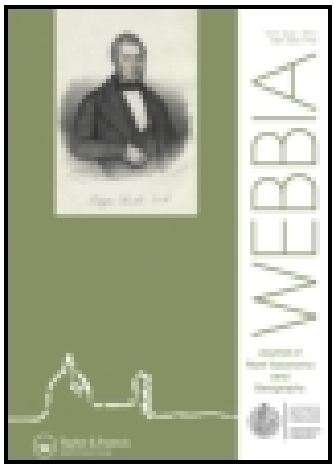
This article was downloaded by: [Memorial University of Newfoundland]
On: 10 October 2014, At: 03:27
Publisher: Taylor & Francis
Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Webbia: Journal of Plant Taxonomy and Geography
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tweb20

Ecogeography and taxonomy of Rogeria J. Gay ex Delile (Pedaliaceae)

Dorothea Bedigian[a]
[a] Herbarium, Missouri Botanical Garden, St. Louis, USA
Published online: 17 Jan 2014.

To cite this article: Dorothea Bedigian (2013) Ecogeography and taxonomy of Rogeria J. Gay ex Delile (Pedaliaceae), Webbia: Journal of Plant Taxonomy and Geography, 68:2, 103-126, DOI: 10.1080/00837792.2013.867609

To link to this article: http://dx.doi.org/10.1080/00837792.2013.867609

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at http://www.tandfonline.com/page/terms-and-conditions

Webbia: Journal of Plant Taxonomy and Geography, 2013
Vol. 68, No. 2, 103–126, http://dx.doi.org/10.1080/00837792.2013.867609

Taylor & Francis
Taylor & Francis Group

Ecogeography and taxonomy of *Rogeria* J. Gay ex Delile (Pedaliaceae)

Dorothea Bedigian*

Herbarium, Missouri Botanical Garden, St. Louis, USA

(*Received 16 October 2013; final version received 30 November 2013*)

Presented here are an extensive revision of *Rogeria* J. Gay ex Delile, a key to its three accepted species, a description of a new species, *Rogeria armeniaca* Bedigian from the Kunene region of Namibia and Angola, and a description of a new subspecies, *Rogeria adenophylla* subsp. *rosea* Bedigian, in Namibia and Angola. Specimens of the new species and subspecies were until now included in the polymorphic *Rogeria adenophylla* J. Gay ex Delile. Morphology and preliminary molecular study of the genus *Rogeria* supports the recognition of the new taxa. *Rogeria armeniaca* is identifed by its distinctive apricot-coloured flowers, and glossy, elongate, deeply lobed leaves with sharply pointed, acute apices. Subsp. *rosea* is distinguished by its bright rose-pink corolla with a golden yellow interior, and broadly deltoid or lobed, pubescent leaves with truncate apices. Morphological traits allowing *Rogeria* to survive in hot, arid environments include mucilage-bearing glandular trichomes and persistent woody capsules that decompose slowly.

Keywords: Angola; arid; disjunction; indumenta; Kaokoland; Namibia; Pedaliaceae, *Rogeria*; serotiny, Sudan

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Introduction

The African endemic genus *Rogeria* J. Gay ex Delile is a striking member of the Pedaliaceae, easily recognizable by its densely packed capsules bearing sharp prickles that release seed gradually. Three well-defined species: *Rogeria adenophylla* J. Gay ex Delile, *Rogeria bigibbosa* Engl. and *Rogeria longiflora* (L.) J. Gay are native to dry parts of tropical and warm temperate Africa, and can be distinguished by their robust, annual, or occasionally perennial habit as woody herbs to small shrubs up to 2.5 m tall, with sticky indumenta. Plants characteristically occur on basement rock. Most plants are single-stemmed, or with just a few branches borne at an acute angle to the main stem. Stems are glandular-hairy, quadrangular in cross-section and sulcate, with a single groove on each surface. Leaves are highly variable in shape, opposite or alternate, and glandular-hairy.

As do all genera of Pedaliaceae, *Rogeria* possesses unique anatomical structures: mucilage-secreting glandular trichomes that cover stems, flowers, capsules and leaves; the last have lower surfaces with especially dense trichomes. Trichomes of Pedaliaceae are distinctive: capitate, short-stalked mucilage hairs, composed of a stalk of one to three cells supporting a tetrad of cells convexly arched outwards from the apex of the stalk, and the lumina almost completely filled with mucilage (Metcalfe and Chalk 1950). Also present are one- or two-celled hairs with verrucose surfaces. The production of slimy osmiophilic material (Hallahan et al. 2000) coating the plant surface may reduce solar heating or evaporative loss.

Rogeria flowers are zygomorphic and their serotinous woody capsules persist on the plant after maturity, resisting decomposition for several years. Eventually, wind and extreme desiccation drive the capsule to dehisce, releasing seed sporadically.

Background and methods for this study

Wide-ranging fieldwork by the author in numerous regions of Sudan: southeast of Gedaref in 1980 and 1999; central, between the Blue and White Nile rivers and the Nuba Mountains of South Kordofan, 1979; Darfur, 1999; and North Kordofan, 2003, led to a focus on specific morphological and ecological adaptations of the exceptional genus *Rogeria*. Further exploration in Mali in 1997 and 1999–2000 and in Namibia 2006, allowed assessment of its distribution and use and enabled study of the systematics of the genus.

Plants were examined in the field and herbarium, using collections from the following herbaria, in Africa: ADD, BOL, DSM, EA, J, KHU, MHU, NHT, PRE, WIND, WM; Europe: B, BM, BR, BRLU, C, COI, FT, G, HBG, K, LISC, LISU, M, P, S, W, WAG, Z; India: CAL; and United States: F, GH, MO, NY, PH, UC, US, indicate the presence of taxonomically important characters for the separation of undescribed taxa of *Rogeria*.

The Kaokoveld Desert occupies a coastal strip covering 45,700 km^2 (17,600 square miles), from 13° to 21°S bounded by the Atlantic Ocean to the west, the Namibian savanna woodlands to the east, and the Namib Desert to the south. It includes the Mossamedes Desert of southern Angola. The Kaokoveld is a harsh desert of drifting sand dunes and rocky mountains. It receives most of its rainfall during the summer, which distinguishes it from the adjacent Namib Desert to the

*Email: dbedigian@yahoo.com

© 2013 Dipartimento di Biologia, Università di Firenze

south, which receives most of its rain during the winter. The Kunene River is the only permanent watercourse but many dry riverbeds (including the Hoanib, Hoarusib and Khumib Rivers) carry moisture through the desert. Other than those, the area is ancient desert sand, moistened by occasional coastal fog.

This study has confirmed observations by van Wyk and Smith (2001: 158): "large parts of the KOC [Kaokoland of Namibia] are still botanically unexplored and several additions to the flora can therefore be expected in the future. The Kaokoveld [Afrikaans for Kaokoland] and Brandberg populations of many of the more widespread species are somewhat deviant in one or several respects: this may well merit taxonomic recognition of these forms at the infraspecific level." The decision to define *Rogeria armeniaca* as a new species applies the following species concept: a set of populations, represented by herbarium specimens, demonstrating significant and diagnosable morphological discontinuities from all other sets of populations, with a definable geographic and/or ecological range. The subspecies definition followed here applies Dobzhansky (1951) and Grant (1963).

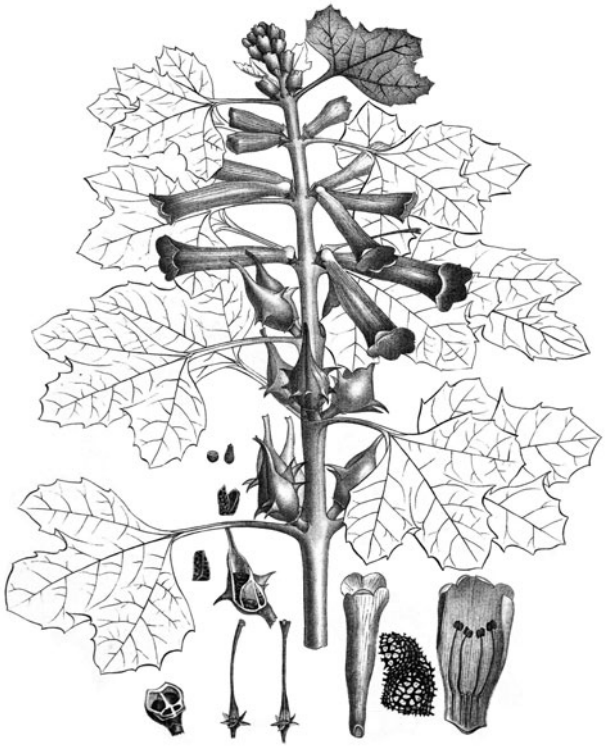


Figure 1. *Rogeria adenophylla* subsp. *adenophylla* sketch ex Cailliaud 1827. Centurie de Plantes d'Afrique du 'Voyage à Méroé' recueilliés par M. Cailliaud et décrites par M. Raffeneau-Delile 4:368–372. Paris: L'Imprimerie Royale.

Taxonomic history

Rogeria J. J. Gay ex Delile Cent. Pl. Afr. 4: 368, Plate 62. 1826/1827.
Endlicher (1832) Linnaea 7: 1–42. Stapf (1904) Fl. Capensis 4(2):460–462. Stapf (1906) FTA 4(2): 548–550. Heine FWTA (1963) 2: 389. Merxmüller and Schreiber (1968) FSWA 131: 6–8.

The history of *Rogeria* begins with the publication by Jacques Étienne Gay (1824) of short Latin descriptions of three species: *R. adenophylla*, *R. longiflora* and *R. brasiliensis*. However, Gay's publication does not constitute a valid description, because no generic description was included at the time of publication. Subsequently, Delile (1826) published a short formal description of *Rogeria*, accompanied by a figure (plate 62; Figure 1) of *R. adenophylla*, as an appendix in Cailliaud's *Voyage à Méroé* (1827). Delile's *Centurie de Plantes de l'Afrique du 'Voyage à Méroé* 78 (1826) is a separate publication, which was subsequently published again in Cailliaud's *Voyage à Méroé* vol. 4 (1826 or 1827), as an appendix (Heine 1963). The plate number in the whole work is LXII and the reference to the genus is accordingly, 4:368 (1827). The genus name honours Baron J.F. Roger, colonial governor of Senegal from 1821 (or 1822) to 1826 (or 1827) (Gillett 1962).

Rogeria longiflora was described originally as *Martynia longiflora* by Linnaeus, but was transferred to *Rogeria* by Gay (1824). Engler (1888b: 64) recorded a variant form, *R. longiflora* var. *triloba*; he also described the new species, *R. bigibbosa* Engl. (1888b). The record of *R. brasiliensis*, now *Pterodiscus gayii* Decne. in Brazil appears erroneous (Decaisne 1865; Schinz 1888), having arisen because of confusion over the provenance of an early Angolan collection (Goldblatt 1978). The Namibian endemic *R. petrophila* De Winter was transferred to a new monospecific genus as *Dewinteria petrophila* (De Winter 1971) Van Jaarsv. & A.E. van Wyk (van Jaarsveld and van Wyk 2007).

Description of the genus *Rogeria*

Erect robust annual or occasionally short-lived sub-shrubs. *Stem* simple or sparsely branched near base, up to 2.5 m tall, glandular-hairy, quadrangular in cross-section and sulcate, with a single groove on each surface. *Leaves* opposite or occasionally alternate, somewhat succulent, petioles long, blade broad, ovate to rhomboid or deltoid, curved to lobed, margins entire to sinuate-dentate, prominently three-veined, especially beneath; mealy-glandular. Inflorescences terminal and axillary one- to three-flowered cymes, pedicels with two to several black nectar glands at base. *Flowers* large, zygomorphic, white, cream, apricot, pink, rose, maroon or purple; *calyx* persistent, much shorter than corolla tube, five sepals, free, ovate or lanceolate, often unequal; *corolla* with tube slightly gibbous to saccate on posterior base, then cylindrical, becoming campanulate above, usually somewhat curved; limb sub-bilabiate, flared or spreading, suborbicular to obovate, subequal. *Stamens* four, didynamous, usually inserted low down on corolla

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

tube, included or slightly exserted; anthers parallel, ultimately diverging, ovate-oblong, dorsifixed. *Ovary* ovoid or elongate-conical, unequally 2-locular, falsely 4-locular; posterior cell much shorter and smaller, divided perfectly by a false septum; anterior cell much longer and larger, divided imperfectly (in lower part); ovules several and about 4-seriate in each of anterior, few and 1-seriate in the posterior divisions; style filiform, exceeding the anthers; stigma two-lobed.

Fruits capsular, chartaceous to woody, obliquely ovoid or lanceolate, beaked, often curved at apex, persisting on the plant for many years; the two chambers distinctly different in size with only the larger anterior carpel opening at beak-like apex, slightly gibbous at base with short spines or tubercles; loculicidal almost to base, or anterior locule tardily loculicidal to middle or lower, and posterior locule indehiscent. *Seeds* obovate to oblong, 5 mm long, dark brown to black, with sculptured surfaces, testa punctate or with large pits. *Basic chromosome number* $x = 8$.

The genus *Rogeria*, centered in southern Africa (Goldblatt 1978) includes four species.

Adaptations of *Rogeria* to the arid environment

Species in *Rogeria* exhibit extraordinary success in occupying a void where hardly any other flowering herb grows, e.g. in the Sudan. They also occur together with other flowering herbs, and are very successful in disturbed areas such as road verges. Constraints of their habitats demand adaptations that fit *Rogeria* taxa to hot, dry climates, and nutrient-poor environments. The leaf surface provides an important interface for plant—environment interactions. Survival of plants in harsh environments may depend on leaf surface characteristics (Solereder 1908: 612). The leaf abaxial surface has the highest trichome density, particularly on the inter-vein areas, as well as on the inflorescence, on the corolla lobes, and on the surface of the developing fruit. Most of the glandular trichomes are in the mature phase on very young, expanding leaves.

