A synoptic review and new infrageneric classification for the genus *Haworthiopsis* (Xanthorrhoeaceae: Asphodeloideae)

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Abstract

Haworthiopsis was established in 2013 to accommodate the species formerly classified under the subgenus *Hexangulares* of the genus *Haworthia*. This new genus is near-endemic to South Africa and found in most of the provinces of the country. It is also known from southern Namibia, Swaziland and possibly Mozambique. A total of 18 species are currently recognised in *Haworthiopsis*. However, this circumscription renders the genus paraphyletic with *H. koelmaniorum* sister to a polytomy comprising the rest of the *Haworthiopsis* taxa and *Gasteria*. In this contribution, seven new combinations are published (*H. fasciata* var. *browniana, H. reinwardtii* var. *reinwardtii* f. *chalumnensis*, *H. reinwardtii* var. *reinwardtii* f. *kaffirdriftensis*, *H. reinwardtii* var. *reinwardtii* f. *olivacea, H. tessellata* var. *crausii*, *H. viscosa*, *H. scabra* var. *smitii*) and two changes of status (*H. koelmaniorum* var. *mcmurtryi*, *H. viscosa* var. *variabilis*). An amplified description of the genus is provided. Six sections formerly recognised under *Haworthia* (subg. *Hexangulares*) are applied and adapted to *Haworthiopsis*, with some amendments. A new section, *H.* sect. *Koelmaniorum*, is described here. New combinations for hybrid taxa in *Haworthiopsis* that were previously described as species of *Haworthia* are given.

Introduction

Alooid and haworthioid species are included in the mainly southern African Xanthorrhoeaceae subfam. Asphodeloideae [following APG III (Angiosperm Phylogeny Group 2009)] or alternatively in Asphodelaceae: Alooideae [following Nyffeler & Eggli (2010)]. In APG IV (Angiosperm Phylogeny Group 2016) the family circumscription is similar to that of APG III, but the family name is given as Asphodelaceae *nom. cons. prop*., according to the pending conservation proposal by Klopper *et al*. (2013). The genus *Haworthiopsis* Rowley (2013a: 4) comprises 18 species with a total of 25 recognised infraspecific taxa. It is centred in South Africa with most taxa being endemic or near-endemic to this country.

Taxonomic history

The taxonomic history of the species now placed in *Haworthiopsis* is quite complex. Bayer (1999) mentioned that the earliest written record of these *Haworthia*-like plants is contained in a list of aloes compiled in 1695 by the German-born South African physician and botanist, Hendrik (Heinrich) Bernard Oldenland, who was then superintendent of the Dutch East India Company's Garden in what is today Cape Town, South Africa. Of the 28 different "aloes" listed, four were haworthioid plants, and two of these were species now included in *Haworthiopsis* [*H. venosa* (Lamarck 1783: 89) Rowley (2013a: 4) and *H. viscosa* (Linnaeus 1753: 322) Gildenhuys & Klopper comb. nov.]. Linnaeus (1753) similarly included all the alooid plants known to him at the time in *Aloe* Linnaeus (1753: 319), including these two species that are now placed in *Haworthiopsis*. Later, the French physician and botanist, Henri Auguste Duval, established the genus *Haworthia* Duval (1809: 7) to accommodate the group of *Aloe* species with smaller white bilabiate flowers. This genus was named in honour of the English naturalist, Adrian Hardy Haworth (1767–1833).

Since the first written records of these plants, travel has become much easier, resulting in the discovery of numerous new species and populations of plants. With all these accumulated collections, it has become far more difficult to classify all the known units sensibly, and to supply names for species concepts that faithfully reflect the natural variation. Despite this, over the past 200 years many authors and enthusiasts have contributed to the knowledge, taxonomy and classification of the haworthioid plants. Unfortunately this has also resulted in a great deal of confusion, with long lists of synonyms and a tangle of often divergent concepts followed by various authors in different eras.

In recent years, scientific advances in molecular and phylogenetic research have provided new insights regarding the relationships of these plants (Grace *et al*. 2013; Daru *et al*. 2013), bringing about changes in the taxonomy of the alooid genera. Most of the species previously classified by Bayer (1976 to 1999; Bayer & Manning 2012) under *Haworthia* subgen. *Hexangulares* (Uitewaal 1947a: 136) Bayer (1971: 160) were put into the new genus *Haworthiopsis*. At the same time the genus *Tulista* Rafinesque (1840: 137) was resurrected to accommodate those of the former *Haworthia* subgen. *Robustipedunculatae* (Uitewaal 1947a: 136) Bayer (1971: 160). However, these taxonomic changes were marred by Rowley's concept of the genus *Tulista*, and errors in the relevant publication. Rowley (2013a & b) combined disparate elements into his heterogeneous concept of *Tulista*, including not only the former subgenus *Robustipedunculatae*, but also the entire genus *Astroloba* Uitewaal (1947b: 53), as well as *Aristaloe aristata* (Haworth 1825: 280) Boatwr. & J.C.Manning in Manning *et al*. (2014: 69) (then *Aloe aristata* Haw.), *Poellnitzia rubriflora* (Bolus 1920: 13) Uitewaal (1940a: 61) [*Astroloba rubriflora* sensu Manning & Smith (2000: 53)], and three species from the former *Haworthia* subgen. *Hexangulares* [namely *Haworthia koelmaniorum* Obermeyer & Hardy (1967: 1502), *Haworthia pungens* Bayer (1999: 188) and *Haworthia viscosa* (Linnaeus 1753: 322) Haworth (1812: 90)]. To add to the confusion, *Haworthia viscosa* was initially erroneously listed as both a species of *Haworthiopsis* and of *Tulista* (Rowley 2013a). Furthermore, *Haworthia granulata* Marloth (1910: 39) was given two new combinations under the genus *Haworthiopsis* (Rowley 2013a). In a later amended version of this classification Rowley (2013b) corrected these mistakes by, amongst others, removing the combinations *Haworthiopsis viscosa* and *Haworthiopsis venosa* var. *granulata* (Marloth) Rowley (2013a: 5), and adding *Haworthiopsis tessellata* (Haworth 1824: 300) Rowley (2013b: 5) (see further comments under 'Taxonomic changes on species and infraspecific level in *Haworthiopsis*' below).

Later, Manning *et al.* (2014) made more coherent changes to the alooid genera. The concept of *Tulista* was adapted to only comprise the species of the former *Haworthia* subgen. *Robustipedunculatae*. *Astroloba* was reinstated as a separate and distinct genus. The species *Tulista koelmaniorum* (Oberm. & Hardy) Rowley (2013a: 5–6) and *Tulista pungens* (M.B.Bayer) Rowley (2013a: 6) were also transferred to *Haworthiopsis* so that the genus correlated with the former *Haworthia* subgen. *Hexangulares*. Based on floral morphology the species of *Haworthiopsis* seem to be related, but questions remain regarding how closely related *Haworthiopsis koelmaniorum* (Oberm. & Hardy) Boatwr. & J.C.Manning in Manning *et al*. (2014: 70) might be to *H. limifolia* (Marloth 1910: 409) Rowley (2013a: 4) and *H. tessellata*, and how closely related these are to the more typical species of *Haworthiopsis* occurring much further to the south and southwest in South Africa.

To truly build a better understanding of these plants (especially at specifc and infraspecific level), an enormous amount of field work is still needed, for example as M. Bruce Bayer has done for *Haworthia* (in the broad sense) in recent decades, and as G.W. Reynolds did for *Aloe*. It is also true that every person's concepts of taxa vary, and the interpretation of their observations plays a vital role. In addition, much remains to be learned from in-depth molecular studies. Work done thus far on the phylogeny of the aloe family has resulted in greatly changed taxonomy in this group. The use of next generation DNA sequencing techniques should be investigated to ascertain its usefulness in resolving the remaining issues.

Material and methods

This paper provides a synopsis of *Haworthiopsis* with emphasis on the sectional classification of the genus. It is based on the study of *Haworthiopsis* plants in the field and in cultivation over many years, as well as an indepth analysis of literature relating to these taxa. Images of important type specimens were obtained from the JSTOR Global Plants repository [http://plants.jstor.org]. Herbarium acronyms follow Thiers (2015).

Distribution

The genus *Haworthiopsis* is near-endemic to South Africa (see Fig. 1). All species are found only within South Africa, except for two that have their main distribution within South Africa, but are also present in neighbouring countries. The first and most widespread of these is *H. tessellata*, which is also found in southern Namibia. The second is *H. limifolia*, which is also present in Swaziland and possibly in southern Mozambique, though very little is known about its occurrence there.

Of the genera with *Haworthia*-like flowers, *Haworthiopsis* has the widest distribution in South Africa, occurring in eight of the nine provinces (see Table 1). This leaves only the Gauteng Province without any known records for the genus. However, the unique and very interesting relative *Chortolirion* Berger (1908: 72) [now included in *Aloe* sect. *Chortolirion* (A.Berger) Boatwr. & J.C.Manning in Daru *et al*. (2012: 13)], with its *Haworthiopsis*-like flowers and *Aloe kniphofioides*-like bulbs and leaves, is found in this province.

TABLE 1. The provinces of South Africa, with the number of *Haworthiopsis* species and number of endemics represented in each province. A list of the relevant species occurring in each province is also provided. (* = Species represented in more than one province)

Province	Number of species (and endemics)	Species
Eastern Cape	14 Species	*H. attenuata*
	(10 endemic)	*H. bruynsii*
		H. coarctata
		H. fasciata
		H. glauca
		H. longiana
		*H. nigra**
		H. pungens
		H. reinwardtii
		*H. scabra**
		H. sordida
		*H. tessellata**
		*H. viscosa**
		H. woolleyi
Western Cape	6 Species	*H. granulata**
	(1 endemic)	*H. nigra**
		*H. scabra**
		*H. tessellata**
		*H. viscosa**
		H. venosa
Northern Cape	3 Species	*H. granulata**
		*H. nigra**
		*H. tessellata**
Free State	1 Species	*H. tessellata**
North-West	1 Species	*H. tessellata**
Limpopo	1 Species	*H. koelmaniorum**
Mpumalanga	2 Species	*H. koelmaniorum**
		*H. limifolia**
KwaZulu-Natal	1 Species	*H. limifolia**

The sections of *Haworthiopsis*

The former three subgenera of *Haworthia* s.l. [*Haworthia*, *Hexangulares* and *Robustipedunculatae* (as *'Robustipedunculares'*)] were established by Bayer (1971), deriving partly from the concept of Uitewaal (1947a). These subgenera have given rise to the three separate genera we now know as *Haworthia* s.str., *Haworthiopsis* and *Tulista*, respectively (Rowley 2013a; Manning *et al*. 2014). Below the genus level, sections have long been used in *Haworthia* s.l. by different authors, including Haworth (1821), Salm-Dyck (1836), Berger (1908), Smith (1950), Scott

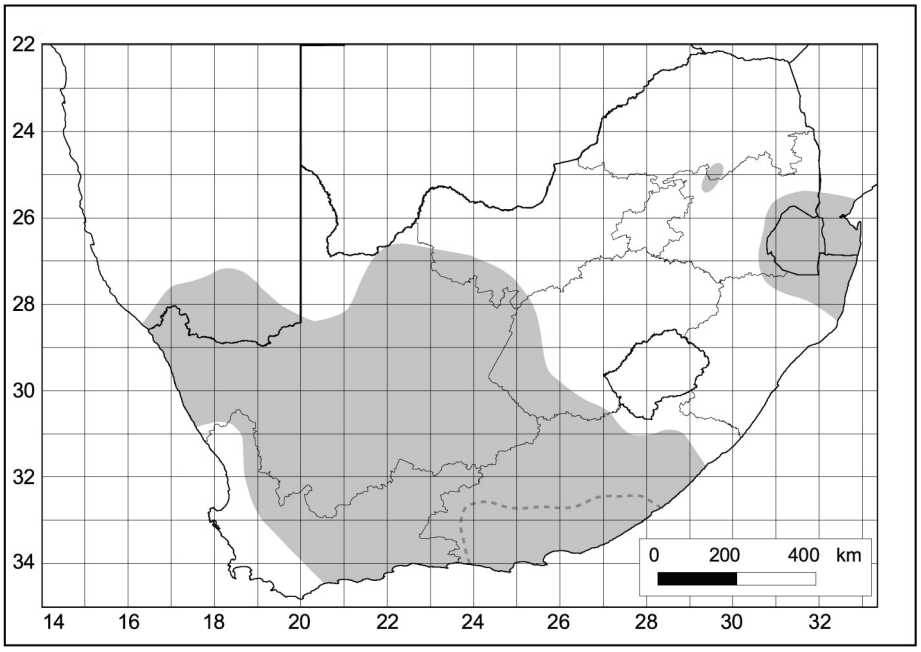

FIGURE 1. Potential distribution range of the genus *Haworthiopsis* (grey shaded area). The area demarkated in dashed lines contains the highest concentration of taxa.

