PLATE 2397 *Lobostemon belliformis*

Lobostemon belliformis Boraginaceae

South Africa

Lobostemon belliformis *Buys* in South African Journal of Botany 62,1: 31 (1996); Buys: 79 (2011).

Lobostemon belliformis is a member of the Boraginaceae, commonly referred to as the forget-me-not or borage family. Species in the family are globally distributed in tropical, subtropical or temperate areas and are annual or perennial herbs (particularly in the Mediterranean region), shrubs, woody climbers or large trees (Heywood et al. 2007). Plants in this family are characterised by distinctive rough hairs on their leaves, an inflorescence that usually coils at the tips, stamens that are attached to the petals and fruits, although formed from two locules, often present as four nutlets by means of false septa. Despite these shared characteristics, taxa traditionally placed in the Boraginaceae have varying morphologies with consensus regarding the circumscription of the family rather elusive. In 2016, Luebert et al. promoted a restricted circumscription of the Boraginaceae and Chacón et al. (2016) recognised three subfamilies consisting of ± 90 genera with 1 600–1 700 species. The Boraginaceae is widely distributed within southern Africa, with members present in the Fynbos, Desert, Savanna, Succulent Karoo, Nama-Karoo and Thicket biomes (Mucina & Rutherford 2007).

Lobostemon, currently with 28 species (Buys 2011), is the largest genus of the southern African Boraginaceae. It is endemic to South Africa, occurring primarily in the Greater Cape Floristic Region (Born et al. 2007). The first species of *Lobostemon*, described by Linnaeus (1753) from the Cape of Good Hope, was initially placed in *Echium* L., namely *E. fruticosum* L. In subsequent years, numerous additional South African *Echium* species were described before Lehmann (1830) described *Lobostemon* for *L. echioides* Lehm. As the main distinguishing generic character, Lehmann stressed the presence of staminal scales (Buys 2006). Indeed, the generic name is in reference to these scales with both Latin and Greek origins – the Latin *lobos* (meaning 'lobe') and the Greek *stemon* (meaning 'stamen'). Buek (1837) extended Lehmann's concept of *Lobostemon* to include taxa that have reduced staminal scales or no staminal scales at all, but instead slightly thickened staminal bases. Consequently, Buek (1837) transferred a number of *Echium* species from South Africa to *Lobostemon*, thereby confining *Echium* to Western Eurasia. The next century saw the South African taxa being moved back and forth between *Lobostemon* and *Echium*; for a detailed discussion of this period, see Buys (2011).

Taxonomic stability returned when Levyns (1934) revised *Lobostemon* and recognised *Echium* as a separate genus, though closely related. This view has been verified by morphological data (Buys 2006) and DNA analyses (Böhle et al. 1996; Chacón et al. 2019; Hilger

PLATE 2397.—1, flowering stem, × 1; 2, sepals and superior ovary, × 1.5; 3, dissected flower, × 1.5. Voucher specimen: *Condy 308* in National Herbarium (PRE), Pretoria; living collection voucher specimen: NBG 562/2004 in Kirstenbosch National Botanical Garden. Artist: Gillian Condy.

