

A taxonomic revision of the genus *Cynorhiza* (Apiaceae: Apioideae)

A.R. Magee*, B-E. Van Wyk, P.M. Tilney

Department of Botany and Plant Biotechnology, University of Johannesburg, P.O. Box 524, Auckland Park 2006, South Africa

Received 29 November 2007; received in revised form 26 May 2008; accepted 30 May 2008

Abstract

The recently reinstated genus *Cynorhiza* Eckl. and Zeyh. is revised. It includes three summer-deciduous species two of which were hitherto placed in the genus *Peucedanum* L., namely *C. typica* Eckl. and Zeyh., *C. meifolia* (Eckl. and Zeyh.) A.R.Magee and a new species, *C. bolusii* A.R.Magee and B.-E.van Wyk. The species are easily distinguished by a combination of both leaf and fruit morphological characters. Possible phylogenetic relationships within the genus were explored using a cladistic analysis of anatomical and morphological characters, the results of which suggests that *C. bolusii* and *C. meifolia* are sister taxa. A formal taxonomic treatment is presented, including a key to the species, correct nomenclature, typifications, descriptions and geographical distributions.

© 2008 SAAB. Published by Elsevier B.V. All rights reserved.

Keywords: Apiaceae; *Cynorhiza*; New species; *Peucedanum*; South Africa; Taxonomic revision

1. Introduction

Cynorhiza Eckl. and Zeyh. is a genus of perennial herbs endemic to South Africa. The name is derived from the Afrikaans vernacular name, *hondewortel* (“dog-root”), for *Cynorhiza typica* Eckl. and Zeyh. This species was also recorded by Smith (1966) under the common names *bierwortel* and *gatagaai*. The former name is derived from the use of the root of this species (Van Wyk and Gericke, 2000), in the Western Cape Province, to brew a highly intoxicating traditional mead (*karri* or honey beer).

Ecklon and Zeyher (1837) included four species in *Cynorhiza*, two of which lacked formal descriptions. The genus was later considered congeneric with *Peucedanum* L. by Sonder (1862). Despite a later reinstatement of the genus by Koso-Poljansky (1917), based largely on fruit anatomical characters, all subsequent authors have followed Sonder’s treatment (Burt, 1991). A recent molecular phylogenetic analysis by Winter et al. (2008) demonstrated that the African species traditionally included in *Peucedanum* were only distantly related to their Eurasian counterparts, forming a clade together with other

African endemic genera within the tribe Tordylieae. A new generic classification of *Cynorhiza* was proposed including *Cynorhiza meifolia* (Eckl. and Zeyh.) Magee and a new species (described herein as *Cynorhiza bolusii* Magee and B.-E.van Wyk).

A taxonomic revision of the genus, including a key to the 3 species, correct nomenclature, typifications, descriptions, illustrations and distribution maps, is presented. Possible phylogenetic relationships within the genus are also explored using a cladistic analysis of morphological and anatomical characters.

2. Materials and methods

All materials of *Cynorhiza* from BM, BOL, JRAU, K, NBG (including SAM and STE), PRE and S (herbarium acronyms as in Holmgren et al., 1990) were examined. Selected specimens on loan from GRA and digital images from HAL and P were also examined. Using this material, together with geographical information from Leistner and Morris (1976), the recorded distribution of all the species was carefully verified and mapped.

FAA and herbarium material were used to study fruit anatomy. The herbarium material was first rehydrated and then

* Corresponding author.

E-mail address: a.r.magee@hotmail.com (A.R. Magee).

placed in FAA for a minimum of 24 h. The material was subsequently treated according to a modification of the method of Feder and O'Brien (1968) for embedding in glycol methacrylate (GMA). This modification involves a final infiltration in GMA of five days. Staining was done according to the periodic acid Schiff/toluidine blue (PAS/TB) staining method (Feder and O'Brien, 1968). Voucher specimens for the fruit anatomical study are listed below.

C. bolusii: Bokkerivier Farms, *Barker 10142* (NBG); Ceres Plain, *Bolus s.n. sub BOL 23408* (NBG). *C. meifolia*: Twenty-Four Rivers Mountains, *Ecklon and Zeyher 2230* (SAM). *C. typica*: Coega and Swartkops River mouth, *Ecklon and Zeyher 2245* (SAM); Cradock Place, near Port Elizabeth, *Galpin 6413* (PRE); Cornellsberg, *Van Jaarsveld 11886* (PRE).

Characters and character states used for the cladistic analysis are given in Table 1. Character states were polarised using the method of outgroup comparison. Where both states were found to co-occur in a single taxon it was coded for the plesiomorphic state. Autapomorphies were omitted from the analysis. Phylogenetic analyses were conducted using the parsimony algorithm of the software package PAUP version 4.0b1 (Swofford, 1998). Characters were treated as ordered and equally weighted (Wagner parsimony; Farris, 1970). Tree searches were performed using a heuristic search with 1000 random sequence additions, tree bisection-reconnection (TBR) branch swapping and the MULPARS option in effect. The species are arranged in the taxonomic treatment according to the results of this analysis.

3. Results and discussion

3.1. Morphology and anatomy

The species of *Cynorhiza* are all non-woody perennial herbs. They are summer-deciduous with their leaves withering soon after flowering. This character is an important generic synapomorphy but evolved convergently in *Annesorhiza* Cham. and Schlecht. (Tilney and Van Wyk, 2001).

The leaves are arranged in a basal rosette in all three species. In *C. typica* they are adapted to climb or scramble up into the dense surrounding vegetation and continue to grow throughout

the growing season, so that they may become up to 1.5 m long. The wide range of variation in leaf morphology between the species proved useful in their identification. The pinnae and pinnules are regularly divided in *C. bolusii* and *C. typica*, or brush-shaped with distinctly short, congested pinnules in *C. meifolia*. The petiole and rachis are glabrous on both surfaces in *C. bolusii* and *C. typica*, but pilose on the abaxial surface in *C. meifolia*. Petioles are flattened in *C. meifolia* and *C. typica* but terete in *C. bolusii*. The lobes of the ultimate leaflet segments are diagnostically sub-terete in *C. bolusii* (Fig. 1b), while flat in *C. meifolia* (Fig. 1c) and *C. typica* (Fig. 1a). The latter species has somewhat larger ultimate leaflet segments but shows extreme variation in both size and shape (Fig. 1a).