(1985) and Breuer (2010). However, Bayer (1976, 1982, 1999) did not make use of any of the previously established sections. To sensibly classify all the known taxa of *Haworthia* s.str. into sections is a formidable task, but within *Haworthiopsis* sections are easier to delimit, although the positioning of a few species is still uncertain.

According to a phylogram published by Manning *et al*. (2014: fig. 1) *Haworthiopsis*, as currently circumscribed, is not a monophyletic group (see Fig. 2 for a simplified version of this phylogram). *Haworthiopsis koelmaniorum* is recovered in a very well-supported clade (clade A in Fig. 2), that is sister to clades containing: 1) the main group of *Haworthiopsis* taxa together with *Gasteria*, and 2) *Tulista*, *Aristaloe*, *Gonialoe* and *Astroloba* (both sister clades lack bootstrap support). Rowley (2013a, 2013b) used the heterogeneous *Tulista* (grey shading in Fig. 2) to group all the seemingly outlying taxa (i.e. *H. koelmaniorum*, *Tulista*, *Aristaloe*, *Gonialoe* and *Astroloba*). In this sense, *H. koelmaniorum* was included in *Tulista*, but was later moved to *Haworthiopsis* by Manning *et al*. (2014). The broad concept of *Tulista* as implemented by Rowley (2013b) did not solve the problem of possible non-monophyly in *Haworthiopsis* sensu Rowley (2013b) (clade B in Fig. 2). This *Haworthiopsis* polytomy does contain some fairly well supported clades, but resolution is generally poor and no further taxonomic conclusions should be made based on these results. The main *Haworthiopsis*-*Gasteria* clade does not have strong bootstrap support. However, the *Gasteria* clade on its own, is well supported in all phylogenies published thus far (Treutlein *et al*. 2003, Manning *et al*. 2014) underlining the taxonomic integrity of this genus. The placement of especially *H. koelmaniorum* remains unsure and further in-depth phylogenetic studies on this and other *Haworthiopsis* taxa not currently included in molecular analyses need to be done to build a better understanding of their relationships. Before all *Haworthiopsis* taxa have been investigated and included in a phylogeny, it would be premature to make further taxonomic adjustments based on this incomplete dataset. Monophyly at generic level cannot be ensured unless all taxa are included in the analysis.

Geographically, *H. koelmaniorum* occurs closest to the species in *Haworthiopsis* sect. *Limifoliae* (Smith 1950b: 3) Gildenhuys & Klopper comb. nov. and sect. *Tessellatae* Salm-Dyck (1836: sect. 8) Gildenhuys & Klopper comb. nov., but it is nonetheless well separated from both. Although populations of *H. koelmaniorum* occurs geographically closest to those in sect. *Limifoliae*, it has much more morphological similarities with sect. *Tessellatae* and appears to have a closer relationship with it. Thus far the phylogenetic affinities of these plants are insufficiently known and as *H. koelmaniorum* cannot be placed in any other section with certainty, its own section is established here. In due course, further evidence may suggest that the species belonging to the *Haworthiopsis* sect. *Koelmaniorum* Gildenhuys & Klopper sect. nov. and sect. *Tessellatae* are better classified as a subgenus of *Haworthiopsis* or even in a genus of their own. The latter option might resolve the issue of non-monophyly in the current classification, but is not a viable option based on the available phylogeny of Manning *et al*. (2014). Inclusion of all species in these two sections in further molecular analyses might provide better resolution and determine the true affinities of these taxa.

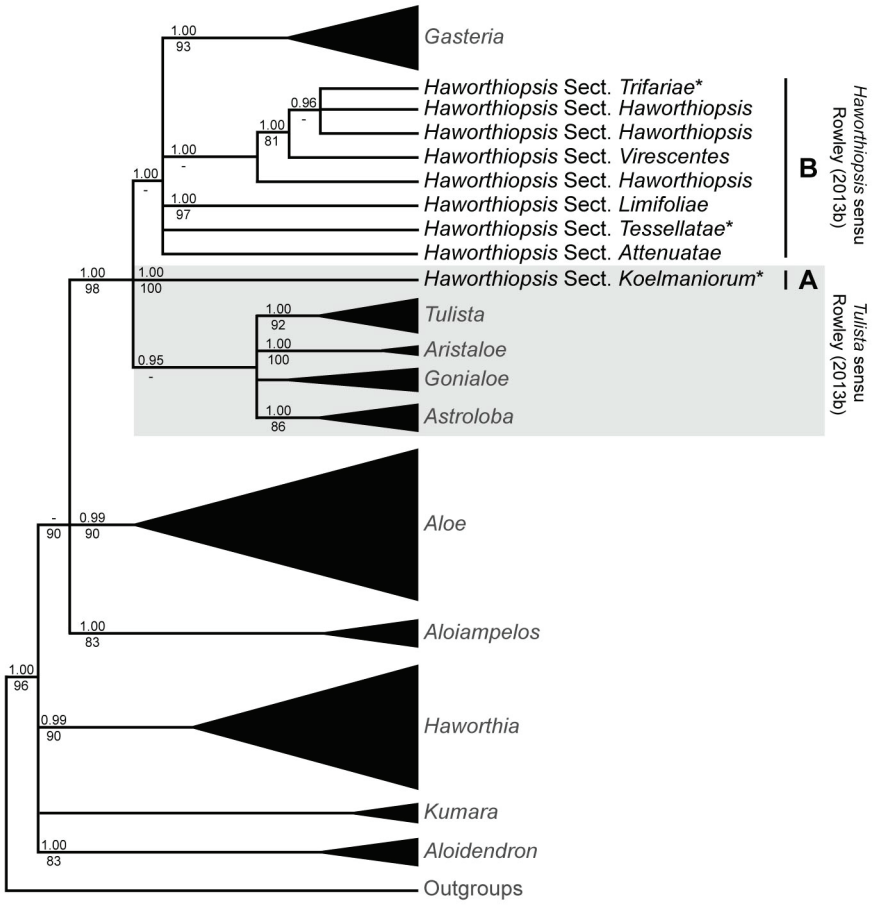

FIGURE 2. Phylogram of the Alooideae (adapted from Manning *et al*. 2014). Maximum parsimony bootstrap support is shown below the branches and Bayesian posterior probabilities above the branches. Only values indicating good support (bootstrap above 70%, Bayesian posterior probabilities above 0.95) are shown. All unsupported branches were collapsed here. An asterisk (*) indicates sections of *Haworthiopsis* where not all the members were included in the molecular analysis of Manning *et al*. (2014).

Haworthiopsis limifolia is recovered in a well-supported clade within the *Haworthiopsis* polytomy (Fig. 2). Geographically *H. limifolia* occurs well separated from the species of the type section, *Haworthiopsis* sect. *Haworthiopsis*, but morphologically it is similar to the species in this section. It is possible that this species belongs to the sect. *Haworthiopsis*, but for the time being, until its placement can be established through further studies, it is recognised in its own section, *Haworthiopsis* sect. *Limifoliae* as previously established by Smith (1950b). *Haworthiopsis* sect. *Haworthiopsis* as circumscribed here is the only section that is not monophyletic based on the phylogram of Manning *et al*. (2014). The inclusion of the remaining species of *H.* sect. *Trifariae* that were not investigated by Manning *et al.* (2014) will likely change the topology of the phylogram and hopefully provide better resolution within this clade. Once a robust phylogeny including all *Haworthiopsis* taxa is available, the sectional classification of *Haworthiopsis*, as proposed here, could be re-evaluated.

Taxonomic changes on species and infraspecific level in *Haworthiopsis*

Bayer (1999) was against the approach of Gerald Graham Smith (1892–1976) who prolifically described and published many new species, varieties and forms of *Haworthia* s.l. Indeed, Bayer (1982) also noted that Smith had intended to describe many more. Many of Smith's taxa and those from other relevant authors are not necessarily viable at species level as intended, but many of these are very significant and distinguishable forms or varieties that are worthy of recognition at infraspecific level. Polymorphism is encountered in *Haworthiopsis*, so that individuals in some populations deviate from the norm in one respect or another, but this sort of natural variation within a population should not give rise to separate taxonomic categories. However, where the majority of individuals within a population from a geographically separated area deviate from the norm of the species in some easily distinguishable way, there are certainly grounds for recognizing a subordinate taxon. In this treatment we follow established concepts for the

recognition of infraspecific taxa at the level of varieties and formas as used by, for instance, Bayer & Manning (2012).

As mentioned previously, Rowley (2013a) made certain nomenclatural mistakes when he published the new combinations in *Haworthiopsis*. Based on the basionym *Aloe viscosa* Linnaeus (1753: 460), Rowley (2013a) simultaneously proposed new combinations in both *Haworthiopsis* and *Tulista* in the new classification offered for the haworthioid taxa (published on 9 April 2013). According to Art. 36(2) of the International Code of Nomenclature for Algae, Fungi and Plants (ICN) (McNeill *et al*., 2012), neither of these combinations are validly published. Manning *et al*. (2014: 70) assumed that the entry under *Tulista* was a mistake by Rowley (2013a) and listed only the invalid combination made by Rowley (2013a) in *Haworthiopsis*. However, Rowley (2013b) had previously corrected his mistake and only included the combination in *Tulista* in the amended version of the classification (published on 2 August 2013), thus validating that combination. It is important to note here that no samples of "*Tulista/Haworthiopsis viscosa*" was included in the molecular analysis of Manning *et al*. (2014). Placement of this taxon in *Tulista* is contrary to the floral and foliar morphology of these plants and we concur with its placement in *Haworthiopsis* by Manning *et al*. (2014). Hence, the new combination for *Aloe viscosa* in *Haworthiopsis* is published here.

Similarly, Rowley (2013a) simultaneously proposed two new combinations for the basionym *Haworthia granulata*, firstly as *Haworthiopsis granulata*, followed by *Haworthiopsis venosa* var. *granulata*. Neither of these combinations in Rowley (2013a) are validly published [McNeill *et al*., 2012, Art. 36(2)]. In the amended version of this classification, Rowley (2013b) validated the combination *Haworthiopsis granulata* by omitting *Haworthiopsis venosa* var. *granulata*. He also added the new combination *Haworthiopsis tessellata*, the publication of which predates that of Manning *et al*. (2014) and their new combination for "*Haworthiopsis tessellata* (Haw.) Boatwr. & J.C.Manning" in Manning *et al*. (2014: 71) is thus superfluous.