Trichomes have a variety of functions. Leaf trichomes increase reflectance of solar radiation, so lowering leaf temperatures, and retarding water loss. Trichomes can reduce transpiration losses by reflecting sunlight from the leaf surface and by increasing the thickness of the boundary layer (Upadhyaya and Furness 1994): "presence and quantity of trichomes declined with decrease in light intensity and increased with increase in soil moisture stress. Such plasticity of leaf surface morphology may be important in the acclimation of these species to harsh environments." A protective role of the trichomes against ultraviolet-B radiation damage is possible.

Mucilage produced in the epidermal glands that coat the plants is likely to play a role in trapping scarce water by providing a hydrophobic barrier, which insulates the leaf from heat and reflects light, so cooling the plants. Bredenkamp and van Wyk (1999) reviewed some possible functions of mucilage, revealing that Haberlandt considered that the greatly thickened mucilaginous inner walls of epidermal cells probably represent a water-storing device. The resultant mucilaginous property provides an economic, applied benefit; the plants are used in Africa to serve as a lubricant in human and veterinary medicine, as described below.

Some of these species have evolved the capacity to intercept fog in environments where rainwater is limited. They may harvest fog: "conveyed to the plant through wind, and wind speed decreases as it gets closer to surfaces, forming an envelope of slow-moving air around objects known as the boundary layer" (Martorell and Ezcurra 2007). Large leaves have thicker boundary layers; larger plants with several wide, long leaves intercept more fog with increased surface area. Plant trichomes can strengthen the leaves mechanically, so reducing the injury caused by wilting. Glandular hairs may provide a significant defence against invertebrate herbivores (Johnson 1975). In fact, I have not seen insect damage, or damage by other animals on herbarium or live plants.

Leaf succulence also protects against water deficiency in dry conditions (Stebbins 1950: 558). Additionally, deep, woody taproots form sturdy underground storage organs and anchor the tall plants firmly. The fruits are serotinous, delaying seed release, the fruits being indehiscent or only partially dehiscent; the woody capsules decompose fully over a number of years. This protracted dehiscence (Stopp 1962) enables delayed release of the stored seed, at least until a new generation of seeds matured (Günster 1994a, 1994b, 1994c). Günster (1992) and van Oudtshoorn and van Rooyen (1999) considered serotiny among examples of adaptations by desert organisms through restriction of dispersal in time by the retention of seeds in temporarily or permanently-closed cones. Stebbins viewed (1950: 130) the failure of dehiscence of the pod to have the highest selective value.

Small sharp-pointed emergences – spines at the base of the capsules – some barbed, may prevent herbivory. This trait makes a botanist's collection and handling of specimens difficult. The plants release a foul scent similar to rotting liver, presumably to deter predation. The climatic variables that seem to exert the most influence on *Rogeria* distribution are temperature and precipitation, key contributing factors, as revealed in this study.

Taxonomy

Rogeria J. Gay ex Delile 1826. Cent Pl Afr. 4: 368, Plate 62. 1826

[J. Gay in Ann Sci. Nat. sér. 1(1): 457 (1824) invalidly as genus invalid]

Type: *Rogeria adenophylla* J. Gay ex Delile.

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Key to the species of *Rogeria*

1a. *Capsules* 4–6 cm long, fusiform, spines absent or two blunt; *leaves* generally ovate, margins entire or deeply toothed; *corolla* predominantly white ……2

Capsules 2.5–3.5 cm long, truncated, conical to pyramidal with four curved dainty spines emerging from each angle near the base, and occasionally additional petite or barbed spines; *leaves* generally triangular, deltoid or three-lobed, margins entire or toothed; *corolla* various colours: off-white, pink, rose, magenta, purple or apricot ……3

2. *Capsules* 4 cm long, without spines, base gibbous, keeled where widest, bulging out posteriorly into two gibbosities; *leaves* slender, not succulent, ovate to triangular, 4.2–5 cm long, 2.5–4 cm broad with distinctive coarsely sinuate, markedly dentate margins, teeth 4.2–5 mm long; *corolla* completely white, 3–4 cm long, cylindrical, inflated slightly at base, lobes short, 2 mm, somewhat flared ……***Rogeria bigibbosa***

Capsules 5–6 cm long, with two straight robust spines near the curved base; *leaves* thick and succulent, ovate, margins entire; *corolla* white to ivory marked with seven or eight purple lines on the interior of the anterior lobe, 6–7 cm long, asymmetrically widened at the base with a sack-like abaxial spur, lobes prominent, 9–10 mm long, flared at right angles to the corolla, salverform then reflexed ……***Rogeria longiflora***

3. *Leaves* elongate, deeply three-lobed with acute apices, cuneate at base, adaxial surface glabrous, bright green; *corolla* 7–8 cm long, lobes 8–10 mm long, pale apricot; tube dark orange to dull red inside, with a prominent sac-like adaxial inflated spur at the base, lobes flaring outward at right angles to the tube……......***Rogeria armeniaca***

Leaves deltoid or lobed with broadly truncate apices, linear to cordate at base, both surfaces pubescent, dark blue-green or violet-green; *corolla* 3–6 cm long, lobes 3–10 mm, various colours – bright rose pink, fuchsia or magenta deepening to purple or to deep burgundy; tube dull white to yellow inside, inflated adaxial basal spur feeble, lobes form a trumpet shape ……..……***Rogeria adenophylla***

1. *Rogeria bigibbosa* Engl Jahrb. 10: 256. 1888a, b
Type: Erongo: Otyimbingue, May, 1886, *Marloth 1485* (iso, PRE).

Description

Stout annual herb, glandular throughout. *Stem* 1–1.5 m high, swollen and about 10.5 mm. thick across the middle; internodes 22–33 mm long. *Leaves* with petiole, 10–15 cm long. blade entire to three-lobed, broadly semi-circular, with deeply dentate margins, boldly tri-nerved, immature leaves with a few uniseriate bi-cellular cylindrical trichomes at the margins; abaxial surfaces of immature leaves encrusted with trichomes, fewer upon maturity. *Flower* yellowish-white; *sepals* 3.5 mm long; *corolla* 20–30 mm long, tube cylindrical with small salverform limb. *Extrafloral nectary* at base of corolla sessile, with a 2-mm protuberance when dry. *Capsules* with two abaxial keels and two inconspicuous horns at adaxial base, 30–40 mm long. *Seeds* deeply pitted, honeycombed, with many air spaces, lightweight, aerodynamic; surface shiny, possibly with mucilage. Flowering time: February–May.

Etymology

Named for its woody, elongated keeled fruit – gibbous but lacking spines (Figure 2).

Distinguishing features

Leaves of *R. bigibbosa* are thin-textured with prominently pointed, sharply toothed margins (Figure 3); corolla yellowish white, short (Figure 4); capsules keeled (Figures 2, 5); seeds deeply pitted (Figure 6).

Distribution

Central and southern Namibia.

Ecology

Hill slope, protected rock crevices. Loam, moist & shady river/streambed; sandy loam; stony soil/rocky. Desert.

Representative specimens examined

Namibia: Erongo, propre Kwei “puty” Otjimbingwe, Hereroland, May 1886, *Marloth 1485* (PRE); Rehoboth, Farm Göllschau, 12 Mar. 1953, *Walter 1769* (B, WIND);



Figure 2. *Rogeria bigibbosa* showing keeled fruit (photo courtesy J.C. Manning).

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014



Figure 3. *Rogeria bigibbosa* showing toothed leaf margins (photo courtesy of J.C. Manning).



Figure 4. *Rogeria bigibbosa* showing toothed leaf margins, short white corolla (photo courtesy of J.C. Manning).

Rehoboth, Oanob Dam Nature Reserve, 28 Apr. 1987, *Sievers 206* (WIND); Karibib, Farm Nudis, 1953–1954, *Seydel 280* (B); Outjo distr, oestlich Fransfontein, Farm Hilldown, 29 Mar. 1963, *Volk 3187* (WIND); Otjimbingwe. Francoise-Feste, Farm Karanab, 21 Apr. 1965, *Giess 8700* (WAG).

2. ***Rogeria longiflora*** (D. Royen) J. Gay ex DC., Prodr. 9: 257. 1845

Type: Namibia, in clivis juxta flumen Swachaub, May 1886, *Marloth 1383* (PRE, SAM).

R. longiflora (D. Royen) J. Gay, Ann. Sci. Nat. sér. 1, 1: 457 (1824) illegitimate name, genus not valid]; Harvey Thes. Cap. 2. 12 t., 118 (1859–1863); Stapf in Dyer, Fl. Cap. 4(2): 459 (1904). *Martynia longiflora* D. Royen, Linn. Syst. Nat. Ed. 12.2: 412 (1767); Meerb. Afbeeld. T. vii (1775–1782). *Pedalium longiflorum* (D. Royen) Decaisne, Ann. Sci. Nat. Bot. ser 5, 3: 331 (1865). *Martynia capensis* Gloxin, Obs. Botanicae 1: 13 (1785). *R. rangeana* Engl., Pflanzenwelt Afr. 1(2): 536, *nom. nud.* (1910); *R. rangeana* Dinter in Feddes Repert. (Beih.) 3: 105 (1918) cited by Merxmüller & Schreiber (1968) as "*rangei*" "err. Typ"; *R. rangeana* Engl. ex Dinter Repert. Spec. Nov. Regni Veg. 23: 136. *nom. inval., nom. nud.* (1926). *R. longiflora* var. *triloba* Engl. (1888a) Bot. Jahrb. Syst. 10: 255

Description

Woody annual or biennial, herb, semi-succulent, glandular. *Stem* up to 2.4 m, with several branches, mealy-glandular only at the very top. *Leaves* long-petioled, petiole 3–9 cm long, lamina ovate to rotundate-ovate, some heart-shaped, 5–15 cm long and broad, subentire with a somewhat wavy margin, apex broad, base subacute to subtruncate, bullate, especially prominent during early development, the bulla is broad at the apex, subacute to subtruncate at the base, glandular and glaucous especially lower leaf surface, boldly three-nerved, veins sunk; grey-green; *Flowers* 2–1 in the axils of leaves and terminal; pedicels densely mealy-glandular, up to 4.2 mm long; *calyx* 3–4.2 mm long, sepals lanceolate, subequal; *corolla* ivory-white, with seven or eight purple lines in throat of lower lobe, 4.2–6.7 cm long, 6.3 mm wide near base, 3.3 mm wide at middle, tube subcylindric, not glandular, ± asymmetrically widened at base, extending very close to base in a substantial, sac-like spur; lobes 3–3.8 cm diam.,±10.5 mm long and broad except lowermost somewhat longer; 1.5–2 mm long spiny projections emerge from base. *Capsules* cone-shaped, oblong, 4–6 cm long, including beak, with two adaxial, recurved conical spines, one either side of base. Flowering time: year-round.

Etymology

Named for its elongate corolla (Figure 7).

Distinguishing features

Leaves orbicular, succulent, entire not lobed, bullate especially when immature (Figures 8, 9); corolla elongated (Figure 10), white with purple lines inside mouth of lower lobe, inflated adaxially at base, capsules with two blunt spines (Figures 7, 11); seeds deeply pitted (Figure 12).



Figure 5. *Rogeria bigibbosa* Dinter specimen ex P, showing keeled fruit.

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014



Figure 6. *Rogeria bigibbosa* seed, Karas, Namibia *Helary 50* (MO). (photo courtesy M. Duncan).



Figure 7. *Rogeria longiflora* showing ants, Karas, Namibia (photo courtesy C. Mannheimer).



Figure 8. *Rogeria longiflora* young leaf (photo courtesy of J.C. Manning).



Figure 9. *Rogeria longiflora* illustration from Meerburgh N. 1775–1782. Afbeeldingen van Zeldzaame Gewassen. T. Vii. Leyden, Johannes le Mair.

Distribution

Namibia: Damaraland, Miss Elliott. Miss Elliott's specimen has the corolla tube more widened at the base (8.5 mm across) so that it might be described as shortly saccate, and the leaves are much smaller than in the type (2.1 mm long) and rather penni-nerved with an indication of three lobes. It is conceivably the same form that Engler described as var. *triloba*. Western region: Cliffs by the Swakop River, 2600 feet (790 m), *Marloth 1383*. Namaqualand: without precise locality, *Wyley 83* (dig. K) (Stapf 1906). Along the edge of the central and southern Namib Desert to the Orange River, Sperrgebiet (Diamond Area 1) (Burke & Mannheimer 2004). **South Africa** altitude range 300–1000 m. Northern Cape (Smithies and Herman 2003).

Ecology

Rogeria longiflora has thick, succulent leaves with entire margins; possessing significant ecological flexibility, it spread in all directions, including areas benefiting from cooler temperatures (Map 1). *Rogeria longiflora* occupies a broad niche and has a wide range, but shares some over-

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014



Figure 10. *Rogeria longiflora* sketch, Harvey 1859–1863, Thesaurus Capensis: or, Illustration of the South African Flora, being figures and brief descriptions of South African plants selected from the Dublin University Herbarium. Dublin: Hodges, Smith & Co.

lap with *R. bigibbosa* (Map 1, 2); very common in a variety of different habitats (gravel plains, dune systems, inselbergs and escarpment) and a steep climatic gradient (Günster 1992); the Kuiseb riverbed (Van Damme et al. 1992); in floods or on the lower slopes of hills (damp, sheltered places) (*Bryant 999* K). Substrate stony soil/rocky. Among dolorite boulders in full sun. Open shrubland, dry thornveld. Succulent leaves provide an advantage for water impoundment (Martorell & Ezcurra 2007; 89; Stebbins 1950: 558). This species is an inselberg specialist in one study area, but also occurs in the surrounding lowlands in other areas (Burke 2004); Burke (2003) further points out the significance of inselbergs in preserving species richness. According to Jürgens (1991: 27–28) *R. longiflora* belongs to the Namaland domain, mostly to the Eastern Gariep District but penetrates deeply into the Succulent Karoo Region via the lowest Orange River valley and some of its tributaries.



