

Non-detriment finding assessment for *Euphorbia bupleurifolia*

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Summary of findings

Euphorbia bupleurifolia 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 for *Euphorbia bupleurifolia* and is based on the best available information, current as of January 2022.

Euphorbia bupleurifolia is an attractive dwarf succulent species comprising of a usually unbranched, short sub-cylindrical tuberculate stem and a crown of delicate long leaves that are replaced by floral structures during the dry season. The species is known to be dioecious but plants of *E. bupleurifolia* may occasionally change sex and have even been observed to bear bisexual flowers at times. *Euphorbia bupleurifolia* is extremely slow growing and long lived. The species regenerates from seed produced by reproductive individuals between winter and early summer. *Euphorbia* plants produce up to three seeds per fruit capsule and the ballistic mode of dispersal is generally limited to short distances. Seedling growth in *E. bupleurifolia* is rapid during the initial years of development and slows down significantly as the plant ages. The absolute annual growth rate of plants in cultivation is 0.55 cm² per year in canopy area. Recent field surveys found variable regeneration potential across the known subpopulations, with the percentage of flowering individuals across nine surveyed sites ranging from 5% to 85%, and flowering observed in only 27% of all individuals assessed. Subpopulations are generally dominated by medium-to-large adults, and seedlings/juveniles are scarce (observed in just three of nine surveyed subpopulations at low numbers (<4%)), indicating that regeneration by seedling recruitment is slow.

The distribution of *E. bupleurifolia* is fragmented across a wide area between Makhanda (Grahamstown) in the Eastern Cape Province and Pietermaritzburg in the KwaZulu-Natal Province. *Euphorbia bupleurifolia* occurs largely in grasslands where areas with low vegetation biomass dominated by bare ground cover were found to be most suitable for this species; these are likely to be sites that are regularly disturbed by fires. A total of 1 724 plants were counted in the field during surveys conducted in 2018 across 31 historical sites. Extant subpopulations were found in just 30% of these sites comprising of between one and 675 individual plants, with the more centrally placed subpopulations having a higher number of individuals compared to those positioned on the periphery of the distribution range.

The conservation status of *E. bupleurifolia* has been upgraded from Least Concern to Critically Endangered A2acd+4acd (in line with the IUCN's (International Union for Conservation of Nature) Red List Categories and Criteria), due to the drastic decline experienced by the species within the last two

decades, particularly within the province of KwaZulu-Natal where only two extant populations are thought to persist. Although anecdotal information suggests that the species is more common in the Eastern Cape than the 2018 field surveys showed, its population size and distribution has been severely reduced by human activities and the species can no longer be considered widespread and abundant.

Continued unsustainable harvesting of the species to supply a local traditional demand and the international horticultural trade, in addition to ongoing habitat loss and degradation threatens the species persistence. The species is projected to have lost a large percentage of its habitat particularly in the KwaZulu-Natal province where expansion of agricultural fields as well as coastal development have been extensive. Ongoing disturbance factors with the potential to further impact subpopulations of the species and its habitat negatively include trampling, grazing, illegal dumping, vehicle damage and fires. Evidence of plant collection was also noted in several of the surveyed subpopulations. International trade in the species is extremely high, with over 73 500 plants having been exported from the country since 1980. Whilst the majority of the specimens exported have been reported as artificially propagated, investigations have revealed evidence of previous and continued large scale removals and laundering of wild plants into the legal trade. Some 8 500 suspected wild collected specimens were observed in local nurseries in 2018 and at least 3 500 wild plants were seized from the largest exporting facility in 2019. In addition to collection for the international market, the species is traded locally for traditional medicine purposes. All materials for this local trade are wild sourced and approximately 1 721 individuals were reportedly harvested in 2018 alone. Due to ease of access, many subpopulations stand at an increased risk from illegal collection and more populations of this species are expected to be lost in the near future under the pressure of all compounding threats.

Data for exports of *E. bupleurifolia* from South Africa are monitored on a regular basis, although the quality of the data is not as good as it should be owing to errors in reporting. South Africa is the primary exporter of *E. bupleurifolia* plants responsible for approximately 76% of all global exports. There are five local nurseries known to be involved in the cultivation and trade of *E. bupleurifolia*, and although four of the five facilities were found during a recent audit to be compliant with the CITES definition of “under controlled conditions”, none of the nurseries were able to produce clearly marked, legally acquired parental stock. Furthermore, most of the plants currently in cultivation within the nurseries show strong signs of being wild collected. Responsible conservation authorities in the Eastern Cape and KwaZulu-Natal do not have sufficient nor adequate staff capacity or the required budget and mechanisms to monitor these nurseries and detect any illegal activities involving the plants. There is no field monitoring programme for the species.

The species is not adequately protected, with less than 5% of the national population located within formally protected areas. Furthermore, the management of these protected areas does not favour the species and the subpopulations are very small, with two reserves having less than 30 plants each and the subpopulation in the third reserve functionally extinct with just one plant observed. *Euphorbia bupleurifolia* is listed as a protected species in the conservation legislation of both the Eastern Cape and KwaZulu-Natal provinces, though this legislation is outdated, providing limited/weak effective protection to the species at present. Revised national and provincial regulations that would strengthen harvest management controls and improve the protection of the species have been delayed in implementation for several years owing to onerous government and public consultation processes. There is low confidence in the protection afforded to the species at present. Harvest of the species is allowed under

permit in the Eastern Cape, though in some areas of the province only written landowner permission is needed. Regulation of harvest in KwaZulu-Natal is weaker, with no restrictions on harvest across lands that are not privately owned and only landowner permission required for harvest outside of private and state protected areas. There is no management plan for the species and resource limitations within both provincial conservation organisations hinders the implementation of the existing harvest controls. There is no quota system for harvesting *E. bupleurifolia* from the wild and neither Ezemvelo KZN Wildlife nor the Eastern Cape Department of Economic Development, Environment Affairs and Tourism (DEDEAT) have issued any permits for the wild collection of *E. bupleurifolia* from anywhere across the species range. It is unknown whether legal harvest of *E. bupleurifolia* occurs on private land and there is no confidence in landowner permission as a control mechanism. All offtake at present is therefore unregulated, unmanaged or illegal with no oversight, and the harvest is taken in a purely opportunistic manner that is unsustainable. As such, no conservation benefit to this species or its habitat can accrue from wild harvesting.

