A morphology based taxonomic revision of the *Euphorbia polygona* species complex

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Fig. 1: Fruiting Euphorbia polygona *var.* minor

Euphorbia polygona Haw. and *Euphorbia horrida* Boiss. are phenotypically[1)] very similar taxa that appear to be closely allied to each other. Other close relatives are *Euphorbia anoplia* Stapf and *Euphorbia inconstantia* R.A.Dyer. White et al. (1941) already suspected that the latter is a natural hybrid. Also according to Bruyns (2012), it is an interspecific cross, possibly between *Euphorbia heptagona* L. and *E. polygona*. Therefore, Bruyns excluded *E. inconstantia* from his nomenclature and typification of southern African species of *Euphorbia* (Bruyns, 2012). Apparently Bruyns made a mistake in the name of one of its parents: *E. heptagona* does not reach any population of *E. polygona* var. *polygona*, and *E. inconstantia* does not display features of *Euphorbia enopla* Boiss. that occurs in the same area as *E. polygona* and which Bruyns (2012) relegated to synonym of *E. heptagona*.

In fact, *E. inconstantia* is most certainly a progeny of *Euphorbia pentagona* Haw. and *E. polygona* (Marx, 1994; White et al., 1941). Marx (1994) reports that the suspected hybrid is only found in association with one or both of its parent species. He also observed *E. inconstantia* plants growing within a radius of just a few metres from their parents; some specimens strongly resembled *E. polygona* and other *E. pentagona*.

It is difficult to ascertain hybrids by morphological features alone. However, because of the field occurrence of *E. inconstantia* and its variable habit, which always displays characteristics of the parent species involved to varying extent, the author concludes that it is positively an interspecific hybrid derived from *E. pentagona* and *E. polygona*. Therefore, it is not taken into account in this revision.

Indeed, *E. anoplia*, *E. horrida*, and *E. polygona* show some distinctive opposing characters including colour of involucral glands, colour of epidermis, length of spines, number and depth of stem angles (ribs). But there are also some inconsistencies in the published descriptions of these close relatives. Marx (2009) points out that there are varieties of *E. horrida*, in fact *E. horrida* var. *noorsveldensis* A.C.White, R.A.Dyer

1) Phenotypes share the same physical (morphological) and ecological (habitat) characteristics.

& B.Sloane and *E. horrida* var. *striata* A.C.White, R.A.Dyer & B.Sloane, which have dark purple glands instead of green. Dark purple glands are supposed to be typical for *E. polygona*. Moreover, *E. polygona* is described as having 12-20 stem angles and *E. horrida* is supposed to have fewer angles (12-16). But this does not apply to the white Uniondale form of *E. horrida* and the large *E. horrida* var. *major* A.C.White, R.A.Dyer & B.Sloane. Both can have up to at least 20 ribs. According to Marx (1994) the only roughly reliable distinguishing characters are the narrower and greener stems of *E. polygona*. There is, however, a dwarf form of *E. horrida* from the Rooiberg and Swartberg Mountain Ranges in the Western Cape Province; it has stems merely up to some 8 cm thick and grows in clumps. (This form is known in the horticultural trade and succulent collections as "var. *minor*", not yet a legitimate variety, apparently never published, but will be formally described in this revision.) Furthermore, since the rediscovery of a *E. polygona* variety with a white epidermis in the wild (Marx, 2009; Schnabel, 2011) a greener stem surface is also no longer a definite distinguishing feature.

Distinct or not distinct?

To decide on this question, the relevant literature regarding *E. anoplia, E. horrida,* and *E. polygona* was reviewed, including the genetic studies on southern African *Euphorbia* by Bruyns et al. (2006). This information was supplemented by extensive studies of plant phenotypes in the field, in cultivation and in virtual herbaria (HBG, MO, S, W), which keep digital images of type specimens available online.

Taxonomically significant morphological parameters (i.e. habit, height, thickness and surface colour of stems, length and number of spines, shape, number and depth of ribs, colour of involucral glands, size, shape, and surface feature of the capsules, etc.) of nearly all taxa throughout much of their known geographical distribution were measured. Almost every taxon was extensively photographed in habitat.

