

A review and update of the conservation status of *Kalanchoe* species (Crassulaceae subfam. Kalanchooideae) in the Flora of Southern Africa region

Gideon F. Smith¹, Estrela Figueiredo² and Kenneth Oberlander³

1. Department of Botany, Nelson Mandela University, P.O. Box 77000, Gqeberha (Port Elizabeth), 6031 South Africa (smithgideon1@gmail.com) Orcid: GFS, <https://orcid.org/0000-0002-5417-9208>. Corresponding author
2. Department of Botany, Nelson Mandela University, P.O. Box 77000, Gqeberha (Port Elizabeth), 6031 South Africa (epnfigueiredo@gmail.com) Orcid: EF, <https://orcid.org/0000-0002-8511-8213>
3. H.G.W.J. Schweickerdt Herbarium, Department of Plant and Soil Sciences, Plant Sciences Complex, University of Pretoria, Private Bag X20, Hatfield, 0028, South Africa. (email: kenneth.oberlander@up.ac.za) Orcid: KCO, <https://orcid.org/0000-0001-6248-351X>

Photographs: Gideon F. Smith

Summary: An overview and update is provided of the conservation status of the twenty species of *Kalanchoe* (Crassulaceae subfam. Kalanchooideae) indigenous in southern Africa. Fourteen of the species grow abundantly in extensive natural geographical distribution ranges and from a conservation perspective are of Least Concern. One species, *K. laciniata*, has a very wide global distribution range but is restricted to Namibia in the southern African region. The other five *Kalanchoe* species that are of conservation concern are all southern African endemics, being additionally endemic to specific Regions or Centres of Endemism. These are: *K. alticola* (Barberton Centre of Endemism), *K. crouchii* (Wolkberg Centre of Endemism), *K. crundallii* (Soutpansberg Centre of Endemism), *K. longiflora* (Maputaland-Pondoland Region of Endemism) and *K. winteri* (Wolkberg Centre of Endemism).

Zusammenfassung: Es wird ein Überblick und eine Aktualisierung des Erhaltungszustands der 20 im südlichen Afrika heimischen *Kalanchoe*-Arten (Crassulaceae subfam. Kalanchooideae) gegeben. Vierzehn der Arten kommen zahlreich in weiträumigen natürlichen Verbreitungsgebieten vor und sind aus Artenschutzsicht ungefährdet. Eine Art, *K. laciniata*, hat ein sehr großes, weltweites Verbreitungsgebiet, ist aber im südlichen Afrika auf Namibia beschränkt. Die anderen fünf *Kalanchoe*-Arten, die aus Sicht des Artenschutzes relevant sind, sind alle im südlichen Afrika endemisch, d. h. sie kommen nur in bestimmten Regionen

oder Endemismuszentren vor. Diese sind: *K. alticola* (Barberton-Endemismzentrum), *K. crouchii* (Wolkberg-Endemismzentrum), *K. crundallii* (Soutpansberg-Endemismzentrum), *K. longiflora* (Maputaland-Pondoland-Endemismzentrum) und *K. winteri* (Wolkberg-Endemismzentrum).

Keywords: conservation history; endemism; grassland; herbarium records; restricted distribution range; savanna; south-tropical Africa

Introduction

Geopolitically, the region covered by the *Flora of Southern Africa* (FSA) project includes Namibia, Botswana, Eswatini (formerly Swaziland), Lesotho and South Africa, the five southernmost countries on the African continent. Three of the countries abutting the FSA, i.e. Zambia, Zimbabwe, and Mozambique, as well as Malawi and Botswana (the latter also covered in the FSA region), are included in the *Flora zambesiaca* region. Angola was previously included in a separate floristic project, the now defunct *Conspectus florum angolensis*.

The family Crassulaceae is rich in both species (c. 260) and genera (5) in the FSA region (Tölken, 1985; Meyer et al., 1997: 69; Smith et al., 2019a: 17–22). With twenty species of *Kalanchoe* Adans. indigenous to the FSA, the genus is the fourth most speciose in the region (Smith et al., 2019a; Smith, 2021; Smith & Figueiredo, 2021). Along with the predominantly southern African *Adromischus* Lem., *Cotyledon* L. and *Tylecodon*

