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DEPARTMENT OF ENVIRONMENTAL AFFAIRS

NO. 1106 **22 AUGUST 2019**

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT NO. 10 OF 2004)

NON-DETRIMENT FINDINGS

CONSULTATION IN TERMS OF SECTION 62(3) OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT NO. 10 OF 2004)

I, Barbara Dallas Creecy, Minister of Environment, Forestry and Fisheries hereby, under section 62(3) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), give notice of my intention to publish non-detriment findings for *Aloe ferox* (Bitter aloe) made by the Scientific Authority in the Schedule hereto.

Members of the public are invited to submit to the Scientific Authority, within 30 days from the date of the publication of the notice in the *Gazette*, written scientific information relating to the non-detriment findings to the following addresses:

By post to: Chair: Scientific Authority
South African National Biodiversity Institute
Attention: Ms M Pfab
Private Bag X101
PRETORIA
0001

By hand at: 2 Cussonia Avenue, Brummeria, Pretoria, 0001
By email: m.pfab@sanbi.org.za
By fax: 086 555 9863

Comments received after the closing date may not be considered.

MS B D CREECY, MP
MINISTER OF ENVIRONMENT, FORESTRY AND FISHERIES

SCHEDULE

Non-detriment finding assessment for *Aloe ferox* (bitter aloe)
Reference Number: Alo_fer_Sep2018
Date: 31 August 2018
Issued by the Scientific Authority of South Africa

Summary of findings

Aloe ferox (bitter aloe) is included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In terms of Article IV of the Convention, an export permit shall only be granted for an Appendix II species when a Scientific Authority of the State of export has advised that such an export will not be detrimental to the survival of that species in the wild. This document details the undertaking of a Non-Detriment Finding (NDF) assessment (Figure 1) for *A. ferox* and is based on the best available information, current as of September 2018.

Aloe ferox is a long-lived, single-stemmed succulent plant that can grow to heights of up to 6 m. The species is adapted to withstand a wide range of climatic conditions and can be found growing on rocky hill slopes and in flat open areas across a range of habitat types including fynbos, grassland, Karoo vegetation and valley bushveld. Flowering usually occurs between May and August when mature plants produce a single, branched inflorescence with 5-12 erect, dense racemes with orange-red flowers and large quantities of seed. The species is considered to be relatively easily propagated by seed although sufficient empirical data regarding the regeneration potential of the species has not yet been developed. *Aloe ferox* has a weed like ecology and is believed to be a pioneer plant due to its ability to thrive in degraded areas. The relatively large distribution range of *A. ferox* generally implies that the species has good dispersal efficiency (wind-dispersed). Young populations form clumps that act as nuclei from which new plants spread slowly over time with mature individuals forming the centre of the densest stands.

Aloe ferox occurs primarily in the Eastern Cape extending down to the Western Cape Province, and up into the south-eastern Free State. The species also occurs in southern Lesotho. It has been previously documented to occur in the KwaZulu-Natal Province, however previous records of *A. ferox* for the province have been confirmed to be records of the similar looking *Aloe candelabrum*. Up-to-date population size estimates for *A. ferox* are lacking; although the species is considered to be common throughout its national distribution range which is estimated to be around 168 000 km^2. The national population trend is currently unknown, however anecdotal information suggests that there has been an overall increase in the population size with limited local extirpations being reported in communal areas in the Eastern Cape. High number of recruits and improved growth rates have been observed in harvested populations compared to unharvested populations.

The major threats to *A. ferox* include over-utilisation and habitat loss resulting from land use changes; however, both these threats are considered to be limited and reversible. Research suggests that a higher density of *A. ferox* in some parts of the Eastern Cape is attributable to the historical decline of large herbivores such as elephants, rhinoceroses and kudu in the landscape. The return of these herbivores may be creating a demographic bottleneck for *A. ferox*, and observations are already showing that the 0.25 – 1 m height class is absent from grazed populations. There is also evidence of a demographic bottleneck in livestock farms, where the 0.25 – 0.5 m height class is disappearing and it is suspected that this is due to cattle trampling. However, these observations require further investigation. Climate change has been identified as a potential threat to the species as cases of severe frost, drought, higher fire intensities and very high temperatures are often associated with plant mortality, as well as lower seed production and recruitment in affected areas.

Aloe ferox is an economically important plant in South Africa, generating financial benefits for local communities and businesses involved in the collection, processing and sale of natural aloe resources for commercial use in

the pharmaceutical and cosmetic industries. Whilst the trade in live plants is negligible, large volumes of *A. ferox* leaves, derivatives and extracts are exported annually to countries including Germany, the United Kingdom and the United States of America. The majority of the material used in marketable *A. ferox* products is obtained from wild sources; hence the species remains one of South Africa's leading wild-harvested commercially traded plants. It is nevertheless challenging to ascertain the amount of plants being impacted by the trade and further comprehensive analyses of field harvests and trade records are needed.

The industry is slowly adapting to regulations on Bioprospecting Access and Benefit Sharing (BABS), which provides for the fair and legal acquisition and sustainable trade of resources governed by an adaptive management framework through permitting systems. The principal method of monitoring harvest presently is through reported exports and imports of *A. ferox* captured within the CITES Trade Database. The national monitoring of exports of the species (from South Africa) is effectively managed by South Africa's Scientific Authority, although the quality of the data is not as reliable as it should be, owing to errors in reporting. There is currently no field monitoring programme for the species and the direct effects of harvest on wild populations need to be elucidated. The local use of, and trade in, *A. ferox* plants and products within South Africa also remains under-evaluated.

It is difficult to ascertain the scale of illegal harvest but earlier research suggest a high likelihood of an illegal trade in *A. ferox* extracts, almost equivalent in scale to that of the legal trade. Whilst this may be an overestimate and is in need of updating, it is possible that an illegal trade is ongoing due to a lack of proactive management in the aloe industry. Furthermore, differing land tenure systems between the Eastern Cape and Western Cape present contrasting findings regarding illegal off-take of the species. *Aloe ferox* harvesting in the Western Cape is better managed as plants mostly occur on private lands where landowners have control over their properties. There is also evidence that traditional harvesting practices which promote sustainable use and that have been passed down over generations are applied across the province. In communal lands of the Eastern Cape however, there have been some reports of illegal harvesting or poorly monitored unsustainable harvesting. This is in part due to the difficulty in implementing harvest control strategies as natural resources are viewed as public goods within and around these shared areas. Illegal harvesting events are nonetheless currently considered to be insignificant at this time.

