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Petalidium sesfonteinense (Acanthaceae), a new species from the Kaokoveld, Namibia

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Abstract

Petalidium sesfonteinense, previously most commonly confused with the widespread *P. variabile*, is here described as a new species. It is only known from the Sesfontein area in the Kaokoveld Centre of Endemism, northwestern Namibia, where it grows on hillsides and along ephemeral riverbeds. Diagnostic characters for *P. sesfonteinense* include the short, stout trunk on older plants, white bark that peels on the younger branches in long, narrow strips, dendritic trichomes on vegetative parts, flowers in short dichasia with acute oblanceolate bracts, flowers with externally glabrous corollas, corolla lobes that are pink, magenta, apricot or cream and with the two upper lobes connate towards the base and the lower lobe with two yellow spots near the base. A comparison of some of the more prominent morphological features to differentiate *Petalidium sesfonteinense* from close relatives is provided. Based on IUCN Red List categories and criteria, a conservation assessment of Least Concern (LC) is recommended for the new species.

Keywords: Desert, endemism, flora, Kaokoveld, Ruellieae, Sesfontein, taxonomy

Introduction

At present, 29 described species of *Petalidium* Nees von Esenbeck (1832: 75) are recognized in the *Flora of southern Africa* region (South Africa, Namibia, Botswana, Eswatini, and Lesotho), of which 27 have been recorded for Namibia (Germishuizen & Meyer 2003, Swanepoel 2020). Here, a localised new species of *Petalidium* is described. This new entity, so far as known, is endemic to the Kaokoveld Centre of Endemism—a biogeographical region rich in range-restricted plants and animals in northwestern Namibia and adjacent southwestern Angola (Van Wyk & Smith 2001, Craven 2009).

During several botanical expeditions to the Sesfontein area, the first author encountered an unfamiliar *Petalidium* characterized by its dwarf shrub habit with a short, stout trunk typical of older plants, white peeling bark, dendritic trichomes, and flowers in short dichasia. The plants were at first seen only sterile, but in June 2021, they were found in flower, enabling the taxon to be identified as an undescribed species. The new species can be confused with several other members of *Petalidium* in northwestern Namibia with which it shares morphological similarities, especially in features of the indumentum, leaves, and flowers. Its closest relatives are *P. kaokoense* Swanepoel (2020: 237), *P. welwitschii* Moore (1880: 227), *P. ohopohense* Meyer (1973: 108), and *P. rossmannianum* Meyer (1961: 68) (see Tripp *et al*. 2017, and discussion below). Another species with which the new species is most often confused is *P. variabile* Clarke (1899: 92).

The Kaokoveld is a pronounced centre of diversity and endemism for *Petalidium* (Craven 2009, Tripp *et al*. 2017) and related Acanthaceae (e.g., Tripp & Dexter 2012, Darbyshire *et al*. 2020), hence the discovery of a new species in this region is not unexpected. A study of the *Petalidium* holdings in WIND revealed several earlier collections of the new species, all filed either under *P. variabile* or *P. rossmannianum*.

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Material and methods

Morphological descriptions and ecological information presented here are based on field observations and material collected during extensive field work in Namibia. Diagnostic features for the new species, *P. coccineum* Moore (1880: 225), *P. kaokoense*, *P. pilosi-bracteolatum* Merxm. & Hainz in Suessenguth & Merxmüller (1955: 69), *P. variabile*, and *P. welwitschii* were determined through examination of fresh material, and for *P. halimoides* Moore (1880: 228), *P. lanatum* Clarke (1899: 90), *P. ohopohense*, and *P. rossmannianum* from herbarium material and high-resolution images (including images of the holotypes) available on the internet through JSTOR Global Plants (https://plants.jstor.org/). This was supplemented by the study of relevant literature (including the protologues) and herbarium collections. The herbarium of the National Botanical Research Institute in Namibia (WIND) was consulted for possible collections of the new species (herbarium codes follow Thiers 2022). A 6.5–45.0× magnification stereo microscope was used for studying morphological features. Terminology follows Beentje (2016) and Manktelow (2000). The distribution map was compiled from specimen data using ArcView 3.1 software. Conservation assessment follows IUCN (2012) recommendations.