Rowley (2013a & b) only recognised *Haworthiopsis reinwardtii* (Salm-Dyck 1821: 37) Rowley (2013a: 5) var. *brevicula* (Smith 1944a: 11) Rowley (2013a: 5), but not the formae previously established under var. *reinwardtii* by Bayer (1976, 1982, 1999). Three of the formae previously accepted under *Haworthia reinwardtii* are here transferred and recognised as formae of *Haworthiopsis reinwardtii* and the new combinations are provided. The former *Haworthia reinwardtii* f. *zebrina* (Smith 1944a: 18) Bayer (1976: 169), which may be only worthy of recognition for horticultural purposes, applies to selected clones of f. *olivacea* (Smith 1944a: 16) Bayer (1976: 142) and is here included in its synonymy.

Taxonomic setting

Haworthiopsis Rowley (2013a: 4)

Type:—*Haworthiopsis coarctata* (Haw.) Rowley (2013a: 4) ≡ *Haworthia coarctata* Haworth (1824: 301) = *Haworthia* sect. *Hexangulares* Uitewaal (1947a: 136) p.p. ≡ *Haworthia* subg. *Hexangulares* (Uitewaal) Bayer (1971: 160)

Detailed description:—Plants dwarf, succulent perennial herbs, solitary to proliferating, acaulescent or caulescent to ca. 400 mm long. Leaves rosulate, arranged in ranks of three or five, or spirally inserted along the length of the stem, 10–350 mm long, and 6–40 mm wide near the base. Leaf surfaces viscid in some, glabrous to scabrous, tuberculate or with ridges, tubercles concolorous to white, in some the upper surfaces windowed, lined and often reticulated. Margins smooth, tuberculate, ridged or with cartilaginous teeth. Inflorescences with few sterile bracts, usually racemose, rarely paniculate. Perianth < 17 mm long, bilabiate, straight or curved, hexangular or rounded-hexangular at base, tapering to pedicel, white with brownish, pinkish or greenish hues or nerves, 3 upper tepals of the bilabiate perianth spreading to recurved, 3 lower tepals generally strongly recurved, inner and outer tepals joined at the base, rarely fused halfway, both whorls adhering. Anthers included. Style straight, included. Fruit a capsule < 24 mm long, narrowly ovoid. Seed <4 mm long, usually black, to dark brown.

Identification key to the sections of *Haworthiopsis* (see Table 2 for a list of species included in the various sections)

1. Leaves rosulate, arranged in a caulescent to acaulescent spiral, or occasionally in a seemingly quinquefarious caulescent spiral; Eastern Cape, Western Cape, Northern Cape, Free State, North-West and Namibia 2

- Leaves significantly arranged in a trifarious caulescent spiral or in three tiers, or in an acaulescent, quinquefarious twisted spiral; Eastern Cape and Western Cape ..... *H.* sect. *Trifariae* (F)
2. Leaves with opaque to translucent windowed areas on upper surface 3
- Leaves without any windowed areas 4
3. Leaves ovate-lanceolate to ovate-deltoid, upper surfaces with translucent windowed areas, leaf tips acuminate; Eastern Cape, Western Cape, Northern Cape, Free State, North-West and Namibia 5
- Leaves navicular, upper surfaces with a truncated opaque to translucent end-area, leaf tips obtuse; Eastern Cape ..... *H.* sect. *Virescentes* (G)
4. Plants proliferating from the base or by stolons, acaulescent to caulescent; leaves incurved, erect to spreading, variable in colour; Eastern Cape, Mpumalanga, Swaziland and KwaZulu-Natal 6
- Plants solitary (rarely offsetting), acaulescent; leaves erect to spreading or recurved, dark green to blackish green; Eastern Cape . ..... *H.* sect. *Virescentes* (G)
5. Plants usually proliferous from base or by stolons, acaulescent to caulescent; upper leaf surfaces smooth; Eastern Cape, Western Cape, Northern Cape, Free State, North-West and Namibia ..... *H.* sect. *Tessellatae* (E)
- Plants mostly solitary, acaulescent; upper leaf surfaces pellucid; Mpumalanga ..... *H.* sect. *Koelmaniorum* (C)
6. Plants proliferous from the base, acaulescent to caulescent; leaves incurved, erect to occasionally spreading; Eastern Cape 7
- Plants stoloniferous, acaulescent; leaves spreading; Mpumalanga, Swaziland and KwaZulu-Natal ..... *H.* sect. *Limifoliae* (D)
7. Upper leaf surfaces usually without any tubercles, lower leaf surfaces glabrous to tuberculated, leaves firm and rigid, fibrous; plants acaulescent to caulescent; inflorescences usually simple (rarely branched) ..... *H.* sect. *Haworthiopsis* (A)
- Upper leaf surfaces sparsely to densely tuberculated, lower leaf surfaces generally tuberculated, leaves softer and with viscid strands only; plants acaulescent; inflorescences usually branched ..... *H.* sect. *Attenuatae* (B)

TABLE 2. The sections of *Haworthiopsis* recognised in this treatment and the species included in each section.

Section	Species
Attenuatae	*H. attenuata*
Haworthiopsis	*H. coarctata*
	H. fasciata
	H. glauca
	H. longiana
	H. reinwardtii
Limifoliae	*H. limifolia*
Koelmaniorum	*H. koelmaniorum*
Tessellatae	*H. granulata*
	H. tessellata
	H. venosa
	H. woolleyi
Trifariae	*H. pungens*
	H. nigra
	H. scabra
	H. viscosa
Virescentes	*H. bruynsii*
	H. sordida

A. *Haworthiopsis* sect. *Haworthiopsis*

≡ *Haworthia* sect. *Coarctatae* Berger (1908: 75). Type:—*Haworthiopsis coarctata* (Haw.) Rowley (2013a: 4) ≡ *Haworthia coarctata* Haworth (1824: 301)

1. *Haworthiopsis coarctata* (Haw.) Rowley (2013a: 4)

Bas.:—*Haworthia coarctata* Haworth (1824: 301) ≡ *Aloe coarctata* (Haw.) Roemer & Schultes (1829: 647) ≡ *Haworthia reinwardtii* subsp. *coarctata* (Haw.) Halda (1997: 40). Type (neotype designated by Breuer & Metzing 1997: 5)**:—**SOUTH AFRICA. Eastern Cape: 16 km from Grahamstown to Bathurst [QDS: 3326DA], 1947, *G.G. Smith 7092* (NBG0068473!)

Distribution:—It is predominantly found in the area south of Grahamstown, from near the Fish River in the east to near Port Elizabeth in the west, Eastern Cape, South Africa. A few collections have also been made to the north of Grahamstown.

1a. var. ***coarctata***

= *Haworthia greenii* Baker (1880: 202) ≡ *Haworthia coarctata* var. *greenii* (Baker) Bayer (1973: 80) ≡ *Haworthia reinwardtii* var. *greenii* (Baker) Halda (1997: 41) ≡ *Haworthia coarctata* f. *greenii* (Baker) Bayer (1999: 172).
= *Haworthia peacockii* Baker (1880: 202)
= *Haworthia chalwinii* Marloth & Berger (1906: 247) ≡ *Haworthia reinwardtii* var. *chalwinii* (Marloth & A.Berger) Resende (1943: 80) ≡ *Haworthia coarctata* f. *chalwinii* (Marloth & A.Berger) Pilbeam (1983: 52)
= *Haworthia fallax* Von Poellnitz (1933: 83) ≡ *Haworthia reinwardtii* var. *fallax* (Poelln.) Von Poellnitz (1937: 209a)
= *Haworthia reinwardtii* var. *conspicua* Von Poellnitz (1937: 210a) ≡ *Haworthia coarctata* f. *conspicua* (Poelln.) Pilbeam (1983: 52)
= *Haworthia reinwardtii* var. *pseudocoarctata* Von Poellnitz (1940a: 43) ≡ *Haworthia coarctata* f. *pseudocoarctata* (Poelln.) Resende (1943: 84)
= *Haworthia coarctata* var. *haworthii* Resende (1943: 84)
= *Haworthia coarctata* var. *kraussii* Resende (1943: 84)
= *Haworthia greenii* f. *bakeri* Resende (1943: 87)
= *Haworthia greenii* f. *minor* Resende (1943: 87)
= *Haworthia reinwardtii* var. *committeesensis* Smith (1943: 93)
= *Haworthia fulva* Smith (1943: 103)
= *Haworthia greenii* var. *silvicola* Smith (1943: 103)
= *Haworthia baccata* Smith (1944a: 20)
= *Haworthia reinwardtii* var. *huntsdriftensis* Smith (1944a: 14)
= *Haworthia musculina* Smith (1948: 49)
["*Haworthia coarctatoidea* Resende & Lopez" (1948: 176) nom. nud.]

Distribution:—The typical variety is found over most of the distribution range of the species.

1b. var. ***adelaidensis*** (Poelln.) Rowley (2013a: 4)

Bas.:—*Haworthia reinwardtii* var. *adelaidensis* Von Poellnitz (1940a: 43) ≡ *Haworthia coarctata* subsp. *adelaidensis* (Poelln.) Bayer (1973: 86) ≡ *Haworthia coarctata* var. *adelaidensis* (Poelln.) Bayer (1999: 172) ≡ *Haworthia adelaidensis* (Poelln.) Breuer (2010: 7). Type (lectotype designated by Breuer & Metzing 1997: 5):—(unpublished icon) "*Haworthia reinwardtii* Haw. var. *adelaidensis* v.P." (B).
= *Haworthia reinwardtii* var. *riebeeckensis* Smith (1944a: 16)
= *Haworthia reinwardtii* var. *bellula* Smith (1945: 70) ≡ *Haworthia coarctata* f. *bellula* (G.G.Sm.) Pilbeam (1983: 52)

Distribution:—It is found in the area north and west of Grahamstown, Eastern Cape, South Africa.

1c. var. ***tenuis*** (G.G.Sm.) Rowley (2013a: 4)

Bas.:—*Haworthia reinwardtii* var. *tenuis* Smith (1948: 51) ≡ *Haworthia coarctata* subsp. *coarctata* var. *tenuis* (G.G.Sm.) Bayer (1973: 80) ≡ *Haworthia tenuis* (G.G.Sm.) Breuer (2010: 8). Type:—SOUTH AFRICA. Eastern Cape: Farm Harvestvale, near Alexandria [QDS: 3326CB], 1940, *G.G. Smith 3420* (holotype NBG0112024!; isotype NBG).

Distribution:—It is only known from near Alexandria, Eastern Cape, South Africa.

2. ***Haworthiopsis fasciata*** (Willd.) Rowley (2013a: 4)

Bas.:—*Apicra fasciata* Willdenow (1811: 270) ≡ *Haworthia fasciata* (Willd.) Haworth (1819: 57) ≡ *Aloe fasciata* (Willd.) Salm-Dyck (1834: 326) ≡ *Haworthia pumila* subsp. *fasciata* (Willd.) Halda (1997: 37). Type (neotype designated by Breuer & Metzing 1997: 6):—SOUTH AFRICA. Eastern Cape: Hankey [QDS: 3324DA], 1962, *F.J. Stayner s.n.* (NBG0110360!).

Distribution:—It is known from Kareedouw in the west, to Port Elizabeth in the east and northwards to north of Uitenhage, Eastern Cape, South Africa.

2a. var. ***fasciata***

= *Aloe fasciata* var. *major* Salm-Dyck (1837: t.158) ≡ *Haworthia fasciata* var. *major* (Salm-Dyck) Haworth (1821: 54)
= *Haworthia fasciata* var. *subconfluens* Von Poellnitz (1937: 133b) ≡ *Haworthia fasciata* f. *subconfluens* (Poelln.) Von Poellnitz (1938a: 95)
= *Haworthia fasciata* f. *ovato-lanceolata* Von Poellnitz (1938a: 96)
= *Haworthia fasciata* f. *sparsa* Von Poellnitz (1938a: 96)
= *Haworthia fasciata* f. *variabilis* Von Poellnitz (1938a: 96)
= *Haworthia fasciata* f. *vanstaadenensis* Von Poellnitz (1938a: 97)

Distribution:—The typical variety is found across most of the range of distribution for the species, it occurs from near Kareedouw in the west to near Port Elizabeth in the east, northward at Uitenhage, Eastern Cape, South Africa.