& Böhle 2000). Levyns (1934) delimited five sections within *Lobostemon*, mainly based on floral morphology. *Lobostemon* section *Grandiflori*, which is important for the context of our species under discussion, is characterised by species with regular tubular corollas, highly reduced staminal scales and stamens of equal length. Levyns (1934) assigned *L. montanus* H.Buek, *L. sanguineus* Schltr. and *L. regulariflorus* (Ker Gawl.) Buys (= *L. grandiflorus* (Andrews) Levyns) to this section. Buys & Van der Walt (1996) remarked with the description of *L. belliformis* that it is similar to *L. regulariflorus* in terms of, for example, leaf shape, corolla colour (to some degree), flower size (corolla tubes ± 44–47 mm long), reduced staminal scales and a glabrous inter-scale area. Yet, there are differences: *L. belliformis* has a bell-shaped corolla tube, whereas *L. regulariflorus* has a corolla tube that widens uniformly (tubular); *L. belliformis* has leaves with revolute margins and indumentum occurs on both surfaces, whereas *L. regulariflorus* has flat leaf margins and the indumentum occurs only on the adaxial surface (Buys 2005). Subsequent to the description of *L. belliformis* and the placement of it in *Lobostemon* section *Grandiflori*, Buys (2006) showed that *Lobostemon* section *Grandiflori* could no longer be justified from an evolutionary perspective and combined it with *Lobostemon* section *Fruticosi*, hypothesising that *L. regulariflorus* and *L. belliformis* are sister taxa. One possible explanation is that convergent evolution, in response to bird pollinators, may explain the similarity between the two mentioned species' floral characters (Buys & Van der Walt 1996). Intriguingly, unpublished molecular sequence data generated by the Royal Botanic Gardens, Kew, does not group *L. regulariflorus* and *L. belliformis* (P. Malakasi & F. Forest, personal communications). Another red-flowered species is *L. sanguineus* and the key below will assist fieldworkers in identifying the three red-flowered species of *Lobostemon* (Figure 1).

Key to the red-flowered *Lobostemon* species

1a. Leaves coriaceous; mature flowers shorter than 35 mm; staminal scales well developed, area between staminal scales pubescent . . . . . *L. sanguineus*
1b. Leaves herbaceous; mature flowers longer than 35 mm; staminal scales reduced to swellings, area between staminal scales glabrous 2
2a. Leaves adaxially and abaxially hairy, leaf margins revolute; flowers varying from white to salmon pink to red, bell-shaped, with red to maroon nectar guides (especially prominent in lighter coloured flowers). . . . . *L. belliformis*
2b. Leaves adaxially hairy, abaxially glabrous, leaf margins not revolute; flowers red, tubular, red nectar guides not prominent . . . . . *L. regulariflorus*

A total of five collections (including the type specimen) were available for study by Buys (2011) – indicative of the rarity of the species. From a conservation perspective, Hilton-Taylor (1996) regarded the species' status as Endangered. Upon reassessment, the status was increased to Critically Endangered (Vlok et al. 2005) with the primary threats identified as habitat degradation, mainly due to invasive alien species, and harvesting. *Lobostemon belliformis* is a slow-growing species that can become very old, the generation time is thought to be 40 years (Vlok et al. 2009). Until recently, the species was only found on stabilised sand dunes associated with Canca Limestone Fynbos (Mucina & Rutherford 2007) near Gourikwa (Figure 2). Turner (2018) reports the remarkable discovery of a new population of *L. belliformis* by the Outramps branch of the Custodians of Rare and Endangered Wildflowers (CREW). The new locality is 200 km to the east of Gourikwa in the vicinity of Spioenkop, Sedgefield (Figure 2), which is associated with Knysna Sand Fynbos (Mucina & Rutherford 2007).

FIGURE 1.—The three red-flowered species of *Lobostemon*: a, *L. sanguineus* with erect, funnel-shaped to shortly tubular flowers and erect corolla lobes; b, *L. belliformis* with bell-shaped flowers and spreading corolla lobes; c, *L. regulariflorus* with tubular flowers and spreading to semi-erect corolla lobes. Photographs: a, G. Malan (CC BY-NC) with permission from iNaturalist; b, c, M.H. Buys.

Most species of *Lobostemon* are difficult to grow from stem cuttings because the cuttings do not root well (Buys & Van der Walt 1996; Lodama et al. 2016; Swarts et al. 2018), which only makes conservation efforts more difficult. It is, therefore, heartening that seedlings of *L. belliformis* have been observed (iNaturalist 2020). Fire is an important factor for all plant species within the Fynbos Biome. *Lobostemon belliformis* escapes fire by growing on rocky outcrops and they also possess very thick bark for some protection (Vlok et al. 2009). The plants can grow from seedbanks or resprout after a fire event, if the seeds or plants are not too severely damaged.