	Reference	<i>Kalanchoe</i> taxa included
1	Hall et al. (1980: 29)	<ol style="list-style-type: none"> 1. <i>K. alticola</i> (Rare¹ in southern Africa and overall) 2. <i>K. crundallii</i> (Vulnerable² and declining in southern Africa and overall) 3. <i>K. laciniata</i> (Rare in southern Africa; not threatened overall) 4. <i>K. longiflora</i> (Uncertain whether safe or not³ in southern Africa and overall)
2	Hall & Veldhuis (1985: 32)	No <i>Kalanchoe</i> taxa included.
3	Hilton-Taylor (1996a: 66)	<ol style="list-style-type: none"> 1. <i>K. alticola</i> (Insufficiently known⁴ in Eswatini; Rare⁵ in South Africa; Rare overall) 2. <i>K. crundallii</i> (Rare overall) 3. <i>K. laciniata</i> (Rare in Namibia; not threatened overall) 4. <i>K. longiflora</i> (Insufficiently known in Eswatini, however the species does not occur in that country) 5. <i>K. sexangularis</i> (Insufficiently known in Eswatini; not threatened overall)
4	Walter & Gillett (1998: 210)	<i>K. crundallii</i> (Rare ⁶)
5	Scott-Shaw (1999: 54)	No <i>Kalanchoe</i> taxa included
6	Craven & Loots (2002: 88), for Namibia	<i>K. laciniata</i> (Data Deficient)
7	Dlamini & Dlamini (2002: 131), for Eswatini	<i>K. alticola</i> (Data Deficient) <i>K. montana</i> ⁷ (Data Deficient) <i>K. sexangularis</i> (Data Deficient)
8	Victor (2002), for South Africa	No <i>Kalanchoe</i> taxa included
9	Burgoyne et al., in Raimondo et al. (2009: 310) Von Staden et al., in Raimondo et al. (2009: 310)	<i>K. alticola</i> (DDD ⁸) <i>K. crundallii</i> (Rare ⁹)
10	http://redlist.sanbi.org/genus.php?genus=3823	Thirteen <i>Kalanchoe</i> taxa assessed (see Table 2)

Table 1. Chronology of the inclusion of southern African *Kalanchoe* taxa in South African, southern African, and global conservation assessments. With the exception of *Kalanchoe laciniata*, which has a very wide distribution range beyond Namibia, the only FSA country from which it has been recorded, all the taxa included in the Table are endemic to southern Africa (see notes opposite).

¹'Rare'. Used for a plant with a relatively small world population that is not declining and is under no known immediate threat. Because of its rarity, the plant should be checked regularly for a decline due to some unexpected pressure (Hall et al., 1980: 9).

²'Vulnerable'. Used for a plant that was recently more widespread, but is on the decline, and is likely to become endangered if the causal factors for its decline continue operating (Hall et al., 1980: 9).

³'Uncertain whether safe or not'. A temporary category used for plants that are so little known that there is an even chance that they could prove to be safe (Hall et al., 1980: 9).

⁴'Insufficiently known'. Used for taxa that are suspected but not definitely known to be Extinct, Endangered, Vulnerable, Rare, or Indeterminate (Hilton-Taylor, 1996a: 9).

⁵'Rare'. Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline (Hilton-Taylor, 1996a: 9).

⁶Based on Hilton-Taylor (1996a: 66).

⁷As *K. luciae* subsp. *montana* (Compton) Toelken.

⁸'DDD'. Applied to taxonomically well-defined taxa that are too poorly known to allow an assessment of possible extinction risks, either because their distribution and habitat are unknown, or they are well known and suspected to be in danger of extinction, but relevant data to measure against criteria for the categories of threat do not yet exist (Raimondo et al., 2009: 9).

⁹'N-Rare'. See Material and methods, above.

Toelken, *Kalanchoe* is included in Crassulaceae subfam. Kalanchooideae.

At present five subgenera are recognised in *Kalanchoe*: the geographically widespread autonymic one; as well as *K.* subg. *Alatae* (Raym.-Hamet) Gideon F.Sm., Shtein & D.-P. Klein (Smith et al. 2021a), *K.* subg. *Bryophyllum* (Salisb.) Koord., and *K.* subg. *Kitchingia* (Baker) Gideon F.Sm. & Figueiredo, all three of which are restricted to Madagascar; and the exclusively southern and south-tropical African *K.* subg. *Fernandesiae* Gideon F.Sm. (Smith & Figueiredo 2018a; Smith et al. 2019a; Smith 2020a: 5). The southern African kalanchoes are split across two of these subgenera, with *K. crouchii*, *K. luciae*, *K. montana*, *K. thyrsiflora*, and *K. winterii* included in *K.* subg. *Fernandesiae* and the others in *K.* subg. *Kalanchoe*.

