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New infrageneric taxa in *Leucospermum* (Proteaceae) and *Tetragonia* L. (Aizoaceae) and a new name in *Aizoon* subgenus *Galenia* (Aizoaceae) in southern Africa

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New infrageneric taxa are described in *Leucospermum* R.Br. (Proteaceae) and *Tetragonia* L. (Aizoaceae) to accommodate species that are currently unplaced in the respective generic classifications. *Leucospermum* section *Hamata* J.C.Manning is described to accommodate the relatively recently described *L. hamatum* Rourke and *L. harpagonatum* Rouke, and *L.* section *Secundifolia* J.C.Manning for *L. secundifolium* Rourke, which was unplaced following the transfer of the type of *L.* section *Xericola* Rourke to the genus *Vexatorella* Rourke. In *Tetragonia* L., *T.* series *Echinatae* J.C.Manning & Klak is described for three species that were left unplaced following their exclusion from subgenus *Tetragonoides* DC. In addition, the three series *T.* series *Chenopodinae*, series *Pedunculares* and series *Macranthae* are incorrectly attributed to Fenzl and are shown to be combinations by Adamson of unranked taxa published by Fenzl. In *Aizoon* L., we replace the illegitimate name, *A. procumbens* (L.f.) Klak, with the new name *A. flavescens* Klak.

Keywords: nomenclature; *Leucospermum* section *Hamata*; *Leucospermum* section *Secundifolia*; *Tetragonia* series *Echinatae*.

Introduction

Advancements in our understanding of species relationships, either from increased phylogenetic insights or from additional discoveries, can result in modifications to existing generic taxonomies. These modifications may happen long after the original classifications were established, and their nomenclatural ramifications may not always be apparent at the time. Two such oversights in the South African flora were uncovered during the preparation of species lists for curatorial purposes. Both are the result of the transfer of the type species of a section or series to another taxon, whilst retaining the remainder of the species in the original section or series without making the necessary nomenclatural changes to accommodate these species. These 'orphan' species thus lack any position within the existing formal classifications. This poses problems for both the curation of these genera and for future testing of the classifications, and also for increasing the democratisation of biological knowledge, which demands the rapid assimilation of new data within existing frameworks.

Here we describe new sections in the genera *Leucospermum* R.Br. (Proteaceae) and *Tetragonia* L. (Aizoaceae) that are required to accommodate a handful of species that are currently unplaced in these genera, following the transfer of the type species of the relevant section or series to some other taxon. In addition, in *Aizoon* L. (Aizoaceae) we propose a new name for the illegitimate

Aizoon procumbens (L.f.) Klak, which was found to be an earlier homonym of *A. procumbens* Crantz.

Taxonomy

1. *Leucospermum* R.Br. (Proteaceae: Proteoideae)

Leucospermum R.Br. (Proteaceae: Proteoideae) is a genus of 48 species from temperate southern Africa, where it is concentrated in the Greater Cape Floristic region, extending along the Eastern Escarpment into eastern Zimbabwe (Rourke 1972, 1994). The genus was monographed by Rourke (1972), at which time the 47 accepted species were segregated among nine sections. Since then an additional three species have been described (Rourke 1979, 1983, 1994) and two have been transferred to the genus *Vexatorella* Rourke (Rourke 1984).

The genus *Vexatorella* Rourke (1984) was established following the discovery of an undescribed species of Proteoideae that could not be accommodated within any of the existing genera. It resembled *Leucospermum* in floral morphology but differed from that genus in its terminal (vs. lateral) inflorescences. The accrescent, woody floral bracts were also anomalous in *Leucospermum* but were common in the genus *Leucadendron* R.Br. Both characters were also identified in two of the three species of *Leucospermum* section *Xericola* Rourke, and they were accordingly transferred to *Vexatorella*. One of them, *L. alpinum* (Salisb. ex Knight) Rourke, was the type of the section, leaving just *L. secundifolium* Rourke still in *Leucospermum* but now unplaced to section. We describe the new section *Secundifolia* to accommodate this species.