Trade in *E. bupleurifolia* is detrimental to the survival of the species in the wild (Fig. 1 & 2). The species' biology, which is characterized by a poor dispersal ability and slow growing long-lived adults that regenerate predominantly from seed, renders *E. bupleurifolia* particularly vulnerable to overutilization. Demand for the species both locally and internationally appears to have increased over the years and has apparently been/is apparently being met largely by plants collected from the wild. There is also strong evidence to suggest that there has been large scale laundering of wild specimens through exporting nurseries. If any trade is to be considered in the future, it should be restricted to strictly artificially propagated specimens (consistent with the requirements of CITES Resolution Conf. 11.11 (Rev. CoP18)), and it should be linked to a restoration programme for the species. Significant improvements to management, control, monitoring, and protection measures are essential to support a sustainable trade in the species.

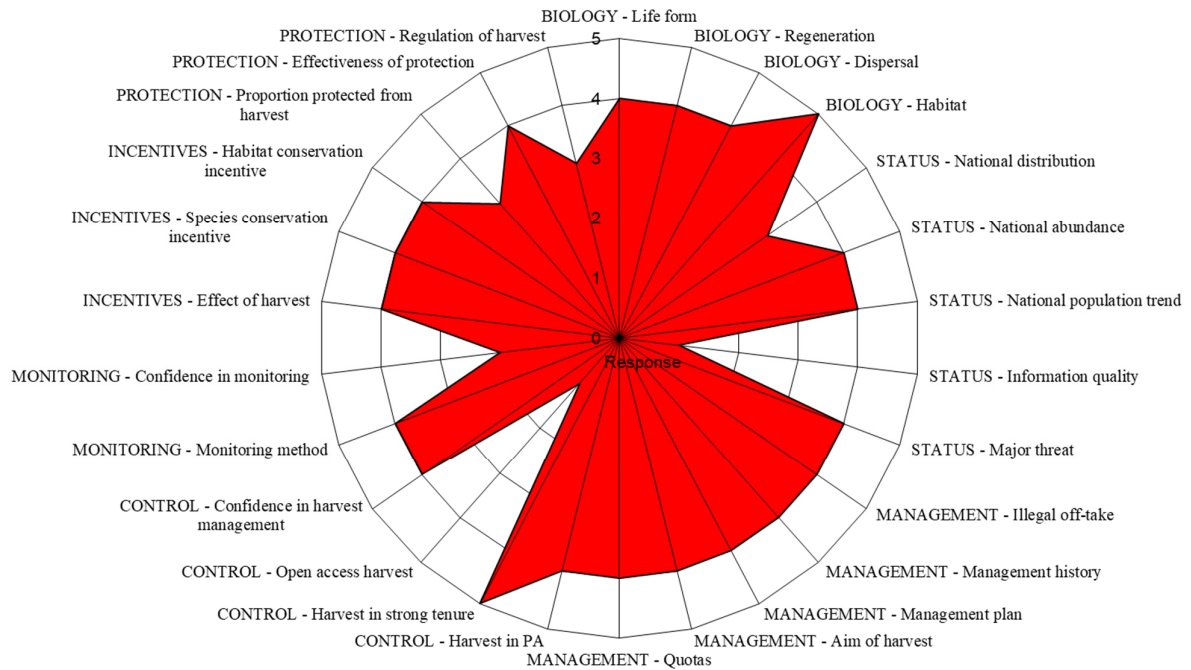


Figure 1: Radar chart summarizing the non-detriment finding assessment undertaken for *Euphorbia bupleurifolia* in accordance with the CITES NDF checklist. Explanations of scores given are detailed in Table 1. Higher scores are indicative of higher risks to the species. The shaded area in the radar chart demonstrates a high risk to the species.

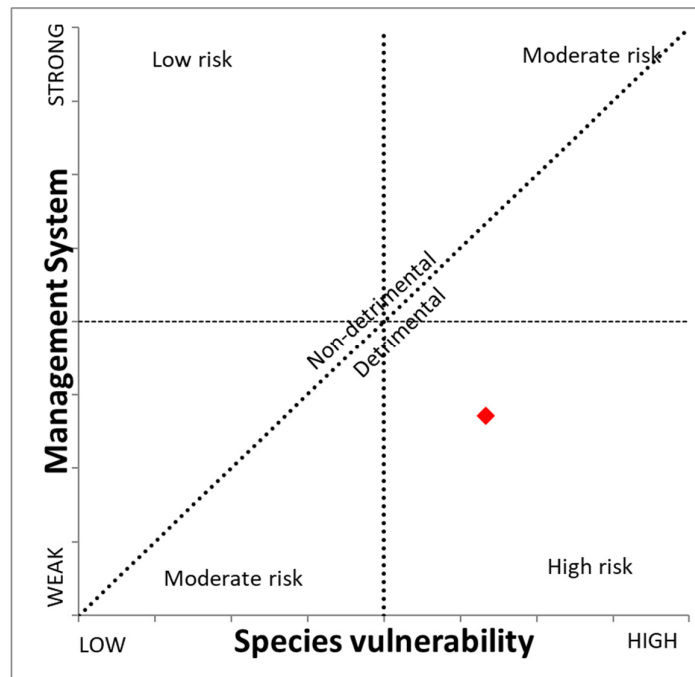


Figure 2: The risk of trading in *Euphorbia bupleurifolia* as represented by the relationship between species vulnerability (biology and status) and the strength of the management system to which the species is subjected (management, control, monitoring, incentives and protection). The figure shows that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

Table 1: Detailed NDF assessment for *Euphorbia bupleurifolia* 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 to the species.

