes, glabrous on both surfaces, bony; basal swelling present, continuous with stem ribs. Capitula radiate, heterogamous, terminal on short axillary shoots, solitary, with 0–3 additional capitula from leaf axils below, prominent peduncles absent. Involucre 4.0–7.0 × 4.0–8.0 mm, hemispherical to cyathiform, tapering at the base; involucre bracts 3-seriate, tightly arranged, margins and apices scarios, membranous apices of all bracts 0.7–1.0 mm long, scarios texture, brown margins absent, median resin canals present; outer bracts broadly ovate sometimes oblong, 2.5–3.0 mm long, rounded; middle bracts broadly obovate sometimes oblong, 3.0–3.5 mm long, rounded; inner bracts narrowly obovate sometimes oblong, 4.3–4.5 mm long, rounded. Receptacle convex to flat; paleae in marginal series, linear, 3.8–4.0 mm long, rounded, scarios. Ray florets 11–14; tube 1.7–2.0 mm long; limb ovate to obovate, 7.0–8.5 × 2.7–3.0 mm, apically 3-dentate, rarely entire sometimes with longer middle tooth, white to purple. Disc florets 22–47, without resin canals; corolla 2.0–2.3 mm long, with only glandular trichomes, yellow to purple; tube 0.9–1.0 mm long; limb very narrowly campanulate, 1.0–1.2 mm long (excluding lobes); lobes erect, 0.3–0.5 mm long, triangular. Anthers 2.4–4.3 mm long (including apical appendage); apical appendage ovate. Style 2.2–3.8 mm long (excluding branches); branches 0.4–1.9 mm long. Cypselas 2.0 × 0.5 mm, narrowly obovate, 12-ribbed, apical rim thickened, slightly dentate, brown, glandular trichomes present, dense, mostly between ribs, mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 10.

Diagnostic Characters—*Phymaspermum appressum* is easily recognised by the prominently appressed leaves, entirely scarios involucre bracts and purplish ray florets. It can only be confused with the closely related *P. oppositifolium*, from which it differs in the alternate leaves, the hemispherical to cyathiform involucre, and the ovate to obovate involucre bracts.

Distribution and Ecology—*Phymaspermum appressum* is endemic to sandstone slopes and ridges above 940 m within the Little Karoo, from Anysberg to the Witteberg (Fig. 10G). Flowering is from April to December.

Additional Specimens Examined—SOUTH AFRICA. Western Cape: 3320 (Montagu): Laingsburg, Wittepoort (–BB), *Compton 11834* (BOL,

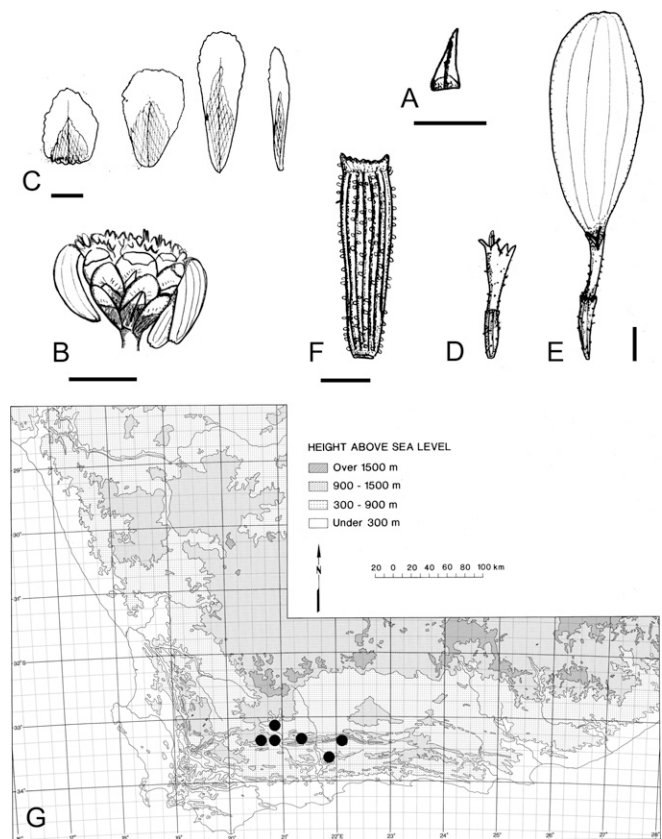


FIG. 10. *Phymaspermum appressum*. A. Leaf. B. Capitula. C. Involucre bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Ray floret. F. Cypselas. G. Known geographical distribution. Vouchers: A. *Zietsman and Zietsman 1689* (PRE); B. *Cattell and Cattell 99* (PRE); C–E. *Oliver 9698* (NBG); F. *Germishuizen 6615* (PRE). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

NBG); Anysberg Nature Reserve, at start of Prince’s Poort (–BC), *Germishuizen 6615* (PRE); south slopes of Anysberg, Ladismith (–BC), *Wurts 1411* (NBG); Buffels Poort Bay, Ladismith (–BD), *Levyms 7429* (BOL). 3321 (Ladismith): Towerkop State Forest, at Besemfontein, near hut (–AD), *Hoekstra 76* (PRE); Klein Swartberg above Besemfontein, mountains just E of Seweweekspoort (–AD), *Oliver 9698* (NBG); south slope of Elandsberg range, N of Klein Swartberg (–AD), *Wurts 1509* (NBG); Gamka Mountain Reserve, Zebra ridge, eastern sector (–DB), *Cattell and Cattell 99* (PRE). 3322 (Oudtshoorn): Swartberg Pass (–AC), *Bolus 1052* (M–image), *Levyms 5037* (BOL), *Tyson 12796* (SAM), *Zietsman and Zietsman 1689* (PRE), *Esterhuysen 4515* (BOL); Prince Albert (–AC), *Stokoe 57099* (SAM two sheets); Prince Albert, Swartberg Pass, north side (–AC), *Acocks 15529* (PRE), *Jackson 14* (BOL), *Bond 1540* (PRE); near summit, *Goldblatt and Porter 12477* (NBG); Hiking trail from Malvadraai, *Goldblatt and Porter 11851* (NBG); Swartberg Pass, Teeberg lookout point (–AC), *Magee and Boatwright 369* (NBG); Top of Boshuise pass, Prince Albert (–AC), *Levyms 11160* (BOL); east slopes of Platberg (–AC), *Stirton 10321* (NBG).

8. *Phymaspermum oppositifolium* Magee and Ruiters sp. nov. —TYPE: SOUTH AFRICA. Eastern Cape, Steytleville (3324): Kouga Mountain, Riverside (–CD), 20 January 2000, *Eusten-Brown 02* (holotype: NBG!)

Single-stemmed, densely leafy shrub, 1.5 m high. Stem much-branched; branches erect to spreading, glabrous; fascicles present in leaf axils. Leaves opposite, closely imbricate, appressed to sometimes erect, 2.0–5.0 × 1.0–2.0 mm, lanceolate, acute to acuminate, sometimes mucronate, entire, without petiole-like base, without secondary basal lobes, glabrous on both surfaces, bony; basal swelling present,

continuous with stem ribs. Capitula radiate, heterogamous, terminal on short axillary shoots, solitary, with 0–3 additional capitula from leaf axils below, prominent peduncles absent. Involucre 5.0–6.0 × 4.0–5.0 mm, funnel-shaped, tapering at the base; involucre bracts 4-seriate, tightly arranged, margins and apices scarios, membranous apices of all bracts 2.4–2.5 mm long, scarios texture, brown margins absent, median resin canals present; outer bracts lanceolate, 3.4 mm long, acute; middle bracts lanceolate, 4.0–4.5 mm long, acute; inner bracts lanceolate, 5.5 mm long, rounded. Receptacle convex; paleae in marginal series, linear, ± 4.0 mm long, rounded, scarios. Ray florets ± 8; tube 1.5 mm long; limb ovate to obovate, 4.8 × 2.3 mm, apically 3-dentate, white to purple. Disc florets ± 20, without resin canals; corolla 2.0 mm long, with only glandular trichomes, yellow to purple; tube 0.8 mm long; limb narrowly campanulate, 1.0 mm long (excluding lobes); lobes erect, ± 0.4 mm long, triangular. Anthers 2.4 mm long (including apical appendage); apical appendage ovate. Style ± 2.0 mm long (excluding branches); branches ± 0.3 mm long. Cypselas 1.9 × 0.6 mm, narrowly obovate, ribbed, apical rim thickened, entire, brown, glandular trichomes present, distribution unknown, discontinuous resin canals in ribs absent. Figure 11.

Diagnostic Characters—*Phymaspermum oppositifolium* is the only opposite leafed species within the genus. It shares the appressed leaves, entirely scarios involucre bracts and

purplish ray florets with the closely related *P. appressum* from which it can be distinguished further by the funnel-shaped involucre and lanceolate involucre bracts.

Distribution and Ecology—This species is known only from the type collection in the Kouga mountains of the Eastern Cape (Fig. 11G), where it was collected at an altitude of 250 m. It was found flowering in January and the collector noticed seeing very few plants (Eusten-Brown pers. comm.).

9. *PHYMASPERMUM ACICULARE* (E. Mey. ex. DC.) Benth. and Hook. f. ex. B.D. Jacks. in Gen. Pl. 2(1): 422 (1873); B.D. Jacks., Index Kew. 11: 339 (1895); Källersjö in Nord. J. Bot. 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Retief and P.P.J. Herman, Pl. N. Prov. S. Afr.: 330 (1997); Germish. and N.L. Meyer, Pl. S. Afr.: 273 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). *Oligoglossa acicularis* E. Mey. ex. DC., Prodr. 6:76 (1838). *Iocaste acicularis* (E. Mey. ex. DC.) Harv. in Harv. and Sond., Fl. Cap. 3: 160 (1864). —TYPE: SOUTH AFRICA. Northern Cape: 'Bei Gaatjie', December 1835, Drège 749 (lectotype: G–DC sheet G00455513–image!, designated here; isolectotypes: G–DC sheet G00386479–image!, P–image!). [Note: de Candolle cited having seen both an Ecklon as well as a Drège collection in the protologue. There are specimens of each in G–DC but the Drège collection (from locality 1,a,36) is selected here as it is rich in vegetative and reproductive material.]

Single-stemmed, leafy shrub, 0.45–1.5 m high. Stem few-branched; branches erect, glabrous with few glands; fascicles rarely present in leaf axils. Leaves alternate, erect to spreading, 3.0–20.0 × 0.8–1.5 mm, linear, mucronate, entire, without petiole-like base, without secondary basal lobes, glabrous on both surfaces, leathery; basal swelling present, continuous with stem ribs. Capitula discoid or radiate, homogamous or heterogamous, terminal, solitary, with 3–5 additional capitula from leaf axils below, pedunculate; peduncles 7.0–48.0 mm long, glabrous. Involucre 4.0–6.0 × 3.0–6.0 mm, broadly to narrowly campanulate or funnel-shaped, usually tapering at the base; involucre bracts 3- or 4-seriate, tightly arranged, margins and apices scarios, sometimes completely scarios especially third and fourth bracts, membranous apices of inner bracts 0.5–1.0 mm long, glabrous, brown margins absent, median resin canals present; outer bracts deltoid to lanceolate, 1.2–1.8 mm long, acute, sometimes mucronate; middle bracts deltoid to lanceolate or elliptic, 1.8–2.8 mm long, rounded to acute or sometimes mucronate; inner bracts narrowly obelliptic to lanceolate or linear, 2.2–3.2 mm long, rounded; innermost bracts narrowly obelliptic to linear, 2.4–4.0 mm long, rounded. Receptacle flat to convex; paleae in marginal series, narrowly obelliptic to linear, 2.7–4.0 mm long, rounded, scarios. Ray florets (when present) 3–4; tube 1.0–1.7 mm long; limb obelliptic, 3.0–5.0 × 1.8–2.8 mm, apically 3-dentate, white. Disc florets 13–32, without resin canals; corolla 2.0–3.5 mm long, with only glandular trichomes, yellow; tube 1.0–2.6 mm long; limb campanulate, 1.0–1.7 mm long (excluding lobes); lobes spreading, ± 0.7 mm long, triangular. Anthers ± 2.8 mm long (including apical appendage); apical appendage elliptic to lanceolate. Style 1.8–2.6 mm long (excluding branches); branches 0.1–0.4 mm long. Cypselas 2.5 × 1.0 mm, obovate, 10-ribbed, apical rim thickened, entire to slightly dentate, glandular

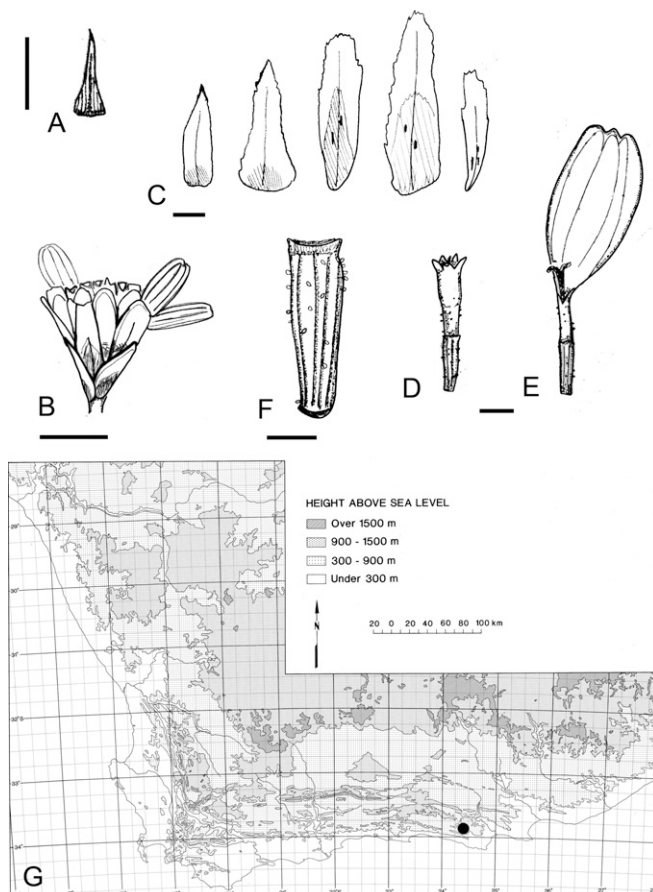


FIG. 11. *Phymaspermum oppositifolium*. A. Leaf. B. Capitula. C. Involucre bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Ray floret. F. Cypselas. G. Known geographical distribution. Voucher: A–F. Eusten-Brown 02 (NBG). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

trichomes present, sparse, scattered, not mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 12.