Taxonomic treatment

Petalidium sesfonteinense Swanepoel & E.Tripp, *sp. nov.* (Figs. 1–3)

Diagnosis:—A woody shrub up to 1 m tall, morphologically most similar to *Petalidium kaokoense* and *P. variabile*; from *P. kaokoense* it differs in having an indumentum on vegetative parts of relatively slender dendritic trichomes (*vs*. relatively stout stalked-stellate trichomes interspersed with dendritic trichomes), bracts oblanceolate (*v*s. linear-oblanceolate or linear-lanceolate), bracteoles symmetrically elliptic or narrowly ovate with long multicellular glandular trichomes and venation weak or not prominent (*vs*. asymmetrically elliptic-oblong, long multicellular glandular trichomes absent, reticulation prominent), corolla with expanded portion of tube glabrous externally (*vs*. strigose), upper lobes connate for 20–30% of their length and obovate (vs. 50%, oblong), lobes variously coloured (white, pink, magenta, apricot, yellow, or cream) and in contrast with maroon throat and mouth (*vs*. lobes, throat, and mouth maroon), seeds cordate (*vs*. discoid or ovate); from *P. variabile* it differs in indumentum on young stems different from that on leaves (*vs*. similar), indumentum on leaves dendritic (*vs*. strigose), bracteoles usually with long multicellular trichomes (*vs*. absent), expanded portion of corolla tube glabrous externally (*vs*. with short appressed simple trichomes), all corolla lobes of same colour and shade (*vs*. front corolla lobe differently coloured or shaded than other lobes), capsule flattened ellipsoid or ovoid, sides rugose or smooth (*vs.* flattened ovoid, sides smooth).

Type:—NAMIBIA. Kunene Region: Eastern tributary to Ganamub River in mountainous area between Giribesvlakte and Hoanib River, 1913AB, 477 m, 14 June 2021, *Swanepoel 568* (holotype WIND!; isotypes COLO!, PRE!, PRU!).

Erect woody shrub to 1 m tall; all relatively young vegetative parts with dense indumentum of relatively slender white dendritic trichomes, glabrescent or nearly so. *Stems*: main stem up to 80 mm diam., bark fissured, cream-coloured or greyish white; bark on distal stems peeling in long, thin, narrow strips; young stems quadrangular with very short simple glandular and short to long eglandular trichomes, often multicellular, also bi-furcating and dendritic or long-stalked stellate trichomes, or trichomes absent; pale green with cystoliths linear or appearing circular. *Leaves* opposite and decussate, petiolate; laminae narrowly ovate, ovate or elliptic, rarely oblanceolate, 15–44 × 8–27 mm, with dense indumentum of dendritic trichomes, grey to greyish green, becoming green to yellowish green with age, cystoliths inconspicuous; apices acute, obtuse or rounded, sometimes minutely apiculate, bases attenuate, decurrent, rarely rounded, margins entire; midribs prominent both sides, lateral veins 4 to 6 each side, usually not prominent, petioles up to 15 mm long. *Flowers* in short dichasia, bracts foliaceous, oblanceolate, up to 15.0 × 2.2 mm, apex acute, sessile; pedicels (below bracteoles) 0.5–1.2 mm long; bracteoles symmetrically elliptic or narrowly ovate, coriaceous, forming prominent bulging on bracteole pair from which corolla limb emerges from one side, apex acute, sometimes slightly acuminate or asymmetric, pale green to yellowish green, reticulation slightly or not prominent, midrib straight, venation indistinct, pale green, ca. 10.6–13.3 × 5.4–6.8 mm, abaxially with dense glandular trichomes of various lengths, few to scattered long multicellular glandular trichomes, sometimes with very long multicellular sparsely branched eglandular simple or dendritic trichomes in addition, strigose towards base, sericous adaxially, margin lanate towards apex, cystoliths visible. *Calyx* 6.6–7.2 mm long including basal tube of ca. 2 mm, strigose in places on both surfaces; lobes 4, lanceolate, acute, anticous lobe indistinctly bifid, anticous and upper ca. 5.6–7.8 × 1.5–1.7 mm, folded