Less than 10% of the species population falls within strictly protected areas, however, owing to the abundance of *A. ferox* plants occurring outside of protected areas, there is no harvesting pressure or demand to harvest on protected areas. The majority of harvesting (70%) occurs on private land while 30% occurs on communal or state-owned land. Responsible industry stakeholders ensure that their tappers are trained and practice sustainable harvesting methods across these areas where possible. Many tappers have self-imposed restrictions on their harvests in that they will only harvest a certain number and size of leaves (from mature plants) to ensure maximum product yield as well as sustained plant regeneration potential. It is also a common practise to ensure that harvesting cycles within an area are no shorter than 12 months to allow harvested plants to recover and produce good quality, harvestable leaves once more. It has been established that the primary purpose for harvesting *A. ferox* is to maximise economic value whilst allowing for appropriate regrowth. *Aloe ferox* cultivation occurs mainly in the Western Cape, however, it only accounts for a very limited portion of the production. This shows how important it is to ensure that wild populations are well managed.

There is currently no management plan for *A. ferox* but the Department of Environmental Affairs has recently initiated a process to develop a Biodiversity Management Plan (BMP) for the species, which should further contribute to sustainable harvesting practices and monitoring of the resource base. However, it should be mentioned that in many areas, particularly in the Western Cape, there is informal management in place which has been informed by ancient indigenous harvesting practices. These are based on knowledge that has been passed down over generations without having changed substantially. Communal harvesting remains problematic in the Eastern Cape and as a result, there is an urgent need for effective management plans in this area.

This NDF indicates that the harvest and international trade in *A. ferox* is non-detrimental and poses a low to moderate risk to the population in the wild (Figure 1 and 2). Since the national population trend is largely unknown, especially in relation to harvesting impacts, a scientifically robust resource assessment is required to assess the size of the resource base and to inform a programme for the monitoring of *A. ferox* subpopulations at key sites. This monitoring programme should form part of the BMP that is in the development process. The BMP should also seek to standardize as far as possible management and control measures for the species across both the Eastern and Western Cape Provinces. The management of *A. ferox* in the Eastern Cape in particular, could be improved.

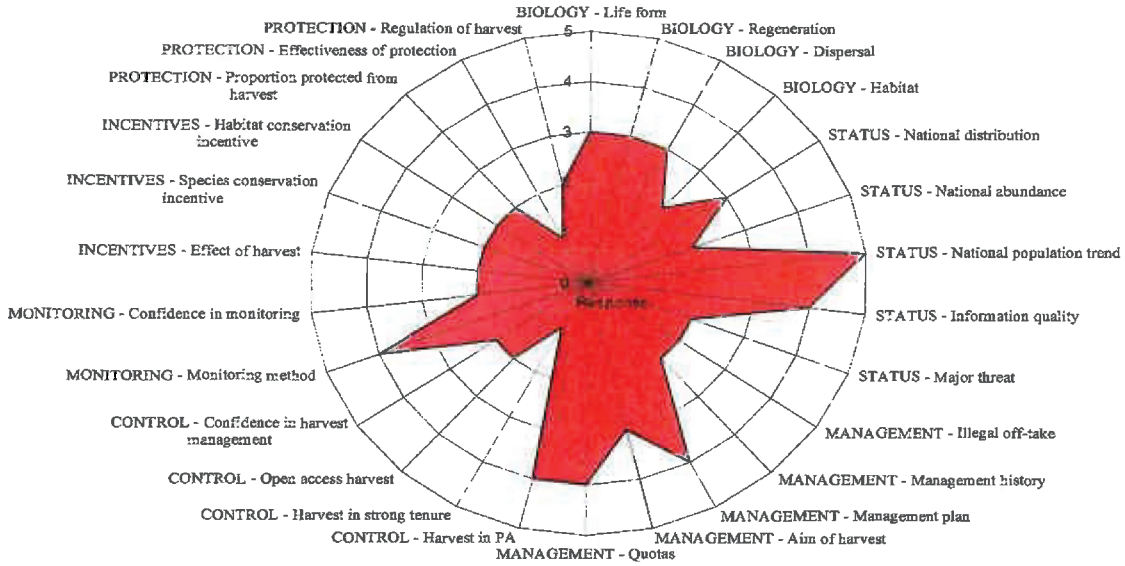

Figure 1: Radar chart summarizing the non-detriment finding assessment for *A. ferox* in accordance with the CITES NDF checklist. Explanations of scores given are detailed in Table 1. Higher scores are indicative of higher risks to the species. The area shaded in the radar chart indicates an overall low to moderate risk to the species.

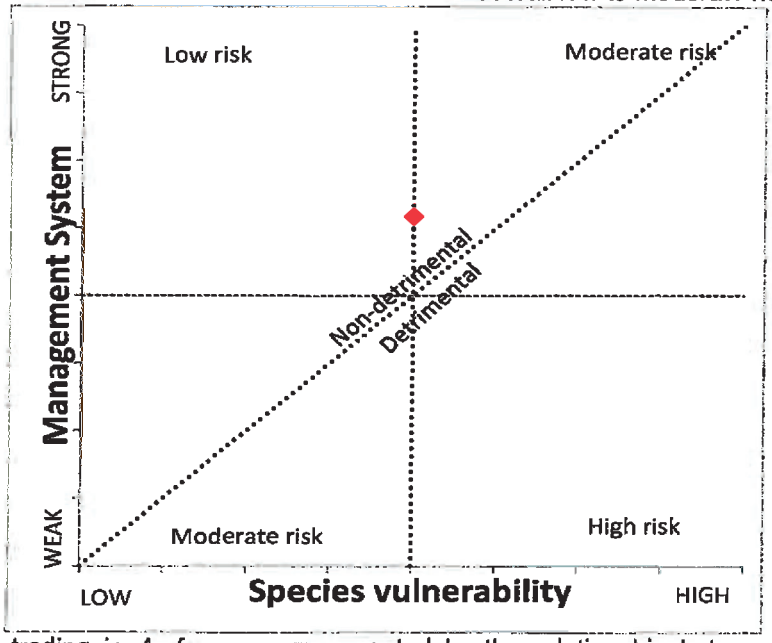

Figure 2: The risk of trading in *A. ferox*, as represented by the relationship between species vulnerability (biology and status) and the management system to which the species is subjected (management, control, monitoring, incentives and protection). The figure shows that the species is currently at a low to moderate risk and trade is non detrimental.

