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Cypsela morphology in the genus *Nolletia* (Asteraceae, Astereae) and a revision of the genus

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Abstract

The genus *Nolletia* has never been revised. There is no key available to all the species, making identification extremely difficult and resulting in misidentifications. For only a few species there are fairly comprehensive species descriptions available. A complete revision of the genus was undertaken, a key to all the species was drawn up, full descriptions were made and distribution maps were provided. Five new species were described: *N. annemarieae, N. annetjieae, N. vanhoepeniae, N. jeanettae* and *N. welmaniae*. One southern African species (*N. arenosa*) is synonymized under *N. chrysocomoides*. The genus could be divided into two groups on the grounds of the cypsela morphology: one group has oblong epicarpic cells arranged in parallel rows, seen in surface view, while the other group has circular to elliptic epicarpic cells, seen in surface view. One species was reported to be poisonous to stock. It was previously identified as *N. gariepina* but is described here as one of the new species, *N. vanhoepeniae*.

Key words descriptions, distribution maps, epicarp, key, taxonomy

Introduction

The genus *Nolletia* Cassini (1825: 479) belongs to the tribe Astereae of the family Asteraceae. Bremer (1994) put it in the *Amellus* group of the subtribe Asterinae but Nesom & Robinson (2007) placed it in the subtribe Homochrominae of the Astereae. Bremer (1994) reported 10 species in the genus, nine in southern Africa and one in North Africa and Spain. Nesom & Robinson (2007) similarly reported 10 species for Africa, one of which extends to Spain. Herman (2003) listed only eight species for southern Africa and Klopper *et al*. (2006) mentioned nine species for Sub-Saharan Africa. Wild (1975) noted three *Nolletia* species for the *Flora Zambesiaca* area, all of which occur also in southern Africa. Durand & Barratte (1910) reported *N. chrysocomoides* (Desfontaines 1799: 269, t. 232) Cassini ex Lessing (1832: 187), the type species of the genus, for Morocco, Algeria, Tunisia and Spain. Recently Dobignard & Chatelain (2011) reported it for Mauritania, Morocco, Algeria, Tunisia and Libya in North Africa.

Until now, no key has been available to all the species. The only available keys were published by Merxmüller (1967), Wild (1975) and Hilliard (1977).The first covers six species and the other two include three species each. The only reasonably comprehensive species descriptions can be found in Wild (1975) and Hilliard (1977).

The cypselae of the Asteraceae are known to render much taxonomically useful information (Harvey 1865, Roth 1977, Bremer 1994, Anderberg *et al*. 2007). In many instances cypsela morphology was used to delimit and refine genera (Pope 1983, Källersjö 1985, Källersjö 1988, McKenzie *et al*. 2005) and to describe new genera and species (Källersjö 1985, Källersjö 1988, Nordenstam 1994, Herman 1999, Nordenstam 2006, Nordenstam *et al*. 2006). The cypselae of the genus *Nolletia* were mostly described as glabrous or variously hairy by Desfontaines (1799), De Candolle (1836), Harvey (1865), Willkomm & Lange (1870), Bentham (1873), Phillips (1951), Merxmüller (1967), Dyer (1975), Wild (1975), Hilliard (1977), Bremer (1994) and

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Herman *et al*. (2000). Nesom & Robinson (2007) also described the cypselae as puberulous to strigillose. However, in their key to the genera of the subtribe Homochrominae, they described the cypsela surfaces of *Nolletia* as 'pocked' and appearing glandular. In his revision of the genus *Felicia*, Grau (1973) compared several characters of closely related genera in the Astereae. He mentioned that *Nolletia* has achenes (cypselae) with pitted surface structures.

The aim of this study was to revise the genus *Nolletia*, to draw up a key to the species and to provide full descriptions of all the species with distribution maps and with some illustrations. The cypsela morphology was also studied and described. The terminology used for the different shapes of the leaves, involucral bracts, style branches, anther appendages and cypselae is according to the definitions in Radford *et al*. (1974). The term *epicarp* is used for the outer epidermal cells of the pericarp (outer cypsela wall) as defined by Roth (1977), Fahn (1982) and Anderberg *et al*. (2007) and applied by Källersjö (1985, 1991) and Karis (1989, 1990). The shape of the epicarpic cells are described as seen in surface view. The shape of the cells is described according to the definitions and illustrations in Radford *et al*. (1974: 128, 129) and Beentje (2010: 133).

Material and methods

The study of the cypselae

Mature and immature cypselae were collected from herbarium material. Mature fruits were studied with a Nikon SMZ-1B stereomicroscope and a Zeiss Discovery V20 stereomicroscope. For light microscopy, the dried cypselae were softened in 'Windolene', temporarily mounted on microscope slides in 'Windolene' and examined with a Zeiss student light microscope, an Olympus Vanox-S light microscope and a Nikon Optiphoto light microscope. Digital images to illustrate the cypselae morphology were obtained with a Zeiss Discovery.V8 stereomicroscope and a Zeiss Axio compound microscope.

For scanning electron microscope (SEM) work, the cypselae were studied either in the dried state, after being sputter-coated with gold or carbon, or they were rehydrated by boiling them in distilled water for ± 10 min. They were fixed in a formaldehyde/glutaraldehyde mixture, washed 3 × in 0.075 M phosphate buffer pH 7.4, post-fixed in osmium tetroxide for 30 min., washed 2 × in the phosphate buffer, and dehydrated in an ethanol series (30%, 50%, 70%, 90%) for ± 10 min. in each, 2 × in 100% ethanol for ± 10 min. and left in 100% ethanol until critical point dried in liquid CO_2. They were mounted on stubs, sputter-coated with gold and examined either under a JEOL JSM-840 or a JEOL JSM-580LV Scanning Electron Microscope.

Taxonomic study

Specimens on loan from the following herbaria were studied: BC, BOL, KMG, M, MSB, NMB, NH, P, WIND, Z. The following herbaria were visited and their specimens examined: GRA, PRU. Images of some specimens, mostly types, from the following herbaria were accessed and studied on the JSTOR website: BM, E, HBG, K, NU, P (JSTOR Plants 2011). Some images were supplied directly by the herbarium in question (A, G, G-DC, KW, M, MO, P, S, SAM (NBG), UPS, W, Z). The following herbaria were contacted for specific type specimens but the type specimens were not housed there: B, BR, C, GOET, L, LD, WAG. Specimens that were studied electronically, are indicated by the letter *e* after the herbarium acronym. All the other specimens quoted in this article were seen by me unless specifically indicated as 'not seen'. In the sections **Specimens examined**, locality citations were reproduced as given on the specimen labels. The southern African material is arranged according to the Degree Reference System (Leistner & Morris 1976) with the place names given within quarter-degree squares (QDS). In a few cases the locality names were corrected and shown in square brackets. Southern Africa, as circumscribed here, represents the following countries: Namibia (South West Africa), Botswana, Swaziland, Lesotho and South Africa as defined by Dyer (1975). South Africa consists of the following provinces: Limpopo, North-West, Gauteng, Mpumalanga, Free State, KwaZulu-Natal, Northern, Western and Eastern Cape.

Results

Cypsela morphology

The cypselae of all the specimens studied are narrowly obovoid in shape (Figs. 1, 2A, E). The surfaces are covered with twin hairs of various lengths and density (Fig. 2B, C, D). The apices of the twin hairs are usually subequal in length and can be either acute (Fig. 2C) or broadened (Fig. 2D). This character is variable and not constant for a given species. Microscopic observations showed that the taxa can be divided into two groups on the grounds of differences in the epicarp morphology.

In one group, consisting of eight species (*N. annemarieae* sp. nov., *N. gariepina*, *N. tenuifolia*, *N. ciliaris*, *N. jeanettae* sp. nov., *N. rarifolia*, *N. ruderalis* and *N. welmaniae* sp. nov., Fig. 1A–G, Table 1), the cypsela surfaces are pale to dark brown or reddish brown and obviously densely to sparsely hairy, the hairs being easily distinguishable under a stereomicroscope. Seen under the light microscope and the SEM, the epicarp consists of small, oblong (axially elongated) cells, in surface view, arranged in regular rows (Figs. 2B–D, 3A, B) (here after referred to as oblong cells). The twin hairs are densely to sparsely arranged on the surfaces and are usually fairly long.

TABLE 1. Summary of female floret and cypsela epicarpic cell characters.

Characters / **Species**	Outer female florets shortly radiate	Outer female florets filiform	Epicarpic cells on cypsela oblong, in rows	Epicarpic cells on cypsela circular
N. annemarieae	√		√	
N. gariepina	√		√	
N. tenuifolia	√		√	
N. ciliaris		√	√	
N. jeanettae		√	√	
N. rarifolia		√	√	
N. ruderalis		√	√	
N. welmaniae		√	√	
N. annetjieae		√		√
N. chrysocomoides		√		√
N. vanhoepeniae		√		√
N. zambesica		√		√

In the other group, consisting of four species (*N. annetjieae* sp. nov., *N. chrysocomoides*, *N. vanhoepeniae* sp. nov. and *N. zambesica*, Fig. 1H–K, Table 1) the surfaces are shiny, orange or honey-coloured and seemingly glabrous. Viewed under the light microscope and the SEM, the epicarpic cells in three of the species (*N. chrysocomoides*, *N. vanhoepeniae* sp. nov. and *N. zambesica*) appear ± circular in surface view, with convex outer walls in the dehydrated state and concave outer walls in the rehydrated state, covering the entire surface of the cypselae (here after referred to as circular cells). They are visible in mature and immature cypselae (Fig. 2E, F, in the dried state, Figs. 2G, 3C, D in the rehydrated state). Each circular cell carries one short twin hair situated near the apex of the cell (Fig. 3D). Seen under the SEM, in the dried condition, the circular cells are depressed (Fig. 2E, F) but when rehydrated, the true globose nature is evident (Figs. 2G, 3C, D). The short, twin hairs are barely visible under the stereomicroscope.

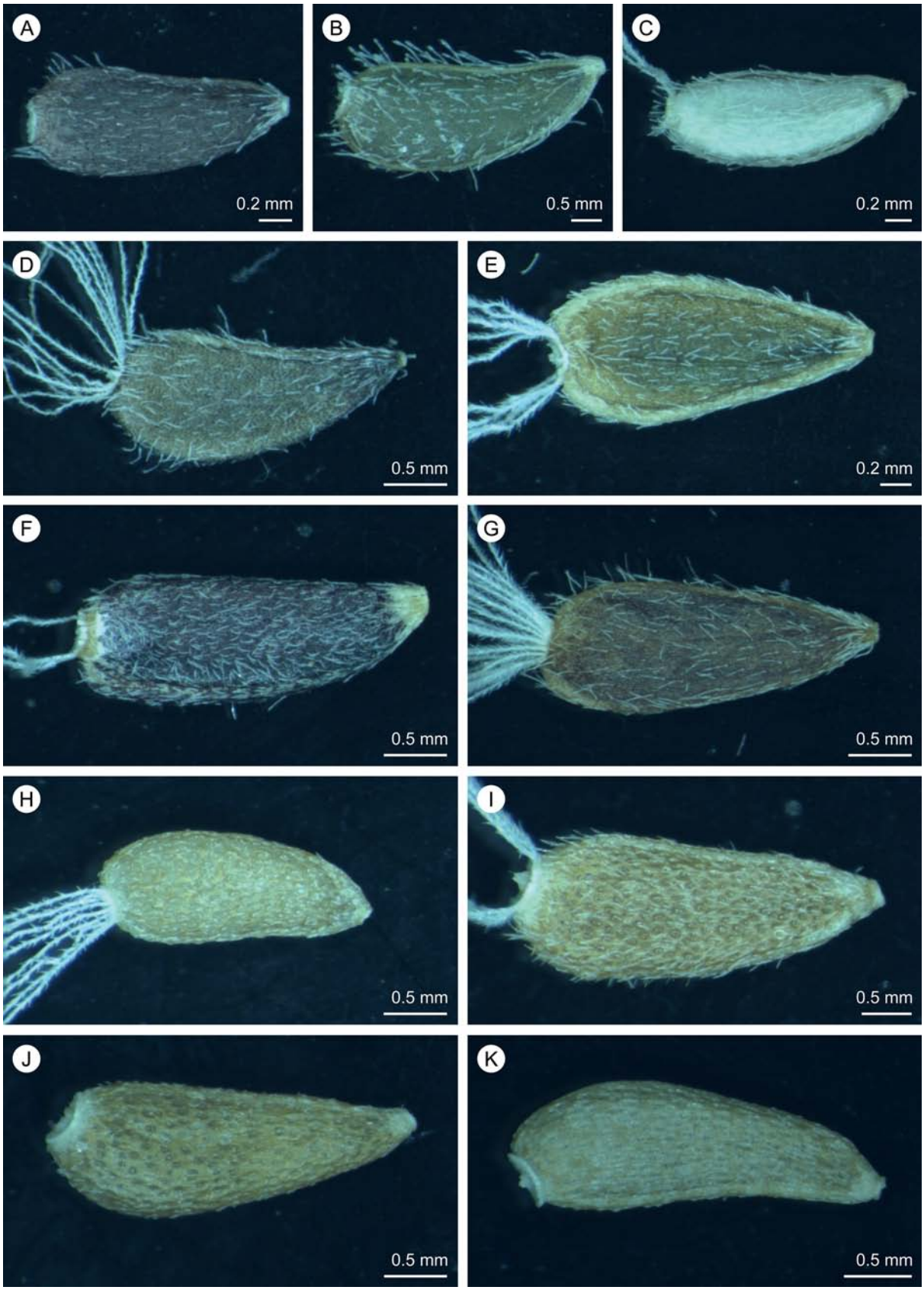

FIGURE 1. Cypselae of *Nolletia* species as seen under the stereomicroscope: (A) *N. gariepina* (*Warren 78*, PRE); (B) *N. tenuifolia* (*Giess 10863*, PRE); (C) *N. ciliaris* (*Jacot Guillarmod 377*, PRE); (D) *N. jeanettae* (*Bester 8534*, PRE); (E) *N. welmaniae* (*Winter 7649*, PRE); (F) *N. rarifolia* (*Van Hoepen 1825*, PRE); (G) *N. ruderalis* (*Compton 27385*, PRE); (H) *N. vanhoepeniae* (*Koekemoer 3899*, PRE); (I) *N. zambesica* (*Maguire 1693*, PRE); (J) *N. chrysocomoides* (*Merxmüller & Giess 3579*, PRE); (K) *N. annetjieae* (*Van Rooyen 3714*, PRE). Photographs by P.P.J. Herman.

A slight variation of the second group was observed in one taxon (*N. annetjieae* sp. nov.). The ± circular to elliptic epicarpic cells, as seen in surface view, are arranged in pairs, parallel to the long axis of the cypselae and with a single twin hair between each pair (Figs. 2H, 3E) (here after referred to as circular cells). Each circular cell contributes one arm of the twin hair: the apical arm arising from the base of the upper circular cell and the other arm of the twin hair arising from the apex of the lower circular cell (Fig. 3F). These paired circular epicarpic cells are scattered over the surfaces of the cypselae (Fig. 2H, in the dried state, Fig. 3E in the rehydrated state). On the cypselae of a few specimens of the closely related *N. chrysocomoides*, a few isolated twin hairs arising from two circular cells, as described above, were also observed among the rest of the circular cells covering the entire surface of the cypsela, each with a twin hair. See Table 1 for a summary of the cypsela epicarp characters of all the species.

After examining the cypsela surfaces under both light and scanning electron microscopes, it is understandable why there are conflicting reports in the literature on the cypsela morphology. It all depends on which species or specimens were examined and used for the descriptions. The epicarpic morphology proved to be very valuable in the identification and classification of the different *Nolletia* species. It is not known at this stage whether the groups defined by these differences are monophyletic or whether parallel evolution has resulted in these patterns. It could be tested by employing phylogenetic methods.

Taxonomy

Nolletia Cassini (1825: 479); Bentham (1873: 285, 286); Hoffmann (1889: 169); Phillips (1951: 785); Merxmüller (1967: 118, 119); Dyer (1975: 671); Wild (1975: 18); Tutin (1976: 120); Hilliard (1977: 96, 97); Ozenda (1977: 423); Bremer (1994: 427); Herman *et al*. (2000: 151); Nesom & Robinson (2007: 293). Type species:—*Nolletia chrysocomoides* (Desfontaines 1799: 269, t. 232) Cassini ex Lessing (1832: 187). Basionym:—*Conyza chrysocomoides* Desf.

= *Leptothamnus* de Candolle (1836: 367); Harvey (1865: 111). Type species:—*Leptothamnus ciliaris* de Candolle (1836: 367); Harvey (1865: 111)

Perennial herbs, suffrutices, dwarf or small shrubs, densely to sparsely leafy. *Stems* much-branched from base or simple below, branching upwards into corymbose synflorescences. *Leaves* alternate, sessile, filiform, linear, narrowly elliptic or narrowly obovate; margin entire; glabrous to appressed or spreading pubescent, sometimes glandular-hairy, often ciliate, sometimes with embedded oil glands on lower leaf surfaces. *Capitula* heterogamous, disciform; solitary or loosely arranged in terminal corymbs. *Involucre* campanulate. *Involucral bracts* imbricate, in 3 or 4 rows; glabrous, spreading or appressed pubescent, sometimes with oil sacs or minutely white-punctate, sometimes purplish at apex; margins often fimbriate; persistent and recurved in old inflorescences. *Receptacle* epaleate, foveolate. *Outer female florets* in 1 row, fertile, filiform or with short ray (Fig. 3G, H, Table 1); with glandular hairs; yellow but sometimes purplish at apex. *Style* usually exserted, bifurcate; *style branches* linear or narrowly elliptic, acute to obtuse; stigmatic areas marginal, confluent at apex, occasionally with reduced deltoid-penicillate apical appendages; often purplish. *Cypsela* and *pappus* as in disc florets. *Disc florets* numerous, regular, bisexual, fertile; corolla tubular below, widening slightly upwards but sides still parallel to each other, widening again into 5-lobed limb; with glandular hairs at first widening and on outside of lobes; yellow, but sometimes lobes and upper part of tube purplish. *Anthers* with narrowly ovate, apical appendages; base slightly calcarate, ecaudate; *filament collar* with thickened cell walls. *Style* exserted, bifurcate; *style branches* linear with deltoid-penicillate apical appendages or obtuse and papillate; stigmatic areas marginal, not confluent at apex. *Cypsela* narrowly obovoid, surface covered either with oblong epicarpic cells arranged in parallel rows, or with circular epicarpic cells; with twin hairs of various lengths; or in 1 species with scattered, circular epicarpic cells arranged in pairs, each pair with 1 twin hair between them (Figs. 1–3F, Table 1). *Pappus* of numerous, caducous, barbellate bristles.

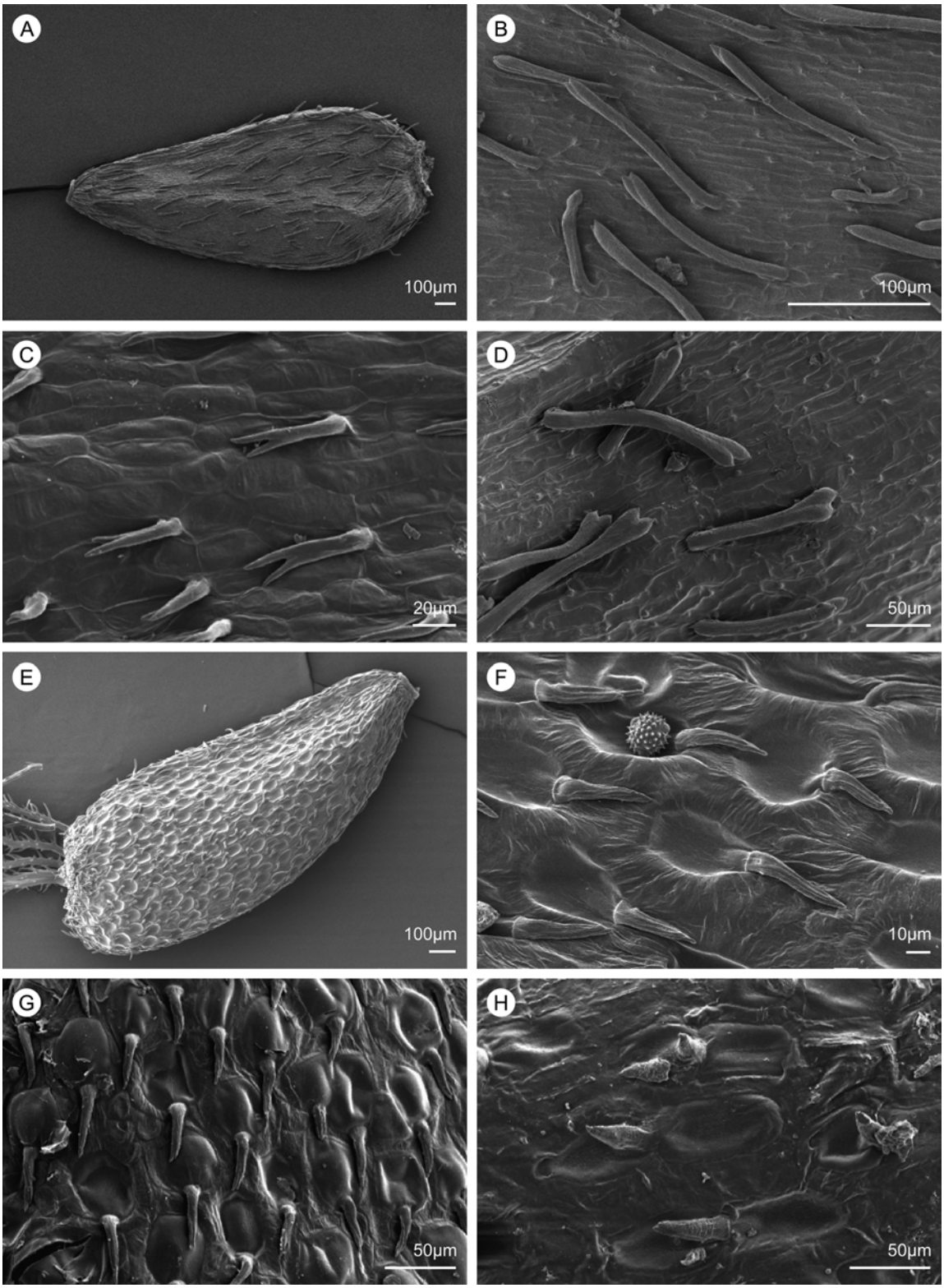

FIGURE 2. Scanning electron micrographs of cypsela features in *Nolletia*: (A) obovoid cypsela of *N. gariepina* (*Dinter 3577*, PRE); (B) oblong epicarpic cells arranged in regular rows and twin hairs on the cypsela of *N. tenuifolia* (*Dinter 7889*, PRE); (C) oblong epicarpic cells arranged in regular rows and twin hairs with acute apices on the cypsela of *N. gariepina* (*Zietsman & Zietsman 794*, PRE); (D) oblong epicarpic cells arranged in regular rows and twin hairs with broadened apices in cypsela of *N. annemarieae* (*Moss & Jacobsen K180*, PRE); (E) obovoid cypsela in the dried state of *N. chrysocomoides* showing the 'pocked' surface (*Germishuizen 7763*, PRE); (F) circular epicarpic cells each with a twin hair on the cypsela of *N. vanhoepeniae* in the dried state (*De Beer B5*, PRE); (G) circular epicarpic cells each with a twin hair, in *N. vanhoepeniae* in the rehydrated state (*De Beer B5*, PRE); (H) paired circular to elliptic epicarpic cells with one twin hair between each pair, scattered over the cypsela surface in *N. annetjieae* in the dried state (*Leistner 1581*, PRE). Photographs by P.P.J. Herman.