In *Cynorhiza* the inflorescence is always several times longer than the diameter of the terminal primary umbel, and bears 0 to 4 (6) smaller lateral umbels. The primary umbel is largely composed of hermaphroditic flowers and the lateral umbels largely of functionally male flowers. The primary umbel may be almost orbicular or flat-topped. The number of rays in the primary umbel can be used to distinguish *C. typica*, which has more than 14 (often up to 78) rays, from *C. bolusii* and *C. meifolia* that have less than 12 rays. Within *C. typica* the number of rays and the size of the primary umbels are extremely variable. Populations in the Western and Northern Cape generally have larger, more radiate primary umbels than those of the Eastern Cape. The flowers are pentamerous, with the sepals either minute (less than 0.2 mm long in *C. typica*) or small but distinct (greater than 0.4 mm long in *C. bolusii* and *C. meifolia*). The petals are elliptic to obovate with incurved tips; the gynoecium is bicarpellate and the stylopodium narrowly conical (rarely broadly conical in *C. typica*).

The fruit of *Cynorhiza* (Fig. 2) are dorsally compressed, with the marginal ribs expanded into very broad, thin wings and the commissure extending over the full width of the mericarp (i.e. to the very edge of both marginal ribs). The fruit are relatively large, usually more than 10 mm long, with somewhat smaller fruit (8–19 mm long) usually found in the Eastern Cape populations of *C. typica* (Figs. 2c1–c5). Within *C. typica* the fruit vary considerably in size and shape; elliptic, rotund, obovate or broadly obovate fruit occur with obtuse, truncate or notched poles. The fruit of *C. bolusii* (Fig. 2a) and *C. meifolia* (Fig. 2b) are obovate to broadly obovate in dorsal view and easily distinguished from those of *C. typica* (Fig. 2c) by their apically lobed wings with rounded, incurved auricles extending well above and over the stylopodium. Similar fruit are found in the genus *Lefebvrea* A.Rich. However, the latter genus consists of monocarpic herbs bearing fruit with the fertile part usually much shorter than the length of the fruit (Townsend, 1989; Winter et al., 2008).

In transverse section the fruit are clearly homomorphic (Fig. 3). The median and lateral ribs are obsolete to somewhat prominent and obtuse in *C. typica* (Fig. 3b), or prominent and triangular in *C. bolusii* (Fig. 3c) and *C. meifolia* (Fig. 3a). The epidermal surface is smooth in *C. typica*, but minutely papillate in *C. bolusii* and *C. meifolia*. Hypodermal collenchyma is present only in *C. meifolia*. The mesocarp is slightly lignified in

Table 1
Characters and character polarisation in *Cynorhiza*

Taxa	Character states						
	1	2	3	4	5	6	7
<i>Afroscidium magalimontanum</i>	0	0	0	0	0	0	0
<i>Cynorhiza bolusii</i>	1	1	1	1	1	1	1
<i>Cynorhiza meifolia</i>	1	1	1	1	1	1	1
<i>Cynorhiza typica</i>	1	1	0	1	0	0	0

Characters: 1. *Seasonality*: winter-deciduous (0); summer-deciduous (1). 2. *Leaf persistence*: present at fruiting (0); absent at fruiting (1). 3. *Sepals*: minute, <0.2 mm (0); small but distinct >0.4 mm (1). 4. *Stylopodium*: broadly conical (0); narrowly conical (1). 5. *Fruit apex*: not auriculate (0); auriculate (1). 6. *Fruit ribs*: obsolete to somewhat prominent (0); prominent (1). 7. *Epidermal surface*: smooth (0); papillate (1).

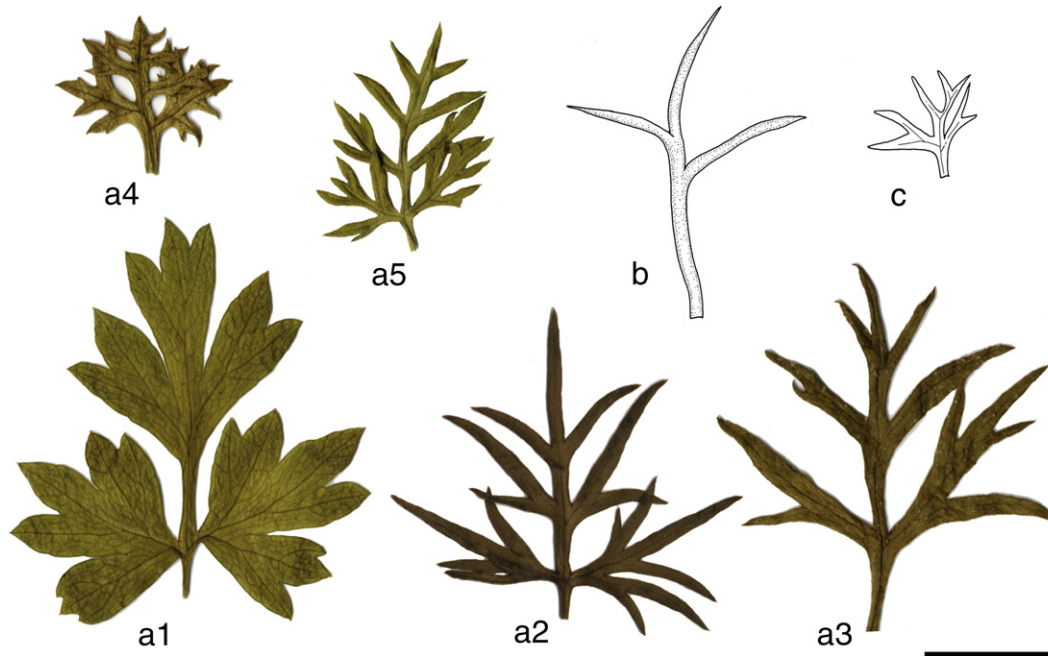


Fig. 1. Variation in the shape of the ultimate leaflet segments of *Cynorhiza* species: (a) *C. typica*; (b) *C. bolusii*; (c) *C. meifolia*. Vouchers: (a1) Van Wyk 3372 (JRAU); (a2) Bolus 2923 (BOL); (a3) Pillans 6972 (BOL); (a4) Magee 53 (JRAU); (a5) Magee 39 (JRAU); (b) Bolus s.n. (PRE); (c) Ecklon and Zeyher 2230 (SAM). Scale a: 10 mm, b and c: 5 mm.

the ribs and wings of the mature fruit; lignified cells of the wings are elongated as in many other African peucedanoid species (Ostroumova and Pimenov, 1997a,b). Rib oil ducts are present both external to the vascular bundles as well as in the distal portion of the marginal wings. In all three species there are two narrow commissural vittae and four solitary vallecular vittae in each mericarp.