Table 1: Detailed NDF assessment for *Aloe ferox* undertaken in accordance with the CITES NDF checklist. Scores assigned to each question are indicated (bold text and shaded blocks) along with detailed explanations/justifications where relevant. Higher scores are indicative of higher risks.

Biological characteristics		
1. Life form: What is the life form of the species?	Annual	1
	Biennial	2
	Perennials (herbs)	3
	Shrub and small trees (max. 12m.)	4
	Trees	5
Aloe ferox *is a long-lived, single stemmed, succulent plant between 2 to 3 m tall, sometimes reaching heights of up to 6 m (Knapp, 2006; Van Wyk and Smith, 1996). The apex of the main stem is covered in a dense rosette of large, succulent leaves that are dull green to blue-green in colour with reddish teeth along the margins (Reynolds, 1950; Boon, 2010; Van Wyk and Van Wyk, 2013). The plants rarely branch from above the base, with the growing stems characteristically clothed in a persistent skirt of old, dry leaves that insulate the stem against bush fires (Bond, 1983; Van Wyk and Smith, 1996).* *According to harvesters and landowners, the time taken from seed germination to the first harvest of aloe leaves is 3 – 4 years. This is a relatively short period of time indicating that* A. ferox *exhibits fairly fast growth compared to plant species such as* Encephalartos. *There is however a lack of consensus and sufficient empirical information regarding the growth rate of the species. Work done by Holland and Fuggle (1982) indirectly estimated that the age of a mature 5 – 6 m individual is 150 years, i.e. an average annual height increment of 3.3 – 4 cm. Newton and Vaughan (1996) reported that* A. ferox *plants of 4 – 6 years are 1 m tall, thus averaging a 16.7 – 25 cm height increment per annum. Shackleton and Gambiza (2007) estimated an annual height increment of 1.7 – 4.6 cm. These differences could be attributed to site conditions such as differences in climate as well as the physical and chemical properties of the soil. Furthermore, the annual increments do not consider differential growth rates during the life of the plant.*		
2. Regeneration potential: What is the regenerative potential of the species concerned?	Fast vegetatively	1
	Slow vegetatively	2
	Fast from seeds	3
	Slow or irregular from seeds or spores	4
	Uncertain	5
Aloe ferox *flowers from May to August, but at higher altitudes, flowering may be delayed until September (Holland* et al., *1978). The plants produce a single, branched inflorescence with 5 – 12 erect, dense racemes with orange-red flowers. Pollination is facilitated by birds and insects (Hoffman, 1988). Large quantities of broadly winged seeds are produced by individual plants (Holland 1978; Newton and Vaughan 1996).* Aloe ferox *is considered to be relatively easily propagated by seed (Holland* et al., *1977; Bosch, 2006; Bairu* et al., *2009) but can also reproduce vegetatively by means of cuttings, although this rarely happens in the wild and the use of cuttings for cultivation is limited by the single stem characteristic of these plants (DAFF 2015). In the wild, seeds of* A. ferox *typically germinate within three weeks of release, with their viability considerably reduced within a year after dispersal (Cousins and Witkowski, 2012).*		
3. Dispersal efficiency: How efficient is the species' dispersal mechanism?	Very good	1
	Good	2
	Medium	3
	Poor	4
	Uncertain	5
Aloe ferox *seeds are wind-dispersed (Holland, 1978). Dispersal is thought to be limited at a small scale, but is medially efficient at a large scale as is evident in the relatively large distribution range of the species. Dispersal distance is dependent on plant height and wind speed (Stokes and Yeaton 1995). There is little or no empirical evidence on* A. ferox *wind dispersal distance. However, Stokes and Yeaton (1995) suggest*		

that selection for limited seed dispersal occurs in the closely related Aloe candelabrum, *a direct consequence of which the spatial distributions of young populations are usually clumped. These clumps act as nuclei from which new plants spread slowly over time, with mature individuals forming the center of the densest stands (Stokes and Yeaton, 1995). At a wind speed of 20 km/hour, seeds can be dispersed over 30 m from individuals that are 3 m tall. During spring winds (40 km/hour), the dispersal distance may exceed 50 m from plants that are taller than 5 m (Stokes and Yeaton, 1995). The relatively large distribution range of* A. ferox *generally implies that the species has a 'good' or high dispersal efficiency; medium is selected here as a compromise.*

4. Habitat: What is the habitat preference of the species?	Disturbed open	1
	Undisturbed open	2
	Pioneer	3
	Disturbed forest	4
	Climax	5

Aloe ferox *grows under a wide range of climatic conditions in a broad range of habitats, such as fynbos, grassland, Karoo vegetation and valley bushveld, typically on rocky hill slopes or across flat open areas (Newton and Vaughan, 1996; Van Wyk and Van Wyk, 2013; DEA, 2014). It is generally more abundant on arid, rocky hillsides up to 1000 m a.s.l. (Anjarwalla* et al., *2013). The plants are able to grow in a variety of soil types, including sandy, loamy sands and silty loams that are moderately fertile and well drained. The species flourishes in extremely dry areas of the Karoo but also in moister areas in the eastern parts of its distribution (Van Wyk and Smith, 1996). The shallow, adventitious root systems that grow only a few centimeters below the soil surface, as well as the ability to store considerably large amounts of water in the leaves and roots (Holland* et al., *1977) allow these plants to benefit from relatively low amounts of precipitation (DAFF, 2015).*