Figure 11. *Rogeria longiflora* (photo courtesy of J.C. Manning).



Figure 12. *Rogeria longiflora* seed, Namibia, Luederitz distr. Rte E to Koichab Pump Stn. Ca 60 km from turnoff to Nam Water *Bedigian 113* (MO, WIND). (photo courtesy M. Duncan).

Conservation status

Rogeria longiflora is common throughout its distribution area and is deemed of 'Least Concern' (Foden & Potter 2005).

Ethnobotanical notes and vernacular names (taken from published sources and herbarium vouchers)

The roasted and ground seeds, sometimes mixed with fat, are applied to burns and wounds to stop bleeding. This mixture rubbed on burns provides relief from pains. Warmed leaves are used as a poultice on wounds, on women's breasts to cure cracked nipples, and to treat skin diseases (Van Damme et al. 1992);

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Local names: Djirrie (e), Witblom (Afrikaans); Nama dau*anab*, gami*awib*. Also used on painful knees or the throat in case of throat pain (Van den Eynden et al. 1992 Topnaar: roasted ground seeds (mixed with fat) put on wounds to stop bleeding; rubbed on burns; warm leaves put on breasts to cure cracked nipples (*Van den Eynden 12.5.d* MO, WIND). Eaten by cattle (*Bryant 999* K). Kandari et al. (2012) reiterate the common name '*gaml awib*' for *R. longiflora*, viewing it as a medicinal plant of the Namibian desert.

Representative specimens examined

Namibia: Damaraland, Dorstrevier, May 1886, *Lindner s.n.* (BR); Keetmanshoop-Ababies-Windhoek; banks of Great Fish River at Holoog, 22 January 1916, *Pearson 9805* (BOLUS, MO); near Orange River at Goodhouse, Apr. 24, 1949, *Wilman 258* (BOLUS); Great Namaqualand. Klein Karas, 12 April 1931, *Örtendahl 82* (MO); Gibeon distr. Farm Heimat; GIB 53, 1 December 1962, *Giess 5044* (LISC, WIND); "Swachaub." 'Horebus Hereroland' [Swachaub=present day Swakopmund], May 1886, *Marloth* 1383 (Type, PRE, SAM); Warmbad distr. Farm Bruinhuiwel: WAR 257, 15 May 1963, *Giess, Volk & Bleissner 6929* (MO); Luederitz distr. Rte E to Koichab Pump Stn. Ca 60 km from turnoff to Nam Water, 9 March 2006, *Bedigian 113* (MO, WIND); 10 km south of Sesriem camp and gate, just north of Namib Rand Reserve, 12 April 2006, *Bedigian 166* (MO, WIND); Fish River Canyon – lookout point. Rte B4, Seeheim, 20 May 2006, *Bedigian 212* (MO, WIND). **South Africa:** Cape Prov., Pofadder distr., 35 miles (56 km) west-southwest of Pofadder, February 1961, *Taunton 363* (BOL); Cape prov. Springbok distr. Vioolsdrift, March 1964, *Hardy 1707* (PRE); Northern Cape, N14 highway, 61.3 road km south of Namibian border, Large pan on north side of road, 27 February 1996, *Snow & Burgoyne 7147* (MO); Cape. Prieska distr., 1 mile (1.6 km) northwest of Koegas, 21 March 1959, *Leistner 1344* (PRE).

Nomenclatural notes and species rejected

IPNI (International Plant Names Index) shows *R. rangeana* Engl. ex Dinter Repert. Spec. Nov. Regni Veg. 23:136 (1926) as *nom. inval. nom. nud.*

Royen was the generally used version of the author of this name, until recently.

Rogeria microcarpa Klotzsch, Protologue: Naturw. Reise Mossambique [Peters]: 190 (1862), a synonym of *Pedalium murex* L.

3. *Rogeria armeniaca* Bedigian, **sp. nov.**

Type: Namibia. Kaokofeld: by the source of the Okombambi, 16 June 1965, *W. Giess 8973* (holo, WIND; iso, PRE) (Figure 13).

Diagnosis

Woody herb, persistent when dry. *Stem* up to 2.5 m high, simple to two- to four-branched. *Leaves* opposite, petioles white, up to 20 cm long; blades up to 10 × 8 cm, deeply three-lobed, central lobe elongated, 0.75 times longer than adjacent lobes, notches between lobes V-shaped, with sharply pointed long-acute apices, base cuneate, surfaces glossy, bright green; with glandular trichomes on abaxial surface, especially when immature, smooth on upper face. *Flower* salverform, colour pale apricot, occasionally pale pink, interior intense burnt orange; *calyx* with sepals 2.5–2.8 by 2 mm.; *corolla* tube 7–7.5 cm, with a 1.2-cm flared lobe, narrow, nearly cylindrical, a sac-like adaxial inflated spur beyond base, lobes pale apricot, curving outward at right angles to the corolla tube; corolla spread out at mouth to 5-cm diameter when dry. Stamens didynamous, terminating 2.5 and 3 cm long from point of attachment, at base of corolla. *Capsules* 2.5–3 cm long by 0.7–1.0 cm at base, widest diameter across line of dehiscence of capsule, somewhat chartaceous, pedicel 3 mm long; base with four to eight fine-tipped spines, some barbed. Flowering time: March-August.

Etymology

Epithet referring to the colour of the corolla (Latin: *armeniaca*, apricot-coloured).

Taxonomic comments

Rogeria armeniaca is distinguished by the apricot-coloured corolla c.7 cm long (Figure 14), leaf lobes with sharply pointed apices (Figures 14, 15); glandular trichomes absent on the adaxial leaf surface, at variance with other species of *Rogeria*, in which the mucilage glands are present on both leaf surfaces. Several botanists have commented on the novel appearance of this species; a collection made by W. Giess bears the annotation *R. brigittae* in Giess's hand (*Giess 8973* WIND) (Figure 13). An anonymous typed note stored with *Rogeria* specimens at PRE states the following, translated from the German: "Divergent form in the vicinity of the Epupa Falls (*Giess 9336*, 11 miles East of Enjandi on the riverbanks of the Kunene), salmon red with a very broad margin, leaves three-lobed without the bluish protective coat (mucilage hairs) on the bottom [on the underside]."

A few of the limited number of collections available, i.e. (*Giess 8948a* WIND; *Merxmüller & Giess 30,502* K, PRE, WAG, WIND; *Giess 8973* PRE, WIND; *Giess 10508a* WIND), were annotated by Ihlenfeldt as subsp. *aurantiaca* [ined.]; Ihlenfeldt (1967a) also remarked on their distinctive appearance from examining just a few specimens.

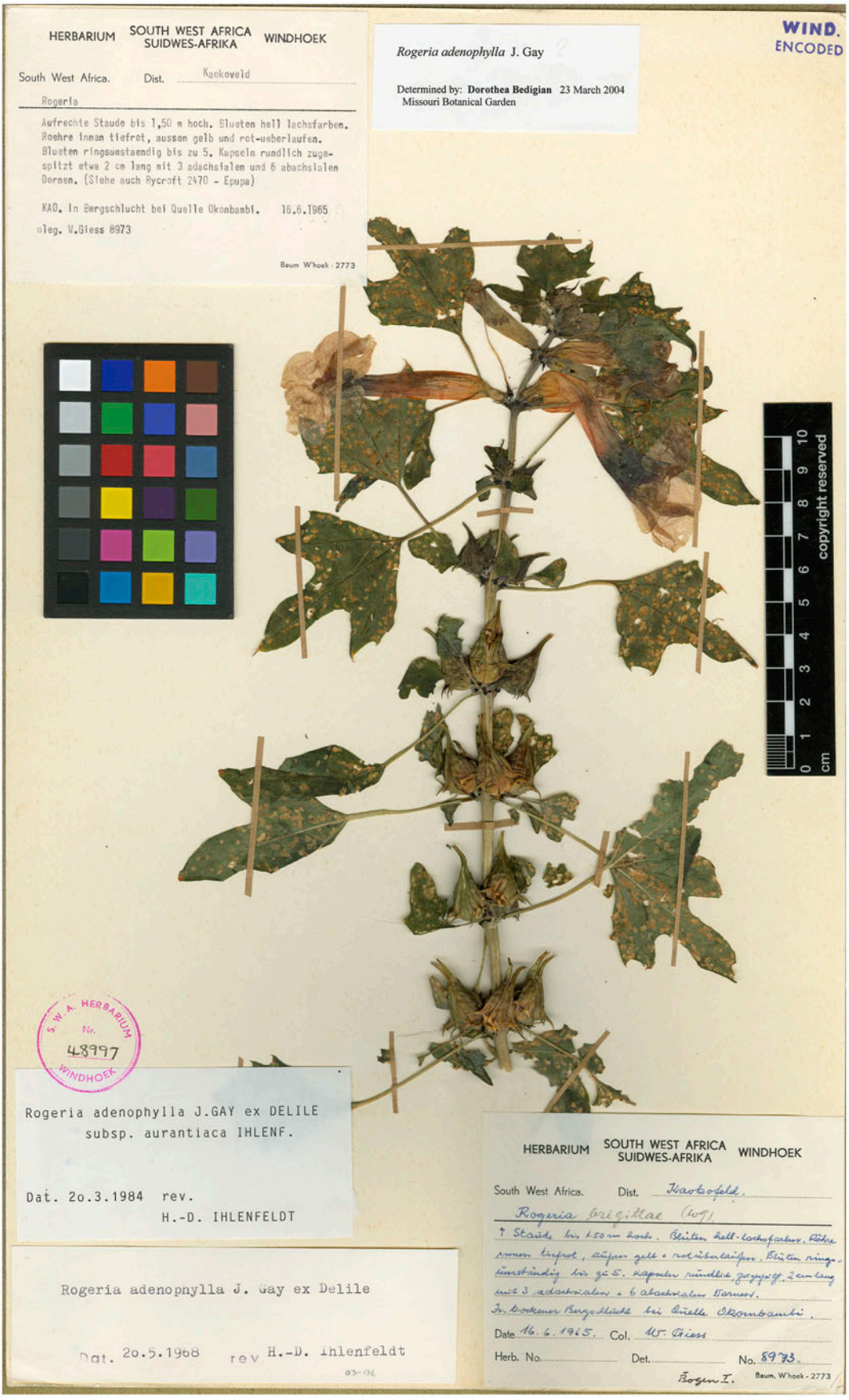


Figure 13. *Rogeria armeniaca* holotype, *Giess 8973* (WIND).

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014



Figure 14. *Rogeria armeniaca* close-up of flower, Oncócua, Angola, photo courtesy N. Jürgens, Southern African Plants. (Photo Guide to Plants of Southern Africa). http://www.southernafricanplants.net/plantdata_sub.php?Mspec_ID=5328



Figure 15. *Rogeria armeniaca* plant habit, Oncócua, Angola, photo courtesy N. Jürgens, Southern African Plants. (Photo Guide to Plants of Southern Africa). http://www.southernafricanplants.net/plantdata_sub.php?Mspec_ID=5328

Distribution

Kunene River Basin (Map 2) of Angola and Namibia, and Kaokoland, Angola and Namibia; i.e. very restricted distribution: Otjihipa Mountains immediately to the south of the Kunene River in Namibia; also shown in photographs from Oncócua (Jürgens 2007).

Ecology

The Kunene River region of Kaokoland represents an edaphic change from the arid gravelly silts where other *Rogeria* occur. Van Wyk and Smith (2001: 152) assess the importance of the Kaokoveld as a centre of plant endemism, characterized by fog, wind and sandstorms. Fog is a critical source of water in this region (Bartlett & Bartlett 1992: 366; Hamilton 1983). As dense fog condenses, water collects on leaves.

Conservation status

Most specimens collected occur outside protected areas. Few visitors travel in the Kunene region of Angola now; however, once the new road is completed and the region is open to tourism, it is likely to become more vulnerable.

Notes

Little investigated – no dedicated survey to study the genus up to now. The subject is data deficient; known from only seven specimens and one collection of photographs. It seems plausible that a reduction in trichome number would free up more leaf surface area for water harvesting.

Specimens examined

Angola: Oncócua, collection shown in photographs (*Photo Guide to Plants of Southern Africa*, no date). **Namibia: Kunene,** Kaokoveld, Posto Velho, Am Flussufer des Kunene bei Otjinungua, 13 June 1965, *Giess 8948a* (WIND); Kaokoveld, 11 miles east Enjandi am Rivierufer des Kunene, 17 April 1966, *Giess 9336* (PRE); Kaokofeld, Okombambi, Baynesberge, 11 September 1968, *Giess 10508a* (WIND); Kaokoveld, 24 km southeast Enyandi am Kunene, Swartbooisdrif, 22 March 1974, *Merxmüller & Giess 30,502* (K, PRE, WIND); Kaokoveld, 15 km west of Epupa Falls towards Orokane, 18 July 1976, *Leistner, Oliver & Vorster 248* (BR, MO, PRE); Kunene valley, W of Swartbooisdrif, 4 August 1995, *Burke 95,290* (WIND).

4. *Rogeria adenophylla* J. Gay ex Delile, Cent. Pl. Afr. 4:368, Plate 62. 1826

Type: J. Gay ex Delile, Voyage à Méroé recuilliés par M. Cailliaud 4:368. LXII., t. 2, Figure 3 (1827). Type specimen not found in any herbarium listed in Materials and methods.