Diagnostic Characters—*Phymaspermum aciculare* is the only species in the genus which can have either discoid or radiate heads. It can be distinguished from the other radiate species by the sparsely radiate heads with no more than four rays, with limbs less than 5 mm long. Amongst the discoid species it shares the non-corymbose capitula and large cypselas (>0.8 mm wide) with *P. erubescens* and *P. peglerae*. It can however be readily distinguished by the glabrous stem and leaves and the smaller (3.0–6.0 mm wide), obconical, sometimes few radiate capitula with 3–5 additional capitula from leaf axils below.

Distribution and Ecology—*Phymaspermum aciculare* is widely distributed from McGregor in the Western Cape to Bloemhof in the North West Province with a disjunction in Namibia (Fig. 12G). A similar Namibian disjunction has also been reported in *Melolobium* (Moteetee and Van Wyk 2006) as well as *Dichilus* (Schutte and Van Wyk 1988). This species prefers hard, dry soil and sometimes occurs on dolerite, at altitudes of

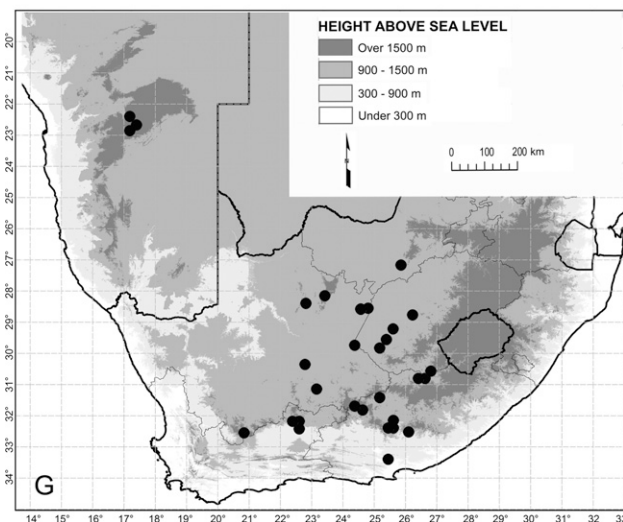
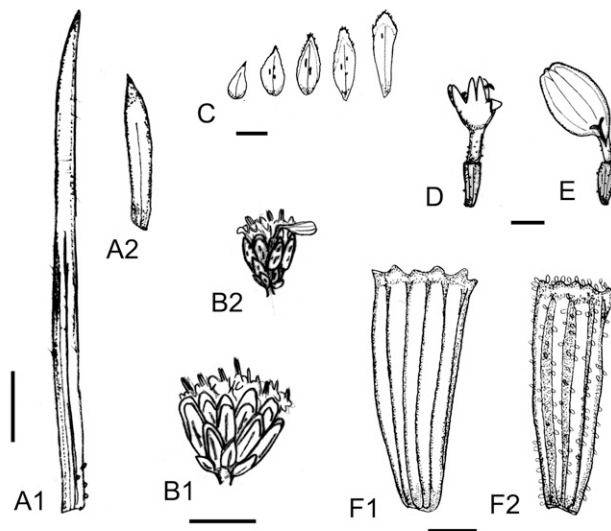


FIG. 12. *Phymaspermum aciculare*. A. Leaves. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Ray floret. F. Cypselas (both glandular and non-glandular). G. Known geographical distribution. Vouchers: A1. *Germishuizen 8586* (PRE); A2, B2, F1. *Anon. H1251* (PRE); B1. *Marloth 4753* (PRE); C–E. *Herman 1152* (PRE); F2. *Acocks 1681* (BOL). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

40 m to 1,700 m. It is reportedly grazed by livestock (*Henrici 2844*, BOL; *Roux 36*, PRE; *Liebenberg 7673*, B-image, PRE). Flowering is from September to May.

Additional Specimens Examined—NAMIBIA. 2217 (*Windhoek*): Dobra river bank (–AC), *Koenen 580* (WIND); Farm Hohenau (–CB), *Walter and Walter 1177* (B-image); Lichtenstein (–CC), *Dinter 3527* (B– two images, PRE, SAM).

SOUTH AFRICA. North West: 2725 (*Bloemhof*): Leeuwfontein, 10 km W from Wolmaranstad (–BB), *Van Wyk 1451* (PRE). Free State: 2824 (*Kimberley*): McGregor Hills, Kamfersdam (–DB), *Esterhuysen 3683* (BOL). 2826 (*Brandfort*): Krugersdriftdam Nature Reserve on Deelkop (–CC), *Muller 1507* (PRE). 2925 (*Jagersfontein*): Bloemfontein, Bestersput near Petrusberg (–BA), *Acocks 8475* (BOL, PRE); Fauresmith (–CB), *Henrici 4710* (PRE); Fauresmith, Rotorua (–CC), *Henrici 2844* (BOL). Northern Cape: 2822 (*Glen Lyon*): Hay division, Floradale (–BD), *Esterhuysen 2359* (BOL two sheets). 2823 (*Griekwastad*): Past Sharon farm on road to Postmasburg at high powerline (–AB), *Germishuizen 8586* (PRE). 2824 (*Kimberley*): Rust en Vrede (–DA), *Anon. H1251* (PRE). 2924 (*Hopetown*): Kraanvogel Valley (–CD), *Acocks 1681* (BOL). 3022 (*Carnarvon*): Grootfontein S of Prieska, Leeuput (–BD), *Roux 36* (PRE). 3123 (*Victoria West*): 36 km from Victoria West on main road to Britstown, farm Rietpoort (–AA), *Herman 1152* (PRE). 3220 (*Sutherland*): Salpeterkop SE slope, between Amandelboom and De Hoek, Fraserburg (–BD), *Moffet and Steensma 3964* (PRE). Western Cape: 3222 (*Beaufort West*): Nieuwveld (–AB), *Marloth 4753* (PRE, BOL) *Drège 389* (SAM); north end of Molteno Pass (–BA), *Acocks 14338* (PRE); Bleak house farm (–BA), *Russel, Robinson and Herman 337* (PRE); Sunnyside (–BC), *Esterhuysen 2718* (BOL). Eastern Cape: 3026 (*Aliwal North*): Burghersdorp (–CD), *Guthrie 4207* (BOL); Niewejaarspruit, between Orange and Caledon rivers (–DB), *Zeyher s.n.* (HGB-image), *Ecklon and Zeyher s.n.* (HAL-image); Eland's Hoek (–DC), *Bolus 235* (BOL). 3225 (*Mahlobyanini East*): Cradock, Mountain Zebra Park, on plains below house of Berghof (–AD), *Liebenberg 7673* (B-image, PRE); Cradock, Bergkwagga Park (–AD), *Liebenberg 7144* (PRE); S of Cradock (–BA), *Maguire 685* (NBG); Cradock (–BA), *Zeyher 225* (SAM two sheets), *Zeyher 961* (K-image, S-image); near Mortimer in Cradock (–BC), *Kensit 9292* (BOL). 3124 (*Hanover*): Herbert, Eureka (–CB), *Acocks 8749* (BOL); Sneeuwbergen (–DC), *Bolus 1846* (NBG); north slopes of Sneeuwberg, Leopard's valley (–DC), *Bolus 3431* (BOL). 3125 (*Steynsburg*): 4 miles from Middelburg on Rietpoort road (–AC), *Commis 703* (BOL); Grootfontein, Middelburg (–AC), *Theron 331* (PRE). 3226 (*Fort Beaufort*): Lefiswane (–CA), *Tyson 38747* (SAM). 3325 (*Port Elizabeth*): Uitenhage, *Ecklon 1142* (G–DC!).

PRECISE LOCALITY UNKNOWN: Luaggasvlakte, *MacOwan 1087* (PRE); *MacOwan 38749* (SAM).

10. PHYMASPERMUM ERUBESCENS (Hutch.) Källersjö in Nord. J. Bot 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Germish. and N.L. Meyer in Pl. S. Afr.: 274 (2003); Klopper et al. in Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). *Brachymeris erubescens* Hutch., Bull. Misc. Inform. Kew, 1916: 173 (1917).—TYPE: SOUTH AFRICA. Eastern Cape, Mthatha (3128): Tembuland: Tabase, near Bazeia (–DA), *Baur 334* (lectotype: K-image!, designated by Källersjö 1986; isolectotype: SAM!).

Phymaspermum equisetoides Thell. in Vierteljahrsschr. Naturf. Ges. Zurich. 68. 446 (1923); Källersjö in Nord. J. Bot 5 (6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006). syn. nov.—TYPE: SOUTH AFRICA. Eastern Cape, Kokstad (3029): Pondoland, Mnceba (–CC), Dec 1913, *Jaccotet and Jaccotet 58* (lectotype: Z sheet 3788-image!, designated here; isolectotype: E-image!, Z sheet 3787-image!) [Note: There are two sheets of this collection in Z. Sheet 3788 is selected here as it is rich in flowering and leaf material.]

Multistemmed, leafy shrublet, up to 0.3 m high. Stems few-branched; branches erect, sparsely hairy to silver villous or

hispid; fascicles sometimes present in leaf axils. Leaves alternate, appressed to erect, 2.0–10.0 × 1.0 mm, linear to lanceolate, acute to acuminate, revolute, entire, without petiole-like base, without secondary basal lobes, glabrous to silver-villous adaxially, glabrous abaxially, fleshy to leathery; basal swelling present, continuous with stem ribs. Capitula discoid, homogamous, terminal, solitary, with 0–3 additional capitula from leaf axils below, pedunculate; peduncles 15.0–60.0 mm long, glabrous. Involucre 5.0–7.0 × 5.0–7.0 mm, hemispherical to cyathiform, rarely tapering at the base; involucre bracts 4-seriate, tightly arranged, margins and apices scarios, membranous apices of all bracts 0.8–1.3 mm long, glabrous, brown margins absent, median resin canals present; outer bracts deltoid to lanceolate, 2.7–3.5 mm long, acute to attenuating; middle bracts triangular ovate, 4.0–4.3 mm long, acuminate; inner bracts lanceolate, 4.6–5.2 mm long, rounded. Receptacle convex; paleae in marginal series, oblanceolate to oblong, 4.6–5.2 mm long, rounded, membranous with scarios margins and apices, scarios apices 0.6–1.2 mm long. Disc florets ±20, without resin canals; corolla 2.0–3.0 mm long, with only glandular trichomes, yellow; tube 1.0–1.2 mm long; limb narrowly campanulate, 1.0–1.2 mm long (excluding lobes); lobes spreading, 0.6–1.0 mm long, triangular ovate. Anthers 2.8–3.6 mm long (including apical appendage); apical appendage obovate. Style 2.4–2.8 mm long (excluding branches); branches 0.4–1.0 mm long. Cypselas 3.6 × 1.0 mm, obovate, 11-ribbed, apical rim thickened, dentate, glandular trichomes present, sparse, scattered, not mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 13.

Diagnostic Characters—*Phymaspermum erubescens* could be confused with *P. peglerae* or discoid specimens of *P. aciculare* but can be readily distinguished by the sparse to dense silvery villous or hispid indumentum on the stems and leaves (densely bronze villous in *P. peglerae* and glabrous in *P. aciculare*), the shorter leaves, 2.0–10.0 mm long and smaller cypselas (when compared to *P. peglerae*) ≤4 mm long.

Distribution and Ecology—*Phymaspermum erubescens* is a relatively poorly collected species which occurs from Lady Frere to King Williams Town in the Eastern Cape (Fig. 13F). It favours sandstone in grasslands at altitudes of 600–1,700 m. Flowering is from October to March.

Additional Specimens Examined—SOUTH AFRICA. Eastern Cape: 3127 (Lady Frere): Farm Ebuhleni ca. 27 km N of Indwe along R 396, track up to Vodacom tower (–AD), Magee et al. 436 (NBG); Farm Ebuhleni, SW mountain slopes, N of homestead (–AD), Bester 7396 (PRE); hills near Cala (–DA), Esterhuysen 29184 (BOL); Ngcobo (–DB), Acocks 12161 (PRE). 3227 (Stutterheim): King Williams Town (–CD), Flanagan 2164 (NBG).

PRECISE LOCALITY UNKNOWN: Kaffraria, Sim 19851 (PRE).

11. PHYMASPERMUM PEGLERAE (Hutch.) Källersjö in Nordic J. Bot. 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Germish. and N.L. Meyer, Pl. S. Afr.: 274 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). *Brachymeris peglerae* Hutch. in Bull. Misc. Inform. Kew, 1916: 174 (1917). —TYPE: SOUTH AFRICA. Eastern Cape, Mthatha (3128): ‘Tembuland, Mthatha River banks’ (–BC), 31 Jan 1861, Pegler 1601 (holotype: K–image!; isotypes: BOL! two sheets, PRE!). [Note: The specimen in K is clearly marked in Hutchinson’s hand as “Type”.]

Multistemmed, densely leafy shrublet, 0.6–0.7 m high. Stems few-branched; branches erect, silvery villous; fascicles sometimes present in leaf axils. Leaves alternate, erect,

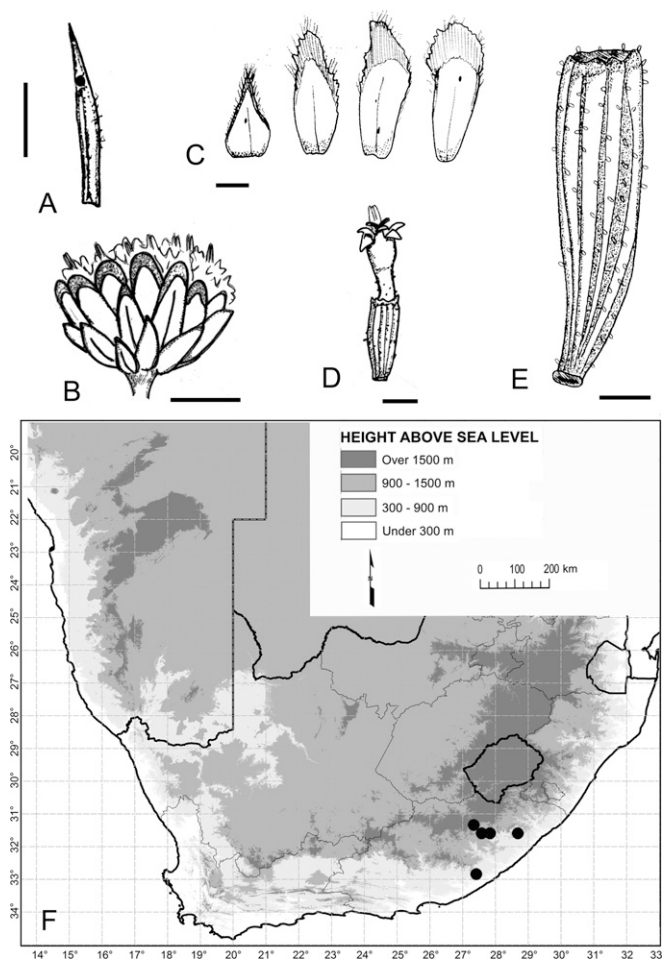


FIG. 13. *Phymaspermum erubescens*. A. Leaf. B. Capitula. C. Involucre bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Cypselas. F. Known geographical distribution. Vouchers: A. Esterhuysen 29184 (BOL); B–D. Bester 7396 (PRE); E. Acocks 12161 (PRE). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 µm.