All twenty *Kalanchoe* species that are indigenous to southern Africa occur in the eastern and northern parts of the subcontinent, with representatives of the genus being largely absent from the western (Mediterranean) and south-central, mostly arid, karoid parts (Smith et al., 2019a: 47; Smith & Figueiredo, 2021).

We here present an overview and update of the conservation status of the species of *Kalanchoe* indigenous to the FSA region. It is shown that fourteen of the twenty species are of 'Least Concern'; one, *K. laciniata* (Figure 1) has a restricted distribution range in southern Africa but has a very wide global distribution range; and five, *K. alticola* (Figure 2), *K. crouchii* (Figure 3), *K.*

crundallii (Figure 4), *K. longiflora* (Figure 5), and *K. winterii* (Figure 6) are of conservation concern. These six species are illustrated.

Material and methods

Information on the conservation status of the *Kalanchoe* taxa indigenous in southern Africa was derived from historical and current literature, herbarium records where accessible, consultations with specialists, and fieldwork. These four sources of information have remained of critical importance in species-level conservation biology studies over several decades.

The definitions of the conservation categories applicable to taxa that are variously regarded as threatened have undergone considerable refinement over the past forty years. We here deliberately reference the conservation assessment categories that were assigned to the various taxa in the original assessments (see 'History of conservation assessments of kalanchoes in the *Flora of Southern Africa* region') and for the sake of clarity define these in the footnotes to Table 1. However, where possible, the recommended categories as defined in the second edition of version 3.1 of the *IUCN Red List categories and criteria* (IUCN, 2012) are used.

Where appropriate and to facilitate comparable conservation discussions in the FSA region, we additionally make use of the expanded red list categories (see <http://redlist.sanbi.org/redcat.php>), where, for example, the category 'N-Rare' is defined as follows: 'A species is Rare when it meets at least

	<i>Kalanchoe</i> species	Conservation status	
		South African Red List	Present study
1	<i>K. alticola</i> Compton	Data Deficient (DDD)	Data Deficient (DDD)
2	<i>K. brachyloba</i> Welw.	Least concern	Least concern
3	<i>K. crenata</i> (Andrews) Haw.	Least concern	Least concern
4	<i>K. crouchii</i> Gideon F.Sm. & Figueiredo	⁻¹	Endangered
5	<i>K. crundallii</i> I.Verd.	Rare	Rare
6	<i>K. decumbens</i> Compton	⁻²	Least concern
7	<i>K. hirta</i> Harv.	⁻³	Least concern
8	<i>K. laciniata</i> (L.) DC.	⁻⁴	Data Deficient (DDD)
9	<i>K. lanceolata</i> (Forssk.) Pers.	Least concern	Least concern
10	<i>K. leblanciae</i> Raym.-Hamet	⁻⁵	Least concern
11	<i>K. longiflora</i> Schltr. ex J.M.Wood	Vulnerable	Vulnerable
12	<i>K. luciae</i> Raym.-Hamet	Least concern	Least concern
13	<i>K. montana</i> Compton	Least concern ⁶	Least concern
14	<i>K. neglecta</i> Toelken	Least concern	Least concern
15	<i>K. paniculata</i> Harv.	Least concern	Least concern
16	<i>K. rotundifolia</i> (Haw.) Haw.	Least concern	Least concern
17	<i>K. sexangularis</i> N.E.Br. var. <i>sexangularis</i>	Least concern	Least concern
18	<i>K. thyrsoiflora</i> Harv.	Least concern	Least concern
19	<i>K. waterbergensis</i> van Jaarsv.	⁻¹	Least concern
20	<i>K. winteri</i> Gideon F.Sm., N.R.Crouch & Mich.Walters	⁻¹	Rare

¹Not described at the time.

²Included in the synonymy of *K. rotundifolia* at the time (see Figueiredo & Smith, 2017; Smith & Figueiredo, 2017a; Smith, 2021).

³Included in the synonymy of *K. crenata* at the time (see Crouch & Smith, 2009; Smith et al., 2018).

⁴In the *FSA* region indigenous to Namibia only and therefore not treated in Raimondo et al. (2009) nor at <http://redlist.sanbi.org/genus.php?genus=3823>.

⁵Not recognised as occurring in the *FSA* region at the time.

⁶Treated as *K. luciae* Raym.-Hamet subsp. *montana* (Compton) Toelken at the time (see Smith et al., 2016).