Lobostemon belliformis (Figure 3), like *L. regulariflorus*, has striking flowers that conform to a floral syndrome associated with bird pollination (ornithophily). Red flowers have been found to be both attractive for birds and repellent for insects (Cronk & Ojeda 2008). In contrast to *L. regulariflorus*, where the flowers are, as far as is known, uniformly red, the flowers of *L. belliformis* vary from entirely red, to salmon pink, to a mixture of white and

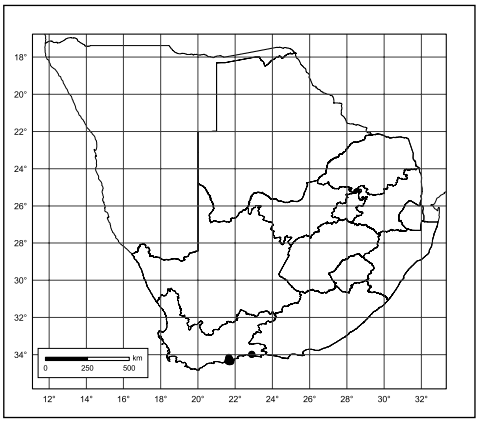

FIGURE 2.—Known distribution of *Lobostemon belliformis*.

pink or red, to almost entirely white. Flowers all possess red to maroon nectar guides visible on both surfaces of the corolla tube. Additional insect exclusion mechanisms present in *L. belliformis* and *L. regulariflorus* are their pendent flowers that do not present a landing platform for insects, coupled with a long corolla tube. The sterile and robust peduncles provide secondary perches for visiting birds in both species and the corolla lobes are the most rigid in the genus to counter any damage visiting birds may cause. In addition, dense floral clustering enables birds to probe several flowers from the same perch. Buys & Van der Walt (1996) observed the Southern

FIGURE 3.—*Lobostemon belliformis* characters: a, leaves with revolute margins and salmon pink flowers; b, white flowers with prominent nectar guides; c, red flowers; d, almost regular flowers with spreading corolla lobes. Photographs with permission from iNaturalist: a, Sandra Falanga (CC-BY-NC); b, Dave Underwood (CC-BY-NC); c, d, Nicola van Berkel (CC BY-SA).

Double-collared (*Cinnyris chalybeus*) and Orange-breasted sunbirds (*Anthobaphes violacea*), and the Cape Sugarbird (*Promerops cafer*) visiting *L. belliformis*. The pollination biology of *L. belliformis* is worthwhile investigating further to confirm ornithophily and to determine the purpose of the nectar guides.

The rarity and remoteness of *Lobostemon belliformis* explains the absence of any recorded details of any potential medicinal purposes. The common name, beaut health-bush, as per iNaturalist (2020), implies healing properties. The association of any species of *Lobostemon* with medical plants is mainly due to *L. fruticosus* (L.) H.Buek (1837) – known colloquially as *agtdaegeneesbos* (eight-day-healing-bush) – which has been used for the treatment of various ailments, especially those concerning wounds, blood poisoning, ringworms, skin diseases and syphilis. The remedies all require an infusion of the leaves or a paste made from either pounding or chewing the leaves (Watt & Breyer-Brandwijk 1962; Van Wyk et al. 1997; Philander 2011; Van Vuuren & Frank 2020). The Boraginaceae are, however, a common source of pyrrolizidine alkaloids that act as cumulative liver toxins and the use of substances containing them is discouraged (Bruneton 1999).

The species name is descriptive of the flowers and is derived from the Latin words *bella*/*bellis* (meaning 'beautiful') and *formis* (meaning 'form'). The specimen used as a voucher for the accompanying plate was cultivated at Kirstenbosch National Botanical Garden and was originally sourced from the Gourikwa site.