The species is able to establish healthy populations within disturbed areas quite well. Field observations at a cultivated site in Albertinia established in 2011 suggested substantial recruitment of young plants where livestock had been excluded. Furthermore, observations suggest that A. ferox *are pioneer plants, and that these plants are the first to emerge when livestock are removed from heavily overgrazed land. Raimondo* et al. *(2012) also suggested that* A. ferox *has a weed like ecology and is a pioneer plant due to its ability to thrive in degraded areas.*

National status

5. National distribution: How is the species distributed nationally?	Widespread, contiguous in country	1
	Widespread, fragmented in country	2
	Restricted and fragmented	3
	Localized	4
	Uncertain	5

Aloe ferox *has a restricted distribution within South Africa (Figure 3) extending from the Western Cape Province, intermittently throughout the Eastern Cape, and up into south-eastern Free State (Smith* et al., *2016). The species also occurs in southern Lesotho (Smith* et al., *2016). Previous records of* A. ferox *in the KwaZulu-Natal Province (e.g., Shackleton and Gambiza 2007), have been confirmed to be records of the similar looking* Aloe candelabrum, *a species which was recently resurrected from the synonymy with* Aloe ferox *(Smith* et al., *2016).*

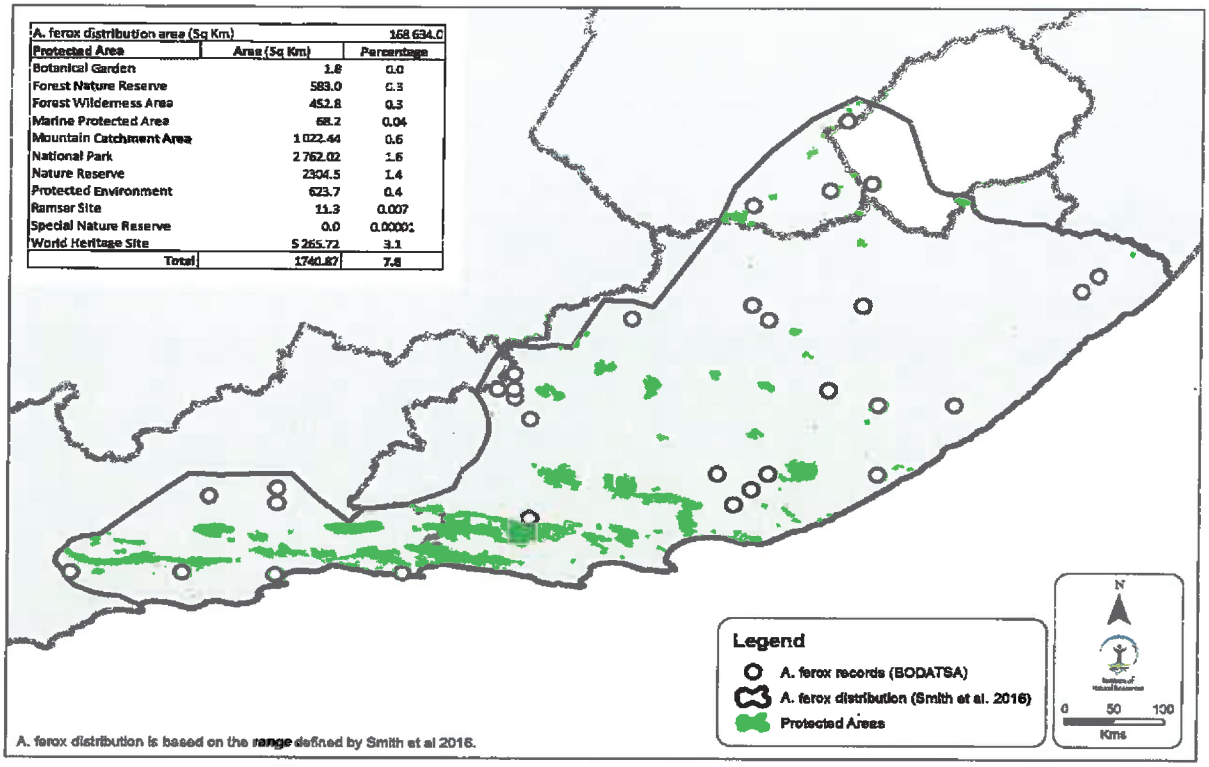

Figure 3: National distribution range of Aloe ferox *(generated using information from the Smith* et al., *2016 distribution map and SANBI BODATSA Data)*

6. National abundance: What is the abundance nationally?	Very abundant	1
	Common	2
	Uncommon	3
	Rare	4
	Uncertain	5

In 2003, Donaldson estimated the population size of A. ferox *to be in excess of 100 000 individuals. Prior to this, Newton and Vaughan (1996) estimated that during the 1990's, 400 tonnes of dried leaf exudate was obtained from the leaves of around 10 million plants, suggesting that the population could be in orders of magnitude greater than that indicated by Donaldson (2003). Parker and Bernard (2008) suggested that the species has become synonymous with the Eastern Cape, having observed large stands of* Aloe ferox *reaching densities of more than 10 plants/km². A more recent study conducted in the province, recorded higher densities of between 4.3 and 7.3 individuals/m² in the communal area near Seymour Town (Melin* et al. *(2017). These numbers however, cannot be extrapolated to the entire range of the species owing to the differences observed in plant numbers within and between subpopulations (DEA, 2014). A resource assessment conducted in 2014 failed to accurately estimate the size of the* A. ferox *population in South Africa (DEA, 2014). Nevertheless, the species is considered to be common throughout its national distribution range which is estimated to be around 168 000km² (Figure 3).*

7. National population trend: What is the recent national population trend?	Increasing	1
	Stable	2
	Reduced, but stable	3
	Reduced and still decreasing	4
	Uncertain	5

Aloe ferox is believed to be an extremely common and abundant species, occurring as large stands in suitable habitat. Due to its weed-like nature and being a pioneer species in disturbed vegetation, its population has been observed to thrive in areas with land degradation. It is therefore speculated that the population size has increased over the past 30 years (Raimondo et al., 2012). Aloe harvesters, industry stakeholders and management authorities in the Eastern Cape and Western Cape however, have differing views regarding the national population trend of the species.