3.2. Cladistic analysis of morphological characters

For the analysis of infrageneric relationships within *Cynorhiza*, seven characters could be logically polarised (Table 1) using the South African species *Afroligusticum magalismsontanum* (Sond.) P.J.D. Winter as the outgroup. Since the majority of these characters are unique, almost any peucedanoid outgroup

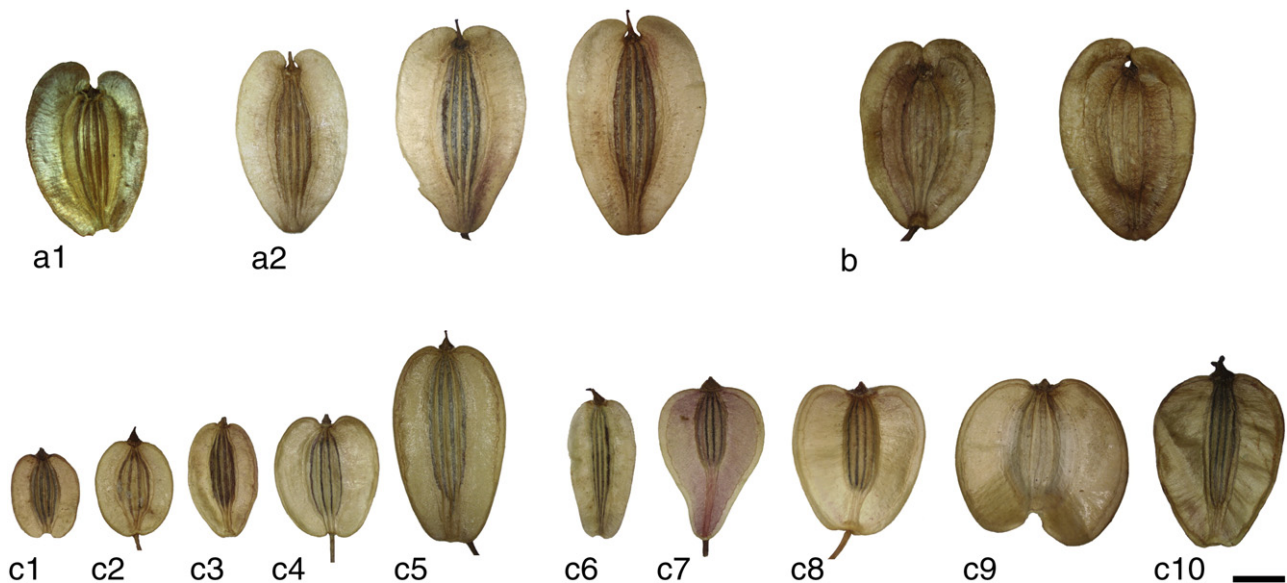


Fig. 2. Variation in the fruit morphology of *Cynorhiza* species: (a) *C. bolusii*; (b) *C. meifolia*; (c) *C. typica*. [for some collections, more than one fruit is shown]. Vouchers: (a1) Barker 10142 (NBG); (a2) Bolus 23408 (BOL), three fruit; (b) Ecklon and Zeyher 2230 (SAM), two fruit; (c1) Zeyher 2692 (PRE); (c2) Paterson 476 (BOL); (c3) Giffen 364 (PRE); (c4) Paterson 5 (GRA); (c5) Bolus 441 (BOL); (c6) Magee 46 (JRAU); (c7) Acocks 15188 (PRE); (c8) Valentine 16 (GRA); (c9) Van Jaarsveld 11886 (PRE); (c10) Adamson 1530 (BOL). Scale: 5 mm.