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
<i>Euphorbia bupleurifolia</i>, known commonly as the cycad spurge, is an attractive, dwarf succulent plant comprised of a sub-cylindrical, geometrically pleasing, tuberculate stem (Fig. 3). The stem is sometimes branched, usually between 40 – 70 mm thick and growing up to 200 mm above the ground (Court, 1981; White <i>et al.</i>, 1941; Manning, 2001). The leaves of the plant are conspicuous, broad and oblanceolate produced in a tuft at the tip of the growing stem during the rainy season in spring. During the dry season, the leaves fall off and are replaced by flowers. The inflorescence consists of several solitary cyathia, which are cupped by two bracts each, at the crown of the plant arising on 10 – 50 mm long peduncles (Court, 1981; White <i>et al.</i>, 1941). In warmer weather, adult plants may be pulled underground with the stems becoming deeply submerged and just the leaves and flowering parts visible above the soil surface (Mhlongo, 2020). <i>Euphorbia bupleurifolia</i> is long-lived and extremely slow growing with growth becoming more staggered as the plant ages (Schwartz and LaFon, 1984). The absolute annual growth rate of cultivated plants (up to 11-14 years of age) was calculated to be 0.55 cm² per year using canopy area as a measure of plant size, or 1.7 cm³ annually using canopy volume (Mhlongo, 2020). True flower formation at which point plants are deemed to be sexually mature, is estimated to start in plants with a minimum canopy area of 2.63 cm² (under nursery conditions), corresponding to a canopy volume of 2.40 cm³ and a plant height of 1.37 cm (Mhlongo, 2020). These figures are likely to differ under field conditions.		
		
Figure 3: <i>Euphorbia bupleurifolia</i> plants pictured in habitat. Photo by Neil Crouch		
	Fast vegetatively	1

2. Regeneration potential: What is the regenerative potential of the species concerned?	Slow vegetatively	2
	Fast from seeds	3
	Slow or irregular from seeds or spores	4
	Uncertain	5
<i>Euphorbia bupleurifolia</i> reproduces sexually by means of seed produced by reproductive individuals in summer. The species typically has male and female flowers produced on separate plants (Adler <i>et al.</i>, 1983) but individuals of <i>E. bupleurifolia</i> may occasionally change sex; bearing male cyathia in one year, female cyathia in the next, and even bisexual flowers in other years (Schwartz and LaFon, 1984; Court, 2000). Flowering begins in midwinter through to late spring / early summer. Initial field studies suggest that flowering in <i>E. bupleurifolia</i> might be fire induced, although this requires further investigation (Mhlongo, 2020). Seed capsules of <i>Euphorbia</i> species are trilocular, carrying up to three seeds each. The seeds are forcefully ejected by explosive dehiscence of the capsules. Recruitment is episodic, and no succulent <i>Euphorbia</i> species are known to maintain persistent seed banks (Milton <i>et al.</i>, 1999). Seedling development is rapid during the initial years of growth and significantly slows down as the plant ages (A. Hankey- Specialist Horticulturalist, pers. comm.). The current <i>E. bupleurifolia</i> population shows variable regeneration potential with the percentage of flowering individuals across nine surveyed subpopulations ranging from 5% to 85% and flowering observed in 27% of all individuals assessed (n= 1724; Mhlongo, 2020). Subpopulations of the species are generally dominated by medium-to-large adults, and seedlings/juveniles are scarce (observed in low numbers (<4%) in just three of the subpopulations), indicating that regeneration by seedling recruitment is slow (Mhlongo, 2020). There is a significantly positive relationship between the number of inflorescences produced and the canopy area of flowering individuals, with larger plants generally bearing more cyathia at a time (Mhlongo, 2020).		
3. Dispersal efficiency: How efficient is the species' dispersal mechanism?	Very good	1
	Good	2
	Medium	3
	Poor	4
	Uncertain	5
Seeds of <i>Euphorbia</i> species are dispersed primarily through the mechanism of ballistic dispersal, which is generally limited to within a few meters (typically <10m) around the mother plant (Stamp and Lucas, 1990; Narbona <i>et al.</i>, 2005; Tamme <i>et al.</i>, 2014). Secondary dispersal by ants (i.e. myrmecochory) has not been assessed for the species, although this process has been discounted for several closely related <i>Euphorbia</i> species due to the absence of elaiosomes (i.e. nutrient rich seed coat) on emergent seeds (Jabar, 2019). The patchy and clumped nature of plants observed in habitat, supports the idea of limited seed dispersal for this species (Mhlongo, 2020).		
4. Habitat: What is the habitat preference of the species?	Disturbed open	1
	Undisturbed open	2
	Pioneer	3
	Disturbed forest	4
	Climax	5
<i>Euphorbia bupleurifolia</i> is primarily a grassland species growing in areas with shallow, sandy soils and a thin grass cover within a range of vegetation types (Manning, 2001; Scott-Shaw, 1999; Mhlongo, 2020). Populations occur at altitudes ranging between 41 – 1 049 meters above sea level, usually on hills with varying degrees of steepness (between 2.4 and 12.4 degrees). <i>Euphorbia bupleurifolia</i> plants appear to have an affinity to microhabitat environments with high amounts of bare ground cover and lower levels of vegetation biomass where there is very little shade (Mhlongo, 2020). Rock cover also does not appear to be a dominant feature in areas where the plants grow (Mhlongo, 2020). These preferences mean that the		

species does not occur continuously across the landscape and is instead confined to pockets of suitable areas across its range of occurrence. Field studies also show that *E. bupleurifolia* is likely to be fire tolerant with a possible significant association between fire and the onset of flowering (Mhlongo, 2020). Incidences of fire are however thought to be favorable only at low intensity and when occurring outside of the actual flowering season.

Eleven different vegetation types were identified across the historical range of the species including; Bisho Thornveld (Least Threatened), Suurberg Quartzite Fynbos (Least Threatened), Buffels Thicket (Vulnerable), Albany Coastal Belt (Least Threatened), Amathole Montane Grassland (Least Threatened), Queenstown Thornveld (Least Threatened), Eastern Valley Bushveld (Least Threatened), East Griqualand Grassland (Vulnerable), Pondoland-Ugu Sandstone Coastal Sourveld (Critically Endangered), KwaZulu-Natal Coastal Belt Grassland (Critically Endangered), KwaZulu-Natal Sandstone Sourveld (Critically Endangered), Ngongoni Veld (Vulnerable), Midlands Mistbelt Grassland (Endangered) (Mucina and Rutherford, 2006; Jewitt, 2018). The majority of these vegetation types are sensitive to change and many have undergone high percentage losses, particularly the grassland ecosystems in KwaZulu-Natal that have been completely lost to development or modified and degraded by agricultural practices. Whilst it is possible to re-vegetate damaged grasslands (dependent on the extent of damage – and usually only at a small spatial scale and if the grassland still retains at least some obvious elements of health (e.g. intact topsoil and a percentage of remaining natural vegetation)), it is very difficult if not impossible to restore them fully to their former state (SANBI, 2013). If managed correctly (with intensive and expensive interventions), basal cover and some grassland ecosystem processes may be restored within five to ten years through the process of succession, but the original species composition will not recover naturally – even over a long period (20-100 years) – because the long-lived, slow-growing species are very slow to colonise a denuded area (SANBI, 2013). Changes in species composition and structure resulting from poor rangeland management are generally reversible in the short to mid-term (5-20 years), however the removal of the primary vegetation cover, such as by ploughing, is often irreversible (SANBI, 2013).