lengthwise, laterals 5.6–7.0 × 0.9–1.1 mm. *Corolla* 20–24 mm long with lobes straightened, narrow unexpanded portion cylindrical, slightly widening towards throat, flattened, ca. 10 mm long, ca. 3.2 mm diam, expanded portion ca. 6 mm long, outside glabrous, inside puberulous on area immediately above insertion of filaments up to mouth, otherwise glabrous; inside of anticous portion of throat yellow, terminating in two narrowly triangular separate markings (nectar guides) on proximal portion of lobes; lobes white, pink, magenta, apricot, yellow or cream, expanded portion (throat and mouth) maroon, front lobe including nectar guides maroon dotted proximally, all lobes patent and with long, stiff, patent, white eglandular trichomes, upper lobes obovate, 5.8–8.2 × 3.5–4.3 mm, connate for 20–30% of their length, overlapping or not, apices rounded, retuse, lateral lobes oblong, 5.2–7.8 × 3.2–4.5 mm, apices retuse or truncate, front lobe broadly obovate, 5.5–8.8 × 6.2–7.2 mm, apex rounded, retuse, all lobe margins entire or irregularly denticulate to dentate; palate prominently transversely 3–7-ribbed. *Filaments* didynamous, inserted dorsally in throat, each long and short filament fused for ca. 1.4 mm at base, fused part prominent, adnate to tube, free parts tapering towards apex, flattened, with scattered short eglandular trichomes, long filament 4.3–5.7 mm long, short filament 2.2–3.3 mm long; filament curtain reduced (Manktelow 2000); anthers 2-thecous, thecae oblong, subequal, 2.1–2.9 mm long with scattered short glandular and eglandular trichomes, apex rounded, with minute spurs at base. *Gynoecium* 12.6–15.6 mm long; ovary ovoid, laterally compressed, 1.5–2.0 × 1.5–1.7 × 1.0–1.2 mm, situated on fleshy disc, glabrous, ovules elliptic, ca. 0.8 mm long; style filiform, 9.9–12.5 mm long, with scattered short eglandular trichomes, stigma lobes linear, slightly flattened, subequal, longer lobe 0.6–0.8 mm long, shorter lobe 0.5–0.7 mm long. *Capsule* flattened ellipsoid or ovoid, 6.2–6.5 × 3.3–3.6 × 1.4–2.0 mm, chestnut, glossy, sides rugose or smooth, glabrous. *Seeds* cordate, ca. 2.6 ×1.8 mm, densely covered with white hygroscopic trichomes.

Phenology:—Flowers have been recorded from March to June. Fruits have been recorded from April to October.

Distribution and habitat:—At present, *Petalidium sesfonteinense* is only known from the vicinity of Sesfontein and the surrounding mountainous area up to Tomakas in the west and Warmquelle in the east (Fig. 3). It occurs on hillsides, along seasonally dry riverbeds and at the base of rocky outcrops at elevations of 340–1070 m a.s.l., about 75–125 km from the Atlantic Ocean. Average annual rainfall in the area is 100–150 mm (Mendelsohn *et al.* 2002).

Conservation status:—*Petalidium sesfonteinense* is locally common and probably more widespread in suitable habitats than currently recorded. It is here considered not in immediate conservation danger, because it occurs in sparsely to unpopulated areas and does not seem to be utilised by humans. However, it is browsed by livestock (goats) of the local inhabitants (pers. obs.). The area of occupancy is estimated at < 20000 km² (2250 km²) with less than 10 (8) subpopulations. However, since no decline in population size or numbers is known, it is here ranked as Least Concern (LC) (IUCN 2012).

Etymology:—The specific epithet refers to Sesfontein, a village in northwestern Namibia near the type locality.