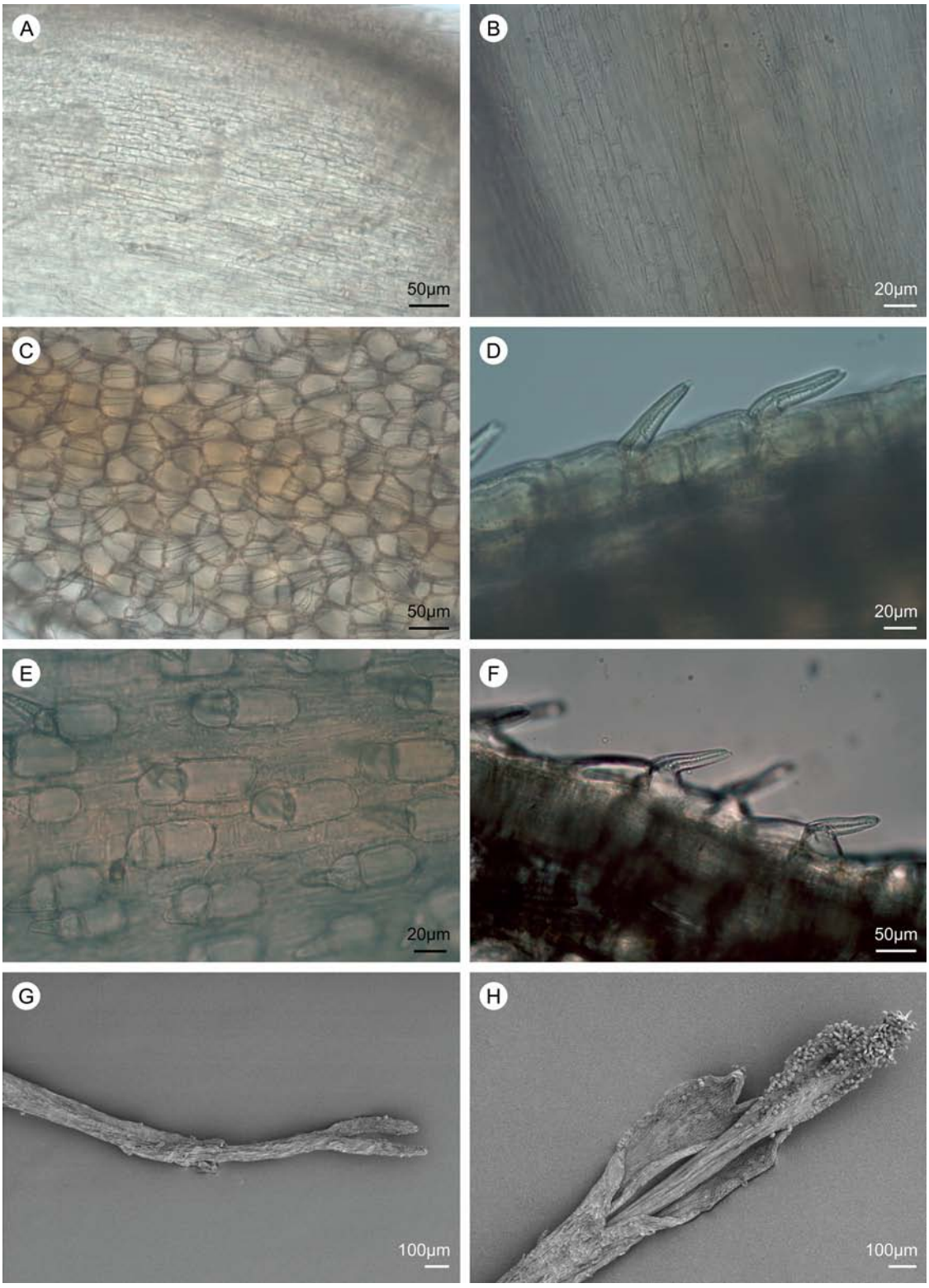

FIGURE 3. Light micrographs of cypsela surfaces of: (A) *N. jeanettae* illustrating the oblong epicarpic cells arranged in parallel rows after rehydration (*Bester 8494*, PRE); and (B) *N. ruderalis* (*Van der Schijff 2041*, PRE), higher magnification; (C) *N. chrysocomoides* showing the circular epicarpic cells after rehydration (*Wiss 2553*, PRE); (D) *N. zambesica* (*Merxmüller 1966*, PRE) showing the twin hairs arising from the apical part of the circular epicarpic cells after rehydration; (E) *N. annetjieae* after rehydration showing the paired circular to elliptic epicarpic cells scattered over the surface, each pair with one twin hair between them (*Koekemoer 3901*, PRE); (F) *N. annetjieae* showing the twin hairs arising from two (paired) circular epicarpic cells (*Van Rooyen 3714*, PRE). Scanning electron micrographs illustrating the different outer female florets of *Nolletia* species: (G) filiform female floret in *N. ciliaris* (*Koekemoer 1062*, PRE); (H) short ray in the outer female floret of *N. gariepina* (*Jensen 208*, PRE). Photographs by P.P.J. Herman.

Note on type species:—The combination *Nolletia chrysocomoides* was previously ascribed to Cassini, but according to Flann *et al*. (2010), Cassini never published this combination, Lessing did, in 1832.

Geographic range: Europe: Spain. North Africa: Mauritania, Morocco, Algeria, Tunisia, Libya. Southern tropical and southern Africa: Angola, Zambia, Namibia, Botswana, Zimbabwe and South Africa.

Key to the species of *Nolletia*

1. Female florets shortly radiate, cypselae with oblong epicarpic cells 2
- Female florets filiform, cypselae with oblong or circular epicarpic cells 4
2. Plants appressed pubescent but not glandular, capitula 14 mm in diameter ..... 1. *N. annemarieae*
- Plants spreading pubescent and glandular-hairy, capitula 8–10 mm in diameter 3
3. Leaves narrowly obovate to narrowly elliptic, (3–)4–15(–22) × (0.8–)1.0–2.5(–3.0) mm ..... 2. *N. gariepina*
- Leaves linear, (7–)10–30(–35) × 0.5–1.5 mm ..... 3. *N. tenuifolia*
4. Cypsela surfaces dull, pale to dark or reddish brown, with oblong epicarpic cells 5
- Cypsela surfaces shiny, orange or honey-coloured, with circular epicarpic cells 9
5. Involucral bracts without yellow, orange or almost black oil sacs 6
- Involucral bracts with yellow, orange or almost black oil sacs 7
6. Involucral bracts appressed pubescent, peduncle glabrous or sparsely appressed pubescent, always stipitate-glandular, leaves ciliate, lower surface appressed pubescent ..... 5. *N. jeanettae*
- Involucral bracts glabrous, peduncle glabrous, rarely with a few stipitate-glands, leaves glabrous ..... 8. *N. ruderalis*
7. Capitula solitary, leaves densely set, imbricate and appressed to the stem ..... 4. *N. ciliaris*
- Capitula corymbosely arranged, leaves spreading, if appressed to the stem, not imbricate 8
8. Plants with simple, upright stems, sparsely branched in upper part into few-headed corymbose synflorescences, leaves few, appressed to stem and inconspicuous (bigger in Mpumalanga and some KZN specimens) ..... 7. *N. rarifolia*
- Plants branched below middle into simple stems, branching upwards into multi-headed corymbose synflorescences, leaves distinct, spreading ..... 6. *N. welmaniae*
9. Plants sparsely leafy, leaves filiform, cypselae with scattered, paired, circular epicarpic cells, each pair with a twin hair between them ..... 12. *N. annetjieae*
- Plants mostly densely leafy, leaves linear, narrowly obovate, narrowly elliptic to narrowly oblong, cypsela surfaces covered with circular epicarpic cells, each cell with a twin hair 10
10. Leaves, stems and peduncles spreading pubescent ..... 9. *N. vanhoepeniae*
- Leaves, stems and peduncle glabrous to appressed pubescent 11
11. Plants up to 1.3 m high, leaves 10–45 × 2–5 mm broad, growing along rivers ..... 10. *N. zambesica*
- Plants up to 0.6 m, rarely up to 1 m high, leaves (10–)15–20(–30) × up to 2 mm broad, growing in desert or semi-desert conditions ..... 11. *N. chrysocomoides*

1. ***Nolletia annemarieae*** P.P.J.Herman *sp. nov.* (Fig. 4)

Similar to *N. chrysocomoides*, but capitula larger (14 mm in diameter), solitary, outer female florets shortly radiate and cypselae with oblong epicarpic cells.

Type:—NAMIBIA. Sanitatas, 25 km NW of Purros, (QDS: 1812DD), 12 April 1985, *Moss & Jacobsen K180* (holotype PRE!, isotype WIND!).

Densely leafy, compact suffrutex, up to about 0.15 m high. Older *branches* with whitish grey bark, stems green upwards, densely covered with appressed white hairs. *Leaves* alternate, sessile, narrowly elliptic, up to 30 × 3–4 mm; apex acute; base cuneate; margin entire; appressed to spreading pubescent on both sides. *Capitula* heterogamous, disciform, 14 mm in diameter, solitary, pedunculate. *Peduncle* about 40 mm long, densely appressed to spreading pubescent. *Involucre* campanulate. *Involucral bracts* imbricate, in 3 rows; outer row narrowly ovate, 3.0–3.5 × 0.5 mm, acuminate, appressed to spreading pubescent; middle row narrowly elliptic, 4.0–4.5 × 0.5 mm, acute to acuminate, with narrowly membranous, faintly fimbriate margin, appressed pubescent; inner row narrowly elliptic to linear, 4.5–5.0 × 0.5 mm, acuminate, with broader membranous, fimbriate margin, sparsely appressed pubescent. *Receptacle* epaleate. *Outer female florets* in 1 row, fertile, shortly radiate; tube about 2 mm long, with glandular hairs; ray about 2 mm long, with a single lobe; corolla yellow. *Style* 2.5–3.0 mm long, bifurcate; style branches linear, 1 mm long, obtuse; stigmatic areas marginal and confluent at apex. *Cypsela* and *pappus* as in disc florets. *Disc florets* regular, bisexual,

FIGURE 4. Scanned image of the holotype of *N. annemarieae* P.P.J.Herman (*Moss & Jacobsen K180*, PRE).

fertile; tubular below, widening slightly about halfway, tube 3–4 mm long with glandular hairs in lower part and around widening; 5-lobed, lobes 0.5 mm long, with glandular hairs; corolla yellow. *Anthers* 1.5–2.0 mm long; with ovate apical appendages; base slightly calcarate, ecaudate. *Style* 3.5 mm long, bifurcate; style branches linear, 1 mm long; apex obtuse, papillate; stigmatic areas marginal, not confluent at apex. *Cypsela* brownish with white, thickened margin, obovoid, laterally compressed, about 2 × 0.6 mm; covered with twin hairs, twin hairs unequal in length, apices broadened (Fig. 2D); epicarpic cells oblong, arranged in parallel rows. *Pappus* of numerous, caducous, barbellate bristles, 3.0–3.5 mm long. *Flowering time*: March.

Distribution and habitat:—Known only from the type locality in northern Namibia (Fig. 5), growing at the base of a rocky hill. Possibly a Namibian endemic. The conservation status of this species is not currently known.

Etymology:—Named for my wife Annemarie.

2. ***Nolletia gariepina*** (de Candolle 1836: 324) Mattfeld (1921: 395); Merxmüller (1967: 120); Gibbs Russell *et al*. (1984: 125; 1987: 216); Herman (1993: 714; 2003: 261; 2006: 232); Craven (1999: 162); Klopper *et al*. (2006: 142).

Basionym: *Nidorella ?gariepina* DC.; Harvey (1865: 91).—*Felicia gariepina* (DC.) L.Bolus (1914: 72), *nom. illeg.*—*Nolletia ligulata* Steetz (1864: 404), *nom. illeg.* Type:—SOUTH AFRICA. Northern Cape: near the Gariep [Orange River], at Verleptpram, on stony and rocky height, (QDS: 2817AA Vioolsdrift), September 1830, *Drège 2803* (holotype G-DC microfiche!, isotypes HBG e!, K e!, MO e!, P!, S e!).

Scattered to densely leafy, compact dwarf or small shrub up to 0.6 m high. Older *branches* woody, often reddish, green and herbaceous upwards; sparsely to densely spreading pubescent and stipitate-glandular. *Leaves* alternate, sessile, usually narrowly obovate, sometimes narrowly elliptic, rarely linear-obovate, (3–)4–15(–22) × (0.8–)1.0–2.5(–3.0) mm (the longer, the broader); apex bluntly acute to obtuse; margin entire; sparsely to densely spreading pubescent and stipitate-glandular. *Capitula* heterogamous, disciform, 8–10 mm in diameter, solitary at ends of branches, pedunculate. *Peduncle* sparsely to densely spreading pubescent and stipitate-glandular. *Involucre* campanulate. *Involucral bracts* imbricate, in 3 or 4 rows, green, sometimes tinged purplish, often with yellow or orange oil sacs along midline, persistent and recurved in old inflorescences; outer row narrowly oblong to narrowly ovate to narrowly obovate, 2.0–2.5 × 0.3–1.0 mm, apex acute to acuminate, often with tuft of hairs, margin sometimes membranous, fimbriate, spreading pubescent and stipitate-glandular; second row narrowly oblong to narrowly obovate, 2.2–3.0 × 0.5–1.0 mm, apex acute to acuminate, often with tuft of hairs, margin sometimes membranous, fimbriate, spreading pubescent and stipitate-glandular; third row narrowly obovate, 3–4 × 0.5–0.6 mm, apex acute to acuminate, margin narrowly membranous, fimbriate, spreading pubescent and stipitate-glandular in upper third; inner row narrowly obovate, 3–4 × 0.5–0.8 mm, apex acuminate, margin membranous, fimbriate, sparsely spreading pubescent and stipitate-glandular in upper third. *Receptacle* epaleate, foveolate. *Outer female florets* 25–35, in 1 row, fertile, shortly radiate (Fig. 3H); tubular below, tube 1–2 mm long, with glandular hairs; limb shortly 3-lobed, lobes 0.5–1.0 mm long, shorter than or as long as style branches; corolla yellow, sometimes purplish in upper part. *Style* 2.0–2.5 mm long, bifurcate; style branches linear-elliptic, 0.5–1.0 mm long, bluntly acute to obtuse; stigmatic areas marginal, confluent at apex; some female florets with style branches similar to those of bisexual florets. *Cypsela* and *pappus* as in disc florets. *Disc florets* 32–62, regular, bisexual, fertile; tubular below, tube 2.5–3.0 mm long, with glandular hairs; 5-lobed, lobes 0.5 mm long, often with dark resinous margins; corolla yellow, sometimes with purplish tinge. *Anthers* 1.5–2.0 mm long; with narrowly ovate apical appendages; base slightly calcarate, ecaudate; filament collar with thickened cell walls. *Style* 2.0–3.5 mm long, bifurcate; style branches 0.5–1.0 mm long, with deltoid-penicillate, apical appendages; stigmatic areas marginal. *Cypsela* dark brown with whitish, thickened margin, obovoid, laterally flattened, 1.5–2.0 × 0.5–1.0 mm (Figs. 1A, 2A); appressed pubescent consisting of twin hairs, equal to subequal in length, apices of twin hairs acute (Fig. 2C), rarely slightly broadened; epicarpic cells oblong, arranged in parallel rows. *Pappus* of caducous, barbellate bristles, 2–3 mm long. *Flowering time*: throughout the year.

Distribution and habitat:—Namibia and Northern Cape (Fig. 5), usually growing in sand amongst boulders or on rocky slopes. The red list status of this species in South Africa is LC (Least Concern) (Raimondo *et al.* 2009).

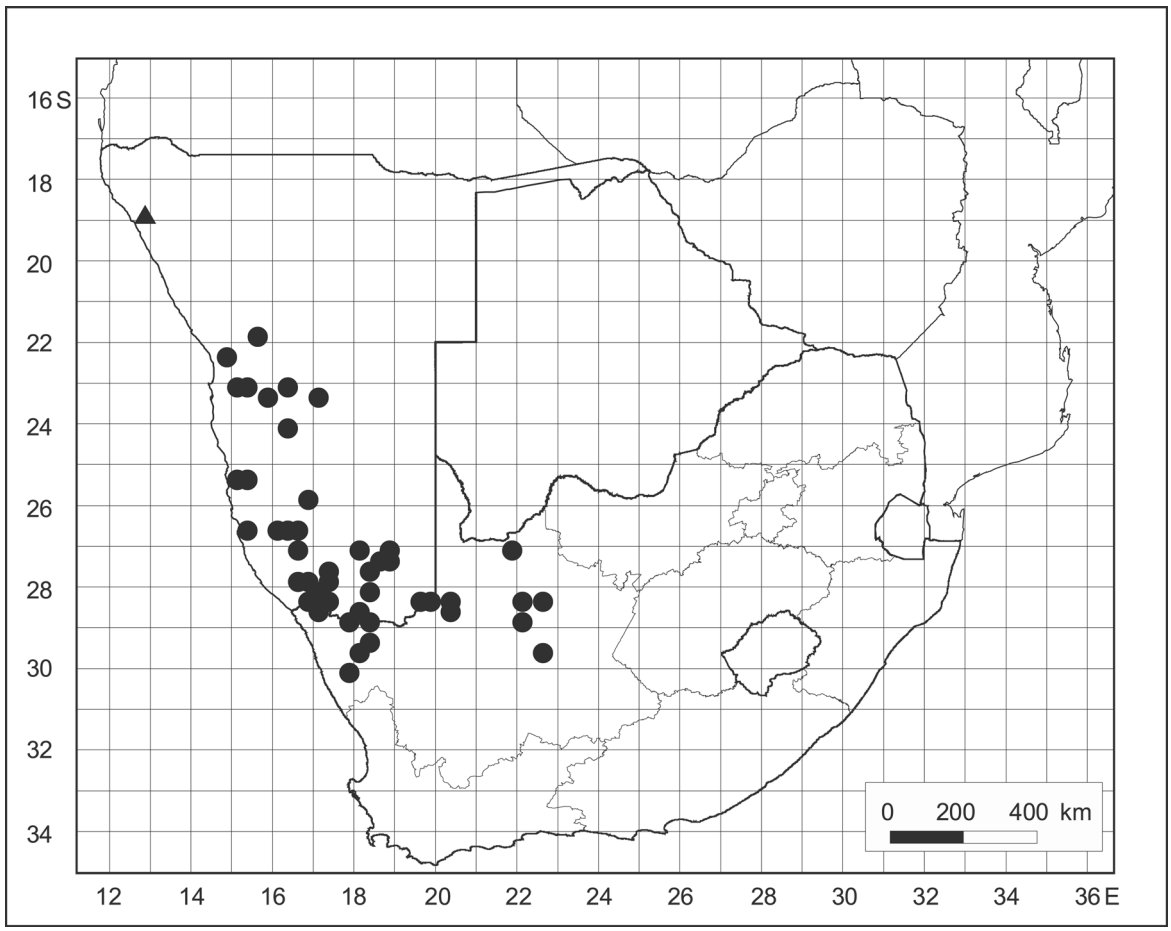

FIGURE 5. Known geographical distribution of *N. annemarieae* (▲) and *N. gariepina* (●).

Discussion

Typification:—The Kew specimen with bar code K000273997 (JSTOR 2011) has written on it 1837, presumably the date of collection. However, according to Glen & Germishuizen (2010), J.F (Franz) Drège was back in Europe by that date. The Paris specimen with code number P031796 has 21/9 30 written on it, which might also indicate a date and is more likely to be the correct one. According to Drège (1843) they were at that locality in September and according to Glen & Germishuizen (2010) the collecting expedition to that area was in 1830.

Note:—The indumentum of this taxon varies immensely from plants with a more or less equal number of spreading and glandular hairs to plants with dense spreading hairs and sparsely glandular to almost no glandular hairs. In the Northern Cape plants are found that are densely glandular and with no or only a few, short, spreading hairs. In one specimen from Namibia (*E. Jensen 185*, WIND) the hairs are appressed. The leaves are usually small and mostly narrowly obovate, even the longer leaves are distinctly obovate. In a few cases the leaves are narrowly elliptic, but still usually quite small. Only rarely are the leaves linear-obovate.

Additional specimens examined

NAMIBIA. Farm Ameib in Erongo Mountains, (QDS: 2115DC Karibib), 18 March 1963, *De Winter & Hardy 8073* (PRE, WIND). Farm Ameib: KAR 60, Jatowhöhle, (QDS: 2115DC Karibib), 14 August 1962, *Giess 3979* (WIND). Farm Ameib: KAR 60, Philliphöhle, (QDS: 2115DC Karibib), 11 August 1962, *Giess 3985* (PRE, WIND). Farm Ameib: KAR 60, (QDS: 2115DC Karibib), 22 March 1965, *Giess 8461* (PRE,

WIND). Farm Ameib KAR 60, Mon Repos, (QDS: 2115DC Karibib), 19 March 1963, *Giess, Volk & Bleissner 5829* (WIND). Ameib, Bull Party, (QDS: 2115DC Karibib), 27 April 1971, *R.A.C. Jensen 54* (WIND), 18 April 1972, *R.A.C. Jensen s.n. WIND34698* (WIND). Farm Ameib, near Gato Caves, (QDS: 2115DC Karibib), 22 March 1965, *Tölken & Hardy 769* (PRE, WIND). Khan Mine, (QDS: 2214BD Swakopmund), February 1963, *E. Jensen 185* (WIND). Namib Plain at Tumas Berg, (QDS: 2315AA Rostock), 13 May 1969, *Jensen 208* (PRE). Erongo, Ganab, Namib-Naukluft Park, (QDS: 2315AB Rostock), 21 April 2002, *Burke 2021* (WIND). Kuiseb crossing on Walvisbay-Rehoboth-Windhoek road, (QDS: 2315BD Rostock), 13 October 1961, *Giess 3797* (PRE, WIND). Farm Djab, edge of Namib, (QDS: 2316AB Nauchas), 26 December 1957, *Merxmüller 890* (PRE, WIND). Oanob Dam Nature Reserve, (QDS: 2317AC Rehoboth), 14 March 1987, *Sievers 55* (WIND). Naukluft MAL 9, Bergzebra Park, (QDS: 2416AB Maltahöhe), 1 June 1968, *Giess 10419* (WIND), 2 September 1972, *Merxmüller & Giess 28167* (PRE, WIND). Namib–Naukluft Park, Naukluft camp site near Bullsport, (QDS: 2416AB Maltahöhe), 26 February 1985, *Hines 257* (PRE, WIND). Uri-Hauchab Mountain Complex, (QDS: 2515AC Awasib), 17 August 1980, *Seely & Ward 17* (WIND); Hauchab Mountain, (QDS: 2515AD Awasib), 19 August 1980, *Seely & Ward 27* (WIND). Helmeringhausen, (QDS: 2516DD Helmeringhausen), 16 August 1963, *Merxmüller & Giess 2828* (PRE). Kovis Mountains 20 miles E of Lüderitz on Lüderitz-Aus road, (QDS: 2615CB Luderitz), 6 March 1963, *De Winter & Hardy 7902* (PRE). Lüderitz South, 7 miles W of Aus, (QDS: 2616CA Aus), 27 March 1958, *Merxmüller 2361* (PRE, WIND). Aus, (QDS: 2616CB Aus), 5 June 1922, *Dinter 3577* (PRE). Farm Aar, Aar river, (QDS: 2616DA Aus), May 1979, *Wendt 155* (WIND). Luderitz South, 40 miles S of Aus, farm Pockenbank, LU 68, (QDS: 2716BA Witputz), 20 February 1963, *Giess, Volk & Bleissner 5313* (WIND). Diamond Area No 1, 15 km W of Rosh Pinah on road to Obib Mountain, (QDS: 2716DC Witputz), 1 September 1989, *Van Wyk 8904* (PRU, WIND). Farm Namuskluft 88, (QDS: 2716DD Witputz), 21 September 2003, *Klaassen, Bartsch & Loots EK1209* (WIND). Namuskluft, (QDS: 2716DD Witputz), 23 August 1980, *Lavranos & Pehlemann 19049* (WIND). Karas, Wegdraai River waterfalls, (QDS: 2717CB Chamaites), 12 April 2002, *Helary 86* (WIND). Karas, farm Mara between Suidewind and Asbosvlakte, (QDS: 2717CD Chamaites), 29 June 1987, *Craven 2822* (PRE, WIND). 30 miles S by W of Narubis, (QDS: 2718AA Grünau), 29 April 1955, *Acocks 18026* (PRE, WIND). Farm Pieterskloof (Kraaikluft): KEE 370, (QDS: 2718BB Grünau), 14 May 1972, *Giess & Müller 11943* (PRE, WIND). Great Karasberg, (QDS: 2718BC Grünau), 17 January 1913, *Pearson 7943* (PRE). Great Karasberg, Naruda South, (QDS: 2718BD Grünau), 9 January 1913, *Pearson 7945* (PRE). Farm Mickberg: WAR 262, (QDS: 2718CB Grünau), 19 May 1972, *Giess & Müller 12063* (PRE, WIND). Haib River, gully towards Orange River, (QDS: 2818AB Warmbad), 11 September 1963, *Merxmüller & Giess 3656* (PRE, WIND). Karuchas, (QDS: 2818AB Warmbad), 20 April 1997, *Strohbach 3452* (PRE, WIND). Farm Sperlingspütz: WAR 259, (QDS: 2818CA Warmbad), 27 May 1972, *Giess & Müller 12247* (PRE, WIND). Farm Witpütz: WAR 258, (QDS: 2818CA Warmbad), 15 May 1963, *Giess, Volk & Bleissner 6962* (PRE, WIND). Goodhouse Poort, (QDS: 2818CD Warmbad), 22 June 1989, *Van Wyk 8642* (PRE, PRU, WIND). Karas, farm Jerusalem 73, (QDS: 2819BC Ariamsvlei), 7 March 2008, *Klaassen et al. EK1825* (WIND). Karas, farm Stolzenfels 74, (QDS: 2819BD Ariamsvlei), 8 March 2008, *Klaassen et al. EK1846* (WIND).