DC. Prodr. ix 256 (1845); Kotschy (1864); Bentham (1876); Pirotta (1903); Schweinf. Beitr. Fl Aethiop. 97.

Pedalium Rogeria, Decne., Ann Sci Nat. Bot. sér. 5, 3:331 (1865).
Pedalium caillaudii Hochstt. ex DC. Prodr. 9:256 (1845).

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Pedalium Caillaudii Delile, Pl. Kotschy It. Nub., *Kotschy 151* (BR; MO, P, HBG, STU, K).

Description

Robust short-lived deciduous perennial or annual shrub-like herb. *Stem* erect, to 2.5 m high, with a single or several branches, stems glabrous at the base, mealy-glandular, glaucous at the upper part, whole plant succulent. *Leaves* opposite, petiole 3–6 cm, blade very broadly obovate, deltoid, sinuate or lobed with broad apices, more or less three-lobed, 5–10 cm long and broad, glandular, particularly beneath, glaucous; lobes broad, shallowly toothed, remotely repand-dentate; teeth subulate, each with a double-gland at the base, surface rugose, blade bullate during early development, violet to blue-green, boldly three-nerved, veined palmately with sunken veins, venation suprabasal; the margin remotely spinulose, acute, truncate or shortly cuneate at the base. *Indumentum* of blade with extremely dense glandular trichomes throughout; on abaxial leaf surface c.1000 cm^{-2}, encrusted, too dense to count accurately. *Flowers* axillary, subsessile, in few- to one-flowered cymes, one to three cymes in the leaf-axils. *Calyx* five-partite. *Sepals* 3.5–4.5 mm long; segments linear-lanceolate. *Corolla* tubular 3–4–5 cm long, about 8.5 mm wide at mid-length, petals more or less the same length, slightly gibbous to saccate on the posterior side of the base; limb deep purple or maroon, spreading, obscurely bi-labiate; lobes suborbicular, subequal, 4–5 mm long at most, anterior lobe with a protrusion inward at the mouth of the tube; cream near base of corolla; inside the corolla tube yellow or dull white, sometimes with shallow sigmoidal curve. Base of gynoecium surrounded by a mostly conspicuous, often asymmetrical, nectary disc. *Capsules* 2–2.5–3 cm long by 1–1.3 cm widest diameter across the line of dehiscence, tapering to a long slender beak; obliquely ovoid, slightly conical, not angled, erect, very lignified, hard, base armed with four spreading conic spines or tubercles up to 6 mm long at the base, often with four smaller ones alternating with longer ones, obliquely ovoid; the large anterior locule tardily dehiscent loculicidally to middle, posterior locule indehiscent; locules divided into four compartments by false septa completely or incompletely; mature capsules open only incompletely, at the top, remaining upright on plant after senescence, thereby releasing seed slowly; the previous year's capsules usually yield several intact seeds. *Seeds* 3–4 mm by 1.5–2.4 mm, oblong, ovoid-angular, pitted, dark brown, testa surface with coarse reticulate pattern surrounding a similar but finer reticulate pattern within, triangular in cross-section with a longitudinal crest at each angle; seeds of unequal carpels differ in number per locule, size and testa structure. Seeds are gradually shed by strong movements of the plant, but a portion of the seeds remain completely locked in the fruit in the indehiscent adaxial carpel, being released only after the capsule has completely disintegrated, over years.



Figure 16. *Rogeria adenophylla* subsp. *adenophylla* (photo courtesy T. Musch Date: 2012–11-11; Niger, Filingué, Bonkoukou**).**

Etymology

Rogeria adenophylla – the specific epithet refers to the glandular leaves (Figure 16).

Distinguishing feautures

Leaves deltoid to three-lobed with blunt apices tomentose, glandular; flowers off-white to purple; capsules pyramid-shaped with four or more spines at base; seeds deeply pitted.

Distribution: disjunction in ***Rogeria adenophylla***

Morphological examination during fieldwork and of herbarium specimens suggests a separate evolutionary lineage for *R. adenophylla* north of the equator, in a narrow strip across the wide sub-Saharan belt in the Sahel zone extending from Sudan to Mauritania, distinct from south of the equator, in Angola and Namibia (Map 3). The form in southwest Africa is somewhat close in morphology and ecological behaviour to *R. adenophylla* subsp. *adenophylla* across the Sahel, but is visually distinct, differentiated by its vivid pink corolla (Figure 17).

Indications from molecular data

Preliminary molecular data (Bedigian and Neubig unpublished 2013) provide strong evidence for separating the two entities as distinct subspecies, validating these morphological observations. The sequence data retrieve separate lineages for each taxon; each subspecies is genetically cohesive, indicating that they are

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014



Figure 17. *Rogeria adenophylla* subsp. *rosea* showing ants, Kunene, Namibia along the main road to the Khowarib Schlucht, *Mannheimer 2893* (WIND) (photo courtesy C. Mannheimer).

disjunct, as suggested by Monod (1971) and reiterated by Ihlenfeldt (1994), Jürgens (1997) and van Rooyen and van Rooyen (1998). "The fact that the sequence data so strongly reflects the geographic data is extremely enticing." (Neubig personal communication 2013).

Inasmuch as they are geographically distinct and visually distinguishable, as well as discrete on a molecular basis, I formally recognize a new subspecies, named *R. adenophylla* subsp. *rosea* Bedigian.

Key to the subspecies of *Rogeria adenophylla*

4a. *Leaves* canescent, silvery white; *corolla* 3–5 cm, nearly cylindrical, tube dull white, deepening to maroon at limbs, limbs 3–6 mm wide, reflexed; dull white, deepening to maroon at limb, interior of corolla off-white ……. ***R. adenophylla*** subsp. ***adenophylla***

4b. *Leaves* powdery tomentose, blue-green to violet-green; *corolla* 4–6 cm, tube narrowly funnel-shaped, of various colours including bright rose pink, crimson, fuchsia deepening to magenta at the limb; limb 3–10 mm wide, gradually conical; interior of corolla golden yellow; flared trumpet-shape …….. ***R. adenophylla*** subsp. ***rosea***

Rogeria adenophylla subsp. ***adenophylla***

Description

A spiny robust woody annual or short-lived perennial shrub. *Leaves* deltoid or three-lobed, glandular, canescent, silvery white to dull green; *corolla* 3–5 cm, nearly cylindrical, tube dull white, deepening to maroon at limbs, limbs 3–6 mm wide, reflexed; interior of corolla off-white. *Capsules* irregularly pyramid-shaped, with four or more spines at base, some barbed.

Flowering time

August to January

Chromosome number

2n = *32* (Miege 1962). Persinos and Quimby (1967) separated alkaloids and other constituents. Potterat et al. (1991) isolated iridoid glucosides from aerial parts. Cepleanu et al. (1994) found cytotoxic activity when screening for pharmacological activity.

Distinguishing feautures

Leaves largely obovate, partially or fully three-lobed, 8 cm length, glandular lower part; lobes blunt; corolla off white and maroon (Figure 16); seeds deeply pitted (Figure 18).

Distribution

Along the Sahel zone south of the Sahara (Quézel 1965, 1978), extending from Sudan to Mauritania (Map 3). Burkina Faso, Cameroun, Cape Verde, Egypt, Eritrea, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan.
Cape Verde: Paiva (1995). **Mali:** Roberty (1954) Louga E (1004); Macina N (596); Ségou (150, 2801); Grand Popo w, sables arides du lido littoral (1577, forme



Figure 18. *Rogeria adenophylla* subsp. *adenophylla* seed, Sudan, Majok village, Nyala, Darfur *Bedigian 55* (MO) (photo courtesy M. Duncan).

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

mineure). Boudet et al. (1986: 305) catalogue *Rogeria* throughout the North ["Gao vers la Montagne Noire; Gao a Korogoussou; Nara; Tondigami; Gao Est, Kabara a Mopti, Goudam, Sompi et Ségou; Adrar des Ifoghas; Ménaka, piste Gao-Tabankort, Diré a Bandiagara"]. **Niger:** Peyre de Fabrègues and Lebrun (1976). **Nigeria:** Kuka, Vugel, 48. **Senegal:** near Richardtol, Döllinger. **Sudan:** Gedaref, Gondokoro, Rahad, Red Sea, Roseires, Sennar, (Schweinfurth and Ascherson 1867). Cordofan, Kotschy 108; 290. Pfund 348, 781. Sudan: banks of the White Nile, Schweinfurth 946. Arashkol Mtn, Kotschy 151. Blue Nile, Muriel, 40. Nubia: Uaratab Mtn, near Suakin, Schweinfurth 1425. Egypt, Gebel Elba. Monod (1971:399) described *Rogeria* among "le genre semble "diastémique" puisqu'il ne figure pas dans la FTEA". Ihlenfeldt's uncertainty (1994: 1067) "Whether this area in its eastern section can be considered to be continuous remains doubtful, due to the small number of records from this area" was unnecessary. Sampling by this author (Bedigian 1988; Bedigian and Harlan 1983) and others (specimens listed below) and published reports (Baumer 1963; Täckholm 1974; Wickens 1976; Boulos 2002; Husseini et al. 2008; Gohary 2008) fill that gap, confirming its widespread occurrence in Sudan and southernmost Egypt, thereby removing those misgivings (Map 3).

Ecology

Habitat dry ruderal, on roadside gravels and sands, arid waste ground and abandoned cultivated land; granitic foothills and crevices of degrading boulders of inselberg outcrops; temporal watercourses. Altitude 550−1850 m. Populations weedy on roadsides indicate tolerance to disturbance. Ephemeral habit and life form clearly linked with dispersal. *Rogeria* capsules are woody, persisting for years, and retaining seeds (serotiny), an adaptation to their habitat, because seed release may occur upon sudden agitation, as caused by winds during a rainstorm.

Of all Pedaliaceae, the genus *Rogeria* settles the most extreme locations (southern edge of the Sahara, eastern edge of the Namib), viewed as an advanced way of life for an annual (Ihlenfeldt 1967b). Obeid and Mahmoud (1969: 151) placed *R. adenophylla* within the *Acacia ehrenbergiana* community type surrounding Khartoum (Mahmoud and Obeid 1971:161).

Rogeria adenophylla encountered in waste areas or along roadsides in Mali and Sudan, standing guard like a sentinel in the desert, is tall, tough with well-armed fruit. Growing in pure stands covering several acres on granitic outcrops in north Darfur, Sudan (*Bedigian 51, 55, 68, 78, 97* MO), its success must be due, in part, to chemical protection, as well as the spines that emerge from its well-sealed capsules.

The whole plant has an unpleasant smell, often compared to rotting liver: fetid, putrid, offensive, etc. (Bedigian 2004b). Although its chemistry is little investigated (Bedigian et al. 1985), it seems reasonable to assume that these constituents provide an advantage in protection against herbivory. The exact organ of scent production is presently unknown, although extrafloral nectaries and glandular trichomes both produce exudates that attract ants. Herbarium collections note ant foraging on two species: *R. adenophylla* (*Bedigian 55* MO; *Craven 962* WIND; *Mannheimer 2893* WIND) and *R. longiflora* (*Bedigian 166* MO, WIND; *Strohbach 2779* WIND; Figure 4) as well as on a number of collections of *Sesamum* (Bedigian in preparation). In Namibia, the ants involved are *Camponotus fulvipilosus* (*Mannheimer 2893* WIND, Figure 17).

An aggressive colonizer, it spreads into unstable arid niches, occupying silts between degrading rocks.

Notes

Cailliaud (1827) was first to mention *R. adenophylla*, after Delile formally and validly named the species referring to a drawing in Cailliaud (1827) Voyage à Méroé, in Nubia, northern Sudan (Figure 1). Kerharo and Adam (1974) described the plants engagingly: "Remarkable characters. Robust erect, woody ramified annual plant or not, reaching 2.50 m top and sometimes more; quadrangular stems have angles rounded and faces depressed."

There is a distinct difference in the size of the carpels: the adaxial carpel is distinctly smaller and indehiscent, with no seed formation, a characteristic not found elsewhere in the family (Ihlenfeldt 2004: 314).