9.0–18.0 × 1.0 mm, linear, acuminate to mucronate, entire, without petiole-like base, without secondary basal lobes, silvery-villous on both surfaces, fleshy; basal swelling present, continuous with stem ribs. Capitula discoid, homogamous, terminal, solitary, pedunculate; peduncles 25.0–80.0 mm long, densely silvery-tomentose. Involucre 8.0–12.0 × 7.0–10.0 mm, hemispherical to cyathiform, not tapering at the base; involucre bracts 3-seriate, tightly arranged, margins and apices scarios, membranous apices of all bracts 0.5–1.0 mm long, densely villous, brown margins absent, median resin canals present; outer bracts lanceolate, 2.7 mm long, attenuating; middle bracts lanceolate, 3.9 mm long, acute to rounded; inner bracts oblong linear, 5.5 mm long, rounded. Receptacle convex; paleae in marginal series, oblong, ± 6.3 mm long, rounded, membranous with scarios margins and apices, scarios apices ±1.3 mm long. Disc florets ± 20, without resin canals; corolla 2.3 mm long, with only glandular trichomes, yellow; tube 1.0 mm long; limb campanulate, 1.0 mm long (excluding lobes); lobes spreading, ± 0.5 mm long, triangular-ovate. Anthers ±3.0 mm long (including apical appendage); apical appendage obovate, obtuse. Style 4.0 mm long (excluding branches); branches 0.5 mm long. Cypselas 4.6 × 1.0 mm, obovate, 12-ribbed, apical rim thickened, dentate, glandular trichomes present, sparse, scattered,

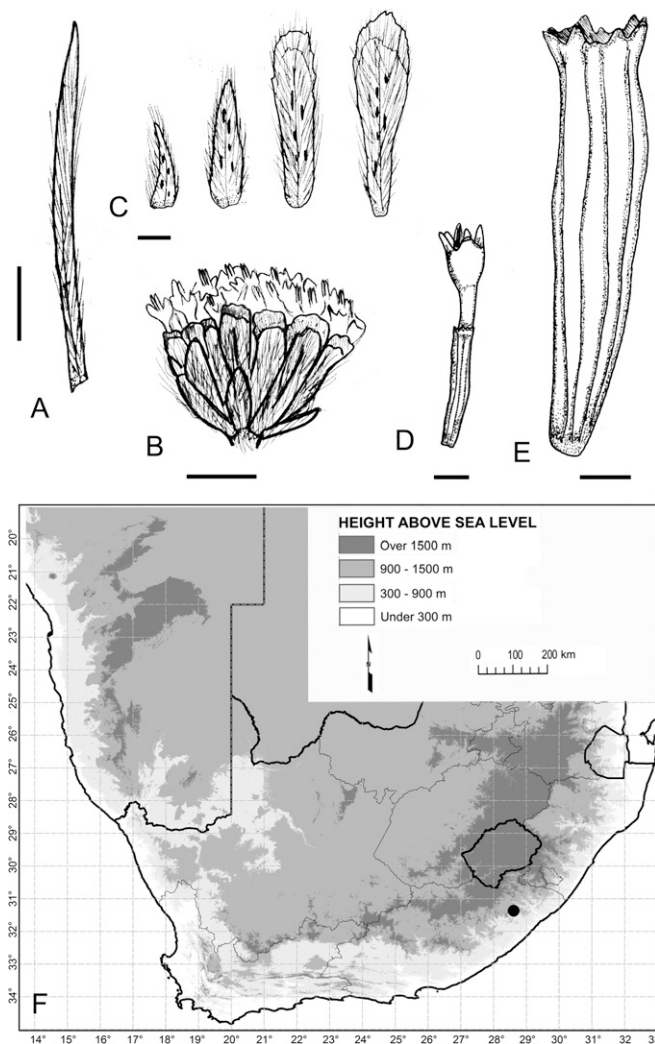


FIG. 14. *Phymaspermum peglerae*. A. Leaf. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Cypsel. F. Known geographical distribution. Voucher: A–E. Pegler 1601 (BOL). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

not mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 14.

Diagnostic Characters—*Phymaspermum peglerae* shares the discoid non-corymbose heads and large fruit with *P. erubescens* and *P. aciculare* but can be distinguished by the densely bronze villous indumentum (sparse to dense silvery villous or hispid indumentum in *P. erubescens* and glabrous in *P. aciculare*), the usually larger leaves 9.0–18.0 mm long and the largest fruit in the genus >4 mm.

Distribution and Ecology—*Phymaspermum peglerae* is known from only two very old collections along the banks of the Mthatha River in the Eastern Cape (Fig. 14F). This species flowers in midsummer, around January.

Additional Specimens Examined—SOUTH AFRICA. Eastern Cape: 3128 (Mthatha): Mthatha River bank (–BC), Bolus 10133 (BOL).

12. PHYMASPERMUM ATHANASIOIDES (S. Moore) Källersjö in Nord. J. Bot 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Retief and Herman, Pl. N. Prov. S. Afr.: 330 (1997); Germish. and N.L. Meyer, Pl. S. Afr.: 274 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243

(2006). *Pentzia athanasioides* S. Moore in J. Bot. 41: 133 (1903). *Brachymeris athanasioides* (S. Moore) Hutch. in Bull. Misc. Inform. Kew 1916: 173 (1917). —TYPE: SOUTH AFRICA. Gauteng, Johannesburg (2628): Near Hospital Hill (–AA), Rand 758 (lectotype: BM-image!, designated here). [Note: This is the only specimen housed in BM and corresponds closely to the original description.] *Brachymeris montana* Hutch. in Bull. Misc. Inform. Kew 1916: 174 (1917), syn. nov. *Phymaspermum montanum* (Hutch.) Källersjö in Nord. J. Bot 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Retief and Herman, Pl. N. Prov. S. Afr.: 330 (1997); Germish. and N.L. Meyer, Pl. S. Afr.: 274 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). —TYPE: SOUTH AFRICA. Limpopo, Pilgrims Rest (2430): Mt. Marovougne (–AB), April, Junod 1278 (holotype: K-image!). [Note: The specimen in K is clearly annotated in Hutchinson's hand as "Type specimen".]

Brachymeris bolusii Hutch. in Bull. Misc. Inform. Kew 1916: 174 (1917), syn. nov. *Phymaspermum bolusii* (Hutch.) Källersjö in Nord. J. Bot 5 (6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Retief and Herman, Pl. N. Prov. S. Afr.: 330 (1997); Germish. and N.L. Meyer, Pl. S. Afr.: 274 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). —TYPE: SOUTH AFRICA. Mpumalanga, Komatipoort (2531): Drakensberg, Devils Kantoort Mt. (–CC), Sept 1886, Bolus 7786 (holotype: K-image!; isotype: BOL!) [Note: The specimen in K is clearly annotated in Hutchinson's hand as "Type."]

Multistemmed, densely leafy shrub, 0.2–2.0 m high. Stems much-branched; branches erect, grey-pubescent; fascicles never present in leaf axils. Leaves alternate, spreading, 6.0–40.0 \times 0.8–2.0 mm, linear to oblong, acute to mucronate, entire to trifid, involute, narrowed into petiole-like base, without secondary basal lobes, glabrous on both surfaces, leathery; basal swelling present, continuous with stem ribs; lobes 2–3, 0.5–10.0 \times 0.5–1.0 mm, linear to oblong, acute to mucronate. Capitula disciform, heterogamous, terminal, many-headed \pm 30, simple to compound corymbs, pedunculate; peduncles 4.0–35.0 mm long, glabrous to white tomentose. Involucre 4.0–8.0 \times 3.5–8.0 mm, hemispherical, cyathiform to urceolate, sometimes tapering at the base; involucral bracts 4- or 6-seriate, tightly arranged, margins and apices scarios, membranous apices of all bracts 0.3–1.2 mm long, glabrous to tomentose especially along the edges, brown margins absent, median resin canals present; outer bracts lanceolate, 2.0–3.0 mm long, acute; middle bracts deltoid to lanceolate, 2.2–4.2 mm long, acute; inner bracts deltoid to lanceolate, 2.2–4.3 mm long, acute to rounded; second inner bracts deltoid to lanceolate, 3.8–4.6 mm long, acuminate to rounded. Receptacle convex; paleae in marginal series, oblong to linear, 3.2–3.7 mm long, acute to attenuating, scarios. Filiform florets \pm 20; corolla 2.3–3.0 mm long, with glandular trichomes, zygomorphic; adaxial lobes 2, 0.7–1.0 mm long, triangular, spreading, abaxial lamina 0.3–0.6 mm long, linear, 3-dentate. Disc florets \pm 100, without resin canals; corolla 2.2–3.0 mm long, with only glandular trichomes, yellow; tube 1.0–2.0 mm long; limb narrowly campanulate, 0.8–1.3 mm long (excluding lobes); lobes erect to spreading,

0.4–0.6 mm long, triangular. Anthers \pm 3.0 mm long (including apical appendage); apical appendage rounded to oblong. Style 2.5–3.1 mm long (excluding branches); branches 0.4–0.7 mm long. Cypselas 2.1–2.2 \times 0.5 mm, obovate, 10- to 12-ribbed, apical rim thickened to membranous, entire to dentate, glandular trichomes present, sparse, scattered, not mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 15.

Diagnostic Characters—*Phymaspermum athanasioides* was previously considered to be a part of a complex with *P. bolusii* and *P. montanum*, distinguished by apparent differences in their involucre bracts. However, upon further study, these characters were found to be highly variable and no clearly recognisable characters could be found to distinguish between them. As a result only a single variable species, *P. athanasioides*, is recognised here. It is readily distinguished from all other species in the genus by the marginal filiform florets and from the other species with corymbosely arranged capitula by the absence of fascicles in the leaf axils and by the mostly entire leaves, which rarely become 2- or 3-fid.

Distribution and Ecology—*Phymaspermum athanasioides* is widely distributed from around Harrismith in KwaZulu Natal to Musina in Limpopo and extending into Swaziland and further north into Zimbabwe (Fig. 15G). It grows in mixed bushveld and grassland, especially on quartzite or sandstone, at an altitude of 1,000 m to 1,750 m. Flowering time is throughout the year but especially in August, hence its vernacular name August Gold.

Additional Specimens Examined—SOUTH AFRICA. Limpopo: **2230 (Musina)**: Soutpansberg, Entabeni Forest Reserve (–CC), *Codd* 3038 (PRE); Venda, Musakwa location (–CC), *Du Toit* 298 (PRE); Hangklip, Louws Kraal, Waterberg Transvaal (–CC), *Maguire* 1426 (NBG). **2329 (Polokwane)**: Soutpansberg Mountain, Letsume at foot of cliffs (–AB), *Venter* 6233 (PRE), *Rogers* 19904 (PRE); Vivo, Farm Llewellyn 35 on Soutpansberg (–AB), *Venter* 10,755 (PRE); Makhado (–BB), *Breyer* 24364 (PRE); Blaauwberg, south slopes at plateau (–CD), *Esterhuysen* 21,435 (BOL); Tomazon farm (–DD), *Nienaber* 26 (PRE); Haenertsburg, Iron Crown Mountain (–DD), *Venter* 10,855 (PRE). **2330 (Tzaneen)**: Polokwane, Wolkberg (–CC), *Van der Merwe* 33 (PRE). **2429 (Zebediela)**: Mokopanet district, summit of highest peak, Zebediela mountains (–AA), *Galpin s.n.* (BOL); 40 km NE of Mokopane, Snymansdrift (–AA), *Maguire* 2997 (B–image). **2430 (Pilgrims rest)**: Shiluvane (–AB), *Junod* 13887 (PRE); Lekgalameetse Nature Reserve (–AB), *Stalmans* 83 (PRE); Lekgalameetse Nature Reserve, Balloon/mountain 1493 m, shrubland on cliff face (–AB), *Stalmans* 1340 (PRE). North West: **2526 (Zeerust)**: On road between Koster and Lichtenburg, Mabaalstat (–DC), *Vahrmeyer* 1438 (PRE); 13 miles from Koster on Mabaalstad road (–DC), *Story* 5642 (PRE). Gauteng: **2527 (Rustenburg)**: Rustenburg (–BA), *Collins* 23957 (PRE), *Galpin s.n.* (BOL); Magaliesberg nature area (–DC), *Ortiz and Anderson* 534 (PRE). **2528 (City of Tshwane)**: Magaliesberg, Vissershoeck, upper slopes on top of range (–CA), *Repton* 1292 (PRE). **2627 (Potchefstroom)**: Witpoortjie Falls, Roodekrantz 83, Krugerdorp, 20 miles NNE of Johannesburg, Orange Grove (–BB), *Mogg* 21,326 (PRE); 3 km N of Krugersdorp (–BB), *Codd* 3149 (PRE); Paardeburch 20 miles from Johannesburg (–BD), *Tufrosis* 1017 (NBG). **2628 (Johannesburg)**: Johannesburg west koppies (–AA), *Laub* 3977 (SAM); Elsburg (–AA), *Rogers* 12143 (BOL); Jeppestown ridge (–AA), *Gillfillan* 6026 (K–image); Johannesburg (–AA), *Moss* 19206 (PRE); Witwatersrand, Hospital Hill, Orange Grove (–AA), *Bryant* G6 (BOL), *Moss* 5072 (BOL), *Cowrath* 405 (K–image); Kensington (–AA), *Gerstner* 6427 (PRE); Melville Koppies central, along path 100 metres from lapa near Kafue Road entrance (–AA), *Magee* 394 (NBG); Heidelberg (–AC), *Schlechter* 3517 (BOL). Mpumalanga: **2430 (Pilgrims Rest)**: Lulu mountains, farm Grootvygenboom (–CA), *Mogg* 16936 (PRE); The Downs, near Tzaneen (–DA), *Rogers* 20101 (BOL), *Nel* 103 (NBG); Mount Sheba estate (–DC), *Boucher* 1836 (NBG), *Kerfoot* 8755 (PRE); Morgenzon Reserve (–DC), *Mohle* 407 (PRE); Motlatserivierpoort Nature Reserve, Muilhuis (–DB), *Zietsman* 3771 (PRE). **2530 (Mashishing)**: Between Lydenburg and Sabie, 12 miles from Lydenburg, Long Tom Pass (–AB), *Balsinhas and Kersberg* 2111 (PRE), *Unknown* 280 (PRE); Mashishing, upper Erica knoll trail, Buffelskloof Nature Reserve (–BC), *Burrows* 8158 (PRE); Buffelskloof Nature Reserve, on plateau overlooking a gorge, along edge (–BC), *Koekemoer* 2091 (PRE); Pilgrims Rest (–BC), *Rogers* 14171 (BOL); Woodbush (–CC), *Jenkins* 13960 (PRE); Next to Berlin off ramp on