Suitable habitat across the Eastern Cape is a mix of Bushveld, Thornveld, Thicket, Grassland and grassy Fynbos. Recovery rates for disturbed areas within these vegetation types range from upwards of a year for grassy fynbos (under favourable conditions, Richardson *et al.*, 1984); and up to more than 50 years in thicket areas (Mills *et al.*, 2009). Nevertheless, given the species preference for certain micro-habitats within these vegetation types, where possible, recovery of suitable conditions and restoration of populations would in all likelihood be very long-term.

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

Euphorbia bupleurifolia is endemic to the Eastern Cape and KwaZulu-Natal provinces of South Africa. The species historical range is reported to have stretched from the inland areas around Pietermaritzburg, down along the coast towards Port Edward in KwaZulu-Natal, and then further west throughout the eastern region of the Eastern Cape up to Makhanda (commonly known as Grahamstown). Of 31 known localities surveyed across the historical range of the species in 2018, plants could only be located at nine sites (Mhlongo, 2020). The species is thought to occur in several additional localities but its distribution can no longer be considered as widespread, with the majority of the remaining populations now restricted to the Eastern Cape (Mhlongo, 2020; Fig. 4).

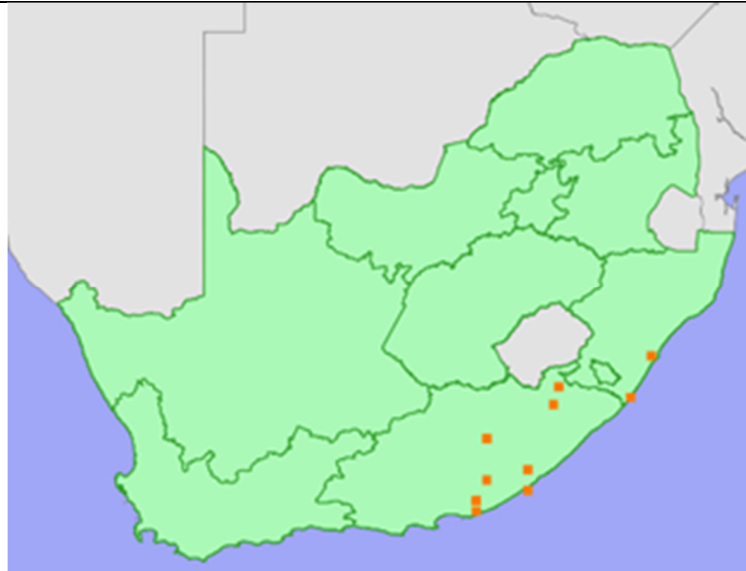


Figure 4: Approximate distribution of several *Euphorbia bupleurifolia* populations within the KwaZulu-Natal and Eastern Cape Provinces of South Africa

Distances between the nearest neighbouring subpopulations is 8 km with the majority of the subpopulations occurring in different towns. Area of occupancy (AOO) for the nine surveyed *E. bupleurifolia* subpopulations is estimated to be 36 km² with an extent of occurrence (EOO) of around 22 205 km² (Mhlongo, 2020).

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

A total of just 1 724 plants were counted during recent systematic field surveys conducted over 31 known historical localities across the species distribution in 2018 (Mhlongo, 2020). There is anecdotal information to suggest that the plants are more common than currently assessed during these surveys, with several additional subpopulation localities (mostly around the Makhanda region) recently identified within the Eastern Cape Province (C. Swart- Biodiversity Officer, DEDEAT, pers. comm.; T. Dold, pers. obs.). An additional extant subpopulation within the KwaZulu-Natal Province was also not assessed owing to time and budgetary constraints. Nevertheless, plants were only found in nine of the 31 known localities surveyed, with subpopulations varying in size from one plant to 675 individuals (Mhlongo, 2020). Six of the subpopulations comprised less than 100 plants each, with the most central populations having a substantially larger number of individuals compared to the peripheral northerly populations and the westernmost populations (Mhlongo, 2020). Just two of the surveyed subpopulations comprised more than 500 plants each. Failure to locate plants in some areas could be attributed to (1) very dated herbarium records which contained vague locality descriptions often listing just the district or town name, (2) the cryptic nature of this dwarf succulent, especially when not in flower, (3) high vegetation biomass which resulted in poor detectability of the plants, (4) habitat loss through transformation and degradation and, (5) the drastic decline in populations due to unsustainable harvesting for both the local medicinal trade and the international horticultural market (Mhlongo, 2020). Some 8 500 suspected wild collected specimens were observed in local nurseries in 2018 whilst an additional 1 700 wild plants were estimated to be harvested for local use in the same year (Mhlongo, 2020). An additional 28 000 plants had been exported between 2010 and 2018 by a nursery known to be involved in the laundering of illegally harvested wild succulent plants, including thousands of *E. bupleurifolia* (L. Jabar- Analyst: Biodiversity Enforcement, Department of Forestry Fisheries and the Environment, pers. comm.). The current known population (based on the best available information) is estimated to comprise

less than 2 500 mature individuals, and whilst this figure is likely an underestimate of the national abundance, this formerly widespread and common species (in habitat) has undoubtedly suffered a significant loss in the number and size of populations owing to ongoing removals and habitat loss across its distribution range.

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

Less than 30% of the historical localities recorded for *E. bupleurifolia* were found to have plants during the most recent field surveys conducted for this species, providing evidence that this species has undergone a drastic decline, particularly within KwaZulu-Natal where only two extant populations are thought to persist (Mhlongo, 2020). Furthermore, 67% of the known remaining subpopulations are very small, comprising less than 100 individuals each. There is currently no known monitoring data available for *E. bupleurifolia*, which makes it difficult to quantify with certainty the decline that this species has undergone, as well as to correctly identify the causes for these population declines. Nevertheless, several subpopulations are thought to have suffered regional extinction as a result of habitat loss through transformation and degradation, as well as a drastic decline in numbers due to unsustainable harvesting – as is evidenced in the population structure of certain subpopulations with irregular size class distributions or absent size classes. Huge quantities of wild plants have been observed in local exporting nurseries whilst large-scale harvesting for local (traditional) use also continues to take place (Mhlongo, 2020). At present, anthropogenic disturbances such as trampling, rubbish dumping, as well as sustained unregulated harvesting, for both local and international trade, threaten the persistence of the surviving wild *E. bupleurifolia* populations. Less than 5% of the remaining subpopulations fall within some type of protected area and more subpopulations of this species are expected to be lost in the future.