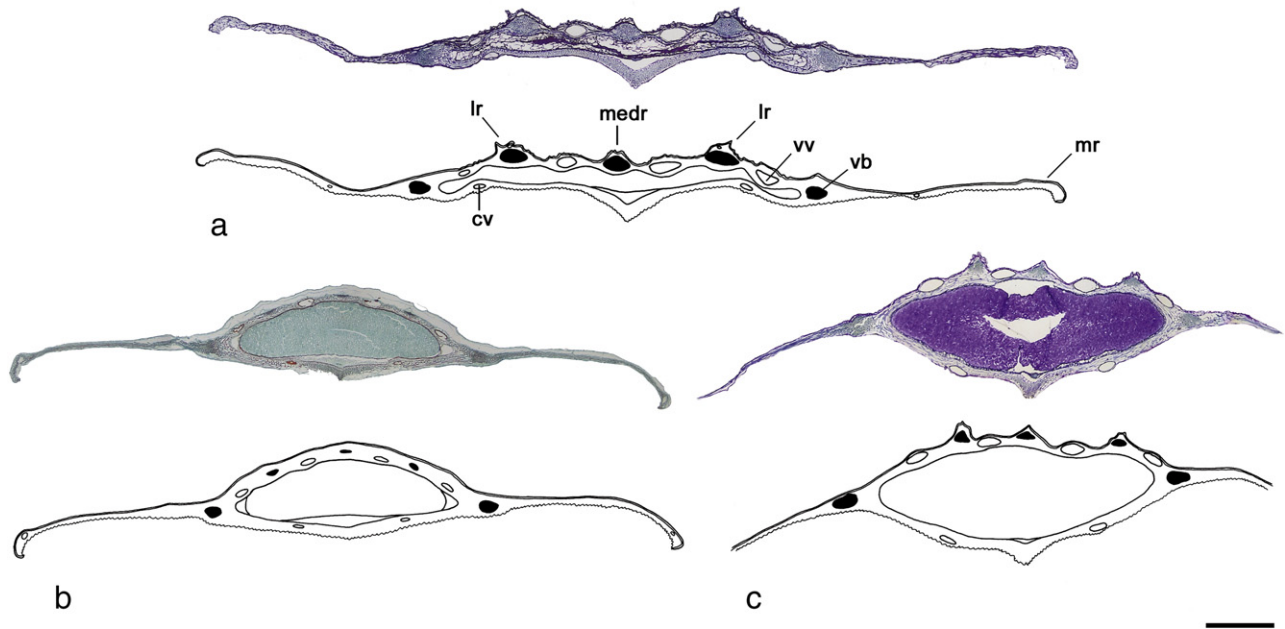


Fig. 3. Transverse sections through the mericarps of *Cynorhiza* species: (a) *C. meifolia*, (b) *C. typica*, (c) *C. bolusii*. Vouchers: (a) Ecklon and Zeyher 2230 (SAM); (b) Galpin 6413 (PRE); (c) Barker 10142 (NBG). Scale: 1 mm. mr, marginal rib; medr, median rib; lr, lateral rib; vb, vascular bundle; vv, vallecular vitta; cv, commissural vitta.

would have given a similar result. A single tree (Fig. 4) was obtained with a length of 8 steps, a CI value of 1.0 and a RI of 1.0. In the absence of suitable material of two of the species for molecular analyses, this result is presented here as a first hypothesis of relationships within the genus.

Cynorhiza was supported as monophyletic by three synapomorphies, namely summer-deciduous leaves, leaves which are absent (or dead) at the time of fruiting, and the narrowly conical stylopodium. *C. bolusii* and *C. meifolia* were supported as sister taxa by the presence of small but distinct sepals more than 0.4 mm long, auriculate apical wing lobes in the fruit, prominent fruit ribs and their minutely papillate epidermal fruit surfaces.

4. Taxonomic treatment

Cynorhiza Eckl. and Zeyh., Enum. Pl. Afric. Austral. 351 (1837); Koso-Pol. in Bull. Soc. Mosc. n. ser. 30. 278 (1917); Endl., Gen. Pl. 2. 780 (1839), emend. Magee in Winter et al., in Taxon 57(2): 358 (2008). Type—*C. typica* Eckl. and Zeyh. [lecto., designated in Winter et al. (2008)].

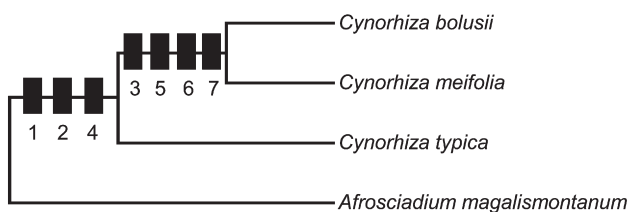


Fig. 4. Single tree obtained from a cladistic analysis of the morphological and anatomical data in Table 1. TL=8. CI=1.0. RI=1.0.

Analyrium E.Mey. in Drège, Zwei Pflanzengeogr. Doc. 163 (1843), nom. nud.; K. Presl in Abh. Boehem. Ges., 5 (3). 505 (1845), nom. nud.

Perennial herbs. *Leaves* rosulate, often creeping or scrambling, deciduous during or soon after flowering, 3- or 4-pinnate; pinnae and pinnules regularly divided or pinnae brush-shaped with pinnules short, congested; rachis glabrous or pilose on abaxial surface. *Petioles* dorsally flattened or terete, glabrous or pilose, base weakly sheathing. *Ultimate leaflet segments* ovate to very broadly ovate or obovate, pinnatisect to bi- or tri-sect, glabrous, bases attenuate; lobes linear to oblong, flat or subterete, apices acute, mucronulate. *Inflorescence* long (several times longer than the diameter of the primary umbel); peduncle striate; umbels compound; primary umbel terminal, orbicular or flat-topped; lateral umbels smaller, 0 to 4 (6); involucre bracts lanceolate to narrowly ovate, numerous, glabrous, apices acute to acuminate; rays 30–360 mm long, unequal, outer rays longer, glabrous; involucre bracteoles usually shorter than the raylets, lanceolate to narrowly ovate, numerous, glabrous, apices acuminate; raylets glabrous; umbellule many-flowered. *Flowers* pentamerous, hermaphroditic; sepals deltoid, minute or small but distinct, glabrous, apices obtuse to acute or acuminate; petals yellow?, elliptic to obovate, glabrous, tips acuminate, inflexed, secretory ducts branched; stamens with tips inflexed; stylopodium narrowly or rarely broadly conical; styles short or long. *Fruit* dorsally compressed, elliptic to rotund or obovate to broadly obovate in dorsal view, 8.0–20.5 mm × 6.5–13.0 mm; bases obtuse, truncate to deeply notched; apices truncate to deeply notched and auriculate (the wings often extending well above and over the stylopodium); mericarps homomorphic; median and lateral ribs obsolete to prominent; marginal ribs very broadly-winged, thin; commissural vittae