Notes:—Some of the morphological features to distinguish between *Petalidium sesfonteinense*, *P. kaokoense*, and *P. variabile* are provided in Table 1.

Hitherto in herbaria, *Petalidium sesfonteinense* has mostly been confused with *P. variabile*, a species from which it differs in indumentum, leaf, inflorescence, and flower characters (Table 1 & Fig. 4). Distribution of the two species, does not overlap: *P. sesfonteinense* occurs in northwestern Namibia in the vicinity of Sesfontein, and *P. variabile* from the Bergsig area 100 km to the south-southeast and southwards to west central Namibia and in northern Namibia near Otavi and Grootfontein. Records of *P. variabile* in Angola have not yet been vetted by the first author and might represent a different taxon. *Petalidium sesfonteinense* can also be confused with *P. ohopohense*, *P. pilosi-bracteolatum*, *P. rossmannianum*, and *P. welwitschii*, especially in herbarium specimens where fresh flowering material is not available. However, distribution of *P. sesfonteinense* does not overlap with these species, with *P. pilosi-bracteolatum* occurring to the south and the other three species to the east or the north of *P. sesfonteinense*. Other species of *Petalidium* occurring within the range of *P. sesfonteinense* are *P. angustitibum* Meyer (1967: 505), *P. coccineum*, *P. halimoides*, and *P. lanatum*. All the mentioned species, including *P. sesfonteinense*, are from the group composed of plants with irregular, four-parted calyces (Obermeijer 1936, Tripp *et al*. 2017). A key to *P. sesfonteinense, P. kaokoense*, *P. variabile* and other species of *Petalidium* within its distribution range is provided.

Indumentum is very useful in differentiating among the mentioned taxa and consists mainly of three types of trichomes: simple (unbranched), stellate, and dendritic. The simple trichomes are either single or multi-celled and gland-tipped or not. The stellate trichomes are either stalked or sessile with arms radiating from a common point. The dendritic trichomes are stalked with the arms spirally arranged, opposite and distichous, or opposite and decussate. Each taxon has a unique combination of trichomes (see Table 1 and key to species).

TABLE 1. Prominent morphological differences between *Petalidium sesfonteinense*, *P. kaokoense*, and *P. variabile.*