Two of the three species of *Leucospermum* that were described after the publication of the generic monograph by Rourke (1972), *L. hamatum* Rourke (1983) and *L. harpagonatum* Rourke (1994), constitute a pair of morphologically similar taxa that are interpreted as closely allied geographical vicariads (Rourke 1994). They cannot be accommodated within the existing classification of the genus and Rourke (1994) was explicit in stating that 'the two species should be placed within a distinct section of their own'. This section was not erected. Currently the two species are treated under the unpublished group name *Hamatum* in online resources (Identifying Pincushions, viewed on 28 October 2021, from https://www.proteaatlas.org.za/pincushid.htm). We describe the new section *Hamata* to accommodate these two species.

Finally, although the affinities of the third pincushion species to be described, *L. winteri* Rourke (1979), were not immediately evident, Rourke (1979) suggested an affinity to certain members in section *Crinita* Rourke and it can be satisfactorily accommodated here.

Leucospermum *R.Br.* in Transactions of the Linnean Society, London 10: 95 (1810), nom. cons. Type: *L. hypophyllocarpodendron* (L.) Druce.

Section **Hamata** *J.C.Manning*, sect. nov. Type: *L. hamatum* Rourke

Prostrate, mat-forming shrublets. *Leaves* glabrescent, entire, obtuse or 3-toothed. *Inflorescence* turbinate, 15–30 mm diam. *Perianth* pink or off-white, tube inflated or utriculose. *Style* retrorsely barbed, recurved distally. *Stigma* conical.

Species: *L. hamatum* Rourke, *L. harpagonatum* Rourke

Section **Secundifolia** *J.C.Manning*, sect. nov. Type: *L. secundifolium* Rourke

Prostrate or decumbent, mat-forming shrublets. *Leaves* glabrous, thick and cartilaginous, entire, obtuse or rarely 3-toothed. *Inflorescence* small, globose, 10–15 mm diam.; bracteoles accrescent and woody. *Perianth* pink or whitish pink, tube subcylindric. *Style* glabrous, suberect. *Stigma* clavate.

Species: type only

2. *Tetragonia* L. (Aizoaceae: Aizooideae)

Tetragonia L. (Aizoaceae: Azooideae) as recently re-circumscribed, is a genus of ± 50 species from temperate and subtropical regions, mainly in the southern Hemisphere (Klak et al. 2017). The southern African taxa were last revised by Adamson (1955), and this remains the current treatment for the species in the region. In his classification, Adamson (1955) segregated the species among the four subgenera *Tetragonia*, *Tetragonoides* DC., *Anisostigma* (Schinz) Engl. and *Tribulocarpus* (S.Moore) Adamson, defined by several characters of the fruits and flowers. The recent molecular phylogenetic analysis of the subfamily by Klak et al. (2017), however, uncovered some unexpected relationships among the species that necessitated realignments among several taxa in order to render them monophyletic. Among these was the removal of *Tetragonia* subgenus *Anisostigma* and subgenus *Tribulocarpus* to the new tribe Anisostigmateae Klak in subfamily Sesuvioideae as the genera *Anisostigma* Schinz and *Tribulocarpus* S.Moore respectively.

In addition to these changes, the circumscription of *Tetragonia* subgenus *Tetragonoides* was greatly altered by the removal from it of most of the southern African taxa previously included there by Adamson

(1955). *Tetragonia* subgenus *Tetragonoides* is now understood to be essentially Australasian in distribution, with the exception of the cosmopolitan littoral species *T. tetragonoides* (Pall.) Kuntze, the type of the subgenus. Two additional subgenera, subgenus *Tetragonella* (Miq.) Klak and subgenus *Americanae* Klak were established to accommodate respectively the other Australasian and the American species (Klak et al. 2017).

The remaining four southern African species that were included by Adamson (1955) in subgenus *Tetragonoides* were retrieved by Klak et al. (2017) as a clade sister to subgenus *Tetragonia* and were accordingly included in it, with the observation that the 'series erected by Adamson (1955) should be maintained'. This alludes to the seven sections recognised by Adamson (1955) in subgenus *Tetragonia*. Although they included these additional four former members of subgenus *Tetragonoides* in subgenus *Tetragonia,* Klak et al. (2017) did not accommodate them within the existing classification.