Description.—Woody shrub, 1.0–1.5 m high. *Branches* alternate, antrorse, young branches hairy becoming hairless with age; cork thick. Leaves herbaceous, sessile, oblanceolate, (50–)60–90(–100) × (5–)8–12(–15) mm, apex acuminate, margins revolute, midvein prominent on the abaxial surface, adaxially and abaxially hairy, hairs similar in length; stipules absent. *Inflorescence* of many flowered, compound cincinni, young flowering axis compact, flower buds loosely arranged, axis spreading slightly in fruiting stage. *Bracts* lanceolate, adaxially and abaxially hairy. *Flowers* more than 3 per cymule, corolla tubular, bell-shaped. *Sepals* narrowly oblong, half of corolla length, dissimilar in width, 2–4 sepals partly fused, adaxially and abaxially copiously hairy, young apices flat. *Corolla* ± 44–45 mm long, white to salmon pink to red, nectar guides red to maroon and particularly visible in white to salmon pink flowers, abaxially hairy, corolla lobes ± 6–7 mm long, spreading. *Stamens* straight, slightly dissimilar in length, included to exserted in adult flowers; anthers dorsifixed; filaments long adnate (> 5 mm) above staminal scales; staminal scales inserted well below the throat of the corolla tube, 3 mm above the base of the corolla tube, reduced to mere swellings, lateral lobes absent, villous, area between scales glabrous. *Gynoecium* 2-carpelled; ovary superior, 4-locular (via false septa); nectariferous disc present; style median sections hairy. *Fruit* smooth, ovoid-trigonous mericarpids (nutlets). *Flowering time*: late June to September. Plate 2397.

REFERENCES

BÖHLE, U.R., HILGER, H.H. & MARTIN, W.F. 1996. Island colonization and evolution of the insular woody habit in *Echium* L. (Boraginaceae). *Proceedings of the National Academy of Sciences* 93: 11740–11745.