2b. var. ***browniana*** (Poelln.) Gildenh. & Klopper comb. nov.

Bas.:—*Haworthia browniana* Von Poellnitz (1937c: 102) ≡ *Haworthia fasciata* f. *browniana* (Poelln.) Bayer (1976: 105) ≡ *Haworthia fasciata* var. *browniana* (Poelln.) Scott (1985: 21). Type (lectotype designated by Breuer & Metzing 1997: 7):—(photographic icon) "*Haworthia browniana* v.P". (B); later published in Von Poellnitz (1937c: 102).

Distribution:—It is only known from the type locality northwest of Uitenhage, Eastern Cape, South Africa.

3. ***Haworthiopsis glauca*** (Baker) Rowley (2013a: 4)

Bas.:—*Haworthia glauca* Baker (1880: 203) ≡ *Haworthia reinwardtii* subsp. *glauca* (Baker) Halda (1997: 41). Type:—SOUTH AFRICA. Cape: Without locality, 1862, *T. Cooper s.n.* (holotype K0256759!). Cited by Scott (1985).

Distribution:—It generally occurs further inland and towards the west than the other stem-forming species in this section. It is reported from near Uitenhage in the east to near Willowmore in the west, Eastern Cape, South Africa.

3a. var. ***glauca***

= *Haworthia carrissoi* Resende (1941: 161)

Distribution:—The typical variety is reported from the Zuurberg Pass in the east to near Willowmore in the west, Eastern Cape, South Africa.

3b. var. ***herrei*** (Poelln.) Rowley (2013a: 4)

Bas.:—*Haworthia herrei* Von Poellnitz (1929a: 24) ≡ *Haworthia glauca* var. *herrei* (Poelln.) Bayer (1976: 122) ≡ *Haworthia reinwardtii* var. *herrei* (Poelln.) Halda (1997: 41). Type (neotype designated by Breuer & Metzing 1997: 7):—SOUTH AFRICA. Eastern Cape: Campherspoort [QDS: 3324AA], 1947, *W.F. Barker 5069* (NBG0068132!).
= *Haworthia herrei* Poelln. var. *depauperata* Von Poellnitz (1933: 86)
= *Haworthia herrei* Poelln. var. *poellnitzii* Resende (1941: 164) nom. illeg.
= *Haworthia armstrongii* Von Poellnitz (1937d: 152) ≡ *Haworthia glauca* f. *armstrongii* (Poelln.) Bayer (1976: 99)
= *Haworthia jacobseniana* Von Poellnitz (1937c: 102) ≡ *Haworthia glauca* f. *jacobseniana* (Poelln.) Pilbeam (1983: 74)
= *Haworthia eilyae* Von Poellnitz (1937d: 152)
= *Haworthia eilyae* Poelln. var. *poellnitziana* Resende (1943: 89) nom. illeg.
= *Haworthia eilyae* Poelln. var. *zantneriana* Resende (1943: 90)
= *Haworthia jonesiae* Von Poellnitz (1937d: 153) ≡ *Haworthia glauca* f. *jonesiae* (Poelln.) Pilbeam (1983: 74)

Distribution:—This variety is known from northwest of Uitenhage, westwards to the area northeast of Willowmore, Eastern Cape, South Africa.

4. ***Haworthiopsis longiana*** (Poelln.) Rowley (2013a: 4)

Bas.:—*Haworthia longiana* Von Poellnitz (1937a: 203) ≡ *Haworthia pumila* subsp. *longiana* (Poelln.) Halda (1997: 37). Type (lectotype designated by Breuer & Metzing 1997: 8):—(photographic icon), "*Haworthia longiana* v.P" (B).
= *Haworthia longiana* Poelln. var. *albinota* Smith (1948: 44)

Distribution:—It has a limited distribution in the Gamtoos River Valley, predominantly from north of Humansdorp, around Hankey and Patensie, Eastern Cape, South Africa.

5. ***Haworthiopsis reinwardtii*** (Salm-Dyck) Rowley (2013a: 5)

Bas.:—*Aloe reinwardtii* Salm-Dyck (1821: 37) ≡ *Haworthia reinwardtii* (Salm-Dyck) Haworth (1821: 53). Type (lectotype designated by Scott 1981a: 36):—(icon) in Salm-Dyck (1836: Aloe t.12 [sect. 6: 16]). Type (epitype designated by Breuer & Metzing 1997: 10):—SOUTH AFRICA. Eastern Cape: Near top of hill above Ncera River Bridge [QDS: 3327BA], 1940, *G.G. Smith 3563* (NBG0068556).

Distribution:—It is found over a relatively narrow range in the Eastern Cape, South Africa, from near East London in the east to near the Bushman's River in the west.

5a. var. ***reinwardtii*** f. ***reinwardtii***

= *Haworthia reinwardtii* var. *major* Baker (1880: 202)
= *Haworthia reinwardtii* var. *pulchra* Von Poellnitz (1937: 209a)
= *Haworthia reinwardtii* var. *archibaldiae* Von Poellnitz (1937: 210a)
= *Haworthia reinwardtii* var. *peddiensis* Smith (1943: 94)
= *Haworthia reinwardtii* var. *haworthii* Resende (1943: 79)
= *Haworthia reinwardtii* var. *triebneri* Resende (1943: 80)
= *Haworthia reinwardtii* var. *valida* Smith (1943: 98)
= *Haworthia reinwardtii* var. *grandicula* Smith (1944a: 12)

Distribution:—The typical variety is found across the range of distribution for the species, mainly along the lower Keiskamma and Great Fish River catchment areas. However, it is also recorded from west of East London in the east to near the Bushman's River in the west, and inland from near Peddie towards Grahamstown, Eastern Cape, South Africa.

5b. var***. reinwardtii*** f. ***chalumnensis*** (G.G.Sm.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia reinwardtii* var. *chalumnensis* Smith (1943: 99) ≡ *Haworthia reinwardtii* f. *chalumnensis* (G.G.Sm.) Bayer (1976: 106). Type:—SOUTH AFRICA. Eastern Cape: on the banks of the Chalumna River, 48.3 km west of East London [QDS: 3327BA], 1934, *G.G. Smith 513* (holotype NBG0068486!; isotype NBG, PRE).

Distribution:—Although various plants occurring near Chalumna and the adjacent Tyolumnqua River (Eastern Cape, South Africa) are often considered as this form, it appears as if the typical robust form is only found from near the Chalumna police station.

5c. var. ***reinwardtii*** f. ***kaffirdriftensis*** (G.G.Sm.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia reinwardtii* var. *kaffirdriftensis* Smith (1943: 12) ≡ *Haworthia reinwardtii* f. *kaffirdriftensis* (G.G.Sm.) Bayer (1976: 126). Type:—SOUTH AFRICA. Eastern Cape: near Kaffirdrift, eastern side of Fish River, about 22 km south south west of Peddie [QDS: 3327AC], 1940, *G.G. Smith 3364* (holotype NBG0068355!; isotype NBG0112001!, PRE0592668!).

Distribution:—It is restricted to a small population, found east of Kaffirdrift on the eastern bank of the Great Fish River, Eastern Cape, South Africa.

5d. var. ***reinwardtii*** f. ***olivacea*** (G.G.Sm.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia reinwardtii* var. *olivacea* Smith (1944a: 16) ≡ *Haworthia reinwardtii* f. *olivacea* (G.G.Sm.) Bayer (1976: 142) ≡ *Haworthia olivacea* (G.G.Sm.) Breuer (2010: 7). Type:—SOUTH AFRICA. Eastern Cape: South east of Kaffirdrift, Peddie District [QDS: 3327AC], 1942, *G.G. Smith 5260* (holotype NBG0112000!; isotype NBG, PRE0592641!).

= *Haworthia reinwardtii* var. *zebrina* Smith (1944a: 18) ≡ *Haworthia reinwardtii* f. *zebrina* (G.G.Sm.) Bayer (1976: 169)

Distribution:—It occurs on both the western and eastern banks, in the vicinity of Kaffirdrift next to the Great Fish River, Eastern Cape, South Africa.

5e. var. ***brevicula*** (G.G.Sm.) Rowley (2013a: 5)

Bas.:—*Haworthia reinwardtii* var. *brevicula* Smith (1944a: 11) ≡ *Haworthia brevicula* (G.G.Sm.) Breuer (2010: 7). Type:—SOUTH AFRICA. Eastern Cape: Between Frazer's Camp and the old fort, Albany Division [QDS: 3326BD], 1940, *G.G. Smith 3138* (holotype NBG0112112!; isotype NBG0068168!, PRE0834962!).

= *Haworthia reinwardtii* var. *diminuta* Smith (1948: 52)

Distribution:—It has a rather limited distribution and is known from a few scattered populations along the Kapp River Valley to the Great Fish River, Eastern Cape, South Africa.

B. *Haworthiopsis* sect. ***Attenuatae*** (Pilbeam) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia* subsect. *Attenuatae* Pilbeam (1983: 15) ≡ *Haworthia* ser. *Attenuatae* (Pilbeam) Rowley (1985: 14) ≡ *Haworthia* sect. *Attenuatae* (Pilbeam) Breuer (2010: 4). Type (lectotype designated here):—*Haworthiopsis attenuata* (Haw.) Rowley (2013a: 4) ≡ *Aloe attenuata* Haworth (1804: 11)

6. ***Haworthiopsis attenuata*** (Haw.) Rowley (2015: 2)

Bas.:—*Aloe attenuata* Haworth (1804: 11) ≡ *Apicra attenuata* (Haw.) Willdenow (1811: 270) ≡ *Haworthia attenuata* (Haw.) Haworth (1812: 92) ≡ *Haworthia pumila* subsp. *attenuata* (Haw.) Halda (1997: 36) ["*Haworthiopsis attenuata* (Haw.) Rowley" (2013a: 4) nom. inval., Art. 41.8.a (McNeill *et al*., 2012)]. Type (neotype designated by Breuer & Metzing 1997: 4): SOUTH AFRICA. Eastern Cape: Sandland, 20 km east of Patensie [QDS: 3324DA], *P.L. Perry 660* (NBG0144672!).

Distribution:—Plants vary over their wide range of distribution in the Eastern Cape, South Africa, from the Gamtoos River Valley in the west to the Bashee (Mbashe) River Valley in the east.

6a. var. ***attenuata***

= *Haworthia radula* var. *magniperlata* Haworth (1821: 54)

= *Haworthia clariperla* Haworth (1828: 186) ≡ *Aloe attenuata* var. *clariperla* (Haw) Salm-Dyck (1834: 12b) ≡ *Haworthia attenuata* var. *clariperla* (Haw.) Baker (1880: 204) ≡ *Haworthia attenuata* f. *clariperla* (Haw.) Pilbeam (1983: 45)

= *Aloe subulata* Salm-Dyck (1829: 1712) ≡ *Haworthia subulata* (Salm-Dyck) Baker (1880: 206)

= *Aloe rugosa* Salm-Dyck (1834: 323) ≡ *Haworthia rugosa* (Salm-Dyck) Baker (1880: 206)

= *Aloe rugosa* var. *laetevirens* Salm-Dyck (1834: 323)

= *Aloe rugosa* var. *perviridis* Salm-Dyck (1834: 323) ≡ *Haworthia rugosa* var. *perviridis* (Salm-Dyck) Berger (1908: 92)

= *Haworthia britteniana* Von Poellnitz (1937: 196a) ≡ *Haworthia attenuata* var. *britteniana* (Poelln.) Von Poellnitz (1937: 166e) ≡ *Haworthia attenuata* f. *britteniana* (Poelln.) Bayer (1982: 63)

= *Haworthia attenuata* var. *o'donoghueana* Farden (1939: 34)

= *Haworthia attenuata* var. *deltoidea* Farden (1939: 36)

= *Haworthia attenuata* var. *linearis* Farden (1939: 36)

= *Haworthia attenuata* var. *minissima* Farden (1939: 37)

["*Haworthia attenuata* var. *uitewaaliana* Farden" (1939: 36) nom. inval. (Art. 39.1, McNeill *et al*., 2012)]
["*Haworthia attenuata* var. *inusitata* Farden" (1939: 38) nom. inval. (Art. 39.1, McNeill *et al*., 2012)]

Distribution:—The typical variety is the most widespread, and is found in the central and western part of the distribution range of the species.