Euphorbia bupleurifolia is listed as Critically Endangered on the Red List of South African plants, owing to a notable population size reduction (~98% over 3 generations) brought on by real levels of exploitation as well as a decline in the species area of occupancy, extent of occurrence and habitat quality over the years (Mhlongo and Pfab, 2022).

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

A detailed study on the ecology and sustainable use of the species was undertaken, and provides recent, quantitative data on the distribution, abundance and structure of the *E. bupleurifolia* population (Mhlongo, 2020).

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 greatest direct threat to the persistence of *E. bupleurifolia* at present is the concomitant impact of continued illegal harvesting of the species to supply trade, and ongoing habitat loss and degradation. Scott-Shaw (1999) stated that *E. bupleurifolia* populations were subjected to habitat loss as a result of expanding agriculture in the KwaZulu-Natal province. Areas such as Uvongo (KwaZulu-Natal) where this species once

occurred have undergone significant transformation in the past few decades. In the coastal areas of KwaZulu-Natal, the habitat of *E. flanaganii*, a close relative to *E. bupleurifolia*, has been severely impacted by development (Williams *et al.*, 2014); this might also be true for *E. bupleurifolia*. Several of the species' preferred vegetation types falls within the Indian Ocean Coastal Belt biome which has experienced an estimated 0.610% per year loss of natural habitat (between 1990 and 2014; Skowno *et al.*, 2019).

Habitat degradation and disturbance is a growing threat to populations surveyed across the Eastern Cape, particularly those in easily accessible areas. Trampling (by both humans and cattle) was noted in all but one of the surveyed subpopulations with between 50 and 75 plants affected in one subpopulation found growing close to a road. Other disturbances observed included illegal dumping (in four subpopulations), grazing (in one subpopulation), vehicle damage (in one subpopulation) and recreational activities including quad-biking, group training activities and cycling (in three subpopulations) – affecting between 1 and 50 individuals each (Mhlongo, 2020). The damage to plants and habitat from these disturbances are postulated to have negative implications for the reproductive output and recruitment of the species (Mhlongo, 2020). Fire disturbance was also noted across five of the subpopulations, but no fire related mortality was observed in any of the *E. bupleurifolia* plants assessed. The species appears to be fire tolerant but fire damage in areas with excessive vegetation biomass can be high and this can be a particularly large problem for populations in protected areas from which fire is actively excluded (Mhlongo, 2020). Majority of the species' habitat remains poorly protected and/or poorly managed and although a large percentage of the natural vegetation still remains intact (including 63.5% of natural Bisho Thornveld, 70.3% of Eastern Valley Bushveld, 85.4% of Amathole Misbelt Grassland, 98.3% of Suurgberg Quartzite Fynbos, and just 45.4% of natural Buffels Valley Thicket (Skowno *et al.*, 2019)), all these areas remain susceptible to overgrazing and inadequate fire management.

International trade in this species is extremely high, with an estimated 73 592 plants having been exported from the country since 1980 (UNEP-WCMC CITES trade database, 2019). While majority of these plants are labelled as “artificially propagated”, it is suspected that many specimens have in fact been wild collected which places wild populations of this species at great risk of extinction. More than some 3 500 wild *E. bupleurifolia* plants were seized from a succulent nursery in the Port Elizabeth area in May of 2019 (L. Jabar, pers. obs.) – the same nursery where some 8 500 suspected wild collected specimens were noted in 2018 (Mhlongo, 2020). The nursery has been actively trading in the species for many years and had exported 28 406 specimens between 2010 and 2018 alone (L. Jabar, pers. comm.). *Euphorbia bupleurifolia* is subjected to additional collection pressure as it is traded locally for traditional medicine, with extensive levels of local harvesting being reported across the Eastern Cape (Victor *et al.*, 2016). Around 1 700 wild plants were estimated to be harvested for local use in 2018 alone (Mhlongo, 2020). Due to ease of access, five populations are vulnerable to illegal collection. Many of the surveyed sites showed evidence of digging, which suggests that harvesting might already be taking place in the majority of these areas (Mhlongo, 2020). Missing size classes observed in the size class distribution patterns in most of the assessed subpopulations further supports these suspicions. Unless these sites are fenced off and protected from illegal collecting (and additional impacting factors), the species faces a high risk of further localized extinctions.

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

At present it appears that *Euphorbia bupleurifolia* is threatened primarily by ongoing illegal removal and trade of wild plants. The species is popular on the international horticultural market but the majority of the plants exported from South Africa were likely sourced directly from the wild. An audit of the five nurseries known to be cultivating the species, conducted at the end of 2018, found that 98% of the ±8 659 *E. bupleurifolia* plants

currently in cultivation show strong indications of being wild collected (Mhlongo, 2020). Four of the five facilities are compliant with the CITES definition of “under controlled conditions” but only three facilities appeared to have plants that resembled artificially propagated specimens (Mhlongo, 2020). None of the facilities were able to provide proof of legal acquisition of their parental stock, with two facilities admitting to sourcing large plants from the wild without the necessary permissions. Whilst three nurseries had only juvenile plants on site, plants from two of the nurseries (with the most stocks) were mostly large (and significantly larger than the 11–14-year-old artificially propagated plants at the Walter Sisulu National Botanical Garden) with distinctive wild features including high degrees of variation in sizes, irregular shaped stems and growth forms, evident animal damage as well as lichen growth along the stems. The nursery in the Eastern Cape that has been responsible for more than 94% of *E. bupleurifolia* exports within the last decade (~28 400 out of 30 354 plants exported between 2010-2018) has since been implicated in laundering of wild plants and was found to have the majority (98.6%) of the total number of *E. bupleurifolia* plants available in cultivation (i.e. ±8 537 out of 8 659) across all five nurseries at the time of the audits (Mhlongo, 2020). Considering the growth rate of the species observed under cultivation, i.e. 0.55 cm² in canopy area/year, it would have taken at least around 30 years for plants at the nursery to grow to their respective sizes assuming linear growth over the years (which is actually an incorrect assumption as the growth of these plants slow down as the plant ages (A. Hankey, pers. comm.)). All of the >8 500 plants were suspected to be wild sourced (Mhlongo, 2020). A total of 3 556 wild *E. bupleurifolia* plants were also seized from this nursery in 2019 (L. Jabar, pers. comm.) and it is furthermore suspected that many of the plants that have previously been exported from this facility over the years may also have been illegally obtained from the wild population.