Character	*P. sesfonteinense*	*P. kaokoense*	*P. variabile*
Indumentum	Very short glandular trichomes, short to long simple trichomes, often multicellular, also bi-forked, dendritic or long-stalked stellate trichomes, some trichome types absent; dendritic trichomes appearing slender, branches relatively long	Short-stalked stellate and dendritic trichomes, appearing relatively stout; stalk of stellate trichomes and branches relatively short	Very short appressed trichomes (densely strigose, trichomes pointing backwards), and short glandular trichomes
Young stems (indumentum)	Very short glandular trichomes, short to long simple trichomes, often multicellular, also bi-forked, dendritic or long-stalked stellate trichomes; some types lacking	Stellate trichomes, interspersed with a few dendritic ones	Densely strigose interspersed with short glandular trichomes
Leaves (indumentum)	Dendritic trichomes	Stalked stellate trichomes, interspersed with dendritic and very short glandular trichomes	Densely strigose trichomes interspersed with short glandular trichomes
Inflorescences	Axis not becoming spiny with age	Axis sometimes becoming spiny with age	Axis sometimes becoming spiny with age
Bracts (shape)	Oblanceolate	Linear-lanceolate or linear-oblanceolate	Oblanceolate
Bracteoles			
Shape & reticulation	Symmetrically elliptic or narrowly ovate; reticulation weak or not prominent; midrib indistinct, straight; venation indistinct, pale green	Asymmetrically elliptic-oblong; reticulation prominent; midrib distinct, curved; venation distinct, dark green to maroon	Asymmetrically elliptic-oblong; reticulation weak or not prominent; midrib distinct, prominent or slightly so
Indumentum (abaxially)	Glandular trichomes of various lengths and few to scattered long multicellular glandular trichomes, sometimes also with very long multicellular sparsely branched eglandular simple or dendritic trichomes	Stalked stellate, dendritic and very short glandular trichomes	Densely strigose interspersed with short glandular trichomes
Corolla			
Indumentum (expanded part, outside)	Glabrous	Densely strigose	Strigose
Upper lobes	Connate for 20–30% the length; obovate	Connate for 50% the length; oblong	Connate for 33–50% the length; narrowly ovate or oblong-elliptic
Lobes (orientation)	Patent	Lateral and upper lobes patent, front lobe ca. at 45 degrees	Upper lobes in line with tube to sub-patent, other lobes patent
Lobes (indumentum)	Patent trichomes on all lobes	Patent trichomes only on front lobe	Patent trichomes on all lobes
Colour	Lobes white, pink, magenta, apricot, yellow, or cream, maroon dotted proximally; throat and mouth maroon, terminating in two conspicuous narrow triangular markings on proximal part of lobes; two yellow nectar guides on front lobe narrowly triangular, relatively long, widely separate	Lobes, throat, and mouth uniformly maroon; two yellow nectar guides on front lobe oblong or oblong-triangular, relatively long, connate towards base	Front corolla lobe differently coloured or shaded than upper and sometimes also lateral lobes: white, pink, or crimson; upper and lateral lobes: brown, dirty orange, pink, or crimson; throat and mouth maroon; two yellow nectar guides on front lobe narrowly triangular, relatively short, separate
Stigma (lobes)	Sub-equal	Unequal	Sub-equal
Capsule	Flattened ellipsoid or ovoid, rugose or smooth	Flattened ovoid, smooth	Flattened ovoid, smooth
Seeds	Cordate	Discoid or ovate	Cordate
Cystoliths	Linear or appearing circular	Linear	Linear or appearing circular
Distribution	Sesfontein and the surrounding mountainous area up to Tomakas in the west and Warmquelle in the east	Hartmann Mountains north of Orupembe to 20 km south of the Kunene River and at Omungwindi ca. 40 km east of the Hartmann Mountains	From the Bergsig area southwards to west central Namibia and in northern Namibia near Otavi and Grootfontein

FIGURE 1. *Petalidium sesfonteinense*. **A.** Habit. Plant about 40 cm tall. **B.** Flower, shoots, and leaves; greyish leaves are still densely covered in trichomes; green leaves almost glabrous. Photographs: W. Swanepoel. *Swanepoel 568*.

Tripp *et al*. (2017) conducted a phylogenomic study of *Petalidium*, sampling several species including *Petalidium sesfonteinense* (therein labelled as "*Petalidium variabile* 16-20"), along with *P. rossmannianum*, *P. welwitschii*, and *P.*

kaokoense (therein labelled with an arrow as "*Petalidium* sp. 8 [cf. *variabile*]"). These four species together formed a strongly supported clade (Clades 7, 8, & 9 Tripp *et al*. 2017) that is sister to Clade 10, which contained *Petalidium crispum* Meuse ex Meyer (1961: 66), *P. coccineum*, and *P. bracteatum* Obermeijer (1936: 161). More sampling combined with next-generation sequencing is needed to further elucidate phylogenetic relatedness of this new species to other species of *Petalidium*, including the widespread *P. variabile* (Manzitto-Tripp *et al*. in prep.). In turn, this would help to clarify geographical limits of these closely related species.