BORN, J., LINDER, H.P. & DESMET, P. 2007. The Greater Cape Floristic Region. *Journal of Biogeography* 34: 147–162.
BRUNETON, J. 1999. *Pharmacognosy: Phytochemistry, medicinal plants*. Intercept, London.
BUEK, H.W. 1837. Echia Capensia. *Linnaea* 11: 129–149.
BUYS, M.H. 2005. The systematic value of the leaf indumentum in *Lobostemon* (Boraginaceae). *Bothalia* 35: 93–99.
BUYS, M.H. 2006. A morphological cladistic analysis of *Lobostemon* (Boraginaceae). *South African Journal of Botany* 72: 383–390.
BUYS, M.H. 2011. Revision of *Lobostemon* (Boraginaceae). *Phytotaxa* 37: 1–131.
BUYS, M.H. & VAN DER WALT, J.J.A. 1996. A new species of *Lobostemon* section *Grandiflori* (Boraginaceae) from South Africa. *South African Journal of Botany* 62: 31–35.
CHACÓN, J., LUEBERT, F., HILGER, H.H., OVCHINNIKOVA, S., SELVI, F., CECCHI, L., GUILLIAMS, C.M., HASENSTAB-LEHMAN, K., SUTORÝ, K. & SIMPSON, M.G. 2016. The borage family (Boraginaceae s. str.): A revised infrafamilial classification based on new phylogenetic evidence, with emphasis on the placement of some enigmatic genera. *Taxon* 65: 523–546.
CHACÓN, J., LUEBERT, F., SELVI, F., CECCHI, L. & WEIGEND, M. 2019. Phylogeny and historical biogeography of Lithospermeae (Boraginaceae): Disentangling the possible causes of Miocene diversifications. *Molecular Phylogenetics and Evolution* 141: 106626.
CRONK, Q. & OJEDA, I. 2008. Bird-pollinated flowers in an evolutionary and molecular context. *Journal of Experimental Botany* 59: 715–727.
HEYWOOD, V.H., BRUMMITT, R.K., CULHAM, A. & SEBERG, O. 2007. *Flowering plant families of the world*. Royal Botanic Gardens, Kew.
HILGER, H.H. & BÖHLE, U.R. 2000. *Pontechium*: a new genus distinct from *Echium* and *Lobostemon* (Boraginaceae). *Taxon* 49: 737–746.
HILTON-TAYLOR, C. 1996. Red Data List of southern African plants. 1. Corrections and additions. *Bothalia* 26: 177–182.
INATURALIST. 2020. *Lobostemon belliformis*. Available at: https://www.inaturalist.org/taxa/589347-Lobostemon-belliformis (accessed 4 March 2020).
LEHMANN, J.G.C. 1830. Plantas Quasdam Novas in Horto Hamburgensium Botanico Cultas. *Linnaea* 5: 371–387.
LEVYNS, M.R. 1934. A revision of *Lobostemon* Lehm., and a discussion of the species problem. *Journal of the Linnean Society, Botany* 49: 393–451.
LINNAEUS, C. 1753. *Species Plantarum*. L. Salvii, Holmiae.
LODAMA, K.E., DU TOIT, E.S., STEYN, J.M., ARAYA, H.T., PRINSLOO, G., DU PLOOY, C.P. & ROBBERTSE, P.J. 2016. Improving rooting of *Lobostemon fruticosus* L. cuttings with delayed auxin treatment. *South African Journal of Botany* 105: 111–115.
LUEBERT, F., CECCHI, L., FROHLICH, M.W., GOTTSCHLING, M., GUILLIAMS, C.M., HASENSTAB-LEHMAN, K.E., HILGER, H.H., MILLER, J.S., MITTELBACH, M. & NAZAIRE, M. 2016. Familial classification of the Boraginales. *Taxon* 65: 502–522.
MUCINA, L. & RUTHERFORD, M.C. 2007. The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
PHILANDER, L.A. 2011. An ethnobotany of Western Cape Rasta bush medicine. *Journal of ethnopharmacology* 138: 578–594.
SWARTS, A., MATSILIZA-MLATHI, B. & KLEYNHANS, R. 2018. Rooting and survival of *Lobostemon fruticosus* (L.) H.Buek stem cuttings as affected by season, media and cutting position. *South African Journal of Botany* 119: 80–85.
TURNER, D. 2018. Outramps CREW. *CREW Newsletter* 15: 28–30.
VAN VUUREN, S. & FRANK, L. 2020. Review: Southern African medicinal plants used as blood purifiers. *Journal of Ethnopharmacology* 249: 112434.
VAN WYK, B.E., VAN OUDTSHOORN, B. & GERICKE, N. 1997. *Medicinal plants of South Africa*. Briza, Pretoria.

VLOK, J.H., BUYS, M.H., HELME, N.A. & RAIMONDO, D. 2005. *Lobostemon belliformis* M.H.Buys. National Assessment: Red List of South African Plants version 2017.1 (accessed 2 March 2020).

VLOK, J.H., BUYS, M.H., HELME, N.A. & RAIMONDO, D. 2009. *Lobostemon belliformis*. In: D. Raimondo, L. Von Staden, W. Foden, J.E. Victor, N.A. Helme, R.C. Turner, D. Kamundi & P. Manyama (eds), Red list of South African plants. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.

WATT, J.M. & BREYER-BRANDWIJK, M.G. 1962. *The medicinal and poisonous plants of southern and eastern Africa*. Livingston, London.

C. WILKINSON[1], L. STRYDOM[1], N.P. BARKER[1,*], M.H. BUYS[2] and GILLIAN CONDY[3]

[1]Department of Plant and Soil Sciences, University of Pretoria, Private Bag X20, Hatfield, 0028 South Africa.

[2]National Forestry Herbarium, NZ Forest Research Institute (Scion), 49 Sala Street, Private Bag 3020, Rotorua, 3046 New Zealand.

[3]South African National Biodiversity Institute, Private Bag X101, Pretoria, 0001 South Africa.

*Author for correspondence: nigel.barker@up.ac.za.