As a result of the comparative morphological analysis, the revision of the *Euphorbia polygona* species complex presented here reduces *E. horrida* and its varieties to varieties of *E. polygona*. As far as *E. anoplia* is concerned, there is no evidence for its separate species status. Hence, it is usually considered a doubtful species. On the other hand, as can be seen below, it is not proved yet that a separate status is unjustified at some level of classification. For that reason *E. anoplia* will be preliminarily classified as *E. polygona* var. *anoplia*.

At this stage, the author does not intend to provide an exhaustive or definitive survey of all elements possibly belonging to the *Euphorbia polygona* complex as discussed here. The objective of the present paper is to identify the currently known diversity of variation within this group of closely related taxa and, consequently, to help towards its conservation in nature.

Problems of modern taxonomy

Modern taxonomists classify organisms by their DNA. Genetic studies on southern African *Euphorbia* species by Bruyns et al. (2006) are particularly helpful in solving the classification problem discussed here. According to their findings, the sequence of nucleotides in the DNA of *E. horrida* does not differ significantly from that of *E. polygona*, therefore, the entities are no longer considered as separate species. In terms of modern botanical nomenclature, priority of publication has to be observed, so Bruyns et al. (2006) treat *E. horrida* Boiss. (1860) as a synonym of *E. polygona* Haworth (1803).

Nevertheless, reliance on molecular data alone is most controversial. Inter alia, Lipscomb et al. (2003, pp. 65-66) state that "The advocates of DNA taxonomy seem not to understand the peerless intellectual content of taxonomy based on all available information, or the hypothesis-driven basis of modern revisionary work. The many levels of hypothesis testing in taxonomy, from characters to species to clades, are essential for all evolutionary biology. To relegate taxonomy, rich in theory and knowledge, to a high-tech service industry would be a decided step backward for science."

Regardless of whether or not this is a justified criticism, without doubt DNA sequence data are an extremely valuable source of information, though not the exclusive one, for classifying biological specimens and managing species diversity. Combining molecular with morphological data enumerated above, the author is convinced that there is enough taxonomic evidence to substantiate and corroborate Bruyns (2012) decision to "lump" *E. horrida* into *E. polygona*.

Adapted from DNA analysis, and apart from a few exceptions, Bruyns (2012) attempts to bring order in the – indeed disorganised – taxonomy of *Euphorbia* in southern Africa by neglecting any taxa below the basic taxonomic rank of species and relegating them to synonymy under the respective species. Ignoring species variation almost completely for, by all appearances, purely regulative reasons is certainly a highly controversial taxonomic issue, and in particular most of the experienced South African field workers will prob-

ably not agree with his relatively illiberal, technocratic approach to classification.

Contrary to Bruyns' approach, the author holds a conservative, pragmatic, and more sensitive view on variations within species and would not go as far as to say that all varieties of *E. polygona* and *E. horrida* should be combined into a single taxon. They display an extensive degree of morphological variation and, for the time being, relatively little is known about genetic variability within and among plant populations in-situ at DNA level. While there is no empirical evidence that the palpable differences in morphology between these entities are not genetically but geographically, ecologically or randomly based, the existence of distinct variations within *E. polygona* still needs recognition by use of further names below the rank of species.

For species protection, this makes a big difference: varieties could belong to a taxon which is not listed in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species or any endangered species programme and, therefore, are not deemed worthy of special protection. In fact, their existence may not even be known. Ignoring them for taxonomic reasons may result in their extinction in the wild and hence lead to a loss of genetic diversity of the parent-species.

Sell & Murrell (2002, p. xviii) rightly lament: "It is unfortunate that many botanists tend to ignore variation completely, and they will certainly ignore it if it has no name at all".

Euphorbia polygona: a synonym for *Euphorbia cucumerina*?

Euphorbia cucumerina Willd. was described by the German botanist Carl Ludwig Willdenow in 1799. He based his description only on notes and a scanty type illustration of the French traveller and ornithologist François Le Vaillant made during his second journey through South Africa from December 1781 to June 1784. *E. cucumerina* has been cited as a valid species to this day e.g. by White et al. (1941) and Eggli (2004).