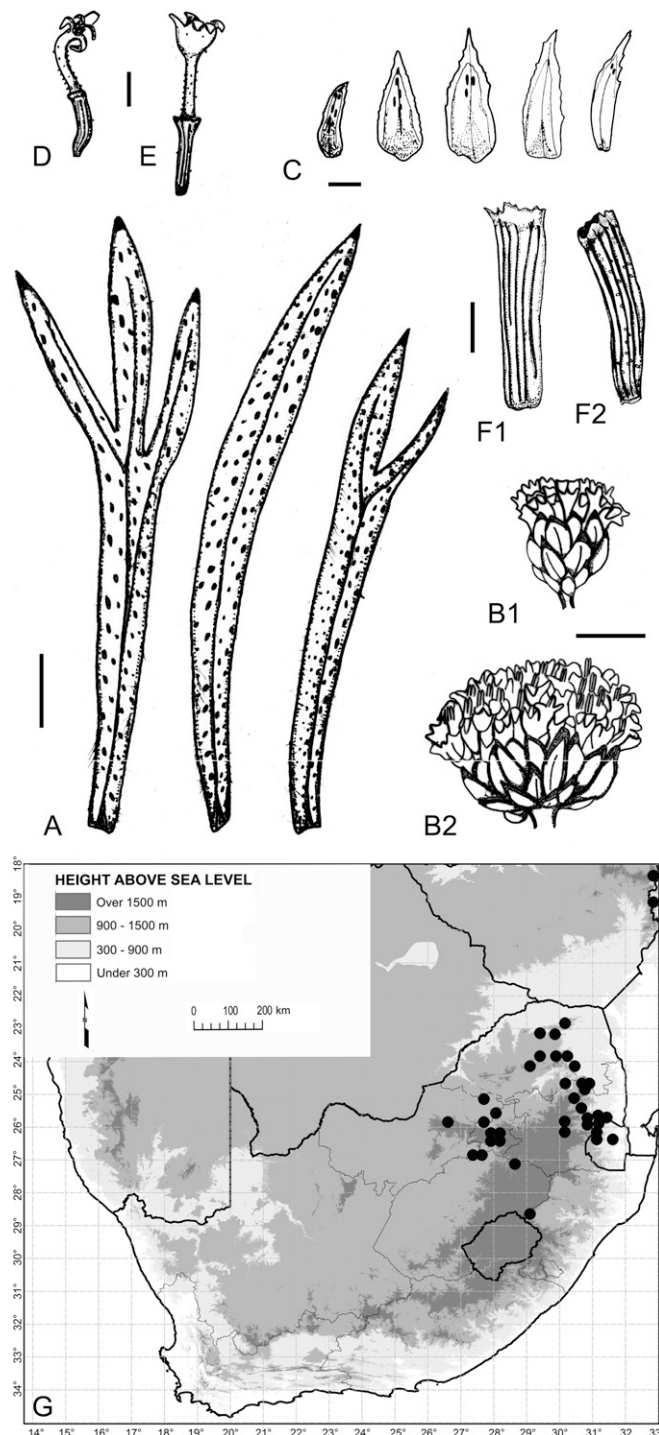


FIG. 15. *Phymaspermum athanasioides*. A. Leaves. B. Capitula. C. Involucre bracts (outermost to innermost series, from left) and single palea (far right). D. Filiform floret. E. Disc floret. F. Cypselas (both non-glandular and glandular). G. Known geographical distribution. Vouchers: A. *Mogg* 21,326 (PRE); B1. *Galpin s.n.* (BOL); B2. *Dlamini s.n.* (PRE); C, E. *Burrows* 757 (NBG); D. *Morris* 346 (NBG); F1. *Bayliss* 1541 (PRE); F2. *Ortiz and Anderson* 534 (PRE). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

Kaapsehoop (–DB), *Mothogoane* NB0019 (PRE); Kaapse Hoop escarpment (–DB), *Nel* 43 (NBG), *Rogers* 19504 (PRE), *Rogers* 21414 (BOL); Near Cythna Letty Nature Reserve (–DD), *Glen* 1329 (PRE); **2531 (Komatipoort)**: Moederlief 109 JU 450m S of Mpageni beacon (–CA), *Deall* 3883 (PRE); Louw's Creek Timbers 3 km N of offices (–CB), *Kluge* 2439 (PRE); SE of Louws Creek. S.A.T.I.C.O forestry station, Bearded Man Peak (–CB), *McMurtry* 12837 (PRE); Three Sisters mountains, SE of Kaapmuiden (–CB),

Meyer BP00224 (PRE); Songimvelo Game Reserve, on the farm Vooruitzicht, Malindweni, Panhandle, en route back to house (–CC), *Balkwill, McCallum and Reddy 11990* (B–image); 6 miles E of Barberton on road to Havelock mine (–CC), *Codd 1603* (PRE); Along firebreak from Lone Tree Hill to Saddleback Hill (–CC), *Reid 1801* (PRE); Duivels Kantoer (–CC), *Thode at 1612* (PRE); on hill above Angle Station (–CC), *Venter 4485* (PRE). **2630 (Carolina)**: Carolina (–AA), *Rogers 19738* (PRE). Free State: **2627 (Potchefstroom)**: Vrededorp, Dwarfsberg (–CD), *Du Preez 1735* (PRE); Vrededorp dome, 20 km WNW of Parys, Farm Buffelskloof 511 IQ, hilly-slopes NNW of Thabela Thabeng resort (–CD), *Kroon 16236* (PRE); Witkop (–DC), *Louw 1881* (PRE). **2728 (Steve Vukile Tshwethe)**: Soutpansberg mountains, Frans Hoek Peak (–BA), *Galpin s.n.* (BOL). KwaZulu Natal: **2829 (Harrismith)**: Oliviershoek Pass, Irenedale farm (–CA), *Klapwijk 184* (PRE).

SWAZILAND. **2631 (Mbabane)**: Komati Bridge (–AA), *Bayliss 1541* (PRE); Ukutula (–AC), *Compton 25113* (PRE); Mbuluzi falls (–AC), *Compton 25134* (PRE); hill west of Mbabane (–AC), *Compton 25844* (PRE); Black Mbuluzi valley (–AC), *Compton 25933* (NBG); Fonteyn (–AC), *Compton 25975* (NBG, PRE); Forbes Reef (–AC), *Compton 31675* (NBG); Mdimba Mountain, Manzini (–AC), *Dlamini s.n.* (PRE); Kangwane mountain grassland (–AC), *Loffler 1182* (NBG); Manzini district tea road, 6 km from junction (–BC), *LaCroix 4924* (PRE).

ZIMBABWE. **1832 (Mutare)**: Rhodes Inyanga experiment station, Inyanga National Park (–BD), *Burrows 757* (NBG). **1932 (Melsetter)**: road from Vumba to Umtali, Rhodesia (–BB), *Morris 346* (BOL).

13. *PHYMASPERMUM WOODII* (Thell.) Källersjö in *Nordic J. Bot.* 5(6): 535 (1986); K. Bremer and Humphries in *Bull. Nat. Hist. Mus. Lond. (Bot.)* 23(2): 94 (1993); Retief and Herman, *Pl. N. Prov. S. Afr.*: 330 (1997); Germish. and N.L. Meyer, *Pl. S. Afr.*: 274 (2003); Klopper et al. *Checklist of the flowering plants of Sub-Saharan Africa*: 147 (2006); Germish. et al. *Checklist S. African Pl.*: 243 (2006). *Pentzia woodii* Thell. in *Vierteljahrsschr. naturf. Ges. Zürich.* 61: 454 (1916). *Athanasia woodii* (Thell.) Hilliard in Hilliard and B.L. Burtt, *Notes Roy. Bot. Gard. Edinburgh* 32 (3): 331 (1973); Hilliard, *Compositae in Natal*: 339 (1977). —TYPE: SOUTH AFRICA. KwaZulu Natal, Pietermaritzburg (2930): Curries Post (–AC), 24 Apr. 1891, Wood 4457 (lectotype: Z–image!, designated here; isolectotype: BOL!, NH–image!) [Note: The specimen in Z, where Thellung was based is selected here.]

Pentzia tysonii Thell. in *Vierteljahrsschr. Naturf. Ges. Zürich.* 61: 454 (1916). —TYPE: SOUTH AFRICA. KwaZulu Natal, Kokstad (3029): Mount Currie (–AD), Mar. 1883, *Tyson 1254* (lectotype: Z–image!, designated here; isolectotypes: BOL! SAM!) [Note: The specimen in Z is selected as it forms part of the collection which Thellung would have studied.]

[*Pentzia pinnatifida* var. *chenoleoides* Hutch. p.p. excl. type.]

Multistemmed, densely leafy shrublet, 0.4–0.6 m high. Stems few-branched; branches erect, white to silvery tomentose; fascicles present in leaf axils. Leaves alternate, spreading, 4.0–35.0 × 0.5–0.8 mm, linear, sometimes involute, deeply pinnatifid, narrowed into petiole-like base, sometimes with secondary basal lobes, white to silvery villous on both surfaces, leathery; basal swelling present, continuous with stem ribs; lobes 3–5, 2.0–28.0 × 0.5–1.0 mm, linear, mucronate. Capitula discoid, homogamous, terminal, few- to many-headed (3–40), simple to compound corymbs, pedunculate; peduncles 2.0–33.0 mm long, white to silvery tomentose. Involucre 5.0–8.0 × 3.0–5.0 mm, narrowly campanulate to urceolate, apically constricted, sometimes tapering at the base; involucre bracts 4- or 5-seriate, tightly arranged, margins and apices scarious, membranous apices of all bracts 0.3–0.8 mm long, glabrous to slightly or densely pubescent or villous, especially edges, very rigid, brown margins light and inconspicuous,

median resin canals present; outer bracts deltoid to lanceolate, 2.2–3.3 mm long, acute to acuminate; middle bracts deltoid to ovate, 2.7–3.4 mm long, acuminate; inner bracts deltoid to lanceolate, 2.7–4.0 mm long, acuminate to rounded; second inner bracts ovate, 3.0–5.0 mm long, rounded; innermost bracts ovate, 4.3–5.8 mm long, rounded. Receptacle convex to flat; paleae in two marginal series, linear to oblong, 4.3–6.0 mm long, rounded, rigid with scarious margins and apices, scarious apices 0.8–1.1 mm long. Disc florets 37–55, without resin canals; corolla 2.3–3.2 mm long, with only glandular trichomes, yellow; tube 1.4–1.8 mm long; limb narrowly campanulate, 1.0–1.4 mm long (excluding lobes); lobes spreading, 0.6–1.0 mm long, narrowly triangular. Anthers 2.7–3.8 mm long (including apical appendage); apical appendage oblong. Style 2.0–3.3 mm long (excluding branches); branches 0.5 mm long. Cypselas 1.8–2.0 × 0.5 mm, oblong to obovate, 11-ribbed, apical rim thickened, entire to slightly dentate, glandular trichomes present, sparse, scattered, not mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 16.

Diagnostic Characters—*Phymaspermum woodii* shares the narrowly campanulate to urceolate involucre and flat, deltoid to ovate, closely appressed involucre bracts with *P. argenteum*

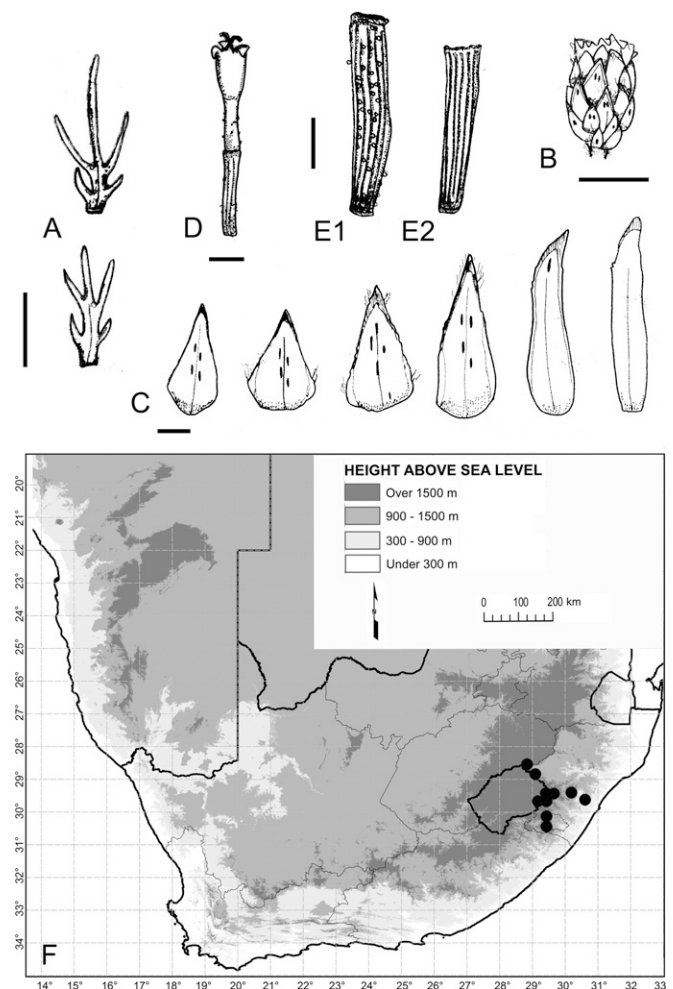


FIG. 16. *Phymaspermum woodii*. A. Leaves. B. Capitula. C. Involucre bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Cypselas (both non-glandular and glandular). F. Known geographical distribution. Vouchers: A. *Wood 1007* (SAM); B. *Magee et al. 457* (NBG); C, D. *Trausel 763* (NU); E1. *Magee et al. 447* (NBG); E2. *Killick 1705* (PRE). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

but can be distinguished by the sparsely villous leaves with narrower lobes (≤ 0.5 mm wide) and the 5-seriate, apically constricted involucre with at most indistinct brown margins. This species could also be confused with the spring flowering *P. pinnatifidum* with which it shares the smaller habit and narrowly lobed leaves but can be readily distinguished by the much narrower campanulate to urceolate, apically constricted involucre with closely appressed involucre bracts, the absence of a prominent membranous crown on the fruit and the later flowering time (late summer into autumn).