In addition to the high annual quantities of plants required to satisfy the international horticultural market, the species is also exploited locally for traditional medicine use and trade. The latex of the species has purported applications in the treatment of various skin ailments and is used in both the Zulu and Xhosa cultures (Schwartz and LaFon, 1984; Hutchings, 1996). Surveys of local traditional medicine trade areas as well as interviews with traditional healers, herbalists and traders (16 participants in total) revealed that at least 1 721 wild *E. bupleurifolia* individuals may have been harvested from the wild in 2018 alone (Mhlongo, 2020). A large proportion of harvesters had reported to collect up to 20 plants at a time, although three individuals claimed to have harvested more than 100 plants each over a period of one year (Mhlongo, 2020). The harvesting techniques employed for these traditional purposes are destructive as the entire plant must be dug out (Mhlongo, 2020). Given that the species has been observed for sale in local markets since the early 90s, the continued annual removals of wild plants for the local trade would have contributed significantly to the decline of *E. bupleurifolia*.

It is estimated that more than 70% of historically recorded *E. bupleurifolia* subpopulations may have disappeared over time and it is highly probable that the apparent unregulated or poorly regulated trade in the species could have contributed to this disappearance (Mhlongo, 2020). Based on current information, annual offtake is estimated to number at least 3 500 *E. bupleurifolia* plants. The historical and ongoing illegal harvest of wild plants has had detrimental impacts on the species contributing to/ resulting in the possible extinction of several populations within the country.

Altogether 83 online advertisements offering *E. bupleurifolia* specimens for sale (at an average price of R389±485) were recorded during a limited online trade survey (conducted May 2018, Mhlongo, 2020). Large, most likely wild collected specimens were also observed for sale online. Advertisements were found across a range of social media platforms such as Facebook, Twitter and Instagram as well as auction websites particularly Ebay (Mhlongo, 2020). The use of such platforms promotes the unregulated trade of threatened species.

	Managed harvest: ongoing with adaptive framework	1
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11. Management history: What is the history of harvest?	Managed harvest: ongoing but informal	2
	Managed harvest: new	3
	Unmanaged harvest: ongoing or new	4
	Uncertain	5
There has been no formal management of wild-harvesting of <i>E. bupleurifolia</i> to date even though the large numbers of plants in local and international trade are collected from wild populations. <i>Euphorbia bupleurifolia</i> is a protected plant in both the Eastern Cape and KwaZulu-Natal but the conservation legislation of these provinces differs quite significantly. In KwaZulu-Natal, the species is considered a protected indigenous plant in terms of Schedule 11 of the Nature Conservation Ordinance [No. 15 of 1974]. The collection of such plants within state and private nature reserves, as well as along any public road (or within the road reserve), requires a permit from the relevant conservation authority. No additional provisions or restrictions are made with regard to the gathering of protected indigenous plants (outside of these areas) within the ordinance, except that landowner permission is required to gather plants on privately owned (reserve and non-reserve) lands (C. Carbutt – Plant Scientist, Ezemvelo KZN Wildlife, pers. comm.). Within the Eastern Cape, <i>E. bupleurifolia</i> is protected under schedule 4 of the provinces' Nature and Environmental Conservation Ordinance [No. 19 of 1974]. No person may pick any protected plant without a permit from the provincial conservation authority or, in the absence of written landowner permission when such a plant occurs on privately owned land (except in the case where a person is the owner of such land or a relative of such owner and any fulltime employee of such owner acting on the instructions or with the consent of the owner). In addition, the Ciskei Nature Conservation Act of 1987 and the Transkei Environmental Conservation Decree 9 of 1992 are also still applicable across parts of the Eastern Cape. The species is protected under schedule 6 in both of these Acts and as such, no plant may be collected without a permit as well as written landowner permission when such a plant occurs on privately owned land. Implementation of existing management controls are hampered by inadequate conservation resources within both the Eastern Cape and KwaZulu-Natal but there are nevertheless no records of permits having been issued for the collection of wild <i>E. bupleurifolia</i> plants from anywhere across the species range within either of the provinces. Any offtake at present is unmanaged with no oversight and the harvest is taken in a purely opportunistic manner that is unsustainable.		
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 for the species in either of the provinces.		
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
Wild-collecting is opportunistic and for the personal benefit of the harvester.		
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 currently no quota system for harvesting <i>E. bupleurifolia</i> from the wild.		
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 of <i>E. bupleurifolia</i> in protected areas of South Africa. The species is known to occur within three formally protected areas. Neither Ezemvelo KZN Wildlife nor the Eastern Cape Department of Economic Development, Environment Affairs and Tourism (DEDEAT) have or will issue permits for the wild harvesting of protected plants 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
It is unknown whether legal harvest of <i>E. bupleurifolia</i> occurs on privately owned land in South Africa. The species is afforded protection under the Eastern Cape Nature Conservation Ordinance [No. 19 of 1974], the Eastern Cape Ciskei Nature Conservation Act of 1987, as well as the Transkei Environmental Conservation Decree 9 of 1992. In the terms set out within these regulatory frameworks, no protected flora may be collected without a permit, and where plants occur on private land, written landowner permission is also required (in some areas of the Eastern Cape, only written landowner permission is needed). These legislative provisions however do not apply to the owner of such land or a relative of such owner and any fulltime employee of such owner acting on the instructions or with the consent of the owner. <i>Euphorbia bupleurifolia</i> is also listed as a protected indigenous plant in terms of Schedule 11 of the KwaZulu-Natal Nature Conservation Ordinance [No. 15 of 1974]. In KwaZulu-Natal, collection of such plants within state and private nature reserves, as well as along any public road (or within the road reserve), requires a permit from the relevant conservation authority. No additional provisions or restrictions are made with regard to the gathering of protected indigenous plants (outside of these areas) within the ordinance except that landowner permission is required to gather plants on privately owned (reserve and non-reserve) lands (C. Carbutt, pers. comm.). Neither Ezemvelo KZN Wildlife nor the DEDEAT have issued any permits for the wild harvesting of <i>E. bupleurifolia</i> from anywhere across the species range (both within and outside of protected areas). Legal harvesting on privately owned land with the permission of the land owner across KwaZulu-Natal and parts of the Eastern Cape (excluding areas that fall within the former Transkei and Ciskei regions as well as private reserves in KwaZulu-Natal), is challenging to supervise and the extent of legal harvest (if any) across private land within both provinces remains uncertain. Harvesting for traditional trade purposes is known to take place within a private timber plantation (managed in part by the Department of Forestry, Fisheries and the Environment (DFFE)) in the Eastern Cape but it is unknown whether or not the harvesters hold the necessary permissions from DFFE to collect these plants.		