Le Vaillant's "cucumber" *Euphorbia* seems nearest to *Euphorbia stellispina* Haw. or an abnormally elongated specimen of *Euphorbia obesa* Hook. fil. More recently, *E. cucumerina* has also been indicated to be similar to *E. polygona* (including *E. horrida*) by Peter Bruyns, and thereupon a new item for this very inadequately known

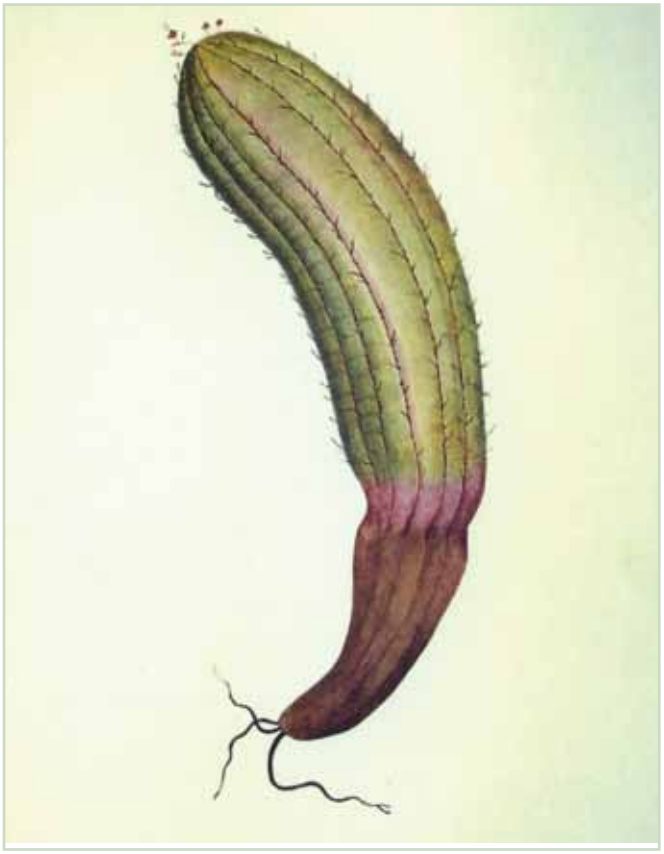

Fig. 2: Le Vaillant's water-colour painting of Euphorbia cucumerina

species was added to TOLKIN[2]. Based on Paul Berry's (2013) general statement that "(...) he [Peter Bruyns] has seen the Le Vaillant illustration, and he thinks this is the same as *E. polygona*, and would be an earlier name for it (...)", *E. polygona* (including its varieties) was relegated to synonymy for *E. cucumerina*.

The author of this article, however, is firmly convicted that *E. cucumerina* has to be treated as species *non satis notae* (not known well enough) since no original material has been rediscovered and the protologue is too vague to allow the species to be identified with any certainty. Also, obviously Bruyns ignores species distribution data completely. Le Vaillant discovered *E. cucumerina* in the Little Namaqualand (Northern Cape). *E. polygona* and its varieties, though, are strictly confined to the Western and Eastern Cape. Consequently, the synonymy has to be rejected.

Furthermore, several points should be kept in mind when interpreting Le Vaillant's notes and drawing. His travel narratives are not scientific papers, and his sketch of *E. cucumerina* leaves plenty of room for interpretation, and cannot be held strictly accountable for accuracy. Winthagen and Lawant (2005) speculate

2) "TOLKIN is an information management and analytical web application to provide informatics support for phylodiversity and biodiversity research projects. As a web-based application, TOLKIN is able to support collaborative projects by providing shared access to a variety of data on voucher specimens, taxonomy, bibliography, morphology, DNA samples and sequences." (retrieved March 28, 2013 from: http://www.tolkin.org)

that Le Vaillant's artwork was possibly influenced by an elongated specimen of *E. obesa* which he could have encountered in the Uitenhage District on his eastbound journey. As is well-known, art is not subject to formal, rigid rules the way botany is.

Taxonomic treatment

Euphorbia cucumerina Willd., in Sp. Pl. 2: 886. 1799, *non satis notæ*

Type: South Africa, Northern Cape Province, Little Namaqualand, between Groene River and Koper Berg (lectotype: illustration by François Le Vaillant).

Description: Stem succulent, spiny, apparently unbranched, about 25 cm (9-10 in.) high, about 3,5 cm (1,5 in.) thick, cylindric, apparently 10-12-angled; **angles** slightly prominent and obtusely rounded, separated by shallow grooves; **spines** (modified peduncles) solitary, about 6 mm (0,25 in.) long; **peduncles** solitary, as long as the spines, some at the apex of the stem, each bearing one rather small involucre, possibly subtended by subulate bracts.