SOUTH AFRICA. Northern Cape: Griqualand West, Rust en Vrede, (QDS: 2721BB Telleriepan), 8 October 1936, *Acocks in Herb. Hafström H1249* (PRE). Richtersveld, Numees Camping Site, (QDS: 2816BD Oranjemund), 26 September 1981, *Hugo 2789* (PRE). Numees experimental site, (QDS: 2816BD Oranjemund), September 1981, *Jürgens 10098* (PRE). Noemees, (QDS: 2816BD Oranjemund), 6 October 1991, *Koekemoer 914* (PRE). Richtersveld National Park, hill top SW of Numees mine, (QDS: 2816BD Oranjemund), 13 September 2010, *Koekemoer 3935* (PRE). Richtersveld, Granite Boss (S of Kuboos), (QDS: 2817AC? Vioolsdrif), 5 November 1962, *Nordenstam 1777* (PRE). Richtersveld, Vandersterrberg, NE of Khubus, (QDS: 2817AC Vioolsdrif), 28 August 1977, *Oliver, Tölken & Venter 240* (PRE). Kloof N of Lelieshoek, (QDS: 2817AC Vioolsdrif), 29 August 1977, *Oliver, Tölken & Venter 368* (PRE). N foot of Rosyntjiesberg, (QDS: 2817AC Vioolsdrif), 30 August 1977, *Thompson & Le Roux 208* (PRE). Richtersveld, Tatasberg, (QDS: 2817AD Vioolsdrif), 4 October 1991, *Germishuizen 5396* (PRE), 5 October 1991,

Koekemoer 913 (PRE). Richtersveld, Ploegberg at Bloubos, (QDS: 2817CA Vioolsdrif), 15 September 1985, *Zietsman & Zietsman 794* (NMB, PRE, PRU). Swartberg Mine, between Steinkopf and Vioolsdrif, (QDS: 2817DD Vioolsdrif), 27 August 1983, *Van Wyk 6520* (PRE, PRU). 7.5 miles S by E of Riemvasmaak, (QDS: 2820AD Kakamas), 22 May 1952, *Acocks 16392* (PRE). 5 km before entrance gate to Augrabies National Park, (QDS: 2820CB Kakamas), 21 February 2005, *Warren 78* (PRE). Dinas Rus, southern Skurweberge, (QDS: 2822AC Glen Lyon), 23 March 1959, *Leistner 1356* (KMG, PRE). Xoung, Langebergen, (QDS: 2822BC Glen Lyon), April 1940, *Esterhuysen 2337* (PRE). Gordonia, Twin Koppies, 15–16 miles NNW of Winstead, (QDS: 2822CC Glen Lyon), March 1937, *Acocks 2048* (KMG). Naib, NE of Springbok, (QDS: 2918AD Gamoep), 26 August 1957, *Acocks 19448* (PRE). Goegap Nature Reserve, Ratelkraal section, Plot 36, (QDS: 2918CA Gamoep), 4 August 2011, *G. van Rooyen 2930* (PRU). Prieska, (QDS: 2922DA Prieska), July 1921, *Bryant J326* (PRE). Farm Prieskapoort, ± 14 km from Prieska on Vosburg/Carnavon road, (QDS: 2922DA Prieska), 8 June 1977, *Smook & Harding 702* (PRE). I'us [?Ouss], (QDS: 3017BB Hondeklipbaai), 26 September 1897, *Schlechter RS46* (NMB).

Localities not found or not sufficiently known. Northern Cape: Hay Division, Excelsior (0286), Langebergen, 8 July 1936, *Acocks 487* (KMG, PRE): the locality Excelsior (0286) could not be found on a map. Northern Cape: north end of Richtersveld near Hellsberg, 10 October 1947, *Rodin 1564* (PRE): this locality is too vague to attach a QDS to it.

3. ***Nolletia tenuifolia*** Mattfeld (1921: 394); Merxmüller (1967: 120); Gibbs Russell *et al*. (1984: 125; 1987: 216); Herman (1993: 714; 2003: 261); Craven (1999: 162); Klopper *et al*. (2006: 142). Type:—NAMIBIA. Okahandja, Buschsteppe, (QDS: 2116DD Okahandja), 21 April 1913, *Engler 6479* (holotype K, e!).

Densely leafy, compact, dwarf or small shrub up to 0.45 m high, branched low down into elongated, sparsely branched upper parts. Older *branches* dark to reddish brown, light brown upwards and finally young branches green, ribbed; densely stipitate-glandular and sometimes with a few scattered, spreading hairs. *Leaves* alternate, sessile, linear, (7–)10–30(–35) × 0.5–1.5 mm; apex obtuse to acute; margin entire; stipitate-glandular and with some scattered, spreading hairs. *Capitula* heterogamous, disciform, 8–10 mm in diameter, solitary, terminal, pedunculate. *Peduncle* stipitate-glandular and with a few spreading hairs. *Involucre* campanulate. *Involucral bracts* in ca. 4 rows, imbricate, sometimes with purplish tinge, mostly with yellow oil sacs along midline; outer bracts narrowly ovate to narrowly oblong, 1.5–2.0(–2.5) × 0.2–0.5 mm, acute, sometimes with tuft of fimbrillate hairs, margin entire to fimbrillate, glabrous or with a few scattered, spreading hairs, with some glandular hairs; second row narrowly oblong to narrowly obovate, 2.0–2.5(–3.0) × 0.5–0.8 mm, acute, margin narrowly membranous, fimbriate, glabrous or sometimes with a few scattered, spreading hairs along the midline, sparsely glandular-hairy; third row narrowly obovate, 2.8–3.5 × 0.5–1.0 mm, acute, with narrow membranous, fimbriate margin, glabrous or sometimes with a few spreading hairs along the midline, sparsely glandular-hairy; inner row narrowly obovate to almost linear, 2.5–3.5(–4.0) × 0.2–0.8 mm, acute, with broader, membranous, fimbriate margin, glabrous or with a few spreading hairs along the midline, sparsely glandular-hairy. *Receptacle* epaleate. *Outer female florets* 27–40, in 1 row, fertile, shortly radiate; tubular below, tube 1.5–2.0 mm long; limb short, 0.3–0.5 mm long, longer than style furcation but shorter than or as long as style branches, entire or mostly 3-lobed; corolla yellow, sometimes flushed purplish, with glandular hairs. *Style* 2.0–2.5 mm long, bifurcate; style branches narrowly elliptic, 0.5–0.8 mm long; stigmatic areas marginal, confluent at apex, rarely apex with short deltoid-penicillate apical appendage. *Cypsela* and *pappus* as in disc florets. *Disc florets* 63–80, regular, bisexual, fertile; tubular below, tube 1.0–1.5 mm long, widening upwards, upper, campanulate part 1.0–2.5 mm long; 5-lobed, lobes 0.5 mm long, sometimes with embedded resin ducts along margins; corolla yellow, rarely flushed purplish, with glandular hairs on tube and lobes. *Anthers* 1(–2) mm long; with narrowly ovate to narrowly triangular, apical appendage; base shortly calcarate, ecaudate; filament collar with thickened cell walls. *Style* up to 3 mm long, bifurcate; style branches oblong, 0.5–1.0 mm long, with deltoid-penicillate apical appendage; stigmatic areas marginal. *Cypsela* pale brownish, obovoid, 0.5–1.5 mm long (Fig. 1B), with thickened margin; covered with

longish twin hairs, more or less equal in length, apices of twin hairs often broadened; epicarpic cells oblong, arranged in parallel rows (Fig. 2B). *Pappus* of many barbellate bristles in 1 row, 2–3 mm long. *Flowering time*: from August to March (May).

Distribution and habitat:—Central Namibia (Fig. 6), a Namibian endemic (Craven & Vorster 2006), growing in gravelly soil, schist on mountain slopes, riverbanks, in grassveld. Until now thought to be confined to the Windhoek area (Quarter Degree Squares 2216 and 2217) but a few specimens recorded north and south of this area. According to Craven & Loots (2002) the Red List status of this taxon is DD (Data Deficient), most probably because of misidentifications and uncertainty about the clear circumscription of the species.

Discussion:—After a search of the major European herbaria, *Dinter 2228* listed by him (Dinter 1919) for this taxon, *Chrysocoma ciliata*, could not be located.

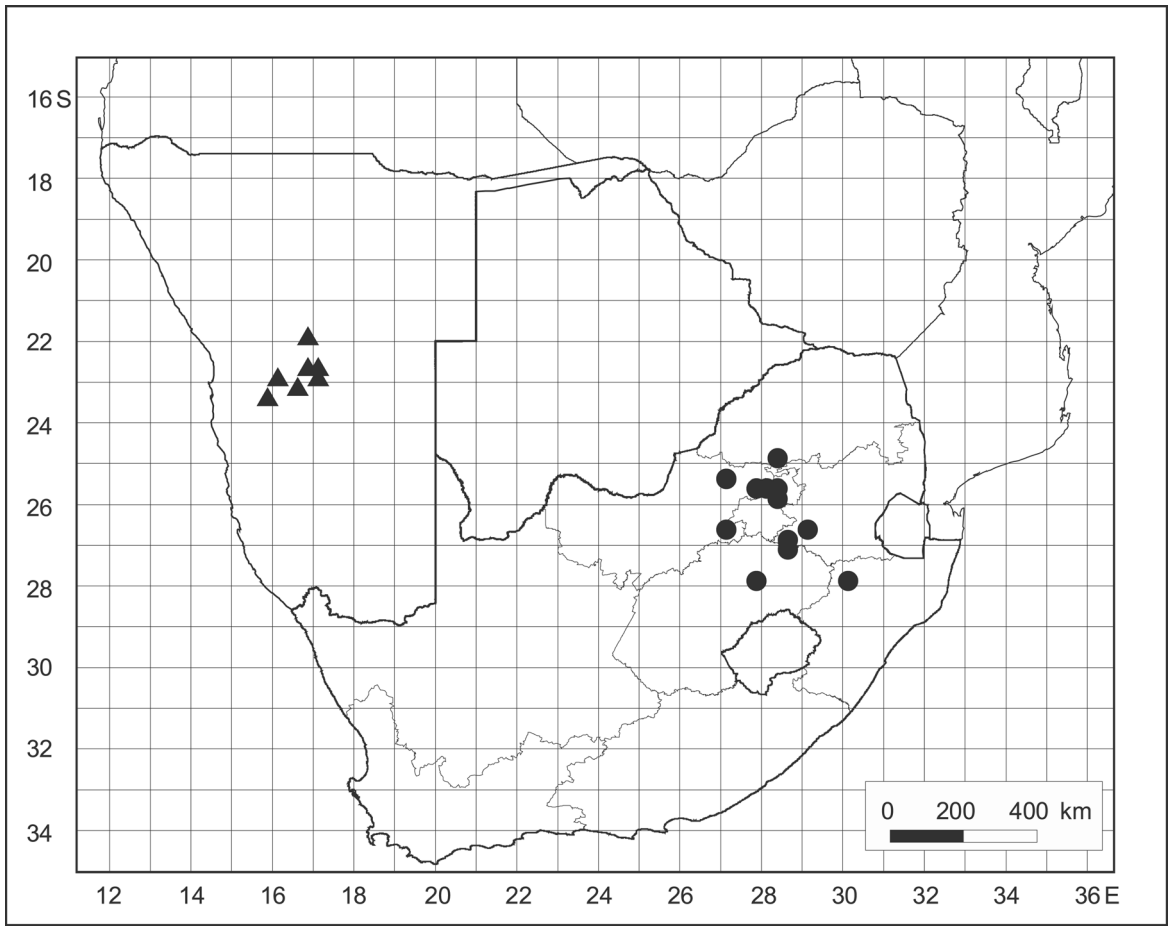

FIGURE 6. Known geographical distribution of *N. tenuifolia* (▲) and *N. jeanettae* (●).

Additional specimens examined

NAMIBIA. 17 km south of Okahandja, (QDS: 2116DD Okahandja), 23 May 1974, *Goldblatt 1903* (WIND). Farm Anuanua [Auuanis], 91 miles W of Windhoek, (QDS: 2216CC Otjimbingwe), 4 March 1955, *De Winter 2630* (PRE). Farm Kaan Damm: WIN 377, (QDS: 2216CC Otjimbingwe), 14 May 1973, *Giess 13511* (PRE, WIND), *Giess 13517* (PRE, WIND). ± 20 km from Windhoek on road C28 to Swakopmund, (QDS: 2216DB Otjimbingwe), 2 March 1996, *Burgoyne & Snow 5102* (PRE, WIND). Khomas, Daan Viljoen Game Park, (QDS: 2216DB Otjimbingwe), 17 August 2007, *Funk et al. 12701* (PRE), 21 August 1972, *Merxmüller & Giess 28065* (PRE, WIND). Khomas Hochland, farm Friedenau, (QDS: 2216DB Otjimbingwe), 19 March 1939, *Gassner 34* (M-0197310) (M!). Windhoek and surroundings, (QDS: 2217CA Windhoek), 9 March 1988, *Bohlmann 88/56* (WIND). Lichtenstein, in the Auasberge, (QDS: 2217CA Windhoek), 12 May 1922, *Dinter 3517* (PRE), 15 October 1934, *Dinter 7889* (PRE, WIND). Goreangabdam, (QDS: 2217CA Windhoek), 7 February 1970, *Giess 10863* (PRE, WIND). Along Gammams River, (QDS:

2217CA Windhoek), 20 November 1962, *Hanekom 300* (PRE, WIND). Windhoek municipal area, at dam, (QDS: 2217CA Windhoek), 1 January 1963, *Hanekom 371* (PRE). ?Windhoek Distr., on Waterberg, (QDS: 2217CA Windhoek), 23 December 1957, *Merxmüller 861* (PRE, WIND). Farm Lichtenstein, (QDS: 2217CC Windhoek), 16 January 1958, *Merxmüller 1250* (PRE, WIND). Farm Lichtenstein: WIN 366, (QDS: 2217CC Windhoek), 4 March 1979, *Giess 15360* (PRE, WIND). Farm Lichtenstein, (QDS: 2217CC Windhoek), May 1949, *Liebenberg 5060* (WIND). Kuiseb crossing, Walvisbay-Rehoboth-Windhoek road, (QDS: 2315BD Rostock), 13 October 1961, *Giess 3797A* (PRE, WIND). Farm Mahonda WIN 39, (QDS: 2316BA Nauchas), 12 July 1963, *Giess 7637* (WIND).

Note:—NAMIBIA. Farm Welbedagh, Fransfontein, (QDS: 2014DB Khorixas), May 1949, *Liebenberg 4953* (PRE). This is probably an incorrect locality. It seems that the label of this specimen was switched with that of another specimen as the identification on the label is *Geigeria alata*.

4. ***Nolletia ciliaris*** (de Candolle 1836: 367) Steetz (1864: 404); Merxmüller (1967: 119); Wild (1975: 19, 20); Hilliard (1977: 97); Gibbs Russell *et al*. (1984: 125; 1987: 215); Merxmüller & Roessler (1984: 84); Herman (1993: 714; 2003: 261; 2006: 232); Retief & Herman (1997: 327); Craven (1999: 162); Klopper *et al*. (2006: 142).

Basionym: *Leptothamnus ciliaris* DC.; Harvey (1865: 111). Type:—SOUTH AFRICA. Northern Cape: Little Klibbolikhonni [Fontein], (QDS: 2723CD Kuruman), 16 December 1812, *Burchell 2512* (lectotype: G-DC (Bar code G00321822) e! designated here; isolectotypes: A photocopy!, K e!, P!, W e!).

= *Nolletia ericoides* Merxmüller (1955: 78); Merxmüller (1967: 119); Gibbs Russell *et al*. (1984: 125; 1987: 215); Herman (1993: 714; 2003: 261); Craven (1999: 162); Klopper *et al*. (2006: 142). Type:—NAMIBIA. Okavango Valley, west of Rundu, on small, sandy, dry hill, (QDS: 1719DC Rundu), 8 May 1939, *Volk 1941* (holotype M e!, isotypes MO e!, PRE!).

Densely leafy, caespitose or ascending, perennial herb or suffrutex, rarely developing into a dwarf shrub, 0.1–0.3 m high. *Stems* upright, sparsely branched, greenish, totally glabrous or basally glabrous to sparsely hairy, apically more hairy and also sometimes stipitate-glandular, older parts of stems with hard, persistent remains of leaf main veins. *Leaves* subopposite at base, alternate upwards, densely set, imbricate, sessile; linear-triangular to linear, (3–)4–6(–12) mm long, less than 1 mm broad; apex acute; base semi-amplexicaul; margin entire, mostly shortly to prominently (up to 1 mm long) ciliate, rarely without cilia; upper surface glabrous; lower surface glabrous to spreading pubescent, sometimes glandular-hairy as well; main vein very prominent abaxially, occupying most of the lower leaf surface; often dark coloured embedded oil glands regularly set on both sides of main vein, visible on abaxial surface; sometimes leaf tufts in axils of lower leaves. *Capitula* heterogamous, disciform, 8–10 mm in diameter, solitary at ends of branches, pedunculate. *Peduncle* 10–40 mm long, glabrous, spreading pubescent and/or glandular-hairy, sometimes with 1 or 2 bracts. *Involucre* infundibuliform to campanulate. *Involucral bracts* in 3 or 4 rows, imbricate, glabrous, often with yellow or dark coloured embedded oil sacs along midline, often purplish, persistent and recurved in old inflorescences; outer bracts narrowly ovate, 2–3 × 0.5–0.6 mm, acuminate, with very narrowly membranous, entire margin, with darker central portion; middle bracts very narrowly ovate to obovate, 2.5–4.0 × 0.5–0.8 mm, acuminate, with narrowly membranous, entire margin, upper central portion darkish, lower portion lighter; inner bracts very narrowly obovate to almost linear to narrowly oblong, up to 3.0–4.5 × 0.5–1.0 mm, acuminate, with broader, membranous entire margin. *Receptacle* epaleate, foveolate. *Outer female florets* up to 45, arranged in 1 or 2 rows, fertile, filiform; tube 1.5–2.0 mm long, shorter than style furcation (Fig. 3G), glabrous, rarely with a few glandular hairs, 3–5-dentate; corolla yellow or purplish. *Style* 2.0–2.5 mm long, bifurcate; branches up to 1 mm long, apex rounded to acute; stigmatic areas marginal, converging at apex. *Cypsela* and *pappus* as in disc florets. *Disc florets* up to 45, regular, bisexual, fertile, corolla infundibuliform; tubular part 2–3 mm long, rarely with a few glandular hairs on tube; 5-lobed, lobes 0.5–1.0 mm long, often with resin ducts in sinuses of closed lobes and resin ducts along margins when opened; corolla yellow or purplish towards apex. *Anthers* 1.0–1.5 mm long; apical appendage narrowly ovate; base shortly calcarate, ecaudate; filament collar

with thickened cell walls. *Style* 2.5–3.5 mm long, bifurcate; branches 0.5–1.0 mm long, apex with deltoid-penicillate apical appendages; stigmatic areas along margin only, not converging at apex. *Cypsela* light brownish (fawn) with darker margin—almost a double line with lighter centre, narrowly obovoid, laterally compressed, 1.5–2.0 × 0.5–0.8 mm (Fig. 1C); with densely set twin hairs, often unequal in length, apices of twin hairs acute or slightly broadened; epicarpic cells oblong, arranged in parallel rows. *Pappus* of barbellate bristles, up to 3.5 mm long. *Flowering time*: September to May.

Distribution and habitat:—Namibia, Botswana, North-West, Gauteng, Free State, KwaZulu-Natal, Lesotho, Northern Cape, Eastern Cape (Fig. 7), growing in sand among rocks, on flats, koppies or slopes in grassveld. The red list status of this species in South Africa is LC (Least Concern) (Raimondo *et al.* 2009).

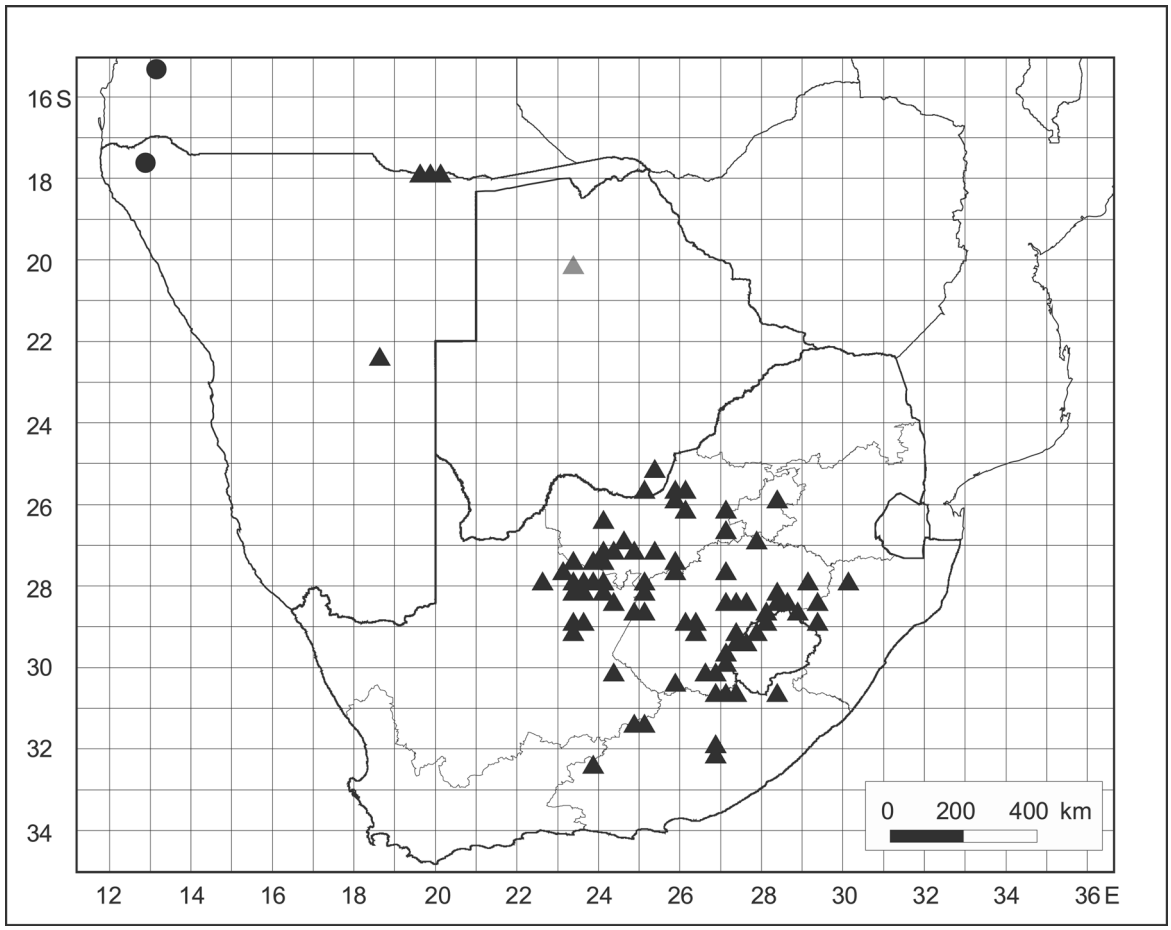

FIGURE 7. Known geographical distribution of *N. ciliaris* (▲) and *N. welmaniae* (●). The grey triangle representing Ngamiland as there was no specific locality.

Notes and discussion:—De Candolle (1836) in his original description of *Leptothamnus ciliaris*, quoted *Burchell 1839* and *2512* and *Drège s.n.* (Klipplat river). Harvey (1865) quoted *Burchell 1839* and *2512* and later in the description quoted *Burchell* with no numbers, presumably referring to the previous two specimens, *Drège* (Klipplaat River), *Zeyher* (Wolwekop) and *Owen* (Zululand). The Drège specimens housed in G-DC (Bar code G00321823, e!) and P e! have the collector's number 3774 and the locality is given as Klipplaatrivier.

Both De Candolle (1836) and Harvey (1865) quoted *Burchell 1839*, but according to a copy of Burchell's collectors register, housed in the Mary Gunn Library, SANBI, Pretoria, *Burchell 1839* is a *Convolvulus* sp. Hilliard (1977) correctly quoted *Burchell 1832*, noted as *Chrysocoma* in Burchell's register. This specimen, housed in G-DC (Bar code G00321821, e!) was collected on 18 November 1811, presumably at Ten Springs. There is a gap in the localities in Burchell's notes: *Burchell 1792* to *1825* were collected at Janz Fonteyn between 16 and 18 November 1811. According to McKay (1943) they were collected at Grootfontein at the

"Lower Spring", near Campbell, Northern Cape. *Burchell 1837* to *1881* were collected at Klaarwater (Griquatown, Northern Cape) on 1 December 1811. In Burchell's register there is no locality noted for his specimens *1826* to *1836* but, according to McKay (1943), these numbers were collected at the "Upper Spring", also near Campbell (Northern Cape). *Burchell 2512*, noted as *Chrysocoma* in his register, was collected on 16 December 1812 at Little Klibbolikhonni (grid reference 2723CD, Leistner & Morris 1976), near Kuruman, Northern Cape. Hutchinson (1946) reported the date of this collection as 14 December. To eliminate possible confusion, *Burchell 2512* housed in G-DC is selected as lectotype.

Burchell 2706-3, noted as *Chrysocoma* in his collectors register, was collected on 7 March 1813 at Rainwater Station (3024AB, Leistner & Morris 1976) and according to McKay (1943) west of Philipstown, Northern Cape. On this specimen there are 2 annotations written in pencil: *Leptothamnus ciliaris* var. ? (with a question mark) and *Leptothamnus glaber* Burch. It seems that this name was never published. It is unclear where the combination *Nolletia glabra*, associated with the image on JSTOR (2011), originated. Clearly Burchell already noticed glabrous specimens and this supports the sinking of *N. ericoides* as synonym under *N. ciliaris* by Merxmüller & Roessler (1984).