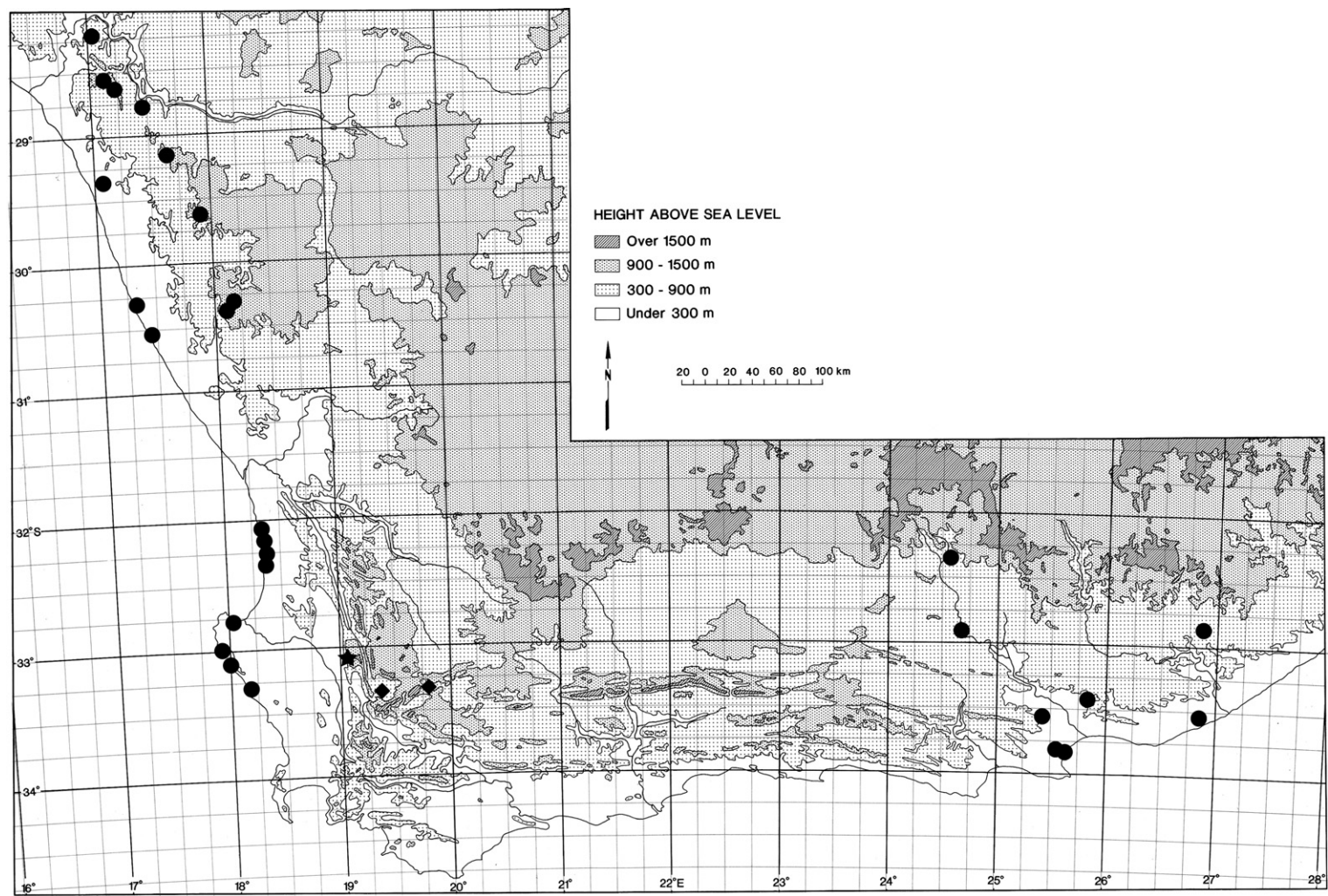


Fig. 5. The known geographical distributions of *Cynorhiza typica* (circles), *C. bolusii* (diamonds) and *C. meifolia* (star).

2, narrow [in total 6–25% of fruit width (excluding the marginal wings)]; vallecular vittae 4, narrow; commissure very broad, 100% of mericarp width; carpophore bipartite.

4.1. Diagnostic characters

The three species are non-woody perennial herbs (the species of the other Cape peucedanoid genera, *Nanobubon* and *Noto-bubon*, are woody shrubs or suffrutices) with summer-deciduous leaves that are senescent at the time of flowering and usually completely absent in the fruiting stage. *Cynorhiza* is thus easily distinguished from all other African peucedanoid genera and species, all of which have actively growing leaves at the time of fruiting (Winter et al., 2008). *Cynorhiza* also has very large fruit (8.0–20.5 mm × 6.5–13.0 mm) with broad, thin marginal wings that often extend above the level of the stylopodium, resulting in the fruit being notched in outline (as is also found in *Lefebvrea* species).

4.2. Distribution and habitat

Cynorhiza is restricted to the Western, Northern and Eastern Cape Provinces of South Africa (Fig. 5). Plants grow in sand dunes along the coast or more inland in sand or clay.

4.3. Phenology

The plants are summer-deciduous and form new leaves annually from May. Flowering commences from late September through to November, at which time the leaves have begun to senesce. Mature fruit are borne on leafless plants from December to March. In the Eastern Cape Province, *C. typica* may sometimes flower earlier in response to sporadic summer rains.

4.4. Key to the species of *Cynorhiza*

- 1a. Petiole and abaxial surface of leaf blade glabrous; pinnae and pinnules regularly divided;
- 2a. Ultimate leaflet segments with flat, broad lobes; petioles flattened; fruit apex if deeply notched then not auriculate in outline 1. *C. typica*
- 2b. Ultimate leaflet segments with sub-terete, linear lobes; petioles terete; fruit apex deeply notched and auriculate in outline 2. *C. bolusii*
- 1b. Petiole and abaxial surface of leaf blade pilose; pinnae brush-like, with pinnules dissected into short, congested linear lobes 3. *C. meifolia*

4.5. *C. typica*

C. typica Eckl. and Zeyh., Enum. Pl. Afric. Austral. 352 (1837); D. Dietr., Syn. Pl. 2. 969 (1840); Winter et al., in Taxon 57(2): 358 (2008). *Peucedanum typicum* (Eckl. and Zeyh.) B.L. Burt in Edinb. J. Bot. 48(2). 239 (1991); Goldblatt and Manning, Cape Pl. 278 (2000). *Peucedanum cynorhiza* Sond. in Harv. and Sond., Fl. Cap. 2. 558 (1862), nom. illegit. Type—South Africa, Eastern Cape Province, Swartkops River [3325

DC], Ecklon and Zeyher 2244 (SAM!, flowering and leaf material, lecto., here designated; S! 2 sheets, P!, isolecto.) [Note: the specimen in SAM is chosen as it bears handwritten annotation by Ecklon].