Additional information can be obtained from Le Vaillant's travel book (1797). He describes this new *Euphorbia* as perfectly looking like a cucumber, of which it has the shape and the curved inflection. Its stem colour is green-yellowish, shaded by a violet tinge near the root. It only clings to the soil by way of some weak roots.

Distribution: Not further known; the species was never found again, and therefore its identity remains mysterious.

Euphorbia polygona var. *polygona* Haw., in Misc. Nat. 184 (1803)

Type: South Africa, Cape, Witpoortsberg, 610-914 m, Aug. c. 1830, J. F. Drège 8212 (neotype: S 2583, isoneotypes: BM, HBG! – 2 sheets, K, MO, P, S!, W! – 3 sheets).

In the protologue of *E. polygona*, no original material and precise locality were indicated. N. E. Brown (1915) described *E. polygona* in Flora Capensis from living plants cultivated at Kew and others sent to Kew by Isaac Louis Drège, nephew of Johann Franz Drège, and Florence Mary Paterson. However, no type specimen was preserved. Bruyns (2012) therefore selected as neotype his designated lectotype specimen of *E. horrida*.

Description: Dioecious (male and female cyathia on separate plants) multi-stemmed succulent shrub, overall shape clump forming; **stems** erect, cylindrical, angular, of varying age and irregular length, sprouting at the base, typically not rebranching above the base or only occasionally and then usually due to injuries, rising to about 170 cm in height, about 7-10 cm thick, green and slightly glaucous on the young growth, becoming grey with age, spiny or almost spineless, 12-20 angles, 7 when very young; **angles** prominent, often undulated, about 1.5 cm deep; **spines** (modified peduncles) 1-3 from a flowering eye, scattered along the angles, 4-10 mm long; **leaves** rudimentary, soon deciduous; **cyathia** solitary from each flowering eye, or at each side of a spine, or 3 together; **peduncles** 2-4 mm long, bearing several bracts; **involucre** cup-shaped, 5-7 mm in diameter, dark purple, usually with 5 glands and 5 minutely toothed lobes; **glands** subcontiguous, elliptic, dark purple; **capsule** up to 6 mm in diameter, globose, densely greyish-pubescent.

The "many-angled" *Euphorbia* is a highly variable taxon, particularly with regard to its spination and epidermis colour. E.g. northwest and northeast of Grahamstown both unusually strongly spined and almost spineless or weak spined forms have been observed. There also used to be a large population of a small, almost spineless, pale green *E. polygona* west of Riebeeck East (Marx, 1994). Gerhard Marx reports that most, if not all, specimens have been removed in the meantime, in all probability by conservationists who could not distinguish between invasive alien cacti and indigenous euphorbias (Gerhard Marx, pers. comm., January 5, 2013). Marx (1994) also reports small, weak spined, bluish-grey plants on the Suurberg Range in the Eastern Cape Province, but these have not yet been seen by the author.

Natural hybridization between *E. polygona* var. *polygona* and *E. enopla* var. *enopla* has been found, e.g., northwest of Uitenhage at the foothills of the Great Winterhoek Mountains as well as northeast of Steytlerville at the foothills of the Lesser Winterhoek and the Suurberg Mountains near Kirkwood. There is also a naturally occurring interspecific hybrid with *E. pentagona* mainly north, northwest and northeast of Grahamstown, from where it was described as *E. inconstantia* by R. A. Dyer (1931).

Distribution: Eastern Cape Province, Port Elizabeth, Uitenhage, Grahamstown, Riebeeck East, Somerset East and Fort Beaufort catchment areas