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 <i>de facto</i> or actual open access?	None	1
	Low	2
	Medium	3
	High	4
	Uncertain	5
The species is afforded some protection under the Eastern Cape Nature Conservation Ordinance [No. 19 of 1974], the Eastern Cape Ciskei Nature Conservation Act of 1987, the Transkei Environmental Conservation Decree 9 of 1992 and the KwaZulu-Natal Nature Conservation Ordinance [No. 15 of 1974]. Neither Ezemvelo KZN Wildlife nor the DEDEAT have issued any permits for the wild harvesting of <i>E. bupleurifolia</i> from anywhere across the species range (both within and outside of protected 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
Responsible conservation authorities in the Eastern Cape and KwaZulu-Natal do not have sufficient resources to effectively implement any management controls. In KwaZulu-Natal, Ezemvelo KZN Wildlife have good administration systems in place to manage permit applications but enforcement and regulation on the ground is challenging given the limited number of staff assigned to large areas, for example, there are only two conservation officials responsible for monitoring and enforcement across the entire Ugo District of the province covering some 4 790km ² (C. Mulqueeny- Scientific Manager, Ezemvelo KZN Wildlife, pers. comm.). The organization's resource management unit (that were tasked to regulate and monitor the harvesting of wildlife resources within protected areas and surrounds) is no longer operational and since no posts are currently being filled within the province, this function has fallen on other staff that have to keep record of resource use on top of all their usual duties. The situation is thought to be more grim in the Eastern Cape.		
Capacity within the conservation sector across the country is an ongoing challenge. Apart from the limited number of staff (and budget) available to manage and monitor species, scientists and practitioners are presently ill-equipped to deal with the evolving pressures put on the country's biodiversity - for example, it is increasingly difficult to detect instances of poaching, smuggling and laundering of succulent plants (that is facilitated largely by the internet and rapidly developing social media platforms) with existing mechanisms. It is also challenging to keep track of collection occurring on privately owned, and there is no confidence in landowner permission as a control mechanism. Monitoring of medicinal trade areas (where wild plants are sold), and nurseries supposedly propagating the species, is also very weak – the thousands of wild plants that have been laundered through an Eastern Cape nursery being a case in point. Although no permits have been issued within KwaZulu-Natal or the Eastern Cape for the collection of wild <i>E. bupleurifolia</i> plants from anywhere across the species range, wild plants continue to be harvested without any form of management or oversight and in a manner that is unsustainable.		
The species is known to occur within three formally protected areas but the number of plants in the reserves is severely reduced with no more than 30 individuals estimated to be remaining in each of the populations. Signs of illegal harvesting has been noted in one reserve within the Eastern Cape and the single reserve within KwaZulu-Natal (Mhlongo, 2020).		
Monitoring of harvest		
	Direct population estimates	1
	Quantitative indices	2

19. Methods used to monitor the harvest: What is the principal method used to monitor the effects of the harvest?	Qualitative indices	3
	National monitoring of exports	4
	No monitoring or uncertain	5

Exports of *E. bupleurifolia* from South Africa (extracted from the CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK) are monitored by the South African National Biodiversity Institute (SANBI) on behalf of South Africa's Scientific Authority. *Euphorbia bupleurifolia* is a popular plant in international trade and there has been a significant increase in the number of plants exported from South Africa over the years. South Africa accounts for 76% of all plants (~97 000 live specimens) exported globally. Close to 73 560 live plants have been exported from the country since 1980 with more than 87% being exported within the last two decades (Fig. 5). Less than 0.0005% (i.e. 10 plants) of these exports have been reported as specimens sourced from the wild. There are currently only five local nurseries known to be 'cultivating' the species but based on recent audits of these facilities (2018), large numbers of illegally sourced wild plants are being laundered into the legal trade. Belgium (68%) and Germany (24%) are the major importers of *E. bupleurifolia*. Trade data also show a recent trend of large supplies coming out of the Taiwan 8 709 *E. bupleurifolia* plants exported over a three-year period between 2018 and 2020.

There is currently no field monitoring programme for the species and monitoring of harvest for the local trade does not take place due to limited capacity and resources within the provinces.