Significantly, the removal of *T. tetragonoides* from this group renders it morphologically more homogenous. The four species share a prostrate, ± annual habit and half-inferior ovary, and differ from all other members of subgenus *Tetragonia* in having the stamens less than twice as many as the perianth segments vs. more than twice as many as the perianth segments (Adamson 1955). The new series *Echinatae* J.C.Manning & Klak is accordingly proposed here to accommodate them.

There are two other nomenclatural corrections required in subgenus *Tetragonia*. The first concerns the authorities for the infrageneric names that were published by Fenzl (1862). Adamson (1955) treats these as series, with Fenzl (1862) as author. However, examination of Fenzl (1862) reveals that they were published as third tier names two ranks below sectional level but without a definite rank. Although they are to be accepted as validly published by Fenzl (1862) they are to be treated as unranked (Turland et al. 2018: 'Art. ***37.3.*** *A name published before 1 January 1953 without a clear indication of its rank is validly published provided that all other requirements for valid publication are fulfilled; it is, however, inoperative in questions of priority except for homonymy. If it is the name of a new taxon, it may serve as a basionym or replaced synonym for subsequent new combinations, names at new ranks, or replacement names at definite ranks.*'). Their later publication by Adamson (1955) with a clear indication of the rank of series serves as the first publication at that rank and they are therefore to be treated as combinations by Adamson (1955).

The second correction concerns the status of the series that includes the type of the genus, *T. fruticosa* L. Although the genus *Tetragonia* was only lectotypified by Britton (1918) after the treatment by Fenzl (1862), the name *T.* [unranked] *Fruticulosae* Fenzl. (1862) is to be treated as not validly published [Turland et al. 2018: 'Art. ***22.2.*** *A name of a subdivision of a genus that includes the type (i.e. the original type or all elements eligible as type or the previously designated type) of the adopted, legitimate name of the genus is not validly published unless its epithet repeats the generic name unaltered. For the purposes of this provision, explicit indication that the nomenclaturally typical element is included is considered as equivalent to inclusion of the type, whether or not it has been previously designated.*']. Similarly, the publication of this taxon at series rank (spelled *Fruticosae*) by Adamson (1955) is to be treated as not validly published. The correct name for this taxon is series *Tetragonia* (Turland et al. 2018: 'Art. ***22.1.*** *The name of any subdivision of a genus that includes the type of the adopted, legitimate name of the genus to which it is assigned is to repeat that generic name unaltered as its epithet, not followed by an author citation.*').

The species of *Tetragonia* subgenus *Tetragonia* are thus distributed among eight series as follows:

Tetragonia *L.*, Species plantarum 1: 480 (1753). Type: *T. fruticosa* L., lecto., designated by Britton, Flora of Bermuda: 125 (1918).

Series **Tetragonia**

Tetragonia [unranked] *Fruticulosae* Fenzl in Flora capensis 2: 460 (1892), nom. inval.

Tetragonia series *Fruticulosae* Adamson in Journal of South African Botany 21: 112 (1955), nom. inval.

Species: *T. arbuscula* Fenzl, *T. arbusculoides* Engl., *T. calycina* Fenzl, *T. fruticosa* L., *T. glauca* Fenzl, *T. macroptera* Pax, *T. reduplicata* Welw. ex Oliv., *T. rangeana* Engl., *T. spicata* L.f., *T. virgata* Schltr.

Note: The Chilean species *T. macrocarpa* Phil. was erroneously included in this series by Klak et al. (2017) instead of the southern African *T. macroptera* Pax.

Series **Robustae** *Adamson* in Journal of South African Botany 21: 123 (1955). Type: *T. robusta* Fenzl.

Species: *T. distorta* Fenzl, *T. robusta* Fenzl, *T. sarcophylla* Fenzl

Series **Salignae** *Adamson* in Journal of South African Botany 21: 127 (1955). Type: *T. saligna* Fenzl.