Table 2. Conservation status of *Kalanchoe* taxa in southern Africa as recorded by Raimondo et al. (2009) for two species, *K. alticola* and *K. crundallii*, at <http://redlist.sanbi.org/genus.php?genus=3823> for thirteen taxa, and as given for one species, *K. laciniata*, in Namibia by Loots (2005), as compared to the outcomes of the present study. A conservation status is proposed for recently reinstated and newly described species (see text for discussions). The taxa are arranged in alphabetical sequence..

one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five criteria used by the IUCN (2012). The four criteria are as follows.

1. Restricted range: Extent of Occurrence (EOO) < 500km²; or

2. Habitat specialist: Species is restricted to a specialised microhabitat so that it has a very small Area of Occupancy (AOO), typically smaller than 20km²; or

3. Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area; or

4. Small global population: Less than 10,000 mature individuals.'

This category, 'Rare', is marked with a superscript ^{'N'} (see above) to indicate that it is a national, non-IUCN Red List category used for species that are not in danger of extinction, but nonetheless considered to be of conservation concern.

Note further that two 'Data Deficient' categories are used: the category 'DDD' is used when there is inadequate information to make an assessment of the risk of extinction of a taxon, but it is taxonomically well defined. This contrasts with 'DDT', a category used for taxa where taxonomic problems negatively impact on determining their distribution ranges and habitats, so preventing an assessment of the possibility of a risk of extinction (see Raimondo et al., 2009: 2, 9–10).

Author citations for the names of southern African *Kalanchoe* taxa are given in Table 2 and not repeated elsewhere. References to the protologues of the names of the species used in this paper are not provided. The names of the authors of other, non-FSA *Kalanchoe* taxa are given at first mention in the text.

Results and history of conservation assessments of kalanchoes in the Flora of Southern Africa region

In the first attempt to assess the threatened plants problem in southern Africa, a state of threat or rarity was assigned to four species of *Kalanchoe* (Hall et al., 1980: 29) (Table 1). These were *K. alticola* (Rare), *K. crundallii* (Vulnerable and declining), *K. laciniata* (Rare), and *K. longiflora* (Uncertain whether safe or not). The conservation status of the species in southern Africa, as well as their global conservation status, was given. Although the work towards Hall et al. (1980) is now more than four decades old – it was started in 1974 – this pioneering version of what was then widely referred to as the 'Red Data List of southern African plants' set a useful baseline for further work in subcontinental plant conservation biology research.

Sixteen and eleven years, respectively, after the publication of Hall et al. (1980) and Hall & Veldhuis (1985) (the latter being a partial update for the Fynbos and Karoo Biomes of South Africa), Hilton-Taylor (1996a) presented an updated list of just over 4,000 southern African taxa whose conservation status had been assessed (Table 1). As in the case of Hall et al. (1980), the geographical coverage was the FSA region and the conservation status of the species in the countries where they are indigenous, as well as their conservation



Figure 1. *Kalanchoe laciniata* has a restricted distribution range in Namibia in northwestern southern Africa. As currently understood the species has a very wide global distribution range. For the species in Namibia a conservation status of Data Deficient (DDD; see text for a discussion of this category) is retained.



Figure 2. For *Kalanchoe alticola*, which is known from the Barberton Centre of Endemism in the Mpumalanga province of South Africa and the adjacent Eswatini (Swaziland), a conservation status of Data Deficient (DDD; see text for a discussion of this category) is retained.



Figure 3. The conservation status of *Kalanchoe crouchii*, which is endemic to the Wolkberg Centre of Endemism, South Africa, is 'Endangered' (D1).



Figure 5. The conservation status of *Kalanchoe longiflora*, a central-KwaZulu-Natal endemic, is confirmed as 'Vulnerable'.



Figure 4. The conservation status of *Kalanchoe crundallii*, which is endemic to the Soutpansberg Centre of Endemism, Limpopo Province, northern South Africa, is confirmed as 'Rare'.



Figure 6. The conservation status of *Kalanchoe winteri*, an endemic of the Wolkberg Centre of Endemism, South Africa, is 'Rare'.

status overall was given. Hilton-Taylor (1996a: 66) included five species of *Kalanchoe*, i.e. *K. alticola* (Insufficiently known in Eswatini; Rare in South Africa; Rare globally), *K. crundallii* (Rare globally), *K. laciniata* (Rare in Namibia; not threatened globally), *K. longiflora* (Insufficiently known in Eswatini), and *K. sexangularis* (Insufficiently known in Eswatini; not threatened globally). However, *K. longiflora* does not occur naturally in Eswatini and the species was likely confused with *K. sexangularis*, which is rather common across its geographical distribution range, likely also in Eswatini. The two updates of Hilton-Taylor (1996a) that were published in quick succession did not suggest any changes to the conservation

status of *Kalanchoe* in southern Africa (Hilton-Taylor, 1996b, 1997).