In the Eastern Cape, members of the A. ferox industry believe that the population of A. ferox is increasing while other stakeholders (e.g. conservation officials and community harvesters) argue that the population is in fact decreasing. Some subpopulations have been extirpated in certain communal areas of the Eastern Cape. Aloe harvesters (commonly referred to as tappers, i.e. those who 'tap' the plants) have observed a substantial decrease of the A. ferox population in the shared lands surrounding King Williams Town in particular, whilst members of the A. ferox industry report that stable populations still occur in some formally protected areas (around Grahamstown). Tappers in the communal areas report having to walk long distances (about two hours) to harvest aloes in dense thickets where their safety and security is compromised. Due to the extirpation of accessible populations, tappers have expressed a desire to cultivate A. ferox but lack resources such as nursery infrastructure and land for cultivation. The declines observed in these populations around communal areas have been credited to the activities of untrained harvesters with inadequate knowledge of tapping. An increase in human population densities, coupled with an increase in the rate of unemployment, is likely the main underlying factor behind the influx of opportunistic harvesters and the subsequent pressure on A. ferox populations that occur on communal land.

In the Western Cape, both tappers and landowners are of the view that A. ferox populations are increasing. They have observed a high number of recruits in areas where they harvest and believe that harvested populations have improved growth rates compared to unharvested populations. Harvesting reportedly has no impact on flowering, with observations indicating that the harvested plants flower at the same time and to the same extent as plants that are not harvested. This anecdotal information however contradicts the findings of the 2014 resource assessment, which found that none of the A. ferox plants at harvesting sites in the Eastern Cape were flowering at the time of the assessment during the flowering season (DEA 2014).

8. Quality of information: What type of information is available to describe abundance and trend in the national population?	Quantitative data, recent	1
	Good local knowledge	2
	Quantitative data, outdated	3
	Anecdotal information	4
	None	5

There is a lack of robust data on the population size and trends of the Aloe ferox population. Current information on abundance and trends is largely anecdotal and is considered to be outdated and in need of further verification. The recent resource assessment report for the species (DEA 2014) failed to present accurate, quantitative estimates on the national status of the A. ferox population.

9. Major threats: What major threat is the species facing (underline following: overuse/ habitat loss and alteration/ invasive species/ other) and how severe is it?	None	1
	Limited/Reversible	2
	Substantial	3
	Severe/Irreversible	4
	Uncertain	5

The major threats facing the species are overutilisation and habitat loss, although the extent of these pressures is considered to be limited or reversible.

Tappers from the Eastern Cape believe that the overharvesting of aloe leaves by untrained harvesters, who leave only one to three leaves remaining on a plant, is a major threat to the species. This is a growing risk in some areas of the province as socioeconomic challenges such as poverty and unemployment are encouraging locals to attempt tapping, as they perceive it as a means of safeguarding their livelihood security (e.g. Chen et al., *2012). Many of these new tappers are not trained and tend to neglect issues of sustainability. Whilst Newton and Vaughan (1996) noted low mortality rates associated with heavy leaf harvesting, officials from the Department of Economic Development, Environmental Affairs and Tourism in Eastern Cape (DEDEAT) have observed plants dying due to overharvesting (e.g. Booysen Park) and disease. Localised damage to harvested plants and low flowering occurrences in over-harvested areas in the Eastern Cape were also observed during the 2014 resource assessment (DEA, 2014). The long-term impacts of high levels of harvesting on populations remains unknown (Melin* et al., *2017).*

A higher population density of A. ferox *in other areas of the Eastern Cape has been attributed to a historical decline of large herbivores such as elephants, rhinoceroses and kudu. Livestock farms are increasingly converted to game farms in the Eastern Cape because game farming is viewed as a more lucrative alternative to cattle farming (Smith and Wilson, 2002; Carruthers, 2008). As a result, the return of large herbivores such as kudu (*Tragelaphus strepsiceros*), is causing a demographic bottleneck for* A. ferox, *where the 0.25 – 1 m tall height class is absent from grazed populations, and it is suggested that this may lead to local extirpations of* A. ferox *subpopulations in the next 70 – 100 years (Van As* et al., *2016), except from areas with steep slopes that limit herbivory (Cowling* et al., *2009). In livestock farms on the other hand, a demographic bottleneck is starting to be observed in the 0.25 – 0.5 m height class, but this is suspected to be due to cattle trampling and requires further investigation (Van As* et al., *2016). At Rooderdraay farm in the KwaZulu-Natal Province, Breebaart* et al., *(2002) found that extensive browsing of* A. ferox *by Boer goats was detrimental to the plants. (Since* A. ferox *does not occur in KwaZulu-Natal, it is likely that the study species was in fact* A. candelabrum*).*

Land use change associated with ploughing lands for crops has become a trend in the Western Cape. In addition, the establishment of game farms is also considered a problem in this province as wild animals often eat through the entire leaves of the plants, severely impacting plant growth. Farmed ostriches will eat the highly nutritious seed when there is a drought or grazing shortage, which can negatively affect recruitment.

Recruitment is also affected in areas where aloe is harvested on steeper land, as trampling reportedly removes valuable groundcover that provides protection for young plants through moisture retention and the provision of shade. Loss of groundcover results in bare and hard surfaces, which limits new plant growth and exacerbates erosion by rainfall. Seedlings and younger plants (~10 years old) are furthermore vulnerable to fires (Holland and Fuggle, 1982), as are older plants without a protective skirt of old leaves. Harvested plants may therefore be easily killed by a blaze (Bond, 1983), though high intensity fires can also kill plants with a protective skirt of old leaves. Shackleton and Gambiza (2007) recorded a 32% mortality following an intense fire, on a site with 50 individuals with the protective skirt of leaves intact.