Stoebe sp. capitulis luteis Dinter (1927: 367): Dinter mistook this specimen as a possible new species of *Stoebe* in a list of specimens collected in South West Africa (Namibia). Merxmüller (1967) realised it was a wrong identification and put the name in synonomy under *N. ciliaris*.

According to Phillips (1917), Watt & Breyer-Brandwijk (1962) and Jacot Guillarmod (1971) the leaves of *N. ciliaris* are smoked by the Southern Sotho for the relief of headaches and as a charm against witchcraft: the ash of the plant, mixed with goat fat, is burnt in the hut, the smoke being credited with the capacity for counteracting the evil. Wells *et al*. (1986) reported that this species could be troublesome because of competitiveness in grassland.

Additional specimens examined

NAMIBIA. Grootfontein North, overflow of Okavango at Rundu, (QDS: 1719DD Rundu), 30 April 1967, *Giess 10087* (PRE, WIND). Okavango, near Katonto, (QDS: 1720CC Sambio), 1 September 1933, *Schoenfelder S156* (PRE). Without precise locality: Okavango Valley, 28 August 1933, *Schoenfelder S136* (PRE). Between Witvley and Kalkfontein [most probably Kalkpan] near Gobabis, (QDS: 2218BC Gobabis), 25 January 1913, *Dinter 2758* (SAM, e!, M e! (fragment)) (Bar code M-0198714). Farm Lammermoor, (QDS: 2218BC Gobabis), 14 January 1958, *Merxmüller 1229* (PRE).

BOTSWANA. Ngamiland, Motsokola, (QDS: 2023AB Kgwebe Hills), 1930–1931, *Curson 133* (PRE), *Curson 773* (PRE). Distr. Kanye, Pharing, (QDS: 2525AB Mafikeng), February 1949, *Miller B/841* (PRE). Morapedi Ranch, (QDS: 2525CA Mafikeng), 26 January 1977, *Hansen 3007* (PRE).

LESOTHO. Leribe, (QDS: 2828CC Bethlehem), December 1912, *Dieterlen 359* (GRA, NH, P, PRE), no date, *Dieterlen 7151* (PRE). Golflinks, (QDS: 2927AD Maseru), 24 December 1931, *Verney s.n. PRE43138* (PRE). Mamathes, (QDS: 2927BB Maseru), 14 November 1948, *Jacot Guillarmod 377* (GRA, PRE). Roma, (QDS: 2927BC Maseru), 14 October 1960, *Ruch 2005* (PRE), October 1961, *Ruch 2236* (PRE), no date, *Schmitz 494* (PRE). Roma University campus, (QDS: 2927BC Maseru), 10 October 1967, *Schmitz 7* (PRE). Mafateng, (QDS: 2927CC Maseru), 26 December 1933, *Gerstner 210* (PRE).

SOUTH AFRICA. North-West: Mafikeng, (QDS: 2525DB Mafikeng), February 1981, *Bohlmann 81/202* (PRE). 5 km S of Slurry (15 km E of Mafeking) under Weltevrede, (QDS: 2525DD Mafikeng), 13 March 1975, *Van der Meulen 340FM060* (PRE). Zeerust, (QDS: 2526CA Zeerust), March 1912, *Jenkins s.n. TvlMus12087* (PRE). Wanganella, (QDS: 2624AC Vryburg), February 1948, *Brueckner 1132* (KMG, PRE). Leon Taljaard Nature Reserve, near Vryburg, (QDS: 2624DC Vryburg), 3 January 1980, *Gubb 10223* (KMG). Armoedsvlakte, (QDS: 2624DC Vryburg), 3 February 1921, *Mogg 7929* (PRE), 5 May 1916, *Pole Evans s.n.* (PRE), 9 April 1912, *Sharpe s.n. Govt.Herb.7416* (PRE). Lichtenburg, (QDS: 2626AA Klerksdorp), March 1912, *Jenkins s.n. TvlMus12094* (PRE). Ventersdorp, Somerville, (QDS: 2627AA Potchefstroom), 28 February 1967, *Louw 4043* (PRU). Boskop, foot of rantjie, (QDS: 2627CA Potchefstroom), 15 October 1939, *Louw 410* (PRE). Kopjeslaagte farm, (QDS: 2724AA Taung), 13 May 1982, *Gubb 8474* (KMG), *Gubb s.n.*

Releve nr 325-26 (PRE). Vryburg, Klipvlakte, (QDS: 2724AB Taung), 16 November 1911, *Burtt Davy 11135* (PRE). Tiger Kloof, (QDS: 2724BB Taung), 3 April 1945, *Brueckner 312* (KMG, PRE). Vryburg/Schweizer Reyneke, (QDS: 2724BB Taung), 23 April 1979, *Gubb 19.4* (PRU), 24 April 1979, *Gubb 20.24* (PRU). Schweizer Reineke, (QDS: 2725AB Bloemhof), April 1933, *Lang s.n. TvlMus31741* (PRE). Wolmaransstad, Boskuil, (QDS: 2725BD Bloemhof), 16 November 1929, *Sutton 274* (PRE). Makwassie on road to Wolmaransstad, at Leeuwfontein turn-off, (QDS: 2725BD Bloemhof), 28 September 1974, *Van Wyk 560* (PRE). Christiana, Kaffraria, (QDS: 2725CC Bloemhof), 25 March 1912, *Burtt Davy 14420* (PRE). Localities not found: Vryburg Distr., between Glenied and Haasforth, 17 November 1911, *Burtt Davy 11200* (PRE); Panfontein Game Reserve, 11 April 1950, *Louw 1851* (PRE).

Gauteng: Rietvlei Reserve, (QDS: 2528CD Pretoria), 4 February 1960, *Repton 5338* (PRE).

Free State: Sasolburg, Wonderwater Section 6, (QDS: 2627DD Potchefstroom), 15 March 1995, *Kroon 11649* (NMB, PRE). Sasol Game Park, Wilgefontein, (QDS: 2627DD Potchefstroom), 6 November 1995, *Kroon 11740* (NMB, PRE). Hoopstad, Sandveld Nature Reserve, Bultfontein, (QDS: 2725DB Bloemhof), 10 February 1976, *Viljoen 61* (NMB, PRE). Kroonstad, (QDS: 2727CA Kroonstad), February 1928, *Pont 413* (PRE). Farm Blanquilla 280, (QDS: 2727CA Kroonstad), 28 March 1968, *Scheepers 1699* (PRE). Warden District, farm Hopedale, (QDS: 2729CC Volksrust), 23 February 1993, *Fuls 329* (PRU). Smitskraal, (QDS: 2825AA Boshoff), 21 September 1911, *Burtt Davy 10049* (PRE). Smitskraal 309, (QDS: 2825AA Boshoff), 22 September 1911, *Burtt Davy 10881* (PRE). Kromrant, c. 20 km SW of Boshoff, (QDS: 2825CA Boshoff), 12 February 1985, *Zietsman & Zietsman 202* (NMB, PRE). Krugersdriftdam Nat. Res., Vlakkraal, (QDS: 2826CC Brandfort), 1 April 1976, *Muller 1851* (NMB), 11 April 1976, *Muller 1851* (PRE). Landboukollege, Glen, (QDS: 2826CD Brandfort), 26 January 1971, *Van den Berg 3874* (PRE). Winburg District, Willem Pretorius Nature Reserve, (QDS: 2827AC Senekal), 16 September 2008, *Zietsman 4367* (NMB, PRE). Willem Pretorius Nature Reserve, Doringberg East, (QDS: 2827AD Senekal), 19 February 1976, *Muller 1822* (NMB, PRE). Senekal, koppie in town, (QDS: 2827BC Senekal), 12 March 1987, *Crosby 436* (PRE). Nonnashoek, 3 miles SE of Bethlehem, (QDS: 2828AB Bethlehem), 15 January 1969, *Werger 80* (PRE). 6 miles SE of Bethlehem on road to Clarens, boundary between farms Poortje and Trekpad, (QDS: 2828AD Bethlehem), 13 February 1967, *Scheepers 1358* (PRE). Golden Gate Nat. Park, Wodehouse, (QDS: 2828BC Bethlehem), 20 January 1965, *Roberts 3021* (PRE). 15 km north of Fouriesburg, (QDS: 2828CA Bethlehem), 27 March 2007, *Meyer 4893* (PRE). Witzieshoek, (QDS: 2828DB Bethlehem), 15 April 1985, *Paton 271* (PRE). Kerkenberg, along way to camping site, (QDS: 2829AD Harrismith), 18 November 1978, *Jacobsz 1439* (PRE). Bloemfontein, Hoewe 18, Lakeview, (QDS: 2926AB Bloemfontein), 26 February 1966, *Hanekom 593* (PRE). Ladybrand, Leliehoek, (QDS: 2927AB Maseru), 18 October 1988, *Zietsman 340* (NMB, PRU). Wepener, (QDS: 2927CA Maseru), 29 January 1945, *Acocks 11170* (PRE). Orange River, near Bethulie, (QDS: 3025BD Colesberg), December 1892, *Flanagan 1498* (NH, PRE). Outskirts of Smithfield, (QDS: 3026BA Aliwal North), 24 February 1946, *Story 896* (PRE). 19 km from Zastron, (QDS: 3026BB Aliwal North), 7 February 1986, *Welman 694* (NMB, PRE). Nieuwejaarspruit [Nuwejaarspruit], (QDS: 3026DB Aliwal North), October [probably December 1840/January 1841], *Zeyher 114.10* (HBG e!, KW e!, P!).

KwaZulu-Natal: Farm Pivaanspoort 10, (QDS: 2730AD Vryheid), 1 December 1999, *Krynauw 1973* (PRE). Dannhauser Municipality Area, Fairbreeze Village, banks of Mbabane River, c. 300 m from Fairbreeze Combined Primary School, (QDS: 2730CC Vryheid), 16 April 2006, *Ngwenya 3036* (NH). Cathedral Peak Forestry Station, (QDS: 2829CD Harrismith), 10 April 1953, *Killick 1920* (PRE).

Northern Cape: 20 miles W of Moeswal, W of Langeberg Mts, (QDS: 2722DC Olifantshoek), 20 March 1960, *Leistner 1686* (KMG, PRE). 19.5 km NE of Kuruman along highway to Vryburg, (QDS: 2723AD Kuruman), 30 January 1974, *Davidse & Loxton 6073* (PRE). Kuruman, CottonSud, (QDS: 2723?AD Kuruman), April 1940, *Ferrar s.n. KMG3379a* (KMG). Close to Camden, (QDS: 2723BD Kuruman), 17 November 1995, *Koekemoer 1062* (PRE). Uitkoms Farm, (QDS: 2723CA Kuruman), 10 February 1981, *Gubb s.n. Releve nr 146/67* (PRE), *Gubb 13101* (KMG). Morgenson farm, (QDS: 2723DC Kuruman), 12 February 1981, *Gubb 13210* (KMG). Rust farm, (QDS: 2723DC Kuruman), 13 February 1981, *Gubb 13252* (KMG). Sanniesrust farm, (QDS: 2723DC Kuruman), 14 February 1981, *Gubb 13328* (KMG). Killarney

farm, (QDS: 2723DD Kuruman), 19 February 1981, *Gubb 13937* (KMG). Rietgat farm, (QDS: 2724AC Taung), 10 May 1982, *Gubb s.n. Releve nr 320-25* (PRE), *Gubb 8099* (KMG). Barkley West A.59, Sandveld, (QDS: 2724CC Taung), February 1921, *Wilman s.n. KMG1273* (KMG), *Wilman s.n. GRA1213* (GRA). Ouplaas farm, (QDS: 2823AB Griekwastad), 26 April 1981, *Gubb 4016* (KMG). Jonasbank II farm, (QDS: 2823BA Griekwastad), 24 April 1981, *Gubb 3799* (KMG), *Gubb 205/70* (WIND). 14 miles NE of Griquatown, (QDS: 2823CD Griekwastad), 17 May 1946, *Codd 1270* (PRE). At Ten Springs, Campbell (according to McKay 1943), (QDS: 2823DC Griekwastad), 18 November 1811, *Burchell 1832* (P e!, PRE). Uitkyk (171k), (QDS: 2824AA Kimberley), 16 December 1936, *Acock 1464* (PRE). Cristaalfontein, (QDS: 2824AA Kimberley), 17 December 1936, *Acocks 1500* (PRE). Koopmansfontein, Silver Bullet, (QDS: 2824AA Kimberley), 6 March 1945, *Brueckner 216* (PRE). Vaalbos National Park, near Hartebeespicket, (QDS: 2824AD Kimberley), 18 March 1993, *Bezuidenhout 507* (KMG, NMB). Barkley West, Waldeck's Plant, (QDS: 2824AD Kimberley), March 1936, *Cooke s.n. KMG3379b* (KMG). Barkley West, between Jacobs' Rush and Sydney-on-Vaal, (QDS: 2824?AD Kimberley), October 1937, *Acocks in Herb. Hafström H821* (PRE), October 1936, *Hafström s.n. KMG3731b* (KMG). Dronfield, 5 miles from Kimberley, (QDS: 2824DB Kimberley), September 1950, *Badenhorst 27* (KMG, PRE). Oranje Oord, (QDS: 2923AB Douglas), 10 March 1937, *Acock 1960* (PRE). Rainwater Station, W of Philipstown, (QDS: 3024AB De Aar), 7 March 1813, *Burchell 2706-3* (K e!, PRE, photo!). Locality not found: Kaap Plateau at Noltes Puts, 3 November 1936, *Acocks & Hafström H1236* (PRE).

Eastern Cape: Lady Grey, near turnoff from main road to Aliwal North, (QDS: 3027CA Lady Grey), 18 March 1996, *Victor 1700* (PRE). Witbergen between Gariep [Orange River] and Caledon rivers, (QDS: 3027CB Lady Grey), October, *Ecklon & Zeyher s.n.* (HBG e!, PRE). 1.7 miles W of Setabataba P.O., (QDS: 3028CB Matatiele), 17 March 1962, *Acocks 22105* (PRE). 4 miles from Middelburg on Rietpoort road, (QDS: 3124BD Hanover), 8 March 1954, *Comins 738* (PRE). 3 miles NW of Middelburg, (QDS: 3124BD Hanover), 22 February 1956, *Leistner 630* (PRE). Middelburg, Grootfontein, (QDS: 3125AC Steynsburg), 4 February 1938, *Gill 37* (PRE). Middelburg, (QDS: 3125AC Steynsburg), April 1924, *Gill 92* (PRE). Base of Madena Hill, (QDS: 3126DD Queenstown), January 1896, *Galpin 1948* (GRA, PRE). Ouplaas, summit of Asbestos Hills, (QDS: 3223BD Rietbron), no date, *Ferrar 5732* (GRA), April 1940, *Ferrar s.n. KMG6596a* (KMG). Baviaansriver (probably incorrect locality), (QDS: 3226AC Fort Beaufort), October, *Ecklon & Zeyher 114.10* (GRA). Klipplaatrivier, (QDS: 3226BB Fort Beaufort), 15 November 1832, *Drège 3774* (G-DC, MO e!, P e!, PRE photo), (date from P specimen, barcode P031808; collector's number from P specimen, barcode P031805 and G-DC, barcode G00321823; no specimen number on photo from MO (JSTOR 2011)).

5. ***Nolletia jeanettae*** P.P.J.Herman *sp. nov.* (Fig. 8)

Similar to *N. rarifolia* and *N. ruderalis* but *N. jeanettae* is a delicate plant reaching only about 0.2 m high, diffusely branched at the base, with solitary inflorescences at the ends of the branches, stems and lower leaf surfaces persistently appressed pubescent, margins ciliate, always with stipitate glands on the upper part of the stem and peduncle and no oil sacs on the involucral bracts.

Type:—SOUTH AFRICA. North-West: along R566 between Pretoria and Brits, south of De Wildt / Ga-Rankuwa, (QDS: 2527DB Rustenburg), 14 September 2008, *Bester 8494* (holotype PRE!, isotypes J, K, M, PRU, PUC, US, Z).

Perennial herb with mostly vertical, sometimes horizontal rootstock, diffusely branched at base, erect to ascending, scattered leafy. Annual *stems* delicate, up to 0.2 m, sparsely branched, reddish purple at the base, green upwards, appressed pubescent, upper part of stem also stipitate-glandular. *Leaves* alternate, linear-filiform, up to 40 mm long, less than 1 mm broad, smaller upwards; lower surface appressed pubescent; upper surface glabrous; margins entire, ciliate; main vein sunken on upper surface; leaves slightly folded lengthwise; upper leaves sometimes also stipitate-glandular. *Capitula* heterogamous, disciform, 8(–10) mm in diameter, solitary, terminal, pedunculate. *Peduncle* up to 65 mm long, sparsely to densely stipitate-glandular, glabrous or sparsely appressed pubescent, with (0)1 or 2 bracts, bracts also stipitate-glandular. *Involucre* campanulate or cup-shaped, 8–10 mm in diameter. *Involucral bracts* in 3 rows, imbricate; outer bracts narrowly ovate, acute, 1.8–2.5 × 0.5–0.6 mm, green with very narrowly membranous, fimbriate margin,

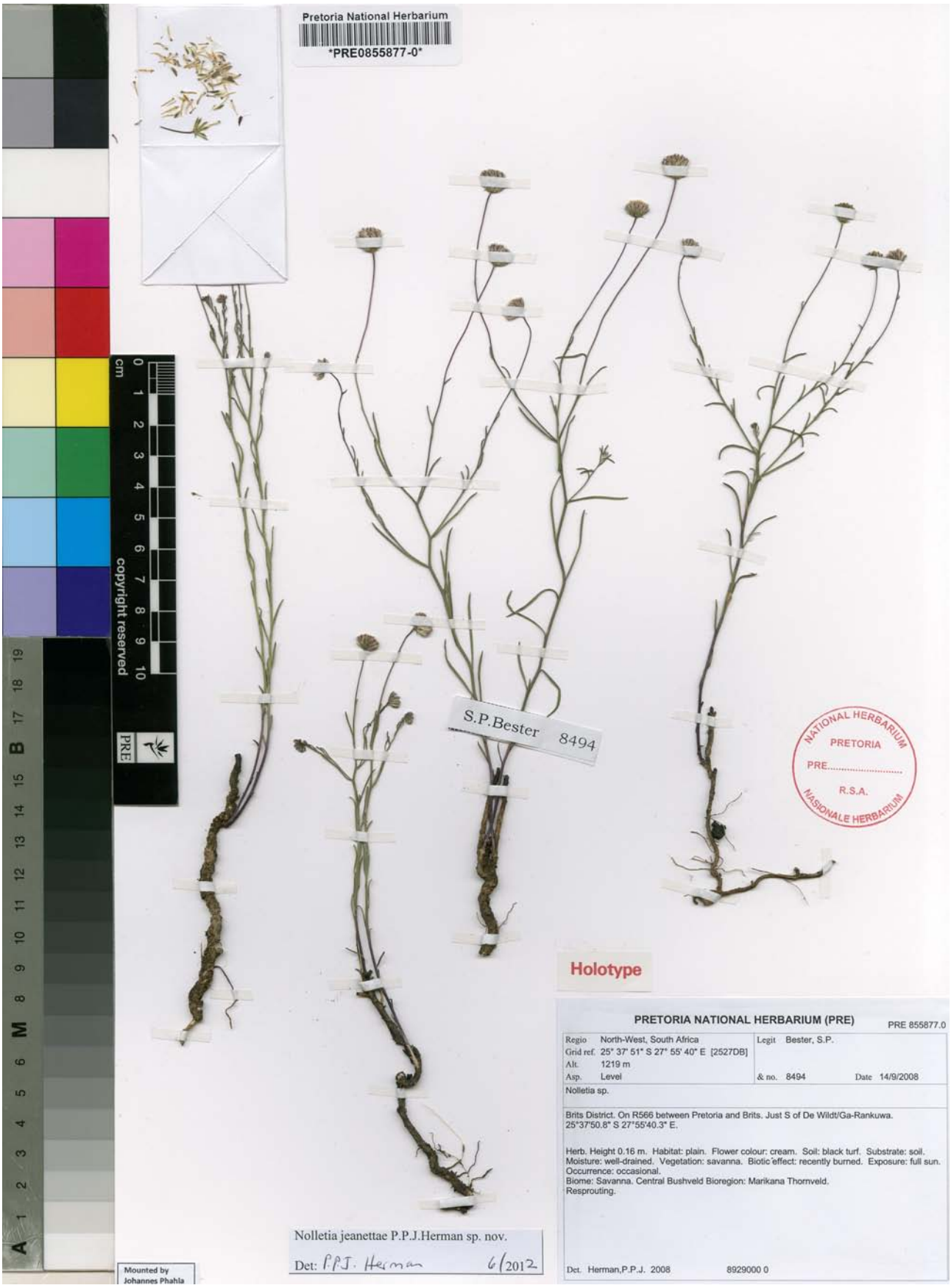

FIGURE 8. Scanned image of the holotype of *N. jeanettae* P.P.J.Herman (*Bester 8494*, PRE).

appressed pubescent; middle bracts narrowly elliptic or narrowly obovate, acute, 2.5–3.5 × 1 mm, central part green but narrower than in outer bracts, appressed pubescent, margins broadly membranous, purplish towards the apex, fimbriate; inner bracts narrowly obovate, acute, 3–4 × 1.0–1.2 mm, with narrow, green, appressed pubescent, central part, margins broadly membranous, purplish towards apex, fimbriate. *Receptacle* epaleate, foveolate. *Outer female florets* about 11–15, in 1 row, fertile, filiform, about 1.0–1.5 mm long, shorter than style branches, with an extended lobe on 1 side, with glandular hairs on tube and at apex; corolla pale yellowish, sometimes purplish at apex. *Style* 1.2–2.0 mm long, bifurcate; style branches slender, 0.5–1.0 mm, often with short, deltoid-penicillate tuft at apex, often purplish; stigmatic areas marginal, confluent at apex. *Cypsela* and *pappus* as in disc florets. *Disc florets* about 30–50, regular, bisexual, fertile; tubular below, tube 2.0–3.5 mm long, widening slightly upwards, with 5 short, erect lobes, 0.5–1.0 mm long; corolla greenish at base, yellowish in middle portion, darker at apex (reddish or purplish); with glandular hairs on lower part of tube and some on corolla lobes. *Anthers* 5, 1–2 mm long; with narrowly triangular apical appendage; base shortly calcarate, ecaudate. *Style* shortly exserted, 2–3 mm long, bifurcate; style branches broadly oblong, 0.6–1.0 mm long, with deltoid-penicillate apical appendages, often purplish; stigmatic areas in 2 separate lines along the margins, not reaching the apex. *Cypsela* brownish or dark purplish, obovoid, laterally compressed, skew to one side, 2.5–3.5 × 1 mm (Fig. 1D); covered with twin hairs, often unequal in length, apices of hairs acute to sometimes broadened; epicarpic cells oblong, arranged in regular rows (Fig. 3A). *Pappus* of barbellate bristles in 1 row, 2–3 mm long. *Flowering time*: August to January, with a peak from September to November.

Distribution and habitat:—Limpopo, North-West, Gauteng, Mpumalanga, Free State, KwaZulu-Natal (Fig. 6), occurring in savanna, in loam soil, black turf or clay, in full sun. The conservation status of this species is not currently known.

Discussion:—Similar to *N. rarifolia* and *N. ruderalis* but:

1. both *N. rarifolia* and *N. ruderalis* are erect herbs, up to about 0.5 m high, producing several simple, upright, unbranched stems from the perennial rootstock, branching upwards, more or less above the middle, into loose, corymbose inflorescences while *N. jeanettae* is a delicate plant reaching only about 0.2 m high, diffusely branched at the base, with solitary inflorescences at the ends of the branches;

2. the stems and lower leaf surfaces of *N. jeanettae* are persistently appressed pubescent and the leaves are ciliate, whereas in *N. rarifolia* the stems and leaves are glabrous to sparsely spreading pubescent and in *N. ruderalis* the stems and leaves are always glabrous;

3. *N. jeanettae* always has stipitate glands on the upper part of the stem and the peduncle, whereas in *N. rarifolia* and *N. ruderalis* there are only occasionally a few glandular hairs present;

4. there are no oil sacs on the involucral bracts of *N. jeanettae* as found on the involucral bracts of *N. rarifolia* nor are they white-punctate as the involucral bracts of *N. ruderalis*.

Not well represented in herbaria. A few old specimens were previously misidentified as *N. arenosa*. Only now recognised as a new species from the abundant material collected by S.P. Bester.

Etymology:—Named for my elder daughter Jeanetta.

Additional specimens examined

SOUTH AFRICA. Limpopo: farm Het Bad 465 KR, 4 km SSE from Warmbad (Bella-Bella), (QDS: 2428CD Nylstroom), 13 November 2011, *Bester 10823* (PRE).

North-West: Boshoek, Boschkoppie 104 JQ, ± 30 km N of Rustenburg–Pilanesberg, (QDS: 2527AC Rustenburg), 4 September 1997, *Jacobsen 5529* (PRE). Veld Preservation Experimental Plot 2, School of Agriculture, (QDS: 2627CA Potchefstroom), 17 November 1927, *Liebenberg 1023* (PRE).