6b. var. ***glabrata*** (Salm-Dyck) Rowley (2015: 2)

Bas.:—*Aloe glabrata* Salm-Dyck (1834: 325) ≡ *Haworthia glabrata* (Salm-Dyck) Baker (1880: 206) ≡ *Haworthia attenuata* var. *glabrata* (Salm-Dyck) M.B.Bayer in Bayer & Manning (2012: 37) ["*Haworthiopsis attenuata* var. *glabrata* (Salm-Dyck) Rowley" (2013a: 4) nom. inval. (Art. 35.1, McNeill *et al*., 2012)]. Type (neotype designated by Smith & Greyling 1990: 332):—(icon) in Salm-Dyck (1840: Aloe t.7).
= *Aloe glabrata* var. *concolor* Salm-Dyck (1849: Aloe t.2) ≡ *Haworthia glabrata* var. *concolor* (Salm-Dyck) Baker (1880: 206)
= *Aloe glabrata* var. *perviridis* Salm-Dyck (1849: Aloe t.1) ≡ *Haworthia glabrata* var. *perviridis* (Salm-Dyck) Baker (1880: 206)

Distribution:—Although it has been known in cultivation for a very long time, it was never known from any wild populations until Bayer (1999) linked this taxon to the interesting material collected by Peter Bruyns from the Bashee River, Eastern Cape, South Africa.

6c. var. ***radula*** (Jacq.) Rowley (2015: 2)

Bas.:—*Aloe radula* Jacquin (1804: 11) ≡ *Apicra radula* (Jacq.) Willdenow (1811: 270) ≡ *Haworthia radula* (Jacq.) Haworth (1812: 93) ≡ *Haworthia attenuata* var. *radula* (Jacq.) Bayer (1999: 167) ≡ *Haworthia pumila* subsp. *radula* (Jacq.) Halda (1997: 37) ["*Haworthiopsis attenuata* var. *radula* (Jacq.) Rowley" (2013a: 4) nom. inval. (Art. 35.1, McNeill *et al*., 2012)]. Type (lectotype designated by Scott 1985: 18):—(icon) in Jacquin (1804: t.422). Type (epitype designated by Breuer & Metzing 1997: 10):—SOUTH AFRICA. Eastern Cape: 1.6 km from Hankey to Thornhill [QDS: 3324DD], 1940, *G.G. Smith 3190* (NBG0115013!).
= *Aloe radula* var. *major* Salm-Dyck (1817: 4)
= *Aloe radula* var. *media* Salm-Dyck (1817: 4)
= *Aloe radula* var. *minor* Salm-Dyck (1817: 4)
= *Haworthia radula* var. *asperior* Haworth (1821: 54)
= *Haworthia radula* var. *laevior* Haworth (1821: 54)
= *Haworthia radula* var. *pluriperlata* Haworth (1821: 54)

Distribution:—This variety is limited in distribution and found in the area of Hankey, Eastern Cape, South Africa.

C. *Haworthiopsis* sect. ***Koelmaniorum*** Gildenh. & Klopper **sect. nov.**

Haworthiopsis G.D.Rowley sect. Koelmaniorum Gildenh. & Klopper Sectio nova Tessellatis affinis sed habitu solitario, depresso, non sobolifero, radicibus valde incrassatis, foliis rigidis, acutis usque triangulatis, supra planis vel convexis, obscure pellucidis, tuberculatis, tuberculis obscure translucentibus, subtus tuberculis irregularibus concoloribus, saepe in cristas transversas confluentibus, differt.
Type:—*Haworthiopsis koelmaniorum* (Oberm. & Hardy) Boatwr. & J.C.Manning in Manning *et al*. (2014: 70) ≡ *Haworthia koelmaniorum* Obermeyer & Hardy (1967: t. 1502)

Affinities with sect. *Tessellatae*. Plants solitary, rarely dividing, rosulate, acaulescent. Roots swollen. Leaves spirally disposed, spreading, firm, acuminate to triangular; upper surfaces flattened to convex, windowed, translucence opaque, with raised translucent bumps, lined inside the window, occasionally connecting transversely; lower surfaces with raised concolorous tubercles often forming transverse ridges; margins with raised cartilaginous tubercles occasionally becoming teeth. Inflorescence simple gracile raceme. Flowers slender and smaller than usually found, tepals fused about halfway towards the base, base rounded-hexangular.

7. ***Haworthiopsis koelmaniorum*** (Oberm. & D.S.Hardy) Boatwr. & J.C.Manning in Manning *et al.* (2014: 14)

Bas.:—*Haworthia koelmaniorum* Obermeyer & Hardy (1967: t.1502) ≡ *Haworthia limifolia* subsp. *koelmaniorum* (Oberm. & D.S.Hardy) Halda (1997: 38) ≡ *Tulista koelmaniorum* (Oberm. & D.S.Hardy) Rowley (2013a: 5). Type:—SOUTH AFRICA. Mpumalanga:

Near Groblersdal, on north facing slopes in sandstone ridges [QDS: 2529AB], 1966, *D.S. Hardy & A.A. Mauve 2267* (holotype PRE0037965!).

Distribution:—This is among the northernmost occurring *Haworthiopsis* species, and is known from a small area in both Limpopo and Mpumalanga, South Africa.

7a. var. ***koelmaniorum***

Distribution:—It is found to the south of Groblersdal, to near Dennilton in the west and to near Maleoskop in the east, Limpopo, South Africa.

7b. var. ***mcmurtryi*** (C.L.Scott) Gildenh. & Klopper **stat. nov.**

Bas.:—*Haworthia mcmurtryi* Scott (1984: 69) ≡ *Haworthia koelmaniorum* var. *mcmurtryi* (C.L.Scott) Bayer (1999: 181) ≡ *Tulista koelmaniorum* var. *mcmurtryi* (C.L.Scott) Rowley (2013a: 6) ≡ *Haworthiopsis mcmurtryi* (C.L.Scott) Zonneveld (2014: 949). Type:—SOUTH AFRICA. Mpumalanga: South west of Loskop Dam [QDS: 2529AB], 1984, *D. McMurtry 5247 in C.L. Scott 7682* (holotype PRE0747960!).

Distribution:—It occurs to the southwest of the typical variety, along a narrow stretch to the west and southwest of Loskop Dam, Mpumalanga, South Africa.

D. *Haworthiopsis* sect. ***Limifoliae*** (G.G.Sm.) Gildenh. & Klopper **comb. nov.**

Bas:—*Haworthia* sect. *Limifoliae* Smith (1950b: 3). Type (designated by Scott 1985):—*Haworthiopsis limifolia* (Marl.) Rowley (2013a: 4) [=*Haworthia limifolia* Marloth (1910: 409)].

8. ***Haworthiopsis limifolia*** (Marl.) Rowley (2013a: 4)

Bas.:—*Haworthia limifolia* Marloth (1910: 409). Type:—SWAZILAND: West of Delagoa Bay [QDS: 2632AB], 1908, *R. Marloth 4678* (holotype PRE0037944!).

Distribution:—This is one of only two *Haworthiopsis* species that are known to occur as far north as Mpumalanga, South Africa (the other being *H. koelmaniorum* that also extends into Limpopo). It is also the only species found in KwaZulu-Natal (South Africa), Swaziland and possibly also Mozambique.

8a. *var.* ***limifolia***

= *Haworthia limifolia* var. *diploidea* Resende (1940: 200)
= *Haworthia limifolia* var. *tetraploidea* Resende (1940: 114)
= *Haworthia limifolia* f. *marlothiana* Resende (1941: 200) ≡ *Haworthia limifolia* var. *marlothiana* (Resende) Resende (1943: 93)
= *Haworthia limifolia* var. *schuldtiana* Resende (1943: 93)
= *Haworthia limifolia* var. *stolonifera* Resende (1943: 94)
= *Haworthia limifolia* f. *pimentelli* Resende (1943: 94)
= *Haworthia limifolia* f. *major* Resende (1943: 94) ≡ *Haworthia limifolia* f. *major* (Resende) Pilbeam (1983: 87)
["*Haworthia limifolia* var. *striata* Pilbeam" (1983: 87) nom. inval. (Art. 40.1, McNeill *et al*., 2012)]

Distribution:—It occurs from the Umfolozi River in KwaZulu-Natal (South Africa) in the south, northward through Swaziland and up to Barberton (Mpumalanga, South Africa) in the north.

8b. *var.* ***arcana*** (Gideon F.Sm. & N.R.Crouch) Rowley (2013a: 4)

Bas.:—*Haworthia limifolia* var. *arcana* Smith & Crouch (2001: 119) ≡ *Haworthia arcana* (Gideon F.Sm. & N.R.Crouch) Breuer (2010: 7). Type:—SOUTH AFRICA. Mpumalanga: Near Hectorspruit [QDS: 2531BC], *N.R. Crouch & G.F. Smith 7* (holotype PRE0500088!)

Distribution:—It is currently only known with certainty from the type locality near Hectorspruit, Mpumalanga, South Africa.

8c. *var.* ***gigantea*** (M.B.Bayer) Rowley (2013a: 4)

Bas.:—*Haworthia limifolia* var. *gigantea* Bayer (1962: 215) ≡ *Haworthia gigantea* (M.B.Bayer) Hayashi (2000: 13). Type:—SOUTH AFRICA. KwaZulu-Natal: Nongoma district [QDS: 2731DC], 1962, *F. Bayer* in *M.B. Bayer 112* (holotype PRE0037946!).

Distribution:—Although it has been reported to have come from Nongoma (KwaZulu-Natal, South Africa), this can not be confirmed (Bayer 1999).

8d. *var.* ***glaucophylla*** (M.B.Bayer) Rowley (2013a: 5)

Bas.:—*Haworthia limifolia* var. *glaucophylla* Bayer (2003: 50) ≡ *Haworthia glaucophylla* (M.B.Bayer) Breuer (2010: 7) ≡ *Haworthiopsis limifolia* var. *glaucophylla* (M.B.Bayer) Rowley (2013a: 5). Type:—SOUTH AFRICA. Mpumalanga: Three Sisters [QDS: 2531CB], *F. Venter 13700* (holotype NBG).

Distribution:—It is currently only known from Three Sisters, Mpumalanga, South Africa.

8e. *var.* ***ubomboensis*** (Verd.) Rowley (2013a: 5)

Bas.:—*Haworthia ubomboensis* Verdoorn (1941: t.818) ≡ *Haworthia limifolia* var. *ubomboensis* (I.Verd.) Smith (1950b: 3). Type:—SWAZILAND: 16 km. south of Stegi, Ubombo Mountains [QDS: 2632CA], 1937, *D.R. Keith s.n.* (holotype PRE0037954!).
= *Haworthia limifolia* var. *keithii* Smith (1950b: 4)

Distribution:—It is only known from the type locality, to the south of Stegi (Isiteki), eastern Swaziland.