For the conservation status of plants in southern African countries, Walters & Gillett (1998) (Table 1) drew largely on Hilton-Taylor (1996a, b, 1997) and, at least for Namibia, Loots (2005: 4) noted that conservation assessments included in Walters & Gillett (1998) that were not based on Hilton-Taylor (1996a, b, 1997) are questionable.

In a regional study of the rare and threatened plants of KwaZulu-Natal and neighbouring regions, Scott-Shaw (1999: 54) found that, of the Crassulaceae assessed, three of the six taxa of the genus *Crassula* L. included in the study were 'Data Deficient' and the other three 'LOWER

RISK (Least Concern)' (Table 1). Note though that 'Data Deficient' is not a category of threat, nor an indication that a taxon is 'Lower Risk'. Rather, for a Data Deficient species data are lacking on the abundance and/or distribution of the taxon, with the implication that more information is required and that future research may indicate that a threatened classification might be appropriate. In contrast, taxa regarded as 'Lower risk Least Concern' do not qualify as 'Conservation Dependant' or as 'Near Threatened'. Scott-Shaw (1999) did not include any of the eastern seaboard kalanchoes in his work, even though *K. longiflora* has long been known to have a very limited distribution range in the KwaZulu-Natal Midlands (Hall et al., 1980; Hilton-Taylor, 1996a).

The book entitled *Southern African Plant Red Data Lists* that was published in 2002 contained information on threatened plants for ten countries, including for the five covered by the *FSA* project (Table 1, row 6). For these five countries, four kalanchoes, *K. laciniata* (Craven & Loots, 2002: 88 for Namibia) and *K. alticola*, *K. montana*, and *K. sexangularis* (Dlamini & Dlamini, 2002: 131 for Eswatini) were included, with all the taxa treated as 'Data Deficient'. South African species of *Kalanchoe* were not included in the work (Victor, 2002).

From the other five non-*FSA* countries included in that study, the following kalanchoes were included on the regional Red Data List.

Mozambique

1. *K. fernandesii* Raym.-Hamet (Vulnerable) (Izidine & Bandeira, 2002: 50).
2. *K. hametorum* Raym.-Hamet (Lower Risk-Near Threatened) (Izidine & Bandeira, 2002: 54).

Zimbabwe

1. *K. velutina* Welw. subsp. *chimanimaniensis* (R.Fern.) R.Fern. (Lower Risk-Near Threatened) (Mapaura & Timberlake, 2002: 173).
2. *K. lobata* R.Fern. (Data Deficient) (Mapaura & Timberlake, 2002: 173).
3. *K. wildii* Raym.-Hamet (Data Deficient) (Mapaura & Timberlake, 2002: 179).

Loots (2005:121), in the *Red Data Book of Namibian plants*, included *K. laciniata* in Appendix 2, a list of data deficient (DD) taxa. The other three kalanchoes that occur naturally in Namibia (*K. brachyloba*, *K. lanceolata*, and *K. rotundifolia*; Kolberg et al., 1992: 31; Craven et al., 1999: 86) were not considered to be of conservation concern. Raimondo et al. (2009) included only two species, *K. alticola* (DDD) and *K. crundallii* (Rare), under

categories of conservation concern on the red list of South African plants (note of the country, not the *FSA* region) (Table 1).

Later, at <http://redlist.sanbi.org/genus.php?genus=3823>, thirteen taxa of *Kalanchoe* were recognised as occurring naturally in South Africa, with the only species indigenous to the *FSA* region that does not occur in the country being *K. laciniata*, which in this region is restricted to Namibia.

Since 2009 three new species of *Kalanchoe* have been described from the *FSA* region (*K. crouchii*, *K. waterbergensis*, and *K. winteri*), two were reinstated as accepted species (*K. decumbens* and *K. hirta*), one was newly recorded for the *FSA* (*K. leblanciae*), while the one species excluded from Raimondo et al. (2009) (*K. laciniata*), indeed occurs in the region, in Namibia only. In addition, *K. montana*, which was treated as *K. luciae* subsp. *montana* by Raimondo et al. (2009), has since been reinstated at species rank.