Aloe ferox *is fairly resistant to diseases (Van Jaarsveld, 1996) and insect pests (Newton and Vaughan, 1996; Sachedina and Bodeker, 1999). Climate change has been suggested as a potential threat to the species, with one stakeholder suggesting that a severe frost that killed many aloe plants in higher lying*

areas around Uniondale and Albertinia is evidence of the impact of changing conditions. Landowners in some parts of the Western Cape are observing fewer flowers and seeds being produced (speculated to be due to a drying climate), and consequently less seedlings and juvenile plants. Reduction in recruitment has also been observed in association with veld degradation.

Harvest management		
10. Illegal off-take or trade: How significant is the national problem of illegal or unmanaged off-take or trade?	None	1
	Small	2
	Medium	3
	Large	4
	Uncertain	5

In the Western Cape, Cape Nature seldom receives reports of illegal A. ferox *harvest because most of the harvesting occurs on small areas of private land, and landowners control activities on their properties. Even when some companies bring their own workers in to harvest an area, harvesting is still undertaken with the permission of the landowner. The tappers and landowners in this region confirm that there have never been any incidents of illegal harvesting.*

In the Eastern Cape however, (where harvesting largely occurs on communal land in accordance with an agreement from the Traditional authority), tappers are concerned about illegal activities. Unskilled tappers (who do not obtain permission to harvest) reportedly follow the compliant tappers into the fields and harvest the remaining leaves from already harvested plants in the region. Sometimes plants are left with only 3 – 5 or fewer leaves (DEA, 2014).

It is difficult to ascertain the scale of illegal harvest but an earlier study by Newton and Vaughan (1996) reported a high likelihood of an illegal trade in A. ferox *extracts, almost equivalent in scale to that of the legal trade and involving the harvest of some 7 million plants per year. Whilst this may be an overestimate and is in need of updating, it is possible that an illegal trade is ongoing (Knapp, 2006; Melin et al., 2017) due to a lack of proactive management in the aloe industry (Knapp, 2006). The current illegal off-take and trade is nevertheless considered to be negligible at this time.*

11. Management history: What is the history of harvest?	Managed harvest: ongoing with adaptive framework	1
	Managed harvest: ongoing but informal	2
	Managed harvest: new	3
	Unmanaged harvest: ongoing or new	4
	Uncertain	5

Aloe ferox *is tapped on private and communal land, especially on land closer to roads (Newton and Vaughan, 1996; Melin, 2009). Most* A. ferox *products (95%) are harvested from wild populations, and a smaller percentage (5%) is harvested from cultivated stands. One farmer in the Western Cape indicated that his cultivated* A. ferox *stock accounts for only 2% of his production, with the remaining volumes sourced from the wild. Harvesting knowledge and skills have been passed down over generations as a family custom, and the harvesting practice (commonly referred to as tapping) hasn't changed much over the past two centuries (Newton and Vaughan, 1996).*

In the Western Cape where harvesting occurs predominantly on privately owned land, the harvesters usually pay a fee to the landowners for access to the plants (O'Brien, 2005; Bosch, 2006) and are permitted to harvest no more than 10 – 12 leaves per plant over a six week period with a harvesting cycle of between 18 and 36 months, depending on the plant condition and season (Newton and Vaughan, 1996; DEA, 2014). Harvest control strategies like these are more difficult to implement in the communal lands of the Eastern Cape, because natural resources are viewed as public goods for all to share.

In general, the Western Cape populations are reportedly better managed for sustainable utilisation than the Eastern Cape populations owing largely to the different land tenure arrangements and informal local control

plans among industry members and trained harvesters.

The Aloe ferox *industry is slowly adapting to new utilization regulations such as the Bioprospecting Access and Benefit Sharing (BABS) principles, which provides for the fair and legal acquisition and sustainable trade of resources governed by an adaptive management framework through permitting systems.*

12. Management plan or equivalent: Is there a management plan related to the harvest of the species?	Approved and co-ordinated local and national management plans	1
	Approved national/state/provincial management plan(s)	2
	Approved local management plan	3
	No approved plan: informal unplanned management	4
	Uncertain	5

There is currently no formal management plan in place for the harvesting of A. ferox *but the Department of Environmental Affairs (DEA) is currently in the process of developing a Biodiversity Management Plan for the species.*

In many areas, particularly in the Western Cape, it has been reported that informal unplanned management in the form of indigenous harvesting practices (based on knowledge that has been passed down over generations without having changed substantially) takes place on privately-owned lands.

Before the tappers decide to harvest the following factors are considered:

- *There must be sufficient leaves on the plant.*
- *Only a fraction of the lower leaves can be cut from each plant so that the growth point is not injured, and only the leaves that would die naturally at the end of the season should be taken.*
- *Leaves must be fat / thick. Thin leaves indicate that if harvested, the plant is less likely to survive the dry period. In addition, thin leaves result in lower product yields, which acts as an economic deterrent to harvesting (i.e. low return per unit effort).*
- *In winter rainfall areas, winter is the better season for harvesting (cooler and wetter); harvesting leaves in summer is not favored as cut leaves develop a skin very quickly, which reduces the bitter yield.*

Tappers reported that regular harvesting of leaves keeps the bitters and sap content high. Often tappers will 'bleed' a new aloe of harvestable size in the year prior to first harvest by cutting off one leaf. Individual plants are generally only harvested once every 18 – 24 months to ensure healthy regrowth for future harvest.

Harvesting on communal and state-owned land in the Eastern Cape unfortunately lacks even these controls.