Distribution and Ecology—*Phymaspermum woodii* is distributed on rocky hillsides in moist grasslands along the southern and eastern Drakensberg in KwaZulu Natal and Free State (Fig. 16F), at altitudes of 1,700–2,750 m. Flowering is in late summer to autumn from February to May.

Additional Specimens Examined—SOUTH AFRICA. FreeState: 2828 (Bethlehem): Royal Natal National Park, Tugela gorge (–DB), Hilliard 2851 (NU). KwaZulu Natal: 2829 (Harrismith): Cathedral Peak (–CC), Unknown s.n. (NU); Cathedral Peak Reserve, Mikes Pass (–CC), Magee et al. 460 (NBG); Cathedral Peak Forest Reserve station, on spur leading to Organ Pipes Pass (–CC), Killick 1705 (BOL, PRE). 2929 (Underburg): Giants Castle, contour walk (–AD), Retief 1687 (PRE); Giants Castle Game Reserve, Bannerman area (–AD), Trauseld 763 (NU), Trauseld 758 (PRE); Highmoor Forest Reserve (–BC), Hilliard 4814 (NU); Merinodale (–BC), Wright 483 (NU); Garden Castle Forest Reserve, Mlabonja Valley (–CA), Hilliard and Burt 15061 (NU); 5–7 miles NNW of Castle View farm, headwaters of Mlahlangubo River (–CB), Hilliard and Burt 15271 (NU–image). 2930 (Pietermaritzburg): Near Curry's Post (–AC), Wood 4457 (BOL), Wood 1007 (GRA–image, SAM); Table Mountain (–DA), Acocks 11505 (PRE); 3029 (Kokstad): Summit of Ntsikeni Mountain in Ntsikeni Nature Reserve (–AB), Magee et al. 547 (NBG); Summit of Mount Currie (–AD), Magee et al. 447 (NBG).

14. PHYMASPERMUM ARGENTEUM Brusse in Bothalia 19: 29 (1989); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Retief and Herman, Pl. N. Prov. S. Afr.: 330 (1997); Germish. and N.L. Meyer, Pl. S. Afr.: 273 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). —TYPE: SOUTH AFRICA. Limpopo (2429): 18 km from the main Polokwane-Tzaneen road near Boyne to Wolkberg Estates, 1 km from the turn-off to Frosch Farm to Wolkberg Estates (–BB), 30 May 1988, Brusse 5567 (holotype: PRE!; isotypes: BM–image!, B–image!, E–image!, K–image!, M–image!, MO–image!, NBG!, P–image!, S–image!, WAG–image!).

Multistemmed, densely leafy shrub, 0.3–1.5 m high. Stems few-branched; branches erect, sparsely to densely silvery tomentose; fascicles present in leaf axils. Leaves alternate, spreading, $8.0\text{--}18.0 \times 0.8\text{--}2.0$ mm, linear when undissected, mucronate, sometimes revolute, entire to pinnatifid, narrowed into petiole-like base, without secondary basal lobes, sparsely to densely silver villous on both surfaces, fleshy; basal swelling present, continuous with stem ribs; lobes 3–5, $3.0\text{--}15.0 \times 1.0\text{--}1.5$ mm, linear, mucronate. Capitula discoid, homogamous, terminal, few to many-headed (10 to +100), compound corymbs, pedunculate; peduncles 5.0–30.0 mm long, slightly to densely silvery-tomentose. Involucre $5.0\text{--}7.0 \times 1.8\text{--}3.5$ mm, narrowly campanulate to cylindrical, tapering at the base; involucre bracts 3- or 4-seriate, tightly arranged, margins and apices scarios, membranous apices of all bracts 0.5–1.0 mm long, glabrous to villous (rarely beyond margins), brown margins dark and distinct, median resin canals present; outer bracts deltoid to lanceolate, 1.7–1.9 mm long, acuminate; middle bracts deltoid to ovate, 2.4–3.1 mm long, acuminate; inner bracts broadly oblong to lanceolate, 2.8–3.8 mm long,

acuminate to rounded. Receptacle convex; paleae in marginal series, oblong, linear, 3.8–4.5 mm long, rounded, rigid with scarios apices, scarios apices ± 0.5 mm long. Disc florets 6–23, without resin canals; corolla 2.3–3.1 mm long, with only glandular trichomes, yellow; tube 1.2–1.7 mm long; limb narrowly to broadly campanulate, 1.0–1.4 mm long (excluding lobes); lobes spreading, 0.7–1.0 mm long, narrowly to broadly triangular. Anthers 2.8–3.4 mm long (including apical appendage); apical appendage oblong to lanceolate. Style 2.0–3.0 mm long (excluding branches); branches 0.2–0.3 mm long. Cypselas $2.0\text{--}2.8 \times 0.7$ mm, oblong, 10-ribbed, apical rim thickened, entire, brown, glandular trichomes present, sparse, scattered, not mucilaginous when soaked, discontinuous resin canals in ribs absent. Figure 17.

Diagnostic Characters—*Phymaspermum argenteum* shares the fleshy, usually silvery sericeous leaves with the closely related *P. comptonii*, but can be readily distinguished by the narrowly campanulate involucre with closely appressed, deltoid to ovate involucre bracts with prominent dark margins.

Distribution and Ecology—*Phymaspermum argenteum* occurs from around Polokwane and Zebediela in Limpopo to near Pilgrims Rest in Mpumalanga (Fig. 17F). It is found in grassland vegetation in dolomite soils at an altitude of 1,450–2,080 m. It flowers from May to September.

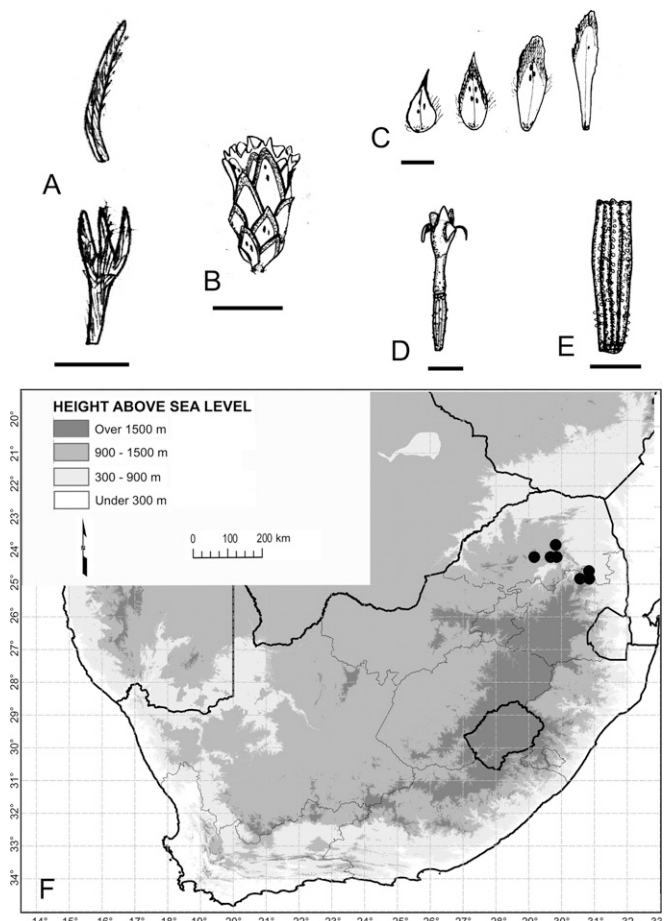


FIG. 17. *Phymaspermum argenteum*. A. Leaves. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Cypselas. F. Known geographical distribution. Vouchers: A. Brusse 5567 (NBG); B. Burrows and Manning 9004 (NBG); C–E. Brusse 5611 (NBG). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

Additional Specimens Examined—SOUTH AFRICA. Limpopo: 2329 (Polokwane): Iron Crown (–DD), Mathews 896 (PRE). 2429 (Zebediela): Mokopane, Makapansgat, “nek” at top of rock gully (–AA), Maguire 2913 (B–image), near top of Diabase gully, Maguire 8200 (B–image); Ga-Maja, Donkerkloof road off the main Polokwane–Burgersfort road, near Chuniespoort, 1.5 km from the radio masts to Chuniespoort, Farm Stylkop 344KS (–BA), Brusse 5783 (B–image, NBG); Bewaarkloof, 3 km from the main Boyne–Wolkberg road to Ashmole Dales, at the Ashmole Dales sign (–BB), Brusse 5611 (B–image, BOL, NBG, NU, WIND); Wolkberg, 12 miles SE of Boyne on road to Ashmole Dales (–BB), Codd 10403 (PRE two sheets); Farm Paardevlei 201 KS (–BB), Venter 10704 (PRE); Wolkberg plateau 14 km SE of Boyne (–BB), Van Vuuren 1533 (K–image, PRE). Mpumalanga: 2430 (Pilgrims Rest): Motlatsepoort Dam Reserve, rocky plateau at Motlatsepoort View Point (–DB), Venter 9524 (PRE); Road from Pilgrim’s rest to Bourke’s Luck, near TGME Sports Club (–DB), Burrows and Manning 9004 (NBG, PRE); 31 km from Ohrigstad on road to Pilgrims Rest (–DC), Clark 1239 (PRE); Lisbon Falls, Graskop (–DD), Compton 19801 (NBG); Lisbon, “Motlatse”, on rocky slopes on top of escarpment (–DD), Liebenberg 3555 (PRE).

15. *Phymaspermum comptonii* Magee and Ruiters sp. nov. — TYPE: SWAZILAND. Mbabane (2631): Bomvu ridge (–AA), 25 Mar. 1964, Compton 32016 (holotype: NBG; isotype: PRE–2 sheets!)

Multistemmed, densely leafy shrublet, 0.75–1.0 m high. Stems few-branched; branches erect to spreading, sparsely to densely silvery tomentose to villous, sometimes with purplish tinge; fascicles present in leaf axils. Leaves alternate, spreading to erect, 7.0–15.0 × 0.5–1.0 mm, linear when undissected, mucronate, involute, entire to pinnatifid, narrowed into petiole-like base, without secondary basal lobes, sparsely to densely silvery villous on both surfaces, fleshy; basal swelling present, continuous with stem ribs; lobes 3, 4.0–15.0 × 0.5–1.5 mm, linear, mucronate. Capitula discoid, homogamous, terminal, few- to many-headed (10–50), simple to compound corymbs, pedunculate; peduncles 5.0–60.0 mm long, silvery tomentose. Involucre 4.0–6.0 × 3.0–4.0 mm, cyathiform to campanulate, sometimes tapering at the base; involucre bracts 3-seriate, loosely arranged, margins and apices scarios, membranous apices of bracts two and three 0.3–0.5 mm long, villous, brown margins absent, median resin canals present (resulting in a distinct dark red line in the centre of each bract); outer bracts lanceolate, 3.0 mm long, acuminate; middle bracts lanceolate, 3.6–3.9 mm long, acuminate; inner bracts lanceolate, 4.0–4.3 mm long, acuminate to rounded. Receptacle convex; paleae usually in 2 marginal series, linear to oblong, 4.3–4.6 mm long, rounded, rigid with scarios apices, scarios apices ±1.0 mm long. Disc florets ± 22, without resin canals; corolla 2.4–2.6 mm long, with only glandular trichomes, yellow; tube 1.3–1.4 mm long; limb campanulate, 0.8 mm long (excluding lobes); lobes spreading, 0.6–0.8 mm long, triangular. Anthers ± 3.1 mm long (including apical appendage); apical appendage oblong to lanceolate. Style ± 2.0 mm long (excluding branches); branches ± 0.5 mm long. Cypselas 1.6 × 0.4 mm, oblong to obovate, 10- to 12-ribbed, apical rim thickened, slightly dentate, glandular trichomes present, sparse, scattered, not mucilaginous when soaked, discontinuous resin canals in ribs rarerly present. Figure 18.

Diagnostic Characters—*Phymaspermum comptonii* shares the fleshy silver sericeous leaves with *P. argenteum*, but is here distinguished by the cyathiform to campanulate involucre and lanceolate, loosely appressed involucre bracts with prominent rounded, scarios appendages (involucre narrowly campanulate and involucre bracts tightly appressed with prominent brown margins in *P. argenteum*).

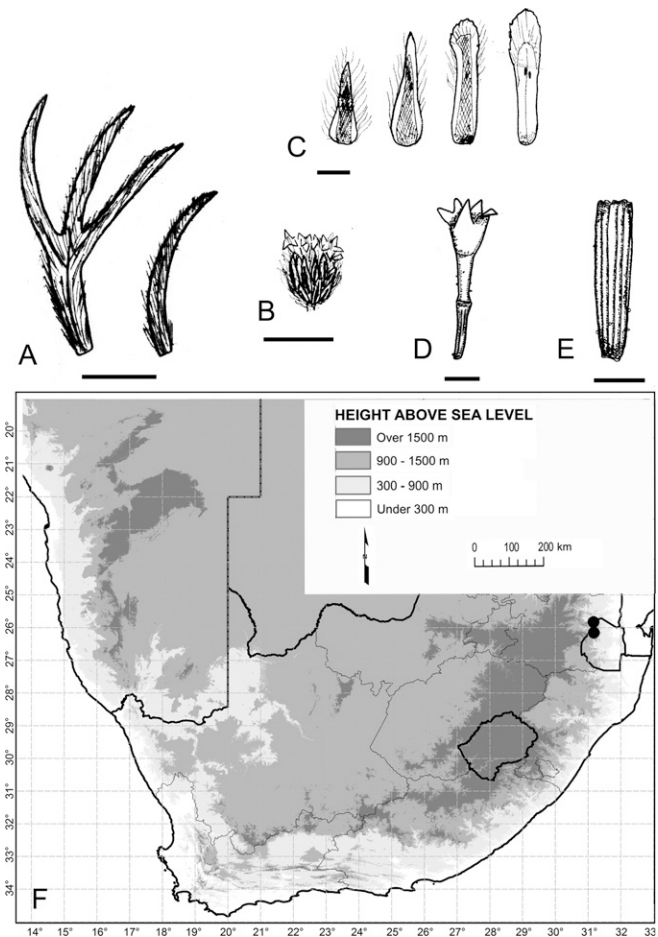


FIG. 18. *Phymaspermum comptonii*. A. Leaves. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Cypselas. F. Known geographical distribution. Vouchers: A, E. Compton 31199 (PRE); B. Brusse 6335 (PRE); C, D. Compton 32016 (PRE). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

Distribution and Ecology—*Phymaspermum comptonii* is a near endemic of Swaziland, extending slightly over the South African border around Barberton (Fig. 18F). It grows in grassland at an altitude of 1,100–1,700 m. Flowering is from December to May.