Fig. 3: Euphorbia polygona *var.* polygona

Fig. 4: Euphorbia polygona *var.* polygona *in its habitat near Grahamstown*

Fig. 5: Capsule of Euphorbia polygona *var.* polygona

Fig. 6: Euphorbia polygona *var.* polygona, *close-up of a male cyathium*

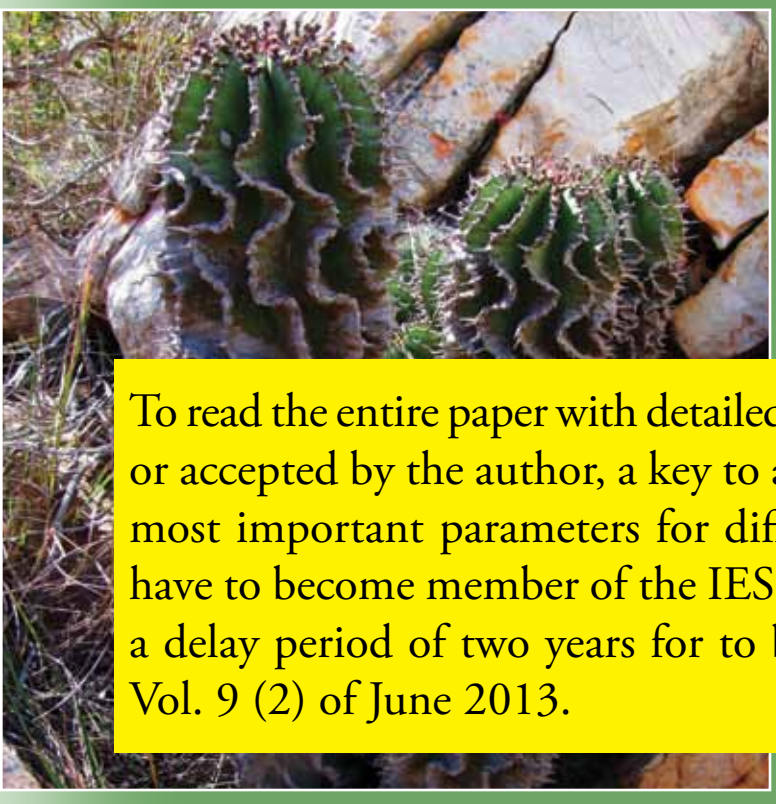

Fig. 7: Euphorbia polygona *var.* polygona *with wavy angles*

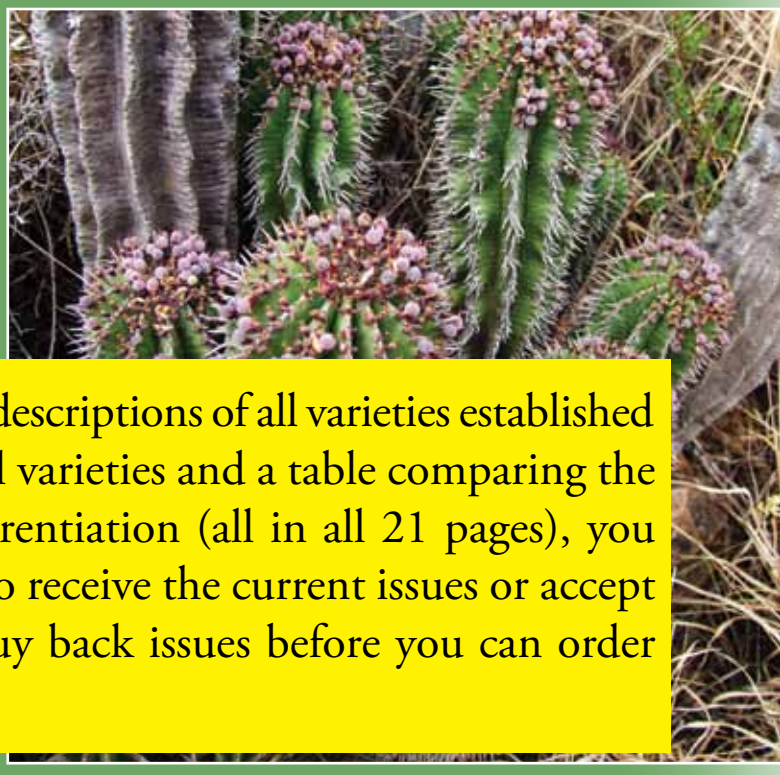

Fig. 8: Euphorbia polygona *var.* polygona, *a comparatively strongly spined specimen*

To read the entire paper with detailed descriptions of all varieties established or accepted by the author, a key to all varieties and a table comparing the most important parameters for differentiation (all in all 21 pages), you have to become member of the IES to receive the current issues or accept a delay period of two years for to buy back issues before you can order Vol. 9 (2) of June 2013.