Cynorhiza montana Eckl. and Zeyh., Enum. Pl. Afric. Austral. 352 (1837); D. Dietr., Syn. Pl. 2. 969 (1840). *Peucedanum zeyheri* Sond. in Harv. and Sond., Fl. Cap. 2. 559 (1862); B.L. Burt in Edinb. J. Bot. 45. 94 (1988), nom. illegit., non Steud. Type—South Africa, Eastern Cape Province, Koegakoppie near Swartkops River [3325 DC], Ecklon and Zeyher 2245 (S!, sheet A, lecto., here designated; S!, 3 sheets, SAM!, 2 sheets, P!, isolecto.). [Note: The specimen on sheet A in S is chosen here as it most closely matches the original description (an umbel with less than 24 rays and leaf material present).]

Cynorhiza olifantiana Koso-Pol. in Bull. Jard. Bot. Petersb. 16. 230 (1916). *Peucedanum olifantianum* (Koso-Pol.) M. Hiroe, Umbell. World 1574 (1979); B.L. Burt in Edinb. J. Bot. 48(2). 235 (1991). Type—South Africa, Eastern Cape Province, near mouths of Coega and Swartkops Rivers [3325 DC], Zeyher 2692 (LE, photo!, specimen on the left, holo.)

Peucedanum sulcatum Eckl. and Zeyh. ex Sond. in Harv. and Sond., Fl. Cap. 2. 559 (1862); Adamson in J. Bot. 76. 346 (1938); B.L. Burt in Edinb. J. Bot. 48(2). 237 (1991). *Cynorhiza? sulcata* Eckl. and Zeyh., Enum. Pl. Afric. Austral. 345 (1837), nom. nud., D. Dietr., Syn. Pl. 2. 969 (1840), nom. nud. Type—South Africa, Northern Cape Province, Namaqualand, Kamiesberg [3018 AC], Ecklon and Zeyher 2247 (S!, sheet with inflorescence, lecto., here designated; S! sheet with leaves only, SAM!, isolecto.). [Note: There are two specimens in Sonder's herbarium in S; the sheet with the inflorescence is chosen here as it shows the typically large umbel on a distinctly sulcate peduncle and bears immature fruit.]

Leaves often creeping or scrambling, 160–1570 mm × 100–350 mm; pinnae and pinnules regularly divided; rachis glabrous. Petioles 55–810 mm long, dorsally flattened, glabrous. Ultimate leaflet segments ovate to very broadly ovate, 7–50 mm × 8–40 mm, pinnatisect to 3-sect; lobes linear to oblong, flat. Inflorescence 160–1500 mm long; primary umbel almost orbicular; lateral umbels smaller, 0 to 4 (6); involucre bracts lanceolate to narrowly ovate, apices acuminate; rays 14 to 78, 30–360 mm long; involucre bracteoles lanceolate to narrowly ovate, apices acuminate. Flowers pentamerous; sepals minute, 0.1–0.22 mm long, apices obtuse to acuminate; petals yellow; stylopodium narrowly or rarely broadly conical; styles short. Fruit elliptic to rotund or obovate to broadly obovate in dorsal view, 8.0–19.0 mm × 6.5–16.5 mm; bases obtuse, truncate to deeply notched; apices truncate to deeply notched; median and lateral ribs of mericarps obsolete.

4.6. Diagnostic characters

C. typica differs from *C. bolusii* and *C. meifolia* most conspicuously in that the fruit apex, even if deeply notched, is never auriculate (Fig. 2c). It differs further from *C. meifolia* in that all parts of the leaf are glabrous and the pinnae are not brush-shaped (pinnules not short and congested as in

C. meifolia). It differs from *C. bolusii* also in the flattened petioles and the flat, laminate lobes of the ultimate leaflet segments (Fig. 1a).

4.7. Regional variation

P. sulcatum is no longer recognized as distinct from *P. typicum* because of the lack of discontinuity in its characters. The overlap between the two species, here considered as allopatric population groups, is shown in the following two descriptions.

4.8. Eastern population group (*P. typicum*)

Leaves 160–480 mm × 100–250 mm. Petioles 65–190 mm long. Ultimate leaflet segments 10–40 mm × 8–40 mm. Inflorescence 160–550 mm long; primary umbel terminal; lateral umbels smaller, 0 to 4; rays 14 to 27, 30–78 mm long. Stylopodium narrowly or rarely broadly conical. Fruit 8.0–11.0 (–19.0) mm × 6.5–10.5 mm.

4.9. Western population group (*P. sulcatum*)

Leaves 170–1570 mm × 250–350 mm. Petioles 55–810 mm long. Ultimate leaflet segments 7–33 (–50) mm × 9–35 mm. Inflorescence 440–1500 mm long; primary umbel terminal; lateral umbels smaller, 0 to 6; rays (16) 20 to 78, 36–360 mm long. Stylopodium narrowly conical. Fruit 12.0–18.5 mm × 7.0–16.5 mm.

4.10. Diagnostic characters

The western population group differs from the eastern population group in the longer leaves, the longer and more branched peduncle bearing larger, more multiradiate umbels and the usually larger fruit (Fig. 2c6–c10). However, all of these characters overlap, so that *P. sulcatum* is reduced into synonymy under *C. typica*.

4.11. Distribution and habitat

The two population groups have a notably disjunct distribution (Fig. 5). The eastern population group usually occurs in dense succulent thicket or dense coastal scrub. The western population group is more widespread, and occurs in a variety of vegetation types, including dense Strandveld along the coast or more inland in succulent Karoo vegetation (either sand or clay loam).