Additional Specimens Examined—SOUTH AFRICA. Mpumalanga: 2531 (Komatipoort): Barberton Mountainlands Nature Reserve (–CC), Burrows 8119 (PRE); Ida Dayer Nature Reserve 38 km SE of Barberton (–CC), Muller 2057 (PRE).

SWAZILAND. 2631 (Mbabane): Mbabane Forbes Reef, Ngwenya mountains near Oshoek border with South Africa, Bomvu Ridge old iron ore mine on path to Bushmen cave, on SW slope as one exits excavated part (–AA), Brusse 6335 (PRE); Bomvu Ridge (–AA), Compton 31199 (PRE), Compton 28823 (PRE two sheets).

16. *PHYMASPERMUM PINNATIFIDUM* (Oliv.) Källersjö in Nordic J. Bot. 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Germish. and N.L. Meyer, Pl. S. Afr.: 274 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). *Pentzia pinnatifida* Oliv. in Hooker’s Icon. Pl. 14. 28, plate 1340 (1881); Hutch. in Kew. Bull. 1916. 10: 253 (1917). *Athanasia pinnatifida* (Oliv.) Hilliard in Hilliard and B.L. Burt, Notes Roy. Bot. Gard. Edinburgh 32 (3): 330–331 (1973); Hilliard, Compositae in Natal: 342 (1977). —TYPE: SOUTH AFRICA. KwaZulu Natal, Pietermaritzburg (2930):

Inanda (–DB), Aug. 1879, *Wood 168* (lectotype: K sheet 000410760–image!, designated here; isolectotypes: BM–image!, K sheet 000410761–image!, PRE!, Z–image!) [Note: As Hooker's *Icones Plantarum* was based on collections from Kew herbarium, sheet K000410760 from that collection is designated here as it also contains the original collection labels (giving both the month and date of collection) and is clearly the material upon which the illustration was based.]

Multistemmed, densely leafy shrub, 0.25–0.5 m high. Stems unbranched; branches erect, glabrous or with few silver-villous hairs, sometimes woolly or matted; fascicles present in leaf axils. Leaves alternate, erect to spreading, 5.0–32.0 × 0.2–1.0 mm, linear, deeply pinnatifid, narrowed into petiole-like base, sometimes with secondary basal lobes, silvery-pubescent villous hairs on both surface, leathery; basal swelling present, continuous with stem ribs; lobes 7–9, 4.0–25.0 mm, filiform to linear, attenuating. Capitula discoid, homogamous, terminal, few- to many-headed (5–30), simple to compound corymbs, pedunculate; peduncles 4.0–35.0 mm long, glabrous to matted. Involucre 6–7 × 4–5 mm, funnel-shaped to cyathiform, rarely tapering at the base; involucre bracts 3- or 4-seriate, loosely arranged, margins and apices scarious (curved shape due to thin rigid centres with resin canals), membranous apices of all bracts 0.2–2.5 mm long, glabrous to villous especially on edges, brown margins absent, median resin canals present; outer bracts triangular to lanceolate or oblong, 2.3–3.0 mm long, attenuating to rounded; middle bracts lanceolate to oblong, 2.7–3.8 mm long, attenuating to rounded; inner bracts linear to oblong, 4.3–5.0 mm long, acute rounded; inner most bracts oblong, 5.2 mm long, rounded. Receptacle convex; paleae in marginal series, linear to oblong, 3.3–5.1 mm long, rounded, rigid with scarious margins and apices, scarious apices 0.7–1.0 mm long. Disc florets 38–44, without resin canals; corolla 2.3–2.5 mm long, with only glandular trichomes, yellow; tube 1.2–1.5 mm long; limb campanulate, 1.0 mm long (excluding lobes); lobes spreading, 0.6–1.0 mm long, triangular to triangular-ovate. Anthers 2.8–3.2 mm long (including apical appendage); apical appendage lanceolate. Style 2.1–2.6 mm long (excluding branches); branches 0.5–0.7 mm long. Cypselas 3.5 × 0.7 mm, oblong to obovate, 12-ribbed, apical rim membranous, dentate, glandular trichomes absent, discontinuous resin canals in ribs present. Figure 19.

Diagnostic Characters—*Phymaspermum pinnatifidum* is a small, spring flowering multistemmed shrublet with discoid corymbosely arranged capitula and cypselas with a prominent membranous apical crown. Together with *P. acerosum* it does not have myxogenic trichomes on the cypselas (the generic synapomorphy) but rather prominent resin canals in the cypselas ribs. It can be readily distinguished from *P. acerosum* by its earlier flowering time, smaller stature (less than 0.5 m tall) with thin herbaceous stems, the broader funnel or cup-shaped involucre and the prominent membranous apical crown on the cypselas. Its small size means that it could also be confused with *P. woodii* but can be readily distinguished by the broader, not apically constricted involucre with loosely appressed involucre bracts, the prominent membranous apical crown on the cypselas and the absence of myxogenic trichomes.

Distribution and Ecology—*Phymaspermum pinnatifidum* is restricted to the Pietermaritzberg district of the KwaZulu

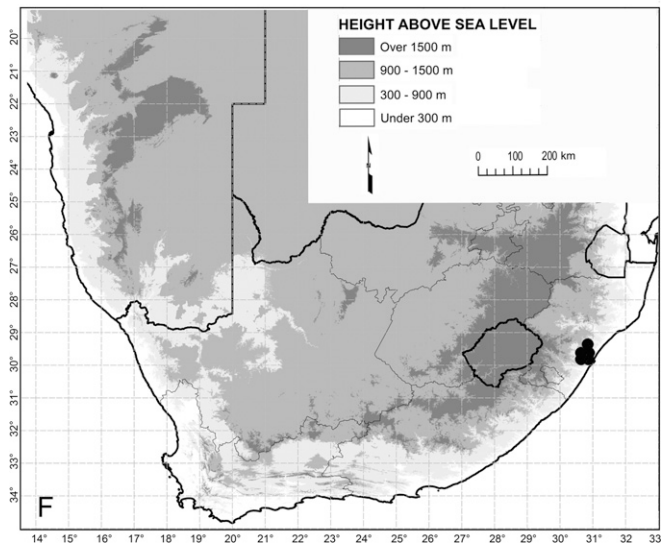
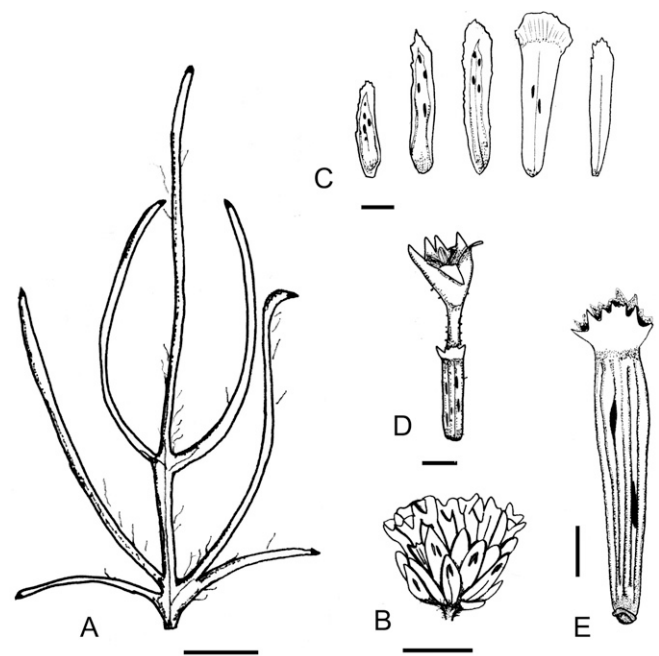


FIG. 19. *Phymaspermum pinnatifidum*. A. Leaf. B. Capitula. C. Involucre bracts (outermost to innermost series, from left) and single palea (far right). D. Disc floret. E. Cypselas. F. Known geographical distribution. Vouchers: A, B. *Rudatis* 2299 (NBG); C, D. *Hilliard* 2047 (NU); E. *Young* 1441 (NBG). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

Natal Province (Fig. 19F) on the Natal group sandstone and is mostly found in grasslands between 450–920 m. The species is early flowering, usually in spring, between August and October, but early fires can result in even earlier flowering (*Hilliard* 1977).

Additional Specimens Examined—SOUTH AFRICA. KwaZulu Natal: 2930 (**Pietermaritzburg**): Mapumulo, Great Noodsberg (–BD), *Strey* 6048 (PRE); Ndwedwe, Ozwatini (–BD), *Strey* 7745 (NU); Noodsberg, Ozwatini plateau (–BD), *Williams* 572 (PRE); Camperdown, Drummond (–DA), *Rump s.n.* (NU), *Galpin* 10297 (PRE); New Hanover, Botha's Hill (–DA), *Young* 2235 (PRE), *Wood* 1480 (SAM); Table Mountain (–DA), *Hilliard* 3986 (NU), *Killick* 188 (NU), *Killick* 673 (NU, PRE); Cato Ridge, Mkabela near Ekuthuleni (–DA), *Williams* 393 (PRE); 8 km S of Wartburg, near Ekithuleni, on farm Windy Hill (–DA), *Balkwill* and *Balkwill* 4695 (B–image); Inanda (–DB), *Wood* 168 (SAM, BOL), *Wood* 606 (BM–image); Inanda, Elephant's Trunk (–DB), *Strey* 6996 (NU); Ndwedwe, Inanda mountain (–DB), *Hilliard* 2047 (NU); Richmond, Mid-Illovo centre, Farm

Ismont, M. Stainbank's farm (–DC), *Young 1214* (NU); Priscilla Vale (–DC), *Young 1441* (NBG); Opposite Key Ridge access from Cliffdale road (–DC), *Styles 915* (NU, PRE); Hillcrest (–DD), *Thode 2957* (NBG), south facing aspect of Mkonka stream, Krantzklouf Nature Reserve (–DD), *Styles 165* (NU), Watsonia Drive, Krantzklouf Nature Reserve (–DD), *Styles 40* (NU), above Pinetown (–DD), *Medley-Wood s.n.*(PRE); Pinetown district, Everton, Eskotene (–DD), *Hilliard 5035* (NU), *Hilliard 4846* (NU), *Hilliard 2874* (NU), Pinetown, Kloof, Forest Hills (–DD), *Hilliard 1853* (NU), Krantzklouf, Murisons farm, back of W Cotterils (–DD), *Hayforth 174* (NBG), Krantzklouf Reserve (–DD), *Edwards 1424* (NU).

PRECISE LOCALITY UNKNOWN: Notnads Hill Station, *Medley Wood 39121* (SAM).

17. *PHYMASPERMUM ACEROSUM* (DC.) Källersjö in Nord. J. Bot 5(6): 535 (1986); K. Bremer and Humphries in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Retief and Herman, Pl. N. Prov. S. Afr.: 330 (1997); Germish. and N.L. Meyer, Pl. S. Afr.: 273 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. Checklist S. African Pl.: 243 (2006). *Morysia acerosa* DC., Prodr. 6: 92 (1838). *Athanasia acerosa* (DC.) D. Dietr., Syn. Pl. 4: 1401 (1847); Harv. in Harv. and Sond., Fl. Cap. 3: 199 (1864); Hilliard and B.L. Burt, in Notes Roy. Bot. Gard. Edinburgh 30(1): 118 (1970); Hilliard and B.L. Burt, in Notes Roy. Bot. Gard. Edinburgh 32(3): 330 (1973); Hilliard, Compositae in Natal: 342 (1977). —TYPE: SOUTH AFRICA. KwaZulu Natal, Port Shepstone (3030): 'Omcomas et Omsanculo' [Umkomaas and Umzimkulu rivers] (–BC), 1852, *Drège 5037* (lectotype: G–DC sheet G00455519–image!, designated here; isolectotype: BM–image!, HAL–image!, HBG–image! two sheets, K–image!, S–image! two sheets, SAM!). [Note: There are five Drège collections of this species in G–DC, but this is the only specimen that bears both the collection number and locality.]

Athanasia natalensis Schltr. in Bot. Jahrb. Syst. 40: 95 (1908). —TYPE: SOUTH AFRICA. KwaZulu Natal, Pietermaritzburg (2930): 'Kronsberg am Noodsberg' [Kranskop at Noodsberg] (–BB) *Rudatis 21* (Z, material not located).

Pentzia stenocephala Thell. in Vierteljahrsschr. Naturf. Ges. Zürich: 456 (1916). —TYPE: SOUTH AFRICA. KwaZulu Natal, Pietermaritzburg (2930): Inchanga (–DC), 1875–1880, *Rehman 7896* (lectotype: Z sheet 000003762–image!, designated here; isolectotypes: Z sheet 000003763–image!, Z sheet 000003764–image). [Note: Thellung cited five collections; this collection of three specimens was chosen because the selected specimen has abundant flowering materials.]

Pentzia pinnatifida var. *chenoleoides* Hutch. in Kew Bull. 10: 241 (1916). —TYPE: SOUTH AFRICA. Limpopo, Tzaneen Natal (2330): Near Murchison (–DC), 1884/5, *Wood 3110* (lectotype: K–image!, designated in Hilliard and Burt (1973); isolectotype: NH–image!).

Athanasia villosa Hilliard in Hilliard and B.L. Burt, Notes Roy. Bot. Gard. Edinburgh 32(3): 330 (1973); Hilliard, Compositae in Natal: 342 (1977), syn. nov. *Phymaspermum villosum* (Hilliard) Källersjö, in Nord. J. Bot 5(6): 535 (1986); K. Bremer and Humphries, in Bull. Nat. Hist. Mus. Lond. (Bot.) 23(2): 94 (1993); Germish. and Meyer, Pl. S. Afr.: 274 (2003); Klopper et al. Checklist of the flowering plants of Sub-Saharan Africa: 147 (2006); Germish. et al. A Checklist S. African Pl.: 243 (2006). —TYPE: SOUTH AFRICA. Eastern Cape, Kokstad (3029): Weza,

above Mpetyne forest (–DA), 05 Jan 1964, *Hilliard 2507* (holotype: NU!; isotypes: E–image!, K–image!, M–image!, NH–image!, PRE!, S–image!).