13. Aim of harvest regime in management planning: What is harvest aiming to achieve?	Generate conservation benefit	1
	Population management/control	2
	Maximize economic yield	3
	Opportunistic, unselective harvest, or none	4
	Uncertain	5

Industry stakeholders strongly believe that the species has an important economic value and A. ferox *is harvested with an aim of maximizing economic yield, whilst allowing for appropriate regrowth. Tappers though generally harvest to meet their livelihood needs and are not necessarily profit driven. In cases where prices paid for bitters and aloe leaves were increased, the quantities harvested decreased proportionally as tappers needed to harvest fewer products to meet their livelihood needs. Income generated by harvesting ventures reportedly range between R400 and R1000 per month in the Eastern Cape (Melin, 2009) and was estimated to be R10 000 per annum for a full time tapper (harvesting all year round) in the Western Cape in 1992 (Newton and Vaughan, 1996). Recent figures are not available but the increasing economic value of* A. ferox *most likely ensures that most tappers are incentivised to harvest*

using sustainable practices to secure their livelihoods in the long term. *In communal lands in the Eastern Cape, there are some cases of opportunistic, unselective harvesting occurring that aims to maximize profits without any consideration of sustainability.*		
14. Quotas: Is the harvest based on a system of quotas?	Ongoing national quota: based on biologically derived local quotas	1
	Ongoing quotas: "cautious" national or local	2
	Untried quota: recent and based on biologically derived local quotas	3
	Market-driven quota(s), arbitrary quota(s), or no quotas	4
	Uncertain	5
There is no formal quota system, though traders applying for BABS Certificates are asked to provide voluntary (reasonable) quotas and as such, according to tappers and landowners, BABS indirectly provides a mechanism for a harvesting quota per permit holder.		
Control of harvest		
15. Harvesting in Protected Areas: What percentage of the legal national harvest occurs in State-controlled Protected Areas?	High	1
	Medium	2
	Low	3
	None	4
	Uncertain	5
There is no legal harvest within protected areas.		
16. Harvesting in areas with strong resource tenure or ownership: What percentage of the legal national harvest occurs outside Protected Areas, in areas with strong local control over resource use?	High	1
	Medium	2
	Low	3
	None	4
	Uncertain	5
Most A. ferox *harvesting, approximately 70%, occurs on private land, where tappers obtain permission from the landowner to harvest, and the landowner monitors access and harvest.*		
17. Harvesting in areas with open access: What percentage of the legal national harvest occurs in areas where there is no strong local control, giving *de facto* or actual open access?	None	1
	Low	2
	Medium	3
	High	4
	Uncertain	5
In communal lands, permits are issued to the Traditional authorities who keep a list of the tappers in their areas of jurisdiction. These areas are however generally perceived as open access areas and, even though there might be a process of requesting permission to harvest from the Traditional authority, there remains little to no strong resource control in these communal lands. The Traditional authorities who are responsible for managing A. ferox *on these lands also have no control over the extent to which the resource is utilised and there is no penalty for people who practice unsustainable harvesting in these areas.*		
18. Confidence in harvest management: Do budgetary and other factors allow effective implementation of management plan(s) and harvest controls?	High confidence	1
	Medium confidence	2
	Low confidence	3
	No confidence	4
	Uncertain	5
In communal areas of the Eastern Cape, Traditional authorities are expected to impose strict protection		

measures in their areas of jurisdiction, but they are reportedly failing to do so, owing to the fact that most people are unemployed and depend on aloe tapping for their income. There is therefore no confidence in harvest management in these communal areas, primarily due to a lack of financial capacity and incentive to conduct effective monitoring and control. Conversely, there is a high confidence that A. ferox *harvest is well managed on private land, both in the Eastern Cape and the Western Cape provinces.*

Monitoring of harvest		
19. Methods used to monitor the harvest: What is the principal method used to monitor the effects of the harvest?	Direct population estimates	1
	Quantitative indices	2
	Qualitative indices	3
	National monitoring of exports	4
	No monitoring or uncertain	5

Exports of Aloe ferox *from South Africa (extracted from the CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK) are monitored by South Africa's CITES Scientific Authority. The bulk of harvested* A. ferox *is destined for the export market, with limited secondary or tertiary processing taking place in the country (Newton and Vaughan, 1996; Sachedina and Bodeker, 1999; Merlin, 2009). South Africa remains the principal exporter of valuable aloe bitters (Chen* et al., *2012), which are produced from* A. ferox *leaves collected primarily in the wild. It is difficult to estimate the quantities of plants being harvested for trade, as the species is exported in many forms including derivatives (47%), extracts (26%), powder (13%) and leaves (7%). The export of live* A. ferox *plants is negligible, and accounted for only 3% of the exports between 2004 and 2013. During this 10 year period, Europe was the primary importer of A. ferox (60% of imports), followed by Asia (15%), and North America (10%). The main importers within each region were Germany (21%) in Europe, USA (73%) in North America, Argentina (58%) in South America, Korea (17%) in Asia; Australia (61%) in Oceania and Nigeria (17%) in Africa. There is currently no field monitoring programme for the species and the direct effects of harvest on wild populations need to be elucidated. The local use of, and trade in,* Aloe ferox *plants and products within South Africa also remains under-evaluated.*

20. Confidence in harvest monitoring: Do budgetary and other factors allow effective harvest monitoring?	High confidence	1
	Medium confidence	2
	Low confidence	3
	No confidence	4
	Uncertain	5

Trade data are regularly extracted from the CITES Trade Database (UNEP World Conservation Monitoring Centre, Cambridge, UK) and analysed. However, data quality was flagged as an issue due to reporting errors. It is also difficult to quantify the number of wild plants impacted from the variety of products exported.

Incentives and benefits from harvesting		
21. Utilization compared to other threats: What is the effect of the harvest when taken together with the major threat that has been identified for this species?	Beneficial	1
	Neutral	2
	Harmful	3
	Highly negative	4
	Uncertain	5

Tappers reported that harvesting has a beneficial effect on aloe as it promotes new growth. Industry stakeholders suggest that A. ferox *plants are increasingly recognized as an economically valuable wild resource, and landowners are therefore making concerted efforts to conserve the species. It should be noted though that this information is largely anecdotal. It is also important to note that illegal harvesting in communal lands, especially by untrained tappers who harvest large amounts of leaves, remains a real threat to the species.*

22. Incentives for species conservation: At the national level, how much conservation benefit to this species accrues from harvesting?	High	1
	Medium	2
	Low	3
	None	4
	Uncertain	5

Aloe ferox *is favored for its therapeutic uses, both locally and internationally (Newton and Vaughan, 1996; Grace* et al., *2008; DAFF, 2015). Owing to the high commercial value of* the *species and its derivatives, the industry is taking measures to implement sustainable harvesting practices that contribute to the conservation of the species. Tappers in the Western Cape implement correct tapping and harvesting practices that have been shared within families over many generations, and which ensure the selection of appropriate plants at each harvest.*

In the Eastern Cape, a joint venture between industry and tappers, known as the Ikhala Agricultural Co–operative (the species is called Ikhala in Xhosa), has been generating incentives for the conservation of the species by involving harvesters and locals in business opportunities and providing them with access to a consistent market (Burgess, 2007). Trained harvesters participate in the collection and pre-processing of raw materials for local and international markets, whilst some locals are provided with the opportunity to make profits from the sales of finished products within and around their communities. Harvesters and locals are thus aware and protective of the benefits they derive from nature.