Representative specimens examined

Burkina Faso: Oursi below Kollel, 19 October 1976, *Grouzis 206* (dig. HNBU); Ouahigouya, 18 October 1986, *IRBET 769* (dig. HNBU). **Cameroun:** Fort Lamy, 20 km from Maroua, 21 August 1964, *Biholong 52* (BR), *Biholong 82* (WAG); 25 km north-northwest of Maroua, along road to Mokolo, 3 September 1964, *de Wilde & de Wilde-Duyfjes 2996* (BR, WAG); Koza, north-northeast of Mokolo, 19 September 1964, *Letouzzey 6957* (BR, WAG). **Cape Verde:** São Vincente, Selada de Entre Picos, 29 October 1990, *Cardoso de Matos & Gomes 6643* (LISC). **Mali:** Goundam, 11 August 1899, *Chevalier 3318* (BR); beyond Segou and Cinzana, before Bla, travelling east, 21 December 2000, *Bedigian 91* (MO); Timbuktu-Douanza, 25 km before Bambaramodi going south, 25 December 2000, *Bedigian 95* (MO). **Mauritania:** Moundoulafour, Plateau des Baguezans, Gorge d' Irelabelaben, est du plateau, September 1946, *Chapelle sn* (dig. IFAN); Vinding, 40 km west of Kaedi near River Senegal, *Hepper 3697* (B, BR, K, WAG). **Niger:** Niamey, 26 October 1979, *Aké Assi 1501* (MO); Matamey - Matemye (S. Zinder), 6 November 1995, *Breyne 6164* (BR). **Nigeria:** Bornu prov., Mongonu distr., Mongonu, Baga locality, 15 January 1950, *Daggash 2496* (dig. FHI); Borno state; Munguno distr. Baga, 26 September 1980, *Ekwuno & Fagbemi 144* (MO). **Senegal:** Richard Toll, 28 January 1823, *Dollinger 68* (dig. K); Matam distr. and village,

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

22 October 1938, *Adam 2794* (MO); Diourbil, December 1950, *Berhaut 1202* (BR); northeast of Lac de Guiers, 12 November 1984, *Bamps 7605* (BR). **Sudan:** Broun & Massey (1929): Red Sea Prov. (Suakin, Jebel Waratab); Berber Prov. (Atbara); Khartoum Prov. (Jebel Auli); Blue Nile Prov. (Rufaa, Sennar); White Nile Prov. (Jebel Arashkol, banks of the White Nile, El Dueim to Tonga; Upper White Nile Prov., Rocky hills). Darfur Prov.: Majok village, Nyala, *Bedigian 55* (MO), Manwashay *Bedigian 68* (MO), Nachr, Kutum, Hilat al Qoz *Bedigian 79* (MO), Gedaref: Jebel Girein, *Bedigian 7303* (CEL), S. Kordofan Prov.: Al Hashaba village, c.25 km south of El Obeid: souk *ab* Shara *Bedigian 51* (MO), N. Kordofan Prov.: Kajmar *Bedigian 97* (MO), Iyal Bachit *Bedigian 100* (MO), Abu Zabid, Abu Ujala village *Bedigian 101* (MO), Al Reyesh village east of Khor Kazgal, Jebel Abu Shujera, *Bedigian 103* (MO); (*Ahmed s.n.* KHU; *Kassas B32* KHU; *Kassas, Mobarak, Fadlallah, Omar, Osman & Täckholm E51* KHU; *Osman B206* KHU; *Salam Mahmoud s.n.* KHU; additional *s.n.* collections KHU).

Collections and literature-based ethnobotanical notes and vernacular names

Edible usage

Reports about palatability for humans vary. Schnell (1957) specified that *R. adenophylla* seeds had been consumed previously in the Sahara. Baumer (1975) indicates that seeds are not eaten by animals, although the nomads in Sudan's Kordofan province crush it in their soups; according to Schnell (1957) they boil the sap of the young leaves and add to cakes of crushed sesame. Etkin and Ross (1994) listed *baba rodo*, *Rogeria adenophylla*, among "semiwild medicinal food plants in the Hausa diet". In contrast, Monod's journal entry in *Itinéraires botaniques* 28 October 1939, noted about *R. adenophylla*: "The seeds are hardly used any more."

Rogeria adenophylla embodies a remnant of indigenous plant use by Sahelian inhabitants. Several accounts indicate usage of *Rogeria* more regularly in earlier times: Chevalier (1952) offers several variant names used by Maures: *soubrassou*, *saoubrassou*, *sahouabh*, describing it as a plant of Senegal and Northern Sudan that extends to Mauritania, the area of Tombouctou (Mali), Adrar of Iforas (Mali), Aïr, etc. Maures collected seeds and consumed them as porridge after having reduced them to flour with a pestle.

Dalziel (1955:446–447) indicated that the viscid juice of *R. adenophylla*'s boiled leaves was occasionally added to cakes made of cereals and oil; it was also used to smear comestibles such as *daudawa*, dough balls, etc. to soften and make them more palatable, as is reported in the Madi Creation Myth (Bedigian 2004b). Citing Chevalier, Dalziel (1955) and Schnell (1957) reported that Moors made soup of the pounded seeds. They placed the leaves in a pot when cooking fish etc., to prevent scorching. A piece of root added to milk, prevents spoiling. Its name *loda*, is also used for *Cissus populnea* Guill. & Perr. (Vitaceae), and the juice is substituted occasionally.

Gritzner (1981) indicates that Monod compiled a list of particularly well-known wild edible plants of the region, including *R. adenophylla.* Usage in northern Nigeria according to Etkin (pers. comm. 2003) is "To thicken *kindirmo* [indigenous yogurt]: *R. adenophylla* root soaked in water." Conversely, Ayantunde et al. (2009) examining uses of local plant species among agropastoralists, reported that ruminants rejected *R. adenophylla* because of its toxicity.

Medicinal use

A healer and informant of the author in Nyala, Darfur Sudan (December 1999) knew the plant well, describing the appearance of its seeds "like *Datura*"; and provided the following formulations for medicinal use:

(1) Take just three to five seeds, powdered. Add to honey, ginger and cloves, for palatability. Regulates heartbeat, anxiety.
(2) Use for fungus – externally. Massage onto corns and calluses on feet.
(3) Softens rough skin – emollient.
(4) For chronic wounds, add powdered iron and massage.
(5) *Rogeria adenophylla* seeds, powdered chickpea seeds, powdered iron and *al abhal* (*Juniperus sabina* L.), dried pomegranate and myrrh powder, used for breast cancer, *saratang* eat this mixture and massage onto breasts.

Broun and Massey (1929) indicate [this account is reiterated by Kirk (1946), Dalziel (1955: 446–447), Bebawi and Neugebohrn (1991) and Vogt (1995)] that *R. adenophylla* provides a mucilaginous infusion that is useful as a vehicle of administration for other medicines in cases of diarrhoea. These compilations, Crowfoot (1928) and fieldwork in Sudan by the author (1979, 1999) contribute two Arabic names: *sakaran* (i.e. drunkard), and *simsim el-afrit* 'demon's sesame'; *sukosuko* – the term is another example of reduplication (Bedigian 2004a) – used by Nuba of Jebel Ghulfan (Bedigian and Harlan 1983).

Notes about treatments in northern Nigeria according to Etkin (personal communication 2003):

"To ease birth for people and animals:

Rogeria adenophylla – leaves + water, rub on hands (mucilaginous) [NB: the same account was provided to the author about usage of *Sesamum angustifolium* in Tanzania (Bedigian 2004b)]

Rogeria adenophylla – leaves + jar *kanwa* – boil, drink.

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

To promote healing of boys' circumcision (*kaciya*): *R. adenophylla* leaves powdered with *goga masu* (*Mitracarpus scabra* Zucc., Rubiaceae), add to meat that the boy will eat; *R. adenophylla* powder applied to the cut as well. To reduce fever (*zazzabi*): crush *R. adenophylla* leaves, rub on head and body.

Kerharo and Adam (1974) give vernacular names in Wolof *xabotö*, *habotö*; and Sérer *ndohar mbind*, *ndogolon*, *toy* (high Ber-); [Bambara] *téléténa* (Berhaut 1967). Kerharo and Adam (1974) regard *Rogeria* as a medicinal species little announced but recommended by the Wolof healers of Walo and Cayor as febrifuge sudorific (energetic massage with packets of fresh leaves soaked in water) and anti-dysenteric (prepare a drink with powdered dry leaves diluted in water, as needed). The prescribers attach such importance to its anti-dysenteric action that, although very seldom noted, they prepare their provisions of this drug for 1 year of treatment, during winter, as soon as the plant has begun to form leaves. The leaves are also contained in the "*U toy*" (remedies against fatigue) *. They even apply the name *toy* – its principal component – to the plant, naming it *toy*. Lucie et al. (2012) include *R. adenophylla* among treatments for sexually transmitted infections.

Witchcraft, superstition and ritual

Usage of *R. adenophylla* subsp. *adenophylla* reveals ancient practices/beliefs/approaches among residents along the Sahel at the edge of the Sahara. As with its sister genus *Sesamum*, *Rogeria* capsules have sharp-pointed spiny appendages that have a strong symbolic association with the spirit world and shamanism, suggesting potency or powerful protection. The woody deep taproots suggest tenacity. Etkin's observations (pers. comm. 2003) about use of *S. radiatum* Schumach. & Thonn. in witchcraft (Bedigian 2004b), was reminiscent of an informant's statement about the use of *R. adenophylla* in Mali, along the road from Timbuktu to Douanza, where Bamana guide and wizard Ousmane of Mopti described this procedure: the plant is burned and the vapours are inhaled to protect against sorcery (*Bedigian 95* MO; Bedigian 2004b). Bedigian (2004b) enumerated similar usage for *Sesamum angolense* Welw.: "an infusion of the leaves was very commonly used as a wash for the treatment of madness [*misala*] and as a protection against witches [*afiti*]." This attribute may result from its adaptations to harsh landscapes: aggressive colonizers, the plants compete well, becoming the dominant species across the range of optimal habitat, dry and rocky. The author observed plants of *R. adenophylla* subsp. *adenophylla* in Darfur, Sudan extending for many km, erect like sentinels, near the village of Manwashay.

As to whether uses such as these continue today, Nina Etkin provided unpublished field notes (pers. comm. 2003) about the use of *R. adenophylla* in Nigeria (presented verbatim, per agreement): "This summarizes the medicinal and other uses of *baba rodo* as reported by participants in my study village, Kausani (pseudonym), in northern Nigeria. *Magunguna karfe* was the most common use. *Maganin karfe*, literally medicine for strength, protective medicines against metal weapons (swords, knives, etc);

Rogeria adenophylla leaves infused in water, *sha da shafe/wanka* (drink and rinse body); *Rogeria adenophylla* leaves + leaves *sasarin kura* (*Cissus quadrangularis* L., Vitaceae) and *warkin tsoho* (*Trichodesma africana* R.Br., Boraginaceae) + roots *malaiduwa* (*Cissus populnea* Guill & Perr, Vitaceae), *karkashi* (*Sesamum radiatum* Schumach. & Thonn., Pedaliaceae), and *yumbururu* (*Ipomoea aquatica* Forssk., *Aniseia martinicensis* (Jacq) Choisy, Convolvulaceae), infuse in water, *sha da wanka*;

Rogeria adenophylla – bark+barks *zuwo* (*Celtis integrifolia* (Lam.) Planch., Ulmaceae), *baure* (*Ficus gnaphalocarpa* Steud. ex Miq., Moraceae), *kawari* (*Ficus ingens* (Miq.) Miq., Moraceae), and *ganji* (*Ficus platyphylla* Delile, Moraceae) + *kwanmakera* (Blacksmith's slag), + seven axe blades + seven *dan makodi* (polishing stones) + skin of crocodile+*kashin kura* – infuse in water in a vessel placed on top of a grinding stone drink three double handfuls and wash body; prepare on a Sunday without using metal bowls, spoons, etc.

Rogeria adenophylla – leaves + leaves *kas kaifi* (*Uraria picta* Desv., Papilionaceae) – powder, add to water, *shafe* on Sunday;

Rogeria adenophylla – leaves + leaves *kas kaifi* (*Uraria picta* Desv., Papilionaceae) + flowers *runhu* (*Cassia/Senna* sp., Fabaceae) – powder, add goat milk, stir with an unopened/intact LUDAYI?????, *shafe* whole body on Sunday;

Prevention against gunshot (*bindiga*): *Rogeria adenophylla* leaves + curled wake pod (*Vigna unguiculata* (L.) Walp., Fabaceae) + roots *kam barawo* (*Leucas martinicensis* R.Br., Lamiaceae), *magarya* (*Zizyphus spina-cristi* L. (Desf), Rhamnaceae), and *zuwo* (*Celtis integrifolia* (Lam) Planch., Ulmaceae) + *kwanmakera* (Blacksmith's slag) – pound, infuse in water in *komo* (specially shaped calabash), *sha da shafe*;

Arrow poison: *Rogeria adenophylla* root (preparation not specified);

Medicine to treat/cure *kazwa*: the *R. adenophylla* leaves plus *datarniya* (*Thelepogon elegans* Roth, Poaceae) and *yumbururu* (*Ipomoea aquatica* Forssk., *Aniseia martinicensis* (Jacq.) Choisy, Convolvulaceae) infused in water, used as wash early in the morning."