Discussion

Geographically, southern Africa east of the Drakensberg massif is home to the largest diversity of *Kalanchoe* species in southern Africa, with this region being host to a total of seventeen (85%) of the twenty kalanchoes thus far recorded for the subcontinent (Smith & Figueiredo, 2021: 208, Table 1). Eight of the twenty indigenous subcontinental species (40% of the southern African kalanchoes) have comparatively narrow distribution ranges that stretch from central KwaZulu-Natal in the south in a broad swathe to the Limpopo River in the north (Smith & Figueiredo, 2021). A further nine species are also indigenous to eastern southern Africa, but have very broad distribution ranges. Two other southern African species are endemic to the north (*K. crundallii*) and west (*K. waterbergensis*) of the Drakensberg massif, while one (*K. laciniata*) occurs in northern Namibia in the far northwest of the *FSA* region.

Most southern African kalanchoes are very common in their natural habitats and, from a conservation perspective, the majority of the species is of least concern (Table 2).

Southern African kalanchoes of least concern

Based on information available at present, fourteen of the *Kalanchoe* taxa indigenous to southern Africa are of least concern given their wide geographical distribution ranges and abundance in their natural habitats. These taxa are: *K. brachyloba* (Smith & Figueiredo, 2017b), *K. crenata*, *K. decumbens*, *K. hirta*, *K. lanceolata*, *K. leblanciae*, *K. luciae*, *K. montana*, *K. neglecta*, *K. paniculata* (Smith & Figueiredo, 2017c), *K.*

rotundifolia, *K. sexangularis* var. *sexangularis* (Figueiredo et al., 2016), *K. thrysiflora*, and *K. waterbergensis*. Included among these are all ten *Kalanchoe* taxa that Raimondo et al. (2009) listed as being of ‘Least Concern’.

Southern African kalanchoes of conservation concern

The six southern African species (30% of the total number of indigenous species) of *Kalanchoe* that are of some conservation concern are: (1) *K. alticola*, (2) *K. crouchii*, (3) *K. crundallii*, (4) *K. laciniata*, (5) *K. longiflora*, and (6) *K. winteri*. Five of the six species are southern African endemics, with the discussion of their conservation status therefore also applicable on a world scale. One species, *K. laciniata*, which in southern Africa is restricted to Namibia, is common elsewhere and on a world scale is of Least Concern.

A. *Kalanchoe alticola*

In Raimondo et al. (2009: 310) *K. alticola* (Figure 2), an endemic of the Barberton Centre of Endemism (Van Wyk & Smith, 2001: 116–119), was listed as ‘Data Deficient’ because of a lack of precise sites in South Africa and existing collections being ‘old’. Its occurrence in Eswatini (at the time as ‘Swaziland’) was noted as being impacted by the cultivation of sugarcane.

This situation persists. *Kalanchoe alticola* is a low-growing species that often evades detection in its natural habitat and only a few herbarium specimens have been collected and recorded to date. In terms of both vegetative and reproductive morphology *K. alticola* resembles *K. rotundifolia* and can easily be mistaken for the latter species. The main character that differentiates *K. alticola* from *K. rotundifolia* is the much longer, rather robust, erect to claw-like sepals. In *K. rotundifolia* the sepals are usually not significantly developed. It should further be noted that the Barberton area in the Mpumalanga Province, South Africa, adjacent to northwestern Eswatini, from where *K. alticola* has been recorded, is undergoing very rapid urban expansion.

We at present retain a status of Data Deficient (DDD), i.e. a category that includes well-defined taxa but since their distribution and habitat are too poorly known an assessment of extinction risk cannot be conducted, for *K. alticola*.

B. *Kalanchoe crouchii*

As understood at present, the recently described *K. crouchii* (Figure 3) has a very limited natural distribution range in South Africa’s Mpumalanga Province, in the vicinity of Pilgrim’s Rest, a

former gold mining town. This locality falls in the Wolkberg Centre of Endemism (Van Wyk & Smith, 2001: 120–125), within which about thirty succulent plant species, including *K. crouchii*, in at least eight families are endemic.

Kalanchoe crouchii is a grassland species that evades the regular fires that pass through such habitats by growing in shallow, humic soils along dolomite ridges (Smith & Figueiredo, 2018b; Smith et al., 2021b).

Only about 100 plants are known at and near the type locality, which is in very close proximity to forestry activities. Given the apparent natural paucity in populations and individuals, and that plantations for commercial timber, paper and pulp production are encroaching on the known populations, prompt the treatment of *K. crouchii* as Endangered (D1, i.e. less than 250 mature individuals in the global population).