Gauteng: Montana Agricultural Holdings, (QDS: 2528CA Pretoria), 26 August 2006, *Bester 7239* (B, BM, E, NMB, NY, P, PRE, PRU). Doornpoort, drainage line running north to south, crossing Amandelboom road, (QDS: 2528CA Pretoria), 10 September 2008, *Bester 8487* (PRE, PRU). West of Rosslyn towards Brits, NE of Strydfontein, (QDS: 2528CA Pretoria), 14 September 2008, *Bester 8496* (BM, K, M, NY, PRE, Z). Onderstepoort, (QDS: 2528CA Pretoria), January 1913, *Theiler's lab s.n. TvlMus14634* (PRE); October 1933,

Meebold 14082 (M-0197313) (M). Montana Tuine ext. 49, Bougainvilla Drive, (QDS: 2528CB Pretoria), 2 November 2009, *Bester 9736* (J, JRAU, PRE, PRU, PUC, S, US). Willow Park Manor, veld east of Libertas road, (QDS: 2528CD Pretoria), 12 September 2008, *Bester 8491* (P, PRE, PRU).

Mpumalanga: Balfour District, 6 km direct N of Villiers, ca. 1.5 km off the N3 on road R547 towards Val, (QDS: 2628DC Johannesburg), 16 November 2008, *Bester 8576* (PRE). Highveld Bridge District, ca. 6 km direct SW from Secunda on southern corner of the R580 and R546, (QDS: 2629CA Bethal), 13 November 2008, *Bester 8534* (JRAU, MO, NH, PRE, PRU, UPS). ?Mpumalanga: Waterval River, (QDS: ?2629BD Bethal?), 17 October 1893, *Schlechter 3473 TvlMus30521* (PRE).

Free State: ca. 10 km NE of Lindley on route R707 towards Petrus Steyn, (QDS: 2727DD Kroonstad), 15 November 2008, *Bester 8559* (NMB, PRE). Villiers, on SW outskirts of town, (QDS: 2728BA Frankfort), 15 November 2008, *Bester 8569* (PRE).

KwaZulu-Natal: Dannhauser, farm Fairbreeze, above Mbabane River, (QDS: 2730CC Vryheid), 24 December 1992, *Ngwenya 1092* (PRE).

6. ***Nolletia welmaniae*** P.P.J.Herman *sp. nov.* (Fig. 9)

Similar to *N. rarifolia* and *N. ruderalis* but leaves persistently ciliate and with an occasional hair on leaf surfaces. Also similar to *N. jeanettae* but peduncles glabrous and inflorescences arranged in loose terminal corymbs. Superficially very similar to *N. zambesica* but cypselae with oblong epicarpic cells.

Type:—NAMIBIA. Kunene, Kaokoveld, Etengua–Baynes Mountains road, (QDS: 1712DB Posto Velho), 1 February 2009, *Klaassen et al. EK1964* (holotype WIND!).

Virgate suffrutex, up to 0.5 m tall, branched at the base into few, long, initially simple stems, scattered leafy, branching upwards into loose corymbose inflorescences. *Stems* woody at base, bark brown, herbaceous and green upwards; sparsely appressed pubescent, glabrescent upwards to almost totally glabrous below capitula; with tufts of hairs in axils of leaves. *Leaves* alternate, sessile, linear, up to 40 × (1.0–)1.5(–2.0) mm, smaller upwards passing into bracts; apex bluntly acute; margins entire, ciliate, sometimes with few hairs on main vein on lower surface and on rest of surfaces, otherwise glabrous. *Capitula* 10 mm in diameter, arranged in loose, terminal corymbs. *Involucre* campanulate. *Involucral bracts* imbricate, arranged in 4 rows, glabrous, with yellow or almost black oil sacs along midline, totally recurved and persistent after flowering; outer row narrowly ovate to narrowly triangular, acute, 1.8 × 0.5 mm; second row narrowly ovate, acute to acuminate, 2.0–2.5 × 0.5 mm, margins narrowly membranous, sparsely fimbriate; third row narrowly obovate, acuminate, 3.0–3.5 × 0.5–0.8 mm, margins membranous, fimbriate; inner row narrowly obovate, acuminate, 3–4 × 0.5–0.6 mm, margins membranous, fimbriate. *Receptacle* epaleate, foveolate. *Outer female florets* in 1 row, fertile, filiform; tube 1.5–2.0 mm long, with 1 enlarged lobe and 4 smaller lobes; with many glandular hairs in upper two-thirds, sometimes a few twin hairs on tube; corolla yellow. *Style* 2.2–2.5 mm long, bifurcate; style branches linear-elliptic, 0.5–1.0 mm long, obtuse; stigmatic areas marginal, confluent at apex. *Cypsela* and *pappus* as in disc florets. *Disc florets* regular, bisexual, fertile; tubular below, widening slightly upwards, tube 2.5–3.0 mm long, with many glandular hairs in upper two-thirds; 5-lobed, lobes 0.5 mm long; corolla yellow. *Anthers* 1.5 mm long with narrowly ovate apical appendage; slightly calcarate at base, ecaudate. *Style* 2.5–3.0 mm long, bifurcate; style branches narrowly elliptic, 0.8–1.0 mm long; stigmatic areas marginal, not confluent at apex, with broadish ovate, papillate appendages. *Cypsela* brown, obovoid, laterally flattened, with thickened margin, 2 × 1 mm (Fig. 1E); with longish twin hairs, twin hairs unequal in length, apices acute; epicarpic cells oblong, arranged in parallel rows. *Pappus* of many barbellate bristles, 3–4 mm long. *Flowering time*: January and February.

Distribution and habitat:—Known from only two localities in northern Namibia and southern Angola (Fig. 7), on rocky outcrops. The conservation status of this species is not currently known.

FIGURE 9. Scanned image of the holotype of *N. welmaniae* P.P.J.Herman (*Klaassen et al. EK1964*, WIND).

Discussion:—Similar to *N. rarifolia* and *N. ruderalis* but in *N. welmaniae* the leaves are persistently ciliate and with an occasional hair on the leaf surfaces, whereas in *N. rarifolia* the leaves are glabrous to sparsely spreading pubescent and in *N. ruderalis* the leaves are always glabrous. Also similar to *N. jeanettae* but in that species the upper part of the stem and the peduncle always have stipitate glands and the capitula are solitary at the ends of the branches. In *N. welmaniae* the peduncles are glabrous and the inflorescences are arranged in loose terminal corymbs. Superficially very similar to *N. zambesica* but in that species the stems and leaves are appressed pubescent and the cypselae have circular epicarpic cells.

Figueiredo & Beentje (2008) did not list any *Nolletia* species for Angola. This would then represent a new record for that country.

Etymology:—Named for my colleague, Ms W.G. (Mienkie) Welman, who has been responsible for the curation of *inter alia* the family Asteraceae in PRE for many years, and who was my tutor when I started working on the family Asteraceae.

Additional specimen examined

ANGOLA. Namibe Province, road from Leba Pass to Caraculo, (QDS: 1513AA), 16 January 2009, *Winter 7649* (PRE).

7. ***Nolletia rarifolia*** (Turczaninow 1851: 65) Steetz (1864: 404); Wood (1904: 348); Hilliard (1977: 98); Gibbs Russell *et al*. (1984: 125; 1987: 216); Herman (1993: 714; 2006: 232; 2006: 232); Retief & Herman (1997: 327); Klopper *et al*. (2006: 142).

Basionym: *Leptothamnus rarifolius* Turcz.; Harvey (1865: 111). Type:—SOUTH AFRICA. Gauteng: Magaliesberg, (QDS: 2527DC/DD Rustenburg), October 1841, *Zeyher 802* (holotype KW e!, isotypes G (Bar code G00370732) e!, P e!, SAM (NBG) e!, W e!).

Iconography:—Germishuizen & Clarke (2003, Fig. p. 129), Van Wyk & Malan (1988, Fig. 248, p. 115).

Mostly inconspicuously leafy, erect, perennial herb or suffrutex, up to 0.45 m high, more prominently leafy in Mpumalanga and some KwaZulu-Natal specimens. Simple, annual *stems* arise from vertical underground rootstock, often purplish at base, sparsely branched in upper part, ribbed, often with embedded dark gland dots, spreading pubescent below, glabrescent to glabrous upwards, rarely with some glandular hairs as well. *Leaves* alternate, few, usually much shorter than internodes, appressed to stem, sessile, linear-triangular to linear, 2–20 (up to 35 mm in Mpumalanga specimens) × 0.5–1.0 mm; acute; broadened at base and semi-clasping; often folded lengthwise; margins entire, sometimes sparsely ciliate; mostly glabrous to sparsely spreading pubescent on lower surface, rarely with a few glandular hairs; with embedded gland dots on lower surface between midrib and margin. *Capitula* heterogamous, disciform, 10–12 mm in diameter, arranged in loose, terminal corymbs. *Involucre* campanulate. *Involucral bracts* arranged in 4 rows, imbricate, all with orange to almost black oil sacs along midrib, rarely without dark oil sacs, apices sometimes purplish, persistent after flowering, recurved; outer bracts narrowly ovate or narrowly obovate, 2 × ± 0.2–0.6 mm, acute to acuminate, with very narrowly membranous margin, spreading pubescent or glabrous; second row narrowly ovate or obovate, 2.5–4.0 × 0.5–1.0 mm, acute to acuminate, with narrowly membranous, fimbriate margin, spreading pubescent or glabrous; third row narrowly ovate to narrowly obovate, 3.2–6.0 × 0.8–1.4 mm, acute to acuminate, with broadly membranous, fimbriate margin, glabrous or with a few spreading hairs along the midrib; inner row narrowly obovate, 4.5–6.0 × 1.0–1.6 mm, acute, with broadly membranous, fimbriate margin, glabrous or with a few spreading hairs along the midrib. *Receptacle* epaleate, foveolate. *Outer female florets* 15–24, in 1 row, fertile, filiform; tube 1.5–2.0 mm long, with glandular hairs; 3- or 4-(5-)lobed, lobes much shorter than style furcation; corolla yellow. *Style* 2.4–3.0 mm long, bifurcate; style branches 0.5–0.8 mm long, apex rounded to acute; stigmatic areas along margin and confluent at apex. *Cypsela* and *pappus* as in disc florets. *Disc florets* 50–79, regular, bisexual, fertile; tubular below, widening slightly above, tube 2–3 mm long, with glandular hairs on lower half of tube, 5-lobed, lobes 1 mm long, often with dark lines (resin ducts) along margins; corolla yellow. *Anthers* 1.2–2.0 mm long; with ovate apical appendage, 0.5 mm long; base shortly calcarate, ecaudate; filament collars with thick-walled cells. *Style* 3.5–4.0 mm long, bifurcate;

style branches 0.5–0.8 mm long, with deltoid-penicillate apical appendages; stigmatic areas along margins, not confluent at apex. *Cypsela* dark reddish brown with whitish, thickened margin, obovoid, laterally flattened, 2.0–3.5 × 1.0–1.5 mm (Fig. 1F); covered with twin hairs, often unequal, apices of hairs acute; epicarpic cells oblong, arranged in regular rows. *Pappus* bristles barbellate, in 1 row, 2.5–4.0 mm long. *Flowering time*: September to April.

Distribution and habitat:—Limpopo, North-West, Gauteng, Mpumalanga, Free State, KwaZulu-Natal, Eastern Cape (Fig. 10), growing in grassland in sandy or rocky soil, on flats, hill slopes and rocky outcrops. The red list status of this species is LC (Least Concern) (Raimondo *et al*. 2009).

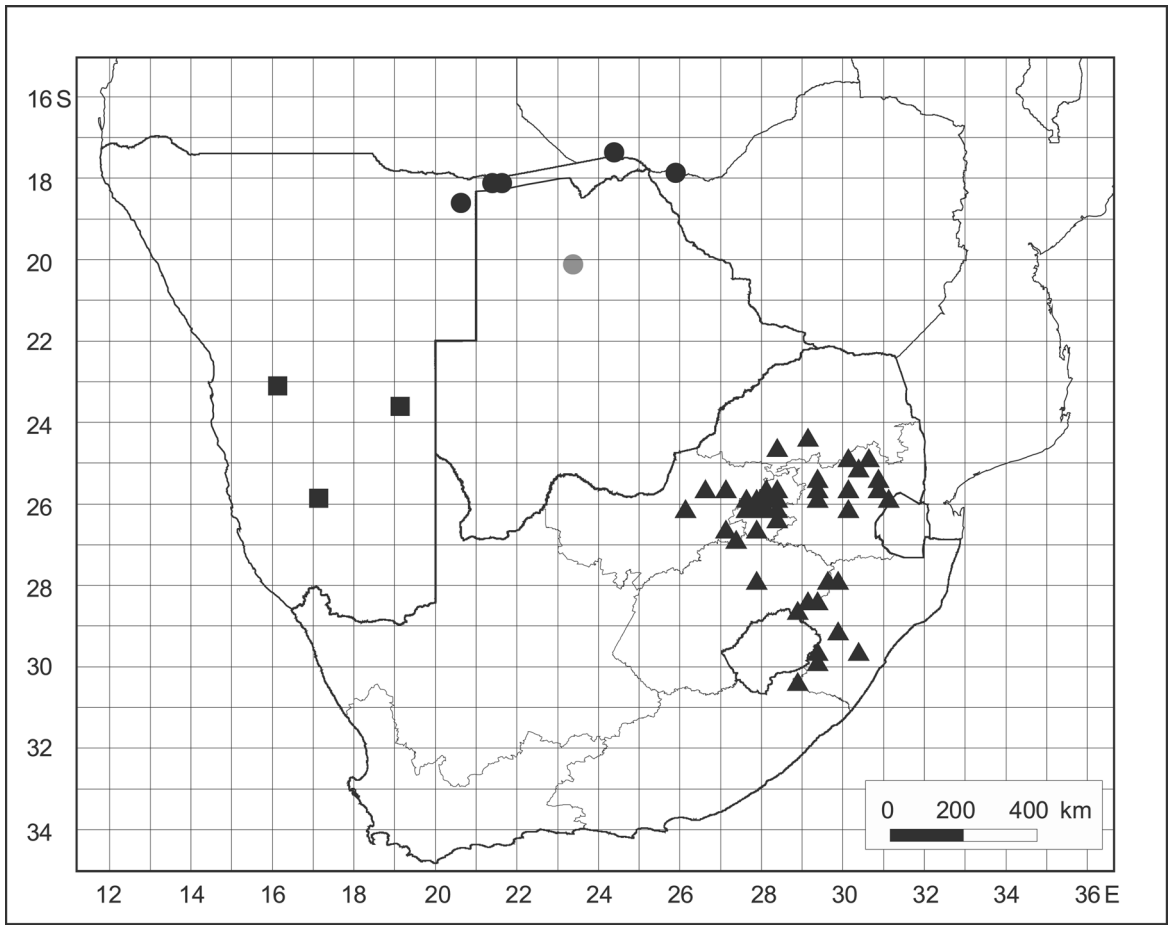

FIGURE 10. Known geographical distribution of *N. rarifolia* (▲), *N. zambesica* (●) and *N. chrysocomoides* × *N. annetjieae* (■). The grey dot representing Ngamiland as there was no specific locality.

Discussion:—The leaves of the specimens from the Lydenburg, Nelspruit and Barberton areas (Mpumalanga) and some KwaZulu-Natal specimens are much longer than those of specimens from the rest of the distribution range, almost approaching those of *N. ruderalis*. However the orange or dark coloured oil sacs in the involucral bracts of *N. rarifolia* are distinct and give it a characteristic appearance, in contrast to the pale and minutely white-punctate involucral bracts of *N. ruderalis*.

Typification:—Turczaninow (1851) quoted only *Zeyher 802* in his description of *Leptothamnus rarifolius*, but did not mention any locality. The SAM (NBG) specimen of *Zeyher 802* has written on it 164.10. The 10 represents the month of flowering (October) and the 164 is the Zeyher locality. According to Glen & Germishuizen (2010) the locality 164 was at Magaliesberg where Zeyher collected in 1841. The *Zeyher 803* specimen on JSTOR (2011) had written on it Magaliesberg. Steetz (1864) also quoted *Zeyher 802* when he made the new combination in *Nolletia*. It is clear that *Zeyher 802* is the type and not *Zeyher 803*, nor *Gilfillan 6015* as indicated on JSTOR (2011).

Additional specimens examined

SOUTH AFRICA. Limpopo: 16 miles N of Nylstroom, (QDS: 2428CB Nylstroom), 3 October 1938, *Hafström & Acocks 1825* (PRE). Magotokloof, (QDS: 2429AC Zebediela), 8 January 1969, *Robbertse 531* (PRU). Without precise locality: Zoutpansberg, 15 September 1934, *Pole-Evans 3728a* (PRE).

North-West: Swartruggens Distr., farm Brakfontein, ± 2 km SE of town, (QDS: 2526DA Zeerust), 26 September 1982, *Van Hoepen 1825* (PRE). Morgenzon, (QDS: 2527CA Rustenburg), 4 October 1943, *Rose Innes 149* (PRE). Rustenburg, (QDS: 2527CA Rustenburg), 6 October 1910, *Leendertz s.n. TvlMus9733* (PRE). Rustenburg Nature Reserve, (QDS: 2527CA Rustenburg), 26 February 1970, *Jacobsen 794* (PRE). Lichtenburg, Grasfontein, (QDS: 2626AA Klerksdorp), 31 January 1931, *Sutton 558* (PRE). Experimental Plots, School of Agriculture, (QDS: 2627CA Potchefstroom), 12 October 1927, *Phillips & Liebenberg 913* (PRE). Vredefort Dome, 20 km WNW of Parys, farm Buffelskloof 511, NW-NNW of Thabela Thabeng Resort, (QDS: 2627CD Potchefstroom), 5 October 2000, *Kroon 16259* (NMB, PRE). Localities not found: Potchefstroom, Klington, 20 September 1940, *Goossens 1665* (PRE); Welverdiend, no date, *Louw 58* (PRE).

Gauteng: Uitkomst 499 JQ, (QDS: 2527DC Rustenburg), 19 November 1970, *Coetzee 399* (PRE), *Coetzee 406* (PRE, PRU), 24 January 1971, *Coetzee 557* (PRE). Uitkomst 499 JQ, (QDS: 2527DD Rustenburg), 9 October 1970, *Coetzee 312* (PRE). Cradle of Humankind, S of Hartbeespoortdam, (QDS: 2527DD Rustenburg), 24 September 2004, *Krige 297* (PRU). Beyond Daspoort, (QDS: 2528CA Pretoria), October 1925, *Munro s.n. PRE3320* (PRE). Riviera, N slope of Meintjes Kop, (QDS: 2528CA Pretoria), 27 September 1925, *Smith 666* (PRE). Meintjes Kop, (QDS: 2528CA Pretoria), 30 September 1934, *Dyer 2511* (PRE), 3 October 1928, *Mogg 15362* (PRE). Arcadia, (QDS: 2528CA Pretoria), 14 October 1925, *Smith 880* (PRE), January 1926, *Smith 2090* (PRE). Roodeplaatdam Nature Reserve, (QDS: 2528CB Pretoria), 13 November 1979, *Van Rooyen 2061* (PRE, PRU). Magaliesberg between Baviaanspoort and Edendale, (QDS: 2528CB Pretoria), 30 September 1933, *Young s.n. TvlMus32377* (PRE). Silverton, (QDS: 2528CB Pretoria), 27 October 1959, *Schlieben & Strey SKF836* (PRE), no date, *Nel 292* (PRU). Koppie behind Silverton, (QDS: 2528CB Pretoria), 9 November 1945, *Codd 648* (PRE). Pretoria National Botanical Garden, (QDS: 2528CB Pretoria), 7 November 2003, *Bester 4349* (PRE), 1 October 1974, *Dryfhout 629* (PRE), 1 December 1993, *Hobson 1983* (PRE). Brummeria, (QDS: 2528CB Pretoria), 1 December 1967, *Müller 141* (PRE). 20–30 miles NE of Pretoria, (QDS: 2528CB Pretoria), 6 December 1958, *Werdermann & Oberdieck 1261* (PRE). Muckleneuk, (QDS: 2528CC Pretoria), 11 September 1930, *Goossens 72* (PRE). Brooklyn, (QDS: 2528CC Pretoria), 6 December 1931, *Mogg 12265* (PRE). Groenkloof, (QDS: 2528CC Pretoria), 9 October 1924, *Pole-Evans 463* (PRE). Doornkloof 391 JR, Portion 330, (QDS: 2528CC Pretoria), November 2009, *Van Greuning 845* (PRU). Schanskop, (QDS: 2528CC Pretoria), 19 November 1928, *Mogg 15750* (PRE), 22 September 1937, *Repton 1099* (PRE), 13 September 1925, *Smith 569* (PRE). Fountains Valley, (QDS: 2528CC Pretoria), 25 November 1928, *Repton 130* (PRE). Along John Rissik Drive, (QDS: 2528CC Pretoria), 23 October 1937, *Van Huyssteen s.n. PRU3003* (PRU). Irene, (QDS: 2528CC Pretoria), October 1929, *Obermeyer 87 TvlMus27703* (PRE). Pinedene, (QDS: 2528CC Pretoria), 27 October 1904, *Burtt Davy 2200* (PRE). Rietvlei Research Station, 11 miles S of Pretoria, (QDS: 2528CD Pretoria), 29 September 1946, *Codd 1745* (PRE). Rietvlei Reserve, (QDS: 2528CD Pretoria), September 1946, *Repton 3098* (PRE). Pretoria, without precise locality, 28 September 1904, *Leendertz 304 TvlMus8751* (PRE). Pretoria, without precise locality, new site township, 23 September 1933, *Mogg 14142* (PRE). Pretoria, without precise locality, October 1933, *Meebold 14076* (M-0197312) (M). Magaliesberg, without specific locality, *Zeyher 803* (K e!). Krugersdorp, Sterkfontein Caves, Isaac Stegman Nature Reserve, (QDS: 2627BA Potchefstroom), 21 November 1966, *Mogg 35994* (PRE). Krugersdorp, farm Honingklip (72) 178 IQ, (QDS: 2627BB Potchefstroom), 21 November 1998, *Reddy, Reddy & Reddy 1896* (PRE). Roodepoort Distr., 2 km NE of Walter Sisulu Botanical Garden (Witwatersrand Bot gdn), Ruimsig Entomological Reserve, (QDS: 2627BB Potchefstroom), 3 October 1997, *Reddy, Reddy & Reddy 538* (PRE). Roodepoort, Walter Sisulu Botanical Garden (Transvaal Botanic Garden), (QDS: 2627BB Potchefstroom), 29 September 1983, *Behr 568* (PRE). Witpoortjie falls, 20 miles NW of Johannesburg, (QDS: 2627BB Potchefstroom), 12 November 1949, *Prosser 1325* (PRE). Johannesburg, Randburg ridge, (QDS: 2627BB Potchefstroom), October 1976, *Liebenberg 8472*

(PRE). Vereeniging, (QDS: 2627DB Potchefstroom), December 1913, *Rogers 11901* (PRE). Jeppe'stown Ridges, (QDS: 2628AA Johannesburg), October 1898, *Gilfillan 32a* (K e!, PRE), *Gilfillan s.n. Herb. Galpin6015* (GRA). Johannesburg, without precise locality, (QDS: 2628AA Johannesburg), December 1908, *Leendertz s.n. TvlMus6080* (PRE). Modderfontein, (QDS: 2628AA Johannesburg), October 1904, *Haagner s.n.* (GRA). Benoni, (QDS: 2628AB Johannesburg), 9 September 1934, *Bradfield T94* (PRE). Heidelberg, (QDS: 2628AD Johannesburg), 23 November 1909, *Leendertz s.n. TvlMus10262* (PRE).

Mpumalanga: Ohrigstad Nature Reserve, (QDS: 2430CC Pilgrim's Rest), 19 November 1970, *Jacobsen 1246* (PRE). Along road between Pilgrim's Rest and Lydenburg, (QDS: 2430DC Pilgrim's Rest), 16 February 1981, *Welman 290* (PRE). Morgenzon Nature Reserve, (QDS: 2430DC Pilgrim's Rest), 17 November 1979, *Kluge 2073* (PRE). Middelburg, Loskop Dam Nature Reserve, (QDS: 2529AD Witbank), 16 December 1959, *Mogg 31024* (PRE). Middelburg, Doornkop 273 J.S., (QDS: 2529CB Witbank), 13 January 1969, *Du Plessis 1314* (PRU). Middelburg, (QDS: 2529CD Witbank), 6 November 1933, *Young A26 TvlMus32603* (PRE). Farm Zwagershoek, (QDS: 2530AB Lydenburg), January 1930, *Obermeyer 288 TvlMus27539* (PRE). Nelspruit, Lowveld Botanic Garden, (QDS: 2530BD Lydenburg), 7 November 1969, *Buitendag 287* (PRE). Nelspruit, on site of Subtropical Experimental Station, (QDS: 2530BD Lydenburg), 3 December 1926, *Smith 3540* (PRE). Belfast, (QDS: 2530CA Lydenburg), 7 December 1909, *Leendertz s.n. TvlMus9172* (PRE). Berlin State Forest, (QDS: 2530DB Lydenburg), 19 November 1991, *Leverkusen RSA20291* (PRE). Along road from Barberton to Havelock, (QDS: 2531CC Komatipoort), 18 November 1991, *Leverkusen RSA21591* (PRE). Barberton, (QDS: 2531CC Komatipoort), December 1916, *Pott 5429 TvlMus16614* (PRE). Carolina, without precise locality, (QDS: 2630AA Carolina), 29 October 1932, *Galpin 12518* (PRE). Locality not found: Belfast, near Helvetica (Machadodorp-Schoeman's Kloof road), 13 November 1933, *Young A264 TvlMus32604* (PRE).