E. *Haworthiopsis* sect. ***Tessellatae*** (Salm-Dyck) Gildenh. & Klopper **comb. nov.**

Bas.:—*Aloe* sect. *Tessellatae* Salm-Dyck (1836: sect. 8) ≡ *Haworthia* sect. *Tessellatae* (Salm-Dyck) Baker (1880: 199). **Type** (designated by Manning *et al*. 2014)**:**—*Haworthiopsis tessellata* (Haw.) Rowley (2013b: 5) ≡ *Haworthia tessellata* Haworth (1824: 300).
= *Haworthia* sect. *Venosae* Berger (1908: 75)

9. ***Haworthiopsis granulata*** (Marloth) Rowley (2013b: 4)

Bas.:—*Haworthia granulata* Marloth (1910: 39) ≡ *Haworthia venosa* subsp. *granulata* (Marloth) Bayer (1976: 120) ≡ *Haworthia scabra* subsp. *granulata* (Marloth) Halda (1997: 35) ["*Haworthiopsis granulata* (Marloth) Rowley" (2013a: 4) nom. inval. (Art. 36.2, McNeill *et al*., 2012); *Haworthiopsis venosa* var. *granulata* (Marloth) Rowley" (2013a: 5) nom. inval. (Art. 36.2, McNeill *et al*., 2012)]. Type (neotype designated by Breuer & Metzing 1997: 13):—SOUTH AFRICA. Northern Cape: Verlatenkloof, south of Sutherland [QDS: 3220AD], 1968, *H. Hall 3168* (NBG0087961!).
= *Haworthia schoemanii* Hayashi (2003: 14)

Distribution:—It is known in the south from near Touwsrivier and Laingsburg (Western Cape) and northwards to near Sutherland (Northern Cape), South Africa.

10. ***Haworthiopsis tessellata*** (Haw.) Rowley (2013b: 5)

Bas.:—*Haworthia tessellata* Haworth (1824: 300) ≡ *Aloe tessellata* (Haw.) Roemer & Schultes (1829: 635) ≡ *Haworthia venosa* subsp. *tessellata* (Haw.) Bayer (1976: 161) ≡ *Haworthia venosa* var. *tessellata* (Haw.) Halda (1997: 39) ["*Haworthiopsis tessellata* (Haw.) Boatwr. & J.C.Manning" in Manning *et al*. (2014: 71) nom. superfl.] Type (lectotype designated by Scott 1978: 75):—(icon) in (K) later published in Scott (1978: 75).

Distribution:—This species is the most widespread of all the species of *Haworthiopsis*. It is found in the drier interior, mostly summer rainfall areas, of five of the South African provinces (Eastern, Western and Northern Cape, Free State and North-West), as well as southern Namibia.

10a. *var.* ***tessellata***

= *Haworthia parva* Haworth (1824: 301) ≡ *Aloe parva* (Haw.) Roemer & Schultes (1829: 653) ≡ *Haworthia tessellata* var. *parva* (Haw.) Baker (1880: 211)
= *Haworthia tessellata* var. *inflexa* Baker (1880: 211)
= *Haworthia engleri* Dinter (1914: 31) ≡ *Haworthia tessellata* var. *engleri* (Dinter) Von Poellnitz (1938b: 202)
= *Haworthia pseudotessellata* Von Poellnitz (1929b: 133)
= *Haworthia tessellata* var. *tuberculata* Von Poellnitz (1937a: 214)
= *Haworthia minutissima* Von Poellnitz (1939a: 193) ≡ *Haworthia tessellata* var. *minutissima* (Poelln.) Viveiros (1949: 200)
= *Haworthia tessellata* var. *elongata* Van Woerden (1940: 37)
= *Haworthia tessellata* var. *simplex* Resende & Von Poellnitz (1942: 49)
= *Haworthia tessellata* var. *stepheneana* Resende & Von Poellnitz (1942: 50)
= *Haworthia tessellata* var. *luisierii* Resende & Von Poellnitz (1942: 51)
= *Haworthia tessellata* var. *palhinhiae* Resende & Von Poellnitz (1942: 51)
= *Haworthia tessellata* var. *velutina* Resende & Von Poellnitz (1942: 52)
= *Haworthia tessellata* var. *obesa* Resende & Von Poellnitz (1942: 54)
= *Haworthia tessellata* var. *coriacea* Resende & Von Poellnitz (1942: 53) ≡ *Haworthia coriacea* (Resende & Poelln.) Breuer (2010: 7)
= *Haworthia tessellata* f. *longior* Resende & Von Poellnitz (1942: 53)
= *Haworthia tessellata* f. *brevior* Resende & Von Poellnitz (1942: 53)

Distribution:—This widespread variety is known from the drier interior, mostly summer rainfall areas, of South Africa (Eastern, Western and Northern Cape, Free State and North-West), and southern Namibia.

10b. *var.* ***craussii*** (M.Hayashi) Gildenh. & Klopper **comb. et stat. nov.**

Bas.:—*Haworthia crausii* Hayashi (2001: 16). Type:—SOUTH AFRICA. Northern Cape: Postmasburg [QDS 2823AC], *M. Hayashi 97-001* (holotype TUAT-RIEB).

Distribution:—This variety is known from the north eastern range of the distribution for this species. It is known from the Griekwastad, Postmasburg, Danielskuil and Riverton areas (Northern Cape).

11. ***Haworthiopsis venosa*** (Lam.) Rowley (2013a: 4)

Bas.:—*Aloe venosa* Lamarck (1783: 89) ≡ *Haworthia venosa* (Lam.) Haworth (1812: 51). Type (lectotype designated by Scott 1987: 35):—(icon) in Commelijn (1703: t.29). Type (epitype designated by Breuer & Metzing 1997: 13): SOUTH AFRICA. Western Cape: Swellendam, west of Breede River Bridge [QDS: 3420AB], 1970, *M. B. Bayer 168* (NBG0110636).
= *Aloe anomala* Haworth (1804: 25) ≡ *Apicra anomala* (Haw.) Willdenow (1811: 273)
= *Haworthia venosa* var. *oerthendahlii* Hjelmquist (1943: 233)
= *Aloe recurva* Haworth (1804: 10) ≡ *Haworthia recurva* (Haw.) Haworth (1812: 94) ≡ *Haworthia venosa* subsp. *recurva* (Haw.) Bayer (1976: 149)
= *Aloe tricolor* Haworth (1804: 25)
= *Haworthia distincta* Brown (1876: 130)

Distribution:—It is predominantly known from rocky areas of the Breede River Valley to the south of Swellendam, Western Cape, South Africa. An odd population of plants has also been recorded from the Gouritz River Valley towards the east.

12. ***Haworthiopsis woolleyi*** (Poelln.) Rowley (2013a: 5)

Bas.:—*Haworthia woolleyi* Von Poellnitz (1937f: 269) ≡ *Haworthia venosa* (Lam.) subsp. *woolleyi* (Poelln.) Halda (1997: 40) ≡ *Haworthia venosa* (Lam.) subsp. *woolleyi* (Poelln.) Bayer (1999: 204) *nom. superfl.* Type (lectotype designated by Breuer & Metzing 1997: 13):—(photographic icon) "*Haworthia woolleyi* v.P." (B), later published in Von Poellnitz (1938c: 3)

Distribution:—It is restricted to a single and small population on a hill near Kleinpoort to the east of Steytlerville, an arid area of the Eastern Cape, South Africa.

F. *Haworthiopsis* sect. ***Trifariae*** (Haw.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia* sect. *Trifariae* Haworth (1821: 49) ≡ *Aloe* sect. *Triquetrae* Salm-Dyck (1836: sect. 3) ≡ *Aloe* sect. *Tortuosae* Salm-Dyck (1836: sect. 4). Type (designated by Scott 1985: 26):—*Haworthiopsis viscosa* (L.) Gildenh. & Klopper, *comb. nov.* [=*Aloe viscosa* Linnaeus (1753: 322)].

= *Haworthia* sect. *Luridae* Haworth (1821: 50)

= *Haworthia* sect. *Rigidae* Haworth (1821: 49)

= *Haworthia* sect. *Scabrae* Berger (1908: 75) ≡ *Haworthia* ser. *Scabrae* (A.Berger) Rowley (1985: 5)

13. ***Haworthiopsis pungens*** (M.B.Bayer) Boatwr. & J.C.Manning in Manning *et al*. (2014: 14)

Bas.:—*Haworthia pungens* Bayer (1999: 188) ≡ *Tulista pungens* (M.B. Bayer) Rowley (2013a: 6). Type:—SOUTH AFRICA. Eastern Cape: Braamrivier, Joubertina [QDS: 3323DD], *P.V. Bruyns 7090* (holotype B).

Distribution:—It has a limited distribution and is currently only known from populations north of Joubertina and Kareedouw, Eastern Cape, South Africa.

14. ***Haworthiopsis nigra*** (Haw.) Rowley (2013a: 5)

Bas.:—*Apicra nigra* Haworth (1825: 302) ≡ *Aloe nigra* (Haw.) Roemer & Schultes (1829: 657) ≡ *Haworthia nigra* (Haw.) Baker (1880: 203) ≡ *Haworthia venosa* subsp. *nigra* (Haw.) Halda (1997: 39) ≡ *Haworthia viscosa* subsp. *nigra* (Haw.) Halda (1998: 44). Type (neotype designated by Breuer & Metzing 1997: 10):—SOUTH AFRICA. Eastern Cape: Campherspoort [QDS: 3324AA], 1947, *W.F. Barker 5099* (NBG0068251!). Type (lectotype designated by Breuer 2000: 600):—(icon) "*Haworthia nigra*" in (K).

Distribution:—It has a rather wide distribution and is found in the drier interior parts of the Western and Eastern Cape provinces of South Africa, from near Tsomo in the east to near Merweville in the west.

14a. var. ***nigra***

= *Haworthia schmidtiana* Von Poellnitz (1929a: 23) ≡ *Haworthia nigra* var. *schmidtiana* (Poelln.) Uitewaal (1948: 51)

= *Haworthia schmidtiana* var. *angustata* Von Poellnitz (1937g: 169) ≡ *Haworthia nigra* var. *angustata* (Poelln.) Uitewaal (1948: 51) ≡ *Haworthia nigra* f. *angustata* (Poelln.) Pilbeam (1983: 101)

= *Haworthia schmidtiana* var. *suberecta* Von Poellnitz (1937g: 169) ≡ *Haworthia nigra* var. *suberecta* (Poelln.) Uitewaal (1948: 51)

= *Haworthia schmidtiana* var. *pusilla* Von Poellnitz (1938b: 240) ≡ *Haworthia nigra* var. *pusilla* (Poelln.) Uitewaal (1948: 51)

= *Haworthia ryneveldii* Von Poellnitz (1939b: 271)

Distribution:—The typical variety is found on the eastern end of the distribution range of the species where it is widespread in the interior parts of the Eastern Cape, South Africa. It is known as far east as the Tsomo River, and occurs in the Great Fish River catchment area and to the vicinity of Aberdeen in the west.

14b. var. ***diversifolia*** (Poelln.) Rowley (2013a: 4)

Bas.:—*Haworthia diversifolia* Von Poellnitz (1937a: 200) ≡ *Haworthia schmidtiana* var. *diversifolia* (Poelln.) Von Poellnitz (1938b: 205) ≡ *Haworthia nigra* var. *diversifolia* (Poelln.) Uitewaal (1948: 51). Type (lectotype designated by Breuer 1998: 135):—(icon) "*Haworthia diversifolia*" v.P. in (B). Type (epitype designated by Bayer 1999: 187):—SOUTH AFRICA. Eastern Cape: Willowmore, Kruidfontein [QDS: 3323AB], *P.V. Bruyns in KG435/75* (NBG).