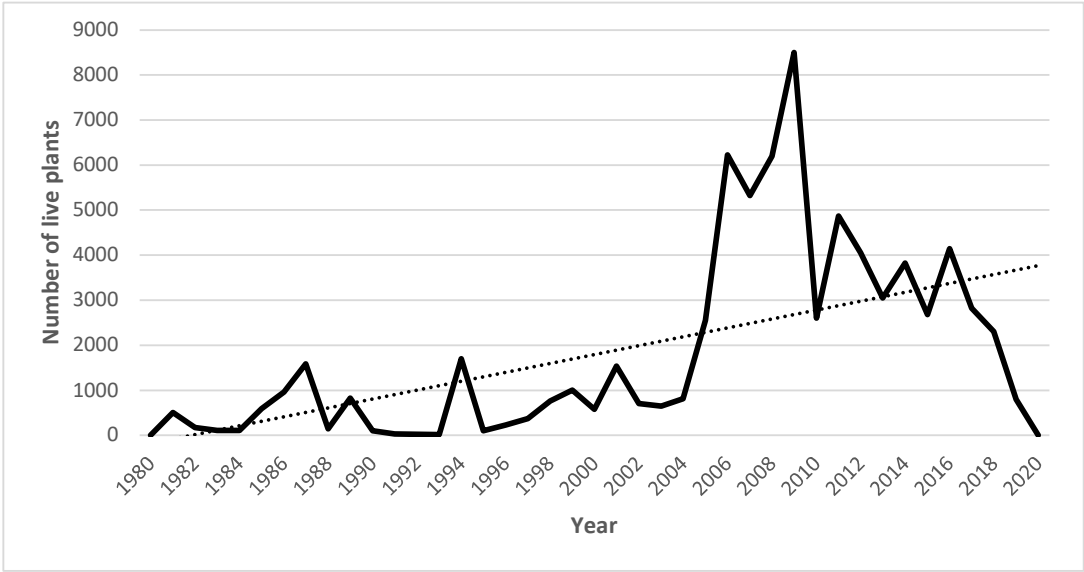


Figure 5: Gross exports of live *Euphorbia bupleurifolia* plants from South Africa (with trend in trade over time indicated by the dashed line). An average of 3 059 plants ($\pm$ SD 2250.17) have been exported annually since the year 2000 (up to 2020).

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. The quality of the data is not always as good as it should be owing to errors and inconsistencies in reporting by both exporting and importing countries. Lack of monitoring across local nursery facilities also undermines the accuracy of the trade data as some nurseries have been taking advantage of poor oversight loopholes by mis-declaring wild plants of many species as artificially propagated. With an increase in the illegal collection and laundering of wild succulents noted across the

country in recent years, provincial conservation authorities are now more aware of the issue and understand the need to commit more resources towards increased and improved monitoring efforts of local exporting nurseries.

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

Continued unsustainable harvest of wild plants seems to be the major threat to the species at present. Previous and ongoing collection of large plant specimens for both local use and international trade, are predicted to have directly contributed (in addition to habitat loss and degradation) to the decline (and possible extirpation) of the species across much of its former range. The single largest growing facility that operates exclusively as a wholesale nursery and is responsible for the majority of international exports of the species, has recently been implicated in the laundering of wild plants and had a total of 8 537 *E. bupleurifolia* plants (many with wild characteristics) in 2018 - nearly five times the number of wild plants encountered in the field during field assessments conducted in the same year (Mhlono, 2020). In addition, the species is also impacted by local collection for the traditional medicine trade with some 1 721 plants estimated to have been collected in 2018 alone (Mhlono, 2020). The combined annual offtake of wild plants (based on average annual exports and harvest for the medicinal trade) is estimated to number at least 3 500 specimens (Mhlono, 2020). Long-lived species are highly sensitive to extractive use of adult plants and unregulated removals of large individuals would be detrimental to the persistence of wild populations. The continued harvest of large numbers of *E. bupleurifolia* plants cannot be sustained (especially in the context of additional threats) and could result in the extinction of the species in the near future without immediate intervention.

Based on the best current available information, the population reduction of this species is estimated to be 98%, with the continued exploitation of individuals and the significant decline in the area of occupancy, extent of occurrence, and habitat quality qualifying the species for a Critically Endangered listing (IUCN Standards and Petitions Committee, 2019; Mhlono, 2020). Only the discovery of large, previously undocumented subpopulations would contest this category change.

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

Since all offtake is currently unregulated or illegal, no conservation benefit to this species accrues from harvesting and harvest continues to the detriment of the species.

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

Since all offtake is currently unregulated or illegal, no conservation benefit to this species or its habitat accrues from harvesting.

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
There is no legal harvest of <i>E. bupleurifolia</i> within protected areas of South Africa. <i>Euphorbia bupleurifolia</i> is a protected plant in both the Eastern Cape and KwaZulu-Natal and collection of such plants within state and private nature reserves requires a permit from the relevant conservation authority. No permits have been issued within KwaZulu-Natal or the Eastern Cape for the collection of wild <i>E. bupleurifolia</i> plants from anywhere across the species range and it is unlikely that authorities would issue permits for such activities within protected areas. Three of nine surveyed <i>E. bupleurifolia</i> populations occur within protected areas (i.e. two reserves managed by Eastern Cape Parks and Tourism Agency (ECPTA) and one managed by Ezemvelo KZN Wildlife) accounting for less than 5% of the known population.		
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
Although three of the known populations can be found within protected areas (from which harvest is legally excluded), the numbers of plants in each of these reserves are severely depleted with a single plant remaining in one of the Eastern Cape reserves and less than 30 individuals observed in each of the remaining two reserves (Mhlongo, 2020). Access to two reserves found in the Eastern Cape is quite restrictive (C. Swart, pers. comm.), whilst the third reserve in the KwaZulu-Natal province is easily accessible and the <i>E. bupleurifolia</i> population here is not difficult to locate (N. Mhlongo, pers. obs.). Signs of illegal plant removal have also been noted in two of the reserves (Mhlongo, 2020). Ezemvelo KZN Wildlife used to have a dedicated resource management unit that were responsible for regulating and monitoring the harvest of wildlife resources within protected areas and surrounds, but this group has since been disbanded and there are presently no dedicated posts to deal with resource use across the province. At present, resource limitations within both provinces prevent the effective protection of this species (both within and outside of protected areas). A fourth population occurs on a private protected area within the Eastern Cape and harvesting of plants by traditional healers is known to occur within the area (Mr. Zulu – traditional healer/plant harvester, pers. comm.) although whether or not this takes place with the necessary permissions is uncertain.		
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
The conservation legislation of both the Eastern Cape and KwaZulu-Natal provinces is unfortunately outdated, providing limited/weak effective protection to the species at present. Past and possible present levels of harvesting for the species are unknown and therefore unmanaged. The severe limitations with respect to the capacity (including relevant skillsets) and budget within both provinces, furthermore, renders existing harvest and management controls ineffective, not only hindering active field monitoring of the species populations but also the ability to detect any illegal activities involving the species. The species has been proposed as a schedule 7 threatened plant species on the KwaZulu-Natal Environmental, Biodiversity		

and Protected Areas Management Bill, 2014. This Bill has not yet been enacted into law as some details are still being finalized, but once approved, the Bill will repeal all the other acts and afford additional protection to the species across its range within the KwaZulu-Natal province. In addition, *E. bupleurifolia* has been proposed for inclusion on the revised national Threatened or Protected Species (ToPS) list (South Africa, 2013). Unfortunately, owing to a decade of challenging government and public consultation processes, the updated regulations are yet to be gazetted for implementation.

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