Free State: Lindley, (QDS: 2727DD Kroonstad), 24 April 1936, *Phillips 437* (PRE). Witzie's Hoek, (QDS: 2828DB Bethlehem), February 1917, *Junod s.n. TvlMus17382* (PRE). Farm Rensburgskop, Mount Manyenyeza, (QDS: 2829AC Harrismith), 6 January 1979, *Jacobsz 626* (PRE).

KwaZulu-Natal: Newcastle District, summit of Normandien Pass, (QDS: 2729DC Volksrust), 20 December 1963, *Hilliard 2371* (NH). Newcastle, (QDS: 2729DD Volksrust), 3 October 1893, *Schlechter 3412* (P e!, PRE). Slopes of Drakensberg, near Tugela Falls, (QDS: 2828DB Bethlehem), 12 January 1886, *Medley Wood 3597* (NH). Van Reenen, (QDS: 2829AD Harrismith), 16 December 1912, *Medley Wood 12139* (PRE). Near Mooi River, (QDS: 2929BB Underberg), 28 November 1888, *Medley Wood 4065* (NH). Griffin's Hill, (QDS: 2929BB Underberg), 15 October 1944, *Acocks 10672* (NH, PRE). Drakensberg, Polela, (QDS: 2929CB Underberg), February 1896, *Evans 702* (NH). Ottery near Underberg, (QDS: 2929CD Underberg), 20 November 1994, *Grice s.n. NH125135* (NH). World's View, (QDS: 2930CB Pietermaritzburg), 18 December 1972, *Venter 152* (PRE).

Eastern Cape: 15 miles NNW of Matatiele, (QDS: 3028BD Matatiele), 26 September 1947, *Acocks 13848* (PRE).

8. ***Nolletia ruderalis*** Hilliard (1973: 367); Hilliard (1977: 98); Gibbs Russell *et al*. (1984: 125; 1987: 216); Herman (1993: 714; 2003: 261; 2006: 232); Retief & Herman (1997: 327); Klopper *et al*. (2006: 142). Type:—SOUTH AFRICA. KwaZulu-Natal: Hlabisa distr., Hluhluwe Game reserve, (QDS: 2832AA Mtubatuba), 27 October 1953, *Ward 1623* (holotype NU e!, isotypes E e!, NH!, PRE!).

Perennial herb or suffrutex up to 0.5 m high, sparsely to scattered leafy. *Stems* erect or ascending, sparsely branched, green, straw-coloured at base, ribbed, glabrous. *Leaves* alternate, scattered, sessile to semi-amplexicaul, linear, up to 40 × 1–2 mm, progressively smaller upwards and passing into inflorescence bracts; apex acute, mucronate; margin entire; glabrous. *Capitula* heterogamous, disciform, 10–12 mm in diameter, terminal, solitary or arranged in few-headed loose corymbs, sometimes with a few stipitate glands on peduncle below capitula. *Involucre* campanulate. *Involucral bracts* imbricate, in 3 or 4 rows, glabrous, rarely with some stipitate glands on the margins and apices of outer bracts when young, usually minutely white-punctate; outer bracts narrowly triangular to narrowly ovate, 1.5–2.0 × 0.5 mm, acute; second row narrowly

ovate, 2.5–3.0 × 0.5–0.8 mm, acute, with narrowly membranous, fimbriate margin; third row narrowly obovate, 3.5–4.5 × 0.8–1.0 mm, acute, with narrowly membranous, fimbriate margin; inner row narrowly obovate to oblong, 4.5–6.0 × 0.8–1.0 mm, acute, with broader membranous, fimbriate margin. *Receptacle* epaleate, foveolate. *Outer female florets* up to 14, in 1 row, fertile, filiform; tube 1.5–2.5 mm long, shorter than style furcation, with glandular hairs, apex dentate or divided in 1–5 lobes up to 0.5 mm long; corolla yellow, sometimes tinged reddish at apex. *Style* exserted, up to 3.5 mm long, bifurcate; style branches 0.5–1.0 mm long, apex rounded or rarely with apical deltoid-papillate appendage; stigmatic areas along margin, converging at apex. *Cypsela* and *pappus* as in disc florets. *Disc florets* up to 65, regular, bisexual, fertile; tubular below, tube 1.0–1.5 mm long, widening upwards, upper campanulate part 1.5–2.0 mm long; 5- or rarely 6-lobed, lobes 0.5–1.0 mm long; with glandular hairs on tube and lobes; corolla yellow. *Anthers* 1.5–2.0 mm long; with ovate apical appendage; base shortly calcarate, ecaudate; filament collars with thickened cell walls. *Style* up to 4 mm long, bifurcate; style branches 1.0–1.5 mm long, with deltoid-papillate apical appendage; stigmatic areas marginal, not converging at apex. *Cypsela* brownish, margin thickened, whitish, obovoid, laterally flattened, 2.5–3.0 × 1 mm (Fig. 1G); covered with longish twin hairs, equal or subequal in length, apices of twin hairs acute; with oblong epicarpic cells arranged in parallel rows (Fig. 3B). *Pappus* of numerous barbellate bristles, up to 4 mm long. *Flowering time*: from October to March.

Distribution and habitat:—Mpumalanga, Swaziland, KwaZulu-Natal (Fig. 11) in open or disturbed areas in grassveld, on mountain slopes, in sandy, loam or rocky soil. The red list status of this species in South Africa is LC (Least Concern) (Raimondo *et al*. 2009).

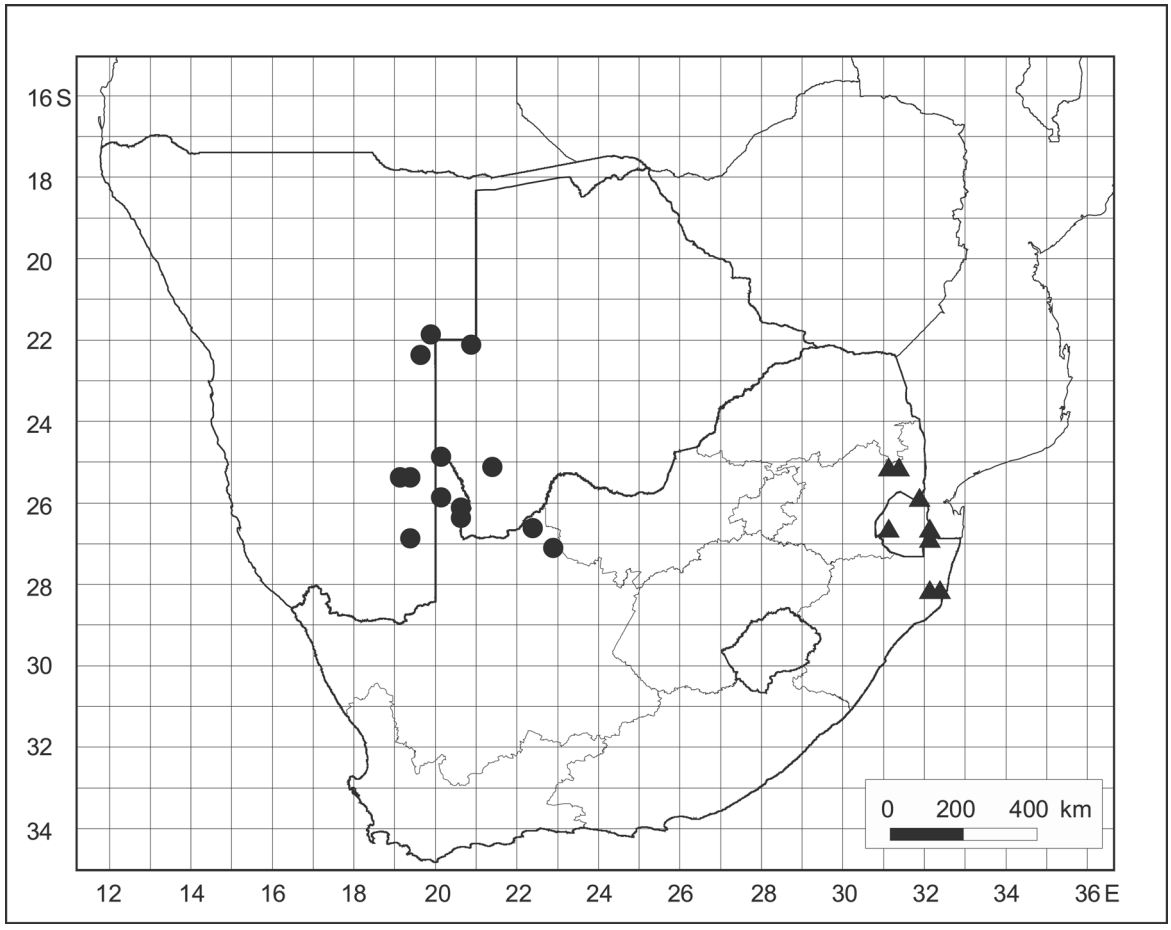

FIGURE 11. Known geographical distribution of *N. ruderalis* (▲) and *N. vanhoepeniae* (●).

Notes:—1. In her original description, Hilliard (1973) reported that the specimen *Moll & Pooley 4190* was homogamous, lacking the outer, female florets. In the duplicate specimen studied at PRE, outer filiform female florets were observed.

2. In the following specimens the corolla of the outer, filiform female florets has distinguishable lobes, although still shorter than the style branches: *Compton 27385*, *Koekemoer 2585*, *Van der Schijff 2055* and *Venter 1718*. Of these, the apices of the style branches in the female florets of *Van der Schijff 2055* looked almost like those of the bisexual disc florets, with deltoid-papillate apical appendages, although the appendages are not quite as long as in the styles of the bisexual florets. In *Venter 1718*, the apices of the style branches in the female florets have a short tuft, like a reduced deltoid-papillate apical appendage.

Additional specimens examined

SWAZILAND. Mananga Mountain, (QDS: 2531DD Komatipoort), 10 March 1977, *Venter 1718* (PRE). Malkerns, (QDS: 2631CA Mbabane), 19 December 1957, *Compton 27385* (PRE). Lubombo Province: Above Mtibhlati River near Ipoye trig point, NE of Maphungwane, (QDS: 2632CA Bella Vista), 23 Novembr 2002, *Koekemoer 2585* (PRE).

SOUTH AFRICA. Mpumalanga: Kruger National Park, Numbi Gate, (QDS: 2531AA Komatipoort), 15 December 1952, *Van der Schijff 2041* (PRE). Kruger National Park, Pretoriuskop, (QDS: 2531AB Komatipoort), 10 February 1953, *Van der Schijff 2055* (PRE).

KwaZulu-Natal: Nkonjane/Aberkorn drift, (QDS: 2632CC Bella Vista), 31 October 1969, *Moll & Pooley 4190* (PRE). Hlabisa Distr., Hluhluwe Game Reserve, (QDS: 2832AA Mtubatuba), 4 November 1954, *Ward 2431* (PRE). Hlaza/Mbemkedwini corridor, (QDS: 2832AA Mtubatuba), 18 November 1971, *Hitchins 715* (PRE). Mtubatuba, Hluhluwe, airstrip, (QDS: 2832AB Mtubatuba), 2 January 1973, *Ward 8226* (PRE). Locality not found: Zululand, N'Tondweni, 7 December 1903, *Medley Wood 9434* and *Medley Wood TvlMus4632* (PRE).

9. ***Nolletia vanhoepeniae*** P.P.J.Herman *sp. nov.* (Fig. 12)

Similar to *N. gariepina* but leaves linear, not narrowly obovate; outer female florets filiform, not shortly radiate and cypselae covered with circular epicarpic cells, not oblong and arranged in parallel rows.

Type:—BOTSWANA. Kgalagadi Transfrontier Park, 8.8 km W of Mosemane Camp Site on route to Nossob on Mabuasehube Wilderness Trail, Duneveld, (QDS: 2521AB Kwai Pan), 14 May 2010, *Koekemoer 3899* (holotype PRE!, isotypes PRU, US).

Iconography:—Kellerman *et al*. (2005, Fig. 5.13, p. 228, as *N. gariepina*).

Scattered to densely leafy dwarf shrub, up to 0.4 m high. *Stems* woody below, herbaceous upwards, spreading pubescent. *Leaves* alternate, sessile, linear to very narrowly obovate, 10–23(–30) × 0.5–1.5 mm; apex acute to obtuse; base sometimes slightly broadened; margins entire; spreading pubescent on both sides. *Capitula* heterogamous, disciform, 8–10 mm in diameter, mostly arranged in loose corymbs or solitary at ends of branches, pedunculate. *Peduncle* spreading pubescent. *Involucre* campanulate. *Involucral bracts* imbricate, in 3 or 4 rows, green, apices sometimes purplish, persistent and recurved in old inflorescences; outer bracts ovate to narrowly oblong, 1.5–2.0 × 0.4–0.5 mm, acute, spreading pubescent; middle row narrowly ovate to narrowly obovate, 2.2–3.0 × 0.5–0.8 mm, acute to acuminate, margin narrowly membranous, slightly fimbriate in upper part, spreading pubescent along central portion; inner row narrowly obovate, 2.8–3.5 × 0.8–1.0 mm, acute, margin narrowly membranous, slightly fimbriate in upper part, glabrous or spreading pubescent along central upper portion. *Receptacle* epaleate, foveolate. *Outer female florets* 23–26, arranged in 1 row, fertile, filiform; tube 1.0–1.5 mm long, shorter than style furcation, with glandular hairs, 1–5-toothed; corolla yellow. *Style* 1.5–2.0 mm long, bifurcate; style branches linear, 0.5–1.0 mm long, rounded to acute; stigmatic areas along margin, confluent at apex. *Pappus* and *cypsela* as in disc florets. *Disc florets* 31–56, regular, bisexual, fertile; tubular below, tube 2.0–2.5 mm long, with glandular hairs, 5-lobed, lobes 0.4–0.5 mm long; corolla yellow, sometimes with purplish apices. *Anthers* 1.0–1.4 mm long; with ovate apical appendages; base shortly calcarate, ecaudate; filament collars with thickened cell walls. *Style* 1.5–2.5 mm long, bifurcate; style branches 0.5–1.0 mm long, with deltoid-penicillate apical appendages; stigmatic areas along the margin, not confluent at apex. *Cypsela* honey-brownish, with faint marginal line, obovoid, 1.0–1.5 × 0.5 mm (Fig. 1H), shiny because of circular epicarpic cells, covering surfaces of cypselae, each with short

twin hair (Fig. 2F, G), apices of twin hairs acute but subequal in length. *Pappus* of caducous, barbellate bristles, 2–3 mm long. *Flowering time*: (December) February to March (June).

FIGURE 12. Scanned image of the holotype of *N. vanhoepeniae* P.P.J.Herman (*Koekemoer 3899*, PRE).

Distribution and habitat:—Namibia, Botswana, Northern Cape (Fig. 11), growing in sand, often over calcrete. The conservation status of this species is not currently known.

Discussion:—In June 2000 the late Prof. Theuns Naude (Onderstepoort Veterinary Institute, Pretoria) submitted a plant specimen that caused poisoning amongst cattle for identification. It was at that stage misidentified as *Nolletia gariepina* (Du Plessis *et al*. 2004, Kellerman *et al*. 2005). It is here described as a new species. Not well represented in herbaria and previously misidentified as *N. arenosa* or *N. gariepina*.

Etymology:—Named for Mrs Estelle van Hoepen, who was in charge of the identification service for a very long time at the National Herbarium, Pretoria (PRE) and acting curator for a short while during the early 1980's.

Additional specimens examined

NAMIBIA. Omaheke, along D1851, (QDS: 2119DD Epukiro), 17 May 2001, *Klaassen EK423* (PRE). Babi Babi, (QDS: 2219BC Sandfontein), December 1921, *Wilman s.n. KMG1591* (KMG). Farm Vergenoeg: GIB 196, (QDS: 2519AC Koes), 26 May 1970, *Giess & Wolf 10917* (PRE, WIND). Farm Houmoed GIB 468, (QDS: 2519AD Koes), 28 May 1970, *Giess & Wolf 10933* (WIND). Farm Brakpan KEE 257, (QDS: 2619CD Aroab), 23 May 1963, *Giess, Volk & Bleissner 7231* (WIND).

BOTSWANA. 10 km NE of Kalkfontein along road to Ghanzi, (QDS: 2220BB Kalkfontein), 11 February 1979, *Skarpe S-304* (PRE).

SOUTH AFRICA. Northern Cape: Kalahari Gemsbok National Park, Long Rambuka Pan, (QDS: 2420CC Union's End), 15 March 2000, *Van Rooyen 4939* (PRU). Kalahari Gemsbok National Park, 2 miles N of Mata-Mata, (QDS: 2520CC Mata Mata), 19 February 1963, *Liebenberg 7060* (PRE). Kalahari Gemsbok National Park, Gemsbokplein, (QDS: 2620BA Twee Rivieren), 12 March 1981, *De Beer B5* (PRE). Kalahari Gemsbok National Park, Nossob River, (QDS: 2620BC Twee Rivieren), 5 February 1989, *Van Rooyen & Bredenkamp 104* (PRU). 150 km NE of Kuruman, farm Tom Brown, (QDS: 2622CB Tshabong), 8 June 2000, *Naude s.n. PRE62520* (PRE). Along Moshaweng river, NE of Vanzylsrus on road Aansluit to Concordia, (QDS: 2622CB Tshabong), 27 February 2000, *Smook 10709* (PRE). 61 miles E by S of Van Zylsrus in bed of Kuruman river, (QDS: 2722BB Olifantshoek), 17 October 1961, *Leistner s.n. KMG8284* (KMG).

10. ***Nolletia zambesica*** R.E.Fries (1914: 331); Merxmüller (1967: 120); Wild (1975: 21); Gibbs Russell *et al*. (1984: 125; 1987: 216); Herman (1993: 714; 2003: 261); Craven (1999: 162); Klopper *et al*. (2006: 142). Type:—ZIMBABWE. Victoria Falls, on Livingstone Island, (QDS: 1725DD Livingstone), 31 July 1911, *Fries 165* (holotype UPS, e!).

= *Nolletia rhodesiana* S.Moore (1917: 104). Type:—ZIMBABWE. Victoria Falls, (QDS: 1725DD Livingstone), May 1915, *Rogers 13299* (holotype BM e!, isotypes BOL!, Z e!).

Scattered to densely leafy, regularly branched, suffrutex or small shrub, up to 1.3 m high; older branches brown, glabrescent, younger branches tawny to green, appressed pubescent. *Leaves* alternate, sessile, linear to narrowly elliptic to narrowly oblong, 10–45 × 2–5 mm; apex acute; margin entire; sparsely to fairly densely appressed pubescent, bright to dark green. *Capitula* heterogamous, disciform, about 10 mm in diameter, loosely corymbosely arranged at ends of branches, pedunculate. *Peduncle* appressed pubescent with 1 or 2 bracts. *Involucre* campanulate. *Involucral bracts* imbricate, in 3 rows, persistent after flowering, recurved; outer row ovate, 2.0–2.2 × 0.5 mm, acute, margin fimbriate, appressed pubescent; middle row oblong to narrowly obovate, 3.0–3.5 × 0.8–1.0 mm, acute to acuminate, with narrowly membranous, fimbriate margin, appressed pubescent; inner row narrowly obovate, 3–4 × 0.5–1.0 mm, acute to acuminate, with broader membranous, fimbriate margin, appressed pubescent. *Receptacle* epaleate, foveolate. *Outer female florets* up to 35, in 1 row, fertile, filiform; tube 1.4–2.0 mm long, shorter than style furcation, with glandular hairs; corolla pale yellow. *Style* 1.6–2.0 mm long, bifurcate; style branches oblong-elliptic, 0.5 mm long; stigmatic areas marginal, confluent at apex. *Cypsela* and *pappus* as in disc florets. *Disc florets* up to 76, regular, bisexual, fertile; tubular below, tube 1.5–2.0 mm long, with glandular hairs, widening upwards, campanulate upper part

1–2 mm long; 5-lobed, lobes 0.5 mm long; corolla yellow. *Anthers* 1.5 mm long; with ovate apical appendage; shortly calcarate, ecaudate at base; filament collar with thickened cell walls. *Style* 2–3 mm long, bifurcate; style branches oblong, up to 1 mm long, with deltoid-penicillate apical appendages; stigmatic areas marginal. *Cypsela* brownish, obovoid, 1.8–2.0 × 0.6–0.7 mm (Fig. 1I), surface shining because of circular epicarpic cells, covering surface of cypsela, each with a short, twin hair, subequal in length, apices of twin hairs acute. *Pappus* of barbellate bristles in 1 row, ± 3 mm long, caducous. *Flowering time*: from December to May (July).

Distribution and habitat:—Northern Namibia, north-western Botswana, Zambia and Zimbabwe (Fig. 10). Along rivers, on riverbanks in sandy soil. The conservation status of this species is not currently known.

Additional specimens examined

ZAMBIA (Northern Rhodesia). Sesheke, (QDS: 1724AD Katima Mulilo), 19 June 1950, *Fanshawe F 5750* (M-0197314) (M).

NAMIBIA. Okavango, Omuramba Khaudum, E of Tamso, (QDS: 1820DA Tarikora), 14 February 1956, *De Winter & Marais 4658* (PRE, WIND). Okavango, Island Tahuê, opposite Andara Mission Station, (QDS: 1821AB Andara), 17 January 1956, *De Winter 4297* (P e!, WIND). Caprivi, Grootfontein North, Andara, on bank and islands in Okavango River, (QDS: 1821AB Andara), 8 March 1958, *Merxmüller 1966* (PRE). Okavango River, near Andara, Popa Falls, (QDS: 1821BA Andara), 20 July 1952, *Maguire 1693* (PRE). Bagani, riparian forest, (QDS: 1821BA Andara), 22 May 1939, *Volk 2124* (PRE).

BOTSWANA. Ngamiland, without precise locality, (QDS: 2023?AB Kgwebe Hills), 1930–1931, *Curson 795* (PRE).

11. **Nolletia chrysocomoides** (Desfontaines 1799: 269, t. 232) Cassini ex Lessing (1832: 187); Cosson & Kralik (1857: 180); Willkomm & Lange (1870: 35); Battandier & Trabut (1888: 424; 1902: 172); Bonnet & Barratte (1896: 206); Durand & Barratte (1910: 121); Tutin (1976: 120); Ozenda (1977: 423); Dobignard & Chatelain (2011: 327).

Basionym: *Conyza chrysocomoides* Desf. Type:—TUNISIA. Kerwan [Kairouan], *Desfontaines s.n.* (holotype P-Desf., e!).
= *Conyza pulicarioides* Cosson & Durand *ined*. (manuscript name)
= *Nolletia arenosa* O.Hoffmann (1893: 76); Merxmüller (1967: 119); Wild (1975: 19); Gibbs Russell *et al*. (1984: 125; 1987: 215); Herman (1993: 714; 2003: 261; 2006: 232); Retief & Herman (1997: 327); Craven (1999: 162); Klopper *et al*. (2006: 142). *syn. nov.* Type:—NAMIBIA. Zwischen Ausis und Khuias (Huib Plateau), (QDS: 2616CB/CD Aus), March 1885, *Schenck 209* (lectotype Z!, designated here).
= *Chrysocoma dinteri* Muschler (1911: 104). Type:—NAMIBIA. Anabriver, (QDS: 2717BA Chamaites), 5 September 1897, *Dinter 1190* (holotype Z!).