= *Haworthia schmidtiana* var. *diversifolia* f.*nana* Von Poellnitz (1938b: 240) ≡ *Haworthia nigra* var. *diversifolia* f. *nana* (Poelln.) Uitewaal (1948: 51) ≡ *Haworthia nigra* f. *nana* (Poelln.) Pilbeam (1983: 101)

Distribution:—This variety is known from the western limit of the distribution range of the species. It is found in the drier interior, particularly in the Great Karoo (Western Cape), but occurs from near Merweville (Western Cape) in the west, eastwards to just northeast of Willowmore (Eastern Cape), South Africa.

14c. var. ***elongata*** (Poelln.) Rowley (2013a: 4)

Bas.:—*Haworthia schmidtiana* var. *elongata* Von Poellnitz (1938b: 240); *Haworthia nigra* var. *elongata* (Poelln.) Uitewaal (1948: 51). Type (lectotype designated by Breuer 1998: 237):—(icon) "*Haworthia schmidtiana* var. *elongata"* v.P. (B). Note: The neotypification by Bayer & Manning (2012: 20) is superfluous as it is superceded by the lectotypification by Breuer (1998).

Distribution:—Not much is known about the distribution range of this taxon. The original collection is reported to have come from Bulkraal near Slagtersnek, Eastern Cape, South Africa.

15. ***Haworthiopsis scabra*** (Haw.) Rowley (2013a: 5)

Bas.:—*Haworthia scabra* Haworth (1819: 58). Type (lectotype designated by Scott 1980: 274):—(icon) (K), later published in Scott (1980: 274).

Distribution:—It is predominately found in the Little Karoo, from near Ladismith (Western Cape) in the west to near Willowmore (Eastern Cape) in the east, and extending further east to near Joubertina (Eastern Cape), South Africa. It is also found to the south, across the Outeniqua and Tsitsikamma mountains near Plettenberg Bay, Western Cape, South Africa.

15a. var. ***scabra***

= *Haworthia tuberculata* Von Poellnitz (1931: 219) ≡ *Haworthia scabra* var. *tuberculata* (Poelln.) Halda (1997: 35) ≡ *Haworthia scabra* var. *tuberculata* (Poelln.) Hayashi (2000: 13)
= *Haworthia tuberculata* var. *acuminata* Von Poellnitz (1938b: 218)
= *Haworthia tuberculata* var. *sublaevis* Von Poellnitz (1938b: 219)
= *Haworthia tuberculata* var. *subexpansa* Von Poellnitz (1938d: 56)
= *Haworthia tuberculata* var. *angustata* Von Poellnitz (1940b: 27)
= *Haworthia scabra* var. *johanii* Hayashi (2001: 16) ≡ *Haworthia johanii* (M.Hayashi) Breuer (2010: 7)

Distribution:—It is predominantly found in the Little Karoo, generally inland across the coastal mountains, known from near Ladismith (Western Cape) in the west, and eastwards to near Joubertina (Eastern Cape), South Africa.

15b. var. ***lateganiae*** (Poelln.) Rowley (2013a: 5)

Bas.:—*Haworthia lateganiae* Von Poellnitz (1937c: 103) ≡ *Haworthia starkiana* var. *lateganiae* (Poelln.) Bayer (1976: 128) ≡ *Haworthia scabra* var. *lateganiae* (Poelln.) Bayer (1999: 195). Type (lectotype designated by Breuer & Metzing 1997: 12):—(icon) in (B), later published in Von Poellnitz (1937c: 103).

Distribution:—It has a limited distribution near Grootkruis in the area northeast of Oudtshoorn, Western Cape, South Africa.

15c. var. ***morrisiae*** (Poelln.) Rowley (2013a: 5)

Bas.:—*Haworthia morrisiae* Von Poellnitz (1937b: 132) ≡ *Haworthia scabra* var. *morrisiae* (Poelln.) Bayer (1976: 137). Type (lectotype designated by Breuer & Metzing 1997: 12):—(icon) *Haworthia morrisiae* "v.P. VI. 1937" in (B) later published in Von Poellnitz (1937b: 132).

Distribution:—It is known from the area around the Cango Caves and Koos Raubenheimer Dam to the north of Oudtshoorn, Western Cape, South Africa.

15d. var. ***smitii*** (Poelln.) Gildenh. & Klopper **comb. et stat. nov.**

Bas.:—*Haworthia smitii* Von Poellnitz (1938e: 186) ≡ *Haworthia pumila* var. *smitii* (Poelln.) Halda (1997: 36). Type (lectotype designated by Breuer 1998: 245):—(icon) "*Haworthia smitii* v.P." (B) later published in Poellnitz (1938e: 187).

Distribution:—Despite being well represented in collections, not much is known about the distribution of this variety, but it is reported to have come from the conglomerate hills to the east of Oudtshoorn, Western Cape, South Africa.

15e. var. ***starkiana*** (Poelln.) Rowley (2013a: 5)

Bas.:—*Haworthia starkiana* Von Poellnitz (1933: 73) ≡ *Haworthia scabra* subsp. *starkiana* (Poelln.) Halda (1997: 35) ≡ *Haworthia scabra* var. *starkiana* (Poelln.) Bayer (1999: 197). Type (lectotype designated by Breuer & Metzing 1997: 12):—(icon) "*Haworthia starkiana* v.P." (B).

Distribution:—It has a limited distribution in the area of Schoemanspoort, north of Oudtshoorn, Western Cape, South Africa.

16. ***Haworthiopsis viscosa*** (L.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Aloe viscosa* Linnaeus (1753: 332) ≡ *Haworthia viscosa* (L.) Haworth (1812: 90) ≡ *Tulista viscosa* (L.) Rowley (2013b: 6) ["*Haworthiopsis viscosa* (L.) Rowley" (2013a: 5) nom. inval. (Art. 36.2, McNeill *et al*., 2012); "*Tulista viscosa* (L.) Rowley" (2013a: 6) nom. inval. (Art. 36.2, McNeill *et al*., 2012)]. Type (lectotype designated by Scott 1981b: 98):—(icon) in Commelijn (1703: t.31). Type (epitype designated by Breuer & Metzing 1997: 13):—SOUTH AFRICA. Western Cape: Blackburn Valley, Calitzdorp [QDS: 3321DA], 1947, *W.F. Barker 5073* (NBG0068204!).

Distribution:—It is the third most widespread species after *H. tessellata* and *H. nigra* and occurs widely in the Western and Eastern Cape, South Africa.

16a. var. ***viscosa***

= *Aloe pseudotortuosa* Salm-Dyck (1817: 8) ≡ *Haworthia pseudotortuosa* (Salm-Dyck) Haworth (1819: 59) ≡ *Haworthia viscosa* var. *pseudotortuosa* (Salm-Dyck) Baker (1880: 200); *Haworthia viscosa* f. *pseudotortuosa* (Salm-Dyck) Pilbeam (1983: 141)
= *Haworthia concinna* Haworth (1819: 59) ≡ *Aloe concinna* (Haw.) Roemer & Schultes (1829: 653) ≡ *Haworthia viscosa* var. *concinna* (Haw.) Baker (1880: 200)
= *Haworthia asperiuscula* Haworth (1819: 60) ≡ *Aloe asperiuscula* (Haw.) Roemer & Schultes (1829: 653) ≡ *Haworthia viscosa* f. *asperiuscula* (Haw.) Pilbeam (1983: 141)
= *Haworthia cordifolia* Haworth (1819: 59) ≡ *Aloe cordifolia* (Haw.) Roemer & Schultes (1829: 653)
= *Haworthia indurata* Haworth (1821: 49) ≡ *Aloe viscosa* var. *indurata* (Haw.) Salm-Dyck (1836: t.3) ≡ *Haworthia viscosa* var. *indurata* (Haw.) Baker (1880: 200)
= *Haworthia viscosa* var. *major* Haworth (1821: 49)
= *Haworthia viscosa* var. *minor* Haworth (1821: 49)
= *Haworthia viscosa* var. *parvifolia* Haworth (1821: 49)
= *Haworthia torquata* Haworth (1827: 123) ≡ *Aloe torquata* (Haw.) Roemer & Schultes (1829: 654) ≡ *Haworthia viscosa* var. *torquata* (Haw.) Baker (1880: 201); *Haworthia viscosa* f. *torquata* (Haw.) Pilbeam (1983: 141)]
= *Aloe subtortuosa* Roemer & Schultes (1829: 654)
= *Haworthia viscosa* var. *subobtusa* Von Poellnitz (1938b: 240) ≡ *Haworthia viscosa* f. *subobtusa* (Poelln.) Pilbeam (1983: 141)
= *Haworthia viscosa* var. *caespitosa* Von Poellnitz (1938b: 240)
= *Haworthia beanii* Smith (1944b: 137); ≡ *Haworthia viscosa* f. *beanii* (G.G.Sm.) Pilbeam (1983: 141)
= *Haworthia beanii* var. *minor* Smith (1944b: 138)
= *Haworthia viscosa* var. *cougaensis* Smith (1945: 65)
= *Haworthia viscosa* var. *viridissima* Smith (1945: 67)
= *Haworthia asperiuscula* var. *subintegra* Smith (1945: 68)
= *Haworthia asperiuscula* var. *patagiata* Smith (1946: 11)
= *Haworthia viscosa* var. *quaggaensis* Smith (1948: 46)
= *Haworthia viscosa* subsp. *derekii-clarkii* Halda (1998: 43) as '*dereki-clarki*'

Distribution:—It is found widespread in the Little Karoo especially around Calitzdorp and Oudtshoorn (Western Cape), as well as to the northwest near Laingsburg (Western Cape) and into the Eastern Cape, South Africa.

16b. var. ***variabilis*** (Breuer) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia viscosa* var. *variabilis* Breuer (2003: 61) ≡ *Haworthia variabilis* (Breuer) Breuer (2010: 8) ≡ *Haworthiopsis variabilis* (Breuer) Zonneveld (2014: 949). Type:—SOUTH AFRICA. Eastern Cape: Nordwestlich Joubertina [QDS: 3324CD], *DMC 8979 in IB 7193* (holotype TUAT-RIEB)

Distribution:—It is found in a limited area north of Kareedouw in the Kouga Mountains, Eastern Cape, South Africa.

G. *Haworthiopsis* sect. *Virescentes* (Baker) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia* sect. *Virescentes* Baker (1880: 199). Type (lectotype designated here):—*Haworthiopsis sordida* (Haw.) Rowley (2013a: 5) [=*Haworthia sordida* Haworth (1821: 51)].

17. ***Haworthiopsis bruynsii*** (M.B.Bayer) Rowley (2013a: 4)

Bas.:—*Haworthia bruynsii* Bayer (1981: 789) ≡ *Haworthia retusa* subsp. *emelyae* var. *bruynsii* (M.B.Bayer) Halda (1997: 49). Type:—SOUTH AFRICA. Eastern Cape: 20 km south east of Steytlerville [QDS: 3324BC], *G.J. Rossouw 456* (holotype NBG0132381!).

Distribution:—It is found in a small area to the southeast of Steytlerville, an arid part of the Eastern Cape, South Africa.

18. ***Haworthiopsis sordida*** (Haw.) Rowley (2013a: 4)

Bas.:—*Haworthia sordida* Haworth (1821: 51) ≡ *Aloe sordida* (Haw.) Roemer & Schultes (1829: 644) ≡ *Haworthia scabra* subsp. *sordida* (Haw.) Halda (1997: 34). Type (neotype designated by Scott 1985: 7):—(icon) in Salm-Dyck (1836: *Aloe* t. 1 [sect 7: 2]).