4.12. Additional specimens examined

South Africa. Northern Cape Province.-2817 (Violsdrif): Kodaspeak (-AA), Oliver et al. 480 (PRE); Cornellsberg (-CA), Van Jaarsveld 11886 (PRE); summit of Ploegberg (-CA), Williamson 4587 (NBG 1 and 2); Richtersveld, Quaggas (-CA), Van Jaarsveld 11965 (NBG); Richtersveld National Park, summit of Helskloof (-CD), Williamson 6001 (NBG).-2917

(Springbok): Port Nolloth (-AC), Batten 731 (NBG), Williamson 3824 (BOL, NBG 1 and 2); along road leading E. of Steinkopf/Port Nolloth/Kossies road (-BA), Snijman 422 (NBG 1 and 2); Springbokfontein (-DB), Valentin s.n. (GRA).-3017 (Hondeklip Bay): Hondeklip Bay (-AD), Pillans 18057 (BOL); Garies, Bitterriviermond (-CB), Van Jaarsveld 12766 (JRAU).-3018 (Kamiesberg): Kamiesberg (-AC), Adamson 1550 (BOL 1 and 2); Leliefontein (-AC), Adamson 1518, 1530 (BM). Western Cape Province.-3218 (Clanwilliam): Lamberts Bay (-AB), Acocks 15188 (BOL 1, 2, 3, PRE), Henrici 3308 (PRE); 5.3 km from Lamberts Bay to Elands Bay (-AB), Bayer and Chandler 1077 (PRE); 4.8 km from Lamberts Bay to Elands Bay (-AB), Magee et al. 53 (JRAU); Elands Bay (-AD), Lavranos 11649 (PRE); Gouduine north of Elands Bay (-AD), Hugo 1029 (NBG, PRE); St Helena Bay (-CC), Marloth 8007 (PRE 1, 2, 3).-3317 (Saldanha): Saldanha Bay (-BB), Bolus 12700 (BOL), Leighton 1741 (BOL), Marloth 8362, 10176 (PRE); Saldanha Bay, Hoogland lookout point (-BB), Magee and Boatwright 98 (JRAU).-3318 (Cape Town): Langebaan (-AA), Pillans 6972 (BOL); Yzerfontein (-AC), Pillans 9187 (BOL), Magee and Boatwright 39 (JRAU); Magee et al. 46 (JRAU); Koeberg Nature Reserve (-CB), Magee et al. 121 (JRAU, NBG). Eastern Cape Province.-3224 (Graaff-Reinet): Graaff-Reinet (-BC), Bolus 441, 16456 (BOL); Gannahoek (-DC), Hoffman 783 (GRA).-3226 (Fort Beaufort): Victoria East, Sandilekop (-DD), Giffen 365 (PRE).-3325 (Port Elizabeth): Addo Elephant Park (-BD), Botha 5682 (GRA); Brakleege (-CB), Dold 2428 (GRA), Hoffman 1040 (GRA), Van Wyk 3372 (JRAU); Redhouse (-DC), Paterson 5 (BOL, GRA), Paterson 476 (BOL, PRE); Coega and Swartkops River mouth (-DC), Zeyher 2692 (SAM, PRE), Ecklon and Zeyher 2693 (SAM).-3326 (Grahamstown): Kowie, E. branch of Hem River (-DB), Britten 477 (PRE); Port Alfred (-DB), Martin 964 (GRA), Tyron s.n. sub PRE 13393 (PRE).

Precise locality unknown: Uitenhage district, Ecklon and Zeyher 422, 508 (BM).

4.13. *C. bolusii*

C. bolusii Magee and B.-E. van Wyk, *species nova*, *Cynorhizae meifoliae C. typicaeque foliis deciduis et apice fructus profunde inciso vel auriculato similis, sed petiolo tereto et segmentis folioli extremi subteretis differt. (In C. meifolia C. typicaeque sunt petiolum dorsaliter complanatum et segmenta foliorum plena.)*. Type—South Africa, Western Cape Province, Ceres plain [3319 AD], Bolus 8617 (BOL!, holo.); Bolus s.n. sub BOL 23408 (BOL!, NBG!, PRE!, BM!, iso.?). [Note: the specimens listed here as possible isotypes have exactly the same label information as Bolus 8617 and are almost certainly part of the same collection.]

Leaves 210–240 mm × 60–80 mm; pinnae and pinnules regularly divided; rachis glabrous. Petioles 80–140 mm long, terete, glabrous. Ultimate leaflet segments ovate to obovate, 10–12 mm × 8–10 mm, weakly pinnatisect or bi- to tri-sect; lobes linear, sub-terete. Inflorescence 590–635 mm long; primary umbel, flat-topped; lateral umbels smaller, 0 to 4; involucre bracts linear to narrowly ovate, apices acute to

acuminate; rays 9 to 10, 35–90 mm long; involucre bracteoles lanceolate, apices acuminate. *Flowers* pentamerous; sepals small but distinct, ± 0.4 mm long, apices acute; petals unknown; stylopodium narrowly conical; styles long. *Fruit* obovate to broadly obovate in dorsal view, 17.0–20.5 mm \times 10.5–13.0 mm; bases truncate to slightly notched; apices deeply notched and auriculate, wings extending well above the stylopodium; median and lateral ribs of mericarps prominent.

4.14. Diagnostic characters

The new species is similar to *C. meifolia* and *C. typica* in the deciduous leaves and the deeply notched to auriculate fruit apex (Fig. 2) but differs in the terete petiole and sub-terete ultimate leaflet segments (Fig. 1b) (petiole dorsally flattened and ultimate leaflet segments flat in *C. meifolia* and *C. typica*). The petiole and rachis are glabrous (as in *C. typica*), not pilose as in *C. meifolia*.

4.15. Distribution and habitat

This poorly known species has been collected at only two localities around Ceres in the Western Cape Province where it was found in very deep sand (Fig. 5). In 2006 we conducted a thorough search of the Bokkerivier Farms locality but did not relocate the species.

4.16. Additional specimens examined

South Africa. Western Cape Province.-3319 (Worcester): Bokkerivier Farms (-BD), *Barker 10142* (NBG).

4.17. *C. meifolia*

C. meifolia (Eckl. and Zeyh.) Magee in Winter et al., in *Taxon* 57(2): 358 (2008). *Ferula meifolia* Eckl. and Zeyh., *Enum. Pl. Afric. Austral.* 348, (1837); *D. Dietr., Syn. Pl.* 2. 963 (1840); *Walp., Repert. Bot. Syst.* 2. 408 (1843). Type—South Africa, Western Cape Province, Twenty-Four Rivers Mountains [3319 AA], *Ecklon and Zeyher 2230* (S! sheet 141, lecto., here designated; K!, S! sheet 140, SAM!, W!, HAL!, isolecto.). [Note: *Ecklon and Zeyher 2230* in S was designated by *Burt* (1991) as the lectotype for *Sonder's Peucedanum millefolium*]

P. millefolium Sond. in *Harv. and Sond., Fl. Cap.* 2. 559 (1862); *B.L. Burt* in *Edinb. J. Bot.* 48(2). 234 (1991); *Goldblatt and Manning, Cape Pl.* 278 (2000). Type—*Ecklon and Zeyher 2230* (S!, sheet 141, lecto., here designated; K!, S! sheet 140, SAM!, W!, HAL!, isolecto.). [Note: In transferring *Ferula meifolia* to *Peucedanum*, *Sonder* renamed the species as the oldest epithet was already in use. *Burt* (1991) designated the collection in S as lectotype, however, two specimens were found in this collection. As a result a further designation of sheet 141 was necessary.]