Hunters mixed its juice with that from plants known as *kaskaifi* to rub on the body as a magical preventive of

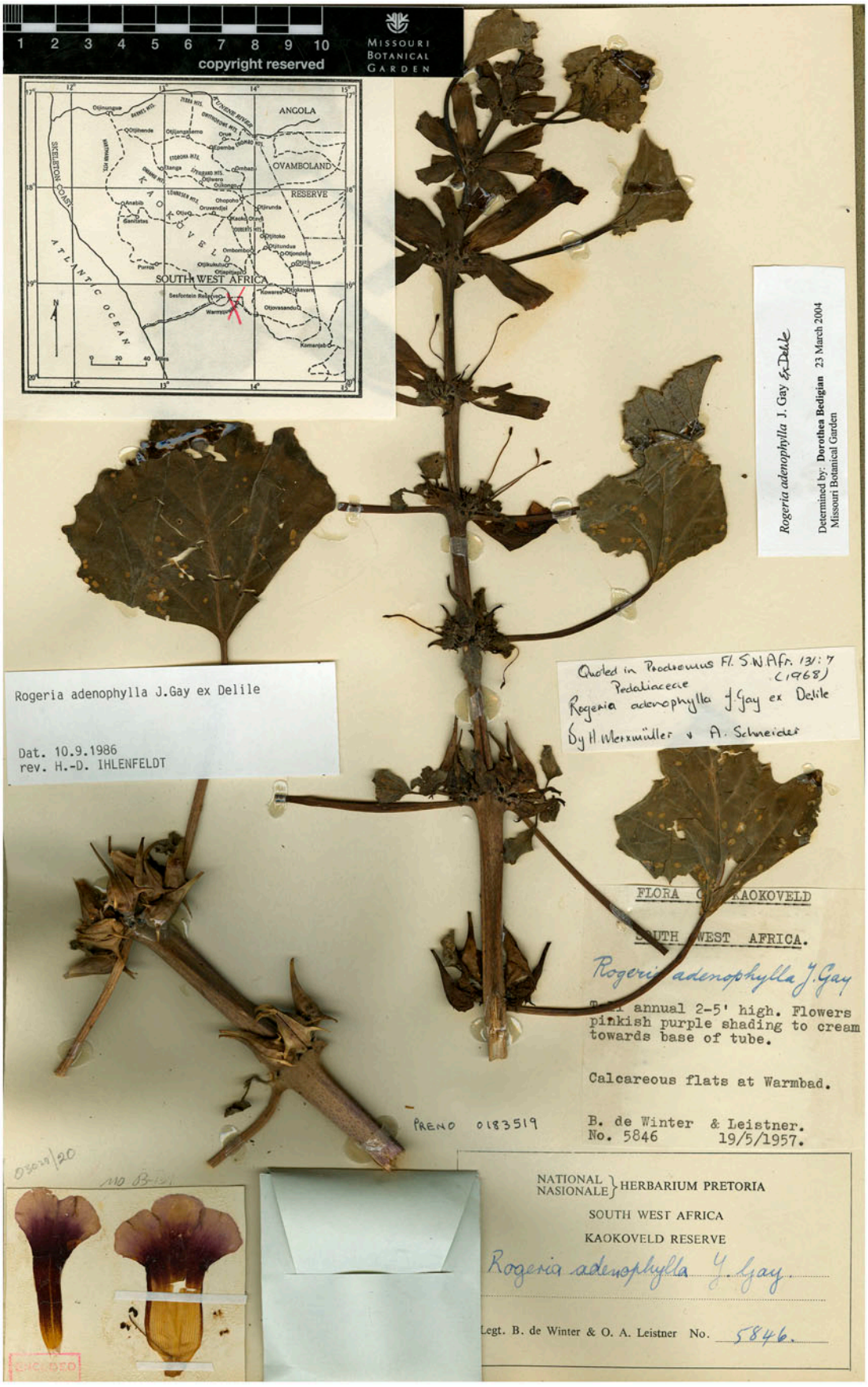


Figure 19. *Rogeria adenophylla* subsp. *rosea* holotype, *de Winter & Leistner 5846* (PRE).

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

wounds by cutting instruments (Dalziel 1955:446–447). Kirk (1946) reports no record of its use as poison.

6. *Rogeria adenophylla* subsp. *rosea* Bedigian, subsp. nov.

Type: Namibia. Kunene, Kaokoveld: Sesfontein, at Warmbad, 19 May 1957, *de Winter & Leistner 5846* (holo, designated here PRE; iso, K, WIND) (Figure 19).

J. Gay ex Delile (1826). Cent. Pl. Afr. 4:368, Plate 62. (1826); Merxmüller and Schreiber FSWA 131:6–8 (1968).

Diagnosis

Robust short-lived deciduous perennial or annual herbs or suffrutex. *Stem* erect, 1–2 m high with a single or several branches; stems mealy-glandular in the upper part, suffrutex, succulent. *Leaves* deltoid, narrowing to a rounded apex or slightly three-lobed, lobes obtuse, base truncate or shortly cuneate, margins shallowly and irregularly denticulate, teeth subulate, dark blue-green or violet-green, glandular especially below, and rather glaucous, powdery tomentose. Flowers one to three in the leaf axils, subsessile. *Corolla* narrowly funnel shaped, up to 5–6 cm long including the lobes, lobes flaring broadly, 0.5–1 cm long, whole bright rose pink, fuchsia or magenta deepening to maroon, or overcast with Tyrian pink and pale rosolane/rocellin purple to hellebore red (Ridgeway 1912), or corolla three-coloured, pinkish purple, occasionally orange, shading to cream toward base of tube; inside of throat rich golden yellow, bright gold, pale yellow or cream. *Capsule* 2.5–3 cm long, with four spreading spines near the base, often with four smaller ones between them. Flowering time: March to July.



Figure 20. *Rogeria adenophylla* subsp. *rosea* seed, Kunene, along the main road to the Khowarib Schlucht, Namibia *Mannheimer 2893* (MO, WIND) (photo courtesy M. Duncan).

Etymology

The subsp. epithet refers to the colour of the corolla (*rosea* = pink, rose coloured).

Distiguishing features

Leaves blue green to purplish green; glandular trichomes on abaxial and adaxial leaf surfaces; Corolla rose pink, flaring gently from the tube at the mouth (Figure 17); seeds deeply pitted (Figure 20).

Distribution

Angola: Mossamedes; banks of the Bero and Maiombo Rivers, *Welwitsch 1657*. Pedra do Rei, near Boca do Bero, Welwitsch, fruit, 42. Figueiredo and Smith (2009). **Namibia: Omaruru,** Brandberg, Tsisab Valley mouth, Nordenstam (1974), who adds: "Upper Numas Valley, according to Wiss (1974): 60)".

Ecology

Black stony kopjes, Nordenstam (1974). Dry stony riverbed (*Hennig & Gindrig 59* WIND); next to granite outcrops (*Le Roux 448* PRE, WIND).

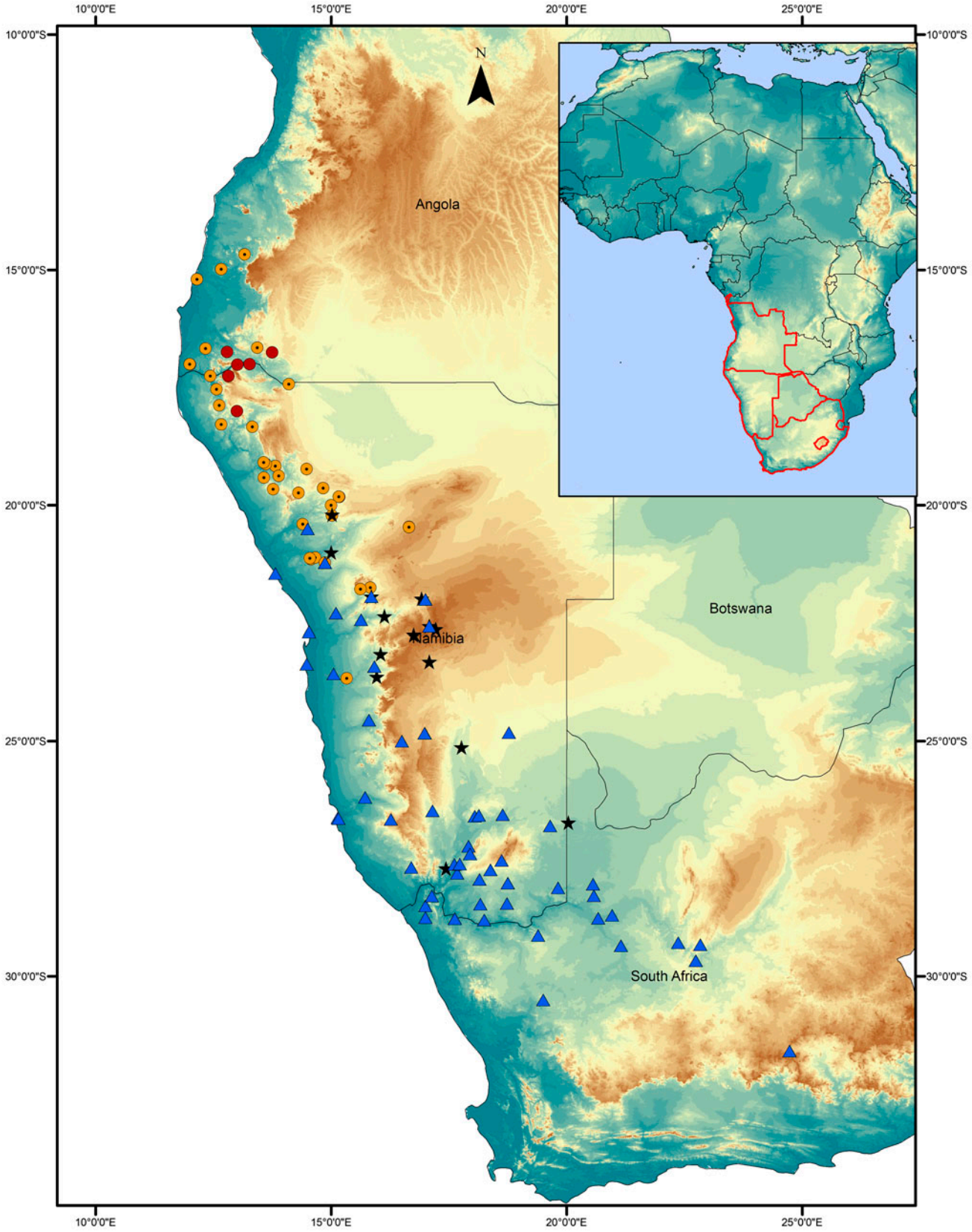
Notes

Hiern (1900) writing about plants from Mossamedes described the plant expressively: "flowers handsome: corolla orange in color outside, the interior of the tube and the whole limb felted with a pale purple velvet; capsule many-sided, scarcely 4-celled, beaked with the remains of the style, the beak obliquely truncate, the testa of the seeds deeply foveolate or scrobiculate […] the plant affords a mucilaginous infusion which is useful in cases of diarrhoea etc."

Representative specimens examined

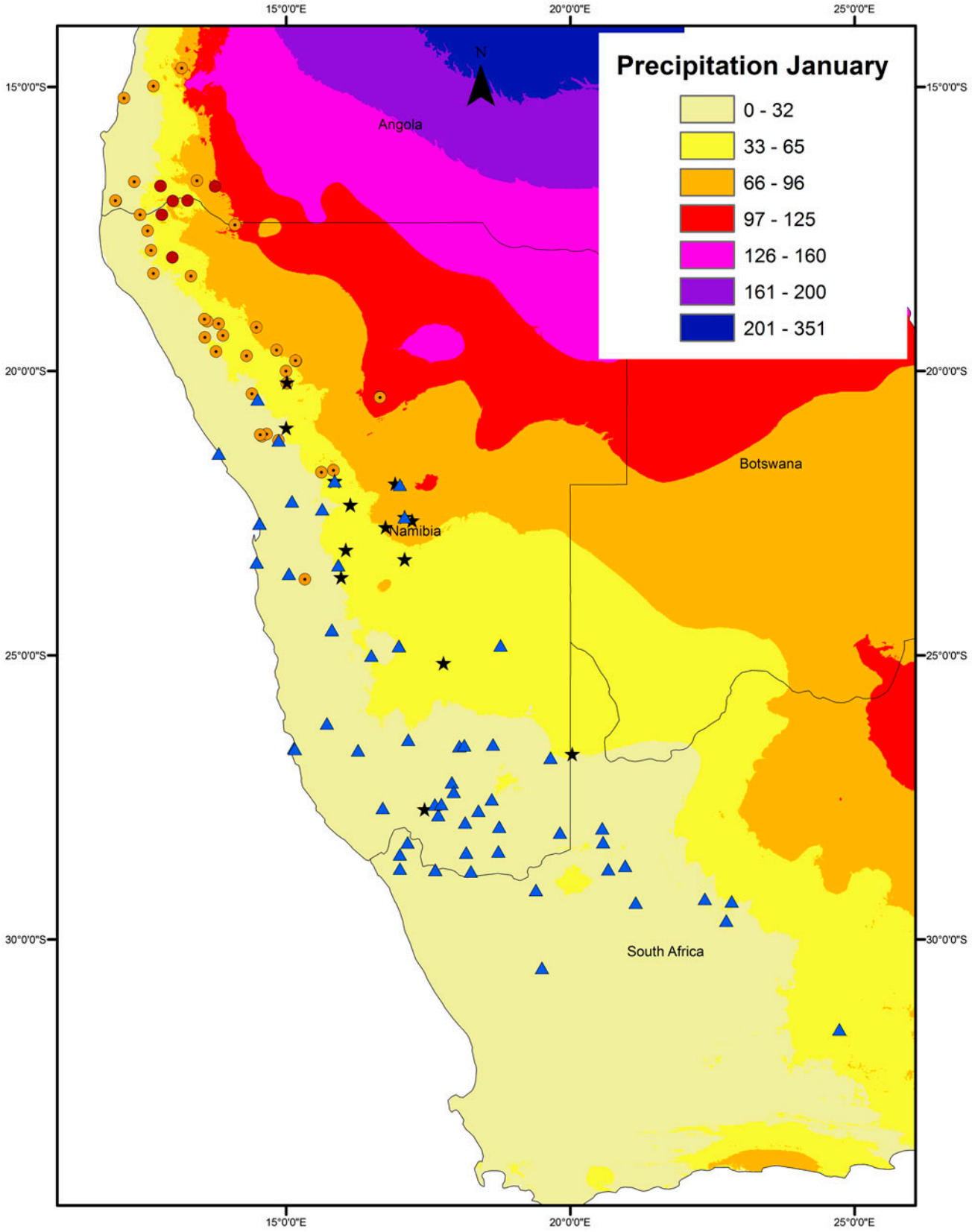
Angola: Huilla distr. Oncócua-Pediva, 15 km de Pediva, 14 July 1950, *Teixeira 384* (PRE).
Namibia: Erongo, Uis, Brandberg, Numasschlucht, 18 June 1961, *Giess 3642* (WIND); Karibib, Farm Ameib, 20 April 1968, *Giess 10,359* (WIND); Karibib, Track Amieb c.3 km east of Amieb farmhouse, north-northeast of Usakos, near "Bull Party", 21 April 1968, *Wanntorp & Wanntorp 988* (K, PRE); Brandberg, valley of the White Lady, 16 May, 1976, *Oliver, Muller & Steenkamp 6687* (MO, PRE, WAG); Brandberg-Sonuseb, 12 April 1985, *Craven 2237* (WIND). **Kunene,** Kaokoveld, Ruacana Falls near banks of Kunene, 16 August 1956, *Story 5818* (WIND); Sesfontein, Kaokofeld, Warmquelle, 22 June 1960, *Giess 3190* (PRE, WIND); Outjo distr. Farm Pamela: OU 58. Otjiwarongo, 28 March 1963, *Giess, Volk & Bleissner 6094* (MO); Kaokoveld (Swartbooisdrif) Okapupa, 17 July 1969, *Goyns 56* (PRE); Sesfontein. Warmquelle auf Warmbad, 28 December to 12 January. 1972–1973, *Lukaschik 5* (WIND); Kamanjab to Otjivasandu, 14 April 1972, *Le Roux 448* (PRE, WIND); Welwitschia,