Distribution:—It is known only from a narrow band in the Eastern Cape, South Africa, stretching from near Addo in the east to near Steytlerville in the west.

18a. var. ***sordida***

= *Haworthia agavoides* Zantner & Von Poellnitz (1938: 232) ≡ *Haworthia sordida* var. *agavoides* (Zantner & Poelln.) Smith (1950a: 2)

Distribution:—The typical variety is most widespread and is found across the range for the species from Kirkwood, Addo and Uitenhage in the east to near Kleinpoort in the west, Eastern Cape, South Africa.

18b. var. ***lavranii*** (C.L.Scott) Rowley (2013a: 4)

Bas.:—*Haworthia sordida* Haw. var. *lavranii* Scott (1981c: 124) ≡ *Haworthia scabra* subsp. *sordida* var. *lavranii* (C.L.Scott) Halda (1997: 35) ≡ *Haworthia lavranii* (C.L.Scott) Breuer (2010: 7). Type:—SOUTH AFRICA. Eastern Cape: Perdehoek, 36 km south-east of Steytlerville [QDS: 3324AC], *A. Hechter s.n.* (holotype PRE0616285!).

Distribution:—It is only known from a few populations near Steytlerville, Eastern Cape, South Africa.

***Haworthiopsis* hybrids**

Even though *Haworthiopsis* species often co-occur with, or are found in close proximity to, species of *Haworthia* and *Tulista*, intergeneric hybrids are extremely rare (Rowley 2014: 21). Occasionally two species of *Haworthiopsis* are found in close proximity, usually *H. viscosa* with one of the other species, and this co-occurrence occasionally results in the presence of natural hybrids. Hybrids are known between *H. viscosa* and the following taxa: *H. fasciata*, *H. glauca*, *H. longiana* and *H. scabra*, some of which that are fertile. Bayer (1999) has also reported a natural hybrid between *H. sordida* and *H. woolleyi*.

New combinations in *Haworthiopsis* for hybrids formerly described as species of *Haworthia*

There are several dubious taxa that have been previously described, some of which are obvious hybrids that have been given nothospecific epithets. In many cases it is uncertain if the hybrids were of horticultural origin or were introduced from the wild.

1. ***Haworthiopsis* ×*broteriana*** (Resende) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia broteriana* Resende (1941: 159) ≡ *Haworthia sampaiana* f. *broteriana* (Resende) Resende & Pinto Lopes (1946: 178). Type (neotype designated by Breuer 1998: 111):—Photographic illustration in Resende (1943: 16, fig.4a).

Notes:—This hybrid is of horticultural origin. The plant was cultivated and found at the botanical garden in Lisbon, Portugal. It is named in honour of the Portuguese botanist, Felix de Silva Avellar Brotero (1744–1828).

2. ***Haworthiopsis* ×*cassytha*** (Baker) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia cassytha* Baker (1896: 337). Type:—Not designated.

Notes:—It is known that plant material was received from plant grower, Gebhart Ludwig Carl Pfersdorff (1815–1898) in 1875 and was cultivated at Kew (Breuer 2000). This plant is often considered synonymous with *H. viscosa*, but is a hybrid of this species.

3. ***Haworthiopsis* ×*curta*** (Haw.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia curta* Haworth (1819: 60) ≡ *Aloe curta* (Haw.) Sprengel (1825: 69) ≡ *Haworthia tortuosa* var. *curta* (Haw.) Baker (1896: 336). Type:—Not designated.

Notes:—This hybrid has been cultivated at the Chelsea Physic Garden (England) since before 1817, and appears to be one of many hybrid plants that have been described. It was said to be much smaller (Haworth 1819) than *H. ×tortuosa* (Haworth 1804: 7) Gildenhuys & Klopper comb. nov.

4. ***Haworthiopsis* ×*expansa*** (Haw.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Aloe expansa* Haworth (1804: 8) ≡ *Haworthia expansa* (Haw.) Haworth (1812: 91) ≡ *Aloe rigida* var. *expansa* (Haw.) Salm Dyck (1836: t.3) ≡ *Haworthia rigida* var. *expansa* (Haw.) Baker (1880: 203). Type (neotype designated by Breuer 1998: 139):—Illustration in Salm-Dyck (1836: Aloe t.9).

Notes:—This plant has been compared (Haworth 1812) with *H. ×rigida* (Lamarck 1783: 89) Gildenhuys & Klopper comb. nov. in the past and is also of hybrid origin. It may be a synonym of *H. ×rigida.*

5. ***Haworthiopsis* ×*hybrida*** (Salm-Dyck) Gildenh. & Klopper **comb. nov.**

Bas.:—*Aloe hybrida* Salm-Dyck (1817: 7) ≡ *Haworthia hybrida* (Salm-Dyck) Haworth (1821: 51). Type (neotype designated by Breuer 1998: 158):—Illustration in Salm-Dyck (1837: Aloe t.7).

Notes:—Originally described as *Aloe hybrida* Salm-Dyck from plants grown in the Botanical Garden of Vienna (Austria), and it was only later introduced to Kew.

6. ***Haworthiopsis* ×*kewensis*** (Poelln.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia kewensis* Von Poellnitz (1940c: 57). Type (neotype designated by Breuer 1998: 163):—Photographic illustration in Resende (1943: 76, fig.30e).

Notes:—The type plant with the name "*Haworthia peacockii*" was received by Von Poellnitz from Kew in 1937, and was later described as *Haworthia kewensis*.

7. ***Haworthiopsis ×lisbonensis*** (Resende) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia lisbonensis* Resende (1946: 175). Type (lectotype designated by Breuer 1998: 170):—Photographic illustration in Resende (1946: 179, fig.1).

Notes:—This plant was brought to the attention of Resende by a gardener, Mr. Gomes-Amarai at the Lisbon Botanical Garden in Portugal.

8. ***Haworthiopsis ×major*** (Salm-Dyck) Gildenh. & Klopper **comb. et. stat. nov.**

Bas.:—*Aloe tortuosa* var. *major* Salm-Dyck (1837: t.6) ≡ *Haworthia tortuosa* var. *major* (Salm-Dyck) Baker (1896: 336). Type (lectotype designated by Breuer 1998: 259): Photographic illustration in Salm-Dyck (1837: Aloe t.6).

Notes:—Initially described as a variety of *Aloe tortuosa* Salm-Dyck (1837). In later years *Aloe pseudorigida* Salm-Dyck (1817: 9), *Haworthia curta* Haworth (1819: 60) and *Haworthia tortella* Haworth (1819: 61) were transferred to *Haworthia tortuosa* (Haw.) Haw. as varieties thereof. All of these and *H. tortuosa* var. *major* (Salm-Dyck) Baker are of hybrid origin. Since each description was based on individual clones, and it is unlikely that wild populations exist or existed, it does not seem sensible to have hybrids classified as varieties of another hybrid. All of these are here treated as separate hybrid taxa at species level.

9. ***Haworthia ×pseudorigida*** (Salm-Dyck) Gildenh. & Klopper **comb. nov.**

Bas.:—*Aloe pseudorigida* Salm-Dyck (1817: 9) ≡ *Apicra pseudorigida* (Salm-Dyck) Haworth (1819: 62) ≡ *Haworthia tortuosa* var. *pseudorigida* (Salm-Dyck) Berger (1908: 79). Type:—SOUTH AFRICA. Cape: Origin unknown. Not preserved.

Notes:—A hybrid of *H. viscosa*.

10. ***Haworthiopsis ×resendeana*** (Poelln.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia resendeana* Von Poellnitz (1938f: 225). Type (lectotype designated by Breuer 1998: 225):—Photographic illustration "Haworthia Resendeana v.P." in (B); later published in Von Poellnitz (1938f: 226).

Notes:—This horticultural hybrid was named in honour of the Portuguese botanist, Flávio P. de Resende (1907–1967).

11. ***Haworthiopsis ×revendettii*** (Uitewaal) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia revendettii* Uitewaal (1940b: 44). Type (lectotype designated by Breuer 1998: 230):—Photographic illustration in Uitewaal (1940b: 44).

Notes:—This plant had been known as "*Haworthia revendettii"* for several years in cultivation prior to its official description. Even though the origin and the person after whom the plant was named were unknown, Uitewaal retained the name and described it officially in 1940.

12. ***Haworthiopsis ×rigida*** (Lam.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Aloe cylindrica* var. *rigida* Lamarck (1783: 89) ≡ *Aloe rigida* (Lam.) de Candolle (1799: 62) ≡ *Apicra rigida* (Lam.) Willdenow (1811: 272) ≡ *Haworthia rigida* (Lam.) Haworth (1821: 49). Type (neotype designated by Breuer 1998: 125):—Illustration in Salm-Dyck (1836: Aloe t.21).

Notes:—This plant appears to be a hybrid with *H. viscosa*.

13. ***Haworthiopsis ×rubrobrunnea*** (Poelln.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia rubrobrunnea* Von Poellnitz (1940c: 57). Type (neotype designated by Breuer 1998: 231):—Photographic illustration in Resende (1943: 91, fig.35c).

Notes:—Von Poellnitz received the plant labelled as "*Haworthia* no. 3" from Kew without any locality. This is a hybrid of unknown parentage but morphologically clearly belongs in *Haworthiopsis*. The name refers to the reddish brown leaf colouration.

14. ***Haworthiopsis ×sampaiana*** (Resende) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia coarctata* var. *sampaiana* Resende (1938: 177) ≡ *Haworthia sampaiana* (Resende) Resende (1940: 192). Type (neotype designated by Breuer 1998: 120):—Photographic illustration in Resende (1943: 73, fig.28a).

Notes:—This plant has been growing in the Hamburg Botanic Garden (Germany) since as early as 1905. It was named in honour of the Portuguese botanist, Gonçalo António da Silva Ferreira Sampaio (1865–1937).

15. ***Haworthiopsis ×subrigida*** (Roem. & Schult.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Aloe subrigida* Roemer & Schultes (1829: 654) ≡ *Haworthia subrigida* (Roem. & Schult.) Baker (1880: 201). Type (neotype designated by Breuer 2000: 759):—Illustration in Salm-Dyck (1836: Aloe t.7).

Notes:—This species was said to be intermediate between *H. ×tortuosa* and *H. ×rigida* and is of hybrid origin (Baker 1896). This plant was introduced to cultivation at Kew by Salm-Dyck.

16. ***Haworthiopsis ×tauteae*** (Archibald) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia tauteae* Archibald (1946: 992, as '*tautae*'). Type:—SOUTH AFRICA. Western Cape Province: George district [QDS: 3322-CD], *Taute s.n.* (holotype, GRA).

Notes:—This plant was named in honour for Mrs. Taute who collected it in 1943. It is a hybrid between *H. viscosa* and *H. scabra*, and is reported by Bayer (1999) to have come from Kleinspoort, east of Oudtshoorn, South Africa.

17. ***Haworthiopsis ×tortella*** (Haw.) Gildenh. & Klopper **comb. nov.**

Bas.:—*Haworthia tortella* Haworth (1819: 61) ≡ *Haworthia tortuosa* var. *tortella* (Haw.) Baker (1896: 336). Type:—Not designated.

Notes:—This hybrid was once included as a variety of *H. ×tortuosa*.

18. ***Haworthiopsis ×tortuosa*** (Haworth) Gildenh. & Klopper **comb. nov.**

Bas.:—*Aloe tortuosa* Haworth (1804: 7) ≡ *Apicra tortuosa* (Haw.) Willdenow (1811: 274) ≡ *Haworthia tortuosa* (Haw.) Haworth (1812: 90). Type (neotype designated by Breuer 1998: 259):—Illustration in Salm-Dyck (1837: Aloe t.5).

Notes:—A widely cultivated hybrid of *H. viscosa*.

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