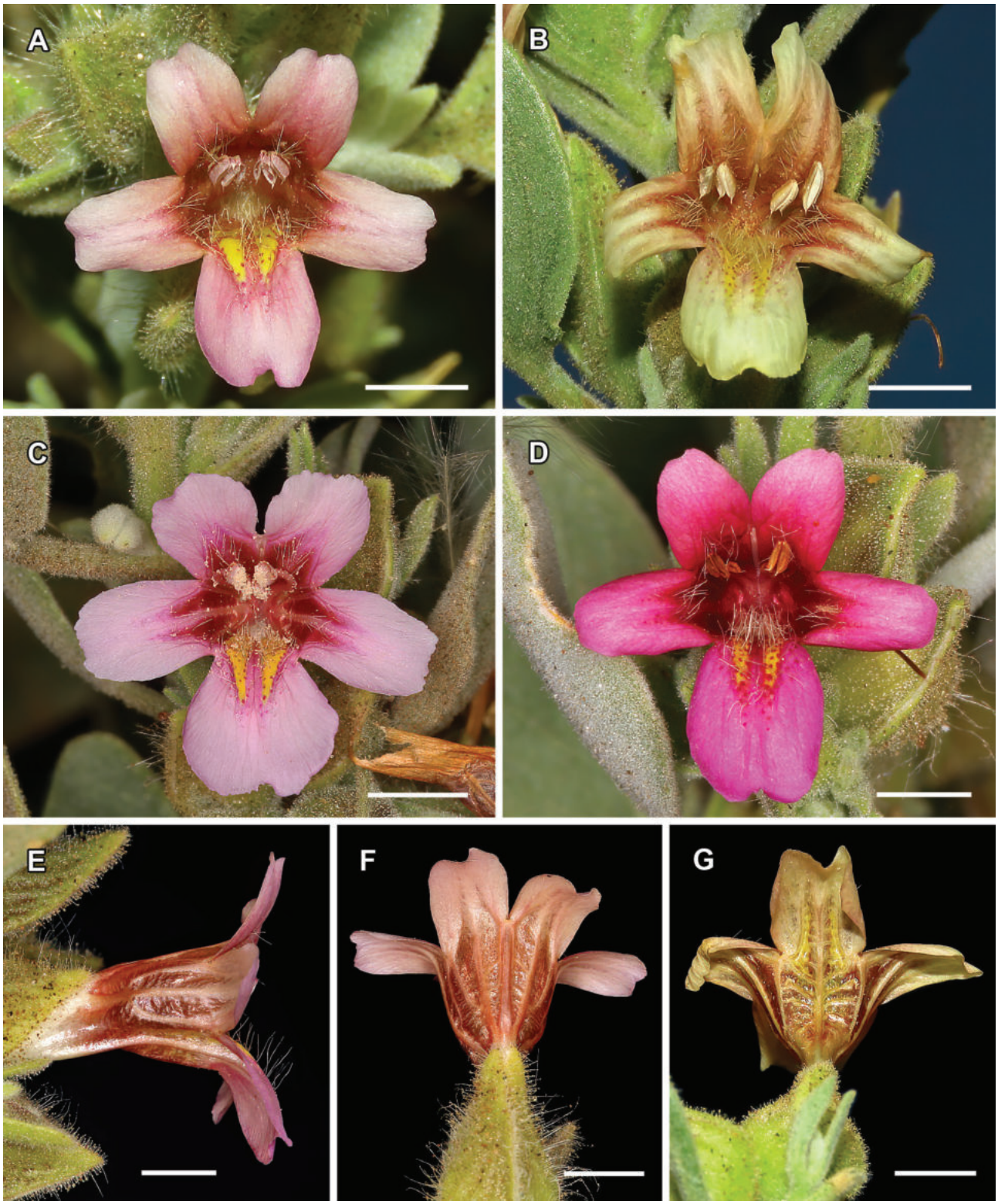

FIGURE 2. *Petalidium sesfonteinense*. Morphology of flowers. **A–D.** Flowers in front view showing variation in corolla colour and lobe margins, with two yellow nectar guides. **E.** Corolla in lateral view. **F.** Corolla in dorsal view. **G.** Corolla in ventral view. Scale bar = 5 mm. Photographs: W. Swanepoel. *Swanepoel 568* (E, F & G).