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014



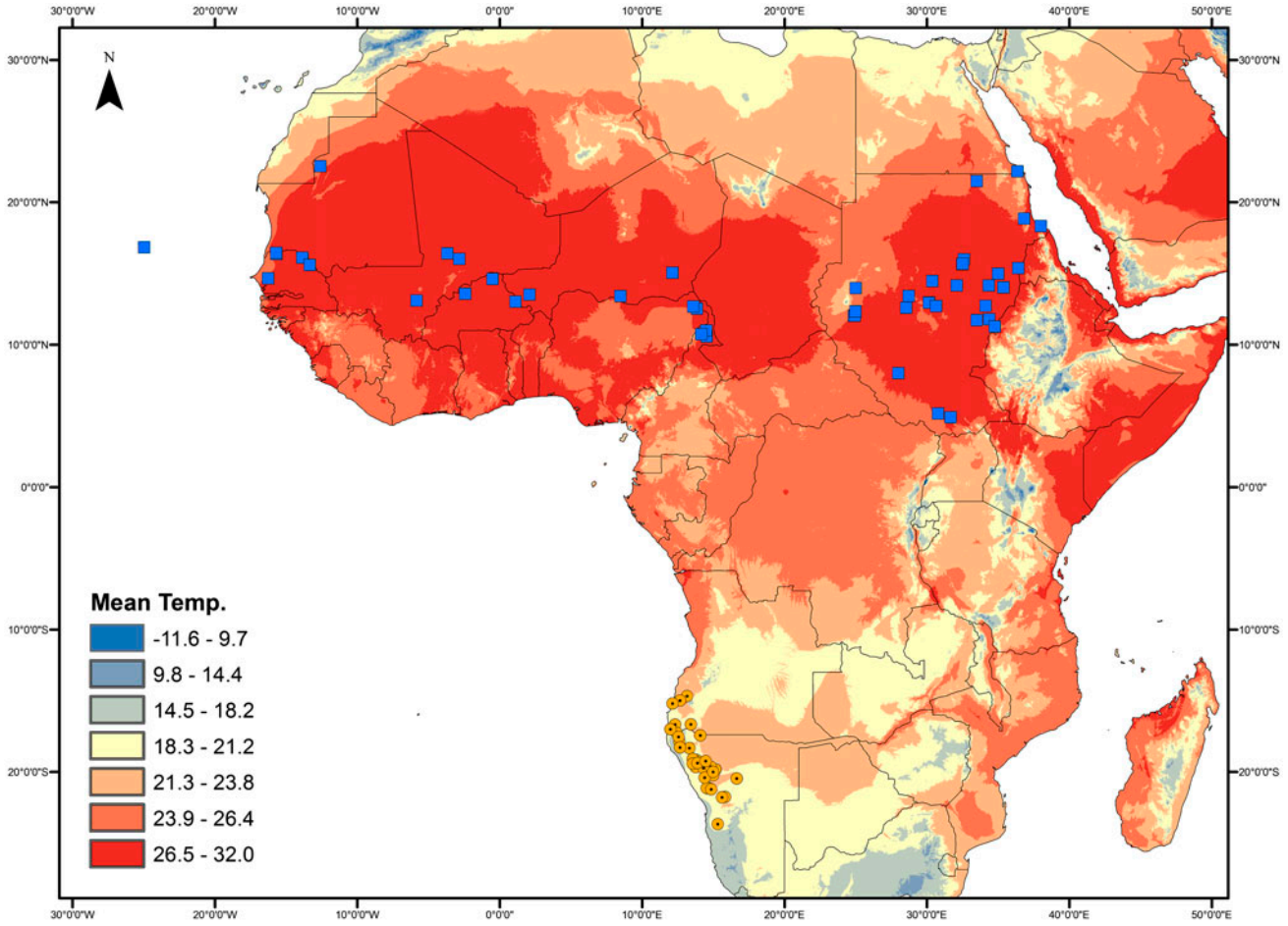
Map 1. Occurrence of southwest African *Rogeria* spp. in relation to mean temperatures (°C). *Rogeria longiflora* (blue triangles); *Rogeria bigibbosa* (black stars); *Rogeria adenophylla* subsp. *rosea* (yellow circles); *Rogeria armeniaca* (red dots).

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014



Map 2. Occurrence of southwest African *Rogeria* spp. in relation to precipitation (mm). *Rogeria longiflora* (blue triangles); *Rogeria bigibbosa* (black stars); *Rogeria adenophylla* subsp. *rosea* (yellow circles); *Rogeria armeniaca* (red dots).

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014



Map 3. Occurrence of *Rogeria adenophylla*, north and south of the equator, in relation to mean temperatures (C°).

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Fransfontein, 29 April 1972, *Schmidt 265* (WIND); Posto Velho, Kaokoveld, Otjinungua, June 1978, *Rusch 59* (WIND); Sanitatas, Purros, 12 April 1985, *Jacobsen & Moss K169* (PRE, WIND); near Okanambahe, 27 April 1988, *Craven 3135* (WIND); Kaokoland, south of Kunene in broad valley west of the Hartmann Mts., Marienfluss, 20 May 1991, *Smook 7711* (PRE); Ohangwena, Kunene. Sesfontein, 3 May 1995, *Sullivan 231* (WIND); Khowarib Schlucht, 11 April 2006, *Mannheimer 2893* (MO, WIND); west of Sesfontein, 4 May 2006, *Bedigian 185* (MO, WIND); Hoanib River, 10 May, 2006, *Bedigian 202* (MO). **Oshikoto,** Okaukuejo. Farm Otjitambi, 28 March 1980, *Giess 15,427* (WIND). **Otjozondjupa,** Hoada Camp Grounds, Rte C40, toward Palmweg, 3 May 2006, *Bedigian 183* (MO, WIND).

Invalid names

Rogeria gayii Baillon (1887) Bull. Mens. Soc. Linn. Paris 1: 668. (= *Pterodiscus Gayi*, Decne.). Angola.

Acknowledgements

I am indebted to many for their encouragement of this review. Permission to do research in Namibia was granted by the Ministry of Environment and Tourism, and in Sudan by Sudan's Agricultural Research Corporation headquarters at Wad Medani and area offices at El Fasher, El Obeid and Nyala; additional authorization was offered by the Ministry of Agriculture, Khartoum and Gedaref. A.R.M. Tahir, director of Sudan's Nyala agricultural research station, offered immeasurable logistical support under complicated conditions. Individuals at numerous institutions in both countries offered superb encouragement and hospitality, their actions serving as valuable examples in similar instances.

I am grateful to Missouri Botanical Garden herbarium curator J.C. Solomon, who obtained specimen loans and offered suggestions for this study, part of ongoing research about biogeography and systematics in Pedaliaceae, and to each herbarium curator, thanked wholeheartedly for access to their specimens. K. Neubig (FLAS) contributed the molecular analysis; B. Bassüner (MO) produced a series of distribution maps; D. Austin (ASDM), P. Goldblatt (MO), G. McPherson (MO), C. Mannheimer (WIND), and S. Smithies (PRE), provided valuable critiques of the manuscript; M. Duncan, Wright State

University, Dayton OH prepared seed photographs; S. Smithies (PRE) offered a handwritten note by J. Abels (HBG), stored in a cupboard with *Rogeria* specimens at PRE; floral images by N. Jürgens (HBG), C. Mannheimer (WIND), J.C. Manning (NBG), T. Musch (University Bayreuth/Germany).

Fieldwork and herbarium study received partial support from the Crop Evolution Laboratory, University of Illinois Urbana-Champaign (1979–1980), and from National Geographic Society Research and Exploration grants #6218-98 and #7732-04. Publication no. 128 of the Centro Studi Erbario Tropicale of the University of Florence (FT herbarium).

References

Ayantunde AA, Hiernaux P, Briejer M, Udo H, Tabo R. 2009. Uses of local plant species by agropastoralists in south-western Niger. Ethnobot Re and App. 7:53–66.

Baillon HE. 1887. Bulletin Mensuel de la Société Linnéenne de Paris: Edouard Duruy.

Bartlett D, Bartlett J. 1992. Africa's Skeleton Coast. Nat Geogr. 181(1):54–85.

Baumer M. 1963. The ranges of Dar Meganin I. Sudan Notes and Records. 44:120–135.

Baumer MC. 1975. Catalogue des plantes utiles du Kordofan (Rep Sudan) particulièrement du point de vue pastoral. J Agr Trop Bot Appl. 22:81–119.

Bebawi FF, Neugebohrn L. 1991. Review of Plants of Northern Sudan with Special Reference to Uses. Deutsche Gesellschaft für Technische Zusammenarbeit: Eschborn, Federal Republic of Germany.

Bedigian D. 1988. *Sesamum indicum* L. (Pedaliaceae): ethnobotany in Sudan, crop diversity, lignans, origin and related taxa. In: Goldblatt P, Lowry PP, editors, Modern Systematic Studies in African Botany. Proceedings of the Eleventh Plenary Meeting of the Association for the Taxonomic Study of the Flora of Tropical Africa at the Missouri Botanical Garden, St. Louis June 10-14, 1985. St. Louis: Monogr Syst Bot Missouri Bot Gard. 25:315–321.

Bedigian D. 2004a. History and lore of sesame in Southwest Asia. Econ Bot. 58(3):329–353.

Bedigian D. 2004b. Slimy leaves and oily seeds: distribution and use of wild relatives of sesame in Africa. Economic Botany. 58[Supplement issue]:S3–S33.

Bedigian D, Harlan JR. 1983. Nuba agriculture and ethnobotany with particular reference to sesame and sorghum. Econ Bot. 37(4):384–395.

Bedigian D, Seigler DS, Harlan JR. 1985. Sesamin, sesamolin and the origin of sesame. Biochem. Syst Ecol. 13:133–139.

Bentham G. 1876. Pedalineae. In: Bentham G, Hooker JD. Genera Plantarum 2:1054–1060. London: Reeve & Co. p. 1055.

Berhaut J. 1967. Flora du Sénégal. Dakar: Éditions Clairafrique.

Boudet G, Lebrun JP, Demange R. 1986. Catalogue des Plantes Vasculaires du Mali. Département du Centre de Coopération Internationale en Recherche Agronomique pour le Développement: Institut d'Elevage et de Médecine Véterinaire des Pays Tropicaux. Bamako.

Boulos L. 2002. Pedaliaceae. Flora of Egypt 3:104–106. Cairo: Al Hadara Publ.

Bredenkamp CL, van Wyk AE. 1999. Structure of mucilaginous epidermal cell walls in Passerina. Bot J Linn Soc. 129:223–238.

Broun AF, Massey RE. 1929. Flora of the Sudan. London: Thomas Murby & Co.

Burke A. 2003. The role of Namibian inselbergs in contributing to local and regional plant species richness. Biodivers Conserv. 12:469–486.

Burke A. 2004. From plains to inselbergs: species in special habitats as indicators for climate change? J Biogeogr. 31:831–841.

Burke A, Mannheimer C. 2004. Plant species of the Sperrgebiet (Diamond Area 1). Dinteria. 29:79–109.

Cailliaud F. 1827. *Rogeria adenophylla*. Centurie de Plantes d'Afrique du 'Voyage à Méroé' recueilliés par M. Cailliaud et décrites par M. Raffeneau-Delile 4:368–372. Paris: L'Imprimerie Royale.

Candolle AP de. 1845. *Sesameae*. In: De Candolle AP, De Candolle A, editors. Prodromus 9:249–257, 564. Paris: Fortin, Masson.

Cepleanu F, Hamburger MO, Sordat B, Msonthi JD, Gupta MP, Saadou M, Hostettmann K. 1994. Screening of tropical medicinal plants for molluscicidal, larvicidal, fungicidal and cytotoxic activities and brine shrimp toxicity. Pharm Biol. 32(3):294–307.

Chevalier A. 1952. Le Sahara et sa végétation. Revue de Botanique Appliquée et d'Agriculture Tropicale. 12:875.

Crowfoot GM. 1928. Flowering Plants of the Northern and Central Sudan. Leominster, England: Orphans' Printing Press.

Dalziel JM. 1955. The Useful Plants of West Tropical Africa: Appendix to the Flora of West Tropical Africa. Hutchinson J & Dalziel JM, editors, Flora of West Tropical Africa. 2nd reprint ed. (1st ed. 1937). London: Crown Agents for Overseas Governments and Administrations; p. 446–447.

Damme P van, Eynden V van den, Vernemmen P. 1992. Plants used by the Topnaar of the Kuiseb Valley Namib Desert. Afrika Focus. 8(3–4):223–252.

Decaisne J. 1865. Revue du groupe des Pedalinées. Ann Sci Nat Bot sér. 5(3):331–336.

Delile AR. 1826. Appendix to Centurie de Plantes de l'Afrique du 'Voyage à Méroé' recueilliés par Cailliaud M, 4:368–372, t 62. Paris: L'Imprimerie Royale. See also Cailliaud F.