Multistemmed, densely leafy shrub, 0.3–1.8 m high. Stems unbranched to few-branched; branches erect, glabrous or scabrous to silvery villous; fascicles present in leaf axils. Leaves alternate, spreading, 6.0–40.0 × 0.5–1.0 mm, linear when undissected, mucronate, sometimes involute, entire (usually on upper branches) to deeply pinnatifid, narrowed into petiole-like base when dissected, sometimes with secondary basal lobes, glabrous to silvery villous on both surfaces, leathery; basal swelling present, continuous with stem ribs; lobes 3–9, 2.0–24.0 × 0.5–1.0 mm, linear, mucronate. Capitula discoid, homogamous, terminal, few- to many-headed (5 to +100), simple or compound corymbs, pedunculate; peduncles 8.0–42.0 mm long, tomentose. Involucre 3.0–6.0 × 1.5–3.0 mm, narrowly campanulate to cylindrical, tapering at the base; involucre bracts 3- or 4-seriate, loosely to tightly arranged, margins and apices scarious, membranous apices of inner bracts ± 0.5 mm long, glabrous to villous, brown margins absent, median resin canals present; outer bracts lanceolate, 1.4–2.5 mm long, acute to acuminate; middle bracts lanceolate, 2.4–3.5 mm long, acute to acuminate; inner bracts lanceolate to oblong, 3.3–4.2 mm long, rounded. Receptacle convex; paleae in marginal series (rarely rudimentary inner paleae present), oblong to linear, 4.0–4.8 mm long, acute, rigid with thick scarious margins and apices, scarious apices ± 0.6 mm long. Disc florets 3–18, sometimes with resin canals in the tube, limb and lobes; corolla 2.3–2.6 mm long, with only glandular trichomes, yellow; tube 1.0–1.5 mm long; limb campanulate, 0.8–1.2 mm long (excluding lobes); lobes spreading, 0.6–0.7 mm long, triangular. Anthers 2.5–2.8 mm long (including apical appendage); apical appendage oblong. Style 2.0–2.8 mm long (excluding branches); branches 0.5–0.6 mm long. Cypselas ca. 2.0 × 0.5 mm, oblong, 13- to 14-ribbed, apical rim thickened, entire to slightly dentate, light to dark brown, glandular trichomes absent, discontinuous resin canals in ribs present. Figure 20.

Diagnostic Characters—*Phymaspermum acerosum* shares the narrowly lobed pinnatifid leaves, the absence of myxogenic trichomes on the cypselas and the presence of prominent resin canals in the cypselas ribs with *P. pinnatifidum*. It can be distinguished by its narrowly campanulate to oblong involucre and the absence of a prominent apical crown on the cypselas (only at most a thickened apical rim which can be entire to shortly dentate). *Phymaspermum acerosum* is also a much larger more robust shrub growing to more than 0.5 m tall with much thicker and woodier stems than the smaller *P. pinnatifidum* which tends to have much more slender and herbaceous stems.

The previously recognised species *P. villosum* was at first distinguished from *P. acerosum* by having much broader oblong and hairy involucre. *Phymaspermum acerosum* was considered to only have narrowly campanulate involucre however, after many specimens were examined, *P. acerosum* is now considered to have involucre which vary from narrowly campanulate to broad and oblong and *P. villosum* is now a synonym of *P. acerosum*.

Distribution and Ecology—*Phymaspermum acerosum* is widely distributed from Port Elizabeth in the Eastern Cape Province to Noodsberg in the Limpopo Province (Fig. 20 F) where it occurs in grassland and forest margins at an altitude

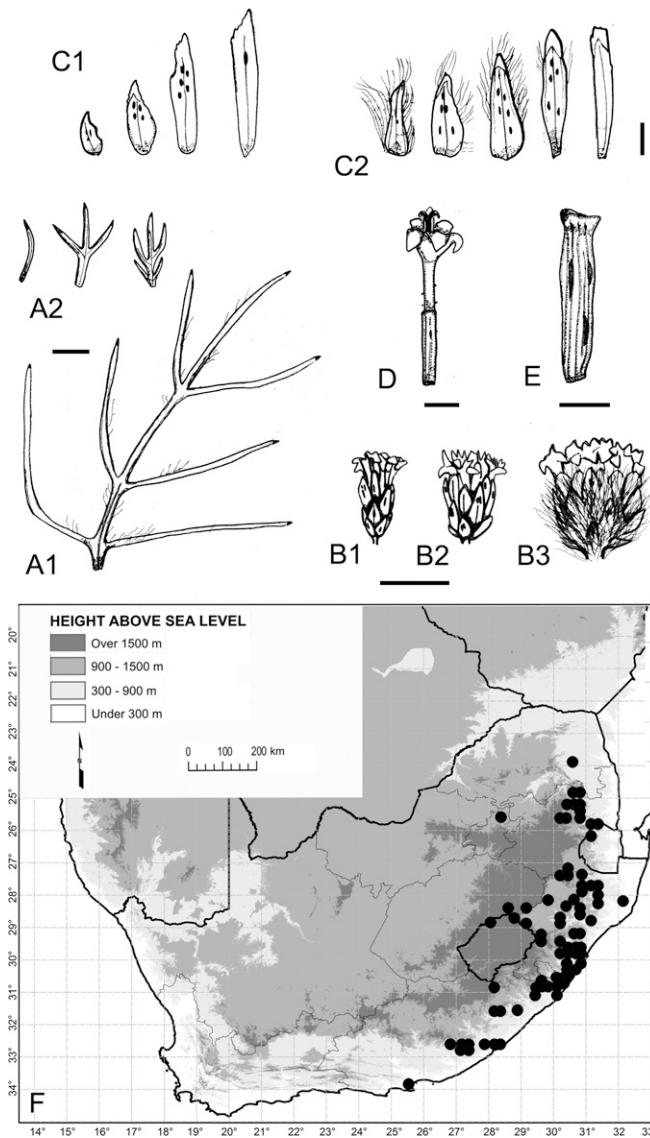


FIG. 20. *Phymaspermum acerosum*. A. Leaves. B. Capitula. C. Involucral bracts (outermost to innermost series, from left) and single paleae (far right). D. Disc floret. E. Cypsela. F. Known geographical distribution. Vouchers: A1. *Buitendag* 887 (NBG); A2. *Drège* s.n. (NBG); B1. *Pentz and Acocks* 10313 (PRE); B2. *Hafström and Acocks* 1855 (PRE); B3, C2. *Hilliard* 2507 (NU); C1, D. *Hilliard* 4865 (NU); E. *Ward* 11272 (PRE). Scale: A–B = 4 mm; C–D = 1 mm; E = 500 μ m.

of 60–2,200 m. It flowers throughout the year, with a peak between April and July.

Additional Specimens Examined—SOUTH AFRICA. Gauteng: **2528 (City of Tshwane)**: Doornpoort (–CB), *Mogg* 2161 (PRE). Mpumalanga: **2430 (Pilgrims Rest)**: Ohrigstad Nature Reserve (–DC), *Theron* 3633 (PRE), *Theron* 3607 (PRE), *Jacobsen* 2903 (PRE); Morgenzon Nature Reserve, near Graskop (–DC), *Reid* 3 (PRE); Mount Sheba Nature Reserve (–DC), *Kerfoot* 8757 (PRE); near Graskop (–DD), *Phillips* 3491 (PRE); Graskop, above Kowyns Pass, along road (–DD), *Koekemoer* 2123 (PRE); near Mac-Mac Falls (–DD), *Burt Davy* 438 (PRE, BOL). **2530 (Mashishing)**: 8 miles from Pilgrims Rest on Mashishing road (–AB), *Story* 1215 (PRE); Mashishing (–AB), *Burt Davy* 1165 (BOL), *Wilms* 791 (BM–image), *Wilms* 790 (BM–image, NU); Mashishing, near turn off to Mount Anderson from Long Tom Pass (–BA), *Koekemoer* 2280 (PRE); Pilgrims Rest, between Mashishing and Sabie (–BA), *Schuff* 5465 (PRE); Between Mashishing and Sabie (–BA), *Pole Evans* 3995 (PRE); Hartbeesvlakte (–BA), *Mohle* 20 (PRE); Sabie valley (–BB), *Galpin* 39 (BOL); Rosehaugh (–BD), *Rogers* 20377 (PRE), *Sim* 546 (BOL); Entokozweni (–CB), *Young* 1476 (PRE); Emakhazeni near Entokozweni (–CA), *Codd* 7759 (PRE); Helopmith, Kaapse Hoop road,

12 miles out (–DB), *Liebenberg* 2553 (PRE). **2531 (Komatipoort)**: Barberton (–CC), *Williams* 10512 (PRE); 7 miles NW of Havelock Mine, Barberton (–CC), *Codd* 7846 (PRE). **2730 (Vryheid)**: Hoedjie, Farm Suikerhoek, Wakkerstroom (–AB), *Devenish* 1698 (NU). Free State: **2828 (Bethlehem)**: Qwa Qwa National Park Avondrust II (–BC), *Zietsman* 3349 (PRE). **2829 (Harrismith)**: Harrismith Botanic Garden (–AC) *Zeyde* s.n. (NBG); Rensburgskop, 7 km van Swineburne (–AC), *Jacobsz* 428 (PRE); Farm Gravolette, 16 miles S of Harrismith (–AC), *Zeyde* s.n. (NBG); Sterkfontein Dam (–AC), *Blom* 162 (PRE). Kwazulu Natal: **2730 (Vryheid)**: Mooihoek, Piet Retief district (–AC), *Devenish* 1638 (NU); Utrecht, on road to Wakkerstroom to Paulpietersburg, Mooifontein farm, Guquka, south hills of Pongola mountain series (–AC), *Jordaan* 2815 (PRE); Nauwhoek, Utrecht (–AD), *Devenish* 1133 (PRE two sheets), *Devenish* 490 (PRE); Wakkerstroom district, Guquka farm, 25 km from Wakkerstroom on the PaulPolokwane road (–AD), *Meyer* 218 (PRE); south side of Dumble Mountain (–BD), *Acocks* 11542 (PRE); Vryheid, 12 miles from Natal Spa on Vryheid-PaulPolokwane road (–DB), *Ross* 1251 (NU); Bloemhof, Emnyathi (–DD), *Thode* 2962 (NBG); Leeuwnek Pass, Emnyathi Mountain (–DD), *Shirley* (NU two sheets). **2731 (Louwsburg)**: 2 miles from Vryheid on road to Louwsburg on north facing slope (–CA), *Hardy* 37 (PRE); 19 miles from Vryheid on Louwsburg road, Nkongolwana River (–CA), *Ross* 1224 (NU); Ngotshe, Itala Nature Reserve (–CB), *Hilliard and Burt* 10018 (NU), *Hilliard and Burt* 8546 (NU); Louwsburg (–CB), *Compton* 19702 (NBG); Ngotshe district, Ngome (–CD), *Hilliard and Burt* 9849 (NU); Ngotshe, 7 miles W of Ngome (–CD), *Codd* 9580 (PRE two sheets); Ngome Forest, about 10 km from main office of forestry on road to Vryheid (–CD), *Germishuizen* 2103 (PRE). **2829 (Harrismith)**: Inkupe Hill in the Biggarsberg (–BB), *Acocks* 10465 (PRE); Cathedral Peak Reserve, Mikes Pass (–CC), *Magee et al.* 460 (NBG). **2830 (Dundee)**: Helpmekaar/Elandsdraal road (–AD), *Hilliard* 1575 (NU), *Shirley* s.n.(NU); Nqutu (–BA), *Codd* 1363 (PRE); hill on east side of Zungeni Peak (–BD), *J.P.H. Acocks* 11553 (PRE); Pomeroy district Jobskop on summit plateau (–CA), *Venter* 1775 (PRE); Pangolo mountains to Kaffir drift (–CA), *Thode* A327 (PRE); 12 miles Muden/Weenen road (–CC), *Moll* 3244 (PRE two sheets, NU); Umhlumba mountain top (–CC), *Acocks* 13864 (PRE); Qudeni-Nqutu road (–DB), *Edwards* 2249 (NU). **2831 (Nkandla)**: Mahlabatini, Ceza forest (–AB), *Hilliard and Burt* 3312 (NU); Lower part of Nkandla Forest, 14.7 miles from Nkandla Hotel on road to Eshowe (–CC), *Winter* 8261 (PRE). **2832 (Mtubatuba)**: Hlabisa, Hluhluwe Game Reserve (–AA), *Ward* 2620 (PRE, NU). **2929 (Underburg)**: 17 km E of Mooi river on Hlatikulu road, Farm Lanner Veane (–BA), *Balkwill and Manning* 468 (NU); Central Drakensberg, Highmoor forestry station (–BC), *Breytenbach* 5072 (PRE); Estcourt district side of Kamberg Nature Reserve, Rosette road (–BC), *Wright* 176 (NU); Impendhle district, Loteni area (–BC), *Roberts* s.n. (NU). **2930 (Pietermaritzburg)**: Karkloof (–AC), *Rehman* 7417 (Z–image), *TL* 1139 (BOL); below Bridle Road view site, Karkloof Nature Reserve (–AC), *Styles* 25 (NU); Hgononi Veld near Michaelhouse (–AC), *Pentz and Acocks* 10313 (PRE); Mount Park Dargle, Lions River (–AC), *Johnson* 433 (BOL); Lions River, The Dayle (–AC), *Hilliard* 2157 (NU); Lions River, Karkloof, near turnoff to farm Klatine (–AC), *Hilliard* 4857 (NU); 4 miles from Currys Post/ Nottingham road, Lions River (–AC), *Moll* 886 (NU); 25 km NNE Howick, Twin Falls (–AC), *Groze* 51 (NU); Lions River, Curry's Post, Mehleys Bush (–AC), *Hilliard* 4853 (NU); Lions River, E of Karkloof Gorge (–AC), *Parry* 18 (NU); Whitecliffe, Greytown (–BA), *Wood* 889 (SAM); De Rust, Greytown (–BA), *Thode* 2955 (NBG); Greytown (–BA), *Wylie* 34065 (PRE), *Wylie* 21927 (PRE); "Mowhay" Ahrens (–BB) *Fisher* 463 (NU); Lions River, Silverdale (–CB) *Wright* 1502 (NU); Swartkops Hill (–CB), *Esterhuysen* 20,294 (BOL); Writers Kloof (–CB), *Carnegie* 1216 (BOL); Chase Valley (–CB), *Canham* 28 (NU); World's View (–CB), *Moll* 2647 (NU); along roadside above Sweet Waters, on the way to Hilton (–CB), *Warren* 5 (NU); Town Bush (–CB), *Randles* 29 (NU); Byrne, Keerom (–CC), *Strey* 11268 (NU); Richmond, Byrne Valley (–CC), *Schofield* s.n. (NU), *Galpin* s.n. (BOL); Richmond (–CD), *Medley Wood* 9844 (NU two sheets); Richmond, Enon Estate (–CD), *Hilliard* 2037 (NU); Drummond (–DA) *Bromhead* s.n.(NU), Camperdown, Drummond (–DA), *Camden Smith* 32 (NU); Table Mountain (–DA), *Killick* 628 (NU), *Johnstone* 195 (NU); Ndwedwe, Inanda (–DB), *Wood* 921 (BOL), *Hilliard* 2052 (NU); Inanda (–DB) *Wood* s.n. (Z–image); Near Summerveld Equine Hospital Assagay, Ethekwini Municipality (–DC), *Wragg* 671 (NU); Hammarsdale area, Hector (ESKOM) substation site (–DC), *Ward* 13017 (NU); Camperdown, Nagle Dam (–DC), *Wells* 1543 (NU); M. Stainbanks farm, Mid Illovo (–DC), *Young* 1087 (NU); Summerveld part of Assagay (–DC), *Wragg* 88 (NU); Krantzklouf (–DD), *Schlechter* 3182 (BOL), *Clarkson* 29 (NU), *Galpin* s.n. (NBG), *Galpin* 12078 (PRE); Pinetown, Everton, Eskotene (–DD), *Hilliard* 1501 (NU), *Hilliard* 4865 (NU-3); Gillitts area, Stockville Valley, Farm Stockville 1382 (–DD), *Ward* 11272 (NU, PRE); Pinetown, Mbilo River Valley, below Paradise Valley Nature Reserve