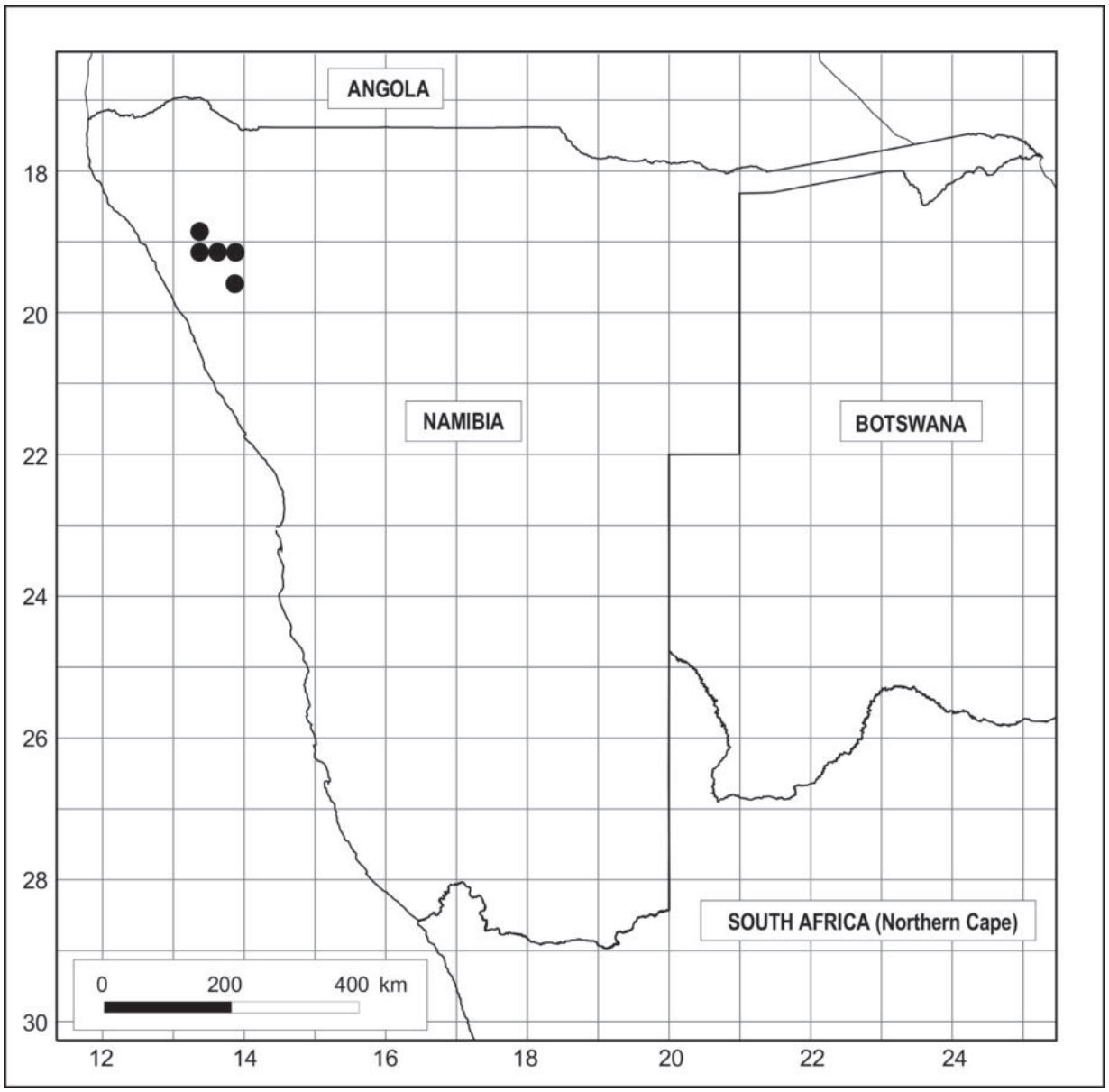

FIGURE 3. Known distribution of *Petalidium sesfonteinense* based on herbarium specimens.

FIGURE 4. Flowers of two species related to *Petalidium sesfonteinense*, for purposes of comparison. **A.** *P. kaokoense.* Note the one-coloured lobes of similar shade with relatively long yellow nectar guides (Hartmann Mountains, Kaokoveld). **B.** *P. variabile*. Note the difference in shade between lobes and the relatively short yellow nectar guides (Okahandja, central Namibia). Photographs: W. Swanepoel.