Species: *T. erecta* Adamson, *T. haworthii* Fenzl, *T. lasiantha* Adamson, *T. saligna* Fenzl

Series **Decumbentes** *Adamson* in Journal of South African Botany 21: 130 (1955). Type: *T. decumbens* Mill.

Species: *T. decumbens* Mill., *T. namaquensis* Schltr., *T. verrucosa* Fenzl

Series **Macranthae** *(Fenzl) Adamson* in Journal of South African Botany 21: 133 (1955). *T.* [unranked] *Macranthae* Fenzl in Flora capensis 2: 461 (1892). Type: *T. hirsuta* L.f.

Species: *T. hirsuta* L.f., *T. rosea* Schltr.

Series **Pedunculares** *(Fenzl) Adamson* in Journal of South African Botany 21: 135 (1955). *T.* [unranked] *Pedunculares* Fenzl in Flora capensis 2: 460 (1892). Type: *T. herbacea* L., lecto., designated by Adamson: 135 (1955).

Species: *T. halimoides* Fenzl, *T. herbacea* L., *T. nigrescens* Eckl. & Zeyh., *T. portulacoides* Fenzl, *T. sphaerocarpa* Adamson

Series **Chenopodinae** *(Fenzl) Adamson* in Journal of South African Botany 21: 141 (1955). *T.* [unranked] *Chenopodinae* Fenzl in Flora capensis 2: 460 (1892). Type: *T. chenopodioides* Eckl. & Zeyh., lecto., designated by Adamson: 141 (1955).

Species: *T. chenopodioides* Eckl. & Zeyh., *T. galenioides* Fenzl. *T. pillansii* Adamson

Series **Echinatae** *J.C.Manning & Klak*, ser. nov. Type: *T. echinata* Aiton.

Prostrate ± annual herbs. *Flowers* sessile or subsessile, solitary or in small groups. *Stamens* as many as and alternating with perianth segments, sometimes in pairs, or sometimes fewer. *Ovary* half-inferior. *Fruit* not winged, often with ridges or projections at top or sides.

Species: *T. acanthocarpa* Adamson, *T. caesia* Adamson, *T. echinata* Aiton, *T. microptera* Fenzl

Note: The accession identified as '*T. microptera* (voucher *Klak 2430*, BOL)' in Klak et al. (2017) was subsequently found to be misidentified, and true *T. microptera* was thus never included in the analysis. This species is therefore placed in series *Echinatae* based on the morphological characteristics that it shares with the other species in this series (Adamson 1955).

3. *Aizoon* L. (Aizoaceae: Aizooideae)

The generic circumscription of *Aizoon* L. (Aizooideae, Aizoaceae) was recently enlarged to include those species previously treated in the genus *Galenia* L. (Klak et al. 2017). In its new circumscription, *Aizoon* is recognized by capsules with reduced expanding tissue, and leaves and/or stems covered by silvery hairs or hair-like to rounded papillae. The species previously placed in *Galenia* subgenus *Galenia* were transferred to *Aizoon* subgenus *Galenia* (L.) Klak, which now includes six species. Among these, the new combination *A. procumbens* (L.f.) Klak proposed by Klak et al. (2017) for *G. procumbens* L.f. (1782) is, however, a later homonym of *A. procumbens* Crantz (1766: 135). Consequently, the proposed name is illegitimate (Turland et al. 2018: Art. ***53.1*** and ***53.2***), and a replacement name is required.

Although this species was originally described as 'procumbent', most forms are erect shrublets, some of which have been grouped under the manuscript name '*Galenia flavescens*', which alludes to the yellow to orange colour of the leaves (Adamson, 1956: 96). Since a new name is required, this unpublished epithet is taken up here.

Aizoon flavescens *Klak*, nom. nov. pro *Galenia procumbens* L.f., Supplementum plantarum: 227 (1782). *Aizoon procumbens* (L.f.) Klak in Taxon 66: 1163 (2017), nom. illeg., non *A. procumbens* Crantz in Institutiones Rei Herbariae 1: 135 (1766).

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