- (–DD), *Ward 10956* (NU); Hillcrest (–DD) Neuwoudt 31 (NU), *Ross 336* (NU); Marianhill (–DD), *Strey 9193* (NU, PRE); Fields Hill (–DD), *Rehman 7977* (Z–image). **3030 (Port Shepstone)**: Farm Fairfield, S of Dumisa on SAPPi property (–AB), *Balkwill 10284* (B–image); Hlokozi, Alexandra city (–AD), *Rudatis 2962* (NBG); Umgai (–AD), *Strey 10974* (PRE,NU); Umbogintwini (–BB) *Brooks 7* (NU); Vernon Crookes Nature Reserve (–BC), *Ward 9886* (NU); Oribi Flats, top of Oribi Gorge (–CA), *Mc Clean 579* (PRE); boundary between Alfred and Port Shepstone escarpment above Oberburn (–CA), *Hilliard 1638* (NU); Port Shepstone (–CB), *Dinock Brown 405* (BOL); Near Port Shepstone on St. Faith's road (–CB), *Hafström and Acocks 1855* (PRE); Above Mthamvuna River, borderland Estate Farm (–CC), *Nicholson 1473* (PRE); Mthamvuna River (–CC), *Nicholson 1014* (PRE); Zuurberg (–CC), *Tyson 2162* (BOL, SAM), *Tyson 1060* (SAM); 'Umgeni ad catarhactam' (–CD), *Rehman 7472* (Z–image). **3130 (Port Edward)**: 5 miles from Port Edward on Izingolweni road (–AA), *Hilliard 1130* (NU); Mthamvuna Nature Reserve 20 km NW of Port Edward on Izingolweni road (–AA), *Nicholson 2249* (PRE); Mthamvuna Nature Reserve, hidden valley, Farm Clearwater, near cottages (–AA), *Hilliard and Burt 10246* (NU), *Jordaan 3684* (PRE), *Balkwill 382* (NU), *Germishuizen 8083* (PRE). EASTERN CAPE: **3028 (Matatiele)**: Maclear, Little Pot River (–CC), *Hilliard 3899* (BOL, NU). **3029 (Kokstad)**: Insizwa, Mount Ayliff (–CD), *Strey 10759* (NU), *Hilliard and Burt 6531* (NU, PRE two sheets); Insizwa roadside bank (–CD), *Strey 11250* (NU, PRE); Bulembu, forest marqin (–DA), *Kotze 600* (PRE); Alfred district, Mpetyn forest, Weza (–DA), *Hilliard 2503* (NU); Ntlenzi kloof forest (–DC), *Strey 8689* (NU, PRE); 5 miles from Bizana, on Kokstad road (–DD), *Acocks 10953* (PRE); Bizana division 5–7 miles E, near Umzamba River Mouth (–DD), *Lewis 4652* (SAM). **3128 (Mthatha)**: Roma (–CA), *Schmitz 9062* (PRE); Bhaziya Mountain (–CB), *Baur 185* (SAM); Misty Mountain, approx 8–9 miles from Mthatha (–DB), *Sole 1* (NBG). **3129 (Bizana)**: Pondoland (–AB), *Bowker 5569* (SAM). **3226 (Fort Beaufort)**: Alice, Pefferskop (–DB), *Acocks 8980* (PRE). **3227 (Stutterheim)**: Keiskammahoek (–CA), *Strey 3487* (PRE); Dohne Hill (–CB), *Sim 78* (NU), *Sim 77* (NU); Perie, Kaffraria (–CC), *Sim 19736* (NU, PRE); King William Town (–CD), *Tyson 5561* (SAM); near Komsha (–DB), *Flanagan 57* (PRE); *Elliot 99* (PRE). **3228 (Butterworth)**: Kei River (–CA), *Flanagan 1476* (NBG), *MacOwen 1476* (K–image); West of Kei Mouth (–CB), *Flanagan 57* (SAM); Centane valleys (–CB), *Pegler 472* (BOL). **3325 (Port Elizabeth)**: Sydenham (–DC), *Medley-Wood 12427* (NU).
- PRECISE LOCALITY UNKNOWN: Natal, *Badenhuizen and party J28934* (NU), *Wood 268* (BOL, SAM), *Drège 16936* (SAM), *Cooper 1139* (K–image, BM–image); Prope Macamae, *Leu 157* (BOL); Entumani Zululand, *Medley Wood 3969* (SAM); Zululand, *Gerrard 1038* (BM–image); *Plant 100* (TCD–image, S–image).
- SWAZILAND. **2631 (Mbabane)**: Mucuceni hills (–AA), *Compton 31524* (PRE, NBG). **2531 (Komatiport)**: Devils Bridge, Piggs Peak (–CD), *Compton 30044* (NBG).
- LESOTHO. **2828 (Bethlehem)**: Lelingvana Basutoland, Leribe, Mealavaneng (–CC), *Dieterlin 822* (BOL, PRE two sheets, SAM), *Dieterlin 881* (PRE, SAM); Witzieshoek (–DB), *Thode 5621* (NBG).
- ACKNOWLEDGMENTS. The curators and staff of the cited herbaria are thanked for their kind hospitality and assistance during visits and for making specimens available on loan. Mr. Nick Helme is thanked for bringing his collection of what turned out to be a new species from around Robertson to our attention and the landowner, Mr. Ernst Bruwer, for allowing us to collect type material and study the plant in situ. Dr. AnneLise Scutte-Vlok and Mr. Jan Vlok are thanked for supplying us with material and images of *P. aphyllum*. Dr. Laurent Gautier and herbarium staff from Conservatoire Botanique de la Ville de Genève are thanked for supplying electronic images of type material. Cape Nature, the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism, and Ezemvelo KZN Wildlife are thanked for providing the relevant permits. This work is based upon research supported by the National Research Foundation and Department of Science and Technology under the SABI Programme and the University of Johannesburg.
- LITERATURE CITED
- Bremer, K. and C. J. Humphries. 1993. Generic monograph of the Asteraceae- Anthemideae. *Bulletin of The Natural History Museum (Botany)* 23: 71–177.
- Calendini, F. and J.-F. Martin. 2005. PaupUP v1.0.3.1 A free graphical front end for Paup Dos software.
- Farris, J. 1970. Methods for computing Wagner Trees. *Systematic Zoology* 34: 21–24.
- Feder, N. and T. P. O'Brien. 1968. Plant microtechnique: Some principles and new methods. *American Journal of Botany* 55: 123–142.
- Germishuizen, G., N. L. Meyer, Y. Steenkamp, and M. Keith. 2006. A checklist of South African plants. Southern African Botanical Diversity Network Report No. 41. City of Tshwane: SABONET.
- Harvey, W. H. 1864. Compositae. in *Flora Capensis* 3. eds. W. H. Harvey and W. Sonder. Dublin: Hodges, Smith & Co.
- Hilliard, O. M. 1977. *Compositae in Natal*. Pietermaritzburg: University of Natal Press.
- Hilliard, O. M. and B. L. Burt. 1973. Notes on some Plants of Southern Africa Chiefly from Natal: III. *Notes from the Royal Botanic Garden Edinburgh* 32: 303–387.
- Hutchings, A. 1996. *Zulu medicinal plants: An inventory*. Pietermaritzburg: University of Natal Press.
- Källersjö, M. 1986. Fruit structure and generic delimitation of *Athanasia* (Asteraceae-Anthemideae) and related South African genera. *Nordic Journal of Botany* 5: 527–542.
- Källersjö, M. 1991. The genus *Athanasia* (Compositae-Anthemideae). *Opera Botanica* 106: 1–76.
- Kirschner, J. and Z. Kaplan. 2002. Taxonomic monographs in relation to global red lists. *Taxon* 51: 155–158.
- Lessing, C. F. 1832. *Synopsis Generum Compositarum Earumque Dispositionis Novae Tentamen Monographiis Multarum Capensium Interjects*. Berlin: Sumptibus Dunckeri et Humblotii.
- Leistner, O. A. and J. W. Morris. 1976. *Southern African place names. Annals of the Cape Provincial Museums*, Vol. 12. Grahamstown: Albany Museum.
- Mace, G. M. 2004. The role of taxonomy in species conservation. *Philosophical Transactions of the Royal Society* 359: 711–719.
- Magee, A. R. and J. C. Manning. 2010. Two new species of Asteraceae (tribe Anthemideae, subtribe Pentziinae) from the Cape Floristic Region of South Africa. *South African Journal of Botany* 76: 279–284.
- Magee, A. R. and P. M. Tilney. 2012. A taxonomic revision of *Pentzia* (Asteraceae, Anthemideae) I: the *P. incana* group in southern Africa, including the description of the new species *P. oppositifolia* Magee. *South African Journal of Botany* 79: 148–158.
- Magee, A. R., J. S. Boatwright, and L. Mucina. 2014. Four new species of *Ursinia* (Asteraceae, Anthemideae) from South Africa, with an updated key to the genus in Namaqualand. *Phytotaxa* 177: 137–145.
- Magee, A. R., A. K. Ruiters, P. M. Tilney, and B.-E. Van Wyk. 2013. Proposal to conserve the name *Phymaspermum* (Asteraceae) with a conserved type. *Taxon* 62: 407–408.
- Magoswana, S. L. and A. R. Magee. 2014. A taxonomic revision of *Hymenolepis* (Asteraceae, Anthemideae). *South African Journal of Botany* 91: 126–141.
- Magoswana, S. L., A.-L. Schutte-Vlok, and A. R. Magee. 2015. *Hymenolepis glabra* (Anthemideae, Asteraceae), a new species from the Little Karoo (South Africa). *Phytotaxa* 230: 189–192.
- Moteteete, A. and B.-E. VanWyk. 2006. A revision of the genus *Melolobium* (Genisteae, Fabaceae). *South African Journal of Botany* 72: 51–98.
- Norlindh, T. 1943. *Studies in the Calendulae* 1, Michigan: The University of Michigan.
- Oberprieler, C., S. Himmelreich, and R. Vogt. 2007. A new subtribal classification of the tribe Anthemideae (Compositae). *Willdenowia* 37: 89–114.
- Powell, R. F. and A. R. Magee. 2013. *Athanasia argentea* and *A. gyrosa* (Asteraceae), two new species from the Cape Floristic Region of South Africa. *South African Journal of Botany* 88: 219–222.
- Powell, R. F., J. S. Boatwright, and A. R. Magee. 2014. A taxonomic revision of the *Cotula coronopifolia* group (Asteraceae) and implications for the conservation statuses of the species. *South African Journal of Botany* 93: 105–117.
- Powrie, L. 2004. *Common names of Karoo plants*. Strelitzia 16. City of Tshwane: National Botanical Institute.
- Schatz, G. E. 2002. Taxonomy and herbaria in service of plant conservation: Lessons from Madagascar's endemic families. *Annals of the Missouri Botanical Garden* 89: 145–152.
- Schutte, A. L. and B.-E. Van Wyk. 1988. A synopsis of the genus *Dichilus* (Fabaceae – Crotalariaeae). *South African Journal of Botany* 54: 182–186.
- Shearing, D. and K. Van Heerden. 1994. *Karoo. South African Wild Flower Guide* 6. Cape Town: Botanical Society of South Africa, Kirstenbosch.
- Smith, C. A. 1966. *Common names of South African plants*. Memoirs of the Botanical Survey of South Africa 35. City of Tshwane: Department of Agricultural Technical Services.
- Swelankomo, N. 2011. FSA contributions 19: Asteraceae: *Eumorphia*. *Bothalia* 41: 277–282.

Swofford, D. L. 1998. PAUP*: Phylogenetic Analysis using Parsimony (*and Other Methods), version 4.0. Sinauer Associates, Sunderland, Massachusetts.

Vlok, J. and A. L. Schutte-Vlok. 2010. *Plants of the Klein Karoo*. City of Tshwane: Umदाus Press.

APPENDIX 1. Morphological characters and character states used in the cladistic analysis. 1, Habit: single-stemmed = 0; multistemmed = 1.

2, Leaves: erect to spreading = 0; appressed = 1. 3, Capitula: peduncles undivided to lax corymbs = 0; arranged in dense corymbs = 1. 4, Capitula paleae: present = 0; only marginal = 1. 5, Involucral bracts: rigid = 0; scarious = 1. 6, Ray florets: absent = 0; present = 1. 7, Cypselas: width \leq 0.8 mm = 0; width $>$ 0.8 mm = 1. 8, Cypselas ribs: $<$ 10 = 0; $>$ 10 = 1. 9, Cypselas surface: not papillose = 0; papillose = 1. 10, Glandular trichomes: absent = 0; present = 1. 11, Glandular trichomes distribution: dense = 0; sparse = 1. 12, Resin canals in ribs: present = 0; absent = 1.