Additional specimens examined (paratypes):—NAMIBIA, Kunene Region:—1813: North of Sesfontein, (–CD), 31 March 2004, *Burke 04080* (WIND!); 42 km before Sesfontein from Puros, (–CD), 446 m, 18 May 2014, *Klaassen EK2548* (WIND!); Hills 2 km north of Okarondokavi, (–CD), 742 m, 14 May 2022, *Swanepoel 579* (WIND); Hills 2.5 km north of Okarondokavi, (–CD), 760 m, 14 May 2022, *Swanepoel 580* (WIND); 6 km south of Okovikuta on road to Ganamub, (–CD), 694 m, 14 May 2022, *Swanepoel 581* (WIND!).—1913: 33 km from Sesfontein turn-off to Hoanib River, (–AB), 347 m, 17 May 2014, *Klaassen EK2542* (WIND!); 20 km Noord van Sesfontein, dolomiet berge, (–BA), 21 May 1976, *Viljoen 313* (WIND!); ca. 3 km W of Sesfontein, (–BA), 600 m, 11 April 1985, *Jacobsen & Moss K130* (WIND!); Dry water course in calcrete hills NW of Sesfontein, (–BA), 11 September 1995, *Sullivan 350* (WIND!); 2 km NW of Sesfontein on D 3707, extremely dry slate slopes hosting on *Ruellia*, *Justicia* and *Petalidium*, (–BA), 26 March 2010, *Tripp & Dexter 865–869* (PRE!, WIND!); Mountains 5 km southwest of Sesfontein, (–BA), 499 m, 12 May 2022, *Swanepoel 578* (WIND!); Hoanib Poort 11 km east of Sesfontein on road to Warmquelle, (–BA), 609 m, 15 May 2022, *Swanepoel 582* (WIND!); 6 km east of Ganamub on road to Sesfontein, (–BA), 631 m, 25 May 2022, *Swanepoel 584* (WIND!); 9 km east-northeast of Warmquelle in poort on road to Beesvlakte, (–BB), 919 m, 12 May 2022, *Swanepoel 576* (WIND!); 12 km east-northeast of Warmquelle in poort on road to Beesvlakte, (–BB), 1068 m, 12 May 2022, *Swanepoel 577* (WIND!); 37 km from Khowarib on road to Palmwag, (–DB), 1006 m, 12 May 2022, *Swanepoel 575* (WIND).

Identification key to *Petalidium sesfonteinense*, *P. kaokoense*, *P. variabile*, and other species of *Petalidium* within the distribution range of *P. sesfonteinense*

1. Plants usually prostrate or at least some branches prostrate....2
1'. Plants erect....4
2. Inflorescence axis elongated. Flowers alternate on axis (up to 40)....*P. angustitubum*
2'. Inflorescence compact balls....3
3. Leaf lamina ca. 1.5× as long as wide or more compact, broadly ovate....*P. halimoides*
3'. Leaf lamina ca. 2.5× as long as wide or thinner, narrowly ovate....*P. lanatum*
4. Indumentum on leaves consisting of simple trichomes, erect or appressed (strigose)....5
4'. Indumentum on leaves consisting of dendritic or stellate trichomes interspersed with very short-stalked glandular trichomes....6
5. Trichomes erect, corolla tube distinctively curved, corolla lobes one-coloured red....*P. coccineum*
5'. Trichomes appressed, corolla tube straight, front corolla lobe differently coloured or of darker shade than other lobes: white, pink, or crimson; other lobes: brown, orange, pink, or crimson....*P. variabile*
6. Indumentum consisting of short-stalked stellate trichomes interspersed with very short-stalked glandular trichomes; expanded portion of corolla strigose outside....*P. kaokoense*
6'. Indumentum consisting of dendritic trichomes only; expanded portion of corolla glabrous outside....*P. sesfonteinense*

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