Dinter K. 1918. Botanische Reisen in Deutsch-Südwest-Afrika. Feddes Repert Beih. 3:1–169.

Dobzhansky T. 1951. Genetics and the Origin of Species. 3rd ed. revised. New York: Columbia University Press.

Endlicher S. 1832. *Ceratotheca*, eine neue Pflanzengattung aus der Ordnung der Sesameen. Linnaea. 7:1–42. Tab. 3: 50–73.

Engler A. 1888a. Pedaliaceae. Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie. 10:255–257.

Engler A. 1888b. Plantae Marlothianae: ein Beitrag zur Kenntnis der Flora Südafrikas Vol. 2. p 65, 93–94. Leipzig: Verlag von Wilhelm Engelmann.

Engler, A. 1910. 1(2):536. *R. rangeana* synonym of *R. longiflora*. Engl ex Dinter - Repert Spec Nov. Regni Veg. 23:136 (1926).

Etkin NL, Ross PJ. 1994. Pharmacologic implications of "wild' plants in Hausa diet. In: Etkin NL, editor. Eating on the Wild Side: The Pharmacologic, Ecologic, and Social Implications of Using Noncultigens. Tucson/London: University of Arizona Press; p. 85–101.

van den Eynden V, Vernemmen P, van Damme P. 1992. The Ethnobotany of the Topnaar. Gent, Belgium: Universiteit Gent.

Figueiredo E, Smith GF. 2009. Succulent flora of Angola. Haseltonia. 15:69–78.

Foden W, Potter L. 2005. *Rogeria longiflora* (Royen) J. Gay ex DC. National Assessment: Red List of South African Plants version 2013.1. [cited 2013 Sep 08.]

Gay JÉ. 1824. Sur le *Pretrea* et le *Rogeria*, deux nouveaux genres de plantes. Ann Sci Nat. sér. 1(1):457.

Gillett JB. 1962. 'Roger dedit': plants from Senegal in the Gay herbarium at Kew. Kew Bulletin. 15(3):431–435.

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014

Gloxin, BP. 1785. *Martynia capensis*. Observationes Botanicae. 1:13.
Gohary IH al. 2008. Floristic composition of eleven wadis in Gebel Elba. Egypt. Int J Agri Biol. 10:151–160.
Goldblatt P. 1978. An analysis of the flora of southern Africa: its characteristics, relationships, and orgins. Annals of the Missouri Botanical Garden. 65(2):369–436.
Grant V. 1963. The Origin of Adaptations. New York/London: Columbia University Press.
Gritzner JA. 1981. Staff report: Environmental Degradation in Mauritania. Washington DC: National Academy Press.
Günster A. 1992. Aerial seed banks in the central Namib: distribution of serotinous plants in relation to climate and habitat. J Biogeogr. 19(5):563–572.
Günster A. 1994a. Phenological niches of coexisting serotinous plants in the Namib Desert. J Trop Ecol. 10(4):531–544.
Günster A. 1994b. Retaining seeds. A winning or losing battle? Veld & Flora. 80:113.
Günster A. 1994c. Seed bank dynamics-longevity, viability and predation of seeds of serotinous plants in the central Namib Desert. J Arid Env. 28:195–205.
Hallahan DL, Gray JC, Callow JA. 2000. Plant Trichomes. San Diego/San Francisco/New York/Boston/London: Academic Press.
Hamilton WJ. 1983. The living sands of the Namib. Nat Geogr. 164(3):364–377.
Harvey, WH. 1859-1863. Thesaurus Capensis: or, Illustration of the South African Flora, being figures and brief descriptions of South African plants selected from the Dublin University Herbarium. Dublin: Hodges, Smith & Co.
Heine H. 1963. Pedaliaceae. In: Hutchinson J, Dalziel JM, editors. Flora of West Tropical Africa, 2nd ed, Vol. 2. Crown Agents for Overseas Governments and Administrations: Millbank, London; p. 388–391.
Hiern WP. 1900. Pedaliaceae. Catalogue of the African plants collected by Dr. Friedrich Welwitsch in 1853-1861. Dicotyledons 1(4):794–801. London: Trustees of the British Museum.
el Husseini N, Abd el Ghani MM, el Naggar SI. 2008. Biogeography and diversity of the Tubiflorae in Egypt. Pol Bot J. 53(2):105–124.
Ihlenfeldt HD. 1967a. Bemerkungen zur taxonomie der Südwestafrikanischen Pedaliaceae. Mitteilungen Staatsinstitut Allgemeine Botanik München. 6:593–612.
Ihlenfeldt HD. 1967b. Über die abgrenzung und die natürliche Gliederung der Pedaliaceae R. Br. Mitteilungen Staatsinstitut Allgemeine Botanik Hamburg. 12:43–128.
Ihlenfeldt HD. 1994. Phytogeography of Pedaliaceae R.Br. In: Seyani JH, Chikuni AC, editors, Proceedings of the 13th Plenary Meeting AETFAT Malawi 2:1063–1075. Zomba: National Herbarium and Botanic Gardens of Malawi.
Ihlenfeldt HD. 2004. Pedaliaceae. In: Kubitzki K, editor. Families and Genera of Vascular Plants, Vol. 7. Berlin/New York: Springer-Verlag; p. 307–322.
van Jaarsveld EJ, van Wyk AE. 2007. Pedaliaceae. *Dewinteria*, a new semisucculent, cliff-dwelling genus endemic to the Kaokoveld, Namibia. Bothalia. 37(2):198–201.
Johnson HB. 1975. Pubescence: an ecological perspective. Bot Rev. 41(3):233–258.
Jürgens N. 1991. A new approach to the Namib Region, I: Phytogeographic subdivision. Vegetatio. 97(1):21–38.
Jürgens N. 1997. Floristic biodiversity and history of African arid regions. Biodivers Conserv. 6:495–514.
Jürgens N. 2007. Southern African Plants. Photo Guide to Plants of Southern Africa. http://www.southernafrican-plants.net/plantdata_sub.php?Mspec_ID=5328
Kandari LS, Kulkarni MG, van Staden J. 2012. Germination and growth requirements of *Rogeria longiflora*–Medicinal plant of the Namib Desert. S Afr J Bot. 79:84–90.
Kerharo J, Adam JG. 1974. La Pharmacopée Sénégalaise Traditionnelle. Paris: Vigot Frères.
Kirk R. 1946. Some vegetable poisons of the Sudan. Sudan Notes and Records. 27:127–152.
Klotzsch JF. 1862. *Rogeria microcarpa* Klotzsch. Naturw. Reise Mossambique 190. Berlin: G. Reimer. [in Peters] 6 (Bot., 1):190. = *Pedalium murex* L.
Kotschy T. 1864. De plantis nilotico-aethiopicis Knoblecherianis: additae sund tabulae I., II ... p. 10 Sesameae. *Rogeria adenophylla* Gay. (Cordofan, Sennar). Wien: K. k. Hof- und Staatsdruckerei; p. 10.
Lucie AT, Dogo S, Valentin K, Emile AC, Mbacké S. 2012. Medicinal plants used in some rural districts in Senegal (West Africa). American-Eurasian Journal of Sustainable Agriculture. 6(4):325–332.
Mahmoud A, Obeid M. 1971. Ecological studies in the vegetation of the Sudan: I. general features of the vegetation of Khartoum Province. Vegetatio. 23(3/4):153–176.
Martorell C, Ezcurra E. 2007. The narrow-leaf syndrome: a functional and evolutionary approach to the form of fog-harvesting rosette plants. Oecologia. 151:561–573.
Meerburgh N. 1775-1782. Afbeeldingen van Zeldzaame Gewassen. T. Vii. Leyden; Johannes le Mair.
Merxmüller H, Schreiber A. 1968. Pedaliaceae. Flora von Südwestafrika 131. Sesamum. Lehre: Verlag von J. Cramer.
Metcalfe CR, Chalk L. 1950. Anatomy of the Dicotyledons. Oxford: Clarendon Press.
Miege J. 1962. Quatrième liste de nombers chromosomiques d'espèces d'Afrique Occidentale. Rev Cytol Biol Vég. 24 (3–4):149–164.
Monod T. 1971. Remarques sur les symmétries floristiques des zones sèches nord et sud en Afrique. Mitt. Bot. Staatssamml. Münch. 10(403):375–423.
Nordenstam B. 1974. The flora of the Brandberg. Dinteria. 11:41.
Obeid M, Mahmoud A. 1969. The vegetation of Khartoum Province. Guide to the Natural History of Khartoum Province, pt. 4. Sudan Notes and Records. 50:134–159.
van Oudtshoorn KR, van Rooyen MW. 1999. Restriction of Dispersal in Time. Dispersal Biology of Desert Plants. Adaptations of Desert Organisms. Berlin/Heidelberg: Springer-Verlag.
Paiva J. 1995. Pedaliaceae. Flora de Cabo Verde. Lisboa: Instituto de Investigação Científica Tropical. Praia: Instituto Nacional de Investigação e Desenvolvimento Agrário; p. 150–151.
Persinos GJ, Quimby MW. 1967. Nigerian plants III. Phytochemical screening for alkaloids, saponins, and tannins. J of Pharm Sci. 56(11):1512–1515.
Peyre de Fabrègues B, Lebrun JP. 1976. Catalogue des Plantes Vasculaires du Niger. Etude Botanique No 3. In: Lebrun JP, editor. France: Institut d'Elevage et de Médécine Veterinaire des Pays Tropicaux; p. 209.
Pirotta, R. 1903. Flora della colonia Eritrea, Part 1. Barca agordat alt 500 m - *Rogeria adenophylla* Gay. Ann. Sc nat. I. 1824. p. 457; D.C. Prod. IX.
Potterat O, Saadou M, Hostettmann K. 1991. Iridoid glucosides from *Rogeria adenophylla*. Phytochemistry. 30(3):889–892.
Quézel P. 1965. La Végétation du Sahara. Du Tchad à la Mauritanie. Stuttgart: Gustav Fischer Verlag.
Quézel P. 1978. Analysis of the Flora of Mediterranean and Saharan Africa. Annals of the Missouri Botanical Garden. 65(2):479–534.
Ridgeway R. 1912. Color standards and color nomenclature. Washington, DC: The author.
Roberty G. 1954. Note sur la flore de l'ouest-africain. Bulletin de L'Institut Français d'Afrique Noire. 16(4):993–1021.

van Rooyen N, van Rooyen MW. 1998. Vegetation of the south-western arid Kalahari: an overview. Transactions of the Royal Society of South Africa. 53(2):113–130.

Royen P. 1767. *Martynia longiflora*. In: Linnaeus Syst Nat Ed. 12.2:412.

Schinz H. 1888. Pedaliaceae. Beiträge zur Kenntnis der Flora von Deutsch-Südwest-Afrika. In: Ascherson P, editor. Verhandlung des Botanischen Vereins der provinz Brandenburg; p. 181–182.

Schnell R. 1957. Plantes alimentaires et vie agricole de l'Afrique Noire. Paris: Editions Larose.

Schweinfurth GA, Ascherson P. 1867. Aufzählung sämmtlicher zur Zeit bekannten Phanerogamen und Gefässkrytogamen-Arta aus dem Gesammtegebiete der Nil-Länder. Beitrag zur Flora Aethiopiens. Berlin: G. Reimer; p. 97.

Smithies SJ, Herman PPJ. 2003. Pedaliaceae. In: Germishuizen G, Meyer NL, editors. Plants of Southern Africa: an Annotated Checklist. Strelitzia. Pretoria: National Botanical Institute, 14:772–774.

Solereder H. 1908. Pedalineae. Systematic Anatomy of the Dicotyledons: a Handbook for Laboratories of Pure and Applied Botany. Oxford: Clarendon Press.

Stapf O. 1904. *Rogeria*. In: Thiselton-Dyer WT, editor. Flora Capensis: being a Systematic Description of the Plants of the Cape Colony, Caffraria, & Port Natal. London: Lovell Reeve & Co, Vol. 4(2): p. 460–462.

Stapf O. 1906. Rogeria. In: Oliver D, Thiselton-Dyer WT, Prain D, editors. Flora of Tropical Africa. London: Lovell Reeve & Co, Vol. 4(2): 548–550.

Stebbins GL. 1950. Variation and Evolution in Plants. New York/London: Columbia University Press.

Stopp K. 1962. Antitelechore einrichtungen bei den gattungen *Sesamum, Rogeria* und *Psilocaulon*. In: Egle K, Troll W, editors. Beiträge zur Biologie der Pflanzen. Berlin: Duncker & Humblot; p. 63–76.

Täckholm V. 1974. Pedaliaceae. Students' Flora of Egypt. Cairo: Cairo University.

Upadhyaya MK, Furness N. 1994. Influence of light intensity and water stress on leaf surface characteristics of *Cynoglossum officinale*, *Centaurea* spp., and *Tragopogon* spp. Can J Bot. 72:1379–1386.

Vogt K. 1995. Common Trees and Shrubs of Dryland Sudan. Khartoum: SOS Sahel International.

Wickens G. 1976. The flora of Jebel Marra (Sudan Republic) and its geographical affinities. Kew Bulletin Additional Series. 5:1–368.

de Winter B. 1971. Floristic relationships between the Northern and Southern arid areas in Africa. Mitteilungen aus der Botanischen Staatssammlung, München. 10:424–437.

Wiss HJ. 1974. Pedaliaceae. Botanische Mitteilungen No. 8. Namibia: S.W.S. Wissenschaftliche Gesellschaft.

van Wyk AE, Smith GF. 2001. Regions of floristic endemism in Southern Africa. Hatfield, South Africa: Umdaus Press.

Downloaded by [Memorial University of Newfoundland] at 03:27 10 October 2014