Analyrium millefolium E.Mey. in *Drège, Zwei Pflanzengeogr. Doc.* 103, 163 (1838), nom. nud.; *K. Presl in Abh. Boehem. Ges.* 5(3). 505 (1845), nom. nud. [Note: this illegitimate name was based on the only other known collection of the species (from the same locality) by *Drège* (P!, W!, PRE!).]

Leaves 170–400 mm \times 30–40 mm; pinnae brush-shaped with pinnules short, congested; rachis pilose on abaxial surface. *Petioles* up to 100–120 mm long, dorsally flattened, pilose. *Ultimate leaflet segments* ovate to broadly ovate, 5–7 mm \times 3–4 mm, weakly pinnatisect; lobes linear, flat. *Inflorescence* 450–600 mm long; *primary umbel* flat-topped; lateral umbels smaller, 2; involucre bracts linear to narrowly ovate, apices acute to acuminate; rays 10 to 12, 40–50 mm long; involucre bracteoles lanceolate, apices acuminate. *Flowers* pentamerous; sepals small but distinct, ± 0.5 mm long, apices obtuse; petals yellow?; stylopodium narrowly conical; styles long. *Fruit* obovate to broadly obovate in dorsal view, 17.5–19.0 mm \times 12.5–13.0 mm; bases truncate; apices deeply notched and auriculate, wings extending well above the stylopodium; median and lateral ribs of mericarps prominent.

4.18. Diagnostic characters

C. meifolia is distinct in the short and congested pinnules, giving the pinnae a brush-like appearance. Furthermore, it is easily recognised by the pilose hairs on the petiole and abaxial leaf surface. It differs from *C. bolusii* also in the flattened petiole and flat, laminate lobes of the ultimate leaflet segments (Fig. 1c). The last-mentioned species and *C. meifolia* both have deeply notched and auriculate fruit apices (Fig. 2a).

4.19. Distribution

C. meifolia is known only from the Twenty-Four Rivers Mountains near Porterville in the Western Cape Province (Fig. 5). It has not been collected for more than 150 years and appears to be a rare and/or highly localised species.

4.20. Additional specimens examined

South Africa. Western Cape Province.-3319 (Worcester): Twenty-Four Rivers Mountains (-AA), *Drège s.n.* (P, W, PRE).

Acknowledgements

We thank the directors and staff of the cited herbaria for making specimens available on loan, the Western Cape Nature Conservation Board for granting collecting permits, Mr. H. Westman from the Koeberg Nature Reserve for his help with collection on the reserve and Dr. H.F. Glen for kindly translating the diagnosis into Latin. Financial support from the National Research Foundation and the University of Johannesburg is gratefully acknowledged.

References

- Burt, B.L., 1991. Umbelliferae of southern Africa: an introduction and annotated checklist. *Edinburgh Journal of Botany* 48, 133–282.
- Ecklon, C.F., Zeyher, C., 1837. *Enumeratio Plantarum Africae Australis Extratropicae*. Hamburg, pp. 330–355.
- Farris, J., 1970. Methods for computing Wagner trees. *Systematic Zoology* 19, 83–92.

- Feder, N., O'Brien, T.P., 1968. Plant microtechniques: some principles and new methods. *American Journal of Botany* 55, 123–142.
- Holmgren, P.K., Holmgren, N.H., Barnett, L.C., 1990. *Index Herbariorum 1: The Herbaria of the World, Regnum Vegetabile*, 8th ed. New York Botanical Garden, New York.
- Koso-Poljansky, B.M., 1917. *Sciadophytorum systematis lineamenta: Mantissa prior*. *Bulletin de la Société Impériale des Naturalistes (Moscou)*, 30, p. 278.
- Leistner, O.A., Morris, J.M., 1976. Southern African place names. *Annals of the Cape Province Museum* 12.
- Ostroumova, T.A., Pimenov, M.G., 1997a. Carpological diversity of African *Peucedanum* s.l. (Umbelliferae) I. The species of southern Africa. *Feddes Repertorium* 108, 299–318.
- Ostroumova, T.A., Pimenov, M.G., 1997b. Carpological diversity of African *Peucedanum* s.l. (Umbelliferae) II. The species of Tropical Africa. *Feddes Repertorium* 108, 533–547.
- Smith, C.A., 1966. Common names of South African plants. *Memoirs of the Botanical Survey of South Africa: 35*. Department of Agricultural Technical Services, Pretoria.
- Sonder, O.W., 1862. Umbelliferae. In: Harvey, W.H., Sonder, O.W. (Eds.), *Flora Capensis*, 2. Hodges Smith, Dublin, pp. 524–567.
- Swofford, D.L., 1998. PAUP: Phylogenetic Analysis using Parsimony, version 4.0. Sinauer Associates, Sunderland.
- Tilney, P.M., Van Wyk, B-E., 2001. A revision of the genus *Annesorhiza* (Apiaceae). *Nordic Journal of Botany* 21, 615–649.
- Townsend, C.C., 1989. In: Polhill, R.M. (Ed.), *Umbelliferae. Flora of Tropical East Africa*, Rotterdam, pp. 89–115.
- Van Wyk, B-E., Gericke, N., 2000. *People's Plants*. Briza Publications, Pretoria, p. 182.
- Winter, P.J.D., Magee, A.R., Phephu, N., Tilney, P.M., Downie, S.R., Van Wyk, B-E., 2008. A new generic classification for African peucedanoid species (Apiaceae). *Taxon* 57, 347–364.