23. Incentives for habitat conservation: At the national level, how much habitat conservation benefit is derived from harvesting?	High	1
	Medium	2
	Low	3
	None	4
	Uncertain	5

Due to the commercial value of A. ferox, *there is a high incentive for habitat conservation; landowners are thus encouraged to conserve the habitat to maximize sustainable harvest. Field visits also suggested that abandoned croplands are starting to be reestablished with* A. ferox *plants. There is however a lack of incentives for habitat conservation in communal land.*

Protection from harvest		
24. Proportion strictly protected: What percentage of the species' natural range or population is legally excluded from harvest?	>15%	1
	5-15%	**2**
	<5%	3
	None	4
	Uncertain	5
It is estimated that 7.8 % of the distribution of A. ferox *occurs within protected areas (see Figure 3). Legal harvest is excluded from these protected areas.*		
25. Effectiveness of strict protection measures: Do budgetary and other factors give confidence in the effectiveness of measures taken to afford strict protection?	**High confidence**	**1**
	Medium confidence	2
	Low confidence	3
	No confidence	4
	Uncertain	5
There have been no reports of illegal harvesting of A. ferox *from protected areas in either the Eastern or Western Cape.*		
26. Regulation of harvest effort: How effective are any restrictions on harvesting (such as age or size, season or equipment) for preventing overuse?	Very effective	1
	Effective	**2**
	Ineffective	3
	None	4
	Uncertain	5
In the Eastern Cape, the majority of the tappers are informally trained by traders and processers of A. ferox *and they are also provided with illustrated training manuals in order to further facilitate the sustainable harvesting of the species. There is an issue of untrained harvesters in some communal areas, but permitted tappers who form part of the Ikhala Agricultural Co–operative in the province have been well trained and equipped with training manuals published by the International Trade Centre (Domeisen* et al., *2006; Melin* et al., *2017). The manual recommends that only larger plants (>0.5 m) should be harvested and approximately 16 – 20 leaves should be left on individual plants. This is consistent with recommendations by Shackleton and Gambiza (2007), suggesting that young non-reproductive plants (< 0.5m) and taller plants (>2.5 m) that are difficult to harvest by hand should be excluded from harvest.* *In the Western Cape where the bulk of the tapping occurs on privately-owned land, landowners strictly control the access to, and harvesting of plants on their properties. Many tappers in the province also implement self-imposed restrictions on their harvests in that they will only harvest leaves that are of sufficient length and thickness because yields of bitters decrease dramatically in smaller, developing leaves. Other factors that limit overuse include limited road infrastructure for transporting harvested material, inaccessible and steep areas, as well as the distance to processing facilities (the approximate economic radius for collecting leaves is 30 km).* Aloe ferox *can generally not be harvested in the dry season as sap yields are much lower (Adams, 2014).* *The industry is also required to comply with the South African National Standards (SANS) 368 standard for* A. ferox, *developed by the South African Bureau of Standards (SABS), that outlines when and how the plants can and should be harvested based on historical harvesting methods used by previous generations of tappers.*		

List of participants:

1. Michele Pfab (SANBI)
2. Prof Neil Crouch (SANBI)
3. Jon McCosh
4. Lutendo Mugwedi
5. Thabo Gwiji (DEDEAT)
6. Neil Crouch
7. Ricky Hannan (DEDEAT)
8. Noluthando Bam (DEDEAT)
9. Luzuko Dali (DEDEAT)
10. Sam Coetzee (Industry)
11. Tertus Cloete (Aloe Exports)
12. Carlo van Tonder (Cape Nature)
13. Gert Schoonbee (Schibuna Aloe)
14. Phoebe Schoonbee (Schibuna Aloe)
15. Mark Kilbridz (Meihuizen International)
16. K Paulsen (K P Botanicals)
17. Roy Gower (Gower Enterprices)
18. Prince Ramafalo (DEA)
19. Mncedisi Cindi (DEA)
20. Mpho Tjiane (DEA)
21. Chris Pattinson (Organic Aloe)
22. Johan Canstenson
23. Ken Dodds (KAloes)
24. Sibusiso Ngubane (Cape Nature)
25. Micheal Hanson (Cape Nature)
26. Ben-Erik Van Wyk (Aloe Council-University of Johannesburg)
27. Henriette du Plessis (African Aloe)

Tappers meeting in Eastern Cape, Alice

28. N. Peter
29. Lindiwe Sigoyo
30. W.S. Zongethwa
31. B. Maki
32. M.J. Mathiso
33. D.A. Blom
34. R.S. Teyise
35. N.Z. Tokoyi
36. N. SikadeN. Kayiyaha
37. N. Matahila
38. M. Njanya
39. V.H. Sentha
40. F. Mani
41. A.M. Mananga
42. B. Kilani
43. B.N. Manzi
44. V.D Kanela
45. Bukelwa Joni
46. Busiwe Ntuli
47. Mphakamiseni koli
48. N.E. Lukwe
49. N. Nqina

50. N. Tyutyani
51. N.E. Petse

Tappers meeting in Western Cape, Albertina

52. Dorina
53. Maria Barels
54. Jacob Cupido
55. Shaun Kiewiet
56. Shantel Kiewiet
57. Irish Groenewald
58. Marry Muller
59. Elsie Helinis
60. Niek Cronje
61. J.C. Cronje
62. TLJ Kemp
63. Tania Lann
64. P.Du Plessis
65. S Aspinall

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