Usually ascending to erect, virgate, rarely caespitose, perennial herb or suffrutex, but also small woody shrubs, up to (0.1–)0.2–0.4(–0.5) m high, mostly divided at the base into a few initially simple stems, only branching upwards into the inflorescences, rarely consisting of a main stem with side branches, these branching into inflorescences; basal part with pale, yellowish brown or reddish bark, herbaceous and green upwards, appressed pubescent, densely to scattered leafy. *Leaves* alternate, scattered to fairly densely set, sessile, linear, lower leaves mostly (10–)15–20(–30) × (0.5–)1.0–1.5(–2.5) mm but sometimes up to 35–40 mm long, decreasing in size upwards; apex bluntly acute; margins entire; appressed pubescent on both surfaces. *Capitula* heterogamous, disciform, 8–10(–12) mm in diameter, usually arranged in few-headed, loose corymbs, rarely solitary at ends of branches. *Involucre* campanulate. *Involucral bracts* imbricate, in 3 or 4 rows, green but sometimes tinged purplish, persistent and recurved in old inflorescences, very variable in shape; outer row linear or narrowly linear-triangular to narrowly ovate or narrowly obovate, 1.0–2.5 × 0.2–1.0 mm, apex acute, appressed pubescent; second row narrowly ovate to narrowly obovate or narrowly oblong to narrowly elliptic, 1.8–3.6 × 0.4–1.0 mm, apex acute to acuminate, with very narrowly membranous margin, appressed pubescent; third row narrowly ovate to narrowly obovate or narrowly elliptic, 2.2–4.5 × 0.5–1.0 mm, apex acute to acuminate, with narrowly membranous, faintly fimbriate margin, appressed pubescent; inner row linear to narrowly elliptic or narrowly obovate, 3–5 × 0.4–1.0 mm, apex acute to acuminate, with membranous, faintly fimbriate margin, central portion sparsely appressed pubescent. *Receptacle* epaleate, foveolate. *Outer*

female florets ± 13–50, in 1 row, fertile, filiform; tube 1–2 mm long, shorter than style furcation, with numerous glandular hairs, apex with single lobe or toothed, in North African material one lobe more obvious, with glandular hairs; corolla yellow. *Style* 1.0–2.5 mm long, bifurcate; style branches elliptic, 0.5–1.0 mm long, apex rounded; stigmatic areas marginal, confluent at apex, sometimes with short penicillate, apical appendage. *Pappus* and *cypsela* as in disc florets. *Disc florets* ± 40–90, regular, bisexual, fertile; tubular below, tube 2.0–4.0 mm long, widening slightly after about 1 mm but still tubular and then widening slightly towards lobes, with glandular hairs around first widening; lobes 5, ± 0.5 mm long, also with some glandular hairs; corolla yellow but sometimes purplish on upper part of tube and lower part of lobes. *Anthers* 1.2–2.0 mm long; with narrowly ovate apical appendages and slightly calcarate at base, ecaudate; filament collars with thickened cell walls. *Style* 1.5–3.5 mm long, bifurcate; style branches linear, 0.5–1.0 mm long; stigmatic areas marginal, not confluent at apex, with deltoid-penicillate apical appendages. *Cypsela* honey-coloured, shiny, with faint marginal line, narrowly obovoid, laterally compressed, often slightly skew to one side, 1.2–2.5 × 0.5–1.0 mm (Fig. 1J); surface covered with circular epicarpic cells each with short twin hair (Figs. 2E, 3C), apices of twin hairs acute but subequal in length. *Pappus* of caducous, barbellate bristles, 2 mm long in female florets, 3 mm long in disc florets. *Flowering time*: in southern Africa throughout the year, but with peaks in April–May, August and December; in North Africa from January to August but with a peak from March–June.

Distribution and habitat:—In southern Africa: Namibia, Free State, Northern Cape; in North Africa: Mauritania, Morocco, Algeria, Tunisia and Libya and in Europe: Spain (Fig. 13), growing in sand under desert or semi-desert conditions. According to Wild (1975) this species also occurs in Angola but Figueiredo & Beentje (2008) did not list any *Nolletia* taxa for that country. Wild (1975) also recorded this species for Botswana, but a duplicate of the specimen he quoted (*Wild 5157*), housed in PRE, was identified as the new species *N. annetjieae*. The red list status of this species in South Africa is LC (Least Concern) (Raimondo *et al.* 2009).

Discussion:—A very variable species as far as growth form and involucral bracts are concerned. I could not find any reason to keep the northern African and southern African specimens separate, although there is some degree of variation in the growth form (the North African specimens tend to be more dwarf shrubs), the degree of hairiness (often more densely hairy in North African specimens), the slightly longer lobe of the female florets in the North African specimens and the short penicillate, apical appendages more often present on the apices of the style branches of the female florets in the North African specimens. Abnormal inflorescences were observed in some specimens from Morocco, Algeria and Tunisia (North Africa) (*Mairé s.n.* (P), *Cosson s.n.* (P), *Cosson et al.* (P) and *Chevallier s.n.* (P)). The individual florets are borne on elongated pedicels or ovaries, crowned with abnormal pappus hairs, so that the individual florets rise above the involucral bracts. Some inflorescences appear spicately arranged: the capitula arranged one above the other.

Typification:—Hoffmann (1893), in his original description of *N. arenosa*, listed the following specimens: *Schinz*, with no number(-s), collected at Aus, Byzondermeid [Besondermaid] and *Schenck 209*, collected between Ausis and Khuias (Huib-Plateau). Merxmüller (1967) listed the following specimens as Syntypes: Namibia, Aus, *Schinz 699* and *Schinz 700*; Byzondermeid, *Schinz 701*; zwischen Ausis und Khuias, *Schenck 209*. The following specimens received from Z were studied: *Schenck 209* collected March 1885 zwischen Ausis und Khuias (between Ausis and Khuias); *Schinz 699*, collected at Aus, 20 January. On the label the year was altered and it is unclear whether it is 1875 or 1895. According to Glen & Germishuizen (2010) the date should be 1885. *Schinz 700* has no indication of an exact locality except for the region: Gross-Namaland. The date of collection is given as 5 December but again it is unclear from the label whether it was in 1874 or 1894. According to Glen & Germishuizen (2010) the date should be 1884. Of the two *Schinz 701* specimens, the label on one sheet indicated only a year (1885), no month, and that it was collected at Byzondermeid [Besondermaid]. The label on the second sheet indicated that it was collected at the same locality in January, in the year 1885 according to Glen & Germishuizen (2010). On the JSTOR website (2011) *Schinz 707* is listed as the type specimen but the label on the scanned specimen clearly shows *701*. As it is unclear whether Hoffmann (1893) saw all the *Schinz* specimens, I decided to choose the *Schenck* specimen as lectotype, in order to eliminate all uncertainties.

In Muschler's (1911) description of *Chrysocoma dinteri*, he stated that the plant flowered and had fruit in December 1897, but the label on the *Dinter s*pecimen received from Z (*Dinter 1190*), collected at Anabriver, clearly shows 5 September 1897.

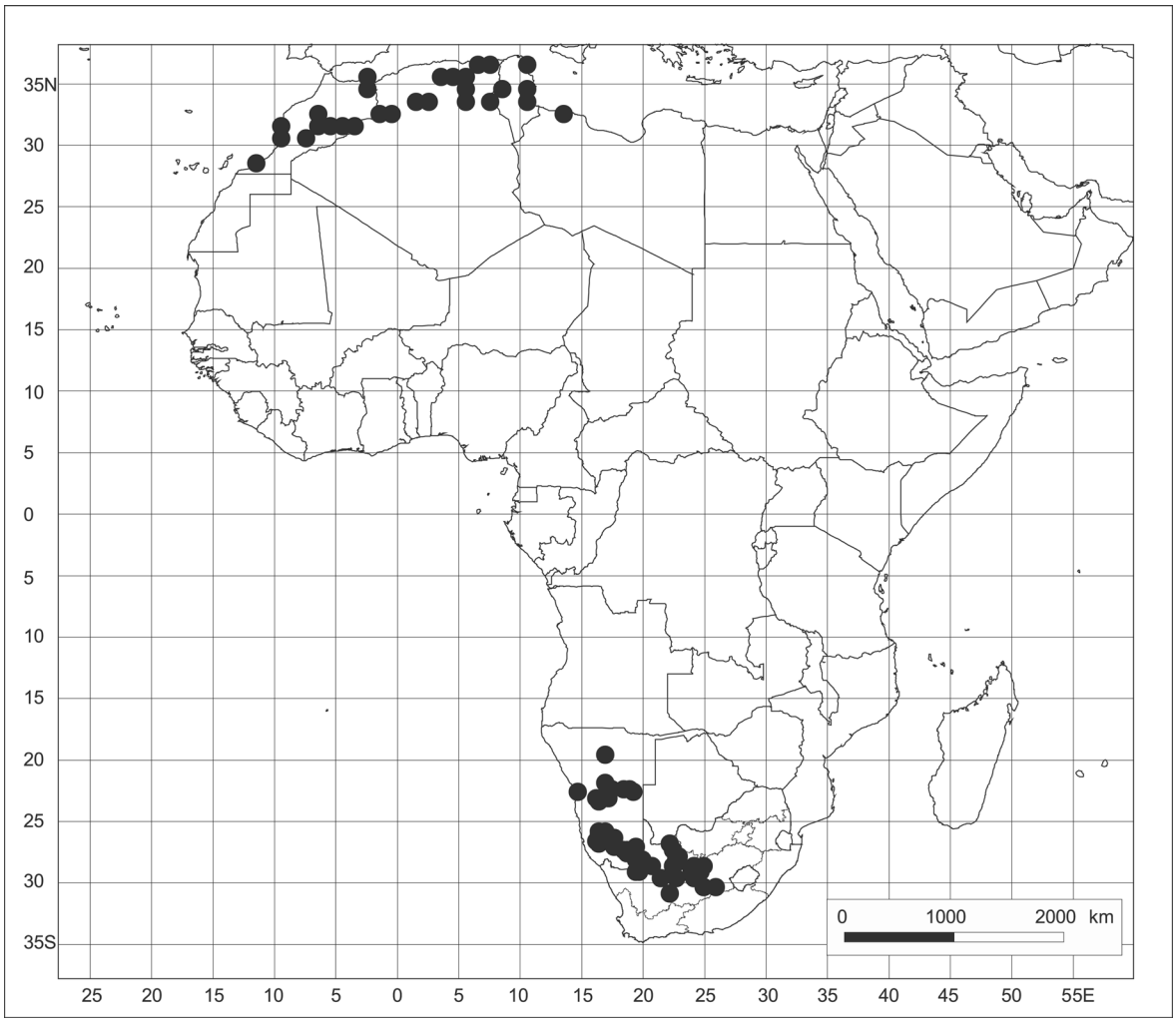

FIGURE 13. Known geographical distribution of *N. chrysocomoides* in Africa.

Additional specimens examined

SPAIN. Southern Spain, Malaga Prov., mount Bermeja, in gravel, 2 May 1907, *Gandoger s.n.* (Barcode M-0197321 & Barcode M-0197317) (M).

MOROCCO. Prov. Tan Tan, between Tan Tan and Oued Draa, 5 km SW Oued Draa Police Post, 28°28'59"N 11°00'44"W, 7 February 2007, *S.L. Jury & T.M. Upson 20504* (Barcode BC-871285) (BC). 10 km NE of Tan-Tan along the road to Goulimine, 28°29'N 11°03'W, 10 April 1986, *Podlech 40416* (Barcode MSB-005384) (MSB). Prov. Agadir, Sous-Ebene, 18 km SW of Ait Baha, N of Imi Mqoum, along the road from Inezgane to Tafraoute, 30°10'N 9°15'W, 29 April 1989, *Podlech 45470* (Barcode MSB-005374) (MSB). Prov. Agadir: 5 km S of Ait-Melloul, near the road to Tiznit, Brachfelder, 2 km to Agadir, 30°18'N 9°30'W, 8 April 1986, *Hagen 112* (Barcode M-0197316) (M). Prov. Agadir, 5 km S of Ait-Malloul, near the road to Tiznit, Brachfelder, 30°18'N 9°30'W, 8 April 1986, *Podlech 40210* (Barcode MSB-137000) (MSB). Agadir, dunes, 30°22'N 9°36'W, no date, *Herbier G. L'Hermite s.n.* (Barcode P04315593) (P). Agadir, to Ighir, in coastal sand, 30°22'N 9°36'W, 3 April 1926, *Mairé s.n.* (Barcode P02404447) (P). [ABNORMAL INFLORESCENCES!]. Prov. of Agadir, mouth of wadi Sous, northern bank, dunes, salt marshes, 30°22'N 9°36'W, 2 May 1989, *Podlech 45714* (Barcode P04295431) (P). Prov. Agadir, S of Agadir, dunes on north bank of Oued Sous, near the mouth, ± 10 m NN, 30°22'N 9°36'W, March 1990, *Schuhwerk 90/159* (Barcode

M-0197326) (M). Around Agadir, dunes between the town and the mouth of the wadi Sous, 30°26'N 9°36'W, 2 April 1952, *De Retz 31700* (Barcode P04371533) & (Barcode P03891825) (P). Anti-Atlas, between Aoulouz and Tazenakht, S of Jebel Siroua, 30°35'N 7°12'W, 14 April 1967, *Merxmüller & Oberwinkler 22483* (Barcode M-0197319) (M). Prov. Ouarzazate, 11 km ENE of Skoura along the road to Boumaine, 31°05'N 6°28'W, 18 April 1986, *Podlech 41102* (Barcode MSB-005386) (MSB). Prov. Safi, dunes S of Essaouira, ± 4 km S of Diabat, 31°26'N 9°46'W, 7 April 1986, *Podlech 40060* (Barcode MSB-005379) (MSB); 6 April 1997, *Podlech 53257* (Barcode MSB-005380) (MSB). Essaouira, ± 4 km S of Diabat, 31°26'N 9°46'W, 23 March 1990, *Schuhwerk 90/90* (Barcode M-0197325) (M). Right bank of wadi Asseb, near Mogador, 31°30'N 9°47'W, May 1867, *Balansa s.n.* (Barcode P02814524) (P), *Balansa s.n.* (Barcode P02415600) (P), *Balansa s.n.* (Barcode P02814492) (P). 3 km S of Essaouira, littoral dune, 31°30'N 9°47'W, 28 April 1997, *Fco. Gómiz 29RMQ2783* (Barcode BC-840766) (BC). Mogador, 31°30'N 9°47'W, May 1869, ?*Herb. Schoushoe 20* (Barcode P02814484) (P). Southern Morocco, near Mogador, 31°30'N 9°47'W, April–May 1871, *Hooker s.n.* (Barcode P02814481) (P). Mogadar, dunes, 31°30'N 9°47'W, 25 April 1923, *E. Jahandiez 173* (Barcode BC-144924) (BC). Essaouira Prov., Essaouira (= Mogador), ± settled coastal dunes, near the lighthouse, 31°30'N 9°47'W, 18 April 1984, *Lambinon & Lewalle 84/M/315* (Barcode M-0197324) (M) (Barcode MSB-005385) (MSB). Western Morocco, dunes SE of Essaouira (Mogador), 31°30'N 9°47'W, 11 April 1967, *Merxmüller & Oberwinkler 22347* (Barcode M-0197323) (M). Prov. Ouarzazate: Todra-Schlucht (Gorge du Todra), 12–14 km N of Tinerhir, 31°37'N 5°35'W, 17 April 1987, *Lippert 22191* (Barcode M-0197315) (M). Prov. Er Rachidia, 11 km W of Boudnib along the road P32 to Er Rachidia, 31°58'N 3°45'W, 4 April 1993, *Podlech 51010* (Barcode MSB-005383) (MSB). Ksar-es-Souk, Jebel Tisdafine, 5 km E of turn-off to Alnif along P32, 31°58'N 4°25'W, 21 August 1978, *Krach & Koepff 3909* (Barcode MSB-005375) (MSB). Dar Ould Zidouh, South-west Morocco, Mardochée, 32°07'N 6°26'W, 1875, no collector (Barcode P02814527) (P). Prov. Oujda, 7 km W of Figuig along the road P19 to Bouârfa, 32°09'N 1°18'W, 6 April 1993, *Podlech 51139* (Barcode MSB-005382) (MSB). Berkane, sandy places near Oued (Wadi) Ouaklane, 34°59'N 2°20'W, 30 May 1928, *A. Faure s.n.* (Barcode BC-144925) (BC), 12 May 1933, *Faure s.n.* (Barcode P02814523) (P).

Localities not found: Chtonka, Mardochée, South-west Marocco, 1875, *Herb Cosson* (Barcode P02814486) (P). Eaguereoualt, 17 May 1889, *Ibrahim s.n.* (P02814538) (P), *Ibrahim s.n.* (Barcode P02814493) (P). South-west Morocco, mountainous land, Mardochée, 1876, *Oubouzia, Cakoust & Zelten s.n.* (Barcode P02814513) (P). Oudjan, South-west Morocco, Mardochée, 1875, no collector (Barcode P02814495) (P).

ALGERIA. Aïn Sefra, south-west in the province of Oran, 32°45'N 0°35'W, 7 May 1856, *Cofson s.n.* (Barcode P02814421) (P). Cunetanae, in coastal sands at Nadour, 35°12'N 2°55'W, 24 May 1854, *Kralik 80a* (Barcode P02814463) (P). Desert steppe between Dzioua and Guerrara (Dept. Oasis), 33°14'N 5°14'E, 10 May 1964, *Faurel ?66* (Barcode P04323683) (P). Wilaya Biskra, 9 km W of Bou Aroua along the road to El Oued, 33°44'N 7°29'E, 10 March 1980, *Podlech 32865* (Barcode MSB-005377) (MSB). Sandy dunes at Aïn Ben Kheld, south of Chott el Rarbi, prov. of Oran, 33°?50'N 1°?50'E, 28 April 1856, *Kralik s.n.* (Barcode P02814507) (P). Laghouat, sandy soil, 33°50'N 2°59'E, 22 April 1899, *Chevallier s.n.* (Barcode P02814502) (P). Laghouat, in the south of the province Alger [ABNORMAL INFL.], 33°50'N 2°59'E, 1 June 1858, *Cosson s.n.* (Barcode P02814415) (P) and (Barcode P02814404) (P). Sand dunes at Laghouat, south in the prov. of Alger, 33°50'N 2°59'E, 11 June 1856, *Kralik s.n.* (Barcode P02814489) and (Barcode P02814428) (P). Wilaya Biskra, 20 km WSW along the road to Bou-Saada, 34°44'N 5°32'E, 5 June 1984, *Podlech 38618* (Barcode MSB-005378) (MSB). Gravel of the Wadi Biskra, at Biskra, 34°50'N 5°52'E, 9 April 1853, *Balansa s.n.* (?773) (P02814496) and (Barcode P02814430) (P). Biskra, in the south of the prov. Constantine, 34°50'N 5°52'E, 4 April 1858, *Cosson s.n.* (Barcode P02814430) (P). Biskra, sand at Aii Oumach, 34°50'N 5°52'E, 20 April 1892 *Chevallier s.n.* A; banks of the wadi, 34°50'N 5°52'E, 22 April 1892, *Chevallier s.n.* B; Dj Maouia, June 1897, *Chevallier s.n.* C [ABNORMAL INFL.] (Barcode P02814499) (P). Biskra, in the south of the prov. Constantine, 34°50'N 5°52'E, 1 April 1858, *Cosson s.n.* (Barcode P02814415) (P). In the neighbourhood of Biskra, 34°50'N 5°52'E, April 1856, *Schmitt s.n.* (?139) (Barcode P02814404) (P). Biskra, 34°50'N 5°52'E, ?8 July 1854, ?*Durand s.n.* (Barcode P02814424) (P). Sands at Biskra, 34°50'N 5°52'E, 10 June 1852, *Jamin*

s.n. (Barcode P02814429) (P). Biskra, Oued Biskra, dunes, 34°50'N 5°52'E, ?1914, *Renner s.n.* (Barcode M-0197318) (M). Sandy area of the banks N of Chergui Zahrez., Dept. of Alger, 35°12'N 3°32'E, 16 June 1938, *Dubuis s.n.* (Barcode P04323682) (P). Bou-Saâda, 35°12'N 4°11'E, 10 April 1931, *Herbier Gombault* (Barcode P02814439) (P). Sahara, El-Outaya (?Aïn Touta), Biskra, in sand and gravel desert, 35°26'N 5°59'E, 15 April 1896 & 11 May 1896, *Chevallier s.n.* (Barcode P02814432) (P). El Outaia (Aïn Touta) between Batna and Biskra, province of Constantine, 35°26'N 5°59'E, 27 May 1853, *Cosson s.n.* (Barcode P02814423) (P). El Outaia (?Aïn Touta), 35°26'N 5°59'E, no date, *Herb. De La Perraudière* (Barcode BC-144926) (BC). Dunen Caibel al guiblia, in Wadi Souf, in the south-east of the prov. Constantine, 36°22'N 6°37'E, 21 April 1858, *Cosson s.n.* (Barcode P02814417) (P). Quemar (?Guelma), in the Souf, in the south-east of the prov. Constantine, ?36°28'N 7°26'E, 16 April 1858, *Cosson s.n.* (Barcode P02814415) (P).

Localities not found: Sisi Kralil, in Wadi R'ir, in the south of the province Constantine, 11 April 1858, *Cosson s.n.* (Barcode P02814430) (P). ?Province of Oran, Leamba, 4 May 1856, *Cofson s.n.* (Barcode P02814421) (P). Sandy desert steppe 25 km to the east of Ksar-el-Hirane, 29 April 1965, *Faurel ?5684* (Barcode P04402156) (P). Route Mojador, Forest, 20 km, ?November 1939, *Herbier G. L'Hermite ?H45* (Barcode P04323680) & (Barcode P04323681) (P). Pl. Cunetanae, in sand, uncultivated, 29 May 1854, ?*L. Kralik ?80 Herb. De La Perraudière* (Barcode BC-144927) (BC).

TUNISIA. Governance of Medenine, Djerba island, coast NE of Houmt Souk, on a level with Ras Rmel, waste land on clayish sand close to the sea, 33°21'N 10°30'E, 6 January 2005, *Lambinon 05/Tu/45* (Barcode MSB-119829) (MSB). Governance of Gafsa, Palmenhai, SE Kris (NE of Tozeur), very salty soil, 34°00'N 8°19'W, 1 April 1981, *Podlech 35608* (Barcode MSB-005376) (MSB). Gafsa, 34°25'N 8°48'E, 19 April 1909, *Herbier Hibon s.n.* (Barcode P02814434) (P). Southern Tunisia, ± 46 km NE of Gafsa, along Kairouan-Gafsa road, 34°25'N 8°48'E, 17 April 1968, *Hertel 8523* (Barcode M-0197320) (M). Gafsa, sands of Wadi Baïach, 34°25'N 8°48'E, 10 January 1884, *Robert s.n.* (Barcode P02814433) (right hand specimen; left not *Nolletia*) (P). Gafsa, in sandy desert, 34°25'N 8°48'E, 1908, *C.J. Pitard s.n.* (Barcode BC-31482) (BC); March 1908, *C.J. Pitard s.n.* (Barcode BC-31483) (BC), (Barcode M-0197322) (M). Graiba, 34°30'N 10°13'E, 1 April 1912, *Humbert s.n.* (Barcode P03269172) (P). Forest of Enfidha, north of and near Batria [ABNORMAL INFL.], 36°07'N 10°23'E, 2 June 1883, *Cosson, Doûmel-Adanson, Letourneux, Keboud, Barratte, Bonnel s.n.* (Barcode P02814402) (P). Kroumbalia (?Grombalia), 36°36'N 10°30'E, 11 May 1883, *Cosson, Doûmel-Adanson, Letourneux, Keboud, Barratte, Bonnel s.n.* (Barcode P02814473) (P). East of Menzel Bou Zelfa, 36°41'N 10°36'E, 23 May 1883, *Cosson, Doûmel-Adanson, Letourneux, Keboud, Barratte, Bonnel s.n.* (Barcode P02814397) (P) and (Barcode P02814402) (P).

Localities not found: Aghaïssa, 26 April 1888, *Barratte s.n.* (Barcode P02814532) (P). Oued (wadi) Bateha, 18 April 1884, *Doumet-Adanson & Bonnet s.n.* (Barcode P02814467) (P). Gouifla, 9 May 1884, *Doumet-Adanson & Bonnet s.n.* (Barcode P02415599) (P). Wadi Cherchara, on sandy hills, 26 June 1884, *Letourneux s.n.* (Barcode P02814456) (P). El Toouara, 19 April 1887, *Letourneux s.n.* (Barcode P02814464) (P).

LIBYA. 28 km S of (Funduq) Bin Ghashir, vast plain of low sandy dune, 32°41'N 13°11'E, 2 March 1974, *Ellenberger 1778* (Barcode P04323686) (P). Tripoli, in sandy desert at Gargaresh, 32°54'N 13°11'E, 21–23 April 1933, *Bornmüller 761* (Barcode P02814437) (P). Tripoli, in moving sands at sea coast, Punta Tadjura, 32°54'N 13°11'E, 19 April 1933, *Bornmüller 762* (Barcode P02814478) (P).