C. *Kalanchoe crundallii*

In Raimondo et al. (2009: 310) *K. crundallii* (Figure 4) was listed as ‘Rare’, with the Extent of Occurrence given as 52km² and the Area of Occurrence as < 1km². The species was then only known from four or five sites with subpopulations being small and considered to be severely fragmented. A slight potential threat of harvesting for horticultural purposes was recorded. However, the species hardly has gardening potential as it has the general, horticulturally unexciting appearance of *K. rotundifolia*, albeit a somewhat more robust version of that species. Although the flowers of *K. crundallii* are very different from those of *K. rotundifolia*, it is additionally shy to flower in cultivation, and acquiring material will only interest completist collectors.

Kalanchoe crundallii, a cloud woodland specialist, is endemic to the Soutpansberg Centre of Endemism in the Limpopo Province in northern South Africa (Van Wyk & Smith, 2001: 134–139; Hahn, 2002, 2017). Based on the known geographical distribution range and the sizes and health of known populations recorded during fieldwork in February and July 2018, Smith & Hahn (2018: 112–117) proposed that a conservation status of ‘Rare’ (see <http://redlist.sanbi.org/redcat.php>) be retained for *K. crundallii*, a view with which we agree. Smith & Hahn (2019: 112–117) argued that, while there might be justification for treating the species as ‘Vulnerable’, additional information on its geographical distribution range would be required to warrant such a classification. In early- and mid-2018 the observed populations appeared to be stable, with the largest population consisting of more than 1,000 plants.

Smith & Hahn (2019: 117) further noted that future fieldwork should focus on locating previously unrecorded subpopulations that might occur between the western- and eastern-most populations of *K. crundallii*. In addition, long-term monitoring of the restricted habitat of the species within the high-altitude, cloud woodlands should record environmental and climatic trends that may negatively impact on the survival of the species.

D. *Kalanchoe laciniata*

A number of species of *Kalanchoe* have extraordinarily wide natural geographical distribution ranges. At least three southern African species fall in this category with, especially, *K. laciniata*, *K. lanceolata*, and *K. rotundifolia* having been recorded from southern Africa in the south, northwards well into the northern hemisphere.

In southern Africa, *K. laciniata* (Figure 1) is only known from a single record collected in bushveld vegetation (Mopane Savanna sensu Giess, 1971: 10, 23, 37–38, 1998: 10–11, 22–23, 35–36) in central Kaokoland, northwestern Namibia, on a weathered dolomite koppie. In this vegetation type *Colophospermum mopane* (J.Kirk ex Benth.) J.Léonard is the characteristic species. The specimen, *Bernard de Winter & Otto A. Leistner* 5579, was collected on 21 April 1957 (see South African National Biodiversity Institute, 2021; Tölken, 1985: 66). De Winter and Leistner, then both attached to South Africa's Botanical Research Institute (one of the forerunners of the current South African National Biodiversity Institute), jointly collected in Kaokoveld, Namibia, then South West Africa, from March to May 1957 (Gunn & Codd, 1981: 130). We are not aware of any other specimens of *K. laciniata* having been collected in southern Africa in the more than sixty years since. *Kalanchoe laciniata* also occurs in neighbouring south-western Angola, in eastern and north-eastern Africa (see for example Pickering & Darbyshire, 2015: 155–156 and Smith et al., 2019a: 165–169), on the Arabian Peninsula (Collenette, 1985: 190), and in Asia.

Craven & Loots (2002: 88) noted that the area where *De Winter & Leistner* 5579 was collected in 1957 had been transformed. For *K. laciniata* in Namibia we at present retain a status of Data Deficient (DDD), i.e. a category that includes well-defined taxa but since their distribution and habitat are too poorly known, an assessment of extinction risks cannot be conducted.

D. *Kalanchoe longiflora*

From a conservation perspective, *K. longiflora* (Figure 5) is a distinct paradox as it has a very

small natural geographical distribution range in central KwaZulu-Natal, where it is endemic to the Maputaland-Pondoland Region of Endemism (Van Wyk & Smith, 2001: 82–85), but it is one of the most popular kalanchoes in horticulture in southern Africa (Smith, 2020b). It essentially thrives in virtually any soil type and situation where temperatures do not fall below freezing (Smith, 2020b: 41–43), is very drought-tolerant, and is easily multiplied through stem cuttings (Smith & Figueiredo, 2017d). It has also gained popularity as a garden subject in other parts of the world (see for example Maire, 1976: 255, Figure 85, on the kalanchoes encountered in North Africa).

At present no information exists that would be indicative of a relaxation in the current conservation status of *K. longiflora* as 'Vulnerable'. Given that *K. longiflora* is extremely common in cultivation, chances that it will ever become extinct ('EX') are very slim, but its natural habitat should be monitored to determine any decline in the occurrence of the species.

E. *Kalanchoe waterbergensis*

Although initially known only from the type locality in the Waterberg, Smith & Figueiredo (2021) and Smith et al. (2021c) have recently shown that in the case of *K. waterbergensis*, essentially a *K. rotundifolia*-lookalike species like *K. alticola*, its distribution range stretches beyond the type locality (see also Peckover, 2020: 190). The Waterberg mountain range was recognised by Van Wyk & Smith (2001: 15) as being a possible Centre of Endemism, but they did not treat it because it could benefit from additional floristic surveys; it falls within the Savanna Biome (Distant, 1892: 77; Rutherford et al., 2006), and virtually exclusively in the Limpopo Province of South Africa. In 2001 the Waterberg, which covers an area of 654,033ha, was recognised as a Biosphere Reserve, i.e., an ecosystem of unusual scientific and natural interest (see also Wadley, 2019).

Kalanchoe waterbergensis is a typical bushveld (savanna) species often growing in the shade of mostly deciduous trees, and frequently in close association with the very widespread *K. paniculata* and *K. rotundifolia*.

We regard *K. waterbergensis* as being of 'Least Concern'.

F. *Kalanchoe winteri*

At present, the recently described *Kalanchoe winteri* (Figure 6) is known from only three different localities that span a 50km range (Crouch et al., 2016: 220; Smith et al., 2019b: 65–

	Species (countries in which it occurs)	Hall et al. (1980)	Hilton-Taylor (1996a)	Raimondo et al. (2009)	Red list of SA plants ¹	Proposed status
1	<i>K. alticola</i> (South Africa, Eswatini)	Rare	Rare	Data Deficient	Data Deficient	Data Deficient
2	<i>K. crouchii</i> (South Africa)	-	-	-	-	Endangered
3	<i>K. crundallii</i> (South Africa)	Vulnerable	Rare	Rare	Rare	Rare
4	<i>K. laciniata</i> (Namibia)	Rare	Rare	-	-	Data Deficient
5	<i>K. longiflora</i> (South Africa)	Uncertain	- ²	-	Vulnerable	Vulnerable
6	<i>K. winteri</i> (South Africa)	-	-	-	-	Rare

¹See <http://redlist.sanbi.org/genus.php?genus=3823>.

²Treated as 'Insufficiently known' in Eswatini. However, *K. longiflora* does not occur naturally in Eswatini and the species was likely confused with the common and widespread *K. sexangularis*.

Table 3. Chronological comparison of the conservation status of southern African *Kalanchoe* species that have a history of being of conservation concern. A dash indicates that the species was not known at the time or that it does not occur in the country treated in the reference cited.

66). It occurs on quartzite in grassland vegetation, always in fire protected microhabitats on or near rocks. This species is largely restricted to the Wolkberg mountain range which is included in a broader area that has been recognised as the Wolkberg Centre of Endemism.

Given that *K. winteri* is known from a very small geographical area we treat it as 'Rare'.

Conclusion

Of the twenty species of *Kalanchoe* that are indigenous to southern Africa, fourteen are considered to be of 'Least Concern'. These species occur over very wide geographical distribution ranges and are generally abundant where they grow.

Of the six species that are of conservation concern, four have a history of inclusion on Red Lists for South and southern Africa (Table 3), even though one of them, the Namibian *K. laciniata*, has a massive global geographical distribution range. The conservation status of the three other species (*K. alticola*, *K. crundallii*, and *K. longiflora*) with historical conservation assessments and records has remained static over the past more than ten years (Table 3).

Of the *Kalanchoe* species that were newly

described or reinstated over the past ten years, the conservation status of two, *K. waterbergensis* and *K. decumbens*, is 'Least Concern'. However, the other two recently described species (*K. crouchii* and *K. winteri*) are narrow endemics with very small world populations with a status of 'Endangered' published here for *K. crouchii*, while *K. winteri* is treated as 'Rare'.

With the exception of the Namibian *K. laciniata*, the other five southern African species that are of conservation concern are endemic to the subcontinent, with all of them additionally endemic to recognised Centres or Regions of Endemism. All are restricted to either South Africa, or South Africa and Eswatini (*K. alticola*).

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