NAMIBIA. 43 km from Otavi on road to Outjo, (QDS: 1916DB Gobaub), 9 March 1995, *Germishuizen 7763* (PRE, WIND). Waterberg, Quickborn, Okahandja, (QDS: 2116DD Okahandja), 1928, *Bradfield 35* (PRE) and 10 January 1928, *Bradfield s.n. TvlMus33021* (PRE). ± 1 km above Swakopmund River mouth, (QDS: 2214DA Swakopmund), 13 December 1956, *Seydel 841* (PRE). Swakop River, few km east of town, (QDS: 2214DA Swakopmund), 7 January 1987, *Craven 2972* (PRE). Windhoek and surroundings, (QDS: 2217AC Windhoek), 9 March 1988, *Bohlmann 88/47* (WIND). ± 30 km E of Windhoek along road to Steinhausen, farm Neudamm 63, just after farm Ludwig 64, (QDS: 2217AD Windhoek), 6 April 1968, *Wanntorp & Wanntorp 690* (PRE). Farm Regenstein: WIN 32, Grossherzog Friedrich Berg, (QDS: 2217CA Windhoek), 6 May 1975, *Giess 13719* (PRE, WIND). Windhoek Municipal area, near river at dam, (QDS: 2217CA Windhoek), 23 November 1962, *Hanekom 307* (WIND). Bushveld on Waterberg, (QDS: 2217CA

Windhoek), 23 December 1957, *Merxmüller 8616* (PRE, WIND). Windhoek, at reservoir, (QDS: 2217CA Windhoek), 9 August 1963, *Merxmüller & Giess 3579* (PRE). Regenstein, Aredareigas flats, (QDS: 2217CA Windhoek), 22 August 1972, *Merxmüller & Giess 28038* (PRE, WIND). Farm Oamites, in river at northern border of farm, (QDS: 2217CC Windhoek), May 1961, *Giess 3747* (PRE, WIND). Witvlei townlands, (QDS: 2218AD Gobabis), 21 April 1969, *Mason & Boshoff 2581* (PRE). Edge of Gobabis town, (QDS: 2218BD Gobabis), 14 January 1958, *Merxmüller 1222* (PRE, WIND). Omaheke, Road C22, south of Gobabis, (QDS: 2219CA Sandfontein), 9 March 2002, *Mannheimer CM1789* (WIND). Farm Kos, (QDS: 2316AA Nauchas), 17 December 1957, *Merxmüller 921* (PRE, WIND). Khomas, farm Weener, (QDS: 2316AD Nauchas), 10 February 2004, *Strohbach BS5787* (WIND). Farm Naruchas (REH 254), border with Arovley, (QDS: 2317AA Rehoboth), 29 September 1972, *Merxmüller & Giess 28904* (PRE, WIND). Karas, Tiras Mountains, farm Langsberg, (QDS: 2516CD Helmeringhausen), 11 March 2009, *Klaassen, Rügheimer & Hochobes EK2107* (WIND). South of Helmeringshausen, (QDS: 2516DD Helmeringhausen), 7 April 1992, *Strohbach 142* (WIND). Farm Weissenborn, Riet River, (QDS: 2616AB Aus), 9 July 1949, *Kinges 2447* (PRE, WIND). Namib flats between Neisip and Eureka, (QDS: 2616AD Aus), 16 August 1963, *Merxmüller & Giess 2895* (PRE). 14 km from Helmeringhausen on road to Aus, (QDS: 2616BA Aus), 20 October 1987, *Kolberg & Maggs 127* (PRE, WIND). Farm Neisip Beth No 34, (QDS: 2616BA Aus), 10 June 1972, *Wiss 2553* (PRE, WIND). W of Aus, Klein Aus Vista, near Geister Schlught, ± 5 km from turnoff to Eagles Nest, (QDS: 2616CA Aus), 11 August 2007, *Funk et al. 12689* (PRE). On the Klein Aus Vista reserve near Geister Schlugt, (QDS: 2616CA Aus), 11 August 2007, *Koekemoer 3522* (PRE). Karas, Geisterschlucht Koppies Hike, (QDS: 2616CA Aus), 23 September 2003, *Mannheimer CM2480* (WIND). Farm Klein Aus, (QDS: 2616CA Aus), 25 June 1949, *Kinges 2253* (PRE). Aus, (QDS: 2616CB Aus), 20 January 1885, *Schinz 699* (Z). Byzondermeid [Besondermaid], (QDS: 2617BC Bethanie), January 1885, *Schinz 701* (K e, PRE photo, Z). Karasburg Mountains, where Karasburg-Windhoek road passes through mountain, (QDS: 2718AD Grünau), 27 February 1996, *Burgoyne & Snow 4898B* (PRE, WIND). Great Karas Mountain, 30 miles S of Narubis on road to Grunau, (QDS: 2718BC Grünau), 29 April 1955, *De Winter 3324* (PRE, WIND). Farm Us: KEE162, (QDS: 2718BC Grünau), 17 May 1972, *Giess & Müller 12018* (PRE, WIND). Genadendal, S end of Great Karasberg, (QDS: 2718DA Grünau), 5 May 1976, *Oliver 6294* (PRE). Farm Warmfontein KEE 280, (QDS: 2719AB Tränental), 22 July 1976, *Lensing J1/76* (WIND). Farm Hudab South: WAR 39, (QDS: 2719CD Tränental), 20 May 1963, *Giess, Volk & Bleissner 7116* (WIND). Karas, water course east of Hamab, (QDS: 2819AB Ariamsvlei), 17 April 1997, *Strohbach 3374* (WIND). Ariamsvlei, WAR, W of Ariamsvley, (QDS: 2819BB Ariamsvlei), 14 December 1957, *Merxmüller 733* (PRE, WIND). Without precise locality, Gross-Namaland, 5 December 1884, *Schinz 700* (Z).

SOUTH AFRICA. Free State: Orange River near Bethulie, (QDS: 3025BD Colesberg), December 1893, *Flanagan 1918* (NH, PRE).

Northern Cape: Kalahari Gemsbok National Park, without precise locality, (QDS: 2520 Mata Mata), 12 February 1955, *Brynard 403* (PRE). 23 miles WSW of Van Zylsrus in bed of Kuruman River, (QDS: 2622CC Tshabong), 23 September 1959, *Leistner 1960* (KMG). Tswalu Kalahari Reserve, farm Gosberg, (QDS: 2722AD Olifantshoek), 27 June 2006, *Anderson & Van Heerden 1167* (KMG), 28 June 2006, *Anderson, Van Heerden & Hill 1151* (KMG). 16 miles SSW of Olifantshoek, (QDS: 2722DD Olifantshoek), 28 August 1961, *Leistner & Joynt 2773* (PRE). 10 km from Kakamas along road (N14) to Keimoes, (QDS: 2820DA Kakamas), 20 August 1995, *Rodriguez-Oubina & Cruces 1986* (PRE). ± 16.8 km W of Olifantshoek on Pearson's Hunt road, (QDS: 2822BA Glen Lyon), 10 August 2000, *Smook 10956* (PRE). Dunmurray, the Vlakte, (QDS: 2822BC Glen Lyon), February 1923, *Wilman s.n. KMG2430* (KMG). Witsand Nature Reserve, farm Witsands 250, (QDS: 2822CB Glen Lyon), 17 April 1995, *Bosch 55* (KMG). Witsand Nature Reserve, farm Witsands 591, (QDS: 2822CB Glen Lyon), 12 December 1995, *Bosch 209* (KMG). Witsand, (QDS: 2822CB Glen Lyon), April 1940, *Esterhuysen 2338* (PRE). Zandbult, 20 miles NE of Douglas, (QDS: 2823DD Griekwastad), 22 December 1959, *Leistner 1544* (KMG, PRE). Rooipoort farm, (QDS: 2824CA Kimberley), 10 September 1990, *Phelan 1015* (KMG, PRE). 25 miles NE of Douglas, (QDS: 2824CC Kimberley), 21 December 1959, *Leistner 1542* (KMG, PRE). Zand Heuvel, (QDS: 2824CD Kimberley), April 1937,

Esterhuysen 4761 (KMG, PRE). Kimberley, (QDS: 2824DB Kimberley), May 1919, *Moran 13* (PRE). 27 miles SW of Kimberley, (QDS: 2824DC Kimberley), 3 November 1960, *Leistner 2004* (KMG, PRE). 56 miles WSW of Pofadder, (QDS: 2919AB Pofadder), 25 May 1961, *Leistner 2516* (KMG). Gemsbokvlakte, (QDS: 2919BA Pofadder), 25 May 1989, *Dean 668* (PRE). Lat River, 23 miles SSE of Kenhardt, (QDS: 2921CB Kenhardt), 9 May 1952, *Acocks 16354* (PRE). Prieska, without precise locality, (QDS: 2922DA Prieska), 26 February 1921, *Bryant J204* (PRE), May 1935, *Bryant 1102* (PRE). Herbert, Thornhill, c. 8 miles E of Salt Lake, (QDS: 2924AC Hopetown), 14 March 1959, *Leistner 1286* (KMG). Banks of Riet rivier, near Modder Rivier Station, (QDS: 2924BA Hopetown), November 1919, *Moran s.n. KMG2425b* (KMG). Banks of Orange River near Hope Town Bridge, (QDS: 2924CA Hopetown), 27 May 1938, *Acocks 8765* (KMG, PRE). Carnarvon, without precise locality, (QDS: 3022CC Carnarvon), April 1937, *Esterhuysen s.n. KMG4760* (KMG). Doornkloof Nature Reserve 537, (QDS: 3024BD De Aar), 16 October 1991, *Badenhorst D327* (PRE).

12. ***Nolletia annetjieae*** P.P.J.Herman *sp. nov.* (Fig. 14)

Similar to *Nolletia chrysocomoides* but with fewer and narrower leaves and circular epicarpic cells on cypsela surface scattered and arranged in pairs, each pair with one small twin hair between them. Also similar to *Nolletia rarifola* but cypselae of that species with oblong epicarpic cells and with dark oil sacs on involucral bracts.

Type:—SOUTH AFRICA. Northern Cape: Kgalagadi Transfrontier Park, 6 km NE of Gharagab Wilderness Camp, (QDS: 2520AA Mata Mata), 16 May 2010, *Koekemoer 3901* (holotype PRE!, isotypes K, PRU, US, WIND).

Iconography:—Van Rooyen *et al.* (2001, Fig. p. 195, as *N. arenosa*).

Sparsely to scattered leafy, sometimes almost leafless, virgate or caespitose suffrutex, rarely a small shrub, from woody, vertical rootstock, (0.25–)0.3–0.6(–1) m high. *Stems* wiry, simple or sparsely branched, greenish or yellowish brown at base, herbaceous and green upwards; glabrous to sparsely appressed pubescent, more densely so at tips and below capitula. *Leaves* alternate, sparsely set, held close to stem, sessile, linear-filiform, lower leaves (7–)10–20(–40) × (0.2–)0.5(–1.0) mm, decreasing in size upwards; apex acute; margin entire; glabrous or sparsely to densely appressed pubescent on both surfaces. *Capitula* heterogamous, disciform, 8–10 mm in diameter, arranged in few-headed, loose corymbs or rarely solitary, terminal. *Involucre* campanulate. *Involucral bracts* imbricate, in 3 or 4 rows, green, often tinged purplish, persistent and recurved in old inflorescences; outer row mostly narrowly ovate or narrowly triangular to narrowly elliptic, 1.3–2.2 × 0.3–1.0 mm, apex acute to acuminate, with fimbriate margins, appressed pubescent; second row varying from narrowly elliptic to narrowly oblong or narrowly ovate to narrowly obovate, 2–3 × 0.5–1.0 mm, apex acute, with narrow membranous, fimbriate margin, appressed pubescent; third row mostly narrowly obovate, but also narrowly elliptic to narrowly oblong, 2.1–4.0 × 0.8–1.0 mm, apex acute, with membranous, fimbriate margin, appressed pubescent; inner row narrowly obovate to narrowly elliptic, 3.2–4.1 × 0.5–1.0 mm, apex acute to acuminate, with membranous, fimbriate margin, central part appressed pubescent. *Receptacle* epaleate, foveolate. *Outer female florets* 13–20, in 1 row, fertile, filiform; tube 1.0–1.5 mm long, shorter than style furcation, with numerous glandular hairs; corolla pale yellow, sometimes purplish at apex. *Style* 1.5–3.0 mm long, bifurcate; style branches elliptic, 0.5–1.0 mm long, apex rounded; stigmatic areas marginal, confluent at apex. *Pappus* and *cypsela* as in disc florets. *Disc florets* 26–43, regular, bisexual, fertile; tubular at base, tube 2–3 mm long, widening slightly after ± 1 mm but still tubular, then widening further upwards towards lobes, lobes 5, 0.5–1.0 mm long; with glandular hairs around first widening and few glandular hairs on lobes; corolla yellow or sometimes upper part of tube and lobes purplish. *Anthers* 0.6–1.6 mm long, with narrowly ovate apical appendages; bases shortly calcarate, ecaudate; filament collars with thickened cell walls. *Style* 1.5–3.5 mm long, bifurcate; style branches linear, 0.5–1.0 mm long; stigmatic areas marginal, with deltoid-penicillate apical appendages. *Cypsela* honey-coloured, shiny, narrowly obovoid, laterally compressed, often skew to 1 side, 1.5–2.5 × 0.5–1.0 mm (Fig. 1K); surface with scattered, circular to elliptic epicarpic cells arranged in pairs, each pair with 1 short twin hair between them (Figs. 2H, 3E, F), apices of twin hairs acute, slightly subequal in length. *Pappus* of caducous, barbellate bristles, 2.0–3.2 mm long. *Flowering time*: from December to August, with a peak from January to May.

FIGURE 14. Scanned image of the holotype of *N. annetjieae* P.P.J.Herman (*Koekemoer 3901*, PRE).

Distribution and habitat:—Namibia, Botswana, North-West (doubtful locality), Northern Cape (Fig. 15), growing in sand. The conservation status of this species is not currently known but judging from the number of specimens in herbaria, probably LC (Least Concern).

Discussion:—Similar to *N. chrysocomoides* but distinguished by the long, simple twigs with very few and very narrow leaves and by the circular epicarpic cells scattered and arranged in pairs, with a single, short twin hair between each pair. Also very similar in appearance to *N. rarifolia* but without dark oil sacs on involucral bracts and cypselae with paired circular epicarpic cells as opposed to oblong epicarpic cells in *N. rarifolia*.

Note:—The plant described by Van Rooyen *et al.* (2001) as *N. arenosa* (= *N. chrysocomoides*) is most probably *N. annetjieae* as all the specimens in PRU collected by Van Rooyen, previously identified as *N. arenosa*, were re-identified as this species. Van Rooyen *et al.* (2001) regarded *N. arenosa* as endemic to the southwestern Kalahari.

Etymology:—Named for my younger daughter Annetjie.

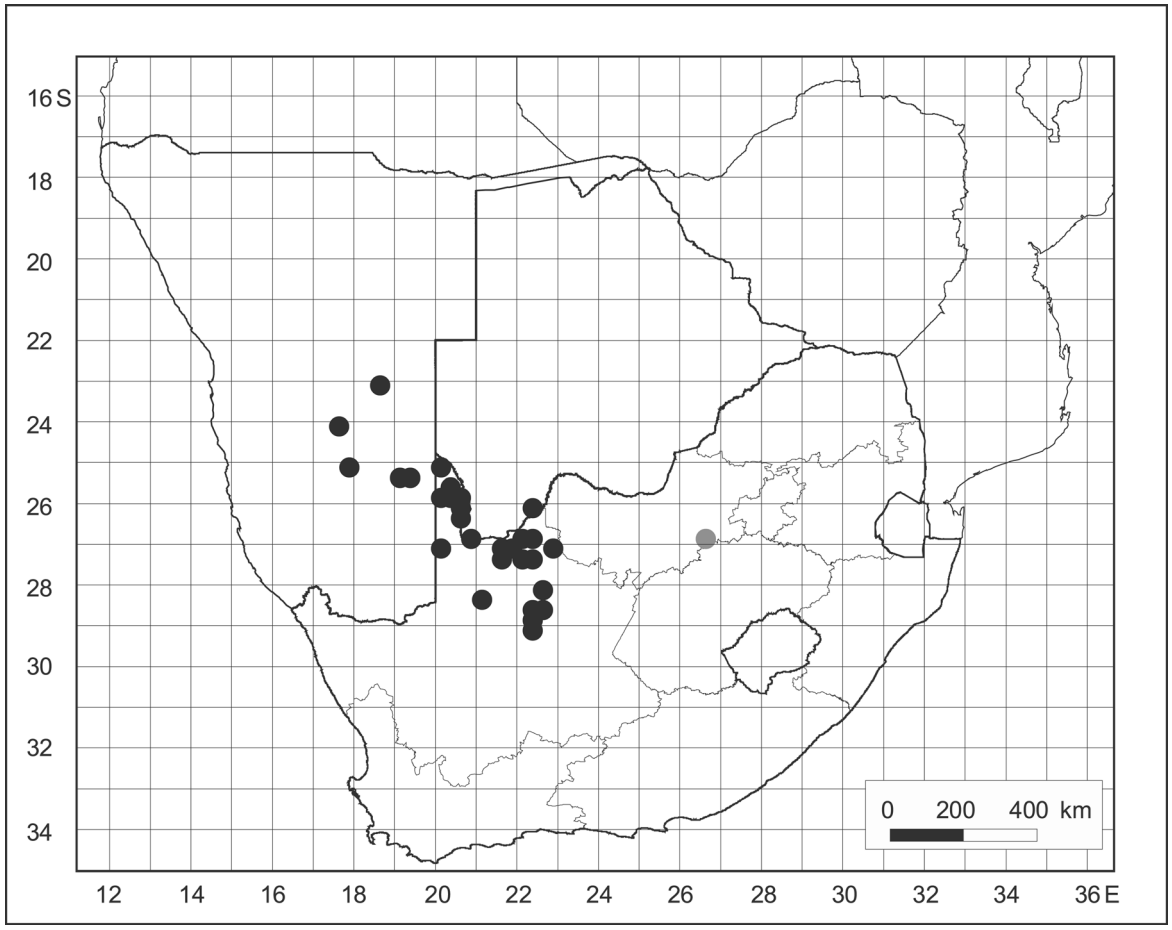

FIGURE 15. Known geographical distribution of *N. annetjieae*. The grey dot represents a doubtful locality.

Additional specimens examined

NAMIBIA. Farm Donnersberg GO 29, (QDS: 2318BA Leonardville), March 1956, *Volk 11663* (WIND). Rehoboth Distr., 4.5 miles SE of Kalkrand, (QDS: 2417BA Mariental), 10 May 1955, *Acocks 18138* (PRE). Farm GIB 465, 24 miles N of Auob, (QDS: 2517BB Gibeon), 25 May 1963, *Giess, Volk & Bleissner 7255* (PRE, WIND). Farm Vergenoeg: GIB 196, (QDS: 2519AC Koës), 26 May 1970, *Giess & Wolf 10905* (PRE, WIND). Farm Houmoed: GIB 468, (QDS: 2519AD Koës), 28 May 1970, *Giess & Wolf 10928* (PRE, WIND).

BOTSWANA. 10 miles S of Tsabong, (QDS: 2622AB Tshabong), 25 February 1960, *Wild 5157* (PRE).

SOUTH AFRICA. North-West: Klerksdorp, banks of Vaal River, (QDS: 2626DC Klerksdorp), May 1977, *Repton 7156* (PRE), *Repton 7156A* (PRE). Doubtful locality.

Northern Cape: Kalahari Gemsbok National Park, Loffiesdraai, (QDS: 2520AA Mata Mata), 16 June 1984, *Van Rooyen 3714* (PRE, PRU), 16 March 1988, *Van Rooyen 4006* (PRU). Kalahari Gemsbok National Park, Stoffelsdraai, (QDS: 2520CB Mata Mata), 12 May 1988, *Van Rooyen 3760* (PRU). Mier, (QDS: 2520CB Mata Mata), 25 March 1979, *Gubb 5-17* (PRU). Kalahari Gemsbok National Park, 10 miles S of Mata Mata, (QDS: 2520CC Mata Mata), 2 December 1957, *Leistner 1005* (KMG, PRE). Kalahari Gemsbok National Park, 2 miles N of Mata-Mata, (QDS: 2520CC Mata Mata), 19 February 1963, *Liebenberg 7061* (PRE). Kalahari Gemsbok National Park, Urikaruus, (QDS: 2520CD Mata Mata), 19 February 1963, *Liebenberg 7053* (PRE). Kalahari Gemsbok National Park, Kij Games?, (QDS: 2520DC Mata Mata), 14 May 1987, *Van Rooyen 3912* (PRU). Kalahari Gemsbok National Park, without exact locality: Mata Mata, western border of Kalahari Gemsbok National Park, 19 May 1956, *Story 5550* (KMG, PRE). Kalahari Gemsbok National Park, Tzamma wind mill, (QDS: 2620AA Twee Rivieren), 10 May 1981, *De Beer B27* (PRE). Kalahari Gemsbok National Park, Kij Garries, (QDS: 2620BA Twee Rivieren), 4 November 1998, *Van Rooyen 4557* (PRU). Kalahari Gemsbok National Park, Twee Rivieren, (QDS: 2620BC Twee Rivieren), 18 November 1999, *Van Rooyen 4773* (PRU). Kalahari Gemsbok National Park, Twee Rivieren, Auob River bed, (QDS: 2620BC Twee Rivieren), 4 February 1989, *Van Rooyen & Bredenkamp 13* (PRU). Askham District, farm Avond Schijn, 50 km E of Bokputs next to Botswana border, (QDS: 2620DD Twee Rivieren), 24 March 2005, *Geldenhuys 70* (PRU). No exact localities: Kalahari Gemsbok National Park, May 1983, *Theron 3954* (PRU) and *Theron 3955* (PRU). Kuruman Distr., 14 miles SE of Van Zylsrus, (QDS: 2622CC Tshabong), 16 January 1960, *Leistner 1581* (KMG, PRE). Van Zijlsrust, Floridale farm, (QDS: 2622CD Tshabong), 30 March 1988, *Venter 12841* (PRE). Naroegas, (QDS: 2720AA Noenieput), July 1976, *Jooste 454* (PRE), *Jooste 484* (PRE). 50 km from Van Zylsrus on road to Witdraai, near farm Tampanbrand, (QDS: 2721BA Telleriepan), 19 April 1989, *Joffe 673* (PRE). On road from Vanzylsrus via Koeipan to Pearson Hunt, (QDS: 2721BB Telleriepan), 23 February 2000, *Smook 10490* (PRE). Gordonia, Massakloutjie, (QDS: 2721BC Telleriepan), 26 April 1961, *Mostert 1317* (NMB). Upington, “Conradie”, (QDS: 2721?BC Telleriepan), 27 April 1961, *Mostert 1317* (PRE). On road from Vanzylsrus to Pearson Hunt, (QDS: 2722AC Olifantshoek), 23 February 2000, *Smook 10456* (PRE). Tswalu Kalahari Reserve, farm Delela, (QDS: 2722AD Olifantshoek), 28 June 2006, *Anderson & Van Heerden 1202* (KMG). Hotazel, T-junction Frylickspan–Van Zylsrus, (QDS: 2722BB Olifantshoek), 6 March 1996, *Smit 714* (PRU). 59 km W of Olifantshoek along Kuruman-Upington Highway, (QDS: 2822BA Glen Lyon), 6 February 1974, *Davidse & Loxton 6428* (PRE). 20 km from Olifantshoek along N14 to Upington, (QDS: 2822BA Glen Lyon), 19 August 1995, *Rodriguez-Oubina & Cruces 1979* (PRE). 4 to 5 miles W of entrance to Padkloof Pass, (QDS: 2822CB Glen Lyon), 15 March 1937, *Acocks 2064* (KMG, PRE). Hay Div., Witsand, (QDS: 2822CB Glen Lyon), 30 March 1937, *Acocks 2164* (KMG, PRE). Farm Rehoboth, camp before main gate to farm, N of Groblershoop, (QDS: 2822CD Glen Lyon), 28 January 1996, *Germishuizen 8480* (PRE). Witsand, (QDS: 2822DA Glen Lyon), March 1938, *Wilman s.n. KMG5357* (KMG). Hay Division, Lelyks Stad [Leliksstad], (QDS: 2922AB Prieska), June 1938, *Acock s.n. KMG5752* (KMG).

Hybrid*: *Nolletia chrysocomoides* × *Nolletia annetjieae

Five specimens were seen where the cypselae on the same plant have a mixture of features from the above two species: some cypselae have circular epicarpic cells all over the surface, each with a twin hair; some cypselae have scattered paired circular epicarpic cells each with a single twin hair between them and some cypselae have circular epicarpic cells all over the surface but with a single twin hair between two cells. Also vegetatively, the plants resemble either *N. chrysocomoides* or *N. annetjieae*. These hybrid specimens were only recorded from Namibia (Fig. 10).

Specimens examined:

NAMIBIA. Rehoboth, farm Koos, (QDS: 2316AA Nauchas), 16 July 1953, *Schwerdtfeger 4297* (WIND): The inflorescences are either old or very young but the cypselae or ovaries have circular epicarpic cells, each with a twin hair, covering the surfaces of the cypselae. Vegetatively it looks like *N. annetjieae* but has

cypselae like those of *N. chrysocomoides*. Gobabis, farm Maramba, (QDS: 2319CA Aminuis), 11 January 1958, *Merxmüller 1130* (PRE, WIND): These two specimens look vegetatively like *N. annetjieae* but some of the cypselae of the WIND specimen have scattered, paired circular epicarpic cells with one twin hair between each pair and some cypselae are covered with circular epicarpic cells, each with a twin hair. The PRE specimen has only young inflorescences and the ovaries have paired circular epicarpic cells each pair with one twin hair between them. Farm Uitkoms BET 3, (QDS: 2517CC Gibeon), 26 February 1963, *Giess, Volk & Bleissner 5539* (PRE, WIND): These two specimens look vegetatively like *N. chrysocomoides* but the cypselae have a mixture of circular epicarpic cells, each with a twin hair, covering the surface, or paired circular epicarpic cells, each pair with one twin hair between them, scattered over the surface or circular epicarpic cells covering the surface but with one twin hair between circular cells.

Species excluded

Nolletia costata Klatt = **Nicolasia costata** (Klatt) Thell.

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